Honeywell

Honeywell Building Solutions

Denville Board of Education District-Wide Energy Savings Plan

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ENERGY SERVICES GROUP

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HONEYWELL PROPRIETARY

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SECTION A EXECUTIVE SUMMARY

Honeywell is pleased to have the opportunity to submit this Energy Savings Plan for Denville Board of Education. During the development of the Energy Savings Plan, Honeywell has completed a thorough investment grade energy audit of Denville Board of Education's buildings and grounds. Based on the audit findings and Honeywell's extensive experience in working with educational institutions, we are able to confidently state that we can deliver a financially viable, comprehensive solution to address the District's facility concerns. Our Energy Savings Plan includes projects that achieve energy and operational efficiencies, create a more comfortable and reliable learning environment and are actionable via the New Jersey Energy Savings Improvement Program (NJ ESIP) in accordance with NJ PL2012, c.55.

The Energy Savings Plan is the core of the NJ ESIP process. It describes the energy conservation measures that are planned and the cost calculations that support how the plan will pay for itself through the resulting energy savings. Under the law, the Energy Savings Plan must address the following elements:

- The results of the energy audit;
- A description of the energy conservation measures (ECMs) that will comprise the program;
- An estimate of greenhouse gas reductions resulting from those energy savings;
- Identification of all design and compliance issues and identification of who will provide these services;
- An assessment of risks involved in the successful implementation of the plan;
- Identify the eligibility for, and costs and revenues associated with, the PJM Independent System Operator for demand response and curtail-able service activities;
- Schedules showing calculations of all costs of implementing the proposed energy conservation measures and the projected energy savings;
- Maintenance requirements necessary to ensure continued energy savings, and describe how they will be provided; and
- If developed by an ESCO, a description of, and cost estimates of a proposed energy savings guarantee.

The purpose of this document is to provide all the information required for Denville Board of Education to determine the best path forward in the implementation of a Campus-Wide NJ ESIP Project. It is important to note that the Energy Savings Plan provides a comprehensive evaluation of ALL potential ECMs within Denville Board of Education. This is not meant to infer that all of the ECMs identified must be or, based upon legislative requirements, can be implemented at this time. However, as long as the ECM is part of this plan, it may be implemented at a later date as additional funding becomes available or technology changes in order to provide an improved financial return.

Our Energy Savings Plan is structured to clearly demonstrate compliance with the NJ ESIP law, while also presenting the information in an organized manner which allows for informed decisions to be made. The information is divided into the following sections:

A. **Executive Summary** (This Section)

B. **Preliminary Utility Analysis –** The Preliminary Utility Analysis (PUA) defines the utility baseline for the District's buildings included in the Energy Savings Plan. It provides an overview of the current usage and also a cost per square foot by building of utility expenses. The report also compares the District's utility consumption to that of other Districts in the same region on a per square foot basis.

C. **Energy Conservation Measures –** This section includes a detailed description of the ECMs we have selected and identified for your District. It is specific to your facilities in scope, savings methodology and environmental impact. It is intended to provide a Basis of Design for each measure in narrative form. It is not intended to be a detailed specification for construction. ALL potential ECMs for the District are identified for the purposes of potential inclusion in the program. Final selected ECMs are to be determined by the District in conjunction with Honeywell during the project development phase of the NJ ESIP process.

D. **Technical and Financial Summary –** This section includes an accounting of all technical and financial outcomes associated with the ECMs as presented on the New Jersey Board of Public Utilities Forms II through IV. Information detailed on the forms includes projected implementation hard costs, projected energy savings, projected operational savings and projected environmental impact. Form IV: Annual Cash Flow Analysis provides a "rolled-up" view of the overall project financials, inclusive of financing costs, on an annual basis as well as over the entire 15 or 20 year term of the agreement.

Based on our preliminary discussions with the District, the following sample self-funding project has been provided for review and consideration:

	Recommended ESIP Project
Value of Project	**$1,816,984**
Term of Repayment	**15 Years**
Projected Savings Over Term	**$2,265,067**
Projected NJ Rebates & Incentives	**$92,637**
Projected Interest Rate	**3.00%**

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
1a	Lighting Upgrades - LED	✓	✓	✓	✓
1b	Vending Misers	✓	✓	✓	
1c	Destratification Fans	✓	✓	✓	
1d	Plug Load Management via Wi-Fi	✓	✓	✓	
2a	Boiler Replacements				
2b	Boiler Burner Controls				
2c	Rooftop Unit Replacement		✓	✓	
2d	Premium Efficiency Motors and VFDs				
2e	Steam Trap Replacement				
2f	Pipe Insulation			✓	
2g	Domestic Hot Water Replacements	✓			
2h	Split System Replacements				
2i	Window AC Unit Replacements				
2j	Unit Heater Replacements				
3a	Building Management System Upgrades	✓	✓	✓	
3b	Demand Control Ventilation				
3c	Energy Monitoring and Education	✓	✓	✓	
4a	Building Envelope Improvements	✓	✓	✓	
4b	Roof Replacements				
5a	Computer Power Management				
6a	Water Conservation				
7a	Demand Response/Permanent Load Reduction	✓	✓	✓	
8a	Renewable Energy – Solar PPA System				

E. **Measurement & Verification and Maintenance Plan –** This section identifies the intended methods of verification and measurement for calculating energy savings. These methods are compliant with the International Measurement and Verification Protocols (IMVP), as well as other protocols previously approved by the Board of Public Utilities (BPU) in New Jersey. This section also includes the recommended maintenance requirements for each type of equipment. Consistent maintenance is essential to achieving the energy savings projected in this plan.

F. **Design Approach –** This section includes a summary of Honeywell's best practices for the successful implementation of a NJ ESIP project. It includes a project specific Safety Management Plan and provides an overview of our project management procedure, construction management and a sample schedule for the overall completion of the project. Within the schedule, we clearly define the tasks directed towards compliance with architectural, engineering and bidding procedures in accordance with New Jersey Public Contracts Law.

G. **Independent Energy Audit –** This section includes, for reference, the independent energy audits as previously received by the District through the Local Government Energy Audit (LGEA) program. The audits, provided by Steven Winters Associates and Dome-Tech, Inc., have been included on a compact disk marked as Appendix 1. A comparison can be made between the ECMs outlined in this Independent Energy Audit and the additional ECMs described in the overall Energy Savings Plan.

H. **Energy Calculations and Greenhouse Gas Reduction Summary –** This section titled Appendix 2: ECM Calculations includes all the energy calculations required to ensure compliance with the law and to confirm the energy savings can, and will, be achieved. These calculations are subject to an independent 3rd party engineering firm review for verification.

   A summary of all savings based on the Recommended ESIP Project includes a **reduction in 672,473 kWh** (kilowatt hours of electricity), **43,044 Therms** (natural gas) and **1,251,264 Pounds of Greenhouse Gas (GHG) emissions**. It is the equivalent of removing **109.3 cars** from the road for an entire year and is the same as planting **65.9 acres of forest**.

I. **Data Logger Graphs** – This section titled Appendix 3: Data Logger Plots includes graphs plotting space temperature, humidity and light levels versus time for select rooms and spaces which were monitored via data loggers during the investment grade energy audit.

J. **Equipment Cut-sheets –** This section titled Appendix 4: Equipment Cut-sheets includes specification data for the equipment which shall be utilized as the Basis of Design for plans and specifications during the subsequent project development and NJ public bid phase.

K. **Safety Management Plan –** This section titled Appendix 5: Safety Management Plan establishes a plan for the implementation of Honeywell's Safe Operations Management (SOM) program. The document includes procedures and requirements specific to the Denville Board of Education necessary to support a safe workplace for all stake holders. The Safety Management Plan is a living document, which will be updated and modified to maintain its relevance throughout the project as site conditions and circumstances change.

In accordance with the NJ ESIP process, the next step in the project development phase is for Honeywell to provide our recommendations and for the District to select the desired content of the project based upon the District's unique goals and objectives. The selections will consider the projected costs, projected energy and operational savings, available financing options at the time of the agreement, interest rates, length of term and District priorities, which will all play a part in the final selection and cash flow of ECMs. The definitive requirement under NJ PL2012, c.55 is that the project is self-funding within the 15 or 20 year term as outlined in the legislation.

Overall, it is evident that Denville Board of Education is well positioned to implement a program that will upgrade your facilities, while funding itself within the requirements of the law and with zero impact on your taxpayer base. We welcome this opportunity to partner with Denville Board of Education in order to improve the comfort and efficiency of your facilities through the successful implementation of this Energy Savings Plan.

Sincerely,

Joseph J. Coscia

Joseph J. Coscia
Energy Account Executive

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SECTION B PRELIMINARY UTILITY ANALYSIS & BENCHMARKING REPORT

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Honeywell

Americas M&V Services

Preliminary Utility Analysis

2014-15 Update

Denville Township BOE

Denville, NJ

Helping customers manage energy resources to improve financial performance

Historical Summary

Denville Township BOE

Utility Analysis Period: 2014-15 vs. 2013-14

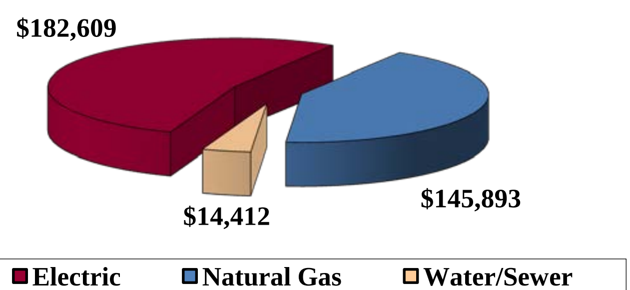
	Current Year (05/14-04/15)			Prior Year (05/13-04/14)		
	Electric	**Nat Gas**	**Wtr/Swr**	**Electric**	**Nat Gas**	**Wtr/Swr**
Utility Costs*	$182,609	$145,893	$14,412	$198,804	$161,783	$14,897
Utility Usage (kWh, Therm, kGal)	1,556,547	138,375	1,440	1,707,249	140,932	1,509
$ Cost/Unit (kWh, Therm, kGal)	$0.117	$1.05	$10.01	$0.116	$1.15	$9.87
Electric Demand (kW)	5,116			5,360		
2014-15 vs. 2013-14	**Electric**	**Nat Gas**	**Wtr/Swr**			
Change in Cost	-8%	-10%	-3%			
Change in Usage	-9%	-2%	-5%			
Change in $ Cost/Unit	1%	-8%	1%			
Change in Electric Demand	-5%					

* Costs include energy and demand components, as well as taxes, surcharges, etc., but exclude non-measured Outdoor Lighting service

Buildings Included in the Analysis

Valleyview Middle School
Lakeview Elementary School
Riverview Elementary School/Modulars
Bus Garage

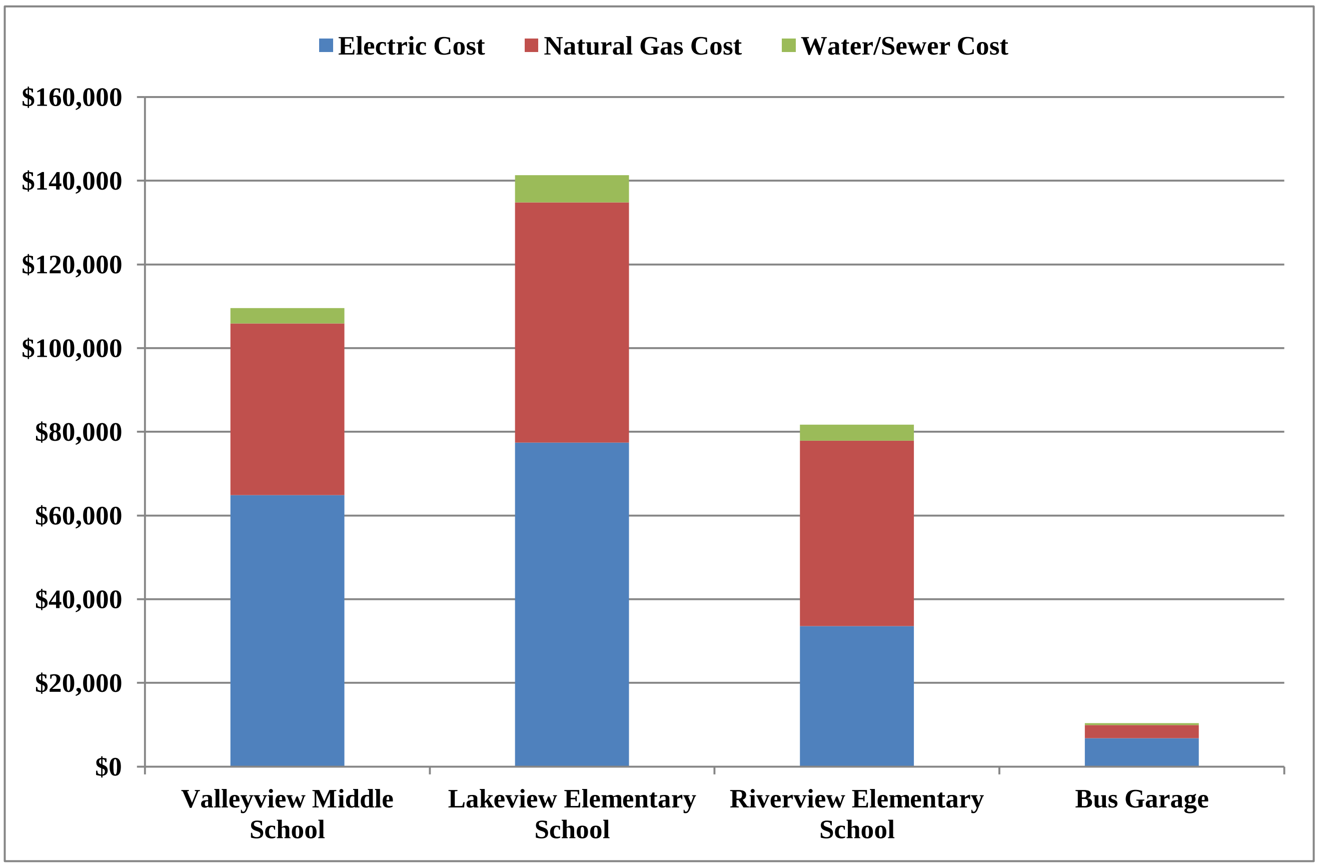
Actual Cost by Utility - 2014-15



Utility Cost and Usage by Location

May 2014 - Apr 2015

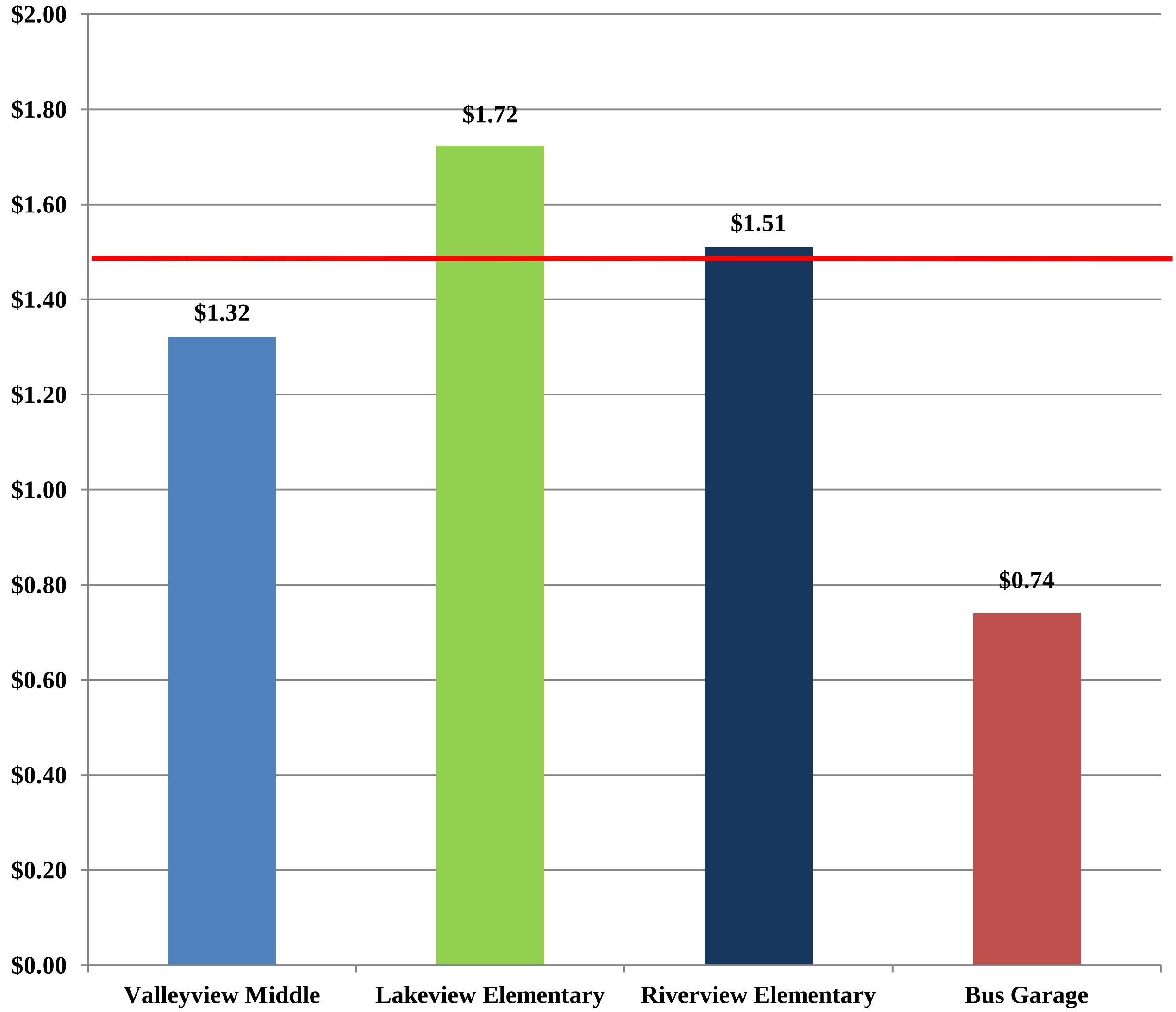
Building	Electric		Natural Gas		Water/Sewer		Total
	kWh	Cost	Therms	Cost	kGals	Cost	Cost
Valleyview Middle School	563,040	$64,861	40,049	$41,035	343	$3,651	$109,547
Lakeview Elementary School	655,520	$77,401	53,681	$57,400	629	$6,507	$141,308
Riverview Elementary School	278,880	$33,549	41,533	$44,319	428	$3,839	$81,706
Bus Garage	59,107	$6,798	3,113	$3,139	40	$415	$10,353
Total	**1,556,547**	**$182,609**	**138,375**	**$145,893**	**1,440**	**$14,412**	**$342,914**



Cost Per Square Foot Comparison

May 2014 - Apr 2015

Combined Electric and Natural Gas Cost

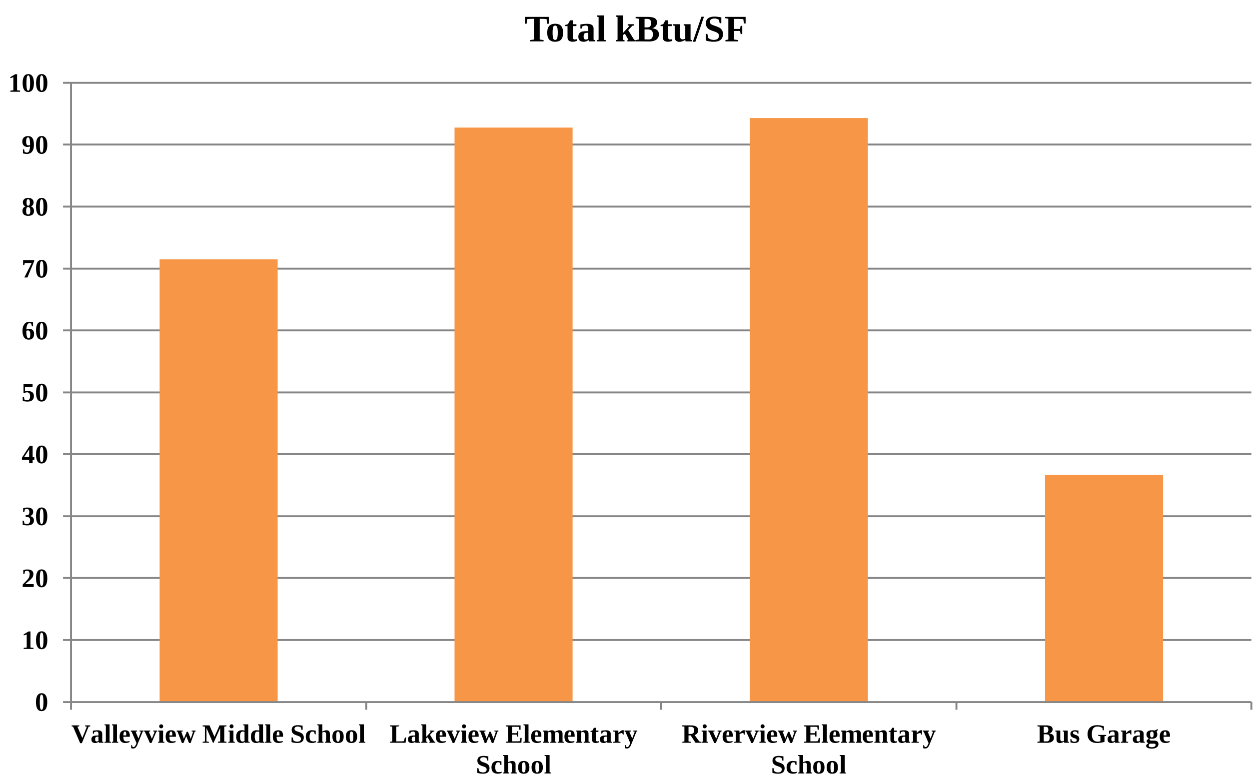


Average Total Cost per Sq Ft. for all Buildings = $1.47 (red line)

Annual Energy Usage (kBtu)

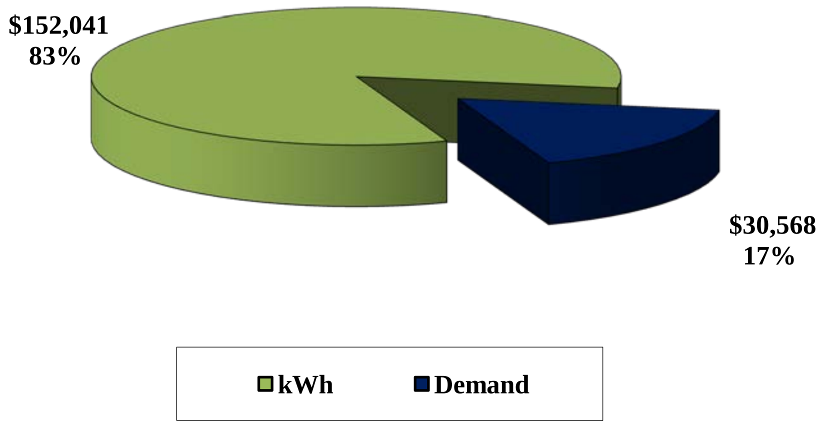
May 2014 - Apr 2015

Building	Square Footage	Electric kBtu/SF	Natural Gas kBtu/SF	Total kBtu/SF
Valleyview Middle School	82,932	23.17	48.29	71.46
Lakeview Elementary School	82,007	27.28	65.46	92.74
Riverview Elementary School	54,121	17.59	76.74	94.33
Bus Garage	14,000	14.41	22.23	36.64



Utility Analysis - Electric

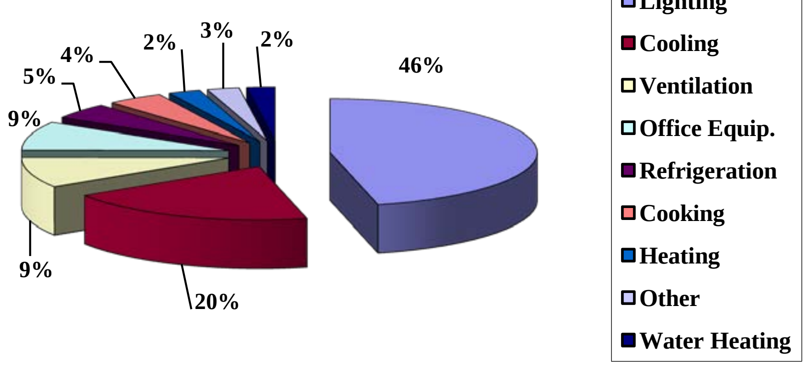
Components of Your 2014-15 Electric Cost



Your facility's demand charges are a significant percentage of total electric cost. This presents an opportunity to achieve substantial energy savings by reducing electric loads with energy-efficient equipment retrofits.

Sources of Electric Consumption

Typical End Use Allocation *



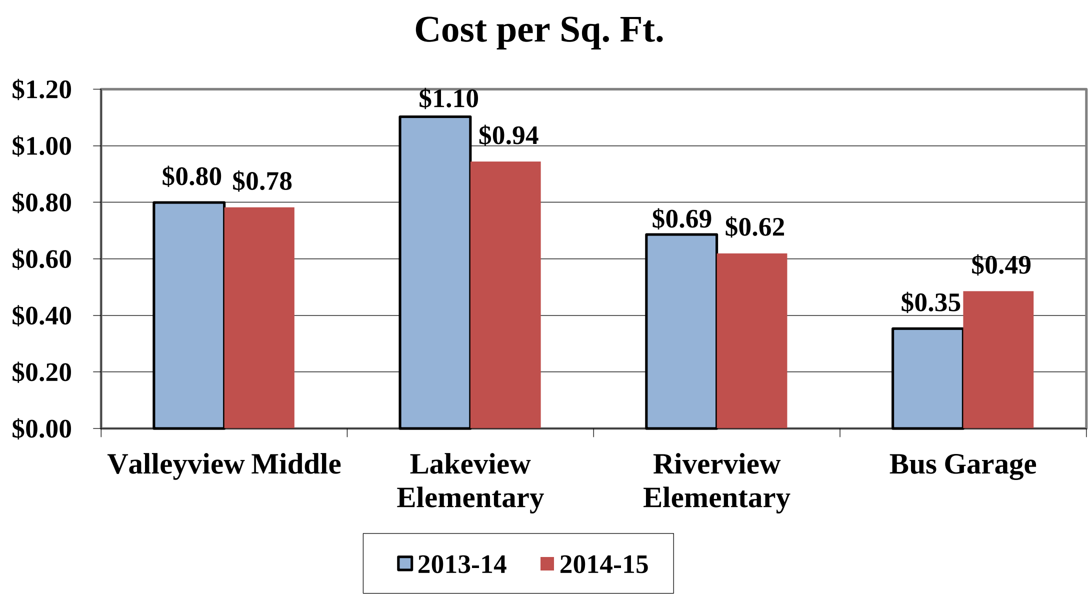
Typical Allocation Applied to Your Electric Cost**

Lighting	$84,548
Cooling	$35,791
Ventilation	$16,800
Office Equip.	$15,704
Refrigeration	$8,583
Cooking	$8,035
Heating	$4,565
Other	$4,565
Water Heating	$4,017
Your 2014 Total Cost	**$182,609**

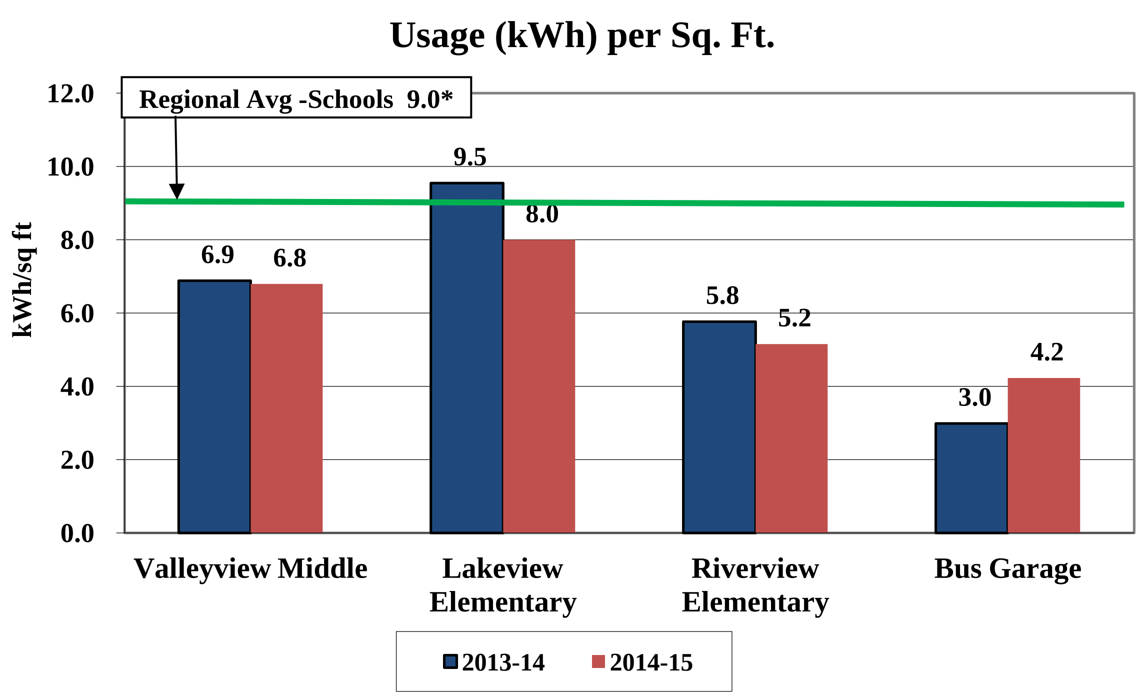
**This allocation is generic and is not a representation of the actual end use in your buildings included in this report.

*Source: Questline Commercial Benchmark Data by Business Segment (Schools) and Climate Zone (Zone 3)

Square Footage Analysis - Electric



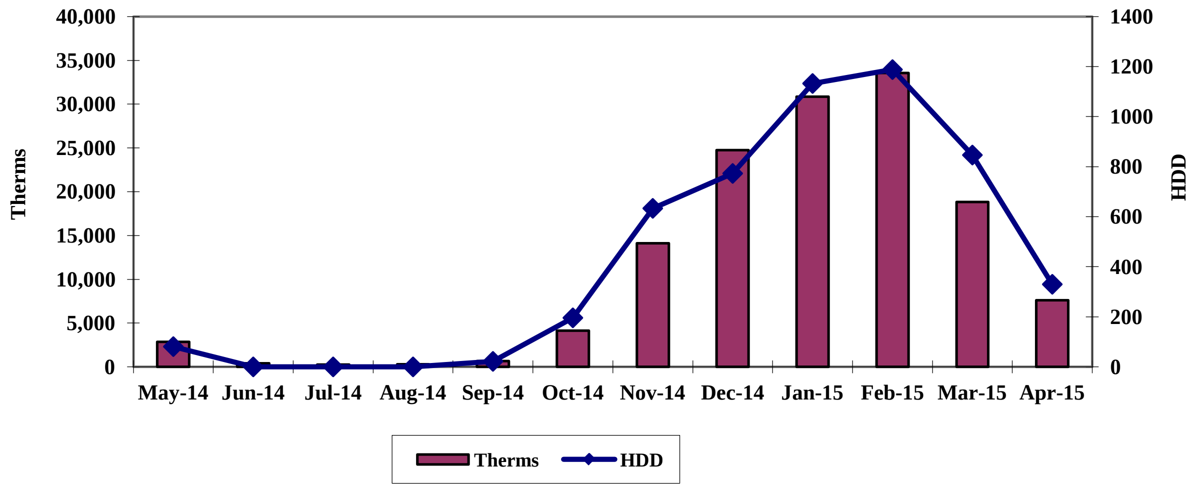
All buildings are below the Central Climate Zone-Schools regional EUI for electricity, indicating they are performing better than the benchmarking average.



*Source: Questline Commercial Benchmark Data by Business Segment (Schools) and Climate Zone (Zone 3)

Utility Analysis - Natural Gas

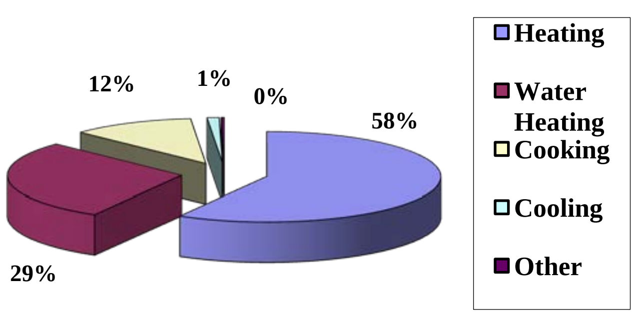
Your 2014-15 Natural Gas Usage and Heating Degree Days



There is a direct correlation between your gas usage and heating degree days, indicating that the majority of your natural gas usage is for space heating. Significant energy savings may be achieved by installing more energy-efficient heating equipment that uses natural gas.

Sources of Natural Gas Usage

Typical End Use Allocation *



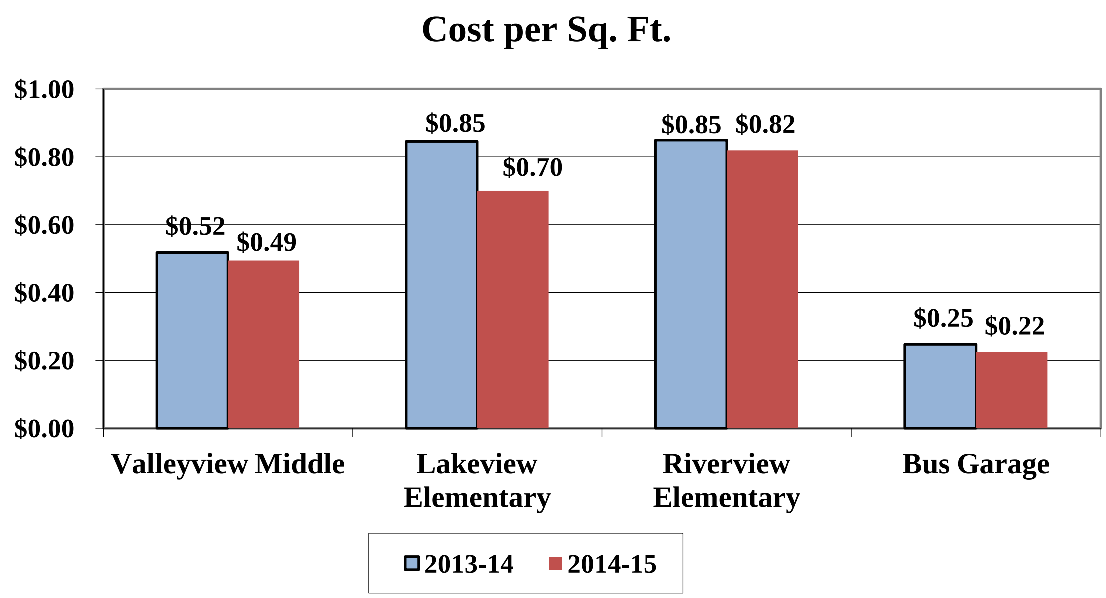
Typical Allocation Applied to Your Gas Cost**

Heating	$85,056
Water Heating	$42,163
Cooking	$16,632
Cooling	$1,605
Other	$438
Your 2014 Total Cost	**$145,893**

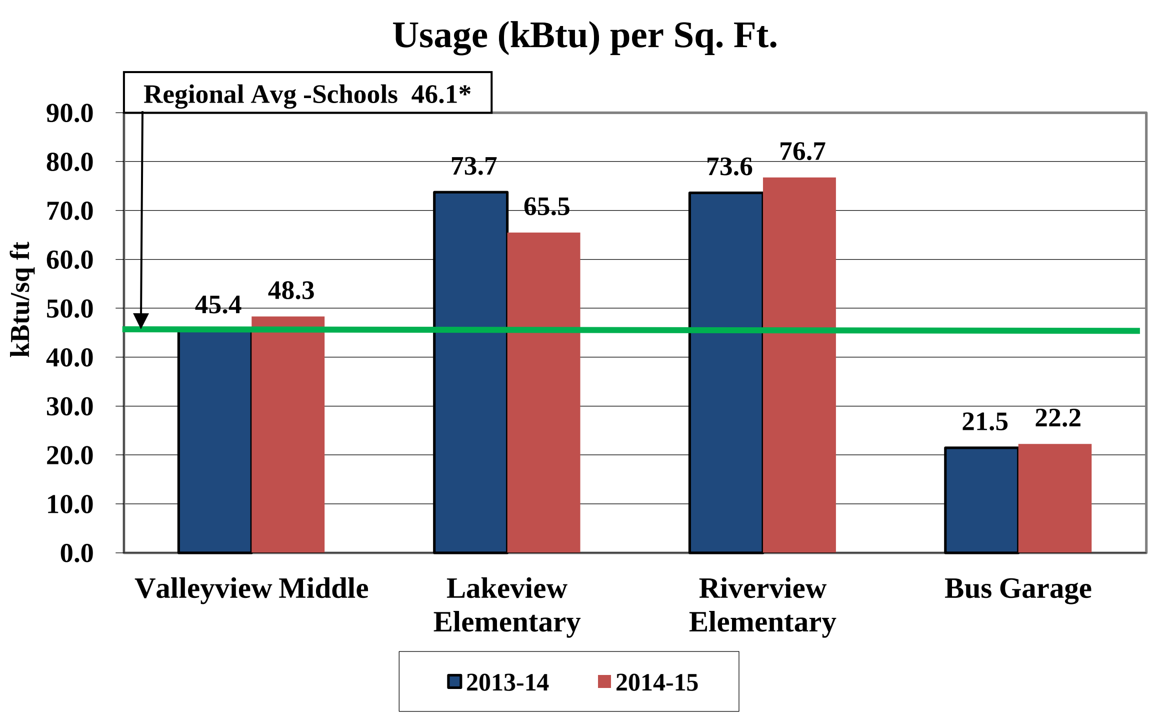
**This allocation is generic and is not a representation of the actual end use in your buildings included in this report.

*Source: Questline Commercial Benchmark Data by Business Segment (Schools) and Climate Zone (Zone 3)

Square Footage Analysis - Natural Gas



Lakeview and Riverview are significantly above the Central Climate Zone-Schools regional EUI for natural gas, indicating they are performing much worse than the benchmarking average.



*Source: Questline Commercial Benchmark Data by Business Segment (Schools) and Climate Zone (Zone 3)

Utility Summary

Denville Township BOE

May 2014 - Apr 2015

Building	Square Footage	Electric									Natural Gas								Water			Sewer			Total Energy		
		Total Cost	Total kWh	Demand Cost	Total kW Demand	Demand Months	$/kW	Blended Rate	Unblended Rate	$ per Square Ft	Total Cost	Therm Cost	Demand Cost	Mo. Svc Charge	Total Therms	Blended Rate	Therm Rate	$ per Square Ft	Total Cost	kGal	Price per kGal	Total Cost	kGal	Price per kGal	$/Sq ft	kBtu/sq ft	Total Cost
Valleyview Middle School	82,932	$64,861	563,040	$ 10,126	1,670	12	$6.07	$0.115	$0.097	$0.78	$41,035	$35,455	$5,108	$472	40,049	$ 1.025	$ 0.885	$ 0.495	$ 2,018	343	$5.88	$ 1,633	343	$ 4.76	$1.28	71.46	$105,896
Lakeview Elementary School	82,007	$77,401	655,520	$ 13,831	2,234	12	$6.19	$0.118	$0.097	$0.94	$57,400	$47,946	$8,974	$480	53,681	$ 1.069	$ 0.893	$ 0.700	$ 3,697	629	$5.88	$ 2,810	629	$ 4.47	$1.64	92.74	$134,801
Riverview Elementary School	54,121	$33,549	278,880	$ 6,160	1,061	12	$5.81	$0.120	$0.098	$0.62	$44,319	$37,109	$6,738	$472	41,533	$ 1.067	$ 0.893	$ 0.819	$ 2,524	428	$5.90	$ 1,315	428	$ 3.07	$1.44	94.33	$77,867
Bus Garage	14,000	$6,798	59,107	$ 450	151	12	$2.98	$0.115	$0.107	$0.49	$3,139	$2,844	$0	$295	3,113	$ 1.009	$ 0.914	$ 0.224	$ 215	40	$5.38	$ 200	40	$ 5.00	$0.71	36.64	$9,937
TOTALS	**233,060**	**$ 182,609**	**1,556,547**	**$ 30,568**	**5,116**		**$ 5.98**	**$ 0.117**	**$ 0.098**	**$ 0.78**	**$ 145,893**	**$ 123,355**	**$ 20,820**	**$ 1,719**	**138,375**	**$1.054**	**$0.891**	**$ 0.626**	**$ 8,454**	**1,440**	**$ 5.87**	**$ 5,958**	**1,440**	**$ 4.14**	**$ 1.41**	**82.17**	**$ 328,502**

Utility Summary

Denville Township BOE

May 2013 - Apr 2014

		Electric								
Building	**Square Footage**	**Total Cost**	**Total kWh**	**Demand Cost**	**Total kW Demand**	**Demand Months**	**$/kW**	**Blended Rate**	**Unblended Rate**	**$ per Square Ft**
Valleyview Middle School	82,932	$66,255	570,560	$ 10,795	1,791	12	$6.03	$0.116	$0.097	$0.80
Lakeview Elementary School	82,007	$90,444	782,880	$ 14,501	2,243	12	$6.47	$0.116	$0.097	$1.10
Riverview Elementary School	54,121	$37,164	312,000	$ 6,816	1,198	12	$5.69	$0.119	$0.097	$0.69
Bus Garage	14,000	$4,941	41,809	$ 326	129	12	$2.53	$0.118	$0.110	$0.35
TOTALS	**233,060**	**$ 198,804**	**1,707,249**	**$ 32,438**	**5,360**		**$ 6.05**	**$ 0.116**	**$ 0.097**	**$ 0.85**

	Natural Gas								Water			Sewer			Total Energy		
Building	**Total Cost**	**Therm Cost**	**Demand Cost**	**Mo. Svc Charge**	**Total Therms**	**Blended Rate**	**Therm Rate**	**$ per Square Ft**	**Total Cost**	**kGal**	**Price per kGal**	**Total Cost**	**kGal**	**Price per kGal**	**$/Sq ft**	**kBtu/sq ft**	**Total Cost**
Valleyview Middle School	$42,994	$37,224	$5,282	$488	37,631	$ 1.143	$ 0.989	$ 0.518	$ 2,274	386	$5.89	$ 1,674	386	$ 4.34	$1.32	68.86	$109,249
Lakeview Elementary School	$69,360	$59,749	$9,123	$488	60,454	$ 1.147	$ 0.988	$ 0.846	$ 3,715	632	$5.88	$ 2,813	632	$ 4.45	$1.95	106.30	$159,804
Riverview Elementary School	$45,965	$38,634	$6,852	$480	39,842	$ 1.154	$ 0.970	$ 0.849	$ 2,690	456	$5.90	$ 1,342	456	$ 2.94	$1.54	93.29	$83,129
Bus Garage	$3,464	$3,159	$0	$305	3,005	$ 1.152	$ 1.051	$ 0.247	$ 188	35	$5.38	$ 200	35	$ 5.71	$0.60	31.66	$8,404
TOTALS	**$ 161,783**	**$ 138,765**	**$ 21,257**	**$ 1,761**	**140,932**	**$1.148**	**$0.985**	**$ 0.694**	**$ 8,868**	**1,509**	**$ 5.88**	**$ 6,030**	**1,509**	**$ 4.00**	**$ 1.55**	**85.47**	**$ 360,586**

Honeywell

Americas M&V Services

Benchmarking Analysis Report

Denville Township BOE
Denville, NJ

Helping customers manage energy resources to improve financial performance

Executive Summary

The following pages provide benchmarking analysis for Denville Township BOE. The energy usage per square foot (kBTU/SF) was calculated for each of these buildings for electric, fuel, and total building analyses.

These energy usages per square foot (also known as Energy Utility Intensity or EUI) were compared to other buildings with similar Market Segments and Building Types within the same geographic region (Middle Atltantic). The Commercial Building Energy Consumption Survey of 2003 was used in addition to the Honeywell Americas M&V Services (AMVS) Database for comparisons. The buildings were also compared against each other.

The report is divided into two main sections:
1) Summary Information
2) Detailed Building Benchmarking

In the Summary Information Section, the Denville Township BOE buildings are shown in tables with similar buildings to show their EUI and relative percentile against the AMVS and CBECS database.

These tables show that of the three school buildings in this project, two of them fall below the median (50%), and one falls above the median on a Total EUI basis.

The Detailed Building Benchmarking Section provides graphs for Total, Electric and Fuel EUI. It also provides the summary utility data for each building.

This report is meant to give an overview of what buildings are in the most need of energy conservation measures.

Benchmarking Summary - K-12 Schools - Elementary/Middle School Buildings

The tables below summarize the Energy Usage/SF (EUI) for the K-12 Schools - Elementary/Middle School buildings in the Denville Township BOE for May 2014 - Apr 2015. The EUI Tables are broken out by Electric, Fuel and Total. They are compared against the Median, Lower and Upper Quartile EUI from the AMVS and CBECS databases.

Total EUI

Building	Pre/Post	Market Segment	Building Type	Total (kBTU/SF)
AMVS Upper 75th Percentile Total		K-12 Schools	**Elementary/Middle School**	63.30
CBECS Upper 75th Percentile Total		K-12 Schools	**Elementary/Middle School**	65.57
Valleyview Middle School	Pre	K-12 Schools	Elementary/Middle School	71.46
AMVS Median Total		K-12 Schools	**Elementary/Middle School**	78.17
CBECS Median Total		K-12 Schools	**Elementary/Middle School**	82.82
Lakeview Elementary School	Pre	K-12 Schools	Elementary/Middle School	92.74
Riverview Elementary School/Modulars	Pre	K-12 Schools	Elementary/Middle School	94.33
AMVS Lower 25th Percentile Total		K-12 Schools	**Elementary/Middle School**	97.82
CBECS Lower 25th Percentile Total		K-12 Schools	**Elementary/Middle School**	99.02

Note: The Total AMVS and CBECS Median is the median of total kBTU/SF and not the combined total of the median electric and median fuel kBTU/SF.

Electric EUI

Building	Pre/Post	Market Segment	Building Type	Electric (kBTU/SF)
CBECS Upper 75th Percentile Total		K-12 Schools	**Elementary/Middle School**	10.60
CBECS Median Total		K-12 Schools	**Elementary/Middle School**	16.33
Riverview Elementary School/Modulars	Pre	K-12 Schools	Elementary/Middle School	17.59
AMVS Upper 75th Percentile Total		K-12 Schools	**Elementary/Middle School**	17.72
AMVS Median Total		K-12 Schools	**Elementary/Middle School**	21.41
Valleyview Middle School	Pre	K-12 Schools	Elementary/Middle School	23.17
CBECS Lower 25th Percentile Total		K-12 Schools	**Elementary/Middle School**	24.34
Lakeview Elementary School	Pre	K-12 Schools	Elementary/Middle School	27.28
AMVS Lower 25th Percentile Total		K-12 Schools	**Elementary/Middle School**	28.16

Fuel EUI

Building	Pre/Post	Market Segment	Building Type	Fuel (kBTU/SF)
AMVS Upper 75th Percentile Total		K-12 Schools	**Elementary/Middle School**	40.68
Valleyview Middle School	Pre	K-12 Schools	Elementary/Middle School	48.29
CBECS Upper 75th Percentile Total		K-12 Schools	**Elementary/Middle School**	53.82
AMVS Median Total		K-12 Schools	**Elementary/Middle School**	55.92
CBECS Median Total		K-12 Schools	**Elementary/Middle School**	63.85
Lakeview Elementary School	Pre	K-12 Schools	Elementary/Middle School	65.46
AMVS Lower 25th Percentile Total		K-12 Schools	**Elementary/Middle School**	73.64

Benchmarking against AMVS

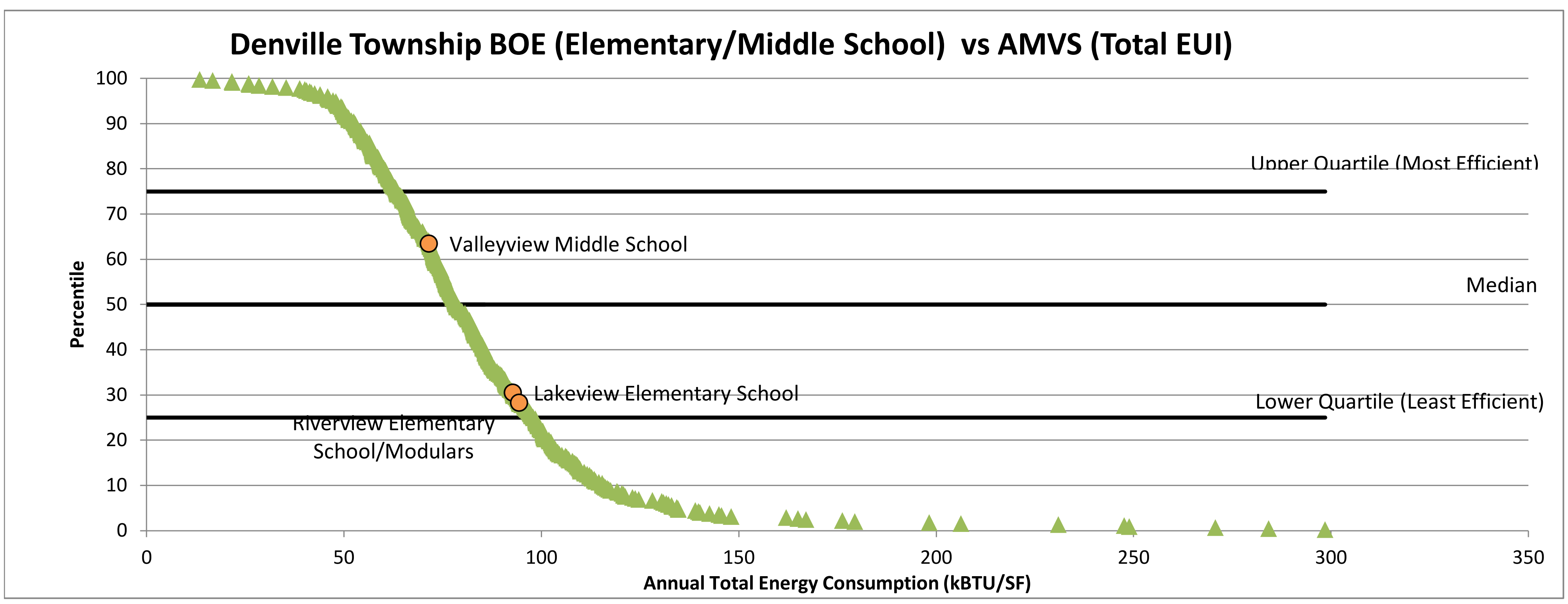
Denville Township BOE (Elementary/Middle School)

Property Type	K-12 Schools
Building Type	Elementary/Middle School
Baseline Period	May 2014 - Apr 2015

		Electricity			Fuels		Total Energy	
Building	Square Footage	kWh/yr	kWh/SF	kBTU/SF	kBTU/yr	kBTU/SF	kBTU/yr	kBTU/SF
Valleyview Middle School	82,932	563,040	6.79	23.17	4,004,938	48.29	5,926,594	71.46
Lakeview Elementary School	82,007	655,520	7.99	27.28	5,368,052	65.46	7,605,342	92.74
Riverview Elementary School/Modu	54,121	278,880	5.15	17.59	4,153,296	76.74	5,105,113	94.33

Total Energy EUI

Upper Quartile			Median 50%			Lower Quartile		
<63.30 kBTU/SF			between 63.30 and 97.82 kBTU/SF			>97.82 kBTU/SF		
Bldg Name	**kBTU/SF**	**Percentile**	**Bldg Name**	**kBTU/SF**	**Percentile**	**Bldg Name**	**kBTU/SF**	**Percentile**
			Valleyview Middle School	71.46	63			
			Lakeview Elementary School	92.74	31			
			Riverview Elementary School/Modulars	94.33	28			



The graph above shows the Annual Total Energy Consumption (kBTU/SF) for all K-12 Schools - Elementary/Middle School buildings in the Honeywell AMVS Benchmarking Database for Middle Atltantic. Those points are shown in green on the graph. A building with a higher percentile (and lower kBTU/SF) is more energy efficient than a building with a lower percentile (and higher kBTU/SF).

The Upper and Lower Quartile (top 75% and lower 25%) and the Median (50%) are also shown. The Building is plotted in orange.

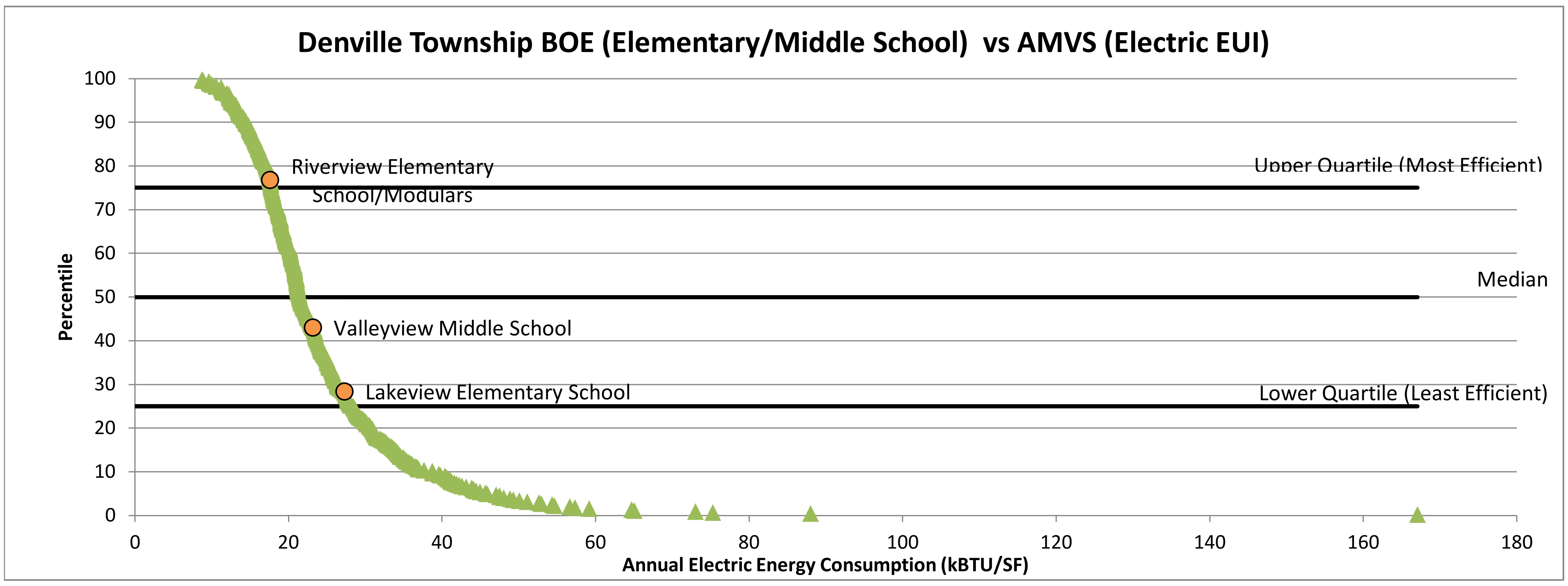
Benchmarking against AMVS

Denville Township BOE (Elementary/Middle School)

Electric EUI

Upper Quartile			Median 50%			Lower Quartile		
<17.72 kBTU/SF			between 17.72 and 28.16 kBTU/SF			>28.16 kBTU/SF		
Bldg Name	**kBTU/SF**	**Percentile**	**Bldg Name**	**kBTU/SF**	**Percentile**	**Bldg Name**	**kBTU/SF**	**Percentile**
Riverview Elementary School/Modulars	17.59	77						
			Valleyview Middle School	23.17	43			
			Lakeview Elementary School	27.28	28			

Electric EUI



The graph above shows the Annual Electric Energy Consumption (kBTU/SF) for all K-12 Schools - Elementary/Middle School buildings in the Honeywell AMVS Benchmarking Database for Middle Atltantic. Those points are shown in green on the graph. A building with a higher percentile (and lower kBTU/SF) is more energy efficient than a building with a lower percentile (and higher kBTU/SF).

The Upper and Lower Quartile (top 75% and lower 25%) and the Median (50%) are also shown. The Building is plotted in orange.

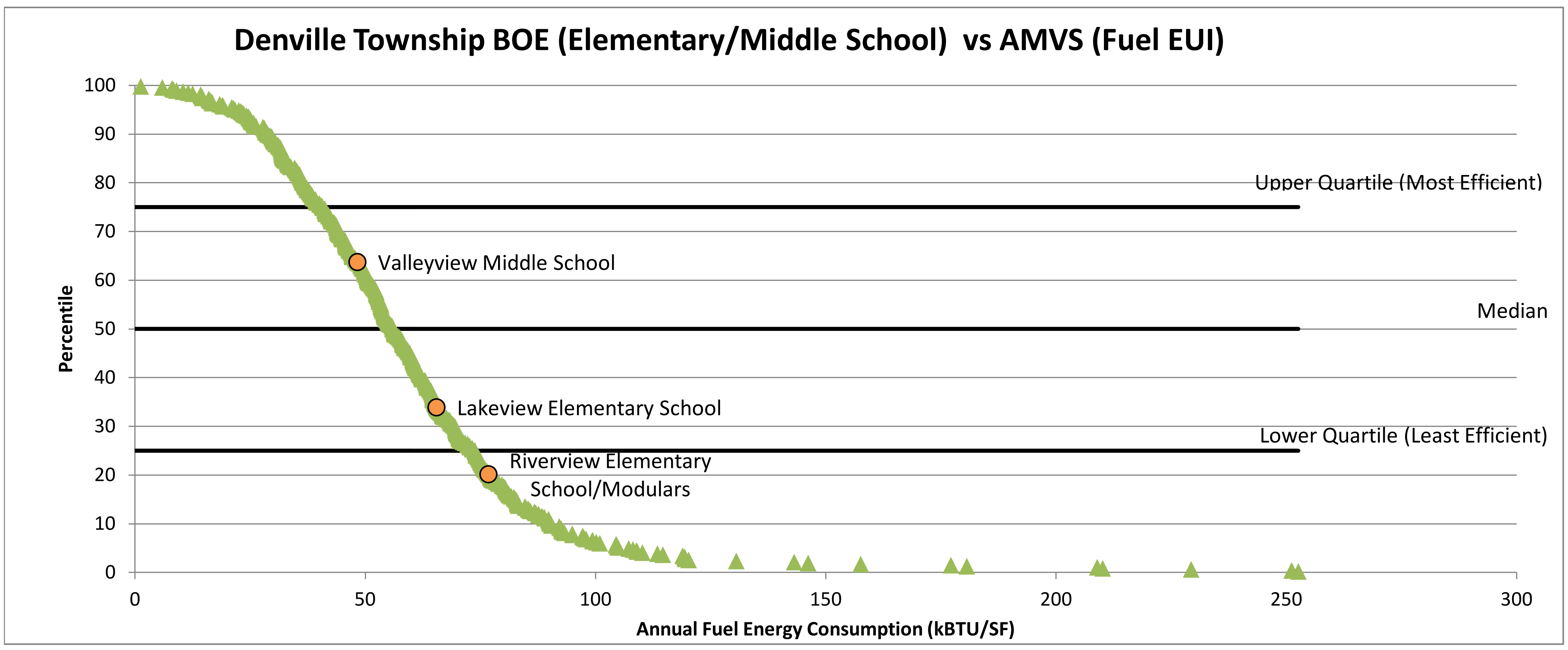
Benchmarking against AMVS

Denville Township BOE (Elementary/Middle School)

Fuel EUI

Upper Quartile			Median 50%			Lower Quartile		
<40.68 kBTU/SF			between 40.68 and 73.64 kBTU/SF			>73.64 kBTU/SF		
Bldg Name	**kBTU/SF**	**Percentile**	**Bldg Name**	**kBTU/SF**	**Percentile**	**Bldg Name**	**kBTU/SF**	**Percentile**
			Valleyview Middle School	48.29	64			
			Lakeview Elementary School	65.46	34			
						Riverview Elementary School/Modulars	76.74	20

Fuel EUI



The graph above shows the Annual Fuel Energy Consumption (kBTU/SF) for all K-12 Schools - Elementary/Middle School buildings in the Honeywell AMVS Benchmarking Database for Middle Atltantic. Those points are shown in green on the graph. A building with a higher percentile (and lower kBTU/SF) is more energy efficient than a building with a lower percentile (and higher kBTU/SF).

The Upper and Lower Quartile (top 75% and lower 25%) and the Median (50%) are also shown. The Building is plotted in orange.

SECTION C ENERGY CONSERVATION MEASURES (ECMS)

Introduction

The information used to develop this Section was obtained through the independent energy audit, building surveys to collect equipment information, interviews with operators and end users, and an understanding of the components to the systems at the sites. The information obtained includes nameplate data, equipment age, condition, the system's design and actual load, operational practices and schedules, and operations and maintenance history.

Honeywell has performed a review of the Energy Conservation Measures (ECMs) which would provide energy and operational cost savings to the Denville School District. This report aims to be an assessment of the feasibility and cost effectiveness of such measures, and an indication of the potential for their implementation. The ECMs listed below have been reviewed throughout your facilities for consideration within a complete Energy Savings Plan. What follows is a general description of the energy auditing process and a detailed description of the Energy Conservation Measures for your facilities.

Energy Conservation Measures Reviewed and Considered

Note: To see which Energy Conservation Measures apply to which buildings, refer to the detailed Energy Conservation Measure below.

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
1a	Lighting Upgrades - LED	✓	✓	✓	✓
1b	Vending Misers	✓	✓	✓	
1c	Destratification Fans	✓	✓	✓	
1d	Plug Load Management via Wi-Fi	✓	✓	✓	
2a	Boiler Replacements		✓		
2b	Boiler Burner Controls			✓	
2c	Rooftop Unit Replacement	✓	✓	✓	
2d	Premium Efficiency Motors and VFDs		✓	✓	
2e	Steam Trap Replacement			✓	
2f	Pipe Insulation			✓	
2g	Domestic Hot Water Replacements	✓	✓		
2h	Split System Replacements	✓		✓	
2i	Window AC Unit Replacements				
2j	Unit Heater Replacements				✓
3a	Building Management System Upgrades	✓	✓	✓	
3b	Demand Control Ventilation	✓	✓	✓	
3c	Energy Monitoring and Education	✓	✓	✓	
4a	Building Envelope Improvements	✓	✓	✓	✓
4b	Roof Replacements	✓			
5a	Computer Power Management	✓	✓	✓	
6a	Water Conservation	✓	✓	✓	
7a	Demand Response/Permanent Load Reduction	✓	✓	✓	
7b	Energy Sourcing	✓	✓	✓	
8a	Renewable Energy – Solar PPA System	✓	✓	✓	

Overview

- Review Site Audits
- Engineering Team Site Visits
- Develop Measures
- Review Measures with Team

Reject and Accept Measures Based On

- Alignment with Critical Success Factors (CSF)
- Value to the District
- Economic Financial Payback
- Equipment Service Life
- Effect on Current Space Conditions

In developing the proposed measures, the following considerations were critical:

- Reduction of space heating and cooling loads by performing a systems review, with complete consideration of current indoor environmental quality standards.
- Review and redesign lighting systems noting reductions in the internal heat gain in the affected spaces.
- Load reduction measures always precede optimization measures.

Bin weather data was used from a 15-year average reported from Newark, NJ. Ventilation rates, taken from ASHRAE published standard, were predicted by using the building's population multiplied by cfm/person during occupied hours.

Reasonable infiltration rates were assumed based on the building's fenestration conditions and expected values for typical school buildings. A reduced infiltration rate was assumed for the unoccupied hours. Envelope heat loss calculations assumed a reasonable heat transmission rate (U value) based on the construction of the buildings. Wall area and glass area were estimated by supplied drawings and field photographs.

Current efficiencies were derived from assumed and later to be measured boiler efficiencies, and assumed system losses due to thermal losses, distribution losses and loose operational control. The current assumed boiler system efficiencies were then applied to the calculated load and calibrated to last year's actual fuel consumption.

Demand Sensitive Operation

Review existing and proposed thermal loads. For example, the review process will facilitate the application of:

1. Optimized flow rates (steam, water, and air).
2. Optimized operation of equipment, matching current occupancy use profiles and considering both outside and indoor space temperatures.

Benefits of Mechanical Improvements

Listed below are some of the benefits that the School would reap from the mechanical portion of the measures:

1. Avoid costly repairs and replace equipment that would have to be replaced in the next five years.
2. Improved compliance with ASHRAE Ventilation Standards.
3. Ability to trend ventilation rates; thus, insuring compliance through documentation.
4. Operating a more weather sensitive facility.
5. Allowing for a greater capability of central monitoring and troubleshooting via remote access.
6. Greater operating flexibility to reduce costs and optimize staff efficiency.

Indoor Air Quality

Implementation of new energy-related standards and practices has contributed to a degradation of indoor air quality. In fact, the quality of indoor air has been found to exceed the Environmental Protection Agency (EPA) standards for outdoor air in many homes, businesses, and factories.

The American Council of Governmental Industrial Hygienists (ACGIH) in their booklet “Threshold Limit Values,” has published air quality standards for the industrial environment. No such standards currently exist for the residential, commercial, and institutional environments, although the ACGIH standards are typically and perhaps inappropriately used. The EPA has been working to develop residential and commercial standards for quite some time.

Recent studies indicate that for even the healthiest students, indoor air pollution can reduce the ability to learn. Honeywell has addressed this issue by focusing on the proper operation and replacement of the unit ventilators and air handler equipment which will assure indoor air quality standards are met.

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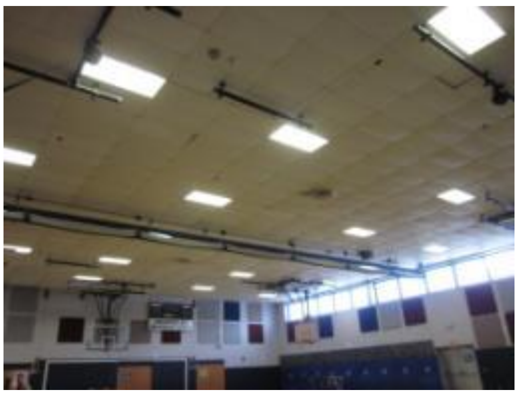
ECM 1A LIGHTING UPGRADES – LED RETROFIT

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
1a	Lighting Upgrades - LED	✓	✓	✓	✓

Existing Conditions

Lighting throughout the schools is comprised mostly of fluorescent tube lay-in fixtures with T-12 lamps and magnetic ballasts. The Lakeview Elementary school C-wing addition lighting consists of modern T-8 lay-in fixtures with electronic ballasts. Large spaces throughout the school district, such as the multi-purpose rooms and gymnasiums, are served by high ceiling metal halide fixtures or high pressure sodium fixtures. Storage rooms, bathrooms and closets are lit with a mixture of incandescent lamps and compact fluorescent lamps. The parking lots are lit with light poles and high pressure sodium lamps or metal halide lamps.



Riverview Elementary School Gymnasium

Lakeview Elementary School Typical Classroom

Scope of Work

The purpose of the audit was to identify opportunities to improve the efficiency of the lighting system, while maintaining or where necessary, increasing the current light levels to code requirements. The proposed lighting system is based on converting the existing light fixtures to Light Emitting Diode (LED) technology bulbs and fixtures throughout the district. Detailed line by line work scopes can be found in the appendix as well as proposed product and fixture data and cut sheets.

Denville School District will receive many benefits from the lighting system upgrade. They include the following:

- **Long Life** - Long life time stands out as the number one benefit of LED lights. LED bulbs and diodes have an outstanding operational life time expectation of up to 100,000 hours. This is 11 years of continuous operation, or 22 years of 50% operation. Operational savings in terms of bulb and ballast replacement are significant based on this technology.

- **Energy Efficiency** – Today's most efficient way of illumination and lighting has an estimated energy efficiency of 80%-90% when compared to traditional lighting and conventional light bulbs. This means that about 80% of the electrical energy is converted to light, while 20% is lost and converted into other forms of energy such as heat. Traditional incandescent light bulbs operate at 20% energy efficiency only, 80% of the electricity is lost as heat.

- **Ecologically Friendly** - LED lights are free of toxic chemicals. Most conventional fluorescent lighting bulbs contain a multitude of materials like mercury that are dangerous for the environment. LED lights contain no toxic materials and are 100% recyclable, and will help to reduce carbon footprint by up to a third. The long operational life time span mentioned above means also that one LED light bulb can save material and production of 25 incandescent light bulbs. A big step towards a greener future!

- **Durable Quality** - LEDs are extremely durable and built with sturdy components that are highly rugged and can withstand even the roughest conditions. Because LED lights are resistant to shock, vibrations and external impacts, they make great outdoor lighting systems for rough conditions and exposure to weather, wind, rain or even external vandalism, traffic related public exposure and athletic areas.

- **Zero UV Emissions** - LED illumination produces little infrared light and close to no UV emissions. Because of this, LED lighting is highly suitable not only for goods and materials that are sensitive to heat due to the benefit of little radiated heat emission, but also for illumination of UV sensitive objects or materials.

- **Design Flexibility** - LEDs can be combined in any shape to produce highly efficient illumination. Individual LEDs can be dimmed, resulting in a dynamic control of light, color and distribution. Well-designed LED illumination systems can achieve fantastic lighting effects, not only for the eye but also for the mood and the mind: LED mood illumination is already being used in airplanes, classrooms and many more locations and we can expect to see a lot more LED mood illumination in our daily lives within the next few years.

- **Operational in Extremely Cold or Hot Temperatures** - LEDs are ideal for operation under cold and low outdoor temperature settings. For fluorescent lamps, low temperatures may affect operation and present a challenge, but LED illumination operates well also in cold settings, such as for outdoor winter settings, freezer rooms etc.

- **Light Disbursement** – LEDs are designed to focus light and can be directed to a specific location without the use of an external reflector, achieving higher application efficiency than conventional lighting. Well-designed LED illumination systems are able to deliver light more efficiently to the desired location.

- **Instant Lighting & Frequent Switching** - LED lights brighten up immediately and when powered on, which has great advantages for infrastructure projects such as traffic and signal lights. Also, LED lights can be switched off and on frequently and without affecting the LED's lifetime or light emission. In contrast, traditional lighting may take several seconds to reach full brightness, and frequent on/off switching does drastically reduce operational life expectancy.

- **Low-Voltage** - A low-voltage power supply is sufficient for LED illumination. This makes it easy to use LED lighting also in outdoor settings, by connecting an external solar-energy source and is a big advantage when it comes to using LED technology in remote or rural areas.

Scope of Work Outdoor Lighting

The exterior wall-packs and pole-mounted shoebox fixtures are currently high wattage metal halide lamps or high pressure sodium lamps. These will be replaced with lower wattage LED fixtures. The LED technologies offer significant advantages such as extended lamp life, minimal lumen depreciation, "instant on," and very high energy conversion efficiency. These fixtures will provide substantial maintenance savings via the new 100,000 hour LED lamp life versus the 20,000 hours of the existing metal halide lamps.

To retrofit these lights with energy efficient LEDs, the existing ballasts that are located in the space behind the light will be removed. Once removed, they will be replaced with LED drivers which will use approximately 24V and will not need the existing ballast. The existing lamps are removed and new energy efficient LED lamps are installed in their place. Replacements or maintenance is not required on these type fixtures for up to 100,000 hours or 15-20 years depending on usage time.

Changes in Infrastructure

New LED lamps will be installed as part of this ECM. Existing poles and shoe box fixtures will be utilized.

Customer Support and Coordination with Utilities

Coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Energy savings will result from reduced electric energy usage. A slight increase in heating energy is resultant from the reduced heat output of more efficient lamps.
Waste Production	All lamps and ballasts that are removed will be properly disposed.
Environmental Regulations	No environmental impact is expected.

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ECM 1B VENDING MISERS

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
1b	Vending Misers	✓	✓	✓	

Existing Conditions

Vending machines are located throughout the school facilities offering soft drinks and snacks to the occupants. A typical cold drink machine consumes over 5,000 kWh annually.

Vending machines in Faculty Rooms

Building	Type	Location	Qty
Valleyview Middle School	Snack	Faculty Room	1
Valleyview Middle School	Cold Beverage	Faculty Room	1
Lakeview Elementary School	Cold Beverage	Faculty Room	1
Riverview Elementary School	Cold Beverage	Faculty Room	1
Riverview Elementary School	Snack	Faculty Room	1
Total			**5**

Table 1B.1 – Existing Vending Machines

Proposed Solution

During the walkthrough, Honeywell noted vending machines that provide an opportunity for energy savings by shutting off non-critical loads during the non-occupied periods.

To control the vending machines, Honeywell proposes to install a vending machine occupancy controller (VMOC) to manage the power consumption. Utilizing a Passive Infrared (PIR) Sensor, the VMOC completely powers down a vending machine when the area surrounding it is unoccupied. Once powered down, the VMOC will monitor the room's temperature and use this information to automatically re-power the vending machine at one to three hour intervals, independent of occupancy, to ensure proper vending product temperature control. .

The VMOC also monitors electrical current used by the vending machine. This ensures that the unit will never power down a vending machine while the compressor is running, so a high head pressure start never occurs. In addition, the current sensor ensures that every time the vending machine is powered up, the cooling cycle is run to completion before powering down the vending machine again. The Coca Cola Company and Pepsi Corporation approve the proposed controller for use on their machines.

Interface with Existing Equipment

All of the plug load control devices are easily installed. The vending machine controllers are installed separately from the machine and implementation will occur during working hours. A period of three (3) weeks will be required to make sure of proper calibration of the sensors.

During the implementation phase, Honeywell will check with the vendor about the type and specification of the vending machines as it relates to any internal time clocks which may exist inside the machine. Should this be the case, the savings and cost will be adjusted accordingly.

Changes in Infrastructure

New vending machine controls will be installed as part of this ECM.

Customer Support and Coordination with Utilities

Minor coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Energy savings will result from reduced electric energy usage.
Waste Production	None.
Environmental Regulations	No environmental impact is expected.

ECM 1C DESTRATIFICATION FANS

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
1c	Destratification Fans	✓	✓	✓	

Existing Conditions

In high ceiling areas such as in a gymnasium and/or cafeteria, warm air stratifies close to the ceiling. Elevated levels of heat transfer through the high walls and roof causes substantial heat loss.

Lakeview Elementary School Gymnasium

Riverview Elementary School Gymnasium

Proposed Solution

In the school gyms with 20+-foot ceilings, there is approximately a 15°F+ temperature difference between the floor and the ceiling. With higher ceilings it is even more. That means to generate the heat necessary to maintain a comfortable 70°F temperature at the floor level where student activities occur, the ceiling could be 85°F or higher.

De-stratification fans de-stratify the air to a 0-3 deg F differential from floor to ceiling and wall to wall. This will allow HVAC systems to have less running time because of the absence of extreme temperatures to heat or cool, thus allowing the local thermostats to be satisfied for longer periods of time.

Systems Evaluation and Selection

An energy-efficient motor drives a near-silent fan that aerodynamically and quietly forces a column of hot air from the ceiling area to the cooler air on the floor below. As this column of warm air nears the floor, it begins to flare out in a circular pattern and rise again creating a torus. While doing so, it warms the cooler air that it mixes with near the floor increasing the temperature of the air and floor. Through a natural law of physics, this torus will continue to re-circulate air through the de-stratification fan suspended near the ceiling and continue mixing warmer air from the ceiling with cooler air near the floor until the ceiling and air temperatures are nearly equal.

As this happens, it will require less and less energy to comfortably heat the work area, allowing thermostats to be lowered and energy savings to be realized. Once started, the entire process of "thermal equalization" will take on average less than 24 hours.

Based on preliminary site investigation conducted by our staff, we propose to install the following as indicated in the table below:

School	Location	Qty	Model
Valleyview Middle School	Cafeteria	5	Air Pear 10
Valleyview Middle School	Gym	6	Air Pear 25

School	Location	Qty	Model
Lakeview Elementary School	Multipurpose Room	4	Air Pear 15
Lakeview Elementary School	Cafeteria	4	Air Pear 15
Lakeview Elementary School	Gym	5	Air Pear 25
Riverview Elementary School	Gym	6	Air Pear 25
Riverview Elementary School	Multipurpose Room	6	Air Pear 15
Total		**36**	

Table 1C.1 – Proposed De-stratification Fans

Scope of Work

Per Destratification Fan:

- Shut off the main electric power to the area in which the unit(s) will be installed.
- Install new de-stratification fan and wiring.
- Re-energize.
- Inspect unit operation by performing electrical and harmonics testing.

Changes in Infrastructure

New de-stratification fans will be installed as part of this ECM.

Customer Support and Coordination with Utilities

Coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Energy savings will result from reduced thermal energy usage. A slight increase in electrical energy is resultant from the increase run time of the fan motors.
Waste Production	None.
Environmental Regulations	No environmental impact is expected.

ECM 1D PLUG LOAD MANAGEMENT VIA WI-FI

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
1d	Plug Load Management via Wi-Fi	✓	✓	✓	

Existing Conditions

A byproduct of the electronic devices such as printers, projectors, televisions, window air conditioning units, and vending machines is their phantom load. Phantom load refers to energy that is used when a device is off. This includes energy used by TV's when they're in standby mode (i.e. when they can be turned on with a remote), and energy used by chargers or a laptop's AC adapter. Studies estimate that phantom load now accounts for 6% of all energy use.

With the increasing number of devices, many facilities managers must rely on people to remember to turn out the lights, or unplug their printers when not in use. Typical electrical draws for when devices are off are as follows:

Device	Wattage
Cold Beverage Machine	384
Snack Machine	60
Large Copier	30
Small Printer / Copier	20
Laptop Charging Cart	35
Projectors	21
Water Fountains	6
Hot / Cold Water Machine	60

Table 1D.1 – Electrical Draw per Typical Device

Proposed Solution

Home automation and control technologies have been around for years, and have the potential to reduce the energy used by a wide variety of devices. Plug load management via Wi-Fi provides a simple solution to the device control dilemma, by using an existing Wi-Fi network to program BERT® electrical plugs to a set schedule defined by the end user. These plugs are in essence a switch that stops all electrical power to the device, turning off equipment and eliminating phantom loads.

The Enterprise Application Program (EAP) is installed on one computer on the network, and is used to set schedules, group devices, and monitor activity. On/Off requests are sent through the existing network router using Wi-Fi. Each BERT plug contains a microchip and antenna that communicates with the enterprise application program on a periodic basis. The BERT enterprise application program uses SNMP (Simple Network Management Protocol) to monitor the activity of connected devices (plugs). When a BERT plug receives an "off" command, the module turns off all power supplied to the plug.

BERT Device	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Totals
Classroom Amplifiers (Front Row)	20	20	19	59
H/C Water Dispenser	1	1	1	3
Lab Monitors Combo	30	24	18	72
Laptop Charging Carts	6	10	6	22
Large Printer/Copiers	2	2	1	5
Medium Printer/Copiers	7	6	5	18
Netbook Charging Stations			4	4
Printer/Monitor Combo	3		13	16
Projector		30	34	64
Small Printers		2	4	6
Smartboard (plug-in)		27	1	28
Smartboard/Projector Combo	35	1	2	38
Televisions	5	3	27	35
AC Units 220 (INLINE)		1	6	7
AC Units 110 15A		12	22	34
Water Fountains (outside plug)			5	5
	109	**139**	**168**	**416**

Table 1D.2 – Device Schedule

The benefits are energy savings and extended bulb life for the white board projectors. It is estimated that one (1) less bulb replacement will be required per year for each projector.

Energy Savings Methodology and Results

Installation of the outlet strips will reduce the operating hours of the connected peripheral devices reducing electrical consumption.

Changes in Infrastructure

Computers and peripherals will be connected to new BERT plugs permitting peripheral operation to be coordinated with the computer to which they are connected.

Customer Support and Coordination

None.

Environmental Issues

Resource Use	Annual savings for student computers are based wattage difference between the two monitor types.
Waste Production	None
Environmental Regulations	No environmental impact is expected.

ECM 2A BOILER REPLACEMENTS

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
2a	Boiler Replacements		✓		

Existing Conditions

In general, the boilers at the Denville School District are new Aerco condensing boilers or have been well maintained which has resulted in additional years of operation. Lakeview Elementary school has two Smith cast iron 28A-5 Series boilers that serve the C-wing addition that are from 2001.

Lakeview Elementary School – Smith Boilers

Lakeview Elementary School – Smith Boilers

School	Manufacturer	Model	Qty	Input (Each)	Burner Make	Fuel
Lakeview Elementary School	Smith	28A-5	2	1,166 MBH	Powerflame	Gas

Table 2A.1 – Existing Equipment

Proposed Solution

It is recommended that the boilers listed in Table 2A.1 be replaced with boilers operating at higher efficiency. The existing boilers to be replaced suffer from elevated stack losses as well as jacket losses (radiation losses) due to the age, deterioration of the heat transfer surfaces and obsolete design. New condensing hot water boilers have thermal efficiencies that range from 88% – 95% depending on the return hot water temperature from the heating loop. With proper design, it is typical to see thermal efficiencies of around 92%. Thermal efficiency is only one part of the equation that makes up the seasonal efficiency of a boiler. Compared to the existing boilers in these schools, the new boilers will provide an increase in boiler efficiency of anywhere between 10% to 15%.

School	Manufacturer	Model	Qty	Input (Each)	Fuel
Lakeview Elementary School	Aerco	BMK 1000	2	1,000 MBH	Gas

Table 2A.2 – Proposed Boiler Equipment

As an alternate solution Honeywell investigated possibly cross connecting the Lakeview Elementary School 2000 and 2010 Boiler Rooms and feed the C Wing with heating how water off the existing 3000 MBH Aerco Units

School	4" HHW Piping	HHW Pumps
Lakeview Elementary School	640 ft	2

Table 2A.3 – Proposed Cross Connect Piping

Piping Scope of Work:

1. Install approximately 640 feet of 4" Hot water and associated piping, pumping, valve and fittings.
2. Connect all associated piping from each boiler room.
3. Start up and commissioning.

Scope of Work

The following outlines the boiler replacement:

- Disconnect gas back to shutoff valve and electric back to source panel-board.
- Remove existing boilers
- Connect gas and heating hot water appurtenances to new boilers.
- Terminate and power new boiler electric circuiting.
- Start up, commissioning and operator training.

Energy Savings Methodology and Results

In general, Honeywell uses the following approach to determine savings for this specific measure:

Existing Boiler Efficiency	= Existing Heat Production/ Existing Fuel Input
Proposed Boiler Efficiency	= Proposed Heat Production/ Proposed Fuel Input
Energy Savings $	= Heating Production (Proposed Efficiency – Existing Efficiency)

Equipment Information

Manufacturer and Type	Several quality and cost effective manufacturers are available. Honeywell and the customer will determine final selections.
Equipment Identification	As part of the ECM design and approval process, specific product selection will be provided for your review and approval.

Changes in Infrastructure

New boiler will be installed in itemized locations; in addition, training for maintenance personnel will be required as well as on-going, annual preventive maintenance.

O&M Impact

The new boilers will decrease the O&M cost significantly for maintaining the boilers.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods. Continuity of service must be maintained for the customer.

Environmental Issues

Resource Use	Energy savings will result from greater combustion efficiency, reduced maintenance costs control and setback.
Waste Production	Existing boilers scheduled for removal will be disposed of properly.
Environmental Regulations	No environmental impact is expected; all regulations will be adhered to in accordance with EPA and local code requirements.

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ECM 2B BOILER BURNER CONTROLS

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
2b	Boiler Burner Controls			✓	

Existing Conditions

Honeywell has surveyed each building's heating and domestic hot water equipment and distribution systems to identify areas for boiler plant optimization. Currently, the existing boiler burners at the schools listed in Table *2B.1* have limited or no fuel / air ratio controls in place.

Riverview Elementary School – Boiler Burners

Proposed Solution

Proposed Systems and Scope of Work

Honeywell will retrofit the existing Burner Management System on boilers with Honeywell ControLinks™ linkageless Fuel/Air Ratio Control system.

Honeywell ControLinks™ will integrate to the existing Burner Management Flame Safe Guard Controller (FSG) to monitor and control the burner fuel and air ratios to maintain proper combustion. The single actuator will be replaced with separate Direct Coupled Actuators (DCA) for air and fuel(s) and will be connected to the existing burner control.

This retrofit will provide a combustion curve and light-off points including minimum/maximum firing rate points resulting in a precise firing rate control over the entire firing rate of the burner. Combustion efficiency will be maximized throughout the combustion curve and will provide a fuel curve in order to achieve maximum efficiency.

Scope of Work

Honeywell ControLinks controllers will be installed on the following boiler burners:

School	Manufacturer	Model	Qty	Output MBH (Each)	Burner Make	Fuel
Riverview Elementary School	Weil McLain	88 Series	3	2,329	PowerFlame WCR3-G-20	Gas

Table 2B.1 – Existing Boilers to Receive ControLinks

Energy Savings Methodology and Results

The savings approach is based upon reducing the amount of time the boiler is ON without reducing the heating response time or system capacity in response to warmer periods of the year and when demand for heating is low or non-existent. The relative savings is based upon the ratio of off time to burn time and the magnitude is between 10% and 15% of fuel used.

Honeywell ControLinks is a patented burner control unit. This unit eliminates mechanical linkages in the traditional burners and replaces the same with electronic equivalents. This eliminates the sluggish operation of the linkages and significantly decreases response time. The air to fuel ratio is therefore maintained accurately, resulting in fuel savings. Case studies have shown that fuel savings range from 4-8% - Honeywell uses 5% savings to be conservative.

Changes in Infrastructure

A new controller for each boiler will be installed and programmed. In addition to the controllers, training for maintenance personnel will be required.

Equipment Information

Manufacturer and Type	Several quality and cost effective manufacturers are available. The following is an example of equipment that may be utilized. Honeywell and the Customer will determine final selections.
Equipment Identification	As part of the measure design and approval process, specific product selection will be provided for your review and approval.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	Energy savings will result from greater boiler load control.
Waste Production	This ECM will produce no waste by-products.
Environmental Regulations	No environmental impact is expected.

Utility Interruptions

Proper phasing procedures will minimize gas interruptions.

ECM 2C ROOFTOP UNIT REPLACEMENT

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
2c	Rooftop Unit Replacement	✓	✓	✓	

Existing Conditions

Some rooftop units serving Valleyview Middle School are inefficient and have exceeded their expected useful service lives. Replacing these units with new, high efficiency units will save energy costs over the long term while reducing repair costs that would otherwise have been necessary to keep the old units in operation.

Riverview ES RTU

Lakeview ES RTU

School		Model	Location Served	Qty.	Tons	EER
Lakeview Elementary School	Carrier	50TJ005M511	Nurse Office	1	4	8.5
Lakeview Elementary School	Carrier	50TJ004M511	Principal's Office	1	3	8.0
Lakeview Elementary School	Carrier	50TJ004M511	Main Office	1	3	8.5
Riverview Elementary School	Trane	YCH061C3HBBE	Office	1	5	8.7
Riverview Elementary School	Trane	YCH151C3H0AA	Library	1	12.5	8.5
Riverview Elementary School	Trane	YCH103C3L0AA	Computer Room	1	8.5	8.5

Table 2C.1 – Existing Rooftop Units to be Re-placed

Proposed Solution

Honeywell proposes replacing the existing rooftop units in Table 2C.1. The new units will be installed in the same location as the existing units. Existing electrical power supply will be reconnected to the new motors. The new units will be equipped with factory-installed microprocessor controls that improve unit efficiency. The units will also communicate with the existing building management system.

School	Make	Model	Location Served	Qty.	Tons	EER
Lakeview Elementary School	Lennox	KGB060S4D	Nurse Office	1	5.0	11.8
Lakeview Elementary School	Lennox	KGA150S4B	Principal's Office	1	12.0	11.0
Lakeview Elementary School	Lennox	KGA102H4B	Main Office	1	8.0	12.2
Riverview Elementary School	Lennox	KCB048S4D	Office	1	4.0	11.5
Riverview Elementary School	Lennox	KCB036S4D	Library	1	3.0	12.5
Riverview Elementary School	Lennox	KCB036S4D	Computer Room	1	3.0	12.5

Table 2C.2 – Proposed Rooftop Units

** Additional units may be added during investment grade audit.*

Scope of Work

The following outlines the scope of work to install the condensing units stated in the above table:

- Disconnect existing RTU electric connections.
- Disconnect piping and air ducts from the unit.
- Remove unit from the base.
- Modify base for new unit if necessary.
- Run new gas line for gas fired heater.
- Rigging and setting new unit at the base.
- Inspect piping and air ducts before reconnecting them to the unit.
- Reconnect piping and air ducts.
- Repair duct and piping insulation.
- Connect electric power.
- Start up and commissioning of new unit.
- Maintenance operator(s) training.

Energy Savings Methodology and Results

The savings approach is based on the energy efficiency between the existing and new units. The savings are generally calculated as:

Electric Energy savings	Existing unit energy consumption (kWh) – replacement unit energy consumption (kWh)

Equipment Information

Manufacturer and Type	Several quality and cost effective manufacturers are available. Honeywell and the School District will determine final selections.
Equipment Identification	Product cut sheets and specifications are available upon request. As part of the measure, design and approval process, specific product selection will be provided for your review and approval.

Customer Support and Coordination with Utilities

Coordination of the electrical tie-in will be required.

Environmental Issues

Resource Use	Energy savings will result from higher efficiency units.
Waste Production	Existing rooftop unit scheduled for removal will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 2D PREMIUM EFFICIENCY MOTORS AND VFDS

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
2d	Premium Efficiency Motors and VFDs		✓		

Existing Conditions

Honeywell has identified standard efficiency electric motors on hot water pumps. Energy savings can be obtained by installing Variable Frequency Drives on the standard efficiency motors.

Lakeview ES Boiler Room Hot Water Pumps

Lakeview ES Mezz. Mechanical Room Hot Water Pumps

The motors that were identified in the buildings are listed as follows:

School	Equipment Label	Qty	Motor HP	Replace Motor Y/N	Add VFD Y/N
Lakeview Elementary School	LV-P-1	1	7.5	Y	Y
Lakeview Elementary School	LV-P-2	1	7.5	Y	Y
Lakeview Elementary School	LV-P-3	1	7.5	Y	Y
Lakeview Elementary School	LV-P-4	1	7.5	Y	Y
Riverview Elementary School	RV-P-1	1	3.0	Y	Y
Riverview Elementary School	RV-P-2	1	3.0	Y	Y

Table 2C.1 – Existing Motors and Replacements

Proposed Solution

Honeywell proposes the installing VFDs on all above-mentioned single speed standard efficiency motors.

Scope of Work

1. Install VFDs on the pumps.
2. Install wiring and controls on the new VFDs.
3. Measure and verify the pre and post-retrofit voltage, amperage, and RPM.

Energy Savings Methodology and Results

The energy consumed by electric motors varies inversely to the cube of the motor speed. Variable speed drives reduce motor speed (in response to load) thus reducing energy consumption exponentially.

Equipment Information

Manufacturer and Type	Several quality and cost effective manufacturers are available. The following is an example of equipment being utilized. Honeywell and Denville SD will determine final selections.
Equipment Identification	Product cut sheets and specifications for generally used are available upon request. As part of the measure design and approval process, specific product selection will be provided for your review and approval.

Changes in Infrastructure

New motors will be installed in place of the old motors. No expansion of the facilities will be necessary.

Customer Support and Coordination with Utilities

Coordination of the electrical tie-in will also be required.

Environmental Issues

Resource Use	Energy savings will result from reducing electrical usage by operating higher efficiency motors for the same horsepower output. The equipment uses no other resources.
Waste Production	This measure will produce waste byproducts. Old motors shall be disposed of in accordance with all federal, state and local codes.
Environmental Regulations	No environmental impact is expected.

ECM 2E STEAM TRAP REPAIR/REPLACEMENT

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
2e	Steam Trap Replacement			✓	

Existing Conditions

Riverview Elementary School uses steam for space heating within the older sections of the buillding. Based on the walkthrough and the provided building floor plans, it was estimated that the steam section contains approximately 41 steam traps. These numbers will be re-evaluated during the investement-grade energy audit.

When steam heats the building and transfers it's heat throughout the building it condenses back to water. Therefore, at each of these end uses, the condensate must be trapped and sent back to the boiler. When steam traps fail, the steam does not condense reducing the heat transfer causing unnecessary heat losses. The inspection and correction of the steam traps will reduce unnecessary losses. Traps are designed to drain only the condensate, and prevent live steam from entering the condensate return piping.

As the distribution system ages, the moving parts in the trap tend to get sluggish or fail altogether. This failure results in live steam entering the condensate return piping. The cumulative effect of this is to return the condensate above the flash point, resulting in steam and hence valuable heating energy loss at the boiler. This loss of energy can be minimized by a thorough survey to identify leaking traps by use of infrared temperature sensing instruments.

Riverview ES – Steam Steam Trap

Riverview ES – Steam Trap

School	Size/Type	# of Steam Traps
Riverview Elementary School	1" Float and Thermostatic	3
Riverview Elementary School	1-¼" Float and Thermostatic	2
Riverview Elementary School	Univent ¼" Thermostatic	30
Riverview Elementary School	Drip Leg ¼" Thermostatic	27
Riverview Elementary School	HVAC ¼" Thermostatic	4
Total		**66**

Table 2E-1 – Steam Trap Replacements

Proposed Solution

This ECM recommends retrofitting the traps per the following scope of work. The steam trap retrofit includes surveying all of the existing steam traps and engineering appropriate replacements. During construction, Honeywell will provide all materials, fittings, labor and supervision for the timely completion of the project. All existing strainers, isolation valves, check valves, and fittings in good repair will be reused.

Thermostatic steam traps will be completely replaced with new thermostatic trap bodies. F&T steam traps will include complete replacement with new steam traps manufactured by Barnes & Jones Inc or equal. Atmospheric vacuum breakers will be installed on the air handling unit coils where thermostatic traps are currently being used as release vacuum.

Energy Savings Methodology and Results

All mechanical steam traps lose some live steam, either through normal cycling, leaking through a closed trap, or failing in the open position. Various sources have stated that the loss through a properly operational trap may exceed ten lbs/hour, while the failed steam trap population ranges between 20-50% at any given time.

We have estimated the steam losses based on a conservative figure of 10% failed, 10% leaking steam trap population. Failure rates are based on what has been found in similar buildings elsewhere in and around New Jersey. In determining steam losses, the trap orifices and steam pressures have been grouped and averaged to create a simpler statistical basis.

Equipment Information

Material and Type	Steam Trap selection will be determined in conjunction with Denville SD
Material Identification	As part of the measure, design and approval process, a full Investment Grade Audit will be conducted to determine final scope. Specific material selection will be provided for your review and approval.

Customer Support and Coordination with Utilities

Coordination of the trap installation.

Environmental Issues

Resource Use	Energy savings will result the reduction of steam loss from malfunctioning traps resulting in lower fuel consumption. The equipment uses no other resources.
Environmental Regulations	Asbestos abatement may be required

ECM 2F PIPE INSULATION

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
2f	Pipe Insulation			✓	

An insulation audit was conducted identifying an approximated quantity of heat that is lost from various locations throughout the buildings. The heat losses result from heating hot water converters and hot water and condensate piping giving off heat to the space around it. This measure will insulate these surfaces, resulting in energy savings and improved comfort of those areas in or near occupied spaces.

Existing Conditions

During the site visits, it was noticed that the steam and hot water supply piping at Riverview Elementary School boiler room was not insulated. The un-insulated piping not only wastes energy along with posing a danger of injury with exposed hot piping, but also caused a comfort issue with classrooms being overheated due to exposed piping directly under the floors.

Riverview ES Un-insulated Hot Water and Steam Piping

Proposed Solution

Honeywell proposes insulating these pipes with appropriately thick fiberglass insulation. The following table lists the recommended insulation thickness.

Location	Pipe Diameter	Insulation Type	Recommended Insulation Thickness	Linear Feet of Pipe
Riverview Elementary School	1.0”	Fiberglass	1.5”	175
Riverview Elementary School	1.5”	Fiberglass	1.5”	201
Riverview Elementary School	2.0”	Fiberglass	2.5”	40
Riverview Elementary School	2.5”	Fiberglass	2.5”	60
Riverview Elementary School	3.0”	Fiberglass	2.5”	20
Riverview Elementary School	4.0”	Fiberglass	3.0”	10

Table 2f-1 – Piping Insulation to be installed

Energy Savings Methodology and Results

Energy savings results from significantly reducing the heat lost to the atmosphere from the piping and tank surfaces. In general, Honeywell uses the following approach to determine savings for this specific measure:

Energy Savings $	= ((Heat Loss Rate per foot of Uninsulated Pipe – Heat Loss Rate per foot of Insulated Pipe) x (Length of Pipe x Hours of Operation) x Cost/btu)/(Boiler Efficiency))

Reference is made to the ASHRAE 1989 Fundamentals text page 22.19, Table 9A "Heat Loss from Bare Steel Pipe to Still Air at 80 degrees F, Btu/hr-ft" for losses from un-insulated lines, and Table 11 "Recommended Thickness for Pipe and Equipment Insulation".

Changes in Infrastructure

The insulation of the steam lines can happen anytime without impact on building operation. In areas were asbestos is present; precautions will be required. Areas that are dangerously hot may require coordination with a normally occurring shutdown of that portion of the system.

Customer Support and Coordination with Utilities

The service to the specific lines may require interruption to allow for the repair or replacement. Coordination with site personnel will be required to minimize interruption to the buildings affected.

Environmental Issues

Resource Use	Energy savings will result the reduction of heat loss from the uninsulated lines resulting in lower fuel consumptions fuel consumption. The equipment uses no other resources.
Waste Production	This measure produces no waste by products.
Environmental Regulations	Asbestos abatement will not be required.

ECM 2G Domestic Hot Water Replacements

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
2g	Domestic Hot Water Replacements	✓			

Existing Conditions

Currently, Valleyview Middle school has a Lochinvar model CWN315PM, natural gas, domestic water boiler that provides hot water for the building. This unit is about nine years old and not very efficient. The Lakeview Elementary School serves the Gym and C-wings and is also inefficient as compared to newer condensing units.

Valleyview Middle School DHW Heater

Lakeview ES DHW Heater

School	Location Served	Manufacturer	Model	Qty	Capacity	Fuel
Valleyview Middle School	Building	Lochinvar	CWN315PM	1	258.3 MBH	Gas
Lakeview Elementary School	C-Wing/Gym	A.O. Smith	BTP-140-199	1	199 MBH	Gas

Table 2G.1 – Existing Equipment

Proposed Solution

Honeywell proposes replacing the existing DHW heater at the above school with a highly efficient condensing DHW heater. New condensing DHW heaters have efficiencies between 92% - 94%. They provide better control with capabilities such as night setback, temperature adjustments and demand control hot water.

School	Location Served	Manufacturer	Model	Qty	Capacity	Fuel
Valleyview Middle School	Building	A.O. Smith	BTH-120	1	120 MBH	Gas
Lakeview Elementary School	C-Wing/Gym	A.O. Smith	BTX-80	1	80 MBH	Gas

Table 2G.2 – Proposed Equipment

Scope of Work

The following outlines the domestic hot water heater replacement:

1. Demolish and remove old water heaters
2. Furnish and install 2 x condensing gas fired domestic hot water heaters as specified in the table above

3. Install all required piping, controls, and breeching
4. Install mixing valve
5. Install circulators for building use and kitchen supply
6. Disconnect hot water storage tank and abandon in place
7. Test and commission

Energy Savings Methodology and Results

The savings are calculated from the domestic hot water heater efficiency differences.

Existing Equipment Efficiency	= Existing Boiler Efficiency + Existing Heat Exchanger Efficiency
Proposed Equipment Efficiency	= Efficiency of the New Domestic Hot Water Heater
Energy Savings	= DHW Load x (Existing Equipment Efficiency – New Equipment Efficiency)

Changes in Infrastructure

A new controller for each boiler will be installed and programmed. In addition to the controllers, training for maintenance personnel will be required.

Equipment Information

Manufacturer and Type	Several quality and cost effective manufacturers are available. The following is an example of equipment that may be utilized. Honeywell and the Customer will determine final selections.
Equipment Identification	As part of the measure design and approval process, specific product selection will be provided for your review and approval.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	Energy savings will result from improved thermal efficiency.
Waste Production	This ECM will produce no waste by-products.
Environmental Regulations	No environmental impact is expected.

Utility Interruptions

Proper phasing procedures will minimize gas interruptions.

ECM 2H SPLIT SYSTEM REPLACEMENTS

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
2h	Split System Unit Replacements	✓		✓	

Existing Conditions

The condensing units serving Riverview and Valleyview Schools are inefficient and have exceeded their expected useful service lives. Replacing this unit with a new, high efficiency unit will save energy costs over the long term while reducing repair costs that would otherwise have been necessary to keep the old units in operation.

Split system serving IT Closet – Riverview Elementary School and Valleyview MS Guidance

School	Make	Model	Location Served	Qty.	Tons	SEER
Riverview Elementary School	Carrier	40QA048320	IT Closet	1	4	11.0
Valleyview Middle School	Carrier	38HDC048510	A01	1	4	8.5
Valleyview Middle School	Carrier	38HDC048510	A02	1	4	8.5
Valleyview Middle School	Goodman	CKL603	C-10,Guidance,C-11	1	5	10.1

Table 2H.1 – Existing Condensing Unit to be Replaced

Proposed Solution

Honeywell proposes replacing the existing condensing unit in Table 2H.1. The new unit will be installed in the same location as the existing unit. Existing electrical power supply will be reconnected to the new motor. The new unit will be equipped with factory-installed microprocessor controls that improve unit efficiency and will also communicate with the existing building management system.

School	Make	Model	Location Served	Qty.	Tons	EER
Riverview Elementary School	Daikin	RZR24PVJU/FHQ24PVJU	IT Closet	1	2	18.1
Valleyview Middle School	Daikin	RZR36PVJU/FHQ36PVJU	A01	1	3	14.0
Valleyview Middle School	Daikin	RZR36PVJU/FHQ36PVJU	A02	1	3	14.0
Valleyview Middle School	Goodman	DSCZ16060/MBVC2060	C-10,Guidance,C-11	1	5	16.0

Table 2H.2 – Proposed Condensing Unit

Scope of Work

The following outlines the scope of work to install the condensing units stated in the above table:

1. Disconnect existing unit electric connections.
2. Remove unit from the base.
3. Modify base for new unit if necessary.
4. Rigging and setting new unit at the base.
5. Reconnecting electric at the unit.
6. Connect electric power.
7. Start up and commissioning of new unit.
8. Maintenance operator(s) training.

Energy Savings Methodology and Results

The savings approach is based on the energy efficiency between the existing and new units. The savings are generally calculated as:

Electric Energy savings	Existing unit energy consumption (kWh) – replacement unit energy consumption (kWh)

Equipment Information

Manufacturer and Type	Several quality and cost effective manufacturers are available. Honeywell and the School District will determine final selections.
Equipment Identification	Product cut sheets and specifications are available upon request. As part of the measure, design and approval process, specific product selection will be provided for your review and approval.

Customer Support and Coordination with Utilities

Coordination of the electrical tie-in will be required.

Environmental Issues

Resource Use	Energy savings will result from higher efficiency units.
Waste Production	Existing unit scheduled for removal will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 2I Window AC Unit Replacements

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
2i	Window AC Unit Replacements	✓			

Existing Conditions

Currently the library, library offices and adjacent computer center are cooled by a series of inefficient Window AC units that are not sized correctly and a cause comfort issues within these spaces.

Window AC Units Serving Media Center

School	Make	Model	Location Served	Qty.	Tons
Valleyview Middle School	Friedrich		Library Univent	1	1.5
Valleyview Middle School	Friedrich		Library Office 1	1	2.0
Valleyview Middle School	Friedrich		Library Office 2	1	1.5
Valleyview Middle School	Friedrich		Computer Lab	1	2.0

Table 2I.1 – Existing Condensing Unit to be Replaced

Proposed Solution

Honeywell proposes replacing the existing Window unit in Table 2I.1. with a Variable Refrigeration Volume (VRV) system consisting of one condenser to provide cooling to the above mentioned spaces. The new units will be installed in the same location as the existing units. The new unit will be equipped with factory-installed microprocessor controls that improve unit efficiency and will also communicate with the existing building management system.

School	Make	Model	Location Served	Qty.	Tons
Valleyview Middle School	Daikin	FXM24PBVJU	Library Univent	1	2
Valleyview Middle School	Daikin	FXM12PBVJU	Library Office 1	1	1
Valleyview Middle School	Daikin	FXM12PBVJU	Library Office 2	1	1
Valleyview Middle School	Daikin	FXM36PBVJU	Computer Lab	1	3
Valleyview Middle School	Daikin	RXYQ120TTJU	Media Center Condenser	1	12

Table 2I.2 – Proposed Condensing Unit

Scope of Work

The following outlines the scope of work to install the VRV units stated in the above table:

1. Disconnect existing unit electric connections.
2. Remove unit from the window
3. Install indoor evap. units
4. Rigging and setting new condensing unit on the base.
5. Reconnecting electric at the unit.
6. Running VRV piping to each unit
7. Connect electric power.
8. Start up and commissioning of new unit.
9. Maintenance operator(s) training.

Energy Savings Methodology and Results

The savings approach is based on the energy efficiency between the existing and new units. The savings are generally calculated as:

Electric Energy savings	Existing unit energy consumption (kWh) – replacement unit energy consumption (kWh)

Equipment Information

Manufacturer and Type	Several quality and cost effective manufacturers are available. Honeywell and the School District will determine final selections.
Equipment Identification	Product cut sheets and specifications are available upon request. As part of the measure, design and approval process, specific product selection will be provided for your review and approval.

Customer Support and Coordination with Utilities

Coordination of the electrical tie-in will be required.

Environmental Issues

Resource Use	Energy savings will result from higher efficiency units.
Waste Production	Existing unit scheduled for removal will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 2J UNIT HEATER REPLACEMENTS

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
2j	Unit Heater Replacements				✓

Existing Conditions

At the Bus Garage, gas-fired unit heaters are used to heat the garage areas. These units are typically inefficient, adequate and are associated with high maintenance costs.

Bus Garage Unit Heater Bay 1

Bus Garage Unit Heater Bay 2

Proposed Solution

Honeywell proposes that the existing unit heaters and heating systems at the Bus Garage be replaced with infrared, gas-fired, tube heaters. Infrared heaters distribute heat more effectively and have higher burner efficiencies.

Building	Location Served	Type	Qty	Capacity	Fuel
Bus Garage	Bus Bays	NG IR Heater	2	50 MBH	Gas

Table 2J.1 – Proposed Equipment

Scope of Work

The following outlines the domestic hot water heater replacement:

1. Disconnect existing gas and electric connections.
2. Disconnect air ducts from the units
3. Remove existing equipment.
4. Install new, gas piping.
5. Install new, exhaust flue stacks.
6. Make electrical modifications.
7. Test and commission

Equipment Information

Manufacturer and Type	Several quality and cost effective manufacturers are available. The following is an example of equipment that may be utilized. Honeywell and the Customer will determine final selections.

Equipment Identification	As part of the measure design and approval process, specific product selection will be provided for your review and approval.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	Energy savings will result from improved thermal efficiency.
Waste Production	This ECM will produce no waste by-products.
Environmental Regulations	No environmental impact is expected.

Utility Interruptions

Proper phasing procedures will minimize gas interruptions.

ECM 3A BUILDING MANAGEMENT SYSTEM UPGRADES

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
3a	Building Management System Upgrades	✓	✓	✓	

Building Scope of Work

1. **Johnson Metasys Direct Digital Controls for the following**:
   a. Refer to the Scope and General Conditions, Clarifications, exclusions for further details below.

2. **Lakeview Elementary School**
   a. Provide a BACnet communication connection to (3) new Daikin MPS units (Nurse's, Main & Principals' Units)
      i. Field wiring of the unit devices provided under separate contract or furnished by others.
   b. Classroom Unit Ventilators (C Wing)
      i. Provide Johnson FEC BACnet DDC with new communications bus
      ii. Replace the following unit components
         1. Room Thermostat w/ setpoint adjust (limited setpoint capable)
         2. Discharge Air Temperature Sensor
      iii. Reuse the following components (as applicable)
         1. 120VAC-24VAC transformer
         2. Unit Fan Start/Stop Control Relay
         3. Unit Fan Status current switch (CS)
         4. Hot Water Control Valve and Actuator (Modulating, 24VAC, 0-10VDC)
         5. Outside Air Damper Actuator (Modulating, 24VAC, 0-10VDC)
         6. Low Temperature Limit Switch

3. **Riverview School**
   a. Provide a BACnet communication connection to (3) new Daikin MPS units (Office, Library, Computer Room)
      i. Field wiring of the unit devices provided under separate contract or furnished by others.

4. **Valleyview School**
   a. Classroom Unit Ventilators
      i. Add Cypress wireless pneumatic thermostat system (Cypress) for classroom controls to the existing boiler room controller at Valley View MS.
      ii. Unit Ventilators (Cypress Type 2-Pipe Wireless Thermostats)(WPT-800)($250)
      iii. Cypress WPT Green Box Coordinator. Repeaters and USB hub
   b. Existing Air Handling Units
      i. Added Overlay the existing pneumatic control on (3) Air Handling Units with unitary JCI FEC controller.
      ii. Includes Outside/Return Air damper Controls
         1. Pneumatic AHU controls for DCV (OA MOD E-P Xdcr)
         2. Monitoring of Supply Air Temperature & Room Temperature.
         3. Provided a Start/Stop of Control of the Unit.
   c. Install New Pneumatic Air Compressor with Air Dryer
   d. Existing Roof Top Units
      i. Provide an Overlay of the existing electronic controls on (3) Roof Top Units with unitary JCI FEC controllers.
      ii. Monitoring of Supply Air Temperature & Room Temperature.
      iii. Scheduling provided via addition of Start/Stop of Control of the Unit.

5. **Provide the following services for a completely functioning controls system as specified.**
    a. System Engineering, Project management, Programming, Technical Labor startup
    b. Site Coordination Meetings & Coordination with any additional Mechanical subcontractors/vendors.
    c. BAS point-to-point network routing, Alarming & Trending
    d. Detailed color graphics for each mechanical ATC DDC controlled unit.
    e. Closeout Documentation as specified (Operating and Instruction Manuals & As-built Drawings)
    f. All Specified training (40 Hours)
    g. 1 Year Warranty on Parts and Labor. Additional Warranty coverage is also available.
    h. 1 Year of Remote Office Phone and diagnostic support with Customer installed Internet Access

6. **All specified control system devices and installation of control wiring as noted above.**
    a. Includes all engineering, supervision, and start-up labor required to meet the requirements of this project. It also includes all labor and material for installation and wiring of the above controls of items indicated above.

7. **Clarifications**
    a. Retro Commissioning of the existing controls is not currently included.
    b. The communication protocol for the integration communications shall be N2 or BACnet
    c. Assumes that all labor shall be performed during second shift.
    d. All wiring in machine room shall be in EMT. Low voltage wiring outside of the MER, where applicable, can be in plenum rated cable.
    e. All ceilings heights are accessible & less than 20 feet AFF (accessible by ladder)
    f. Wire mold is allowable for renovation projects.
    g. All power wiring of equipment by others
    h. All Low voltage power & control wiring by ATC Electrician
    i. Installation and maintenance of any high-speed internet connections by District
    j. Dampers & valves are existing, and shall be reused unless noted above.
    k. Removal of existing controls, including associated control wiring and pneumatic airlines is included.

Energy Savings Methodology and Results

The energy savings for this ECM is realized in the buildings' HVAC equipment due to better control of the HVAC system, night set-back and set-up temperatures, start/stop etc.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	Energy savings will result from reduced electric energy usage and better occupant comfort.
Waste Production	This measure will produce no waste by-products.
Environmental Regulations	No environmental impact is expected.

ECM 3B DEMAND CONTROL VENTILATION

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
3b	Demand Control Ventilation	✓	✓	✓	

Existing Conditions

The roof top and air handling units serving large one zone spaces such as auditoriums, gymnasiums and cafeterias are often designed for peak occupancy conditions to supply outside air to the space with return air from space being exhausted. Most of the time these spaces are not fully occupied, which increase energy demand for heating and cooling of excessive amount of outside air.

Lakeview Elementary School Gym DCV Opportunity

Riverview Elementary School Gym DCV Opportunity

Proposed Solution

Honeywell will install CO_2 sensors at the below Denville SD locations. The CO_2 sensors will provide the control signal for the air handlers to optimize the quantity of fresh air required. The installation of CO_2 sensors will read the levels of CO_2 in the space and ensure that only the required outside air is supplied and heated to meet the minimum outdoor air requirements. This control strategy will reduce amount of outside air intake and thus reduce the heating energy used by the air handling units and electric energy used by the motors. Based on this fact, there is a reduced requirement for outside air to this space

School	Area Served	Number of Units	CFM Total
Lakeview Elementary School	2000 GYM	1	5,500
Lakeview Elementary School	2000 GYM	1	5,500
Lakeview Elementary School	Cafetorium	1	800
Lakeview Elementary School	GYM	1	5,500
Lakeview Elementary School	GYM	1	5,500
Lakeview Elementary School	A36/A37 Receiving	1	3,000
Riverview Elementary School	Cafetorium	1	8,000
Valleyview Middle School	Multipurpose Room	1	5,000
Valleyview Middle School	Multipurpose Room	1	5,000
Valleyview Middle School	Multipurpose Room	1	5,000
Valleyview Middle School	Cafeteria	1	8,000

Table 3B.1 – Existing units to be installed with CO_2 sensors

Energy Savings Methodology and Results

The savings approach is based upon reducing the amount of energy that needs to pre-heat or cool the outside air. The savings are generally calculated as:

Existing Heating BTU & Cost per BTU	= Metered Data from Existing meter readings
Cost of Existing Heating	= Average Site Data $/CCF or $/Gallon
Reduction in Heating/Cooling BTU	= Reduction in Outside air cfm x 1.08 x Delta T x Hours the fan is = Existing BTU x Cost per BTU
Cost of Proposed Heating/Cooling	
Energy Savings $	= Existing Heating Costs – Proposed Heating Costs

The baseline adjustment calculations are included with the energy calculations.

Changes in Infrastructure

None.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	Energy savings will result from reduced energy.
Waste Production	Any removed parts will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

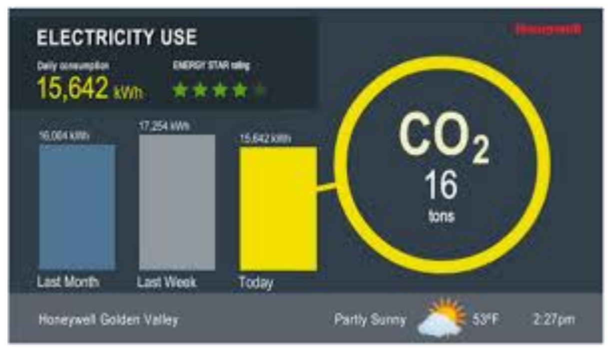
ECM 3C ENERGY MONITORING AND EDUCATION

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
3c	Energy Monitoring and Education	✓	✓	✓	

Existing Conditions

Proposed Programs - Attune Advisory Services

School buildings are more than a collection of classrooms, offices, windows and doors. They are holistic systems that are the cornerstone of the District. Like any other system, if they are poorly maintained they can become a drag on budgets, costing the District money, time and resources. When they are well maintained, they can help you reach your business goals. Honeywell Attune™ Advisory Services is a complete suite of building management services and cloud-based resources from Honeywell. It's designed to monitor energy and operational efficiency, and put the District's facilities on a path to optimization. And since optimization is an ongoing journey, we're positioned to grow with you to meet the schools changing needs. Included is support of our worldwide network of 10,000 plus energy and automation experts, backed by sophisticated analytics technology working to deliver the right level of service and the information you need to maximize your efficiency and achieve your business goals.



To help you take that first step, Attune Advisory Services aligns to your building systems, collects data from those systems and presents it to you in an easy-to-understand format. You'll be able to monitor your building systems and discover peak-use times and areas, variances and anomalies, and you'll have a plan to address the issues.

Awareness Programs

Energy Dashboard

This Web-based display collects your site's energy information and presents it in a customized, easy-to-use format, helping you better understand your facility's energy usage.

Energy Lobby Signage

A public display that shares energy data and comparisons in friendly, graphic-driven terms — spurring occupants to positively alter their behavior and usage, and allows you to showcase results for your energy programs.

Operations

An advanced, web-based monitoring and troubleshooting system that keeps 24-hour watch over your building management system.

Improvement Programs

Operations

Building automation analysis helps to support and improve operations and avoid negative impact to your business objectives. You need an ongoing review of your equipment, systems and practices to assure optimal efficiency for the long term. You'll receive a prioritized list of recommendations that will help you to focus your resources on the changes that will provide the most benefit to your operations.

Optimization Programs

Energy

Honeywell provides facility optimization and energy reduction programs through analysis of energy assessment, problem identification, equipment upgrades and ongoing monitoring, measurement and verification.

Operations

Our experts work with customers to reduce cost overruns and additional energy expenditures, while proactively helping you to plan budgets around equipment life cycle milestones.

Additional Benefits:

- Identifies your organization as forward thinking and environmentally aware
- Demonstrates how your organization is a good citizen
- Stimulates building occupants to be more efficient in their own use of resources
- Builds community support

Honeywell Green Boot Camp

Teachers who teach sustainability inspire students to take those principles out into the world and effect change. Honeywell's Green Boot Camp teaches middle school teachers how to turn their classrooms into fertile ground for a robust sustainability curriculum. This at no cost, four-day workshop could be the opportunity of a lifetime for one of your educators.

At Green Boot Camp, you'll be able to view sustainable educational methods from the perspective of your students. These hands-on, interactive lessons will provide you with experiences to transfer into the classroom. Project-based learning modules include renewable energy, water quality, solar and more. The camp's curriculum is developed by teachers, for teachers. You'll leave with lesson plans and materials to help you teach what you have learned.

We're looking for self-motivated, environmentally-aware teachers from any discipline. Our program will challenge you and help you discover new ways to convey green and sustainable concepts to your students.

Green Boot Camp is a great way to earn continuing education units or professional development hours at no cost. Honeywell is investing in the teachers of tomorrow by offering scholarships to cover the cost of hotel and air travel expenses, as well as meals for all qualifying teachers.

Energy Savings Methodology and Results

Savings are based on increased energy awareness of building occupants.

Changes in Infrastructure

None.

Customer Support and Coordination with Utilities

None.

Environmental Issues

Resource Use	None.
Waste Production	This measure will produce no waste by-products.

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ECM 4A BUILDING ENVELOPE IMPROVEMENTS

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
4a	Building Envelope Improvements	✓	✓	✓	✓

Existing Conditions

Typically, many schools have problems associated with the design and construction of their buildings. Your buildings avoid some of the inefficiency issues associated with more modern construction buildings. Plus, long-term stewardship of your buildings has helped avoid many of the problems often associated with maintenance issues. But there are several significant building envelope retrofit opportunities, which will provide cost savings and comfort improvements to your building occupants.

Denville School District buildings surveyed are masonry in construction. So the areas of concern deal with the openings in the "skin" that are mostly "built-in" during the original construction, created during a "retrofit period" and/or have deteriorated. Air leakage is defined as the "uncontrolled migration of conditioned air through the building envelope" caused by pressure differences due to wind, chimney (or stack) effect, and mechanical systems. It has been shown to represent the single largest source of heat loss or gain through the building envelopes of nearly all types of buildings. Our work has found 30% to 50% of heat loss attributable to air leakage in schools.

Valleyview Middle School Insulation Opportunity

Lakeview Elementary School Exterior

Beyond representing significant energy savings potential, uncontrolled air leakage can affect occupancy comfort, air quality, the imbalance of mechanical systems, and the potential for compromised structural integrity of the building envelope from moisture migration. Control of air leakage involves the sealing of gaps, cracks and holes, using appropriate materials and systems to help create a continuous plane of "air-tightness" to completely encompass the building envelope. Part of this process also incorporates the need to "decouple" floor-to-floor, and to "compartmentalize" components of the building in order to equalize pressure differences. The buildings were inspected visually to identify both the location and severity of air leakage paths. Air leakage paths are detailed in the scope of work below. Floor plans will be used to mark locations of air sealing measures when completed.

Proposed Solution

Roof-Wall Joint

The buildings were found to require roof-wall joint air sealing. To address these problems we recommend using a high performance sealant. In some buildings, a two-component foam will be used. Any cantilevers off the buildings will be sealed with backer rod and sealant. Finally, the inside vestibule corners should be sealed with backer rod and sealant.

Windows and Doors

Most of your building doors require weather stripping and the installation of door sweeps to prevent air leakage. The operable windows in most of your buildings could present air leakage issues that require weather stripping with fuzz or gasket type materials.

Roof Penetrations

There are a number of roof top exhaust fans that require damper cleaning, lubrication, and inspection for proper operation and to seal the roof deck to prevent penetration. Some units may be deemed to be too oversized for this service. The fan final count by the inspector will indicate how many units could be easily serviced without requiring lifting equipment.

Some buildings have roof-top AHUs (air handling units) with ducts that may show air leakage during an investment grade audit. If there is leakage, these duct penetrations will be sealed with two-component polyurethane foam. Skylights will also be sealed. Sealant will be injected behind the drip cap to eliminate airflow.

Benefits

The sealing of your school buildings will allow for more efficient operation of the buildings by reducing heating and cooling losses throughout the year. In addition, the draftiness of the buildings, along with hot and cold spots, will be reduced as a result of this measure. A reduction in air infiltration will also minimize potential concerns for dirt infiltration or indoor air quality concerns.

Scope of Work

1. **Lakeview Elementary School**

Qty	Unit	Description
13	Unit	Door- Single, sweep & W/S
11	Unit	Door- Double Door, W/S & 2 Sweeps
538	LF	Roof to Wall - Easy - 1 :Line 12'h
1075	LF	Roof to Wall - Easy – 2 Line
9	Unit	Other – Window AC Unit Seal
8	LF	Seal Lintel Seam
168	SF	R-6.5 1" Thermax

2. **Riverview Elementary School**

Qty	Unit	Description
3	Unit	Door- Single, sweep & W/S
5	Unit	Door- Double Door, W/S & 2 Sweeps
4	Unit	Door - Sweep Only
20	LF	Window – Window/Door Interior Perimeter Seal
755	LF	Roof to Wall - Easy - 1 :Line 12'h
121	LF	Roof to Wall - Easy – 2 Line
8	LF	Roof to Wall - Easy – 3 Line 12'h
32	LF	Penetration – Panel Perimeter
3	SF	Penetration – Chase Opening
1	Unit	Other – Window AC Unit Seal
8	SF	R-6 Bulk Spray 1" Foam
111	SF	R-6.5 1" Thermax

3. Valleyview Middle School

Qty	Unit	Description
7	Unit	Door- Single, sweep & W/S
6	Unit	Door- Double Door, W/S & 2 Sweeps
864	LF	Window W/S
160	LF	Window – Window/Door Interior Perimeter Seal
171	LF	Sealing Ext. Remove and Replace
272	LF	Roof to Wall - Easy - 1 :Line 12'h
331	LF	Roof to Wall - Easy – 2 Line
21	Unit	Other – Window AC Unit Seal
4	SF	R-6 Bulk Spray 1" Foam
305	SF	R-6.5 1" Thermax

Energy Savings Methodology and Results

The energy savings for this ECM are realized at the buildings' HVAC equipment. The improved building envelope will limit conditioned air infiltration through openings in the building air barrier. Less infiltration means less heating required by the heating system.

Changes in Infrastructure

Building envelopes will be improved with little or no noticeable changes.

Customer Support and Coordination with Utilities

Minimal coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Energy savings will result from reduced HVAC energy usage and better occupant comfort.
Waste Production	Some existing caulking and weather-stripping will be removed and disposed of properly.
Environmental Regulations	No environmental impact is expected.

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ECM 4B ROOF REPLACEMENTS

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
4b	Roof Replacements	✓			

Existing Conditions

The roofs installed in the Denville School District are generally in good shape. However, part of the roof over the Valleyview Middle School is recommended to be replaced. The heat loss and heat gains occur due to low R-value of the existing roof insulation will be improved through the replacement with energy efficient roofing materials. Additionally the rate of infiltration that occurs due to the leakage on the roof around perimeters and equipment curbing is also a major cause of energy loss. The upgrade will result in improved savings and comfort for those affected in the building.


Valleyview Middle School Roof

Proposed System

Honeywell proposes the installation of a new energy efficient, Spray Polyethylene Foam (SPF) roofing material over the traditional Ethylene Propylene Diene Monomer (EPDM) single ply roof. The Poly Spray Foam Roof is one monolithic, selfflashing system with air barrier – no loss of effective R-value. Overall, through the implementation of this measure the district will reduce its heating fuel usage and air conditioning costs each year.

School	Roof Area
Valleyview Middle School	19,754

Table 4B.1 Roof Replacements

Energy Efficiency

EPDM Single-ply roof with an initial R-Value of 18 will have a 15%+ loss in thermal resistance due to thermal shorts of steel fasteners. It will also provide a 10% increase in thermal transmittance when using single layer of insulation board. Finally, R-value and Air permeability of a deck, insulation and membrane has a major impact on System R-value. This will equate to a final overall System R-value equal to approximately 2.42.

An SPF roof has an R Value of approximately 6 per one (1) inch foam (R –Value 6) If three inches of SPF Foam where applied one monolithic, self flashing system with air barrier – no loss of effective R-value would have an overall System R-value: 18

Durability

Single-ply EPDM roof will have a 45 mil water proofing layer, but will also have major fail points such as flashing, seams, fasteners and single-ply punctures. In contrast the SPF roof will not only have a top coat plus SPF insulation which is all water proofing, meaning even damaging top coat will not create leak.

Sustainability

Commercial buildings can have a maximum of 2 roofs in place. In traditional roofing, when a "third" roof is required, a partial or full tear-off is also required. This adds increased cost for tear-off, increased cost for disposal and a negative impact on the environment

With SPF roofing, the top coat is the only part that needs to be re-applied after the warranty period. There is no "tear-off" required or disposal concerns. A quality applied SPF roof should last the life of the building

Energy Savings Methodology and Results

Following approach is used to determine savings for this specific measure:

Existing Roof Efficiency	= Existing U + Existing Infiltration Rate
Proposed Roof Efficiency	= Proposed U + Proposed Infiltration Rate
Energy Savings (Btu) Winter Savings(Therms) Summer Savings (Tons Cooling)	= UAdTproposed – UAdTexisting = Energy Savings/Boiler Eff./100,000 = Energy Savings/12,000 Btu/Ton

Interface with Building:

The new roof will be constructed to match existing, maintaining contours of the existing building.

Energy Savings Methodology and Results

The energy savings for this ECM are realized at the buildings' HVAC equipment. The improved building envelope will limit conditioned air infiltration through openings in the building air barrier. Less infiltration means less heating and cooling required by HVAC systems.

Changes in Infrastructure

Building envelopes will be improved with little or no noticeable changes.

Customer Support and Coordination with Utilities

Minimal coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Energy savings will result from reduced HVAC energy usage and better occupant comfort.
Waste Production	Existing roof materials will be removed and disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 5A COMPUTER POWER MANAGEMENT

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
5a	Computer Power Management	✓	✓	✓	

Existing Conditions

Information Technology (IT) is a major consumer of energy in school buildings and campuses. At more than 25 percent of total energy consumption, energy efficient IT becomes less of a nice-to-have and more of a necessity. IT energy management can no longer be ignored as energy rates continue to rise and as IT demands continue to grow.

Valleyview Middle School Computer Classroom

Lakeview Elementary School laptops

Proposed Solution

Honeywell proposes computer power management software *Surveyor* by Verdiem to manage PC consumption from phantom power, providing a detailed breakdown of usage by IT device type so as to allow energy managers to better plan, manage and optimize an organization's overall power consumption. Energy consumption of distributed IT devices can be reduced by up to 60%. Verdiem helps IT departments to accurately measure IT device energy consumption, enforce policies for greater energy efficiency, and optimize savings.

Verdiem allows a school to accelerate time-to-value with turnkey IT energy management solution VBOX. VBOX is a fully integrated software and hardware appliance for an easy and rapid roll-out. In many schools, it can take months to get a server purchased or a virtual machine provisioned to support a new software solution. Within days, a Verdiem VBOX can be implemented and deployed. Based on a standard 1u server, VBOX is pre-packaged and configured with all necessary components including Verdiem's best-in-class IT energy management solution.

Scope of Work

School	Qty Desktops
Valleyview Middle School	630
Lakeview Elementary School	500
Riverview Elementary School	300
Total	**1,430**

Table 5A.1 – Approximate School Computer Counts

**Computer counts are estimated based on audit and square footage of the building*

Energy Savings Methodology and Results

Annual savings for administrative and student computers are based on previous logging results for computers with similar usage types.

Changes in Infrastructure

VBOX server will be integrated into current IT network.

Customer Support and Coordination with Software

Support will be required for software deployment by IT department.

Environmental Issues

Resource Use	Annual savings for administrative and student computers are based on previous logging results for computers with similar usage types.
Waste Production	None.
Environmental Regulations	No environmental impact is expected.

ECM 6A WATER CONSERVATION

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
6a	Water Conservation	✓	✓	✓	

Existing Conditions

During surveys Honeywell observed 3.5 GPF (Gallons per flush) toilets. Honeywell would recommend that these toilets be replaced with 1.28 GPF toilets depending upon the style of toilet. The toilets were generally American Standard wall hung with diaphragm valves.

In 1996 is when low flow toilets began to be installed due to government regulations. Toilet manufacturers at that time poorly reengineered their products. The flush effectiveness was low and the result was often multiple flushing. Over the years engineering has caught up with the regulations, in fact many of the new 1.28 GPF flush toilets perform much better than the old 1.6 GPF toilets.

High flow faucet

Wall mounted Urinals

Proposed Solution

Domestic water conservation refers to the reduction in water consumption for all students, staff, and visitors throughout the schools as it relates to toilets, urinals, faucets, and showers.

TOILETS

Existing Conditions

Honeywell recommends replacing the flush valve commercial toilets rated at 1.5gpf or higher with 1.28gpf china and manually actuated piston flush valves.

Recommended Toilet Installation Notes

- New toilet bowls will be installed onto existing flanges and carriers with new Beneke (or equivalent) commercial open front plastic seats, less cover (white in color)
- All toilet bowls will be securely connected to water supply lines and waste connections. Minor repairs to floor mount toilet flanges will be made to ensure secure toilet bowl connections. Floor mount toilet flanges will be repaired as needed with a repair anchor flange, Cast Iron Flange Repair Ring anchored to the floor with 4 tap-con screws or spanner flanges

- Minor repairs to water supply connections include replacement of 1" horizontal water lines, as required, to rough plumb flush valves when installing new toilet bowls. All piping modifications will be made with material that complies with standard trade practice and like to existing materials
- New toilets will be installed with new control stop valves or Angle stop valves

Existing Conditions

Honeywell recommends installing manually actuated 0.5 gpf flush valves on all "washout" urinals, existing china will remain intact. "Blowout" urinals cannot be retrofit to use less water and should be completely replaced with new Zurn pint flush urinals and appropriate flush valves.

All new urinal valves will be installed with new control stop valves.

FAUCETS

EXISTING CONDITIONS

Honeywell recommends installing tamper-resistant end use flow restrictors onto the faucets exceeding 1.0gpm. Honeywell recommends faucets that can accept flow controls will be retrofitted with the following controls matched to the end use: bathroom sinks will be fitted with 0.5gpm flow controls, classroom (non-lab style) faucets will be retrofitted with 1.0gpm flow controls.

Changes in Infrastructure

None.

Scope of Work

Retrofit Option	Retrofit Specification	Water Conservation Measures Per Measure Worksheet	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	TOTALS
		TOILETS				
1	N/A	Existing Low Flow Toilet	21	50	23	94
2	Z5655-BWL/Z6000AV-HET	Install 1.28gpf FM china w/ 1.28gpf manual Fl Vl-use St 90 El to 11" VBTP	6	0	4	10
3	Z5655-BWL/Z6000AV-HET	Install 1.28gpf FM china w/1.28gpf manual Fl Vl 11" VBTP	6	3	12	21
5	Z5675-BWL/Z6000AV-HET	Install 1.28gpf Primary Hgt FM china w/ manual Fl Vl 15" VBTP	0	2	0	2
		URINAL				
20	N/A	Existing Low Flow Urinal	2	4	8	14
21	Z6003AV-EWS	Install 0.5gpf manual Fl Vl w/ 3/4" spud 11" VBTP	8	11	2	21
22	Z6001AV-WS1	Install 1.0gpf manual Fl Vl w/ 1-1/4" spud 11" VBTP	0	0	3	3
		FAUCET				
30	N/A	Existing Low Flow (0.5gpm) Faucet (Common)	0	30	2	32
31	Neoperl 0.5 VP	Retrofit public lav faucet w/0.5gpm VP flow control w/ adpt	36	28	32	96
34	Neoperl 1.5 VP	Retrofit kitchen faucet w/1.5gpm VP flow control w/ adpt	7	3	2	12
36	Neoperl 1.0 VP PCA Spray	Retrofit classsroom faucet w/1.0gpm VP flow control w/adpt	6	47	33	86
37	Neoperl 1.0 LVP	Retrofit lab sink with 1.0 gpm VP Laminar-flow control w/ 3/8"m adpt	39	0	1	40

Customer Support and Coordination with Utilities

Minimal coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Water savings will result from lower water flows through new fixtures.
Waste Production	Old fixtures will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 7A DEMAND RESPONSE – PERMANENT LOAD SHED REDUCTION PROGRAM

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
7a	Demand Response/Permanent Load Reduction	✓	✓	✓	

Existing Conditions

The PJM Demand Response Program is a voluntary PJM program that compensates end-use (retail) customers for reducing their electricity use (load), when requested by PJM, during periods of high power prices or when the reliability of the grid is threatened. These customers receive payments from PJM members called Curtailment Service Providers. Denville School District does not currently participate in the PJM Demand Response Program.

Proposed Solution

Demand Response

Honeywell proposes to utilize a registered Demand Response Curtailment Service Provider (CSP) to provide energy response services to the Denville's School District. Through the CSP, the Denville's School District will participate in the PJM Capacity Market Program and PJM Energy Efficiency Program. These programs are offered through the PJM Regional Transmission Organization (RTO), and Independent System Operator (ISO). The Capacity Market Program allows PJM customers the ability to respond to capacity emergencies when called upon by PJM, and the energy efficiency program pays PJM customers for implementing Energy Conservation measures (ECMs) that result in permanent load reductions during defined hours.

Permanent Load Reduction

PJM offers incentives to customers who install energy-efficient equipment that permanently reduces the use of electricity during peak times. Documentation of the type of new energy-efficient equipment installed, when it was installed, and how it is being used is required. PJM also requires a measurement of electricity usage during the peak summer periods to verify whether or not a building is actually using less energy. Also, as a cooperative, PJM relies on its members to combine projects together to make sure the volume is significant enough to impact their system.

Honeywell has calculated savings based on load reduction through decreasing kW by installing LED lights. Although it has not been accounted for, there may be an opportunity in participating in the Demand Response Program.

Energy Savings Methodology and Results

Revenue is generated through participation in the PJM DR program.

Changes in Infrastructure

None.

Customer Support and Coordination with Utilities

Initiation of demand response curtailment will be required.

Environmental Issues

Resource Use	None.
Waste Production	This measure will produce no waste by-products.
Environmental Regulations	None.

ECM 8A RENEWABLE ENERGY – SOLAR PV SYSTEM

ECM	ECM Description	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
8a	Renewable Energy – Solar PV System	✓	✓	✓	

Existing Conditions

Currently Denville School District has no solar photovoltaic systems installed on any of its schools.

A power purchase agreement (PPA) is a financial arrangement in which a third party solar company owns, operates, and maintains the photovoltaic system, while the host customer Denville School District agrees to provide the site for the system on its property. The solar systems power production is purchased by Denville School District for a predetermined price, $/kWh, for a predetermined time period. This price for electricity will be lower than the utilities and third party suppliers, which allows Denville School District to benefit from cheaper electricity prices, a renewable element in their schools, and an educational tool for renewable energy to students, while not adding any additional maintenance costs since the system is owned by a third party solar company.

Proposed Solution

Honeywell can provide the RFP development, solicitation and oversight of the installation of a solar photovoltaic renewable energy system for purposes of a power purchase agreement (PPA). Honeywell is not a PPA provider.

Solar arrays would be installed on the School properties and land areas as agreed to with the School District. Specific details such as site locations, sizing and technical angels of the arrays will be developed as part of the PPA RFP process in accordance with NJ public contract law. Should an acceptable PPA partner be identified with an agreed upon scope that satisfies the school districts requirements, the identified savings may be used to fund additional ECMs as outlined within this Energy Savings Plan.

Below is a summary of the potential solar capability (should roof and ground based areas be deemed appropriate), as identified during our preliminary audit.

Building	kW
Valleyview Middle School	226
Lakeview Elementary School	432
Riverview Elementary School	199

Table 8A.1 – Proposed Solar Arrays

Energy Savings Methodology and Results

Savings are based on the difference in kWh price between the power purchasing agreement and the current electrical supplier for the schools.

Changes in Infrastructure

The proposed solar array would reside on the building roofs or grounds.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

SECTION D TECHNICAL AND FINANCIAL SUMMARY

1. Recommended ESIP Project

	Recommended ESIP Project
Value of Project	**$1,816,984**
Term of Repayment	**15 Years**
Projected Savings Over Term	**$2,265,067**
Projected NJ Rebates & Incentives	**$92,637**
Projected Interest Rate	**3.00%**

Recommended Project Technical and Financial Summary Documents

Form II: Energy Conservation Measures (ECMs) Summary Form
Form III: Projected Annual Energy Savings Data Form
Form IV: Projected Annual Energy Savings Data Form in MMBTUs
Form V: ESCOs Proposed Final Project Cost Form
Form VI: ESCOs Preliminary Annual Cash Flow Analysis Form

Building by Building Simple Payback Summary

A simple payback summary broken down by building by ECM has been provided for Denville Board of Education's use in reviewing available scope combinations and options.

Building By Building Simple Payback Summary (Hard Costs Only)

FORM II: RECOMMENDED PROJECT - ENERGY CONSERVATION MEASURES (ECMs) SUMMARY FORM

FORM II

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ENERGY CONSERVATION MEASUREs (ECMs) SUMMARY FORM
DENVILLE BOARD OF EDUCATION
ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: Honeywell International

Proposed Preliminary Energy Savings Plan: ECMs (Base Project)	Estimated Installed Hard Costs (1) $	Estimated Annual Savings $	Estimated Simple Payback (years)
1A LED Lighting	$ 699,934	$ 90,086	7.77
1B Vending Misers	$ 1,855	$ 324	5.73
1C De-stratification Fans	$ 89,041	$ 6,578	13.54
1D Plug Load Management	$ 49,344	$ 3,500	14.10
2C Roof Top Unit Replacements	$ 137,620	$ 2,237	61.51
2F Pipe Insulation	$ 13,603	$ 1,167	11.65
3A Building Management Systems	$ 244,244	$ 40,387	6.05
3C Energy Monitoring and Education	$ 13,603	$ 1,078	12.62
4A Building Envelope	$ 159,269	$ 12,181	13.08
7A Demand Response/Permanent Load Reduction	$ -	$ -	-
			-
			-
Add additional lines as needed* **Project Summary:**	$ 1,408,515	$ 157,537	8.94

Optional ECMs Considered, but not included with base project at this time	Estimated Installed Hard Costs (1) $	Estimated Annual Savings $	Estimated Simple Payback (years)
2A Boiler Replacements	$ 309,170	$ 2,177	142.04
2B Boiler Burner Controls	$ 55,651	$ 2,109	26.39
2D Premium Efficiency Motors and VFDs	$ 61,216	$ 2,094	29.23
2E Steam Trap Replacements	$ 30,004	$ 1,616	18.57
2G Domestic Hot Water Replacements	$ 22,260	$ 513	43.41
2H Split System Replacements	$ 76,705	$ 452	169.82
2I Window AC Unit Replacements	$ 201,579	$ 385	523.86
2J Unit Heater Replacements	$ 12,367	$ 95	129.67
3B Demand Control Ventilation	$ 50,457	$ 1,194	42.26
4B Roof Upgrades	$ 183,220	$ 4,519	40.55
5A Computer Power Management	$ 35,369	$ 6,525	5.42
6A Water Conservation	$ 44,780	$ 4,377	10.23
8A Solar PPA System	$ 37,100	$ 87,981	0.42
0			-

Add additional lines as needed*

(1) The total value of Hard Costs is defined in accordance with standard AIA definitions that include: Labor Costs, Subcontractor Costs, Cost of Materials & Equipment, Temporary Facilities and Related Items, and Miscellaneous Costs such as Permits, Bonds Taxes, Insurance, Mark-ups, Overhead, Profit, etc.

Form III: Recommended Project - Projected Annual Energy Savings Data Form

FORM III

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP)
PROJECTED ANNUAL ENERGY SAVINGS DATA FORM
DENVILLE BOARD OF EDUCATION
ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: **Honeywell International**

The projected annual savings for each fuel type MUST be completed using the following format. Data should be given in the form of fuel units that appear in the utility bills.

Energy/Water	ESCO Developed Baseline (Units)	ESCO Developed Baseline (Costs $)	Proposed Annual Savings (Units)	Proposed Annual Savings (Costs $)
Electric Demand (KW)	5,116	$30,568	2,008	$12,090
Electric Energy (KWH)	1,509,964	$182,609	672,473	$65,521
Natural Gas (therms)	138,375	$145,893	43,044	$38,348
Fuel Oil (Gal)	0	$0	0	$0
Steam (Pounds)				
Water (gallons)				
Other (Specify Units)				
Other (Specify Units)				
Avoided Emissions (1)	Provide in Pounds (Lbs)			
NOX	1,035			
SO2	1,486			
CO2	1,251,264			

(1) ESCOs are to use the rates provided as part of this RFP to calculate Avoided Emissions. Calculation for all project energy savings and greenhouse gas reductions will be conducted in accordance with adopted NJBPU protocols

(2) “ESCOs Developed Baseline”: Board’s current annual usages and costs as determined by the proposing ESCO; based off Board’s utility information as provided to proposing ESCO.

(3) “Proposed Annual Savings”: ESCOs proposed annual savings resulting from the Board’s implementation of the proposed ESP, as based upon “ESCOs Developed Baseline”.

Form IV: Recommended Project - Projected Annual Energy Savings Data Form in MMBTUs

FORM IV

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
PROJECTED ANNUAL ENERGY SAVINGS DATA FORM IN MMBTUs
DENVILLE BOARD OF EDUCATION
ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: **Honeywell International**

The projected annual energy savings for each fuel type MUST be completed using the following format. Data should be given in equivalent MMBTUs.

ENERGY	ESCO Developed Baseline	ESCO Proposed Savings Annual	Comments
Electric Energy (MMBTUs)	5,152	2,294	
Natural Gas (MMBTUs)	13,838	4,304	
Fuel Oil (MMBTUs)	0	0	
Steam (MMBTUs)			
Other (Specify) (MMBTUs)			
Other (Specify)			

NOTE: MMBTU Defined: A standard unit of measurement used to denote both the amount of heat energy in fuels and the ability of appliances and air conditioning systems to produce heating or cooling.

FORM V: RECOMMENDED PROJECT ESCO'S PROPOSAL PROJECT COST FORM

FORM V

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCOs PROPOSED FINAL PROJECT COST FORM FOR BASE CASE PROJECT
DENVILLE BOARD OF EDUCATION
ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: **HONEYWELL INTERNATIONAL**

PROPOSED CONSTRUCTION FEES

Fee Category	Fees (1) Dollar ($) Value	Percentage of Hard Costs
Estimated Value of Hard Costs (2):	$1,408,515	
Project Service Fees		
Investment Grade Energy Audit	$21,128	1.50%
Design Engineering Fees	$98,596	7.00%
Construction Management & Project Administration	$70,426	5.00%
System Commissioning	$10,564	0.75%
Equipment Initial Training Fees	$3,521	0.25%
ESCO Overhead	$133,809	9.50%
ESCO Profit	$70,426	5.00%
Project Service Fees Sub Total	$204,235	14.50%
TOTAL FINANCED PROJECT COSTS:	$1,816,984	29.00%
ESCO Termination Fee (To be paid only if the Board decides not to proceed beyond the ESP)	$0.00	0.00%

PROPOSED ANNUAL SERVICE FEES

First Year Annual Service Fees	Fees (1) Dollar ($) Value	Percentage of Hard Costs
SAVINGS GUARANTEE (OPTION)	$0.00	0.00%
Measurement and Verification (Associated w/ Savings Guarantee Option)	$15,000.00	Flat Fee
ENERGY STAR™ Services (optional)	Included	0.00%
Post Construction Services (If applicable)	N/A	-
Performance Monitoring	Included	-
On-going Training Services	N/A	-
Verification Reports	Included	-
TOTAL FIRST YEAR ANNUAL SERVICES	$15,000.00	Flat Fee

NOTES:
(1) Fees should include all mark-ups, overhead, and profit. Figures stated as a range will NOT be accepted.
(2) The total value of Hard Costs is defined in accordance with standard AIA definitions that include:

Labor Costs, Subcontractor Costs, Cost of Materials and Equipment, Temporary Facilities and Related Items, and Miscellaneous Costs such as Permits, Bonds Taxes, Insurance, Mark-ups, Overhead and Profit, etc.
ESCO's proposed interest rate at the time of submission: 5% TO BE USED BY ALLRESPONDING ESCOs FOR PROPOSAL PURPOSES

*Annual Service only applies if customer accepts energy guarantee.

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FORM VI: RECOMMENDED PROJECT ESCO'S PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM

FORM VI

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCO's PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM
DENVILLE BOARD OF EDUCATION
ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: **Honeywell International**

Note: Proposers must use the following assumptions in all financial calculations:
(a) The cost of all types of energy should be assumed to inflate at: **2.4%** gas, **2.2%** electric per year and
(b) If it is necessary to inflate any other costs, these costs should also be assumed to inflate at: **2.4%** per year (this general inflation factor should NOT include increases in energy costs reflected above in (a), and should be noted if used in any calculation).

1. Term of Agreement: **15** (Years) (Months)
2. Construction Period (2) (months): **12**
3. Cash Flow Analysis Format:

Project Cost (1): **$ 1,816,984** Interest Rate to Be Used for Proposal Purposes: **3.0%**

Year	Annual Energy Savings	Annual Operational Savings	Energy Rebates/Incentives	Total Annual Savings	Annual Project Costs	Board Costs	Annual Service Costs (3)	Net Cash-Flow to Client	Cumulative Cash Flow
Installation			$ -	$ -	$ -	$ -	$ -	$ -	$ -
1	$ 154,636	$ 41,578	$ 77,309	$ 273,523	$ (267,823)	$ (282,823)	$ (15,000)	$ 5,700	$ 5,700
2	$ 118,603	$ 42,576	$ 5,109	$ 166,288	$ (160,588)	$ (160,588)	$ -	$ 5,700	$ 11,400
3	$ 121,288	$ 31,854	$ 5,109	$ 158,251	$ (152,551)	$ (152,551)	$ -	$ 5,700	$ 17,100
4	$ 124,034	$ 32,618	$ 5,109	$ 161,762	$ (156,062)	$ (156,062)	$ -	$ 5,700	$ 22,800
5	$ 126,842	$ 33,401	$ -	$ 160,244	$ (154,544)	$ (154,544)	$ -	$ 5,700	$ 28,500
6	$ 129,714		$ -	$ 129,714	$ (124,014)	$ (124,014)	$ -	$ 5,700	$ 34,200
7	$ 132,651		$ -	$ 132,651	$ (126,951)	$ (126,951)	$ -	$ 5,700	$ 39,900
8	$ 135,655		$ -	$ 135,655	$ (129,955)	$ (129,955)	$ -	$ 5,700	$ 45,600
9	$ 138,727		$ -	$ 138,727	$ (133,027)	$ (133,027)	$ -	$ 5,700	$ 51,300
10	$ 141,869		$ -	$ 141,869	$ (136,169)	$ (136,169)	$ -	$ 5,700	$ 57,000
11	$ 145,082		$ -	$ 145,082	$ (139,382)	$ (139,382)	$ -	$ 5,700	$ 62,700
12	$ 148,367		$ -	$ 148,367	$ (142,667)	$ (142,667)	$ -	$ 5,700	$ 68,400
13	$ 151,728		$ -	$ 151,728	$ (146,028)	$ (146,028)	$ -	$ 5,700	$ 74,100
14	$ 155,164		$ -	$ 155,164	$ (149,464)	$ (149,464)	$ -	$ 5,700	$ 79,800
15	$ 158,679		$ -	$ 158,679	$ (153,253)	$ (153,253)	$ -	$ 5,426	$ 85,226
Totals	$ 2,083,039	$ 182,028	$ 92,637	$ 2,357,704	$ (2,272,478)	$ (2,287,478)	$ (15,000)	$ 85,226	$ 85,226

NOTES:
(1) Includes: Hard costs and project service fees defined in ESCO's PROPOSED "FORM V"
(2) No payments are made by DENVILLE BOARD OF EDUCATION during the construction period.
(3) This figure should equal the value indicated on the ESCO's PROPOSED "FORM V". DO NOT include in the Financed Project Costs.
(4) First year energy savings include anticipated savings achieved during the installation period.

***Annual Service only applies if customer accepts energy guarantee.**

Note: To see the source of named ranges, use the dropdown menu to the left of the formula bar.

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BUILDING BY BUILDING SIMPLE PAYBACK SUMMARY (HARD COSTS ONLY)

Building & ECM	kWh Savings ($)	kW Savings ($)	Natural Gas Savings ($)	Fuel Oil Savings ($)	Water Savings ($)	Annual Energy Cost Savings ($)	Annual Operational Savings ($)	Net Cost ($)	Simple Payback
Bus Garage	**$ 3,655**	**$ 66.2**	**$ (45)**	**$ -**	**$ -**	**$ 3,676**	**$ -**	**$ 863**	**0.2**
1A LED Lighting	$ 3,655	$ 66.2	$ (45)	$ -	$ -	$ 3,676	$ -	$ 863	0.2
1B Vending Misers	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
1C De-stratification Fans	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
1D Plug Load Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
2C Roof Top Unit Replacements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
2F Pipe Insulation	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
3A Building Management Systems	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
3C Energy Monitoring and Education	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
4A Building Envelope	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
7A Demand Response/Permanent Load Reduction	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
Lakeview Elementary School	**$ 26,339**	**$ 5,387.2**	**$ 14,050**	**$ -**	**$ -**	**$ 64,525**	**$ 18,749**	**$ 557,551**	**6.7**
1A LED Lighting	$ 21,749	$ 5,387.2	$ (1,435)	$ -	$ -	$ 39,450	$ 13,749	$ 314,822	5.9
1B Vending Misers	$ 14	$ -	$ -	$ -	$ -	$ 14	$ -	$ 371	27.2
1C De-stratification Fans	$ (121)	$ -	$ 2,710	$ -	$ -	$ 2,588	$ -	$ 32,154	12.4
1D Plug Load Management	$ 1,056	$ -	$ -	$ -	$ -	$ 1,056	$ -	$ 11,557	10.9
2C Roof Top Unit Replacements	$ 100	$ -	$ -	$ -	$ -	$ 100	$ -	$ 18,743	187.8
2F Pipe Insulation	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
3A Building Management Systems	$ 1,766	$ -	$ 8,801	$ -	$ -	$ 15,567	$ 5,000	$ 102,644	5.0
3C Energy Monitoring and Education	$ -	$ -	$ 416	$ -	$ -	$ 416	$ -	$ 4,328	10.4
4A Building Envelope	$ 1,776	$ -	$ 3,559	$ -	$ -	$ 5,335	$ -	$ 72,932	13.7
7A Demand Response/Permanent Load Reduction	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
Riverview Elementary School	**$ 13,364**	**$ 2,842.7**	**$ 12,055**	**$ -**	**$ -**	**$ 38,222**	**$ 9,961**	**$ 404,145**	**8.4**
1A LED Lighting	$ 10,110	$ 2,842.7	$ (689)	$ -	$ -	$ 19,525	$ 7,261	$ 165,388	6.2
1B Vending Misers	$ 111	$ -	$ -	$ -	$ -	$ 111	$ -	$ 742	6.7
1C De-stratification Fans	$ (123)	$ -	$ 2,138	$ -	$ -	$ 2,015	$ -	$ 29,680	14.7
1D Plug Load Management	$ 1,021	$ -	$ -	$ -	$ -	$ 1,021	$ -	$ 15,972	15.6
2C Roof Top Unit Replacements	$ 811	$ -	$ 105	$ -	$ -	$ 2,116	$ 1,200	$ 118,877	35.9
2F Pipe Insulation	$ -	$ -	$ 1,132	$ -	$ -	$ 1,132	$ -	$ 13,603	12.0
3A Building Management Systems	$ 304	$ -	$ 6,812	$ -	$ -	$ 8,616	$ 1,500	$ 20,405	2.0
3C Energy Monitoring and Education	$ -	$ -	$ 322	$ -	$ -	$ 322	$ -	$ 4,328	13.4
4A Building Envelope	$ 1,130	$ -	$ 2,236	$ -	$ -	$ 3,365	$ -	$ 35,150	10.4
7A Demand Response/Permanent Load Reduction	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
Valleyview Middle School	**$ 23,719**	**$ 3,552.2**	**$ 10,992**	**$ -**	**$ -**	**$ 51,132**	**$ 12,868**	**$ 445,955**	**7.0**
1A LED Lighting	$ 17,013	$ 3,552.2	$ (960)	$ -	$ -	$ 28,973	$ 9,368	$ 218,862	5.7
1B Vending Misers	$ 192	$ -	$ -	$ -	$ -	$ 192	$ -	$ 742	3.9
1C De-stratification Fans	$ (112)	$ -	$ 1,877	$ -	$ -	$ 1,766	$ -	$ 27,207	15.4
1D Plug Load Management	$ 1,352	$ -	$ -	$ -	$ -	$ 1,352	$ -	$ 21,815	16.1
2C Roof Top Unit Replacements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
2F Pipe Insulation	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
3A Building Management Systems	$ 4,212	$ -	$ 7,665	$ -	$ -	$ 15,378	$ 3,500	$ 121,195	6.4
3C Energy Monitoring and Education	$ -	$ -	$ 308	$ -	$ -	$ 308	$ -	$ 4,947	16.1
4A Building Envelope	$ 1,061	$ -	$ 2,102	$ -	$ -	$ 3,163	$ -	$ 51,187	16.2
7A Demand Response/Permanent Load Reduction	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
Project Total	**$ 67,077**	**$ 11,848.3**	**$ 37,052**	**$ -**	**$ -**	**$ 157,555**	**$ 41,578**	**$ 1,408,515**	**7.1**

2. Utility and Other Rebates and Incentives

NJ Pay-for-Performance Program (P4P)

Honeywell has been certified as a Pay for Performance Program Partner to provide technical services under direct contract to you. Acting as your energy expert, Honeywell will develop an Energy Reduction Plan for each project with a whole-building technical component of a traditional energy audit, a financial plan for funding the energy efficient measures and a construction schedule for installation. This supports your ability to take a comprehensive, whole-building approach to saving energy in your existing facilities and earn incentives that are directly linked to your savings.

Eligibility

Existing commercial, industrial and institutional buildings with a peak demand over 100 kW for any of the preceding twelve months are eligible to participate including hotels and casinos, large office buildings, multi-family buildings, supermarkets, manufacturing facilities, schools, shopping malls and restaurants. Buildings that fall into the following five customer classes are not required to meet the 100kW demand in order to participate in the Program: hospitals, public Districts and universities, nonprofits, affordable multifamily housing, and local governmental entities. Your Energy Reduction Plan must define a comprehensive package of measures capable of reducing the existing energy consumption of your building by 15% or more to utilize the Pay Performance Program.

ENERGY STAR Portfolio Manager

Pay for Performance takes advantage of the ENERGY STAR Program with Portfolio Manager, EPA's interactive tool that allows facility managers to track and evaluate energy and water consumption across all of their buildings. The tool provides the opportunity to load in the characteristics and energy usage of your buildings and determine an energy performance benchmark score. You can then assess energy management goals over time, identify strategic opportunities for savings, and receive EPA recognition for superior energy performance.

Incentives

Incentives for the P4P program are based on the annual electric and natural gas savings produced by the Energy Conservation Measures. There are three incentives to the program; details are included in the follow page. The first incentive is distributed after a finalized project is selected and bid. This usually occurs shortly before construction starts or shortly thereafter. The second incentive is distributed a few months after construction is completed, while the third incentive is distributed usually thirteen to fourteen months after the second incentive - once a year of building usage, post-retrofit, is completed.

Incentives, Rebates and Grants Summary

Honeywell has a great deal of experience in applying for, and successfully securing, all available incentives, rebates and grants for our clients. We have been approved for over $5.7M of incentives on behalf of our New Jersey customers alone since the introduction of the Energy Savings Improvement Program legislation in 2009. The New Jersey programs employed included primarily the Office of Clean Energy's Pay for Performance and Cogeneration Incentives. A table of the incentive amounts on a per project basis is provided below.

Building	Rebate Amount
Elizabeth Schools	$934,209
Phillipsburg School District	$496,005
NH-Voorhees Regional HS District	$771,063
Bridgewater-Raritan Regional District	$963,034
Hanover Township School District	$343,139

Building	Rebate Amount
Robbinsville Public School District	$529,092
Camden County Technical Schools	$1,210,370
Town of Kearny	$145,002
Frankford School District	$50,657

In regard to the Denville Board of Education Project, Honeywell has determined **that the District is eligible for $92,637** in total incentives between the NJDCE program rebates. Additional Incentives are available through the PJM Demand program and are estimated in the final cash flow form VI.

3. Financing the ESIP

In accordance with P.L.2012, c.55 an ESIP can be financed through energy savings obligations. The term refers to the two primary financing tools, debt and lease-purchase instruments. Each of these options is discussed below.

Energy savings obligations shall not be used to finance maintenance, guarantees, or the required third party verification of energy conservation measures guarantees. Energy saving obligations, however, may include the costs of an energy audit and the cost of verification of energy savings as part of adopting an energy savings plan or upon commissioning. While the audit and verification costs may be financed, they are not to be considered in the energy savings plan as a cost to be offset with savings.

In all cases, maturity schedules of lease-purchase agreements or energy savings obligations shall not exceed the estimated average useful life of the energy conservation measures.

An ESIP can also include installation of renewable energy facilities, such as solar panels. Under an energy savings plan, solar panels can be installed, and the reduced cost of energy reflected as savings.

The law also provides that the cost of energy saving obligations may be treated as an element of the local unit's utility budget, as it replaces energy costs.

Debt Issuance

The law specifically authorizes municipalities, school districts, counties, and fire districts to issue refunding bonds as a general obligation, backed with full faith and credit of the local unit to finance the ESIP. Because an ESIP does not effectively authorize new costs or taxpayer obligations, the refunding bond is appropriate, as it does not affect debt limits, or in the case of a board of education, require voter approval. The routine procedures for refunding bonds found in the Local Bond Law and Public School Bond Law would be followed for issuance of debt, along with any required Bond Anticipation Notes as authorized pursuant to law.

With regard to bonds for public schools, the Department of Education (DOE) has concluded that debt financed ESIP projects are not covered by State aid for debt service or a "Section 15 EFFCA Grant" as there is no new local debt being authorized.

Tax-Exempt Lease Purchase Financing

The tax-exempt lease is a common form of financing for ESIP projects. Tax-exempt leasing is a tool that meets the basic objectives of debt, spreading the cost of financing over the life of an asset, while avoiding constitutional or statutory limitations on issuing public debt. If structured properly, by including non-appropriation language in the financing documents, the tax-exempt lease will not be considered debt for state law purposes but will be considered debt for federal income tax purposes. Thus for federal purposes, the interest component of the lease payment is tax-exempt.

Under the New Jersey Energy Savings Improvement Program (ESIP), the District may authorize a lease purchase agreement between the District and a financier. Ownership of the equipment or improved facilities will pass to the District when all the lease payments have been made. There are legal expenses and other minimal closing costs associated with this type of structure. The lease purchase agreement may not exceed 15 years (commencing upon completion of the construction work), or 20 years where a combined heat and power or cogeneration plant is included in the project. The primary benefits of a lease are lower rates and the acquisition of essential use property without creating debt.

Under a lease there is typically a single investor. The lease may have non-appropriation language that allows the District to access low tax exempt rates. Some previous customers have chosen to remove the non-appropriation language which has resulted in lower competitive rates.

Repayment of the lease payments is tailored to meet the requirements of the Denville Board of Education. Payments are typically scheduled to commence after the construction is complete and acceptance of the project has been received by the District. Typically, payment terms are structured so there is no up-front capital expense to the District and payments are aligned within your cash flow and fiscal limits.

Certificates of Participation (COP's)

Certificates of Participation are another form of a lease purchase agreement with the differentiating factor being that there are multiple investors participating in the purchase of the lease. COP's require financial disclosure and are typically utilized on higher value projects where one investor doesn't have the capacity to hold a high value lease for a single customer.

Energy Savings Obligations

Energy Savings Obligations can be issued as refunding bonds in accordance with the requirements of N.J.S.A *40A:11-4.6(c)(3)*. These bonds may be funded through appropriation for the utility services in the annual budget of the contract unit and may be issued as refunding bonds pursuant to N.J.S.40A:2-52 et seq., including the issuance of bond anticipation notes as may be necessary, provided that all such bonds and notes mature within the periods authorized for such energy savings obligations. Energy savings obligations may be issued either through the contracting unit or another public agency authorized to undertake financing on behalf of the unit but does not require bond referendum.

SECTION E MEASUREMENT & VERIFICATION AND MAINTENANCE PLAN

1. Baseline

The purpose for establishing a baseline for an energy performance project is to accurately predict what the energy consumption and costs would have been as if the energy project was never completed. The baseline can then be used to measure the improvement in efficiency and determine the overall energy savings of the project. Since the energy consumption of all facilities is somewhat effected by variable weather conditions, a baseline for heating and cooling systems is typically dependent on degree-days or outside temperature. A baseline also needs to incorporate changes in facility use, such as a change in hours of operation or increased levels of outside air. Once again, if these changes would have occurred in the absence of the energy project, they should be incorporated into the project's baseline.

Honeywell will calculate the baseline based on the systems and operating conditions as they currently exist. Honeywell finds baseline development most accurate if specific measurements are taken on equipment over a period of time (early in the audit phase) to determine actual kW, kWh, oil and gas consumption, cfm, gpm, hours of use, etc. A summary of some of the methods, which will be used by Honeywell to establish baselines and support, calculated savings are listed below.

1. Spot measurements of electrical loads such as lighting, fan and pump motors, chillers, electric heat, etc.
2. Measurement of equipment operating hours using electric data recorders.
3. Measurement of existing operating conditions using data recorders for space temperature and humidity, air handler temperatures (mixed, return, cooling and heating coil discharges), and space occupancy using lighting loggers.
4. Spot measurement for boiler efficiencies, water use.
5. Running measurements of chiller operation, including simultaneous measurement of input kWh or steam flow, and chilled water supply and return temperatures and flow (gpm).
6. Records of operating conditions from building management systems and utility-grade meters.

The data from the above is used to calculate existing energy use, which is then reconciled with current facility utility bills, and adjusted as required to provide a mutually agreed baseline.

To provide valid savings evaluations, Honeywell's maintains a significant inventory of metering equipment utilized by its auditors and Energy Engineers to ascertain critical data about the operation of the facility.

Typically, Honeywell's auditors use the following equipment for their onsite measurements:

1. Recording and instantaneous power and harmonic analyzers.
2. Data loggers for pressures, temperatures, flow rates, humidity and CO_2.
3. Lighting level and recording profile/run-hour and occupancy meters.
4. Multimeters, hand held kW meters.
5. Combustion analyzers.
6. Ultrasonic flow meters.
7. Infrared thermometers

The ECMs installed in many projects allow for energy savings to be identified by direct metering or a combination of metering and calculations with accepted assumptions. In the case of lighting, for example, it is relatively easy to meter representative samples of unique fixture types, both before and after a retrofit, to determine the power consumption difference in Watts. When multiplied by the quantity of each fixture type, the total connected load reduction can be derived. In combination with run time assumptions, or meters, the electrical reduction can be accurately determined. Where possible, direct measurement of ECMs during construction (before and after the retrofit) coupled with energy savings calculations is a method the Honeywell finds to be very accurate and cost-effective.

Due to the nature of some ECMs, or when a combination of ECMs is installed, individual (discrete) metering may not be either possible or able to fully document a baseline and calculate savings. Many of these situations can be handled by combining results from metering along with either engineering-based calculations or output from nationally recognized building simulation programs such as DOE II, ASEAM, TRACE or HAP. This method would be used for ECMs such as night setback, and where no other ECMs have significant interaction with the setback measure.

Formulas exercised in energy savings calculations follow the laws of physics, and many are included in the ASHRAE Handbook of Fundamentals. However, such calculations (i.e. equipment operation profiles) must be tempered by experience, past retrofit practice, and expectations of future operating conditions to arrive at achievable values in practice. Honeywell always reviews each and every project, in detail, for the anticipated savings and never hesitates to reduce the anticipated energy calculations where experience dictates necessary. The final result is a coupled project where the final savings are equal to or greater than anticipated.

Calculating the units of energy saved is a critical measure of energy efficiency improvements, but it does not indicate the actual dollars saved. To do this, Honeywell and the District will establish the base rates that will act as "floor" rates in calculating the savings. These are usually the rates that are in effect at the time of the start of the contract or rates used for audit estimated savings.

2. Adjustment to Baseline Methodology[1]

Honeywell's methodology for establishing and adjusting the baseline is determined by the characteristics of the facility, the conservation technology being installed, the technology being replaced, the type of measurement and verification Denville Board of Education requires and the needs of the District for future changes in facility use.

The purpose of this flexible approach is to make the most accurate possible measurement of the changes in energy uses that are specifically attributable to Honeywell installed ECMs. This creates the ability over the life of the contract to continue measuring only savings achieved by Honeywell and leaves the District free to make future changes to the building or systems without affecting the savings agreement. It also necessitates fewer provisions for making adjustments to the baseline.

Modifications to the energy baseline or savings will be made for any of the following:

1. Changes in the number of days in the annual review cycle.
2. Changes in the square footage of the facilities.
3. Changes in the operational schedules of the facilities.
4. Changes in facility indoor temperatures.
5. Significant changes in climate.
6. Significant changes in the amount of equipment or lighting utilized in the facility.

Examples of situations where the baseline needs to be adjusted are: i) changes in the amount of space being air conditioned, ii) changes in auxiliary systems (towers, pumps, etc.) and iii) changes in occupancy or schedule. If the baseline conditions for these factors are not well documented it becomes difficult, if not impossible, to properly adjust them when they change and require changes to payment calculations. To compensate for any addition and deletion of buildings and impact on the baseline model, Honeywell will use sound technical methodologies to adjust the baseline. An example would be to add or delete building energy impact via the calculated cooling load in tons as a percentage of the existing campus tonnage baseline or use indices like W/ft^2 and Btu/ft^2 to calculate the energy consumption of the building and then add or subtract the energy usage to or from the baseline energy consumption.

3. Energy Savings Calculations

In calculating energy savings, Honeywell's highly experienced audit staff uses onsite surveys and measurements, National Oceanic and Atmospheric Administration weather data, detailed discussions with the client's operations and maintenance personnel and engineers, utility records, and other sources to ensure accurate energy, water and O&M savings.

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[1] The energy baseline modifications shall use commonly accepted energy engineering methods that are mutually agreeable to both Honeywell and customer. Should agreement on these methods, including the climate adjustments, not be reached between Honeywell and customer, both parties could appeal to an independent engineering.

Typically, the following data is gathered:

1. Local weather data.
2. Utility bills and sub-metered consumption trends.
3. Utility rate structure.
4. Facility use and occupancy data.
5. Internal equipment loads.
6. Interviews of operations and maintenance staff and management.
7. Building construction, age, use and layout.
8. Schematics of energy and water distribution systems.
9. Identification and inventory of HVAC equipment.
10. Identification and inventory of process equipment.
11. Design, configuration and operating characteristics of HVAC systems.
12. Design, configuration and operating characteristics of process systems.
13. Control strategies and sequences of operation for HVAC and other process equipment.
14. Identification and count of all lighting fixtures and determination of power consumption for each type.
15. Identification and inventory of lighting control methods.
16. Measurement of foot-candle levels at sample locations.
17. Power quality and harmonics, power factor.
18. Indoor air quality issues.

Calculating the units of energy saved is a critical measure of energy efficiency improvements, but it does not indicate the actual dollars saved. To do this, Honeywell and Denville Board of Education will establish the base rates that will act as "floor" rates in calculating the savings. These are usually the rates that are in effect at the time of the start of the contract or rates used for audit estimated savings.

The equation below will be used to calculate the annual savings in dollars.

$$AnnualSavings(\$) = \sum_{m=1}^{12} \{ \left(Rate_{kWh,Base} \times kWh_{Saved,m} \right) + (Rate_{fuel\ Oil,\ Base} \times Fuel\ Oil_{Saved,\ gal,\ m}) +$$
$$(Rate_{Steam,\ Base} \times Steam_{Saved,\ klbs,\ m}) + (Rate_{NG} \times NG_{Saved,\ MCF,\ m}) \} + Agreed(\$)$$

where:

$Rate_{kWh,Base}$= defined base rate for kWh consumption
$kWh_{Saved,m}$= calculated kWh savings for month *m*

$Rate_{Fuel\ Oil,\ Base}$= defined base rate for fuel Oil savings (XX/gal.)
$Fuel\ Oil_{Saved,m}$= calculated chilled water savings in gal. for month *m*

$Rate_{Steam,Base}$= defined base rate for steam consumption ($XX/MMBtu.)
$Steam_{Saved,m}$= calculated Steam savings in MMBtu. for month *m*

$Rate_{NG,Base}$= defined base rate for natural gas consumption ($XX/Therm)
$NG_{Saved,m}$= calculated natural gas savings in Therms for month *m*

Agreed($)= Annual savings in dollars (water, sewer, maintenance, etc.)

Honeywell assigns dollar values to the true incremental value of savings for energy and water. In other words, we do not combine for example, demand and consumptions numbers so that there is an average value to savings. Honeywell looks at each incremental rate to units saved to properly determine the value (dollar) to Denville Board of Education or “real bill reductions”. As noted in the RFP energy escalation rates will be established in accordance with New Jersey Board of Public Utility guidelines.

Based on this, Honeywell will review all utility bills (hourly data), tariffs, special contracts and commodity contracts to develop the incremental value (costs) of each utility.

The O&M savings is typically a function of existing the Denville Board of Education's budgets (labor & direct costs), maintenance contracts and operations (supplier) contracts. Honeywell will analyze the information to provide a conservative savings representation for the Denville Board of Education's review and acceptance. The information will include all calculations and assumptions.

4. Measurement & Verification

The purpose of performing any monitoring and verification is to establish an agreed upon process that provides the customer both a level of satisfaction that the improvements have been delivered and ongoing information as to their operation and performance. Additionally, this effort will be used to assess the actual dollars of savings versus the guarantee level.

It is essential for the success of this program that Honeywell and Denville Board of Education agree on a mutually acceptable methodology for measuring and verifying energy savings that are attributable to the energy conservation measures (ECMs) Honeywell installs. This M&V plan provides the procedures to document the energy and cost savings of each of the proposed ECMs.

The plan for monitoring and verifying energy savings for the proposed ECMs is based on the methods described in the ***International Performance Measurement and Verification Protocol (IPMVP)***[2]. Our approach to M&V is directly consistent with, and in compliance with, the IPMVP. This protocol provides a framework for the most widely accepted and used M&V methods by the industry.

Engineering calculations of energy and cost savings for the project are based on operating parameters (such as weather, temperature settings, run hours, occupancy patterns, and space usage) and equipment performance characteristics. The M&V plan uses the operating parameters established in the baseline for all savings calculations during the term of the project. The intent of the M&V plan is to verify that the ECMs installed by Honeywell will provide the expected energy savings. Therefore, Honeywell will collect data and relative information during the post-retrofit period to demonstrate that the installed equipment is performing at expected levels. It is assumed that the District will continue to be a dynamic institution adding or renovating buildings and desiring to retain the right to set comfort and operating characteristics. To accommodate this, Honeywell will develop its M&V plan in a way that allows the District to adapt to the demands of future campus growth and changes without the need for the District and Honeywell to negotiate energy baseline adjustments.

Our typical M&V plan will utilize broadband Internet access to the appropriate the District's control interfaces to both confirm operating status and to download trend data to verify proper equipment maintenance.

One year after the commencement date of the ECMs, Honeywell will submit a report verifying and calculating the energy and cost savings for the first year. This report will be submitted for facility review and approval. For the remaining contract term, Honeywell will provide annual reports. These reports will include results of inspections of the installed equipment/systems, energy and cost savings, and recommendations to provide optimum energy performance.

The following table lists the information concerning typical M&V equipment used:

Instrument	Make
Power Multi-meter	Fluke 39
Light Meter	Osram or Phillips
Portable Temperature/Humidity Multi-meter	TSI
Retractable Insertion Vortex Flow meter	Hydro-Flow Model 3100
BTU Meter	Hydro-Flow BTU-121 BTU/Energy Measurement System
KW/KWH Transducers	Veris Industries (H6000 SERIES)

[2] www.ipmvp.org.

All permanent measurement equipment will be purchased new with a calibration certificate from the manufacturer. The power multi-meter and the TSI multi-meter will be calibrated annually before using them in the annual inspection.

General Approach to M&V

Energy and water savings are determined by comparing the energy and water use associated with a facility or certain systems within a facility before and after the installation of an ECM or other measure. The "before" case is the baseline. The "after" case is the post-installation or performance period. Baseline and post-installation energy use measurements or estimates can be constructed using the methods associated with M&V options A, B, C, and D, as described in the IPMVP. The challenge of M&V is to balance M&V costs, accuracy, and repeatability with the value of the ECM(s) or systems being evaluated, and to increase the potential for greater savings by careful monitoring and reporting.

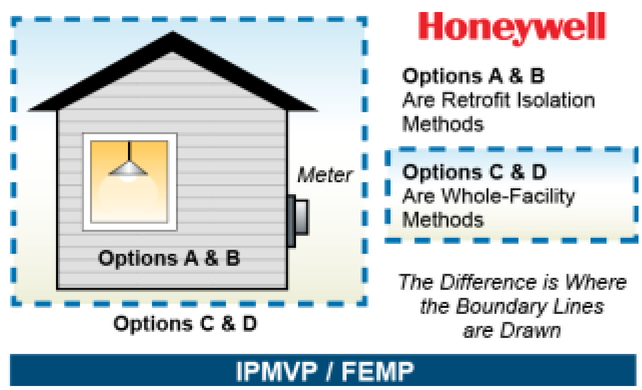
M&V Options

The IPMVP guidelines classify the M&V procedures into four categories, Options A, B, C and D. As shown in the table below, these options differ in their approach to the level of complexity of the M&V procedures.

M&V Option	Performance Verification Techniques
Option A Verifying that the measure has the potential to perform and to generate savings.	Engineering calculations before and after installation spot measurements and use of EMS data points with stipulated values.
Option B Verifying that the measure has the potential to perform and verifying actual performance by end use.	Engineering calculations with metering and monitoring strategy throughout term of the contract
Option C Verifying that the measure has the potential to perform and verifying actual performance (whole building analysis.)	Utility meter billing analysis-using techniques from simple comparison to multivariable regression analysis.
Option D Verifying actual performance and savings through simulation of facility components and/or the whole facility	Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering.

Option A is appropriate for ECMs that have energy use that can be readily quantified, such as the use of high efficiency lighting fixtures, high efficiency constant speed motors, and other standard engineering calculations.

Option B is appropriate for ECMs that require periodic or on-going measurements to quantify energy use; such as the use of variable frequency drives on pump or fan motors.



Option C is used for ECMs for which the energy use or energy savings cannot be measured directly, such as building envelope modifications. Option C is based on the use of utility meters to quantify building energy use.

Option D is used for ECMs for which the energy use or energy savings cannot be measured directly, or savings for individual ECMs are heavily interdependent. Calibrated building simulation is used to separate the energy savings attributable to each ECM.

In general,

ECM Energy Savings = Baseline Energy Use - Post-Installation Energy Use

And

Energy Cost savings ($) = Total Energy Savings x Contractual Energy Rates

Exceptions to this simple equation are as follows:

Projects where an on/off M&V method is used. For example, after a new energy management system is installed, control features are turned off for a set period of time to recreate baseline conditions. Thus, savings are determined after installation by comparing energy use with and without the control features activated.

Since energy use at a facility is rarely, if ever, constant, another way to define M&V is as a comparison of a facility's post-installation energy use with its usage if the ECM or system had not been installed. This takes into account situations in which baseline energy use must be adjusted to account for changing conditions, such as changes in facility operation, occupancy, or use or external factors such as weather.

Post-Retrofit M&V Activities

There are two components associated with M&V of performance contract projects:

1. Verifying the potential of the ECM to generate savings also stated as confirming that the proper equipment/systems were installed, are performing to specification and have the potential to generate the predicted savings.
2. Determining/verify energy savings achieved by the installed ECM(s).

Verifying the Potential to Generate Savings

Verifying baseline and post-installation conditions involves inspections (or observations), spot measurements, and/or commissioning activities. Commissioning includes the following activities:

- Documentation of ECM or system design assumptions
- Documentation of the ECM or system design intent for use by contractors, agencies and operators
- Functional performance testing and documentation necessary for evaluating the ECM or system for acceptance
- Adjusting the ECM or system to meet actual needs within the capability of the system

Post-Installation Verification

Post-installation M&V verification will be conducted by both Honeywell and the Client to ensure that the proper equipment/systems that were installed are operating correctly and have the potential to generate the predicted savings. Verification methods may include surveys, inspections, and/or spot or short-term metering.

Regular Interval Post-Installation Verification

At least annually, Honeywell will verify that the installed equipment/systems have been properly maintained, continue to operate correctly, and continue to have the potential to generate the predicted savings. Savings report for all the installed ECMs will be submitted each year after the acceptance date of the work performed by Honeywell.

Computation of Energy Savings

After the ECMs are installed, energy and cost savings will be determined annually by Honeywell in accordance with an agreed-upon M&V approach, as defined in a project-specific M&V plan.

Construction/Interim Savings

Construction or Interim savings are usually measured by using the same methodology as described in the detail M&V plan for each ECM. The start and the completion time for each ECM must be agreed to between Honeywell and the Denville Board of Education.

Electricity and thermal savings from the ECMs where no detailed long-term data is required to be collected will be stipulated and will be based on the starting and the final completion dates and verification of the operation of the ECMs. For other ECMs where long-term data collection is required by the M&V plan, data will be used to calculate the savings using the same equations as described in the detail plan. For example, to calculate electricity savings for the installation of a VFD, the kW is spot measured at a set speed for selected motors through a sampling plan. The measured kW is subtracted from the baseline kW to calculating the savings. Thermal savings are tied to the electrical savings in the manner described in the detail M&V plan. The results are extrapolated to cover all the VFDs installed by Honeywell.

The savings for each of the monitored VFD is calculated on an interval basis as follows:

$kW_{Saved} = (kW_{Base} – kW_{Spot\ Measured})$

kWh_{Saved} = Estimated operating hours during the interim period * kW_{Saved}

The total kWh savings is the sum of the kWh_{Saved} for all the installed VFDs.

5. Site Specific M&V Plan

ECM # and Name	Summary of ECM	Measurement and Verification Methodology / Recommendation	Description of M&V – Pre and Post Process
ECM 1A - Lighting Upgrades	Upgrade Lighting systems: Re-lamp/Re-ballast T-8 to LED New Fixtures Incandescent to LED Metal Halide and Sodium Vapor to LED High Bays	Option A: Pre and Post measurements Line by Line scope and engineering calculations	Pre M&V: Measurement of KW for 5% sample fixtures in each category Data log usage hours Data Log occupancy schedules Update Line by Line scope with measured KW and usage hours Post M&V: Measurement of KW for 5% sample fixtures in each category Usage Hours to remain same Occupancy schedules to remain same Energy Savings : Update Line by Line scope with measured KW and usage hours and compare to pre retrofit calculated savings
ECM 1B – Vending Misers	Install Vending machine energy management devices	Option A: Pre and Post measurements Line by Line scope and engineering calculations	Pre M&V: Measurement of KW for 5% sample machines in each category Data log usage hours Data Log occupancy schedules Update Line by Line scope with measured KW and usage hours Post M&V: Measurement of KW for 5% sample machines in each category Usage Hours to remain same Energy Savings scope with measured KW and usage hours and compare to pre retrofit calculated savings
ECM 1C - De-Stratification Fans	Install De-Stratification fans in Gymnasiums , Cafeterias and Auditoriums to minimize stratification of hot air and maintain hot air flow below the fan level	Option C: Fuel Savings Utility Bill Comparison for all fuel related measures	Pre M&V: Verify parameters used in engineering calculations with equipment name plate data and savings assumptions Post M&V: Fuel: Compare post installation M&V fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days
ECM 1D - Plug Load Management via Wi-Fi	Provide Wi-Fi enabled programmed electrical outlet strips to shut down computer peripherals and various plug loads when building	Option A: Engineering calculations based on comparison of existing operations and post installation operation	Pre M&V: Verify parameters used in the calculations based on data provided by Data loggers on selected pieces of equipment Post M&V: Verify that the control equipment is installed and programmed as specified. Data log to verify reduced hours of operation

ECM # and Name	Summary of ECM	Measurement and Verification Methodology / Recommendation	Description of M&V – Pre and Post Process
	is not occupied		
ECM 2A – Boiler Upgrades	Replace boilers in select locations to handle base heating load	Option C: Utility Bill Comparison for all fuel related measures	Pre M&V: Baseline annual fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days Perform combustion efficiency test on boilers Post M&V: Compare post installation M&V fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days Perform efficiency test on replaced boilers to insure operating conditions are maintained
ECM 2B - Boiler Burner Controls	Retrofit existing burners with ControLinks	Option C: Utility Bill Comparison for all fuel related measures	Pre M&V: Baseline annual fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days Post M&V: Compare post installation M&V fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days
ECM 2C - Rooftop Unit Replacement	Replace antiquated Roof Top Units with new high efficiency VFD equipped Rooftop Units	Option A: Engineering calculations based on nameplate and manufacturer supplied data for the existing and replacement RTU	Pre M&V: Verify manufacturer provided data for existing unit efficiency (SEER) Post M&V: Verify manufacturer provided data for new condensing unit (SEER) – verify the new equipment and controls are installed and commissioned as recommended by manufacturer
ECM 2D - Premium Efficiency Motors and VFDs	Install Variable Frequency Drives on hot water and chilled water pumps to operate the pump motors in response to the system load. Replace antiquated motors with new premium efficiency motors	Option A: Engineering calculations for variable frequency drives following pump affinity laws. Engineering calculations based on nameplate and manufacturer supplied data for the existing and replacement motors	Pre M&V: Verify manufacturer provided data for the pump performance data and motor efficiencies. Post M&V: Obtain trend data for VFD operation from the BMS system to verify baseline calculation assumptions on system loads Verify efficiency of new motors Verify manufacturer provided data for new chiller efficiency (kW/ton) – verify the new equipment and controls are installed and commissioned as recommended by manufacturer
ECM 2E – Steam Trap Replacement	Replace failed steam traps throughout steam buildings	Option C: Utility Bill Comparison for all fuel related measures	Pre M&V: Baseline annual fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days Post M&V: Compare post installation M&V fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days

ECM # and Name	Summary of ECM	Measurement and Verification Methodology / Recommendation	Description of M&V – Pre and Post Process
ECM 2F – Pipe Insulation	Insulate Steam and Hot Water Piping	Option C: Utility Bill Comparison for all fuel related measures	Pre M&V: Baseline annual fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days Post M&V: Compare post installation M&V fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days
ECM 2G – Domestic Hot Water Replacement	Replace existing domestic hot water heater with condensing natural gas domestic hot water heater	Option C: Utility Bill Comparison for all fuel related measures	Pre M&V: Baseline annual fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days Perform combustion efficiency test on boilers Post M&V: Compare post installation M&V fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days Perform efficiency test on replaced boilers to insure operating conditions are maintained
ECM 2H – Split System Replacement	Replace antiquated Condensing Units with new high efficiency units	Option A: Engineering calculations based on nameplate and manufacturer supplied data for the existing and replacement CU	Pre M&V: Verify manufacturer provided data for existing unit efficiency (SEER) Post M&V: Verify manufacturer provided data for new condensing unit (SEER) – verify the new equipment and controls are installed and commissioned as recommended by manufacturer
ECM 2I – Window AC Unit Replacements	Replace window AC Units with VRV System	Option A: Engineering calculations based on nameplate and manufacturer supplied data for the existing and replacement CU	Pre M&V: Verify manufacturer provided data for existing unit efficiency (SEER) Post M&V: Verify manufacturer provided data for new condensing unit (SEER) – verify the new equipment and controls are installed and commissioned as recommended by manufacturer
ECM 3A - Building Management System Upgrades	Upgrade Building Management Systems to DDC or wireless pneumatic and integrate all systems to a central platform such that the systems may be monitored and controlled as programmed to maintain global settings	Option A: Electric energy savings - Engineering calculations based on programmed parameters. Option C: Fuel Savings Utility Bill Comparison for all fuel related measures	Pre M&V: Verify existing operating parameters match the baseline calculation assumptions Post M&V: Verify that systems are installed as specified and controls are programmed to match the savings assumptions Electric Energy: Verify savings based on programmed parameters and engineering calculations Fuel: Compare post installation M&V fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days

ECM # and Name	Summary of ECM	Measurement and Verification Methodology / Recommendation	Description of M&V – Pre and Post Process
	such as night set back , optimum stop-start etc		
ECM 3B - Demand Control Ventilation	Install Demand Control Ventilations System with Carbon Di-Oxide sensors installed to modulate the outdoor air intake for air handling system based on space occupancy variations	Option A: Electric energy savings - Engineering calculations based on industry standards Option C: Fuel Savings Utility Bill Comparison for all fuel related measures	Pre M&V: Verify parameters used in engineering calculations with equipment name plate data and savings assumptions Post M&V: Verify that systems are installed as specified and controls are programmed to match the savings assumptions Electric Energy: Verify savings based on verified parameters and engineering calculations Fuel: Compare post installation M&V fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days
ECM 4A - Building Envelope Improvements	Install weather stripping on doors, seal roof wall joints and roof penetrations	Option A: Electric energy savings - Engineering calculations based on programmed parameters. Option C: Fuel Savings Utility Bill Comparison for all fuel related measures	Pre M&V: Verify parameters used in engineering calculations with site conditions Post M&V: Fuel: Compare post installation M&V fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days
ECM 4B – Roof Replacements	Install foam spray roof to increase the R-Value of the existing roof and seal exterior leaks	Option A: Electric energy savings Engineering calculations based on the difference in the R-Values of the old and new windows Option C: Fuel Savings Utility Bill Comparison for all fuel related measures	Pre M&V: Validate of replaced square footage Post M&V: Validate R-values of roof replaced against manufacturer specifications Electric Energy: Post retrofit verification data applied against engineering calculations and contractual utility rates Fuel: Compare post installation M&V fuel cost based on fuel billing data and Metrix tuned to normalize to heating degree days
ECM 5A - Computer Power Management	Install computer management software to decrease power consumption	Option A: Engineering calculations based on decreased consumption	Pre M&V: Measure typical computer usage Post M&V: Measure typical computer usage once software is installed Verify savings with engineering calculations

ECM # and Name	Summary of ECM	Measurement and Verification Methodology / Recommendation	Description of M&V – Pre and Post Process
ECM 6A – Water Conservation	Replace regular water fixtures with Low Flow water saving fixtures	Option A: Engineering calculations based on decreased consumption	Pre M&V: Detailed fixture count. Baseline water usage from the utility bills. Student population and school schedules provided by the District. Flow (gpm or gpf) field measurements. Post M&V: Detail fixture count. Occupancy and usage equal baseline hours for fixtures. Flow (gpm or gpf) from sample measurements, manufacturer data/published flow tables. One-time visual inspection of physical condition on a sample of fixtures. Check replacement inventory, interview staff for maintenance and operational problems.
ECM 7A - Demand Response/ Permanent Load Reduction	Participate in utility Permanent Load Reduction program	Option A - stipulated Savings based on incentives offered by Utility (ISO)	Pre M&V: None Post M&V: Savings stipulated based on incentives offered by Utility (ISO)
ECM 8A - Solar PV System	Install Solar Energy arrays at designated schools	N/A	Pre M&V: None Post M&V: None

6. Guarantee of Savings

The approach that Honeywell utilizes in this asset management program includes two key components: a *performance guarantee* and *financial savings*. Honeywell guarantees the District that all installations and work performed are subject to final inspection and the District's acceptance. This procedure ensures all work will be to the level of quality the District expects.

Honeywell also guarantees it will meet the objectives mutually defined with the District. Honeywell takes its commitment to partner with Denville Board of Education for the life of the contract seriously, and looks forward to a successful, long-term partnership.

Honeywell considers the guarantee to be the cornerstone of our service to you. To be considered a *performance contract* an energy guarantee is an optional component under the New Jersey Energy Savings Improvement Program (ESIP) legislation. The basis of an energy performance contract is that the majority of risk is shifted from the District to the ESCO. The strength of the Guarantee is only as good as the Company backing it and their financial solvency. With over $37 Billion in assets, Honeywell has the financial strength and background to support the District for the long term.

Savings Guarantee: With the understanding that Denville Board of Education must maintain fiscal health and accountability, Honeywell can financially guarantee the results of its programs and clearly support this obligation with the commitment to regular review of program results and reconciliation. **Honeywell's financial strength and stability give it the ability to extend a FIRST-PARTY GUARANTEE to Denville Board of Education. A first party guarantee eliminates the risk on the District and places it directly onto Honeywell.** This differs from some other ESCO's who provide a third-party guarantee, which insulates them from the owner through the use of insurance instruments.

If at the end of any year the program has not met or exceeded the guaranteed savings for that year, Honeywell will refund the difference between the guaranteed amount and what was actually saved.

For all equipment covered by the Energy Savings Guarantee, Denville Board of Education shall be responsible for on-going maintenance and component replacement in accordance with manufacturer's standards. The customer will also be responsible for operating the equipment in accordance with manufacturer's specifications.

Honeywell will develop savings methodologies that follow current industry practice, such as outlined by the New Jersey Board of Public Utilities (BPU) and Federal Energy Management Program's (FEMP) M&V Guidelines: Measurement and Verification for Federal Energy Projects. References to M&V protocols from the International Performance Measurement and Verification Protocol (IPMVP), ASHRAE Guideline 14 and the Air-Conditioning Refrigeration Institute (ARI) are used to further qualify the M&V plan.

As stated above, under the New Jersey ESIP legislation acceptance of a performance guarantee is optional at Denville Board of Education sole discretion. In the same way, the duration of the guarantee is also optional. Many of Honeywell's New Jersey customers have elected to keep the guarantee in force for less than the total performance periods, i.e. three (3) to five (5) years. Others have elected to accept a one (1) year guarantee, while reserving the option to renew for additional years after they have had the opportunity to review the track record of actual savings results. Obviously, this a very customer specific decision based on the risk management culture of each unique organization. The key point is that Honeywell is flexible with regard to the structure and duration of the guarantee. The final terms will be discussed and defined as part of our co-authored ESIP project.

Solely for informational purposes, it is worth noting that if the District does elect to accept a guarantee, New Jersey ESIP law requires that the District contract with a third-party independent firm to verify that the energy savings are realized. In order to preserve the independent status of this contractor these costs are required to be incurred directly by the District.

The RFP requires that the cost of the guarantee be identified during this response phase. Honeywell develops and implements every project with the same high level of detail and confidence and therefore will always provide a Savings Guarantee at no additional cost. However, if the District opts to accept the Savings Guarantee, an annual cost of 0.5% of Hard Costs will be applicable to account for on-going Honeywell service costs incurred during the measurement and verification of the savings.

All guarantees require that the owner maintain the system in accordance with the manufacturer's specifications. Regardless of guarantee acceptance, ongoing maintenance as recommended by the BPU, Honeywell and / or manufacturer specifications is required to achieve the projected energy savings. Maintenance should also include a periodic verification of the system to make sure the maintenance is properly conducted and the system is meeting the original specifications and design.

7. Recommended Preventive Maintenance Services

A Comprehensive Portfolio, a Customized Approach.

Honeywell offers a uniquely comprehensive portfolio of services – one of the most extensive in the industry. As part of the Energy Savings Plan, we recommend the following services for consideration to ensure achievement of the Energy Savings outlined in this plan

According to the NJ ESIP program, all services are required to be bid by the District for services as desired. Based on Honeywell's vast service organization, we are uniquely qualified to develop design specification for the public bidding according to NJ Law.

Honeywell strongly believes that the long-term success of any conservation program is equally dependent upon the appropriate application of energy savings technologies, as well as solid fundamental maintenance and support. One of the primary contributors to energy waste and premature physical plant deterioration is the lack of operations, personnel training and equipment maintenance.

Honeywell recommends routine maintenance on the following systems throughout the District for the duration of an energy guarantee of savings

Maintenance, Repair and Retrofit Services:

- Mechanical Systems
- Building Automation Systems
- Temperature Control Systems
- Air Filtration

Honeywell will work with the District to evaluate current maintenance practices and procedures. This information will be the basis of a preventive maintenance and performance management plan designed to maximize building operating efficiencies, extend the useful life of your equipment and support the designed Energy Savings Plan.

At a minimum, we recommend the following tasks be performed on a quarterly basis with the Campus Wide Building Management System.

System Support Services

1. Review recent mechanical system operation and issues with customer primary contact, on a monthly basis.
2. Review online automation system operation and event history logs and provide summary status to the customer primary contact. Identify systemic or commonly re-occurring events.
3. Check with customer primary contact and logbook to verify that all software programs are operating correctly.
4. Identify issues and prioritize maintenance requests as required.
5. Provide technical support services for trouble shooting and problem solving as required during scheduled visits.
6. Provide ongoing system review and operations training support; including two semi-annual lunches and learn sessions.
7. Establish dedicated, site-specific emergency stock of spare parts to ensure prompt replacement of critical components. These will be stored in a secure location with controlled access.

Configuration Management

1. Update documentation and software archives with any minor changes to software made during maintenance work.
2. Verify and record operating systems and databases.
3. Record system software revisions and update levels.
4. Archive software in designated offsite Honeywell storage facility, on an annual basis.
5. Provide offline software imaging for disaster recovery procedures, updated on a regular basis.

Front End / PC Service

1. Verify operation of personal computer and software:
2. Check for PC errors on boot up
3. Check for Windows errors on boot up
4. Check for software operations and performance, responsiveness of system, speed of software
5. Routinely backup system files, on an annual basis:
6. Trend data, alarm information and operator activity data
7. Custom graphics and other information
8. Ensure disaster recovery procedures are updated with current files
9. Clean drives and PC housing, on an annual basis:
10. Open PC and remove dust and dirt from fans and surfaces
11. Open PC interface assemblies and remove dust and dirt
12. Clean and verify operation of monitors.
13. Verify printer operation, check ribbon or ink.
14. Initiate and check log printing functions.
15. Verify modem operation (if applicable).
16. Review IVR schedule for alarms and review (if applicable).

TEMPERATURE CONTROLS

UNIT VENTS

Services Performed
Annual Inspection
1. Inspect motor and lubricate.
2. Lubricate fan bearings.
3. Inspect coil(s) for leaks.
4. Vacuum interior.
5. Test operation of unit controls.

PUMPS

Services Performed
Preseason Inspection
1. Tighten loose nuts and bolts.
2. Check motor mounts and vibration pads.
3. Inspect electrical connections and contactors.

Seasonal Start-up
1. Lubricate pump and motor bearings per manufacturer's recommendations.
2. Visually check pump alignment and coupling.
3. Check motor operating conditions.
4. Inspect mechanical seals or pump packing.
5. Check hand valves.

Mid-season Inspection
1. Lubricate pump and motor bearings as required.

2. Inspect mechanical seals or pump packing.
3. Ascertain proper functioning.

Seasonal Shut-down
1. Switch off pump.
2. Verify position of hand valves.
3. Note repairs required during shut-down.

PACKAGED AIR-CONDITIONING SYSTEMS

Services Performed

Preseason Inspection
1. Energize crankcase heater.
2. Lubricate fan and motor bearings per manufacturer's recommendations.
3. Check belts and sheaves. Adjust as required.
4. Lubricate and adjust dampers and linkages.
5. Check condensate pan.

Seasonal Start-up
1. Check crankcase heater operation.
2. Check compressor oil level.
3. Inspect electrical connections, contactors, relays, operating and safety controls.
4. Start compressor and check operating conditions. Adjust as required.
5. Check refrigerant charge.
6. Check motor operating conditions.
7. Inspect and calibrate temperature, safety and operational controls, as required.
8. Secure unit panels.
9. Pressure wash all evaporator and condenser coils (if applicable)
10. Log all operating data.

Mid-season Inspection
1. Lubricate fan and motor bearings per manufacturer's recommendations.
2. Check belts and sheaves. Adjust as required.
3. Check condensate pan and drain.
4. Check operating conditions. Adjust as required.
5. Log all operating data.

Seasonal Shut-down *
1. Shut down per manufacturer's recommendations.

* If no Shut-down is required then (2) Mid-season Inspections are performed

BOILERS

Services Performed

Preseason Inspection
1. Inspect fireside of boiler and record condition.
2. Brush and vacuum soot and dirt from flues (not chimneys) and combustion chamber.
3. Inspect firebrick and refractory for defects.
4. Visually inspect boiler pressure vessel for possible leaks and record condition.
5. Disassemble, inspect and clean low-water cutoff.
6. Check hand valves and automatic feed equipment. Repack and adjust as required.
7. Inspect, clean and lubricate the burner and combustion control equipment.
8. Reassemble boiler.
9. Check burner sequence of operation and combustion air equipment.
10. Check fuel piping for leaks and proper support.

11. Review manufacturer's recommendations for boiler and burner start-up.
12. Check fuel supply.
13. Check auxiliary equipment operation.

Seasonal Start-up

1. Inspect burner, boiler and controls prior to start-up.
2. Start burner and check operating controls.
3. Test safety controls and pressure relief valve.
4. Perform combustion analysis.
5. Make required control adjustments.
6. Log all operating conditions.
7. Review operating procedures and owner's log with boiler operator.

Mid-season Inspection

1. Review operator's log.
2. Check system operation.
3. Perform combustion analysis.
4. Make required control adjustments.
5. Log all operating conditions.
6. Review operating procedures and log with boiler operator.

Seasonal Shut-down

1. Review operator's log.
2. Note repairs required.

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SECTION F DESIGN APPROACH

In accordance with the ESIP PL 2012, c.55 as part of the implementation process, an agreement between the District and Honeywell will determine the energy conservation measures (ECM's) to be implemented. The services of a NJ Licensed Engineering firm and / or Architectural firm shall then be secured in order to properly comply with local building codes, compliance issues and NJ Public contracts law. Specifications will be designed and developed to exact standards as recommended by Honeywell in order to achieve all savings outlined in this Energy Savings Plan (ESP). Once specifications are completed, Honeywell will publicly solicit contractors capable of meeting the requirements of the specification for each trade. However, even before the completion of the bidding process, Honeywell project management will be engaged in order to maintain the overall project schedule and ensure the District's expectations are met. An overview of these activities and functions are detailed below.

1. Safety Management Plan

All of Honeywell's Project Management Plans begin with safety. By integrating health, safety and environmental considerations into all aspects of our business, we protect our customers, our people and the environment, achieve sustainable growth and accelerated productivity, drive compliance with all applicable regulations and develop the technologies that expand the sustainable capacity of our world. Our health, safety and environment management systems reflect our values and help us meet our customer's needs and our business objectives.

Honeywell's Safety Management Plan is provided in Appendix 5.

2. Project Management Process

Honeywell approaches any ESIP project with a systematic, tested and proven delivery process based upon industry best practices including strong project management, open and collaborative communication, superior technical design and state of the art technologies. We go above and beyond, with multiple NJ delivery teams to ensure sufficient resources, meticulous and thorough training and commissioning, and robust maintenance planning that goes the extra mile for the long term. Honeywell excels at project delivery because of our experience in New Jersey delivering ESIP projects with results that meet or exceed expectations.

Honeywell will demonstrate our partnership-based commitment to Denville BOE throughout the development and delivery of your ESIP project, as we have done for dozens of other public entities throughout New Jersey under the ESIP Law. Our approach is backed by our references and track record and highly experienced engineering resources, which will be fully utilized to help you achieve your unique project goals and requirements.

Honeywell prescribes four phases in the ESIP Process that constitutes your project, including:

- Phase 1: Investment Grade Energy Audit (IGEA)
- Phase 2: Project Implementation
- Phase 3: Commissioning and Training
- Phase 4: Energy Savings Guarantee Period

The IGEA will commence with a kickoff meeting between key project stakeholders of Denville BOE and Honeywell to review the ESIP Process, including the expectations of both parties during the IGEA, audit parameters, reporting methods, building access protocols, availability of utility and building data, et cetera. Phase 2 will commence after our kickoff meeting has concluded with agreed upon next steps.

Honeywell takes a holistic approach in development of a comprehensive solution that is customized to meet your operational and facility needs and project goals. Our integrated project delivery approach supports continuous and collaborative communication between key stakeholders throughout the process. Our IGEA development process includes the following steps:

- **Step 1: Discovery**
    - Ascertain your goals and expectations to define project requirements
    - Involve key decision makers to prioritize

  - Aggregate utility and building data to benchmark energy consumption
  - Ensure site access for energy audits and site measurements to complete survey work
  - Inventory equipment

- **Step 2: Identify and Develop Project**
  - Complete ECM list focused on your requirements
  - Coordinated development effort to refine project scope
  - Conceptual scopes of work to further define
  - Determine modeling approach and M&V methodology

- **Step 3: Cost and Savings Forecasting**
  - Calculate energy and cost savings
  - Identify utility rebates
  - Detailed scopes of work
  - Operating strategies and equipment performance data

- **Step 4: Deliver Solution**
  - Deliver final IGEA report and contract
  - Finalize scope of work
  - Secure financing
  - Deliver positive cash flow
  - Finalize savings guarantee
  - Commissioning, M&V and training program

Step 1: Discovery

The first step of your IGEA is to gain a thorough comprehension of Denville BOE's key priorities and requirements. Honeywell will work with you to identify what your key needs and goals include and investigate your buildings and systems with that in mind during this step.

Honeywell will initiate your IGEA shortly after formal selection with a kickoff meeting involving all key project decision makers of the County and Honeywell. The purpose of this meeting is to establish preliminary project expectations and define key next steps of the process to inform the IGEA.

Honeywell will develop a customized plan for developing an efficient, cost effective and solutions based project including schedule, finance, performance requirements and scheduling activities.

Honeywell will schedule site visits to commence at the earliest convenience. Utility data is a key component used for establishing your energy baseline to project potential energy savings. Building plans and operating schedules will assist Honeywell to focus our time during the site visits and serve to provide the means for our engineers to complete their calculations. Data required for this step includes 24 months of electric, thermal, water/sewer data, original and renovation drawings, equipment lists, equipment operating schedules, occupancy data and maintenance records and repair costs.

Our goal for the site surveys is to understand your systems in each facility and to identify potential energy conservation measures (ECMs) for inclusion in your final project scope. This step allows Honeywell to determine needed improvements by evaluating each building and its systems in terms of condition, performance and age, including lighting and HVAC systems, Building Automation Systems, building envelopes, electrical distribution, domestic water and heating systems, et cetera.

Step 2: Identify and Develop Project

Honeywell will take the findings of our earlier diagnostic phase to develop solutions that address your priorities and key needs as ascertained in Step 1. Our collaborative, solutions based approach will allow you to maximize savings so as to invest more into modernizing buildings and generate maximum rebates to help deliver the most positive cash flow available.

Our primary objective is to ensure quality control and on time delivery throughout your project. Your project will have a dedicated team consisting of project management and engineering who have helped deliver similarly sized project under ESIP in recent past.

Honeywell will create an exhaustive ECM list following the completion of the site survey process. Each opportunity is then analyzed individually to determine both economic and construction feasibility. Input from Denville BOE is critical to determine how each ECM fits within your overall project priorities. Honeywell's ECM Opportunity Funnel will help further narrow down the list of potential ECMs to your final ESIP project scope, by analyzing all aspects of your energy consumption to deliver an optimal project scope based on realistic savings potential. Our unique collaborative approach ensures that we deliver on your expectations while providing for turnkey solutions that are cost effective.

Step 3: Cost and Savings Forecasting

Honeywell will then move on to analyze and quantify your unique savings guarantee utilizing Denville BOE's dedicated ESIP Team. During this step we will quantify energy savings by identifying the scope of work and its impact on your facilities and systems. We will measure individual ECMs based on how they will impact future performance of the building as a whole. This will help to ensure that the ECM savings are accounted for only once. Results are then subject to peer reviews to verify accurate modeling and savings forecasts based on the proposed scope of work.

Honeywell's unique approach to engineering is why we often exceed the savings guarantee of our contracts.

Step 4: Deliver Solution

Honeywell will leverage our experience delivering more than two dozen NJ ESIP projects since 2009 to help Denville BOE complete a successful project on time that maximizes realistic savings, cash rebates and positive cash flow. We have learned through this unrivaled experience that what matters most is to meet your expectations and ensure your involvement in the decision making process. REACT (Rebate Energy Analysis Constructability Tool) will provide for an interactive solution development experience designed to maximize New Jersey Office of Clean Energy rebates. Our No Change Orders policy (which helps distinguish Honeywell from the competition) will further reduce risk and enhance project results. And our in-house finance team (Honeywell Global Finance) will work to ensure that you secure the most competitive financial offering and interest rate available. No ESCO offers more value throughout the ESIP Process than Honeywell.

Our deliverables during this final phase will include:

- Final IGEA Report
- Project Schedule
- Construction Plan
- Commissioning Plan
- M&V Plan
- Training Plan
- Energy Services Contract

A. HONEYWELL PERFORMANCE CONTRACTING

Honeywell is the undisputed performance contracting market leader in the Northeast. Honeywell's Guaranteed Performance Contracting, which we pioneered in the early 1980's, has surpassed the $2 billion mark in cumulative sales. Our performance contracting business features specialized and dedicated resources, including people with expertise specifically to address the needs of our customers. Our portfolio of business experience in the region is over 400 projects and over $500 million in project investment.

B. Project Management Policy: Honeywell's Commitment to Health, Safety the Environment and School

All of Honeywell's Project Management Plans begin with safety. By integrating health, safety and environmental considerations into all aspects of our business, we protect our customers, our people and the environment, achieve sustainable growth and accelerated productivity, drive compliance with all applicable regulations and develop the technologies that expand the sustainable capacity of our world. Our health, safety and environment management systems reflect our values and help us meet our customer's needs and our business objectives.

Our Safety Commitment to School

In today's world, nothing is more important than safeguarding our families at home, at work and at school. Through Honeywell's safety awareness process, we commit to our customers to protect and safeguard our construction sites, our employees, sub-contractors, your staff and most of all your children.

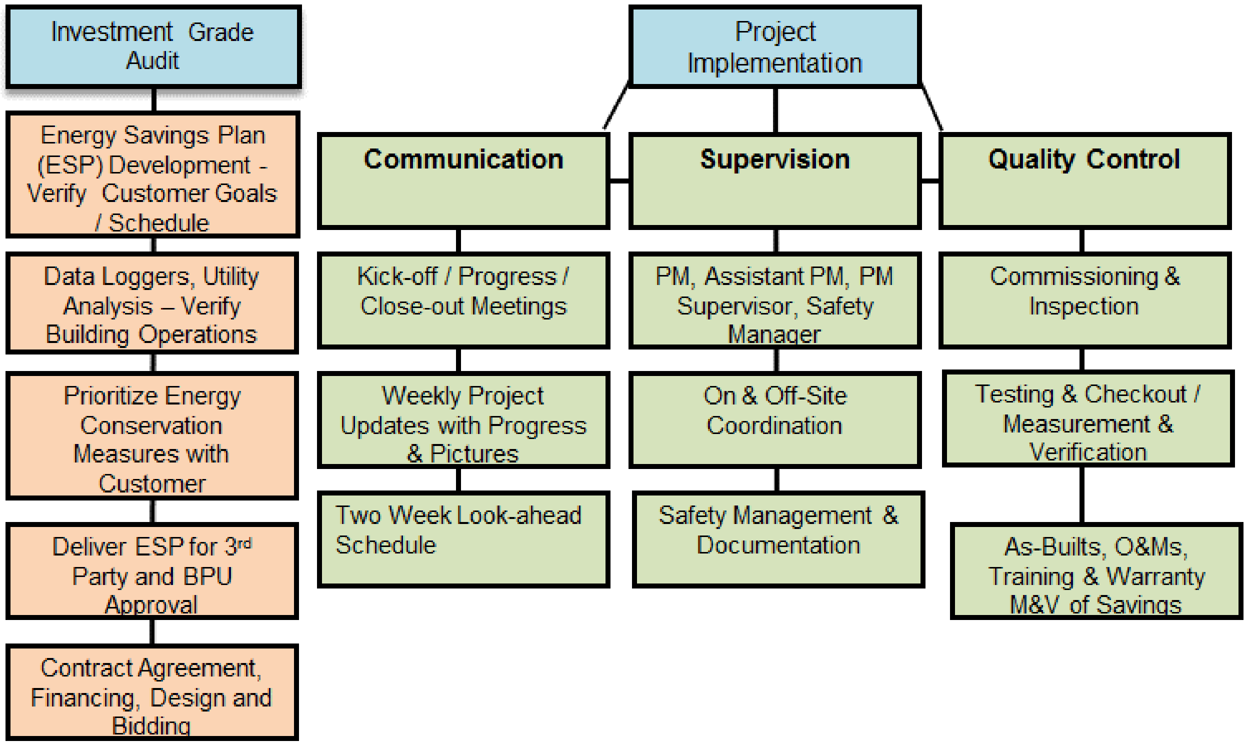
Our projects all begin with the following steps:

- Safety Training for Employee's and Sub-contractors
- Detailed Work Schedules around the day
- Detailed Background Checks of Personnel
- Detail Logs of Sub Contractor Personnel
- On-Site Logs of Time Sheets, Contact Information for All Personnel
- Clearly Displayed Identification Badges of All Construction Personnel
- On-Site Daily Supervision of All Sub-contractors
- Detailed and Weekly Reviews of Accident Reports and Remediation Strategy

We protect the safety and health of our customers and employees through prevention of illness, injury and pollution.

- We actively promote and develop opportunities for expanding sustainable capacity by increasing fuel efficiency, improving security and safety, and reducing emissions of harmful pollutants.
- We are committed to compliance with all of our health, safety, environmental and legal requirements everywhere we operate
- Our commitment to health, safety and the environment is an integral aspect of our design of products, processes and services, and of the lifecycle management of our products.
- Our management systems apply a global standard that provides protection of both human health and the environment during normal and emergency situations
- We identify, control and endeavor to reduce emissions, waste and inefficient use of resources and energy.
- We abide by the company's own strict standards in cases where local laws are less stringent.
- Our senior leadership and individual employees are accountable for their role in meeting our commitments.
- We measure and periodically review our progress and strive for continuous improvement.
- These are our commitments to health, safety, and the environment, and to creating a safe, clean environment everywhere we operate.

C. PROJECT MANAGEMENT PROCESS



The project management process applies technical knowledge, people and communication skills, and management talent in an on-site, pro-active manner to ensure that our contract commitments are met on time, within budget, and at the quality you expect.

A Honeywell Project Management Plan defines plans and controls the tasks that must be completed for your project. But more than task administration, our project management process oversees the efficient allocation of resources to complete those tasks.

Each project and each customer's requirements are unique. At Honeywell we address customer needs through a formal communication process. This begins by designating one of our project managers to be responsible for keeping the customer abreast of the status of the project.

As the facilities improvements portion of the partnership begins, the Project Manager serves as a single focal point of responsibility for all aspects of the partnership. The Project Manager monitors labor, material, and project modifications related to the County/Honeywell partnership and makes changes to ensure achievement of performance requirements in the facilities modernization component. The Project Manager regularly reviews the on-going process of the project with the customers.

The Project Manager will develop and maintain effective on-going contact with the County and all other project participants to resolve issues and update project status.

There are several challenges in this position. The Project Manager must staff the project and create a work force capable of handling the technologies associated with the project (pneumatic or electric/electronic controls, mechanical systems, etc.), and plan for and use these personnel to achieve optimum results focused on occupant comfort and guarantee requirements.

3. Construction Management

Prior to any work in the buildings, our Project Manager will sit down with your administrative and building staff to outline the energy conservation upgrades that we will be installing in their building. We will discuss proper contractor protocol of checking in and out of the buildings on a daily basis, wearing identifiable shirts, identification badges, and checking in with your facilities staff.

We will coordinate certain projects for different times of the day so we do not interrupt the building and learning environments. Our staff will work a combination of first and second shifts to accomplish the pre-set implementation schedule.

Communication is the key success factor in any construction management plan, and our project manager will be the key focal point during the installation process.

Our team will prevent schedule slippages by continuously tracking the location of all equipment and components required for the project. We make sure all equipment and components will be delivered on time prior to the scheduled date of delivery. Our thorough survey, evaluation and analysis of existing conditions, performed prior to the commencement of construction, will also prevent schedule slippages.

Honeywell is required to subcontract various portions of our projects to contractors. Within the Denville Board of Education project, all subcontractors will be selected in accordance with New Jersey public contracts law. Typical areas that are subcontracted are as follows:

- Electrical Installation
- Lighting Retrofits
- HVAC Installation (depends upon the project size and scope)
- Associated General Contracting specialty items to support the project etc., (ceilings, windows, concrete, structural steel, roofing, demolition and removal of equipment, painting and rigging)

Where possible under New Jersey public contracts law, Honeywell uses the following guidelines in hiring subcontractors to perform work on our projects.

- Local Presence in the Community (Customer Recommendations)
- Firm's Qualifications and WBE/MBE Status
- Firm's Financial Stability
- Ability to perform the work within the project timeline
- Price
- Ability to provide service on the equipment or materials installed over a long period of time.

Approval of subcontractors that Honeywell proposes to use lies with the Denville Board of Education.

4. Commissioning

Honeywell provides full commissioning of energy conservation measures (ECM's) as part of our responsibility on this project. We will customize this process based on the complexity of ECMs. Specifically, Honeywell will be responsible for start-up and commissioning of the new equipment and systems to be installed during the project. This will include verifying that the installed equipment meets specifications, is installed and started up in accordance with manufacturer's recommendations, and operates as intended. A commissioning plan will be prepared that describes the functional tests to be performed on the equipment and the acceptance criteria.

Prior to customer acceptance of the project, Honeywell submits the final commissioning report containing signed acceptance sheets for each ECM. Signed acceptance sheets are obtained upon demonstrating the functionality of each ECM to a District appointed representative.

Additionally, Honeywell provides training for facility operators and personnel as needed when each ECM is completed and placed into service. All training is documented in the final commissioning report.

Subsequent to the completion of the Honeywell commissioning effort, in accordance with New Jersey ESIP legislation, the Denville Board of Education will be required to secure the services of a 3rd party independent firm in order to verify that the new equipment and systems meet the standards set forth in the Energy Savings Plan. In order to maintain the independence of this review, these costs must be born directly by the District. However, at the option of the District, these services can be financed as a portion of the total project cost.

5. Installation Standards

When Honeywell designs a solution, we take into account current and future operations. For any upgrades we install, we follow building codes/standards, which dictate certain standards for energy or building improvements. Listed in tables following this section are standards for building design. During the life of the agreement, there is a partnership approach to maintaining these standards for reasons of comfort and reliability. For lighting our standard is to meet or exceed Department of Education light levels requirements, achieving the relevant standards wherever possible.

In the case of fluorescent lighting upgrades, we recommend that a group re-lamping of lamps be done approximately five years after the initial installation depending upon run times. Your building facility staff, on an as needed basis, can complete normal routine maintenance of lamps and ballasts. This maintains the quality of the lighting levels, and color rendering qualities of the lamps.

Space temperatures will be set by the energy management system and local building controls, and will be maintained on an annual basis. Flexibility will be maintained to regulate space temperatures as required to accommodate building occupant needs.

Your facility staff and building personnel will operate the energy management system with ongoing training and support from Honeywell. Therefore, both the District and Honeywell will maintain the standards of comfort. The comfort standards will be maintained throughout the life of the agreement through sound maintenance planning and services recommended as part of this ESP.

With regard to ventilation, Honeywell will upgrade ventilation to meet current standards in those areas where our scope of work involves upgrades to or replacement of systems providing building ventilation. We generally will not upgrade ventilation in those areas where our work doesn't involve the upgrade or replacement of systems or equipment providing ventilation to a building or facility.

Heating and Cooling Standards

Heating Temperatures	Cooling Temperatures	Unoccupied Temperatures
70-72° F	72-74° F	58-62° F

Lighting Standards

Recommended Light Levels	
Task Area	**Foot-candles**
Corridors/Stairways/Restrooms	10-20
Storage Rooms	10-50
Conference Rooms	50-55
General Offices	50-100
Drafting/Accounting	70
Areas with VDTs	75
Classrooms	50-55
Cafeterias	50
Gymnasiums	30-50

Honeywell uses a variety of in-house labor as well as subcontractors to install the energy conservation measures. We have on staff trained professionals in fire, security, energy management systems, all temperature control systems, and HVAC. However, according to the ESIP law, all trades will be publicly bid except for specific controls applications. Listed below is a sampling of some of the disciplines that would apply to the District:

Improvements	Honeywell	Subcontractor
Engineering Design/Analysis	X	
Technical Audit	X	

Improvements	Honeywell	Subcontractor
Construction Administration/Management	X	
On-Site Construction Supervision	X	
Installation of Energy Management System	X	X
Manufacturer of Energy Management Equipment	X	X
Installation of HVAC/Mechanical Equipment		X
Installation of Renewable Technology		X
Installation of Building Envelope		X
Energy Supply Management Analysis/Implementation	X	
Installation of Boilers		X
Maintenance of Energy Management Equipment	X	X
Manufacturer/Installation of Temperature Controls	X	X
Monitoring/Verification Guarantee	X	
Training of Owner Staff	X	
Financial Responsibility for Energy Guarantees	X	

Hazardous Waste Disposal or Recycling

Honeywell disposes of all PCB ballasts or mercury containing materials removed as part of the project per EPA guidelines. Honeywell will complete all of the required paperwork on behalf of the District. Honeywell will work with the Denville Board of Education to review your hazardous material reports, and will identify the areas where work will be completed so that the District can contract to have any necessary material abatement completed.

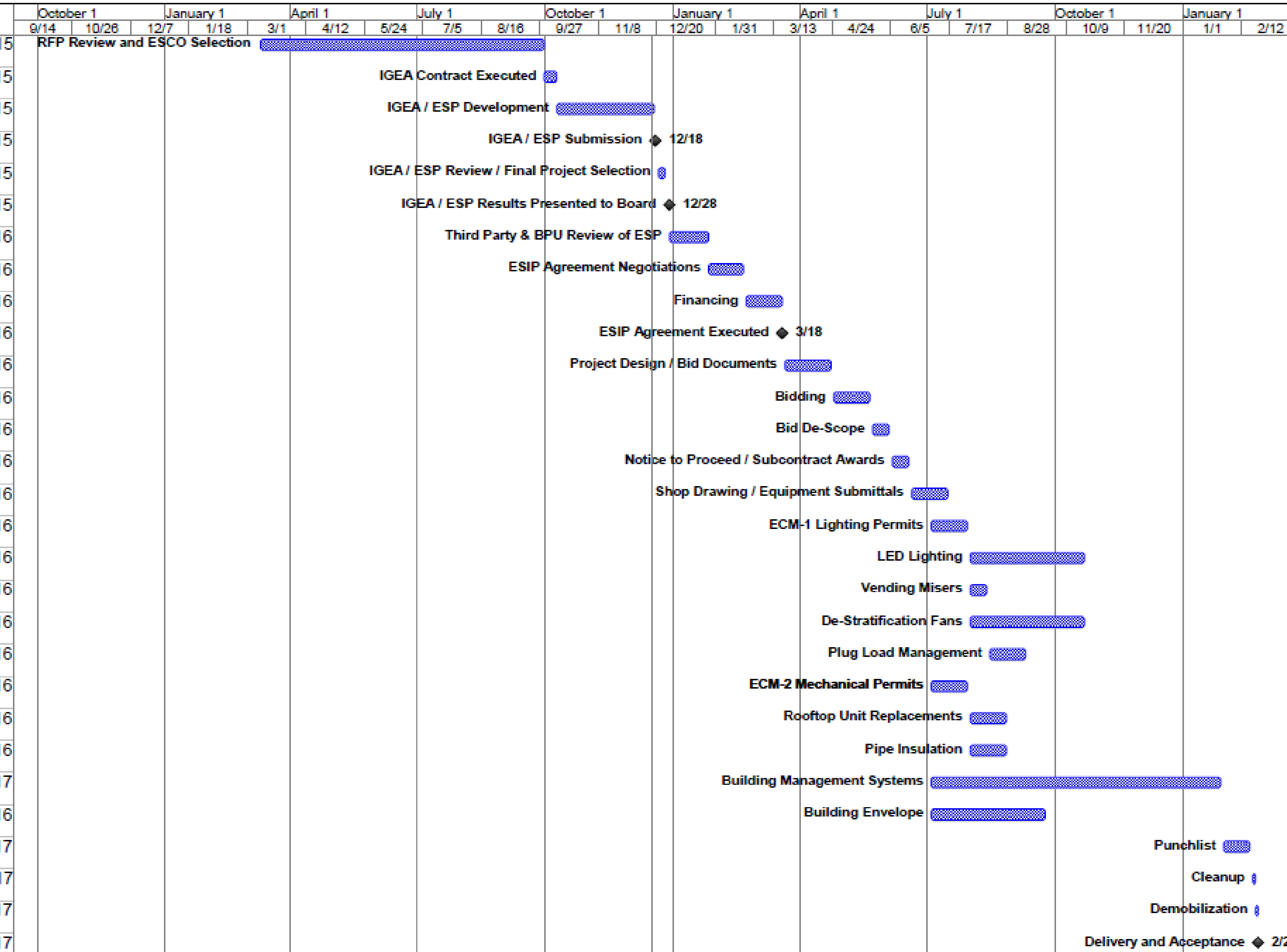
Honeywell can help schedule or coordinate waste removal, but does not contract for, or assume responsibility for, the abatement work. Honeywell also has the capabilities to assist the District in working with the EPA under compliance management issues. We also develop and manufacture automated systems to track and report a wide variety of environmental factors.

6. Implementation Schedule

Attached please find a sample schedule for construction and completion of the Project.

Denville Township Schools
Honeywell Energy Project
Energy Savings Plan Schedule

ID	Task Name	Start	Finish
1	RFP Review and ESCO Selection	Tue 3/10/15	Tue 9/29/15
2	IGEA Contract Executed	Wed 9/30/15	Thu 10/8/15
3	IGEA / ESP Development	Fri 10/9/15	Thu 12/17/15
4	IGEA / ESP Submission	Fri 12/18/15	Fri 12/18/15
5	IGEA / ESP Review / Final Project Selection	Mon 12/21/15	Fri 12/25/15
6	IGEA / ESP Results Presented to Board	Mon 12/28/15	Mon 12/28/15
7	Third Party & BPU Review of ESP	Tue 12/29/15	Mon 1/25/16
8	ESIP Agreement Negotiations	Tue 1/26/16	Fri 2/19/16
9	Financing	Mon 2/22/16	Fri 3/18/16
10	ESIP Agreement Executed	Fri 3/18/16	Fri 3/18/16
11	Project Design / Bid Documents	Mon 3/21/16	Fri 4/22/16
12	Bidding	Mon 4/25/16	Fri 5/20/16
13	Bid De-Scope	Mon 5/23/16	Fri 6/3/16
14	Notice to Proceed / Subcontract Awards	Mon 6/6/16	Fri 6/17/16
15	Shop Drawing / Equipment Submittals	Mon 6/20/16	Fri 7/15/16
16	ECM-1 Lighting Permits	Mon 7/4/16	Fri 7/29/16
17	LED Lighting	Mon 8/1/16	Fri 10/21/16
18	Vending Misers	Mon 8/1/16	Fri 8/12/16
19	De-Stratification Fans	Mon 8/1/16	Fri 10/21/16
20	Plug Load Management	Mon 8/15/16	Fri 9/9/16
21	ECM-2 Mechanical Permits	Mon 7/4/16	Fri 7/29/16
22	Rooftop Unit Replacements	Mon 8/1/16	Fri 8/26/16
23	Pipe Insulation	Mon 8/1/16	Fri 8/26/16
24	Building Management Systems	Mon 7/4/16	Fri 1/27/17
25	Building Envelope	Mon 7/4/16	Fri 9/23/16
26	Punchlist	Mon 1/30/17	Fri 2/17/17
27	Cleanup	Mon 2/20/17	Tue 2/21/17
28	Demobilization	Wed 2/22/17	Thu 2/23/17
29	Delivery and Acceptance	Thu 2/23/17	Thu 2/23/17



Project: Denville Township Schools
Date: Thu 12/17/15

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Progress
Split	External Tasks	Inactive Summary	Manual Summary	Deadline
Milestone	External Milestone	Manual Task	Start-only	
Summary	Inactive Task	Duration-only	Finish-only	

Page 1 Denville ESP Schedule

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APPENDIX 1 INDEPENDENT ENERGY AUDITS

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APPENDIX 2 ECM CALCULATIONS

ENERGY AUDIT – FINAL REPORT

LAKEVIEW ELEMENTARY SCHOOL

44 COOPER ROAD
DENVILLE, NJ 07834
ATTN: JOHN SERAPIGLIA,
BUSINESS ADMINISTRATOR

CEG PROJECT NO. 9C09080

CONCORD ENGINEERING GROUP

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rjohnson@ceg-inc.net

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REPORT DISCLAIMER

I. EXECUTIVE SUMMARY

This report presents the findings of the energy audit conducted for:

Denville Board of Education
Lakeview Elementary School
44 Cooper Road
Denville, NJ 07834

Municipal Contact Person: John Serapiglia
Facility Contact Person:

This audit is performed in connection with the New Jersey Clean Energy - Local Government Energy Audit Program. The energy audit is conducted to promote the mission of the office of Clean Energy, which is to use innovation and technology to solve energy and environmental problems in a way that improves the State's economy. This can be achieved through the wiser and more efficient use of energy.

The annual energy costs at this facility are as follows:

Electricity	$ 117,997
Natural Gas	$ 101,756
Total	$ 219,753

The potential annual energy cost savings for each energy conservation measure (ECM) are shown below in Table 1. Be aware that the ECM's are not additive because of the interrelation of some of the measures. This audit is consistent with an ASHRAE level 2 audit. The cost and savings for each measure is ± 20%. The evaluations are based on engineering estimations and industry standard calculation methods. More detailed analyses would require engineering simulation models, hard equipment specifications, and contractor bid pricing.

Table 1
Energy Conservation Measures (ECM's)

ECM NO.	DESCRIPTION	COST[A]	ANNUAL SAVINGS[B]	SIMPLE PAYBACK (YEARS)	SIMPLE ROI
1	Lighting Upgrade – General	$52,236	$5,436	9.6	10.4%
2	Lighting Controls	$6,490	$3,003	2.2	46.3%
3	HVAC System Controls	$328,028	$10,889	30.1	3.3%
4	Boiler Replacement	$69,326	$9,686	7.2	14.0%
5	Solar PV – Direct Purchase	$2,156,940	$192,236	11.2	8.9%

Notes: A. Cost takes into consideration applicable NJ Smart Start™ incentives and maintenance savings.
B. Savings takes into consideration applicable maintenance savings.

The estimated demand and energy savings for each ECM is shown below in Table 2. The information in this table corresponds to the ECM's in Table 1.

Table 2
Estimated Energy Savings

ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELEC. DEMAND (KW)	ELEC. CONSUMPTION (KWH)	NAT GAS (THERMS)
1	Lighting Upgrade – General	16.6	31,523	-
2	Lighting Controls	-	18,311	-
3	HVAC System Controls	-	5,552	5,939
4	Boiler Replacement	-	-	5,766
5	Solar PV – Direct Purchase	239.7	374,000	-

*Elec. Demand Savings are calculated for cooling season only. Elec. consumption savings are totaled annually.

Concord Engineering Group (CEG) recommends proceeding with the implementation of all ECM's that provide a calculated simple payback at or under ten (10) years. The following Energy Conservation Measures are recommended for the municipal building:

- **ECM #1:** Lighting Upgrade
- **ECM #2:** Lighting Controls
- **ECM #4:** Boiler Replacement

In addition to the ECMs, there are maintenance and operational measures that can provide significant energy savings and provide immediate benefit. The ECMs listed above represent investments that can be made to the facility which are justified by the savings seen overtime. However, the maintenance items and small operational improvements below are typically achievable with on site staff or maintenance contractors and in turn have the potential to provide substantial operational savings compared to the costs associated. The following are recommendations which should be considered a priority in achieving an energy efficient building:

1. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%. Condenser coils at

window level such as window air conditioners are particularly susceptible to dust and dirt created from landscaping and people activity.
2. Maintain all weather stripping on entrance doors. The majority of the entrance doors in the facility have significant leakage area around the doors which increases infiltration into the building.
3. Clean all light fixtures to maximize light output. Cleaned light fixtures providing full light output, may prevent added task lighting from being turned on and left on.
4. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.
5. Set hot water re-circ pump temperature set-point below the domestic hot water supply temperature setting. This will avoid continuous operation of the hot water re-circ pump while still providing the benefit of on demand hot water to the remote fixtures in the facility. Provide a time clock in addition to hot water re-circ aqua stat to stop hot water circulation during unoccupied periods. Keeping the hot water piping hot 24/7 is unnecessary when fixtures will not be used and adds energy consumption in the cooling season due to added cooling load in the building.
6. Set all computers and computer monitors to run in power saving (standby or sleep) mode when not in use. Added heat output from computers compounds the work that air conditioners have to do to remove the heat.
7. Repair leaking faucets in janitorial closets, bathrooms, and maintenance rooms. Although this is not associated with direct energy savings, dripping faucets will corrode and cause calcification on plumbing fixtures resulting in pre-mature replacement.
8. A concern for the facility is the high energy usage per square foot. This building is the least energy efficient of the three buildings. A major contributor could be the ceiling plenum ventilation system. Investigate and confirm that all ceiling plenum ventilation hoods are operating correctly and most importantly, opening only when needed in the heating season could result in significant heating savings.

Overall the energy use for this facility is higher than both Valleyview MS and Riverview ES per square foot. One contributor for increased energy use is the AC systems throughout the building. Even thought the original building was designed without a cooling system, the additions have included central air conditioning for the majority of the office space, and common areas throughout the building such as the library, computer room, etc. The building’s higher percentage of cooled areas, accounts for a large portion of the additional energy usage.

The other major contributor for increased energy use is the large envelope exposed area and entrance / exits throughout the building. Lakeview elementary school’s heat consumption is 75% greater than Valleyview’s heat consumption with the similar if not more efficient heating system. Valleyview middle school’s construction is multi story and with approximately half as many entrance doors as compared to Lakeview. The large perimeter, single story construction with multiple entrances at Lakeview has more roof and wall area exposed to ambient conditions, as well as higher potential for infiltration all resulting in more energy use per square foot of floor space.

II. INTRODUCTION

The comprehensive energy audit covers the 82,007 square foot Lakeview Elementary School that includes classrooms, faculty rooms, a gymnasium, cafeteria, science lab, woodshop, and administrative offices.

Electrical and natural gas utility information is collected and analyzed for one full year's energy use of the building. The utility information allows for analysis of the building's operational characteristics; calculate energy benchmarks for comparison to industry averages, estimated savings potential, and baseline usage/cost to monitor the effectiveness of implemented measures. A computer spreadsheet is used to calculate benchmarks and to graph utility information (see utility profiles below).

The Energy Use Index (EUI) is established for the building. Energy Use Index (EUI) is expressed in British Thermal Units/square foot/year (BTU/ft^2/yr), which is used to compare energy consumption to similar building types or to track consumption from year to year in the same building. The EUI is calculated by converting the annual consumption of all energy sources to BTU's and dividing by the area (gross square footage) of the building. Blueprints (where available) are utilized to verify the gross area of the facility. The EUI is a good indicator of the relative potential for energy savings. A low EUI indicates less potential for energy savings, while a high EUI indicates poor building performance therefore a high potential for energy savings.

Existing building architectural and engineering drawings (where available) are utilized for additional background information. The building envelope, lighting systems, HVAC equipment, and controls information gathered from building drawings allow for a more accurate and detailed review of the building. The information is compared to the energy usage profiles developed from utility data. Through the review of the architectural and engineering drawings a building profile can be defined that documents building age, type, usage, major energy consuming equipment or systems, etc.

The preliminary audit information is gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is spent and opportunities exist within a facility. The entire site is surveyed to inventory the following to gain an understanding of how each facility operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Facility-specific equipment

The building site visit is performed to survey all major building components and systems. The site visit includes detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs

provided by the building manager are collected along with the system and components to determine a more accurate impact on energy consumption.

III. METHOD OF ANALYSIS

Post site visit work includes evaluation of the information gathered, researching possible conservation opportunities, organizing the audit into a comprehensive report, and making recommendations on HVAC, lighting and building envelope improvements. Data collected is processed using energy engineering calculations to anticipate energy usage for each of the proposed energy conservation measures (ECMs). The actual building's energy usage is entered directly from the utility bills provided by the owner. The anticipated energy usage is compared to the historical data to determine energy savings for the proposed ECMs.

> It is pertinent to note, that the savings noted in this report are not additive. The savings for each recommendation is calculated as standalone energy conservation measures. Implementation of more than one ECM may in some cases affect the savings of each ECM. The savings may in some cases be relatively higher if an individual ECM is implemented in lieu of multiple recommended ECMs. For example implementing reduced operating schedules for inefficient lighting will result in a greater relative savings. Implementing reduced operating schedules for newly installed efficient lighting will result in a lower relative savings, because there is less energy to be saved. If multiple ECM's are recommended to be implemented, the combined savings is calculated and identified appropriately.

ECMs are determined by identifying the building's unique properties and deciphering the most beneficial energy saving measures available that meet the specific needs of the facility. The building construction type, function, operational schedule, existing conditions, and foreseen future plans are critical in the evaluation and final recommendations. Energy savings are calculated base on industry standard methods and engineering estimations. Energy consumption is calculated based on manufacturer's cataloged information when new equipment is proposed.

Cost savings are calculated based on the actual historical energy costs for the facility. Installation costs include labor and equipment to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers. The NJ SmartStart Building® program incentives savings (where applicable) are included for the appropriate ECM's and subtracted from the installed cost. Maintenance savings are calculated where applicable and added to the energy savings for each ECM. The costs and savings are applied and a simple payback and simple return on investment (ROI) is calculated. The simple payback is based on the years that it takes for the savings to pay back the net installation cost (Net Installation divided by Net Savings.) A simple return on investment is calculated as the percentage of the net installation cost that is saved in one year (Net Savings divided by Net Installation.)

A simple life-time calculation is shown for each ECM. The life-time for each ECM is estimated based on the typical life of the equipment being replaced or altered. The energy savings is extrapolated throughout the life-time of the ECM. The total energy savings is calculated as the total life-time multiplied by the yearly savings.

IV. HISTORIC ENERGY CONSUMPTION/COST

A. Energy Usage / Tariffs

The electric usage profile (below) represents the actual electrical usage for the facility. Jersey Central Power and Light (JCP&L) provides electricity to the facility under their General Service Secondary Three-Phase rate structure. The electric utility measures consumption in kilowatt-hours (KWH) and maximum demand in kilowatts (KW). One KWH usage is equivalent to 1000 watts running for one hour. One KW of electric demand is equivalent to 1000 watts running at any given time. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges. Rates used in this report reflect the historical data received for the facility.

The gas usage profile shows the actual natural gas energy usage for the facility. New Jersey Natural Gas (NJN) provides natural gas to the facility along with a third party provider Pepco Energy Services. NJN provides natural gas under the General Supply Large (GSL) rate structure. The gas utility measures consumption in cubic feet x 100 (CCF), and converts the quantity into Therms of energy. One Therm is equivalent to 100,000 BTUs of energy.

The overall cost for utilities is calculated by dividing the total cost by the total usage. Based on the utility history provide, the average cost for utilities at this facility is as follows:

Description	Average
Electricity	16.4¢ / kWh
Natural Gas	$1.68 / Therm

Table 3
Electricity Billing Data

Utility Provider: JCP&L, General Service Secondary 3 Phase (Meter # G16649701)			
MONTH OF USE	**CONSUMPTION KWH**	**DEMAND**	**TOTAL BILL**
Jun-08	55,200	185.8	$10,050
Jul-08	47,840	130.1	$8,563
Aug-08	47,520	133.8	$8,537
Sep-08	62,880	202.6	$9,884
Oct-08	62,880	199.8	$9,859
Nov-08	62,240	186.1	$9,720
Dec-08	60,960	161.3	$9,779
Jan-09	89,920	200.0	$14,349
Feb-09	69,760	180.2	$11,279
Mar-09	36,640	202.6	$6,490
Apr-09	61,920	188.3	$9,650
May-09	62,720	186.1	$9,837
Totals	**720,480**	**202.6 Max**	**$117,997**
AVERAGE DEMAND 179.7 KW average			
AVERAGE RATE $0.164 $/kWh			

Figure 1
Electricity Usage Profile

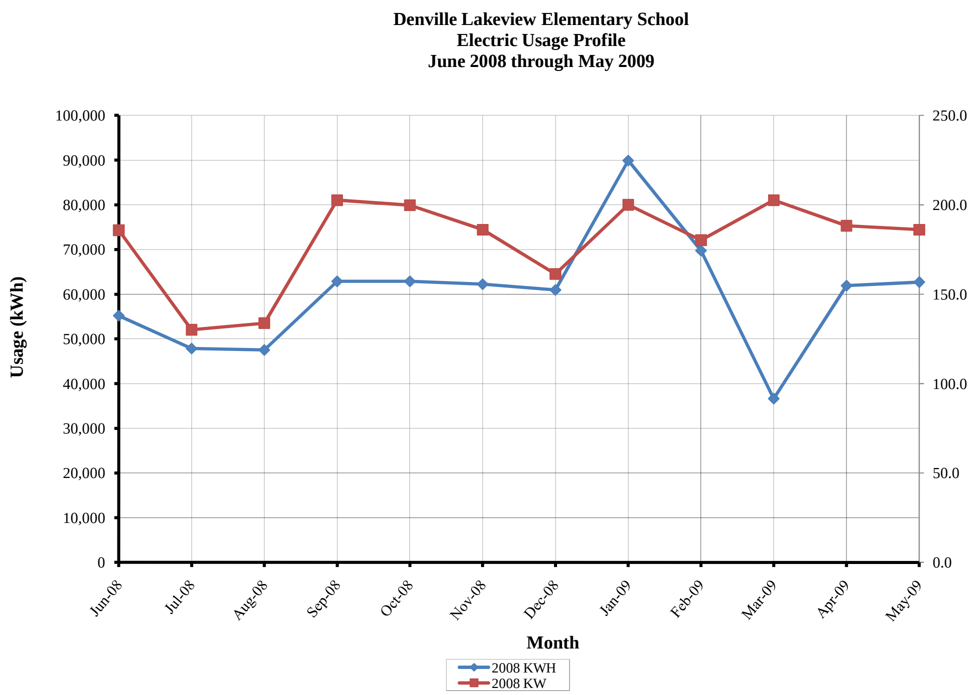
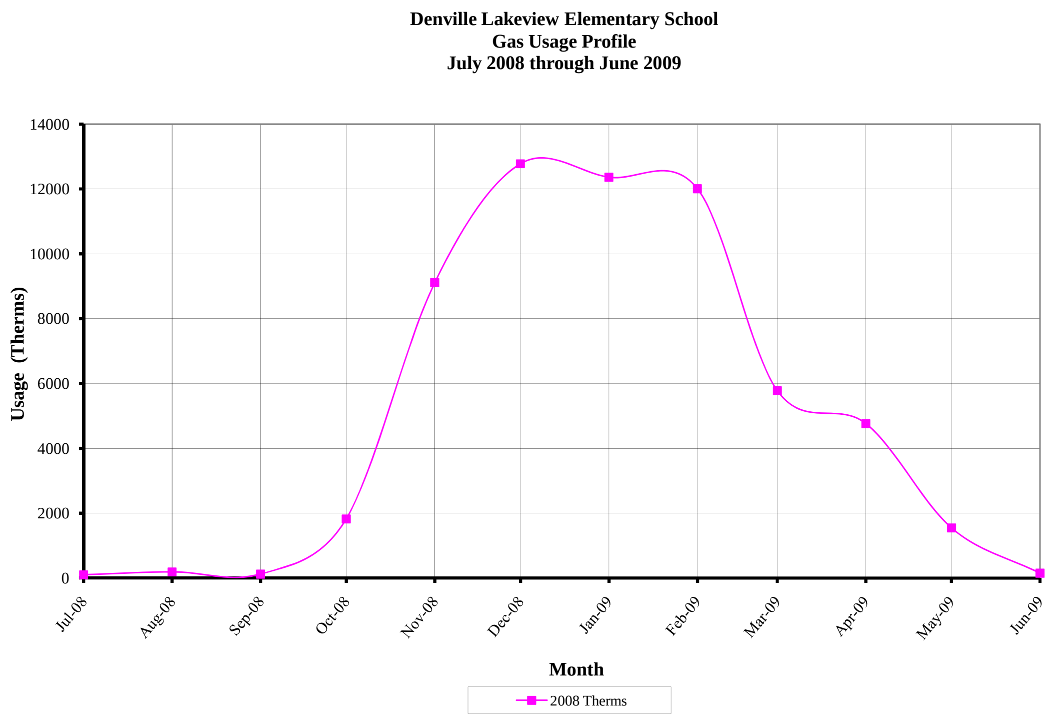


Table 4
Natural Gas Billing Data

Utility Provider: NJN, Rate - GSL, (Meter # 00546216)		
MONTH OF USE	**CONSUMPTION (THERMS)**	**TOTAL BILL**
Jul-08	99.35	$1,260
Aug-08	188.43	$1,447
Sep-08	121.74	$1,265
Oct-08	1,820.86	$3,372
Nov-08	9,114.96	$14,484
Dec-08	12,778.68	$20,154
Jan-09	12,363.79	$19,542
Feb-09	12,009.62	$18,938
Mar-09	5,777.45	$9,199
Apr-09	4,763.16	$7,893
May-09	1,545.61	$3,346
Jun-09	146.53	$858
TOTALS	**60730.18**	**$101,756**
AVERAGE RATE:	**$1.68**	**$/THERM**

Figure 2
Natural Gas Usage Profile



B. Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (BTU) and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.

The site and source EUI for this facility is calculated as follows:

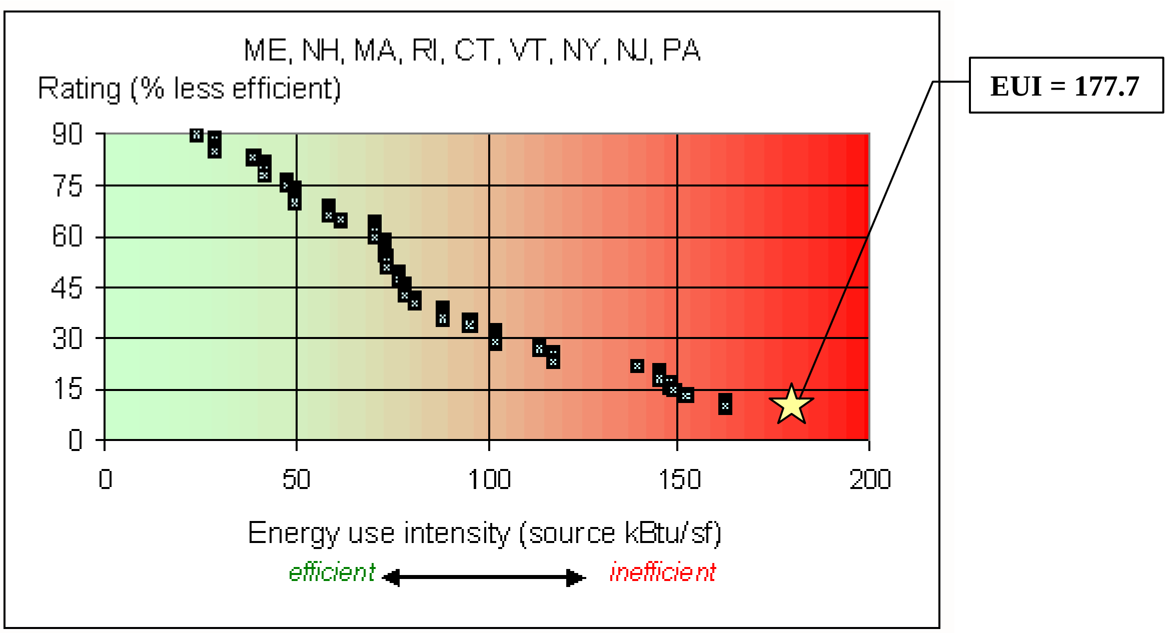
$$Building\ Site\ EUI = \frac{(Electric\ Usage\ in\ kBtu + Gas\ Usage\ in\ kBtu)}{Building\ Square\ Footage}$$

$$Building\ Source\ EUI = \frac{(Electric\ Usage\ in\ kBtu\ X\ SS\ Ratio + Gas\ Usage\ in\ kBtu\ X\ SS\ Ratio)}{Building\ Square\ Footage}$$

Table 5
Denville Lakeview Elementary School EUI Calculations

ENERGY TYPE	BUILDING USE			SITE ENERGY	SITE-SOURCE	SOURCE ENERGY
	kWh	Therms	Gallons	kBtu	RATIO	kBtu
ELECTRIC	720,480			2,459,719	3.340	8,215,461
NATURAL GAS		60,730.18		6,073,018	1.047	6,358,450
FUEL OIL			0.00	0	1.010	0
PROPANE			0.00	0	1.010	0
TOTAL				8,532,737		14,573,910
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
BUILDING AREA		82,007		SQUARE FEET		
BUILDING SITE EUI		104.05		kBtu/SF/YR		
BUILDING SOURCE EUI		**177.72**		**kBtu/SF/YR**		

Figure 3
Source Energy Use Intensity Distributions: Schools



C. EPA Energy Benchmarking System

The United States Environmental Protection Agency (EPA) in an effort to promote energy management has created a system for benchmarking energy use amongst various end users. The benchmarking tool utilized for this analysis is entitled Portfolio Manager. The Portfolio Manager tool allows tracking and assessment of energy consumption via the template forms located on the ENERGY STAR website (www.energystar.gov). The importance of benchmarking for local government municipalities is becoming more important as utility costs continue to increase and emphasis is being placed on carbon reduction, greenhouse gas emissions and other environmental impacts.

Based on information gathered from the ENERGY STAR website, Government agencies spend more than $10 billion a year on energy to provide public services and meet constituent needs. Furthermore, energy use in commercial buildings and industrial facilities is responsible for more than 50 percent of U.S. carbon dioxide emissions. It is vital that local government municipalities assess facility energy usage, benchmark energy usage utilizing Portfolio Manager, set priorities and goals to lessen energy usage and move forward with priorities and goals.

In accordance with the Local Government Energy Audit Program, CEG has created an ENERGY STAR account for the municipality to access and monitoring the facility's yearly energy usage as it compares to facilities of similar type. The following is the user name and password for this account:

https://www.energystar.gov/istar/pmpam/index.cfm?fuseaction=login.login

User Name: denvilleboe
Password: lgeaceg2009

Security Question: What is your birth city?
Security Answer: "Denville"

The utility bills and other information gathered during the energy audit process is entered into the Portfolio Manager. The following is a summary of the results for the facility:

Table 6
ENERGY STAR Performance Rating

FACILITY DESCRIPTION	ENERGY PERFORMANCE RATING	NATIONAL AVERAGE
Denville Lakeview ES	19	50

See the Statement of Energy Performance appendix for the detailed energy summary.

V. FACILITY DESCRIPTION

The 82,007 SF elementary School is a single story facility comprised of classrooms, offices, cafeteria, all purpose room, kitchen, gymnasium, library, and other support spaces. The original building was built in 1964. B-wing was added to the building in 1966, which includes additional classrooms, and outdoor courtyard space. C-Wing was added to the building in 2001 which includes additional classrooms, new gymnasium, library/media center, and computer room. The typical school hours are between 8:15 am and 3:30 pm. The building construction is CMU block with face brick. The exterior walls have minimal insulation typical of the time period. It is unknown if the CMU blocks are filled. The windows throughout the facility are in good condition and appear to be maintained. The window type throughout the facility is double pane, clear glass with aluminum frames. Blinds are internal to the window construction and are utilized through the facility per occupant comfort. The blinds are valuable because they help to reduce solar heat gain in the summer. The roof is a flat rubber roofing system. Roof insulation is above the metal deck. The amount of insulation below the roof membrane is unknown. Most doorways into the school are double doors with weather stripping either missing or in poor condition. The entrances / exits throughout the building are extensive due to the additions. The entrance to the main office and front hallway along with all other entrances except for one do not have vestibules.

HVAC Heating System

The original building is heated by two H.B. Smith industrial hot water boilers. The boilers have been converted to gas. The boilers were built in 1963. The boilers require additional maintenance due to its age. The heating water loop for the original building is circulated with two 5.0 HP and one 1½ HP base mounted pumps with redundancy. The pumps are manually turned on in the heating season. The C-wing addition includes two Smith Cast Iron boilers installed at the time of the C-wing addition which are 8 yrs old. The boiler water in the addition are circulated by two ¾ HP primary inline boiler pumps and two 7.5 HP secondary base mounted pumps. (operating and standby.) The heating water is circulated throughout the building to baseboards, unit ventilators, air handling units with hot water coils. The unit ventilators are operated manually and the blower typically runs 24/7. The heating equipment is controlled by a pneumatic system in the original building and electronic controls for the C-wing addition. The baseboards and hot water coil water flow is regulated by pneumatic driven actuators. Some components in the pneumatic system do not respond and leak. Space temperatures are over / under heating in some areas in the heating season. Some control valves are corroded and in poor condition. The electronic controls are in good condition.

HVAC Cooling System

The building does not have a central cooling plant, however many spaces have dedicated packaged rooftop equipment. A few spaces are air conditioned by either window air conditioners or split systems. The majority of offices as well as the library, computer room, front office, and faculty rooms are conditioned with packaged rooftop units. Window air conditioners are installed for classrooms and support spaces, as needed. The window AC unit are of various size, age, and capacity, however the range of efficiencies for the window AC units is 8.6 – 11.0 energy efficiency ratio (EER). Approximately 70%-90% of the school has some form of air conditioning.

The original building was not designed with a cooling system and include general ventilation for the above ceiling space of wings A and B. Smaller more modern exhaust fans are in place for C-wing. The intent of the ventilation system is to provide hot air relief through stack effect or mechanical exhaust of the ceiling plenum. Common practice would include back draft dampers or motor operated dampers which would close the relief hoods and turn off the exhaust fans in unoccupied periods and in the heating season. The hoods / exhaust fans in A and B wing appear old and in poor condition.

Exhaust System

Air is exhausted from the toilet rooms through the roof exhausters. The toilet room exhaust fans are operated manually by maintenance personnel and typically run 24/7. Some roof exhaust fans do not appear to be operational, however in repairable condition.

Domestic Hot Water

Domestic hot water for lavatories, office lounge, locker room showers, and kitchen facilities is provided by two hot water heaters. Both the original building and C-wing addition hot water heaters are gas fired and independent of the boiler systems to avoid use of the boilers in the non heating season. The original building domestic hot water system is made up of a 69 gallon A.O. Smith hot water heater and the C-wing addition domestic hot water system is made up of a 140 gallon A.O. Smith hot water heater. The domestic hot water is circulated throughout the building by hot water re-circ pumps. The original building circulation pump has no controls and runs 24/7. The C-wing addition hot water re-circ pump is controlled by an aqua stat. The domestic hot water piping insulation appeared to be in good condition.

Lighting

Typical lighting throughout the original building is fluorescent tube lay-in fixtures with T-12 lamps and magnetic ballasts. The C-wing addition lighting consists of modern T-8 lay-in fixtures with electronic ballasts. Storage rooms and closets lit with a mixture of incandescent lamps and compact fluorescent lamps. The parking lot is lit with light poles and high pressure sodium lamps. The gym is lit with high ceiling high pressure sodium fixtures. All interior lighting is manually controlled by the building occupants by wall switches.

VI. MAJOR EQUIPMENT LIST

The equipment list is considered major energy consuming equipment and through replacement could yield substantial energy savings. The list shows the major equipment in the facility and all pertinent information utilized in energy savings calculations. An approximate age was assigned to the equipment if a manufactures date was not shown on the equipment's nameplate. The ASHRAE service life for the equipment along with the remaining useful life is also shown in the Appendix.

Refer to the Major Equipment List Appendix for this facility.

VII. ENERGY CONSERVATION MEASURES

ECM #1: Lighting Upgrade – General

Description:

The lighting in original building (A-wing and B-wing) of Lakeview elementary school is primarily made up of fluorescent fixtures with T-12 lamps and magnetic ballasts. There are a few storage rooms and closets with incandescent lighting and compact fluorescent fixtures.

This ECM includes replacement of the existing fixtures containing T12 lamps and magnetic ballasts with fixtures containing T8 lamps and electronic ballasts. The new energy efficient, T8 fixtures will provide adequate lighting and will save the owner on electrical costs due to the better performance of the lamp and ballasts. This ECM will also provide maintenance savings through the reduced number of lamps replaced per year. The expected lamp life of a T8 lamp is approximately 30,000 burn-hours, in comparison to the existing T12 lamps which is approximately 20,000 burn-hours. The facility will need 33% less lamps replaced per year.

This ECM also includes replacement of all incandescent fixtures to compact fluorescent fixtures. The energy usage of an incandescent compared to a compact fluorescent approximately 3 to 4 times greater. In addition to the energy savings, compact fluorescent fixtures burn-hours are 8 to 15 times longer than incandescent fixtures ranging from 6,000 to 15,000 burn-hours compared to incandescent fixtures ranging from 750 to 1000 burn-hours.

Hours of Operation:

Classrooms, Hallways, Gym, Offices, Library, etc:
8 Hrs per day, 5 days per week, 47 weeks per year – 1880 Hrs per year.

Storage rooms, Boiler room:
24% of normal hours (above) – 470 Hrs per year.

Hallways:
10 Hrs per day, 5 days per week, 47 weeks per year – 2350 Hrs per year.

Outdoor Lighting:
10 Hrs per day, 7 days per week, 52 weeks per year – 3640 Hrs per year.

Energy Savings Calculations:

The Investment Grade Lighting Audit appendix outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start® Program Incentives are calculated as follows:

From the Smart Start Incentive appendix, the replacement of a T-12 fixture to a T-5 or T-8 fixture warrants the following incentive: T-5 or T-8 (1-2 lamp) = $25 per fixture; T-5 or T-8 (3-4 lamp) = $30 per fixture.

$$\text{Smart Start® } Incentive = (\#\ of\ 1-2\ lamp\ \ fixtures \times\ \$10) + (\#\ of\ 3-4\ lamp\ \ fixtures \times\ \$20)$$

$$\text{Smart Start® } Incentive = (567 \times\ \$10) + (11 \times\ \$20) = \underline{\$5,890}$$

Replacement and Maintenance Savings are calculated as follows:

$$Savings = (reduction\ in\ lamps\ replaced\ \ per\ \ year) \times (repacment\ \$\ per\ lamp + Labor\ \$\ per\ lamp)$$

$$Savings = (38\ lamps\ \ per\ \ year) \times (\$2.00 + \$5.00) = \underline{\$266}$$

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$58,126
NJ Smart Start Equipment Incentive ($):	($5,890)
Net Installation Cost ($):	$52,236
Maintenance Savings ($ / yr):	*$266*
Energy Savings ($ / yr):	*$5170*
Net Savings ($ / yr):	*$5,436*
Simple Payback (yrs):	*9.6*
Simple Return On Investment	*10.4%*
Estimated ECM Lifetime (Yr)	*25*
Simple Lifetime Savings ($)	*$135,900*

* ECM#1 Calculations DO NOT include lighting control changes implemented in ECM#2. If ECM#1 and #2 are implemented together the savings will be relatively lower than shown above.

ECM #2: Lighting Controls

Description:

In some areas the lighting is left on unnecessarily. In many cases the lights are left on because of the inconvenience to manually switch lights off when a room is left or on when a room is first occupied. This is common in storage rooms that are occupied for only short periods and only a few times per day. In some instances lights are left on due to the misconception that it is better to keep the lights on rather than to continuously switch lights on and off. Although increased switching reduces lamp life, the energy savings outweigh the lamp replacement costs. The payback timeframe for when to turn the lights off is approximately two minutes. If the lights are off for at least a two minute interval, then it pays to shut them off.

Lighting controls come in many forms. Sometimes an additional switch is adequate to provide reduced lighting levels when full light output is not needed. Occupancy sensors detect motion and will switch the lights on when the room is occupied. Occupancy sensors can either be mounted in place of a current wall switch, or on the ceiling to cover large areas. Photocell control senses light levels and turn off or reduce lights when there is adequate daylight. Photocells are mostly used outside, but are becoming more popular in energy-efficient interior lighting designs as well.

ASHRAE Standard 90.1-2004, Appendix G is a reference standard for modeling building efficiency. The standard estimates that lighting controls provide a 10% reduction in lighting power usage for daytime occupancies in buildings over 5,000 SF, and 15% reduction in buildings under 5,000 SF. This ECM includes dual technology occupancy sensors in the courthouse, each office, open office, conference room, restrooms, lunch room, storage rooms, and file room, as well as a photocell daylight sensor controlling the 1st floor rotunda lighting.

The ECM includes replacement of standard wall switches with sensors wall switches for individual classrooms and offices. Sensors shall be manufactured by Sensorswitch, Watt Stopper or equivalent. See the “Investment Grade Lighting Audit” appendix for details.

The “Investment Grade Lighting Audit” appendix of this report includes the summary of lighting controls implemented in this ECM and outlines the proposed controls, costs, savings, and payback periods. The calculations adjust the lighting power usage by 10% for all areas that include occupancy sensor lighting controls.

Light Energy = 183,105 kWh/Yr. occupancy sensor controlled lighting

Energy Savings Calculations:

$$Energy\ Savings = 10\% \times Occuapancy\ Sensored\ Light\ Energy\ (kWh/Yr)$$

$$Energy\ Savings = 10\% \times 183{,}105\ (kWh) = 18{,}311\ (kWh)$$

$$Savings. = Energy\ Savings\ (kWh) \times Ave\ Elec\ Cost\left(\frac{\$}{kWh}\right)$$

$$Savings. = 18{,}311\,(kWh) \times 0.164\left(\frac{\$}{kWh}\right) = \$3{,}003$$

Installation cost per dual-technology sensor (Basis: Sensor switch or equivalent) is $75/unit including material and labor.

Installation Cost = $75 x 118 motion sensors = $8,850

From the NJ Smart Start appendix, the installation of a lighting control device warrants the following incentive: occupancy = $20 per fixture, daylight = $25 per fixture.

$$\text{Smart Start® } Incentive = (\#\ of\ \ wall\ mount\ devices \times \ \$\ 20) = (118 \times \$20) = \$2360$$

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY*	
Installation Cost ($):	$8,850
NJ Smart Start Equipment Incentive ($):	($2,360)
Net Installation Cost ($):	*$6,490*
Maintenance Savings ($ / yr):	*$0*
Energy Savings ($ / yr):	*$3,003*
Total Energy Savings ($ / yr):	*$3,003*
Simple Payback (yrs):	*2.2*
Simple Return On Investment (%)	*46.3%*
Estimated ECM Lifetime (Yr)	*15*
Simple Lifetime Savings ($)	*$45,045*

* ECM#2 Calculations DO NOT include lighting changes implemented in ECM#1. If ECM#1 and #2 are implemented together the savings will be relatively lower than shown above.

ECM #3: HVAC System Controls

Description:

The existing control system in the original building is an outdated pneumatic control system. The zone thermostats are manually set pneumatic actuators controlling local control valves within the space. The system is original to the building's heating system installed in 1964. The space thermostats are inaccurate due to temperature drift over time, leakage, or frozen actuators. The C-wing addition have modern electronic controls, however the system does not have a central system with logic or programming. The thermostats do not have programmability such as night set back, or morning warm-up features. Modern thermostats and control systems have the capability of saving siginificant energy as well as improve occupant comfort.

This ECM includes installing a Building Automation system through Direct Digital Controls (DDC) wired through an Ethernet backbone and front end controller. The system will include new thermostat controllers for terminal unit ventilators, baseboard zones, and air handling units, wired back to a front end controller with computer interface. The front end device will provide communication between the devices and the main boilers. The system will respond to the overall building's needs and operating schedules as defined by the building operator. The DDC system will provide features such as space averaging, temperature override control, night set-back, morning warm-up mode, heating water loop temperature re-set, etc.

The U.S. Department of Energy sponsored a study to analyze energy savings achieved through various types of building system controls. The referenced savings is based on the "Advanced Sensors and Controls for Building Applications: Market Assessment and Potential R&D Pathways," document posted for public use April 2005. The study has found that commercial buildings have the potential to achieve significant energy savings through the use of building controls. The average energy savings are as follows based on the report:

- Energy Management and Control System Savings - 5%-15%.
- Commissioning - 5%-15%.
- Automatic Fault Detection and Diagnostics - 5%-15%.
- Occupancy Sensors for Lighting Control - 20%-28%.
- Photosensor-Based Lighting Control -20%-60%.
- Demand Controlled Ventilation (DCV) -10%-15%.

Energy savings achieved for "Energy Management and Control Systems," average 5%-15%. Savings resulting from the implementation of this ECM for energy management controls are estimated to be 10% of the total energy cost for the facility.

The cost of a full DDC system with new field devices, controllers, computer, software, programming, etc. is approximately $4.00 per SF. Savings from the implementation of this ECM will be primarily achieved through natural gas savings from reduced heating energy. A small portion of savings will result from the cooling system management for the central AC systems in C-wing.

Cost of complete DDC System = ($4.00/SF x 82,007 SF) = $328,028.

Total Gas usage	= 60,730 Therms
Estimated non-Heat gas usage (kitchen & HW)	= 134 Therms*
(*Averaged from June & September gas usage)	
Average Cost of Gas	= $1.68/Therm
Total Cooling Capacity	= 53.5 tons
Ave Cooling Efficiency	= 9.25 EER
Cooling Season Full Load Cooling Hrs.	= 800 hrs/yr.
Average Cost of Electricity	= $0.164/kWh

Energy Savings Calculations:

Heating Savings Calculations

$$Heating\ Gas\ Input = Total\ Cons.\ (Therms) - \left(Est.\ HW\ /\ Kitchen\ Use\left(\frac{Therms}{Month}\right) \times Use\left(\frac{Months}{Yr}\right)\right)$$

$$Heating\ Gas\ Input = 60{,}730\ (Therms) - \left(134\left(\frac{Therms}{Month}\right) \times 10\left(\frac{Months}{Yr}\right)\right) = 59{,}390 (Therms)$$

$$Savings. = Heating\ Gas\ Input (Therms) \times 10\%\ Savings \times Ave\ Gas\ Cost\left(\frac{\$}{Therm}\right)$$

$$Savings. = 59{,}390\ (Therms) \times 10\% \times 1.68\left(\frac{\$}{Therm}\right) = \$9{,}978$$

Cooling Savings Calculations

$$Est\ Cool\ Cons. = \frac{Cool\ Load\ (Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times Full\ Load\ Cooling\ Hrs.}{Ave\ Energy\ Efficiency\ Ratio\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)}$$

$$Est\ Cool\ Cons. = \frac{53.5\ (Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times 800\ Hrs.}{9.25\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)} = 55{,}524\ (kWh)$$

$$Savings. = Cool\ Cons. (kWh) \times 10\%\ Savings \times Ave\ Elec\ Cost\left(\frac{\$}{kWh}\right)$$

$$Savings. = 55{,}524\,(kWh) \times 10\% \times 0.164 \left(\frac{\$}{kWh}\right) = \$911$$

$$Total\ ECM\ Savings = \$9{,}978 + \$911 = \$10{,}889$$

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY*	
Installation Cost ($):	$328,028
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$328,028
Maintenance Savings ($ / yr):	*$0*
Energy Savings ($ / yr):	*$10,889*
Total Energy Savings ($ / yr):	*$10,889*
Simple Payback (yrs):	*30.1*
Simple Return On Investment (%)	*3.3%*
Estimated ECM Lifetime (Yr)	*15*
Simple Lifetime Savings ($)	*$163,335*

ECM #4: Boiler Replacement

Description:

Lakeview elementary school is heated by two H.B. Smith industrial Gas-fired, sectional boilers. The boilers are original to the building, 43 years old. The C-wing addition is heated by two new Smith Cast Iron hot water boilers built with the addition in 2001, 8 years old. The original boiler efficiency is approximately 78% when producing hot water.

This ECM includes replacing the two original building gas fired hot water boilers with high efficiency boilers. The ECM does not include replacement of the C-wing addition boilers. The basis of this ECM is two (2) Weil – McLain sectional hot water boilers or equivalent with an efficiency of 85.6%.

Existing Heating Hot Water Boiler:

Combustion Efficiency = 78%
Radiation Losses = 5%
Thermal Efficiency = 73%

Replacement Boiler:

High-Efficiency Boiler

Rated Capacity = 2,887 MBh (Each)

Combustion Efficiency = 85.6%
Radiation Losses = 0.5%
Thermal Efficiency = 85.1%

Operating Data:

Original building approximate SF = 54,671 SF
Average Cost of Natural Gas = $1.68/Therm

Energy Savings Calculations:

$$Heat\ Load = \frac{Heat\ Loss\left(\dfrac{Btu}{Hr\ SF}\right) \times Area\ (SF)}{1000\left(\dfrac{Btu}{kBtu}\right)}$$

$$Heat\ Load = \frac{50\left(\frac{Btu}{Hr\ SF}\right)\times 54{,}671\,(SF)}{1000\left(\frac{Btu}{kBtu}\right)} = 2{,}734.57\left(\frac{kBtu}{Hr}\right)$$

$$EnergySavings. = \frac{Heat\ Load\ \left(\frac{kBtu}{Hr}\right)\times Heat\ Deg\ Days\times 24\ Hrs\times Correction\ Factor}{Design\ Temp\ Difference(°F)\times Fuel\ Heat\ Value\left(\frac{kBtu}{Therm}\right)}\times\cdots$$

$$\left(\frac{1}{Efficiency_{OLD}}-\frac{1}{Efficiency_{NEW}}\right)$$

$$EnergySavings = \frac{2{,}734.57\left(\frac{kBtu}{Hr}\right)\times 4{,}888\,(HDD)\times 24\ Hrs\times 0.6}{65\,(°F)\times 100\left(\frac{kBtu}{Therm}\right)}\times\left(\frac{1}{73\%}-\frac{1}{85.1\%}\right)\ldots$$

$$= 5{,}766\,(Therms)$$

$$Savings. = Heat\ Cons.(Therms)\times Ave\ Gas\ Cost\left(\frac{\$}{Therm}\right)$$

$$Savings. = 5{,}766\,(Therms)\times 1.68\left(\frac{\$}{Therm}\right) = \$9{,}686$$

Installed cost of the Weil McLain sectional boilers including removal of existing unit, all piping changes and controls is estimated to be $75,100.
Smart Start Incentive = $1.00/MBh x 5,774/installed MBh = $5,774

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY*	
Installation Cost ($):	$75,100
NJ Smart Start Equipment Incentive ($):	($5,774)
Net Installation Cost ($):	$69,326
Maintenance Savings ($ / yr):	*$0*
Energy Savings ($ / yr):	*$9,686*
Total Energy Savings ($ / yr):	*$9,686*
Simple Payback (yrs):	*7.2*
Simple Return On Investment (%):	*14.0%*
Estimated ECM Lifetime (yr):	*35*
Simple Lifetime Savings ($):	*$339,010*

VIII. RENEWABLE/DISTRIBUTED ENERGY MEASURES

Globally, renewable energy has become a priority affecting international and domestic energy policy. The State of New Jersey has taken a proactive approach, and has recently adopted in its Energy Master Plan a goal of 30% renewable energy by 2020. To help reach this goal New Jersey created the Office of Clean Energy under the direction of the Board of Public Utilities and instituted a Renewable Energy Incentive Program to provide additional funding to private and public entities for installing qualified renewable technologies. A renewable energy source can greatly reduce a building's operating expenses while producing clean environmentally friendly energy. CEG has assessed the feasibility of installing renewable energy technologies for Branchburg NJ, and concluded that there is potential for solar energy generation.

Solar energy produces clean energy and reduces a building's carbon footprint. This is accomplished via photovoltaic panels which will be mounted on all south and southwestern facades of the building. Flat roof, as well as sloped areas can be utilized; flat areas will have the panels turned to an optimum solar absorbing angle. (A structural survey of the roof would be necessary before the installation of PV panels is considered). The state of NJ has instituted a program in which one Solar Renewable Energy Certificate (SREC) is given to the Owner for every 1000 kWh of generation. SREC's can be sold anytime on the market at their current market value. The value of the credit varies upon the current need of the power companies. The average value per credit is around $350, this value was used in our financial calculations. This equates to $0.35 per kWh generated.

CEG has reviewed the existing roof area of the building being audited for the purposes of determining a potential for a roof mounted photovoltaic system. A roof area of 5160 S.F. can be utilized for a PV system. A depiction of the area utilized is shown in Renewable / Distributed Energy Measures Calculation appendix. Using this square footage it was determined that a system size of 239.66 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 374,000 KWh annually, reducing the overall utility bill by approximately 51.9% percent. A detailed financial analysis can be found in the Renewable / Distributed Energy Measures Calculation appendix. This analysis illustrates the payback of the system over a 25 year period. The eventual degradation of the solar panels and the price of accumulated SREC's are factored into the payback.

CEG has reviewed financing options for the owner. Two options were studied and they are as follows: Self-financed and direct purchase without finance. Self-finance was calculated with 95% of the total project cost financed at a 7% interest rate over 25 years. Direct purchase involves the local government paying for 100% of the total project cost upfront via one of the methods noted in the Installation Funding Options section below. Both of these calculations include a utility inflation rate as well as the degradation of the solar panels over time. Based on our calculations the following are the payback periods for the respective method of payment:

PAYMENT TYPE	SIMPLE PAYBACK	SIMPLE ROI	INTERNAL RATE OF RETURN
Self-Finance	11.2 Years	8.9%	12.8%
Direct Purchase	11.2 Years	8.9%	8.0%

The resultant Internal Rate of Return indicates that if the Owner was able to "self-finance" the solar project, the project would be slightly more beneficial to the Owner. However, if the Owner was able to work out a Power Purchase Agreement with a third-party and agree upon a decent base energy rate for kilowatt hour production, the "direct purchase" option could also, prove to be a beneficial route.

In addition to the Solar Analysis, CEG also conducted a review of the applicability of wind energy for the facility. Wind energy production is another option available through the Renewable Energy Incentive Program. Wind turbines of various types can be utilized to produce clean energy on a per building basis. Cash incentives are available per kWh of electric usage. Based on CEG's review of the applicability of wind energy for this facility, it was determined that the average wind speed is not adequate, and the kilowatt demand for the building is below the threshold (200 kW) for purchase of a commercial wind turbine. Therefore, wind energy is not a viable option.

IX. ENERGY PURCHASING AND PROCUREMENT STRATEGY

Load Profile:

Load Profile analysis was performed to determine the seasonal energy usage of the facility. Irregularities in the load profile will indicate potential problems within the facility. Consequently based on the profile a recommendation will be made to remedy the irregularity in energy usage. For this report, the facility's energy consumption data was gathered in table format and plotted in graph form to create the load profile. Refer to the Electric and Natural Gas Usage Profiles included within this report to reference the respective electricity and natural gas usage load profiles.

Electricity:

The Electric Usage Profile demonstrates a fairly atypical load shape. There is increased consumption in the winter period (November -March), with a continuation of April through July. The later summer-time load can be described as air-conditioning load. The air conditioning is supplied by window units, split units and packaged rooftop units. There is also an obvious drop in usage July going into August. A flatter load profile of this type, will allow for more competitive energy prices when shopping for alternative suppliers.

Natural Gas:

The Natural Gas Usage Profile demonstrates a very typical natural gas (heat load) profile. The summer months (May – September) demonstrate extremely low consumption (complimenting the winter heating load). There is an increase in winter consumption (November – March). The increased winter load is caused by heating demand. In this facility the heat is supplied by 2 large industrial natural gas fired boilers for the original building and two new gas fired boiler for the C-wing addition. Also adding to the natural gas demand is the presence of a natural gas fired hot water system, which is independent of the central boiler system. A base-load shaping (flat) will secure more competitive energy prices when procuring energy through an alternative energy source.

Tariff Analysis:

Electricity:

This facility receives electrical service through Jersey Central Power & Light (JCP&L) on a GSS (General Service Secondary – 3 Phase) rate. Service classification GS is available for general service purposes on secondary voltages not included under Service Classifications RS, RT, RGT or GST. This facility's rate is a single or three phase service at secondary voltages. For electric supply (generation), the customer will use the utilities Basic Generation Service (BGS) or a Third Party Supplier (TPS). This facility uses Basic Generation service from the utility. Therefore, they will pay according to the BGS default service. The Delivery Service includes the following charges: Customer Charge, Supplemental Customer Charge, Distribution Charge (kW

Demand), kWh Charge, Non-utility Generation Charge, TEFA, SBC, SCC, Standby Fee and RGGI.

Natural Gas:

This facility receives natural gas Delivery Service through New Jersey Natural Gas Company on a GSL (General Service Large) tariff rate schedule. The GSL rate is available to any Customer in the entire territory served by the Company who uses 5,000 therms or more annually and uses gas for all purposes other than residential and interruptible service. Where the customer uses the Cooling, Air Conditioning and Pool Heating Service (CAC) under Special Provision 1 applicable to customers purchasing gas supply under Rider "A", the Company will, upon application of the Customer, meter the space heating and the "CAC" separately.

This service is considered a "firm" service, where the customer may either purchase gas from Company's Rider "A", for Basic Gas Supply Service (BGSS) or from a Marketer or Broker. A "firm service" is a higher priority of delivery on the natural gas pipeline. Typically the firm users do not have the capability of being interrupted by the utility, so the utility must provide a higher level of service. Much like the telecom industry, the natural gas pipelines were deregulated and various levels of delivery service were created. The "firm service" was the most reliable because it is last on the pecking order for interruption.

The basic charges under this tariff are for: Customer Charge, Demand Charge, Delivery Charge and if the customer elects, the BGSS Supply Charge. The customer can elect to have the Commodity Charge serviced through the utility or by a Third Party Supplier (TPS). Currently Denville is using the services of a TPS, Pepco Energy Services. Note: Should the TPS not deliver, then the customer will receive replacement service from the utility which carries an extremely high penalty cost of service, which is automatically supplied.

Imbalances can occur when Third Party Suppliers are used to supply natural gas and when full delivery is not made, and when a new supplier is contracted or the customer returns to the utility. It is important when utilizing a Third Party Supplier, that an experienced regional supplier is used, otherwise, under delivery can occur, jeopardizing economics and scheduling.

The information provided by Denville states that they are currently utilizing the service of a Third Party Supplier, Pepco Energy Services. CEG believes there is room within these energy costs, for improvement (please see comments under recommendations).

Recommendations:

CEG recommends a global approach that will be consistent with all facilities within the BOE. The primary area for potential improvement is seen in the electric costs. The average price per kWh (kilowatt hour) for all buildings based on 1-year historical average price is $.1388/kWh (this is the average "price to compare" if the client intends to shop for energy). The average price per decatherm for natural gas is $ 12.11 / dth (dth, is the common unit of measure). Energy commodities are among the most volatile of all commodities, however at this point and time, energy is extremely competitive. The BOE could see improvement in its energy costs if it were to take advantage of these current market prices quickly, before energy prices increase. Based on annual historical consumption (May 2008 through April 2009) and current electric rates, the BOE could see an improvement in its electric costs of up to 35% annually. (Note: Savings were calculated using Average Annual Consumption and a variance to a Fixed Average One-Year commodity contract). CEG recommends aggregating the entire electric load to gain the most optimal energy costs. CEG recommends advisement for alternative sourcing and supply of energy on a "managed approach".

CEG's secondary recommendation coincides with the natural gas costs. Based on the current market, Denville could improve its natural gas costs by up to 24%. Currently the BOE is utilizing the services of a Third Party Supplier, Pepco Energy Services. CEG recommends the BOE receive further advisement on these prices through an energy advisor. They should also consider procuring energy (natural gas) through an alternative supply source.

CEG also recommends scheduling a meeting with the current utility providers to review their utility charges and current tariff structures for electricity and natural gas. This meeting would provide insight regarding alternative procurement options that are currently available. Through its meeting with the Local Distribution Company (LDC), the municipality can learn more about the competitive supply process. The BOE can acquire a list of approved Third Party Suppliers from the New Jersey Board of Public Utilities website at www.nj.gov/bpu. They should also consider using a billing-auditing service to further analyze the utility invoices, manage the data and use the information for ongoing demand-side management projects. Furthermore, special attention should be given to credit mechanisms, imbalances, balancing charges and commodity charges when meeting with the utility representative. The Denville BOE should ask the utility representative about alternative billing options, such as consolidated billing when utilizing the service of a Third Party Supplier. Finally, if the supplier for energy (natural gas) is changed, closely monitor balancing, particularly when the contract is close to termination. This could be performed with the aid of an "energy advisor".

X. INSTALLATION FUNDING OPTIONS

CEG has reviewed various funding options for the facility owner to utilize in subsidizing the costs for installing the energy conservation measures noted within this report. Below are a few alternative funding methods:

i. *Energy Savings Improvement Program (ESIP)* – Public Law 2009, Chapter 4 authorizes government entities to make energy related improvements to their facilities and par for the costs using the value of energy savings that result from the improvements. The "Energy Savings Improvement Program (ESIP)" law provides a flexible approach that can allow all government agencies in New Jersey to improve and reduce energy usage with minimal expenditure of new financial resources.

ii. *Municipal Bonds* – Municipal bonds are a bond issued by a city or other local government, or their agencies. Potential issuers of municipal bonds include cities, counties, redevelopment agencies, school districts, publicly owned airports and seaports, and any other governmental entity (or group of governments) below the state level. Municipal bonds may be general obligations of the issuer or secured by specified revenues. Interest income received by holders of municipal bonds is often exempt from the federal income tax and from the income tax of the state in which they are issued, although municipal bonds issued for certain purposes may not be tax exempt.

iii. *Power Purchase Agreement* – Public Law 2008, Chapter 3 authorizes contractor of up to fifteen (15) years for contracts commonly known as "power purchase agreements." These are programs where the contracting unit (Owner) procures a contract for, in most cases, a third party to install, maintain, and own a renewable energy system. These renewable energy systems are typically solar panels, windmills or other systems that create renewable energy. In exchange for the third party's work of installing, maintaining and owning the renewable energy system, the contracting unit (Owner) agrees to purchase the power generated by the renewable energy system from the third party at agreed upon energy rates.

CEG recommends the Owner review the use of the above-listed funding options in addition to utilizing their standard method of financing for facilities upgrades in order to fund the proposed energy conservation measures.

XI. ADDITIONAL RECOMMENDATIONS

The following recommendations include no cost/low cost measures, Operation & Maintenance (O&M) items, and water conservation measures with attractive paybacks. These measures are not eligible for the Smart Start Buildings incentives from the office of Clean Energy but save energy none the less.

A. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.

B. Maintain all weather stripping on windows and doors.

C. Clean all light fixtures to maximize light output.

D. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.

E. Recalibrate existing temperature sensors serving the original building HVAC control system.

F. Confirm that outside air dampers on the rooftop units are functioning properly to take advantage of free cooling for AC unit and avoid excessive outside air on AC and heating unit in unoccupied periods.

G. Set hot water re-circ pump temperature set-point below hot water supply temperature setting to avoid continuous operation. Provide time clock in addition to hot water re-circ aqua stat to stop hot water circulation during unoccupied periods.

H. Repair or replace insulation where old and degraded on heating water piping especially in unconditioned spaces such as the original building boiler room and service garage where the boiler water pumps are located.

I. Set all computers to sleep or hibernate to conserve energy when not in use.

J. Confirm dampers are functioning properly in all exhaust fans and ventilation hoods throughout the building.

In addition to the recommendations above, implementing Retro-Commissioning would be beneficial for this facility. Retro-Commissioning is a means to verify your current equipment is operating at its designed efficiency, capacity, airflow, and overall performance. Retro-Commissioning provides valuable insight into systems or components not performing correctly or efficiently. The commissioning process defines the original system design parameters and recommends revisions to the current system operating characteristics.

INSTALLATION COST AND REBATES

CONCORD ENGINEERING GROUP

Denville - Lakeview Elementary School

ECM 1: LIGHTING UPGRADE

	Qty	Unit Cost $	Material $	Labor $	Total $
Lighting Fixture Replacement	LS	$58,126	-	-	$58,126
Utility Incentive - NJ Smart Start (1-2) lamp fixture	567	$10.00			($5,670)
Utility Incentive - NJ Smart Start (3-4) lamp fixture	11	$20.00			($220)
Total Cost Less Incentive					$52,236

ECM 2: LIGHTING CONTROLS

	Qty	Unit Cost $	Material $	Labor $	Total $
Dual - Technology Sensor	118	$75	$1,770	$7,080	$8,850
Utility Incentive - NJ Smart Start	118	$20			($2,360)
Total Cost Less Incentive					$6,490

ECM 3: HVAC SYSTEM CONTROLS

	SF	Unit Cost $	Material $	Labor $	Total $
DDC Automation System	82007	$4	-	-	$328,028
Utility Incentive - NJ Smart Start					$0
Total Cost Less Incentive					$328,028

ECM 4: BOILER REPLACEMENT

	Qty	Unit Cost $	Material $	Labor $	Total $
2887 MBH High Eff Boiler	2	$34,100	$57,700	$10,500	$68,200
Old Boiler Demolition	2	$3,450		$6,900	$6,900
Utility Incentive - NJ Smart Start (5,774 MBH	5,774	$1			($5,774)
Total Cost Less Incentive					$69,326

ECM 6: SOLAR PV SYSTEM

	Qty	Unit Cost $	Material $	Labor $	Total $
Solar PV System	1	$2,156,940			$2,156,940
Utility Incentive - (see Renewable Energy Measures appendix for details)					-
Total Cost Less Incentive					$2,156,940

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SmartStart Building Incentives

The NJ SmartStart Buildings Program offers financial incentives on a wide variety of building system equipment. The incentives were developed to help offset the initial cost of energy-efficient equipment. The following tables show the current available incentives as of January, 2009:

Electric Chillers

Water-Cooled Chillers	$12 - $170 per ton
Air-Cooled Chillers	$8 - $52 per ton

Gas Cooling

Gas Absorption Chillers	$185 - $400 per ton
Gas Engine-Driven Chillers	Calculated through custom measure path)

Desiccant Systems

Desiccant Systems	$1.00 per cfm – gas or electric

Electric Unitary HVAC

Unitary AC and Split Systems	$73 - $93 per ton
Air-to-Air Heat Pumps	$73 - $92 per ton
Water-Source Heat Pumps	$81 per ton
Packaged Terminal AC & HP	$65 per ton
Central DX AC Systems	$40- $72 per ton
Dual Enthalpy Economizer Controls	$250

Ground Source Heat Pumps

Closed Loop & Open Loop	$370 per ton

Gas Heating

Gas Fired Boilers < 300 MBH	$300 per unit
Gas Fired Boilers ≥ 300 - 1500 MBH	$1.75 per MBH
Gas Fired Boilers ≥1500 - ≤ 4000 MBH	$1.00 per MBH
Gas Fired Boilers > 4000 MBH	(Calculated through Custom Measure Path)
Gas Furnaces	$300 - $400 per unit

Variable Frequency Drives

Variable Air Volume	$65 - $155 per hp
Chilled-Water Pumps	$60 per hp
Compressors	$5,250 to $12,500 per drive

Natural Gas Water Heating

Gas Water Heaters ≤ 50 gallons	$50 per unit
Gas-Fired Water Heaters >50 gallons	$1.00 - $2.00 per MBH
Gas-Fired Booster Water Heaters	$17 - $35 per MBH

Premium Motors

Three-Phase Motors	$45 - $700 per motor

Prescriptive Lighting

T-5 and T-8 Lamps w/Electronic Ballast in Existing Facilities	$10 - $30 per fixture, (depending on quantity)
Hard-Wired Compact Fluorescent	$25 - $30 per fixture
Metal Halide w/Pulse Start	$25 per fixture
LED Exit Signs	$10 - $20 per fixture
T-5 and T-8 High Bay Fixtures	$16 - $284 per fixture

Lighting Controls – Occupancy Sensors

Wall Mounted	$20 per control
Remote Mounted	$35 per control
Daylight Dimmers	$25 per fixture
Occupancy Controlled hi-low Fluorescent Controls	$25 per fixture controlled

Lighting Controls – HID or Fluorescent Hi-Bay Controls

Occupancy hi-low	$75 per fixture controlled
Daylight Dimming	$75 per fixture controlled

Other Equipment Incentives

Performance Lighting	$1.00 per watt per SF below program incentive threshold, currently 5% more energy efficient than ASHRAE 90.1-2004 for New Construction and Complete Renovation
Custom Electric and Gas Equipment Incentives	not prescriptive

MAJOR EQUIPMENT LIST

Concord Engineering Group

"Denville Lakeview Elementary School"

Domestic Hot Water Heater

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Input	Recovery (gal/h)	Capacity (gal)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life
Original Building HW	Boiler Room	A.O. Smith	Gas Fired	1	BTP-700A 920	LF940347680920	700 MBH	636	69	-	Nat Gas	Unknown	10	-
Building Addition HW	Mech Mezz	A.O. Smith	Gas Fired	1	BTP-140-199	-	199 MBH	193	140	-	Nat Gas	9	10	1

AC Units

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Cooling Type	Cooling Capacity	EER*	Heating Type	Heating Capacity (Input)	COP	Fan HP	Motor RPM	Volts	Phase	Approx. Age	ASHRAE Service Life	Remaining Life
Nurse Office	Roof	Carrier	Packaged CV		50TJ005M511	2600G24063	DX R-22	48	10	None	-	-	-	-	208	3	9	15	6
Faculty Room	Roof	Carrier	Packaged CV		50TJ005M511	2600G24062	DX R-22	48	10	None	-	-	-	-	208	3	9	15	6
SIS	Roof	Carrier	Packaged CV		50TJ014541	2100G30360	DX R-22	150	9	None	-	-	-	-	208	3	9	15	6
Library	Roof	Carrier	Packaged CV		50TJ24570AA		DX R-22	240**	9**	None	-	-	-	-	208	3	9	15	6
Computer Lab	Roof	Carrier	Packaged CV		50TJ008521GA	2500G30413	DX R-22	84	8.9	None	-	-	-	-	208	3	9	15	6
Principal's Office	Roof	Carrier	Packaged CV		50TJ004M511	2600G24005	DX R-22	36	10	None	-	-	-	-	208	3	9	15	6
Main Office	Roof	Carrier	Packaged CV		50TJ004M511	2600G24006	DX R-22	36	10	None	-	-	-	-	208	3	9	15	6
GYM	Mech Mezz	Carrier	AHU		39TVCCTK-61039--AA	2900F16917	DX R-22	5500 cfm	-	None	-	-			208	3	9	15	6
GYM	Mech Mezz	Carrier	AHU		39TVCCTK-61039--AA	2900F16950	DX R-22	5500 cfm	-	None	-	-			208	3	9	15	6

*Equipment efficiencies listed above are based on new equipment product data.
**Estimated information due to inadequate model number

Boilers

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Heating Type	Input Capacity	Output Capacity (Approx)	Efficiency (approx)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
Heating Water Loop	Old Boiler Room	H.B. Smith Co	Dual Fuel - Hot Water	2			Gas		1885 MBH	77%	Gas	43	25	(18)	Converted from oil to gas fired burner.
Heating Water Loop	Mezz Mech Room	Smith Cast Iron	Gas Fired - Hot Water	2	28A-5 Series	N2000-518	Gas	1491 MBH	1,166 MBH	78%	Gas	9	25	16	

* 5% efficiency degradation from manufacture data assumed in calculation for H.B. Smith Co. boiler

Boiler Pumps

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Flow	Head	RPM	HP	Volts	Phase	Approx. Age	ASHRAE Service Life	Remaining Life
Heating Water Loop	Loading Dock Room	Bell & Gossett	End Suction Cons Volume	2	185011	-	-	-	1750	5	208	-	Unknown	20	-
Heating Water Loop	Loading Dock Room	Bell & Gossett	End Suction Cons Volume	1		-	-	-	1750	1.5	208	-	Unknown	20	-
Primary Boiler Loop	Mezz Mech Room	Armstrong	End Suction Cons Volume	1	3X3X6	-	115 GPM	12 FT.	1749	0.75	208	-	9	20	11
Heating Water Loop	Mezz Mech Room	Armstrong	End Suction Cons Volume	2	3X2X10	-	170 GPM	75 FT.	1750	7.5	208	-	9	20	11

Split Systems

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Cooling Type	Cooling Capacity	EER	Heating Type	Heating Capacity (Input)	Eff	Fan HP	Motor RPM	Volts	Phase	Approx. Age	ASHRAE Service Life	Remaining Life
IT closet	AHU - Costa Rm	Airedale	Ductless Split System Cooling Only	1		-	DX R-22	9 MBH	-	None	-	-	-	-	208	1	Unknown	15	-
	CU - Roof			1	SCC09DA00A0AA0A	1-99-H-1895-35							-	-	208	1	Unknown	15	-

*Equipment efficiencies listed above are based on new equipment product data.

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Lakeview Elementary School

Building ID: 1810453
For 12-month Period Ending: May 31, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: September 08, 2009

Facility
Lakeview Elementary School
44 Cooper Rd.
Denville, NJ 07834

Facility Owner
Denville Board of Education
501 Openaki Road
Denville, NJ 07834

Primary Contact for this Facility
John Serapiglia
501 Openaki Road
Denville, NJ 07834

Year Built: 1958
Gross Floor Area (ft²): 82,007

Energy Performance Rating[2] (1-100) 19

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	2,458,278
Natural Gas (kBtu)[4]	6,600,905
Total Energy (kBtu)	9,059,183

Energy Intensity[5]

Site (kBtu/ft²/yr)	110
Source (kBtu/ft²/yr)	184

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	726

Electric Distribution Utility
Jersey Central Power & Lt Co

National Average Comparison

National Average Site EUI	82
National Average Source EUI	137
% Difference from National Average Source EUI	35%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards[6] for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Certifying Professional
Ray Johnson
520 South Burnt Mill Road
Voorhees, NJ 08043

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Natural Gas values in units of volume (e.g. cubic feet) are converted to kBtu with adjustments made for elevation based on Facility zip code.
5. Values represent energy intensity, annualized to a 12-month period.
6. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

ENERGY STAR® Data Checklist for Commercial Buildings

In order for a building to qualify for the ENERGY STAR, a Professional Engineer (PE) must validate the accuracy of the data underlying the building's energy performance rating. This checklist is designed to provide an at-a-glance summary of a property's physical and operating characteristics, as well as its total energy consumption, to assist the PE in double-checking the information that the building owner or operator has entered into Portfolio Manager.

Please complete and sign this checklist and include it with the stamped, signed Statement of Energy Performance.
NOTE: You must check each box to indicate that each value is correct, OR include a note.

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Lakeview Elementary School	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	K-12 School	Is this an accurate description of the space in question?		☐
Location	44 Cooper Rd., Denville, NJ 07834	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of acute care or children's hospitals) nor can they be submitted as representing only a portion of a building		☐

Lakeview Elementary School (K-12 School)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	82,007 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Open Weekends?	No	Is this building normally open at all on the weekends? This includes activities beyond the work conducted by maintenance, cleaning, and security personnel. Weekend activity could include any time when the space is used for classes, performances or other school or community activities. If the building is open on the weekend as part of the standard schedule during one or more seasons, the building should select ?yes? for open weekends. The ?yes? response should apply whether the building is open for one or both of the weekend days.		☐
Number of PCs	161	Is this the number of personal computers in the K12 School?		☐
Number of walk-in refrigeration/freezer units	0	Is this the total number of commercial walk-in type freezers and coolers? These units are typically found in storage and receiving areas.		☐
Presence of cooking facilities	Yes	Does this school have a dedicated space in which food is prepared and served to students? If the school has space in which food for students is only kept warm and/or served to students, or has only a galley that is used by teachers and staff then the answer is "no".		☐
Percent Cooled	80 %	Is this the percentage of the total floor space within the facility that is served by mechanical cooling equipment?		☐
Percent Heated	100 %	Is this the percentage of the total floor space within the facility that is served by mechanical heating equipment?		☐
Months	10 (Optional)	Is this school in operation for at least 8 months of the year?		☐

High School?	No	Is this building a high school (teaching grades 10, 11, and/or 12)? If the building teaches to high school students at all, the user should check 'yes' to 'high school'. For example, if the school teaches to grades K-12 (elementary/middle and high school), the user should check 'yes' to 'high school'.		☐

ENERGY STAR® Data Checklist
for Commercial Buildings

Energy Consumption

Power Generation Plant or Distribution Utility: Jersey Central Power & Lt Co

Fuel Type: Electricity		
Meter: Electric (kWh (thousand Watt-hours)) **Space(s):** Entire Facility **Generation Method:** Grid Purchase		
Start Date	**End Date**	**Energy Use (kWh (thousand Watt-hours))**
05/01/2009	05/31/2009	62,720.00
04/01/2009	04/30/2009	61,920.00
03/01/2009	03/31/2009	36,640.00
02/01/2009	02/28/2009	69,760.00
01/01/2009	01/31/2009	89,920.00
12/01/2008	12/31/2008	60,960.00
11/01/2008	11/30/2008	62,240.00
10/01/2008	10/31/2008	62,880.00
09/01/2008	09/30/2008	62,880.00
08/01/2008	08/31/2008	47,520.00
07/01/2008	07/31/2008	47,840.00
06/01/2008	06/30/2008	55,200.00
Electric Consumption (kWh (thousand Watt-hours))		**720,480.00**
Electric Consumption (kBtu (thousand Btu))		**2,458,277.76**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**2,458,277.76**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Natural Gas		
Meter: Gas (therms) **Space(s):** Entire Facility		
Start Date	**End Date**	**Energy Use (therms)**
05/01/2009	05/31/2009	1,545.61
04/01/2009	04/30/2009	4,763.16
03/01/2009	03/31/2009	5,777.45
02/01/2009	02/28/2009	12,009.62
01/01/2009	01/31/2009	12,363.79
12/01/2008	12/31/2008	12,778.68
11/01/2008	11/30/2008	9,114.96
10/01/2008	10/31/2008	1,820.86
09/01/2008	09/30/2008	121.74
08/01/2008	08/31/2008	188.43

07/01/2008	07/31/2008	99.35
Gas Consumption (therms)		**60,583.65**
Gas Consumption (kBtu (thousand Btu))		**6,058,365.00**
Total Natural Gas Consumption (kBtu (thousand Btu))		**6,058,365.00**
Is this the total Natural Gas consumption at this building including all Natural Gas meters?		☐

Additional Fuels	
Do the fuel consumption totals shown above represent the total energy use of this building? Please confirm there are no additional fuels (district energy, generator fuel oil) used in this facility.	☐

On-Site Solar and Wind Energy	
Do the fuel consumption totals shown above include all on-site solar and/or wind power located at your facility? Please confirm that no on-site solar or wind installations have been omitted from this list. All on-site systems must be reported.	☐

Certifying Professional

(When applying for the ENERGY STAR, the Certifying Professional must be the same as the PE that signed and stamped the SEP.)

Name: ____ Date: _____________

Signature: ______________________________________

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
Lakeview Elementary School
44 Cooper Rd.
Denville, NJ 07834

Facility Owner
Denville Board of Education
501 Openaki Road
Denville, NJ 07834

Primary Contact for this Facility
John Serapiglia
501 Openaki Road
Denville, NJ 07834

General Information

Lakeview Elementary School	
Gross Floor Area Excluding Parking: (ft^2)	82,007
Year Built	1958
For 12-month Evaluation Period Ending Date:	May 31, 2009

Facility Space Use Summary

Lakeview Elementary School	
Space Type	K-12 School
Gross Floor Area(ft^2)	82,007
Open Weekends?	No
Number of PCs	161
Number of walk-in refrigeration/freezer units	0
Presence of cooking facilities	Yes
Percent Cooled	80
Percent Heated	100
Months^o	10
High School?	No
School District^o	N/A

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 05/31/2009)	**Baseline** (Ending Date 05/31/2009)	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	19	19	75	N/A	50
Energy Intensity					
Site (kBtu/ft^2)	110	110	64	N/A	82
Source (kBtu/ft^2)	184	184	107	N/A	137
Energy Cost					
$/year	$ 151,546.75	$ 151,546.75	$ 88,044.45	N/A	$ 112,586.60
$/ft^2/year	$ 1.85	$ 1.85	$ 1.07	N/A	$ 1.37
Greenhouse Gas Emissions					
$MtCO_2e$/year	726	726	422	N/A	539
$kgCO_2e/ft^2$/year	9	9	5	N/A	7

More than 50% of your building is defined as K-12 School. Please note that your rating accounts for all of the spaces listed. The National Average column presents energy performance data your building would have if your building had an average rating of 50.

Notes:
o - This attribute is optional.
d - A default value has been supplied by Portfolio Manager.

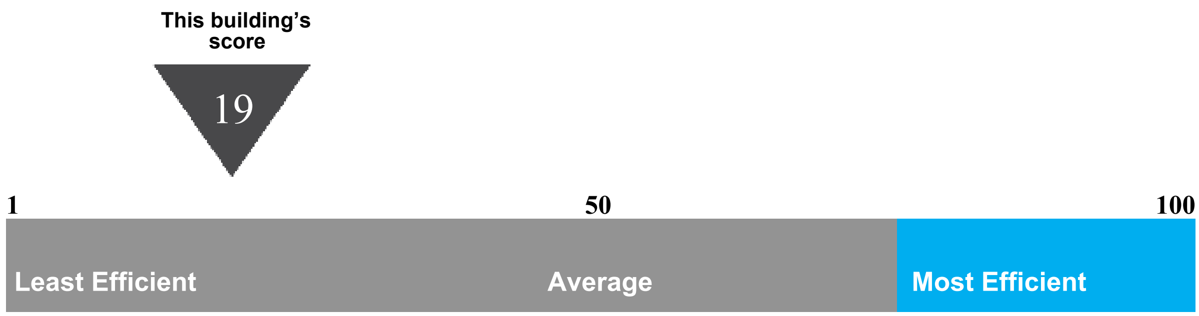
Statement of Energy Performance

2009

Lakeview Elementary School
44 Cooper Rd.
Denville, NJ 07834

Portfolio Manager Building ID: 1810453

The energy use of this building has been measured and compared to other similar buildings using the Environmental Protection Agency's (EPA's) Energy Performance Scale of 1–100, with 1 being the least energy efficient and 100 the most energy efficient. For more information, visit energystar.gov/benchmark.



This building uses 184 kBtu per square foot per year.*

*Based on source energy intensity for the 12 month period ending May 2009

Buildings with a score of 75 or higher may qualify for EPA's ENERGY STAR.

I certify that the information contained within this statement is accurate and in accordance with U.S. Environmental Protection Agency's measurement standards, found at energystar.gov

Date of certification

EPA United States Environmental Protection Agency

Date Generated: 09/08/2009

CEG Job #: 9C09080
Project: Denville Lakeview ES
Address: 44 Coopr Road
Denville, NJ 07834
Building SF: 82,007

"Denville Lakeview Elementary School"

KWH COST: $0.164

ECM #1: Lighting Upgrade - General

EXISTING LIGHTING										PROPOSED LIGHTING									SAVINGS			
CEG Type	Fixture Location	Yearly Usage	No. Fixts	No. Lamps	Fixture Type	Fixt Watts	Total kW	kWh/Yr Fixtures	Yearly $ Cost	No. Fixts	No. Lamps	Retro-Unit Description	Watts Used	Total kW	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
15	Auditorium	1880	8	0	High Pressure Sodium Lights	464	3.71	6,978.6	$1,144.48	8	0	No Change	464	3.71	6978.56	$1,144.48	$0.00	$0.00	0.00	0	$0.00	0.00
15	Stage	1880	4	0	High Pressure Sodium Lights	464	1.86	3,489.3	$572.24	4	0	No Change	464	1.86	3489.28	$572.24	$0.00	$0.00	0.00	0	$0.00	0.00
33		1880	1	0	1-Lamp Incandescents	75	0.08	141.0	$23.12	1	0	18 W CFL Lamp	18	0.02	33.84	$5.55	$5.75	$5.75	0.06	107.16	$17.57	0.33
54		1880	2	0	1 Lamp Incandescents	100	0.20	376.0	$61.66	2	0	26 W CFL Lamp	26	0.05	97.76	$16.03	$5.75	$11.50	0.15	278.24	$45.63	0.25
39	Classroom A1	1880	17	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.36	2,556.8	$419.32	17	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.94	1757.8	$288.28	$100.00	$1,700.00	0.43	799	$131.04	12.97
33	A1 Closet	1880	1	0	1-Lamp Incandescents	75	0.08	141.0	$23.12	1	0	18 W CFL Lamp	18	0.02	33.84	$5.55	$5.75	$5.75	0.06	107.16	$17.57	0.33
39		1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.08	150.4	$24.67	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.96	$100.00	$100.00	0.03	47	$7.71	12.97
39	Classroom A2	1880	17	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.36	2,556.8	$419.32	17	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.94	1757.8	$288.28	$100.00	$1,700.00	0.43	799	$131.04	12.97
33	A2 Closet	1880	1	0	1-Lamp Incandescents	75	0.08	141.0	$23.12	1	0	18 W CFL Lamp	18	0.02	33.84	$5.55	$5.75	$5.75	0.06	107.16	$17.57	0.33
39		1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.08	150.4	$24.67	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.96	$100.00	$100.00	0.03	47	$7.71	12.97
55	Principal's Office	1880	4	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic	58	0.23	436.2	$71.53	4	0	No Change	58	0.23	436.16	$71.53	$0.00	$0.00	0.00	0	$0.00	0.00
56	Principal's Bathroom	1880	1	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	130	0.13	244.4	$40.08	1	3	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.09	171.08	$28.06	$120.00	$120.00	0.04	73.32	$12.02	9.98
57	Communication Closet	1880	1	0	3.-Lamp Incandescent	225	0.23	423.0	$69.37	1	0	(3) 18 W CFL Lamp	54	0.05	101.52	$16.65	$17.25	$17.25	0.17	321.48	$52.72	0.33
58		1880	2	2	2-Lamp, T-12, U-Lamp, Magnetic Ballast, Recessed Mounted	60	0.12	225.6	$37.00	2	2	2'x2' 2-Lamp T-8, Prism Lens Electronic Ballast, Architectural surface or Recessed static METALUX 2AC-217-UNV-EB81-U	34	0.07	127.84	$20.97	$204.00	$408.00	0.05	97.76	$16.03	25.45
39	A1 - A6 Hall	2350	13	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.04	2,444.0	$400.82	13	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.72	1680.25	$275.56	$100.00	$1,300.00	0.33	763.75	$125.26	10.38
55	Conference Room A	1880	6	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.35	654.2	$107.30	6	0	No Change	58	0.35	654.24	$107.30	$0.00	$0.00	0.00	0	$0.00	0.00
39	Conference Room A Bathroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.08	150.4	$24.67	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.96	$100.00	$100.00	0.03	47	$7.71	12.97

55	Classroom A25	1880	2	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.12	218.1	$35.77	2	0	No Change	58	0.12	218.08	$35.77	$0.00	$0.00	0.00	0	$0.00	0.00
39	Classroom A3	1880	16	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.28	2,406.4	$394.65	16	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.88	1654.4	$271.32	$100.00	$1,600.00	0.40	752	$123.33	12.97
39	Classroom A4	1880	16	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.28	2,406.4	$394.65	16	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.88	1654.4	$271.32	$100.00	$1,600.00	0.40	752	$123.33	12.97
39	Classroom A5	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$295.99	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$203.49	$100.00	$1,200.00	0.30	564	$92.50	12.97
39	Classroom A6	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$295.99	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$203.49	$100.00	$1,200.00	0.30	564	$92.50	12.97
39	Classroom A7	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$295.99	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$203.49	$100.00	$1,200.00	0.30	564	$92.50	12.97
39	A-hall Girls Bathroom	1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.16	300.8	$49.33	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$33.92	$100.00	$200.00	0.05	94	$15.42	12.97
59	Janitor's Closet	470	1	0	2 - Lamp Incandescents	100	0.10	47.0	$7.71	1	0	(2) 18 W CFL Lamp	36	0.04	16.92	$2.77	$11.50	$11.50	0.06	30.08	$4.93	2.33
39	A-hall Boys Bathroom	1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.16	300.8	$49.33	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$33.92	$100.00	$200.00	0.05	94	$15.42	12.97
39	A8-A29 Hall	2350	9	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.72	1,692.0	$277.49	9	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.50	1163.25	$190.77	$100.00	$900.00	0.23	528.75	$86.72	10.38
39	Classroom A8	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$295.99	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$203.49	$100.00	$1,200.00	0.30	564	$92.50	12.97
39	Classroom A29	1880	17	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.36	2,556.8	$419.32	17	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.94	1757.8	$288.28	$100.00	$1,700.00	0.43	799	$131.04	12.97
39	Classroom A29 Bathroom	1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.16	300.8	$49.33	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$33.92	$100.00	$200.00	0.05	94	$15.42	12.97
39	Boilerroom Bathroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.08	150.4	$24.67	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.96	$100.00	$100.00	0.03	47	$7.71	12.97
39	Classroom A9	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$295.99	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$203.49	$100.00	$1,200.00	0.30	564	$92.50	12.97
39	Classroom A10	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$295.99	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$203.49	$100.00	$1,200.00	0.30	564	$92.50	12.97
39	Garage	470	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.16	75.2	$12.33	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	51.7	$8.48	$100.00	$200.00	0.05	23.5	$3.85	51.89
60		470	1	0	3.- Lamp Incandescent	150	0.15	70.5	$11.56	1	0	(3) 18 W CFL Lamp	54	0.05	25.38	$4.16	$17.25	$17.25	0.10	45.12	$7.40	2.33

39	Storage	470	4	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic	80	0.32	150.4	$24.67	4	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.22	103.4	$16.96	$100.00	$400.00	0.10	47	$7.71	51.89
61		470	2	0	1 Lamp Incandescents	50	0.10	47.0	$7.71	2	0	18 W CFL Lamp	18	0.04	16.92	$2.77	$5.75	$11.50	0.06	30.08	$4.93	2.33
39	A11	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$295.99	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$203.49	$100.00	$1,200.00	0.30	564	$92.50	12.97
39	A12	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$295.99	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$203.49	$100.00	$1,200.00	0.30	564	$92.50	12.97
62	Small Foyer	1880	6	4	4-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	130	0.78	1,466.4	$240.49	6	3	3 Lamp T-8 GE-332	47	0.28	530.16	$86.95	$29.36	$176.16	0.50	936.24	$153.54	1.15
63	Display Case	1880	1	0	1 Lamp Incandescents	40	0.04	75.2	$12.33	1	0	18 W CFL Lamp	18	0.02	33.84	$5.55	$5.75	$5.75	0.02	41.36	$6.78	0.85
39	Lunch Room	1880	50	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	4.00	7,520.0	$1,233.28	50	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	2.75	5170	$847.88	$100.00	$5,000.00	1.25	2350	$385.40	12.97
63	Storage	470	4	0	1 Lamp Incandescents	40	0.16	75.2	$12.33	4	0	18 W CFL Lamp	18	0.07	33.84	$5.55	$5.75	$23.00	0.09	41.36	$6.78	3.39
39	"Tolerance Hall"	2350	7	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.56	1,316.0	$215.82	7	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.39	904.75	$148.38	$100.00	$700.00	0.18	411.25	$67.45	10.38
36	Communication Closet	1880	4	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	0.52	977.6	$160.33	4	3	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.36	684.32	$112.23	$120.00	$480.00	0.16	293.28	$48.10	9.98
39	B-Hall	2350	19	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic	80	1.52	3,572.0	$585.81	19	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	1.05	2455.75	$402.74	$100.00	$1,900.00	0.48	1116.25	$183.07	10.38
39	Classroom B1	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B2	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B3	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B4	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B5	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B6	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B7	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B8	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97

39	Classroom B9	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B10	1880	9	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.72	1,353.6	$221.99	9	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.50	930.6	$152.62	$100.00	$900.00	0.23	423	$69.37	12.97
39	Classroom B11	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B12	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B12	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B14	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B15	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B16	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
39	Classroom B17	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256.0	$369.98	15	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.83	1551	$254.36	$100.00	$1,500.00	0.38	705	$115.62	12.97
60	Storage B13	470	1	0	3.- Lamp Incandescent	150	0.15	70.5	$11.56	1	0	(3) 18 W CFL Lamp	54	0.05	25.38	$4.16	$17.25	$17.25	0.10	45.12	$7.40	2.33
39	B-Hall Boys Bathroom	1880	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.24	451.2	$74.00	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	310.2	$50.87	$100.00	$300.00	0.08	141	$23.12	12.97
61	Custodial Closet	470	1	0	1 Lamp Incandescents	50	0.05	23.5	$3.85	1	0	18 W CFL Lamp	18	0.02	8.46	$1.39	$5.75	$5.75	0.03	15.04	$2.47	2.33
39	B-Hall Girls Bathroom	1880	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.24	451.2	$74.00	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	310.2	$50.87	$100.00	$300.00	0.08	141	$23.12	12.97
39	Hall Between A and B	2350	6	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.48	1,128.0	$184.99	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	775.5	$127.18	$100.00	$600.00	0.15	352.5	$57.81	10.38
49	Health Room	1880	17	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	1.24	2,333.1	$382.63	17	0	No Change	73	1.24	2333.08	$382.63	$0.00	$0.00	0.00	0	$0.00	0.00
64		1880	1	0	1-Lamp Compact Flourescent	17	0.02	32.0	$5.24	1	0	No Change	17	0.02	31.96	$5.24	$0.00	$0.00	0.00	0	$0.00	0.00
65		1880	1	1	1 - Lamp, T-12, Magnetic Ballast, Surface Mounted	28	0.03	52.6	$8.63	1	1	2' 1-Lamp T-8 17W wall Mtd. Metalux BC117	20	0.02	37.6	$6.17	$148.00	$148.00	0.01	15.04	$2.47	60.00
66		1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	56	0.11	210.6	$34.53	2	0	No Change	56	0.11	210.56	$34.53	$0.00	$0.00	0.00	0	$0.00	0.00
55	Faculty Room	1880	8	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.46	872.3	$143.06	8	0	No Change	58	0.46	872.32	$143.06	$0.00	$0.00	0.00	0	$0.00	0.00

58		1880	1	2	2-Lamp, T-12, U-Lamp, Magnetic Ballast, Recessed Mounted	60	0.06	112.8	$18.50	1	2	2'x2' 2-Lamp T-8, Prism Lens Electronic Ballast, Architectural surface or Recessed static METALUX 2AC-217-UNV-EB81-U	34	0.03	63.92	$10.48	$204.00	$204.00	0.03	48.88	$8.02	25.45
65	Men's Room	1880	1	1	1 - Lamp, T-12, Magnetic Ballast, Surface Mounted	28	0.03	52.6	$8.63	1	1	2' 1-Lamp T-8 17W wall Mtd. Metalux BC117	20	0.02	37.6	$6.17	$148.00	$148.00	0.01	15.04	$2.47	60.00
7	Small Instructional Suite	1880	15	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.87	1,635.6	$268.24	15	0	No Change	58	0.87	1635.6	$268.24	$0.00	$0.00	0.00	0	$0.00	0.00
7	Vice Principal's Office	1880	4	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.23	436.2	$71.53	4	0	No Change	58	0.23	436.16	$71.53	$0.00	$0.00	0.00	0	$0.00	0.00
67	Break Room	1880	2	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.16	308.3	$50.56	2	0	No Change	82	0.16	308.32	$50.56	$0.00	$0.00	0.00	0	$0.00	0.00
67	Room B29	1880	8	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.66	1,233.3	$202.26	8	0	No Change	82	0.66	1233.28	$202.26	$0.00	$0.00	0.00	0	$0.00	0.00
7	Staff Bathroom	1880	1	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.06	109.0	$17.88	1	0	No Change	58	0.06	109.04	$17.88	$0.00	$0.00	0.00	0	$0.00	0.00
24	Foyer	1880	2	0	1 - Lamp Compact Flourescent	18	0.04	67.7	$11.10	2	0	No Change	18	0.04	67.68	$11.10	$0.00	$0.00	0.00	0	$0.00	0.00
67	Room B32	1880	6	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.49	925.0	$151.69	6	0	No Change	82	0.49	924.96	$151.69	$0.00	$0.00	0.00	0	$0.00	0.00
67	Room B25	1880	9	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.74	1,387.4	$227.54	9	0	No Change	82	0.74	1387.44	$227.54	$0.00	$0.00	0.00	0	$0.00	0.00
67	Room B26	1880	6	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.49	925.0	$151.69	6	0	No Change	82	0.49	924.96	$151.69	$0.00	$0.00	0.00	0	$0.00	0.00
67	Office	1880	2	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.16	308.3	$50.56	2	0	No Change	82	0.16	308.32	$50.56	$0.00	$0.00	0.00	0	$0.00	0.00
67	Testing Room	1880	3	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.25	462.5	$75.85	3	0	No Change	82	0.25	462.48	$75.85	$0.00	$0.00	0.00	0	$0.00	0.00
66	New Hall-way	2350	3	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	56	0.17	394.8	$64.75	3	0	No Change	56	0.17	394.8	$64.75	$0.00	$0.00	0.00	0	$0.00	0.00
7		2350	11	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.64	1,499.3	$245.89	11	0	No Change	58	0.64	1499.3	$245.89	$0.00	$0.00	0.00	0	$0.00	0.00
7	C1	1880	2	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.12	218.1	$35.77	2	0	No Change	58	0.12	218.08	$35.77	$0.00	$0.00	0.00	0	$0.00	0.00
7	C2.1	1880	2	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.12	218.1	$35.77	2	0	No Change	58	0.12	218.08	$35.77	$0.00	$0.00	0.00	0	$0.00	0.00
13	Boys Bathroom	1880	1	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.11	204.9	$33.61	1	0	No Change	109	0.11	204.92	$33.61	$0.00	$0.00	0.00	0	$0.00	0.00
13	Girls Bathroom	1880	1	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.11	204.9	$33.61	1	0	No Change	109	0.11	204.92	$33.61	$0.00	$0.00	0.00	0	$0.00	0.00
68		1880	12	0	1 - Lamp T8, Electronic Ballast, Surface mounted	20	0.24	451.2	$74.00	12	0	No Change	20	0.24	451.2	$74.00	$0.00	$0.00	0.00	0	$0.00	0.00

55	Library	1880	52	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	3.02	5,670.1	$929.89	52	0	No Change	58	3.02	5670.08	$929.89	$0.00	$0.00	0.00	0	$0.00	0.00
24		1880	5	0	1 - Lamp Compact Flourescent	18	0.09	169.2	$27.75	5	0	No Change	18	0.09	169.2	$27.75	$0.00	$0.00	0.00	0	$0.00	0.00
55	Library Office	1880	2	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.12	218.1	$35.77	2	0	No Change	58	0.12	218.08	$35.77	$0.00	$0.00	0.00	0	$0.00	0.00
55	Work Room	1880	4	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.23	436.2	$71.53	4	0	No Change	58	0.23	436.16	$71.53	$0.00	$0.00	0.00	0	$0.00	0.00
13	Storage	1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.22	409.8	$67.21	2	0	No Change	109	0.22	409.84	$67.21	$0.00	$0.00	0.00	0	$0.00	0.00
55	Computer Room	1880	30	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	1.74	3,271.2	$536.48	30	0	No Change	58	1.74	3271.2	$536.48	$0.00	$0.00	0.00	0	$0.00	0.00
13	Trailer 1	1880	9	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.98	1,844.3	$302.46	9	0	No Change	109	0.98	1844.28	$302.46	$0.00	$0.00	0.00	0	$0.00	0.00
66		1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	56	0.11	210.6	$34.53	2	0	No Change	56	0.11	210.56	$34.53	$0.00	$0.00	0.00	0	$0.00	0.00
55		1880	3	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.17	327.1	$53.65	3	0	No Change	58	0.17	327.12	$53.65	$0.00	$0.00	0.00	0	$0.00	0.00
13	Trailer 2	1880	9	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.98	1,844.3	$302.46	9	0	No Change	109	0.98	1844.28	$302.46	$0.00	$0.00	0.00	0	$0.00	0.00
66		1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	56	0.11	210.6	$34.53	2	0	No Change	56	0.11	210.56	$34.53	$0.00	$0.00	0.00	0	$0.00	0.00
55		1880	3	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.17	327.1	$53.65	3	0	No Change	58	0.17	327.12	$53.65	$0.00	$0.00	0.00	0	$0.00	0.00
55	Trailer 3.A	1880	4	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.23	436.2	$71.53	4	0	No Change	58	0.23	436.16	$71.53	$0.00	$0.00	0.00	0	$0.00	0.00
55	Trailer 3.B	1880	4	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.23	436.2	$71.53	4	0	No Change	58	0.23	436.16	$71.53	$0.00	$0.00	0.00	0	$0.00	0.00
55	Trailer 4C	1880	5	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.29	545.2	$89.41	5	0	No Change	58	0.29	545.2	$89.41	$0.00	$0.00	0.00	0	$0.00	0.00
7	C-Hall	2350	15	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.87	2,044.5	$335.30	15	0	No Change	58	0.87	2044.5	$335.30	$0.00	$0.00	0.00	0	$0.00	0.00
24		2350	21	0	1 - Lamp Compact Flourescent	18	0.38	888.3	$145.68	21	0	No Change	18	0.38	888.3	$145.68	$0.00	$0.00	0.00	0	$0.00	0.00
13	Communications Closet	1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.22	409.8	$67.21	2	0	No Change	109	0.22	409.84	$67.21	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C21	1880	18	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.96	3,688.6	$604.92	18	0	No Change	109	1.96	3688.56	$604.92	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C5	1880	18	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.96	3,688.6	$604.92	18	0	No Change	109	1.96	3688.56	$604.92	$0.00	$0.00	0.00	0	$0.00	0.00

7	Prep Room	1880	4	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.23	436.2	$71.53	4	0	No Change	58	0.23	436.16	$71.53	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C6	1880	18	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.96	3,688.6	$604.92	18	0	No Change	109	1.96	3688.56	$604.92	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C20	1880	8	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.87	1,639.4	$268.86	8	0	No Change	109	0.87	1639.36	$268.86	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C19	1880	16	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.74	3,278.7	$537.71	16	0	No Change	109	1.74	3278.72	$537.71	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C18	1880	16	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.74	3,278.7	$537.71	16	0	No Change	109	1.74	3278.72	$537.71	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C7	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,868.9	$470.50	14	0	No Change	109	1.53	2868.88	$470.50	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C8	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,868.9	$470.50	14	0	No Change	109	1.53	2868.88	$470.50	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C9	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,868.9	$470.50	14	0	No Change	109	1.53	2868.88	$470.50	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C10	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,868.9	$470.50	14	0	No Change	109	1.53	2868.88	$470.50	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C11	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,868.9	$470.50	14	0	No Change	109	1.53	2868.88	$470.50	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C12	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,868.9	$470.50	14	0	No Change	109	1.53	2868.88	$470.50	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C13	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,868.9	$470.50	14	0	No Change	109	1.53	2868.88	$470.50	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C14	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,868.9	$470.50	14	0	No Change	109	1.53	2868.88	$470.50	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C15	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,868.9	$470.50	14	0	No Change	109	1.53	2868.88	$470.50	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C16	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,868.9	$470.50	14	0	No Change	109	1.53	2868.88	$470.50	$0.00	$0.00	0.00	0	$0.00	0.00
13	Classroom C17	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,868.9	$470.50	14	0	No Change	109	1.53	2868.88	$470.50	$0.00	$0.00	0.00	0	$0.00	0.00
13	Girls Bathroom	1880	3	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.33	614.8	$100.82	3	0	No Change	109	0.33	614.76	$100.82	$0.00	$0.00	0.00	0	$0.00	0.00
66		1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	56	0.11	210.6	$34.53	2	0	No Change	56	0.11	210.56	$34.53	$0.00	$0.00	0.00	0	$0.00	0.00
13	Boys Bathroom	1880	3	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.33	614.8	$100.82	3	0	No Change	109	0.33	614.76	$100.82	$0.00	$0.00	0.00	0	$0.00	0.00
66		1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	56	0.11	210.6	$34.53	2	0	No Change	56	0.11	210.56	$34.53	$0.00	$0.00	0.00	0	$0.00	0.00
7	Hall Between C-Wing and New Gym	2350	16	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.93	2,180.8	$357.65	16	0	No Change	58	0.93	2180.8	$357.65	$0.00	$0.00	0.00	0	$0.00	0.00
15	Gym	1880	24	0	High Pressure Sodium Lights	464	11.14	20,935.7	$3,433.45	24	0	No Change	464	11.14	20935.68	$3,433.45	$0.00	$0.00	0.00	0	$0.00	0.00

13	Gym Office	1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.22	409.8	$67.21	2	0	No Change	109	0.22	409.84	$67.21	$0.00	$0.00	0.00	0	$0.00	0.00
7	Gym Storage	1880	7	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.41	763.3	$125.18	7	0	No Change	58	0.41	763.28	$125.18	$0.00	$0.00	0.00	0	$0.00	0.00
7	Boys Bathroom	1880	3	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.17	327.1	$53.65	3	0	No Change	58	0.17	327.12	$53.65	$0.00	$0.00	0.00	0	$0.00	0.00
7	Girls Bathroom	1880	3	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.17	327.1	$53.65	3	0	No Change	58	0.17	327.12	$53.65	$0.00	$0.00	0.00	0	$0.00	0.00
7	Boiler Room	470	12	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.70	327.1	$53.65	12	0	No Change	58	0.70	327.12	$53.65	$0.00	$0.00	0.00	0	$0.00	0.00
55	Main Office	1880	9	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.52	981.4	$160.94	9	0	No Change	58	0.52	981.36	$160.94	$0.00	$0.00	0.00	0	$0.00	0.00
39	Lobby	1880	8	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.64	1,203.2	$197.32	8	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.44	827.2	$135.66	$100.00	$800.00	0.20	376	$61.66	12.97
70	Bathrooms	1880	4	0	3.- Lamp Incandescent	180	0.72	1,353.6	$221.99	4	0	(3) 18 W CFL Lamp	54	0.22	406.08	$66.60	$17.25	$69.00	0.50	947.52	$155.39	0.44
69		1880	1	0	2 - Lamp Incandescents	120	0.12	225.6	$37.00	1	0	(2) 18 W CFL Lamp	36	0.04	67.68	$11.10	$11.50	$11.50	0.08	157.92	$25.90	0.44
71	Outside	3640	24	0	High Pressure Sodium Lights, Wall Mount	300	7.20	26,208.0	$4,298.11	24	0	No Change	300	7.20	26208	$4,298.11	$0.00	$0.00	0.00	0	$0.00	0.00
24		3640	23	0	1 - Lamp Compact Flourescent	18	0.41	1,507.0	$247.14	23	0	No Change	18	0.41	1506.96	$247.14	$0.00	$0.00	0.00	0	$0.00	0.00
17		3640	4	0	1 Lamp Flood Light	90	0.36	1,310.4	$214.91	4	0	26 W CFL Lamp	26	0.10	378.56	$62.08	$5.75	$23.00	0.26	931.84	$152.82	0.15
72		3640	5	0	High Pressure Sodium Lights, Pole Mount	300	1.50	5,460.0	$895.44	5	0	No Change	300	1.50	5460	$895.44	$0.00	$0.00	0.00	0	$0.00	0.00
	Totals		1310	112			124.64	251,778	$41,291.53	1310	111			108.01	220,254	########		$58,125.66	16.63	31523	$5,169.80	11.24

NOTES: 1. Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.
2. Lamp totals only include T-12 tube replacment calculations

CEG Job #: 9C09080
Project: Denville Lakeview ES
Address: 44 Coopr Road
Denville, NJ 07834
Building SF: 82,007

"Denville Lakeview Elementary School"

KWH COST: $0.164

ECM #2: Lighting Controls

EXISTING LIGHTING										PROPOSED LIGHTING										SAVINGS			
CEG Type	Fixture Location	Yearly Usage	No. Fixts	No. Lamps	Fixture Type	Fixt Watts	Total kW	kWh/Yr Fixtures	Yearly $ Cost	No. Fixts	No. Lamps	Retro-Unit Description	Watts Used	Total kW	Reduction (%)	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
15	Auditorium	1880	8	0	High Pressure Sodium Lights	464	3.71	6,979	$1,144.48	8	0	None	464	3.71	0%	6,979	$1,144.48	$0.00	$0.00	0.00	0	$0.00	0.00
15	Stage	1880	4	0	High Pressure Sodium Lights	464	1.86	3,489	$572.24	4	0	None	464	1.86	0%	3,489	$572.24	$0.00	$0.00	0.00	0	$0.00	0.00
33		1880	1	0	1-Lamp Incandescents	75	0.08	141	$23.12	1	0	None	75	0.08	0%	141	$23.12	$0.00	$0.00	0.00	0	$0.00	0.00
54		1880	2	0	1 Lamp Incandescents	100	0.20	376	$61.66	2	0	None	100	0.20	0%	376	$61.66	$0.00	$0.00	0.00	0	$0.00	0.00
39	Classroom A1	1880	17	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.36	2,557	$419.32	17	2	Dual Technology Occupancy Sensor	80	1.36	10%	2,301	$377.38	$75.00	$75.00	0.00	255.68	$41.93	1.79
33	A1 Closet	1880	1	0	1-Lamp Incandescents	75	0.08	141	$23.12	1	0	None	75	0.08	0%	141	$23.12	$0.00	$0.00	0.00	0	$0.00	0.00
39		1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.08	150	$24.67	1	2	None	80	0.08	0%	150	$24.67	$0.00	$0.00	0.00	0	$0.00	0.00
39	Classroom A2	1880	17	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.36	2,557	$419.32	17	2	Dual Technology Occupancy Sensor	80	1.36	10%	2,301	$377.38	$75.00	$75.00	0.00	255.68	$41.93	1.79
33	A2 Closet	1880	1	0	1-Lamp Incandescents	75	0.08	141	$23.12	1	0	None	75	0.08	0%	141	$23.12	$0.00	$0.00	0.00	0	$0.00	0.00
39		1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.08	150	$24.67	1	2	None	80	0.08	0%	150	$24.67	$0.00	$0.00	0.00	0	$0.00	0.00
55	Principal's Office	1880	4	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic	58	0.23	436	$71.53	4	0	Dual Technology Occupancy Sensor	58	0.23	10%	393	$64.38	$75.00	$75.00	0.00	43.616	$7.15	10.49
56	Principal's Bathroom	1880	1	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	130	0.13	244	$40.08	1	3	None	130	0.13	0%	244	$40.08	$0.00	$0.00	0.00	0	$0.00	0.00
57	Communication Closet	1880	1	0	3.-Lamp Incandescent	225	0.23	423	$69.37	1	0	Dual Technology Occupancy Sensor	225	0.23	10%	381	$62.43	$75.00	$75.00	0.00	42.3	$6.94	10.81
58		1880	2	2	2-Lamp, T-12, U-Lamp, Magnetic Ballast, Recessed Mounted	60	0.12	226	$37.00	2	2		60	0.12	10%	203	$33.30	$75.00	$0.00	0.00	22.56	$3.70	0.00
39	A1 - A6 Hall	2350	13	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.04	2,444	$400.82	13	2	Dual Technology Occupancy Sensor	80	1.04	10%	2,200	$360.73	$225.00	$225.00	0.00	244.4	$40.08	5.61
55	Conference Room A	1880	6	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.35	654	$107.30	6	0	Dual Technology Occupancy Sensor	58	0.35	10%	589	$96.57	$75.00	$75.00	0.00	65.424	$10.73	6.99
39	Conference Room A Bathroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.08	150	$24.67	1	2	None	80	0.08	0%	150	$24.67	$0.00	$0.00	0.00	0	$0.00	0.00

55	Classroom A25	1880	2	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.12	218	$35.77	2	0	Dual Technology Occupancy Sensor	58	0.12	10%	196	$32.19	$75.00	$75.00	0.00	21.808	$3.58	20.97
39	Classroom A3	1880	16	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.28	2,406	$394.65	16	2	Dual Technology Occupancy Sensor	80	1.28	10%	2,166	$355.18	$75.00	$75.00	0.00	240.64	$39.46	1.90
39	Classroom A4	1880	16	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.28	2,406	$394.65	16	2	Dual Technology Occupancy Sensor	80	1.28	10%	2,166	$355.18	$75.00	$75.00	0.00	240.64	$39.46	1.90
39	Classroom A5	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,805	$295.99	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1,624	$266.39	$75.00	$75.00	0.00	180.48	$29.60	2.53
39	Classroom A6	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,805	$295.99	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1,624	$266.39	$75.00	$75.00	0.00	180.48	$29.60	2.53
39	Classroom A7	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,805	$295.99	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1,624	$266.39	$75.00	$75.00	0.00	180.48	$29.60	2.53
39	A-hall Girls Bathroom	1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.16	301	$49.33	2	2	Dual Technology Occupancy Sensor	80	0.16	10%	271	$44.40	$75.00	$75.00	0.00	30.08	$4.93	15.20
59	Janitor's Closet	470	1	0	2 - Lamp Incandescents	100	0.10	47	$7.71	1	0	Dual Technology Occupancy Sensor	100	0.10		47	$7.71		$0.00	0.00	0	$0.00	0.00
39	A-hall Boys Bathroom	1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.16	301	$49.33	2	2	Dual Technology Occupancy Sensor	80	0.16	10%	271	$44.40	$75.00	$75.00	0.00	30.08	$4.93	15.20
39	A8-A29 Hall	2350	9	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.72	1,692	$277.49	9	2	Dual Technology Occupancy Sensor	80	0.72	10%	1,523	$249.74	$225.00	$225.00	0.00	169.2	$27.75	8.11
39	Classroom A8	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,805	$295.99	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1,624	$266.39	$75.00	$75.00	0.00	180.48	$29.60	2.53
39	Classroom A29	1880	17	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.36	2,557	$419.32	17	2	Dual Technology Occupancy Sensor	80	1.36	10%	2,301	$377.38	$75.00	$75.00	0.00	255.68	$41.93	1.79
39	Classroom A29 Bathroom	1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.16	301	$49.33	2	2	Dual Technology Occupancy Sensor	80	0.16	10%	271	$44.40	$75.00	$75.00	0.00	30.08	$4.93	15.20
39	Boiler room Bathroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.08	150	$24.67	1	2	None	80	0.08	0%	150	$24.67	$0.00	$0.00	0.00	0	$0.00	0.00
39	Classroom A9	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,805	$295.99	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1,624	$266.39	$75.00	$75.00	0.00	180.48	$29.60	2.53
39	Classroom A10	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,805	$295.99	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1,624	$266.39	$75.00	$75.00	0.00	180.48	$29.60	2.53
39	Garage	470	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.16	75	$12.33	2	2	None	80	0.16	0%	75	$12.33	$0.00	$0.00	0.00	0	$0.00	0.00
60		470	1	0	3.- Lamp Incandescent	150	0.15	71	$11.56	1	0	None	150	0.15	0%	71	$11.56	$0.00	$0.00	0.00	0	$0.00	0.00

39	Storage	470	4	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic	80	0.32	150	$24.67	4	2	None	80	0.32	0%	150	$24.67	$0.00	$0.00	0.00	0	$0.00	0.00
61		470	2	0	1 Lamp Incandescents	50	0.10	47	$7.71	2	0	None	50	0.10	0%	47	$7.71	$0.00	$0.00	0.00	0	$0.00	0.00
39	A11	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,805	$295.99	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1,624	$266.39	$75.00	$75.00	0.00	180.48	$29.60	2.53
39	A12	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,805	$295.99	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1,624	$266.39	$75.00	$75.00	0.00	180.48	$29.60	2.53
62	Small Foyer	1880	6	4	4-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	130	0.78	1,466	$240.49	6	4	Dual Technology Occupancy Sensor	130	0.78	10%	1,320	$216.44	$75.00	$75.00	0.00	146.64	$24.05	3.12
63	Display Case	1880	1	0	1 Lamp Incandescents	40	0.04	75	$12.33	1	0	None	40	0.04	0%	75	$12.33	$0.00	$0.00	0.00	0	$0.00	0.00
39	Lunch Room	1880	50	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	4.00	7,520	$1,233.28	50	2	Dual Technology Occupancy Sensor	80	4.00	10%	6,768	$1,109.95	$75.00	$75.00	0.00	752	$123.33	0.61
63	Storage	470	4	0	1 Lamp Incandescents	40	0.16	75	$12.33	4	0	None	40	0.16	0%	75	$12.33	$0.00	$0.00	0.00	0	$0.00	0.00
39	"Tolerance Hall"	2350	7	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.56	1,316	$215.82	7	2	Dual Technology Occupancy Sensor	80	0.56	10%	1,184	$194.24	$225.00	$225.00	0.00	131.6	$21.58	10.43
36	Communication Closet	1880	4	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	0.52	978	$160.33	4	3	Dual Technology Occupancy Sensor	130	0.52	10%	880	$144.29	$75.00	$75.00	0.00	97.76	$16.03	4.68
39	B-Hall	2350	19	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic	80	1.52	3,572	$585.81	19	2	Dual Technology Occupancy Sensor	80	1.52	10%	3,215	$527.23	$225.00	$225.00	0.00	357.2	$58.58	3.84
39	Classroom B1	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B2	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B3	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B4	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B5	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B6	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B7	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B8	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03

39	Classroom B9	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B10	1880	9	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.72	1,354	$221.99	9	2	Dual Technology Occupancy Sensor	80	0.72	10%	1,218	$199.79	$75.00	$75.00	0.00	135.36	$22.20	3.38
39	Classroom B11	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B12	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B12	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B14	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B15	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B16	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
39	Classroom B17	1880	15	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.20	2,256	$369.98	15	2	Dual Technology Occupancy Sensor	80	1.20	10%	2,030	$332.99	$75.00	$75.00	0.00	225.6	$37.00	2.03
60	Storage B13	470	1	0	3.- Lamp Incandescent	150	0.15	71	$11.56	1	0	None	150	0.15	0%	71	$11.56	$0.00	$0.00	0.00	0	$0.00	0.00
39	B-Hall Boys Bathroom	1880	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.24	451	$74.00	3	2	Dual Technology Occupancy Sensor	80	0.24	10%	406	$66.60	$75.00	$75.00	0.00	45.12	$7.40	10.14
61	Custodial Closet	470	1	0	1 Lamp Incandescents	50	0.05	24	$3.85	1	0	None	50	0.05	0%	24	$3.85	$0.00	$0.00	0.00	0	$0.00	0.00
39	B-Hall Girls Bathroom	1880	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.24	451	$74.00	3	2	Dual Technology Occupancy Sensor	80	0.24	10%	406	$66.60	$75.00	$75.00	0.00	45.12	$7.40	10.14
39	Hall Between A and B	2350	6	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.48	1,128	$184.99	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	1,015	$166.49	$150.00	$150.00	0.00	112.8	$18.50	8.11
49	Health Room	1880	17	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	1.24	2,333	$382.63	17	0	Dual Technology Occupancy Sensor	73	1.24	10%	2,100	$344.36	$75.00	$75.00	0.00	233.308	$38.26	1.96
64		1880	1	0	1-Lamp Compact Flourescent	17	0.02	32	$5.24	1	0		17	0.02	10%	29	$4.72	$0.00	$0.00	0.00	3.196	$0.52	0.00
65	Faculty Room	1880	1	1	1 - Lamp, T-12, Magnetic Ballast, Surface Mounted	28	0.03	53	$8.63	1	1	Dual Technology Occupancy Sensor	28	0.03	10%	47	$7.77	$0.00	$0.00	0.00	5.264	$0.86	0.00
66		1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	56	0.11	211	$34.53	2	0		56	0.11	10%	190	$31.08	$0.00	$0.00	0.00	21.056	$3.45	0.00
55		1880	8	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.46	872	$143.06	8	0		58	0.46	10%	785	$128.75	$75.00	$75.00	0.00	87.232	$14.31	5.24

58		1880	1	2	2-Lamp, T-12, U-Lamp, Magnetic Ballast, Recessed Mounted	60	0.06	113	$18.50	1	2		60	0.06	10%	102	$16.65	$0.00	$0.00	0.00	11.28	$1.85	0.00
65	Men's Room	1880	1	1	1 - Lamp, T-12, Magnetic Ballast, Surface Mounted	28	0.03	53	$8.63	1	1	Dual Technology Occupancy Sensor	28	0.03	10%	47	$7.77	$75.00	$75.00	0.00	5.264	$0.86	86.88
7	Small Instructional Suite	1880	15	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.87	1,636	$268.24	15	0	Dual Technology Occupancy Sensor	58	0.87	10%	1,472	$241.41	$75.00	$75.00	0.00	163.56	$26.82	2.80
7	Vice Principal's Office	1880	4	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.23	436	$71.53	4	0	Dual Technology Occupancy Sensor	58	0.23	10%	393	$64.38	$75.00	$75.00	0.00	43.616	$7.15	10.49
67	Break Room	1880	2	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.16	308	$50.56	2	0	Dual Technology Occupancy Sensor	82	0.16	10%	277	$45.51	$75.00	$75.00	0.00	30.832	$5.06	14.83
67	Room B29	1880	8	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.66	1,233	$202.26	8	0	Dual Technology Occupancy Sensor	82	0.66	10%	1,110	$182.03	$75.00	$75.00	0.00	123.328	$20.23	3.71
7	Staff Bathroom	1880	1	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.06	109	$17.88	1	0	None	58	0.06	0%	109	$17.88	$0.00	$0.00	0.00	0	$0.00	0.00
24	Foyer	1880	2	0	1 - Lamp Compact Flourescent	18	0.04	68	$11.10	2	0	None	18	0.04	0%	68	$11.10	$0.00	$0.00	0.00	0	$0.00	0.00
67	Room B32	1880	6	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.49	925	$151.69	6	0	Dual Technology Occupancy Sensor	82	0.49	10%	832	$136.52	$75.00	$75.00	0.00	92.496	$15.17	4.94
67	Room B25	1880	9	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.74	1,387	$227.54	9	0	Dual Technology Occupancy Sensor	82	0.74	10%	1,249	$204.79	$75.00	$75.00	0.00	138.744	$22.75	3.30
67	Room B26	1880	6	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.49	925	$151.69	6	0	Dual Technology Occupancy Sensor	82	0.49	10%	832	$136.52	$75.00	$75.00	0.00	92.496	$15.17	4.94
67	Office	1880	2	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.16	308	$50.56	2	0	Dual Technology Occupancy Sensor	82	0.16	10%	277	$45.51	$75.00	$75.00	0.00	30.832	$5.06	14.83
67	Testing Room	1880	3	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.25	462	$75.85	3	0	Dual Technology Occupancy Sensor	82	0.25	10%	416	$68.26	$75.00	$75.00	0.00	46.248	$7.58	9.89
66	New Hall-way	2350	3	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	56	0.17	395	$64.75	3	0	Dual Technology Occupancy Sensor	56	0.17	10%	355	$58.27	$150.00	$150.00	0.00	39.48	$6.47	23.17
7		2350	11	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.64	1,499	$245.89	11	0		58	0.64	10%	1,349	$221.30	$0.00	$0.00	0.00	149.93	$24.59	0.00
7	C1	1880	2	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.12	218	$35.77	2	0	Dual Technology Occupancy Sensor	58	0.12	10%	196	$32.19	$75.00	$75.00	0.00	21.808	$3.58	20.97
7	C2.1	1880	2	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.12	218	$35.77	2	0	Dual Technology Occupancy Sensor	58	0.12	10%	196	$32.19	$75.00	$75.00	0.00	21.808	$3.58	20.97
13	Boys Bathroom	1880	1	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.11	205	$33.61	1	0	Dual Technology Occupancy Sensor	109	0.11	10%	184	$30.25	$75.00	$75.00	0.00	20.492	$3.36	22.32
13	Girls Bathroom	1880	1	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.11	205	$33.61	1	0	Dual Technology Occupancy Sensor	109	0.11	10%	184	$30.25	$75.00	$75.00	0.00	20.492	$3.36	22.32
68		1880	12	0	1 - Lamp T8, Electronic Ballast, Surface mounted	20	0.24	451	$74.00	12	0		20	0.24	10%	406	$66.60	$150.00	$150.00	0.00	45.12	$7.40	20.27

55	Library	1880	52	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	3.02	5,670	$929.89	52	0	Dual Technology Occupancy Sensor	58	3.02	10%	5,103	$836.90		$0.00	0.00	567.008	$92.99	0.00
24		1880	5	0	1 - Lamp Compact Flourescent	18	0.09	169	$27.75	5	0		18	0.09	10%	152	$24.97	$0.00	$0.00	0.00	16.92	$2.77	0.00
55	Library Office	1880	2	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.12	218	$35.77	2	0	Dual Technology Occupancy Sensor	58	0.12	10%	196	$32.19	$75.00	$75.00	0.00	21.808	$3.58	20.97
55	Work Room	1880	4	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.23	436	$71.53	4	0	Dual Technology Occupancy Sensor	58	0.23	10%	393	$64.38	$75.00	$75.00	0.00	43.616	$7.15	10.49
13	Storage	1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.22	410	$67.21	2	0	Dual Technology Occupancy Sensor	109	0.22	10%	369	$60.49	$75.00	$75.00	0.00	40.984	$6.72	11.16
55	Computer Room	1880	30	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	1.74	3,271	$536.48	30	0	Dual Technology Occupancy Sensor	58	1.74	10%	2,944	$482.83	$75.00	$75.00	0.00	327.12	$53.65	1.40
13	Trailer 1	1880	9	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.98	1,844	$302.46	9	0	Dual Technology Occupancy Sensor	109	0.98	10%	1,660	$272.22	$75.00	$75.00	0.00	184.428	$30.25	2.48
66		1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	56	0.11	211	$34.53	2	0		56	0.11	10%	190	$31.08	$0.00	$0.00	0.00	21.056	$3.45	0.00
55		1880	3	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.17	327	$53.65	3	0		58	0.17	10%	294	$48.28	$0.00	$0.00	0.00	32.712	$5.36	0.00
13	Trailer 2	1880	9	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.98	1,844	$302.46	9	0	Dual Technology Occupancy Sensor	109	0.98	10%	1,660	$272.22	$75.00	$75.00	0.00	184.428	$30.25	2.48
66		1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	56	0.11	211	$34.53	2	0		56	0.11	10%	190	$31.08	$75.00	$0.00	0.00	21.056	$3.45	0.00
55		1880	3	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.17	327	$53.65	3	0		58	0.17	10%	294	$48.28	$75.00	$0.00	0.00	32.712	$5.36	0.00
55	Trailer 3.A	1880	4	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.23	436	$71.53	4	0	Dual Technology Occupancy Sensor	58	0.23	10%	393	$64.38	$75.00	$75.00	0.00	43.616	$7.15	10.49
55	Trailer 3.B	1880	4	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.23	436	$71.53	4	0	Dual Technology Occupancy Sensor	58	0.23	10%	393	$64.38	$75.00	$75.00	0.00	43.616	$7.15	10.49
55	Trailer 4C	1880	5	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.29	545	$89.41	5	0	Dual Technology Occupancy Sensor	58	0.29	10%	491	$80.47	$75.00	$75.00	0.00	54.52	$8.94	8.39
7	C-Hall	2350	15	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.87	2,045	$335.30	15	0	Dual Technology Occupancy Sensor	58	0.87	10%	1,840	$301.77	$225.00	$225.00	0.00	204.45	$33.53	6.71
24		2350	21	0	1 - Lamp Compact Flourescent	18	0.38	888	$145.68	21	0		18	0.38	10%	799	$131.11		$0.00	0.00	88.83	$14.57	0.00
13	Communications Closet	1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.22	410	$67.21	2	0	Dual Technology Occupancy Sensor	109	0.22	10%	369	$60.49	$75.00	$75.00	0.00	40.984	$6.72	11.16
13	Classroom C21	1880	18	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.96	3,689	$604.92	18	0	Dual Technology Occupancy Sensor	109	1.96	10%	3,320	$544.43	$75.00	$75.00	0.00	368.856	$60.49	1.24
13	Classroom C5	1880	18	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.96	3,689	$604.92	18	0	Dual Technology Occupancy Sensor	109	1.96	10%	3,320	$544.43	$75.00	$75.00	0.00	368.856	$60.49	1.24

7	Prep Room	1880	4	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.23	436	$71.53	4	0	Dual Technology Occupancy Sensor	58	0.23	10%	393	$64.38	$75.00	$75.00	0.00	43.616	$7.15	10.49
13	Classroom C6	1880	18	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.96	3,689	$604.92	18	0	Dual Technology Occupancy Sensor	109	1.96	10%	3,320	$544.43	$75.00	$75.00	0.00	368.856	$60.49	1.24
13	Classroom C20	1880	8	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.87	1,639	$268.86	8	0	Dual Technology Occupancy Sensor	109	0.87	10%	1,475	$241.97	$75.00	$75.00	0.00	163.936	$26.89	2.79
13	Classroom C19	1880	16	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.74	3,279	$537.71	16	0	Dual Technology Occupancy Sensor	109	1.74	10%	2,951	$483.94	$75.00	$75.00	0.00	327.872	$53.77	1.39
13	Classroom C18	1880	16	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.74	3,279	$537.71	16	0	Dual Technology Occupancy Sensor	109	1.74	10%	2,951	$483.94	$75.00	$75.00	0.00	327.872	$53.77	1.39
13	Classroom C7	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,869	$470.50	14	0	Dual Technology Occupancy Sensor	109	1.53	10%	2,582	$423.45	$75.00	$75.00	0.00	286.888	$47.05	1.59
13	Classroom C8	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,869	$470.50	14	0	Dual Technology Occupancy Sensor	109	1.53	10%	2,582	$423.45	$75.00	$75.00	0.00	286.888	$47.05	1.59
13	Classroom C9	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,869	$470.50	14	0	Dual Technology Occupancy Sensor	109	1.53	10%	2,582	$423.45	$75.00	$75.00	0.00	286.888	$47.05	1.59
13	Classroom C10	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,869	$470.50	14	0	Dual Technology Occupancy Sensor	109	1.53	10%	2,582	$423.45	$75.00	$75.00	0.00	286.888	$47.05	1.59
13	Classroom C11	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,869	$470.50	14	0	Dual Technology Occupancy Sensor	109	1.53	10%	2,582	$423.45	$75.00	$75.00	0.00	286.888	$47.05	1.59
13	Classroom C12	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,869	$470.50	14	0	Dual Technology Occupancy Sensor	109	1.53	10%	2,582	$423.45	$75.00	$75.00	0.00	286.888	$47.05	1.59
13	Classroom C13	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,869	$470.50	14	0	Dual Technology Occupancy Sensor	109	1.53	10%	2,582	$423.45	$75.00	$75.00	0.00	286.888	$47.05	1.59
13	Classroom C14	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,869	$470.50	14	0	Dual Technology Occupancy Sensor	109	1.53	10%	2,582	$423.45	$75.00	$75.00	0.00	286.888	$47.05	1.59
13	Classroom C15	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,869	$470.50	14	0	Dual Technology Occupancy Sensor	109	1.53	10%	2,582	$423.45	$75.00	$75.00	0.00	286.888	$47.05	1.59
13	Classroom C16	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,869	$470.50	14	0	Dual Technology Occupancy Sensor	109	1.53	10%	2,582	$423.45	$75.00	$75.00	0.00	286.888	$47.05	1.59
13	Classroom C17	1880	14	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.53	2,869	$470.50	14	0	Dual Technology Occupancy Sensor	109	1.53	10%	2,582	$423.45	$75.00	$75.00	0.00	286.888	$47.05	1.59
13	Girls Bathroom	1880	3	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.33	615	$100.82	3	0	Dual Technology Occupancy Sensor	109	0.33	10%	553	$90.74	$75.00	$75.00	0.00	61.476	$10.08	7.44
66		1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	56	0.11	211	$34.53	2	0		56	0.11	10%	190	$31.08	$0.00	$0.00	0.00	21.056	$3.45	0.00
13	Boys Bathroom	1880	3	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.33	615	$100.82	3	0	Dual Technology Occupancy Sensor	109	0.33	10%	553	$90.74	$75.00	$75.00	0.00	61.476	$10.08	7.44
66		1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	56	0.11	211	$34.53	2	0		56	0.11	10%	190	$31.08	$0.00	$0.00	0.00	21.056	$3.45	0.00
7	Hall Between C-Wing and New Gym	2350	16	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.93	2,181	$357.65	16	0	Dual Technology Occupancy Sensor	58	0.93	10%	1,963	$321.89	$150.00	$150.00	0.00	218.08	$35.77	4.19
15	Gym	1880	24	0	High Pressure Sodium Lights	464	11.14	20,936	$3,433.45	24	0	None	464	11.14	0%	20,936	$3,433.45	$0.00	$0.00	0.00	0	$0.00	0.00

13	Gym Office	1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.22	410	$67.21	2	0	Dual Technology Occupancy Sensor	109	0.22	10%	369	$60.49	$75.00	$75.00	0.00	40.984	$6.72	11.16
7	Gym Storage	1880	7	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.41	763	$125.18	7	0	Dual Technology Occupancy Sensor	58	0.41	10%	687	$112.66	$75.00	$75.00	0.00	76.328	$12.52	5.99
7	Boys Bathroom	1880	3	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.17	327	$53.65	3	0	Dual Technology Occupancy Sensor	58	0.17	10%	294	$48.28	$75.00	$75.00	0.00	32.712	$5.36	13.98
7	Girls Bathroom	1880	3	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.17	327	$53.65	3	0	Dual Technology Occupancy Sensor	58	0.17	10%	294	$48.28	$75.00	$75.00	0.00	32.712	$5.36	13.98
7	Boiler Room	470	12	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.70	327	$53.65	12	0	None	58	0.70	0%	327	$53.65	$0.00	$0.00	0.00	0	$0.00	0.00
55	Main Office	1880	9	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	58	0.52	981	$160.94	9	0	Dual Technology Occupancy Sensor	58	0.52	10%	883	$144.85	$75.00	$75.00	0.00	98.136	$16.09	4.66
39	Lobby	1880	8	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.64	1,203	$197.32	8	2	Dual Technology Occupancy Sensor	80	0.64	10%	1,083	$177.59	$75.00	$75.00	0.00	120.32	$19.73	3.80
70	Bathrooms	1880	4	0	3.- Lamp Incandescent	180	0.72	1,354	$221.99	4	0	Dual Technology Occupancy Sensor	180	0.72	10%	1,218	$199.79	$75.00	$75.00	0.00	135.36	$22.20	3.38
69		1880	1	0	2 - Lamp Incandescents	120	0.12	226	$37.00	1	0		120	0.12	10%	203	$33.30	$0.00	$0.00	0.00	22.56	$3.70	0.00
71	Outside	3640	24	0	High Pressure Sodium Lights, Wall Mount	300	7.20	26,208	$4,298.11	24	0	None	300	7.20	0%	26,208	$4,298.11	$0.00	$0.00	0.00	0	$0.00	0.00
24		3640	23	0	1 - Lamp Compact Flourescent	18	0.41	1,507	$247.14	23	0	None	18	0.41	0%	1,507	$247.14	$0.00	$0.00	0.00	0	$0.00	0.00
17		3640	4	0	1 Lamp Flood Light	90	0.36	1,310	$214.91	4	0	None	90	0.36	0%	1,310	$214.91	$0.00	$0.00	0.00	0	$0.00	0.00
72		3640	5	0	High Pressure Sodium Lights, Pole Mount	300	1.50	5,460	$895.44	5	0	None	300	1.50	0%	5,460	$895.44	$0.00	$0.00	0.00	0	$0.00	0.00
	Totals		1310	112			124.64	251,778	$41,291.53	1310	112			124.64		233,467	########		$8,850.00	0.00	18311	$3,002.93	2.95

NOTES: 1. Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.
2. Lamp totals only include T-12 tube replacment calculations

Project Name: LGEA Solar PV Project - Denville Lakeview Elementary School
Location: Denville, NJ
Description: Photovoltaic System 95% Financing - 25 year

Simple Payback Analysis

	Photovoltaic System 95% Financing - 25 year
Total Construction Cost	$2,156,940
Annual kWh Production	374,000
Annual Energy Cost Reduction	$61,336
Annual SREC Revenue	$130,900
First Cost Premium	**$2,156,940**
Simple Payback:	**11.22** Years

Life Cycle Cost Analysis

Analysis Period (years):	25	Financing %:	95%
Financing Term (mths):	240	Maintenance Escalation Rate:	3.0%
Average Energy Cost ($/kWh)	**$0.164**	Energy Cost Escalation Rate:	3.0%
Financing Rate:	7.00%	SREC Value ($/kWh)	$0.350

Period	Additional Cash Outlay	Energy kWh Production	Energy Cost Savings	Additional Maint Costs	SREC Revenue	Interest Expense	Loan Principal	Net Cash Flow	Cumulative Cash Flow
0	$107,847	0	0	0	$0	0	0	(107,847)	0
1	$0	374,000	$61,336	$0	$130,900	$141,892	$48,747	$1,597	($106,250)
2	$0	372,130	$63,176	$0	$130,246	$138,368	$52,271	$2,783	($103,467)
3	$0	370,270	$65,071	$0	$129,594	$134,590	$56,049	$4,027	($99,441)
4	$0	368,418	$67,024	$0	$128,946	$130,538	$60,101	$5,331	($94,110)
5	$0	366,576	$69,034	$3,776	$128,302	$126,193	$64,446	$2,921	($91,189)
6	$0	364,743	$71,105	$3,757	$127,660	$121,534	$69,105	$4,370	($86,819)
7	$0	362,920	$73,238	$3,738	$127,022	$116,539	$74,100	$5,883	($80,936)
8	$0	361,105	$75,436	$3,719	$126,387	$111,182	$79,457	$7,464	($73,472)
9	$0	359,300	$77,699	$3,701	$125,755	$105,438	$85,201	$9,114	($64,358)
10	$0	357,503	$80,030	$3,682	$125,126	$99,279	$91,360	$10,834	($53,524)
11	$0	355,716	$82,431	$3,664	$124,500	$92,674	$97,965	$12,628	($40,896)
12	$0	353,937	$84,903	$3,646	$123,878	$85,593	$105,047	$14,497	($26,399)
13	$0	352,167	$87,451	$3,627	$123,259	$77,999	$112,640	$16,443	($9,957)
14	$0	350,407	$90,074	$3,609	$122,642	$69,856	$120,783	$18,468	$8,511
15	$0	348,654	$92,776	$3,591	$122,029	$61,124	$129,515	$20,575	$29,087
16	$0	346,911	$95,560	$3,573	$121,419	$51,762	$138,877	$22,766	$51,853
17	$0	345,177	$98,426	$3,555	$120,812	$41,722	$148,917	$25,044	$76,896
18	$0	343,451	$101,379	$3,538	$120,208	$30,957	$159,682	$27,410	$104,307
19	$0	341,734	$104,421	$3,520	$119,607	$19,414	$171,225	$29,868	$134,175
20	$0	340,025	$107,553	$3,502	$119,009	$7,036	$183,603	$32,420	$166,596
21	$0	338,325	$110,780	$3,485	$118,414	$5,965	$168,788	$50,956	$217,552
22	$0	336,633	$114,103	$3,467	$117,822	$4,083	$138,897	$85,478	$303,030
23	$0	334,950	$117,526	$3,450	$117,232	$0	$0	$231,309	$534,338
24	$0	333,275	$121,052	$3,433	$116,646	$0	$0	$234,266	$768,604
25	$0	331,609	$124,684	$3,416	$116,063	$0	$0	$237,331	$1,005,935
	Totals:	7,135,145	$1,648,123	$58,198	$2,497,301	$1,763,690	$2,049,093	$2,356,778	$2,470,067
				Net Present Value (NPV)			**$149,791**		
				Internal Rate of Return (IRR)			**12.8%**		

Project Name: LGEA Solar PV Project - Denville Lakeview Elementary School
Location: Denville, NJ
Description: Photovoltaic System - Direct Purchase

Simple Payback Analysis

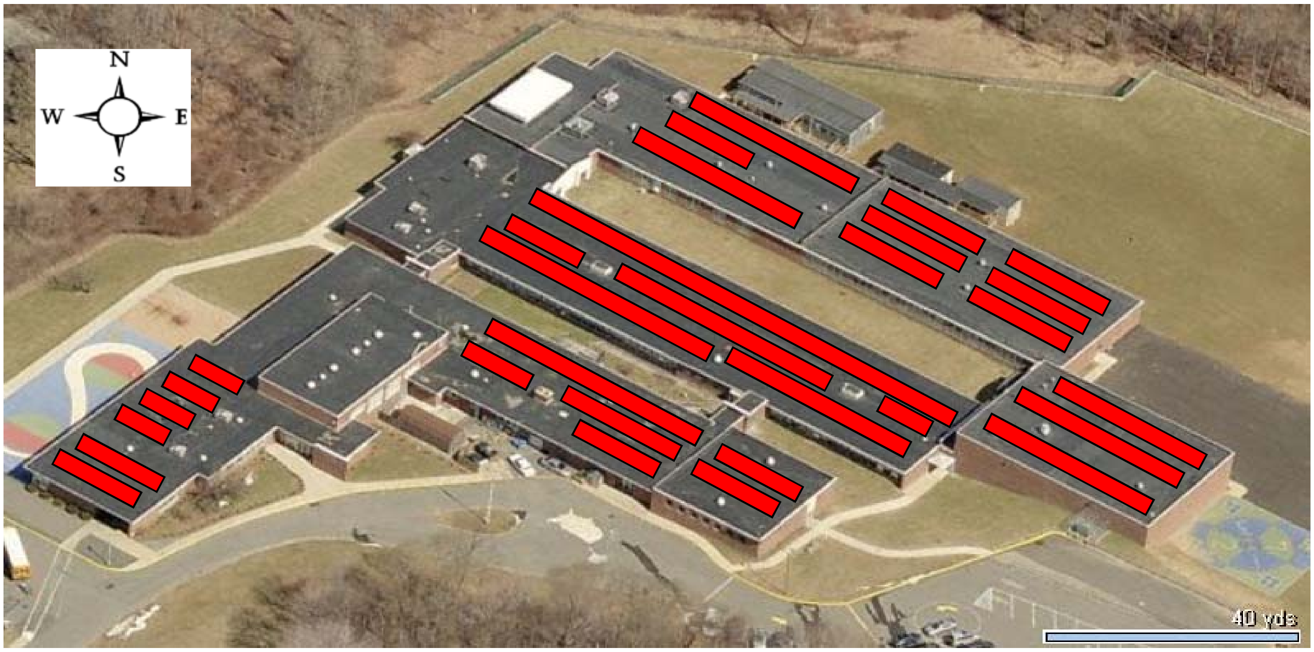
	Photovoltaic System - Direct Purchase
Total Construction Cost	$2,156,940
Annual kWh Production	374,000
Annual Energy Cost Reduction	$61,336
Annual SREC Revenue	$130,900
First Cost Premium	**$2,156,940**
Simple Payback:	**11.22** **Years**

Life Cycle Cost Analysis

Analysis Period (years):	25	Financing %:	0%
Financing Term (mths):	0	Maintenance Escalation Rate:	3.0%
Average Energy Cost ($/kWh)	**$0.164**	Energy Cost Escalation Rate:	3.0%
Financing Rate:	0.00%	SREC Value ($/kWh)	$0.350

Period	Additional Cash Outlay	Energy kWh Production	Energy Cost Savings	Additional Maint Costs	SREC Revenue	Net Cash Flow	Cumulative Cash Flow
0	$2,156,940	0	0	0	$0	(2,156,940)	0
1	$0	374,000	$61,336	$0	$130,900	$192,236	($1,964,704)
2	$0	372,130	$63,176	$0	$130,246	$193,422	($1,771,282)
3	$0	370,270	$65,071	$0	$129,594	$194,666	($1,576,616)
4	$0	368,418	$67,024	$0	$128,946	$195,970	($1,380,646)
5	$0	366,576	$69,034	$3,776	$128,302	$193,560	($1,187,086)
6	$0	364,743	$71,105	$3,757	$127,660	$195,009	($992,077)
7	$0	362,920	$73,238	$3,738	$127,022	$196,522	($795,555)
8	$0	361,105	$75,436	$3,719	$126,387	$198,103	($597,452)
9	$0	359,300	$77,699	$3,701	$125,755	$199,753	($397,699)
10	$0	357,503	$80,030	$3,682	$125,126	$201,473	($196,225)
11	$0	355,716	$82,431	$3,664	$124,500	$203,267	$7,042
12	$0	353,937	$84,903	$3,646	$123,878	$205,136	$212,178
13	$0	352,167	$87,451	$3,627	$123,259	$207,082	$419,259
14	$0	350,407	$90,074	$3,609	$122,642	$209,107	$628,367
15	$0	348,654	$92,776	$3,591	$122,029	$211,214	$839,581
16	$0	346,911	$95,560	$3,573	$121,419	$213,405	$1,052,986
17	$0	345,177	$98,426	$3,555	$120,812	$215,683	$1,268,669
18	$0	343,451	$101,379	$3,538	$120,208	$218,049	$1,486,719
19	$0	341,734	$104,421	$3,520	$119,607	$220,507	$1,707,226
20	$0	340,025	$107,553	$3,502	$119,009	$223,060	$1,930,286
21	$1	338,325	$110,780	$3,485	$118,414	$225,709	$2,155,994
22	$2	336,633	$114,103	$3,467	$117,822	$228,457	$2,384,452
23	$3	334,950	$117,526	$3,450	$117,232	$231,309	$2,615,760
24	$4	333,275	$121,052	$3,433	$116,646	$234,266	$2,850,026
25	$5	331,609	$124,684	$3,416	$116,063	$237,331	$3,087,357
	Totals:	7,135,145	$1,648,123	$58,198	$2,497,301	$5,244,297	$4,087,226
					Net Present Value (NPV)	**$3,087,382**	
					Internal Rate of Return (IRR)	**8.0%**	

Building	Roof Area (sq ft)	Panel	Qty	Panel Sq Ft	Panel Total Sq Ft	Total KW	Total Annual kWh	Panel Weight (33 lbs)	W/SQFT
Denville Lakeview Elementary School	15312	Sunpower SPR230	1042	14.7	15,322	239.66	374,000	34,386	15.64



.= Proposed PV Layout

Notes:
1. Estimated kWH based on 4.68 hours full output per day per 365 day year. Actual kWH will vary day to day.

ENERGY AUDIT – FINAL REPORT

RIVERVIEW ELEMENTARY SCHOOL

33 ST. MARY'S PLACE
DENVILLE, NJ 07834
ATTN: JOHN SERAPIGLIA,
BUSINESS ADMINISTRATOR

CEG PROJECT NO. 9C09080

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REPORT DISCLAIMER

I. EXECUTIVE SUMMARY

This report presents the findings of the energy audit conducted for:

Denville Board of Education
Riverview Elementary School
33 St. Mary's Place
Denville, NJ 07834

Municipal Contact Person: John Serapiglia
Facility Contact Person:

This audit is performed in connection with the New Jersey Clean Energy - Local Government Energy Audit Program. The energy audit is conducted to promote the mission of the office of Clean Energy, which is to use innovation and technology to solve energy and environmental problems in a way that improves the State's economy. This can be achieved through the wiser and more efficient use of energy.

The annual energy costs at this facility are as follows:

Electricity	$ 55,476
Natural Gas	$ 65,430
Total	$ 120,907

The potential annual energy cost savings for each energy conservation measure (ECM) are shown below in Table 1. Be aware that the ECM's are not additive because of the interrelation of some of the measures. This audit is consistent with an ASHRAE level 2 audit. The cost and savings for each measure is ± 20%. The evaluations are based on engineering estimations and industry standard calculation methods. More detailed analyses would require engineering simulation models, hard equipment specifications, and contractor bid pricing.

Table 1
Energy Conservation Measures (ECM's)

ECM NO.	DESCRIPTION	COST[A]	ANNUAL SAVINGS[B]	SIMPLE PAYBACK (YEARS)	SIMPLE ROI
1	Lighting Upgrade – General	$42,428	$5,525	7.7	13.0%
2	Lighting Controls	$4,015	$1,782	2.3	44.4%
3	HVAC System Controls	$189,684	$6,865	27.6	3.6%
4	Hot Water Reset Controller	$4,275	$3,243	1.3	75.9%
5	Solar PV – Direct Purchase	$989,460	$88,700	11.2	8.9%

Notes: A. Cost takes into consideration applicable NJ Smart Start™ incentives and maintenance savings.
B. Savings takes into consideration applicable maintenance savings.

The estimated demand and energy savings for each ECM is shown below in Table 2. The information in this table corresponds to the ECM's in Table 1.

Table 2
Estimated Energy Savings

ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELEC. DEMAND (KW)	ELEC. CONSUMPTION (KWH)	NAT GAS (THERMS)
1	Lighting Upgrade – General	15.7	31,532	-
2	Lighting Controls	-	10,673	-
3	HVAC System Controls	-	6,865	3,749
4	Hot Water Reset Controller	-	-	1,875
5	Solar PV – Direct Purchase	110	171,566	-

*Elec. Demand Savings are calculated for cooling season only. Elec. consumption savings are totaled annually.

Concord Engineering Group (CEG) recommends proceeding with the implementation of all ECM's that provide a calculated simple payback at or under ten (10) years. The following Energy Conservation Measures are recommended for the municipal building:

- **ECM #1:** Lighting Upgrade
- **ECM #2:** Lighting Controls
- **ECM #4:** Hot Water Reset Controller

In addition to the ECMs, there are maintenance and operational measures that can provide significant energy savings and provide immediate benefit. The ECMs listed above represent investments that can be made to the facility which are justified by the savings seen overtime. However, the maintenance items and small operational improvements below are typically achievable with on site staff or maintenance contractors and in turn have the potential to provide substantial operational savings compared to the costs associated. The following are recommendations which should be considered a priority in achieving an energy efficient building:

1. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%. Condenser coils at

window level such as window air conditioners are particularly susceptible to dust and dirt created from landscaping and people activity.

2. Maintain all weather stripping on entrance doors. The majority of the entrance doors in the facility have significant leakage area around the doors which increases infiltration into the building.
3. Clean all light fixtures to maximize light output. Cleaned light fixtures providing full light output, may prevent added task lighting from being turned on and left on.
4. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.
5. Set hot water re-circ pump temperature set-point below the domestic hot water supply temperature setting. This will avoid continuous operation of the hot water re-circ pump while still providing the benefit of on demand hot water to the remote fixtures in the facility. Provide a time clock in addition to hot water re-circ aqua stat to stop hot water circulation during unoccupied periods. Keeping the hot water piping hot 24/7 is unnecessary when fixtures will not be used and adds energy consumption in the cooling season due to added cooling load in the building.
6. Set all computers and computer monitors to run in power saving (standby or sleep) mode when not in use. Added heat output from computers compounds the work that air conditioners have to do to remove the heat.
7. Repair leaking faucets in janitorial closets, bathrooms, and maintenance rooms. Although this is not associated with direct energy savings, dripping faucets will corrode and cause calcification on plumbing fixtures resulting in pre-mature replacement.
8. A major concern for the facility is the extremely high gas usage compared to the heating square footage. This building consumes more gas heat than Valleyview middle school which is almost two times the size. A major contributor could be the ceiling plenum ventilation system. Investigate and confirm that all ceiling plenum ventilation hoods are operating correctly and most importantly, opening only when needed in the heating season could result in significant heating savings.

II. INTRODUCTION

The comprehensive energy audit covers the 47,421 square foot Riverview Elementary School that includes classrooms, support spaces, a gymnasium, cafeteria/all purpose room, and administrative offices.

Electrical and natural gas utility information is collected and analyzed for one full year's energy use of the building. The utility information allows for analysis of the building's operational characteristics; calculate energy benchmarks for comparison to industry averages, estimated savings potential, and baseline usage/cost to monitor the effectiveness of implemented measures. A computer spreadsheet is used to calculate benchmarks and to graph utility information (see Appendix A).

The Energy Use Index (EUI) is established for the building. Energy Use Index (EUI) is expressed in British Thermal Units/square foot/year (BTU/ft^2/yr), which is used to compare energy consumption to similar building types or to track consumption from year to year in the same building. The EUI is calculated by converting the annual consumption of all energy sources to BTU's and dividing by the area (gross square footage) of the building. Blueprints (where available) are utilized to verify the gross area of the facility. The EUI is a good indicator of the relative potential for energy savings. A low EUI indicates less potential for energy savings, while a high EUI indicates poor building performance therefore a high potential for energy savings.

Existing building architectural and engineering drawings (where available) are utilized for additional background information. The building envelope, lighting systems, HVAC equipment, and controls information gathered from building drawings allow for a more accurate and detailed review of the building. The information is compared to the energy usage profiles developed from utility data. Through the review of the architectural and engineering drawings a building profile can be defined that documents building age, type, usage, major energy consuming equipment or systems, etc.

The preliminary audit information is gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is spent and opportunities exist within a facility. The entire site is surveyed to inventory the following to gain an understanding of how each facility operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Facility-specific equipment

The building site visit is performed to survey all major building components and systems. The site visit includes detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs

provided by the building manager are collected along with the system and components to determine a more accurate impact on energy consumption.

III. METHOD OF ANALYSIS

Post site visit work includes evaluation of the information gathered, researching possible conservation opportunities, organizing the audit into a comprehensive report, and making recommendations on HVAC, lighting and building envelope improvements. Data collected is processed using energy engineering calculations to anticipate energy usage for each of the proposed energy conservation measures (ECMs). The actual building's energy usage is entered directly from the utility bills provided by the owner. The anticipated energy usage is compared to the historical data to determine energy savings for the proposed ECMs.

It is pertinent to note, that the savings noted in this report are not additive. The savings for each recommendation is calculated as standalone energy conservation measures. Implementation of more than one ECM may in some cases affect the savings of each ECM. The savings may in some cases be relatively higher if an individual ECM is implemented in lieu of multiple recommended ECMs. For example implementing reduced operating schedules for inefficient lighting will result in a greater relative savings. Implementing reduced operating schedules for newly installed efficient lighting will result in a lower relative savings, because there is less energy to be saved. If multiple ECM's are recommended to be implemented, the combined savings is calculated and identified appropriately.

ECMs are determined by identifying the building's unique properties and deciphering the most beneficial energy saving measures available that meet the specific needs of the facility. The building construction type, function, operational schedule, existing conditions, and foreseen future plans are critical in the evaluation and final recommendations. Energy savings are calculated base on industry standard methods and engineering estimations. Energy consumption is calculated based on manufacturer's cataloged information when new equipment is proposed.

Cost savings are calculated based on the actual historical energy costs for the facility. Installation costs include labor and equipment to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers. The NJ SmartStart Building® program incentives savings (where applicable) are included for the appropriate ECM's and subtracted from the installed cost. Maintenance savings are calculated where applicable and added to the energy savings for each ECM. The costs and savings are applied and a simple payback and simple return on investment (ROI) is calculated. The simple payback is based on the years that it takes for the savings to pay back the net installation cost (Net Installation divided by Net Savings.) A simple return on investment is calculated as the percentage of the net installation cost that is saved in one year (Net Savings divided by Net Installation.)

A simple life-time calculation is shown for each ECM. The life-time for each ECM is estimated based on the typical life of the equipment being replaced or altered. The energy savings is extrapolated throughout the life-time of the ECM. The total energy savings is calculated as the total life-time multiplied by the yearly savings.

IV. HISTORIC ENERGY CONSUMPTION/COST

A. Energy Usage / Tariffs

The electric usage profile (below) represents the actual electrical usage for the facility. Jersey Central Power and Light (JCP&L) provides electricity to the facility under their General Service Secondary Three-Phase rate structure. The electric utility measures consumption in kilowatt-hours (KWH) and maximum demand in kilowatts (KW). One KWH usage is equivalent to 1000 watts running for one hour. One KW of electric demand is equivalent to 1000 watts running at any given time. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges. Rates used in this report reflect the historical data received for the facility.

The gas usage profile shows the actual natural gas energy usage for the facility. New Jersey Natural Gas (NJN) provides natural gas to the facility along with a third party provider Pepco Energy Services. NJN provides natural gas under the General Supply Large (GSL) rate structure. The gas utility measures consumption in cubic feet x 100 (CCF), and converts the quantity into Therms of energy. One Therm is equivalent to 100,000 BTUs of energy.

The overall cost for utilities is calculated by dividing the total cost by the total usage. Based on the utility history provide, the average cost for utilities at this facility is as follows:

Description	Average
Electricity	16.7¢ / kWh
Natural Gas	$1.73 / Therm

Table 3
Electricity Billing Data

Utility Provider: JCP&L, General Service Secondary 3 Phase (Meter # G28742831)			
MONTH OF USE	**CONSUMPTION KWH**	**DEMAND**	**TOTAL BILL**
Jul-08	21,760	95.7	$4,139
Aug-08	26,080	66.7	$4,630
Sep-08	27,840	113.4	$5,138
Oct-08	25,920	87.4	$4,082
Nov-08	25,440	86.2	$4,028
Dec-08	29,120	98.9	$4,734
Jan-09	31,840	99.2	$5,242
Feb-09	30,560	96.5	$5,054
Mar-09	32,960	98.9	$5,334
Apr-09	32,800	94.2	$5,237
May-09	24,640	103.2	$4,015
Jun-09	22,400	115.5	$3,845
Totals	**331,360**	**115.5 Max**	**$55,476**
AVERAGE DEMAND 96.3 KW average			
AVERAGE RATE $0.167 $/kWh			

Figure 1
Electricity Usage Profile

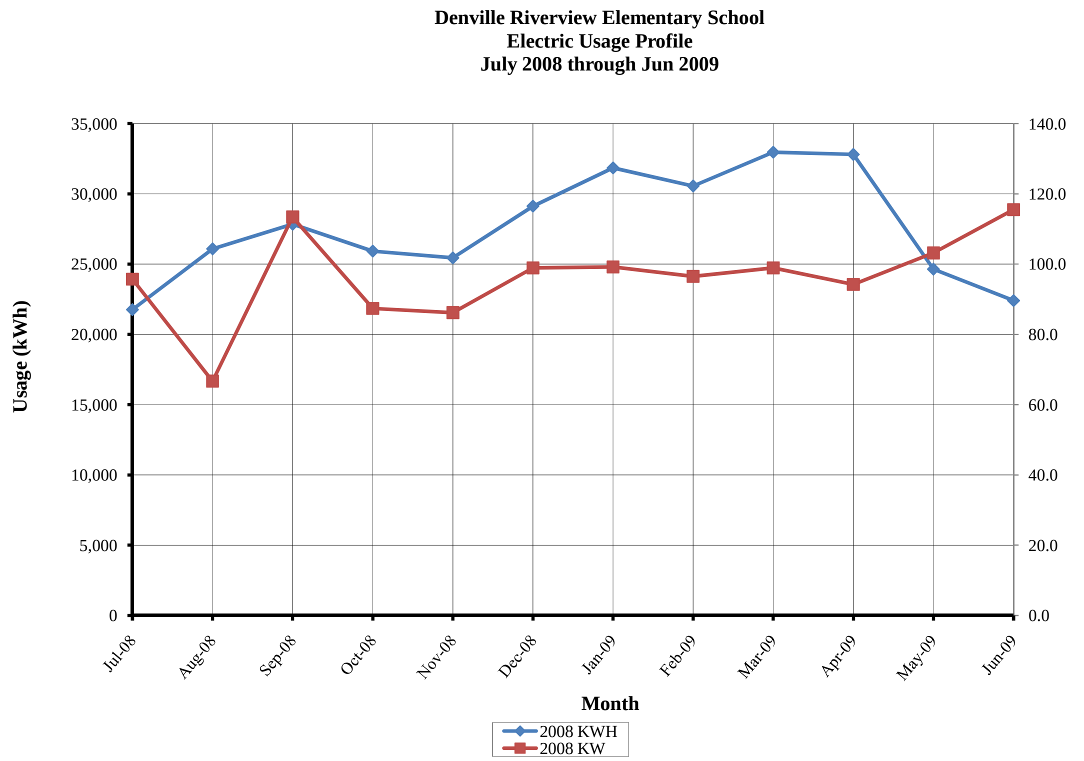
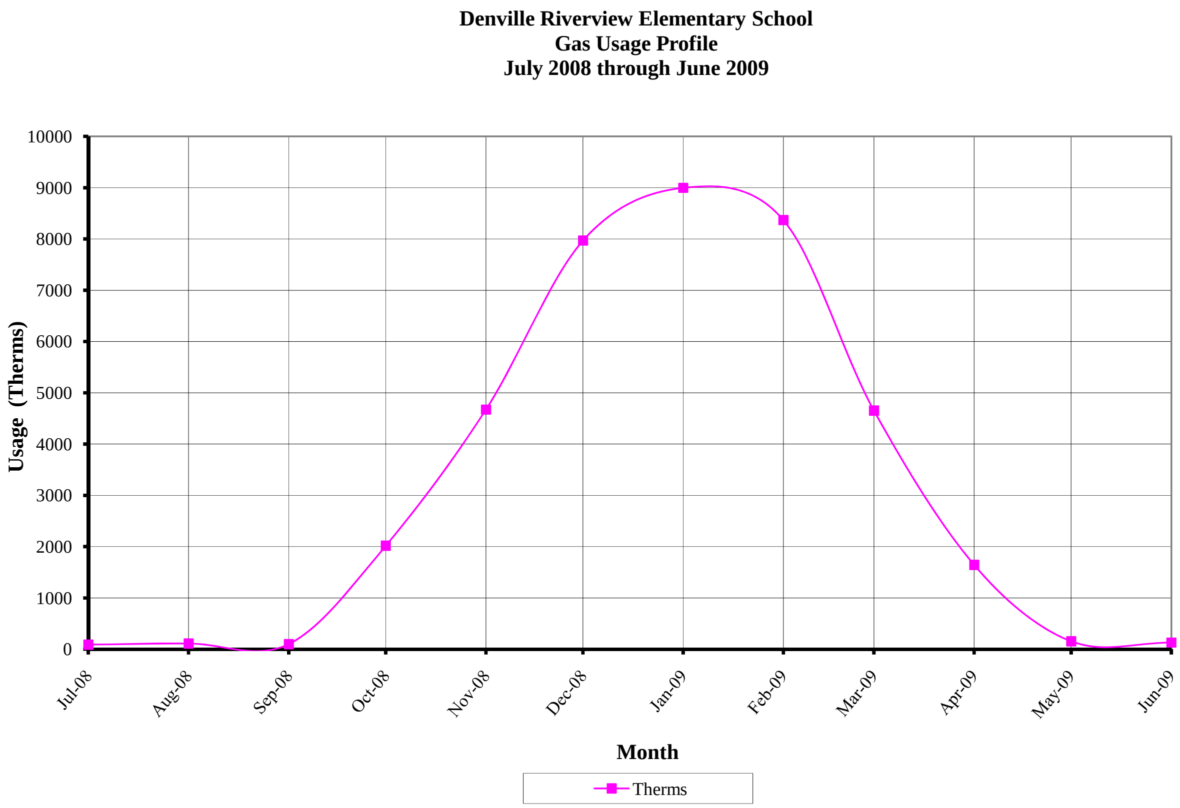


Table 4
Natural Gas Billing Data

Utility Provider: NJN, Rate - GSL, (Meter # 00546261)		
MONTH OF USE	**CONSUMPTION (THERMS)**	**TOTAL BILL**
Jul-08	89	$1,094.36
Aug-08	109	$1,087.26
Sep-08	97	$1,060.34
Oct-08	2,016	$3,697.08
Nov-08	4,672	$7,755.39
Dec-08	7,969	$12,762.98
Jan-09	8,996	$14,271.08
Feb-09	8,368	$12,859.09
Mar-09	4,653	$7,616.29
Apr-09	1,643	$3,226.44
May-09	152	$911.22
Jun-09	129	$875.17
TOTALS	**38,892**	**$67,217**
AVERAGE RATE:	**$1.73**	**$/THERM**

Figure 2
Natural Gas Usage Profile



B. Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (BTU) and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.

The site and source EUI for this facility is calculated as follows:

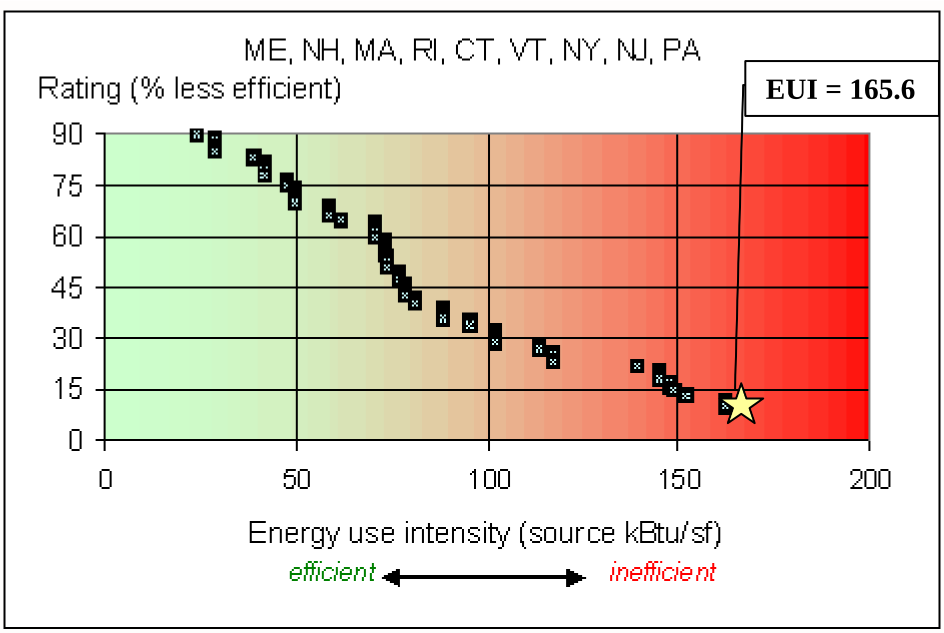
$$Building\ Site\ EUI = \frac{(Electric\ Usage\ in\ kBtu + Gas\ Usage\ in\ kBtu)}{Building\ Square\ Footage}$$

$$Building\ Source\ EUI = \frac{(Electric\ Usage\ in\ kBtu\ X\ SS\ Ratio + Gas\ Usage\ in\ kBtu\ X\ SS\ Ratio)}{Building\ Square\ Footage}$$

Table 5
Denville Riverview Elementary School EUI Calculations

ENERGY TYPE	BUILDING USE			SITE ENERGY	SITE-SOURCE	SOURCE ENERGY
	kWh	Therms	Gallons	kBtu	RATIO	kBtu
ELECTRIC	331,360			1,131,263	3.340	3,778,419
NATURAL GAS		38,891.97		3,889,197	1.047	4,071,989
FUEL OIL			0.00	0	1.010	0
PROPANE			0.00	0	1.010	0
TOTAL				5,020,460		7,850,408
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
BUILDING AREA		47,421		SQUARE FEET		
BUILDING SITE EUI		105.87		kBtu/SF/YR		
BUILDING SOURCE EUI		**165.55**		**kBtu/SF/YR**		

Figure 3
Source Energy Use Intensity Distributions: Schools



C. EPA Energy Benchmarking System

The United States Environmental Protection Agency (EPA) in an effort to promote energy management has created a system for benchmarking energy use amongst various end users. The benchmarking tool utilized for this analysis is entitled Portfolio Manager. The Portfolio Manager tool allows tracking and assessment of energy consumption via the template forms located on the ENERGY STAR website (www.energystar.gov). The importance of benchmarking for local government municipalities is becoming more important as utility costs continue to increase and emphasis is being placed on carbon reduction, greenhouse gas emissions and other environmental impacts.

Based on information gathered from the ENERGY STAR website, Government agencies spend more than $10 billion a year on energy to provide public services and meet constituent needs. Furthermore, energy use in commercial buildings and industrial facilities is responsible for more than 50 percent of U.S. carbon dioxide emissions. It is vital that local government municipalities assess facility energy usage, benchmark energy usage utilizing Portfolio Manager, set priorities and goals to lessen energy usage and move forward with priorities and goals.

In accordance with the Local Government Energy Audit Program, CEG has created an ENERGY STAR account for the municipality to access and monitoring the facility's yearly energy usage as it compares to facilities of similar type. The following is the user name and password for this account:

https://www.energystar.gov/istar/pmpam/index.cfm?fuseaction=login.login

User Name: denvilleboe
Password: lgeaceg2009

Security Question: What is your birth city?
Security Answer: "Denville"

The utility bills and other information gathered during the energy audit process are entered into the Portfolio Manager. The following is a summary of the results for the facility:

Table 6
ENERGY STAR Performance Rating

FACILITY DESCRIPTION	ENERGY PERFORMANCE RATING	NATIONAL AVERAGE
Denville Riverview ES	32	50

See the Statement of Energy Performance appendix for the detailed energy summary.

V. FACILITY DESCRIPTION

The 47,421 SF Elementary School is a two story facility comprised of classrooms, offices, cafeteria, kitchen, gymnasium, and library on the first floor, and additional classrooms on the 2nd floor. The building was originally a single story building built in 1951. A two story addition was added to the south side of the building in 1966, which includes a science room art room and classrooms. The typical school hours are between 8:30 am and 3:30 pm. The building construction is CMU block with face brick. The exterior walls have minimal insulation typical of the time period. It is unknown if the CMU blocks are filled. The windows throughout the facility are in good condition and appear to be maintained. The window type throughout the facility is double pane, clear glass with aluminum frames. Blinds are installed on the inside of some of the windows; however this is not standard throughout. The blinds are valuable because they help to reduce solar heat gain in the summer. The roof is a flat roof. Approximately 50% of the roof is a rubber roof and 50% light crushed stone. Roof insulation is above the metal deck. The amount of insulation below the roof membrane is unknown. Most doorways into the school are double doors with weather stripping either missing or in poor condition. The main entrance to the school does not have a vestibule.

HVAC Heating System

The School is heated by 3 large gas fired steam boilers. The boilers were installed in 2006 and are in good condition. Each boilers input capacity is 3753 MBH. The boilers are configured to produce low pressure steam since half of the building operates with steam terminal devices. Boiler steam is provided unit convectors, unit ventilators in the original part of the building. The addition portion of the building operates with a heating water loop. The boiler’s steam runs through a shell and tube heat exchanger to provide heat for the heating water loop. The heating water loop is circulated with two 3 HP base mounted pumps (operating and standby). The pumps are controlled by a local control panel. The heating water is circulated throughout the building to baseboards, unit ventilators, air handling units with hot water coils. The unit ventilators are operated manually and the blower typically runs 24/7. The heating equipment is controlled by a pneumatic system. The baseboards and hot water coil water flow as well as the steam flow for the unit convectors and unit ventilators are regulated by old pneumatic driven control valves. Some components in the pneumatic system do not respond and leak. Space temperatures are over / under heating in some areas in the heating season. The unit ventilators in the original portion of the building are currently being replaced with new steam unit ventilators.

HVAC Cooling System

The building does not have a central cooling system. A few spaces are air conditioned by either window air conditioners, split systems or packaged rooftop air conditioners. Window air conditioners are installed throughout the building for perimeter offices, support spaces, and classrooms as needed. The window AC unit are of various size, age, and capacity, and the range of efficiencies for the window AC units is 8.6 – 11.0 energy efficiency ratio (EER). The Packaged rooftop units provide conditioned air for higher heat load areas including the front office, library, and computer lab. A ductless split system is dedicated for the IT closet for 24/7 cooling. Approximately 50% of the school is air conditioned.

Due to the lack of cooling originally designed for the building, large ventilation ducts and Exhaust fans / hoods are in place to ventilate the ceiling plenum space. The intent of the ventilation system is to provide hot air relief through stack effect or mechanical exhaust of the ceiling plenum. Common practice would include back draft dampers or motor operated dampers which would close the relief hoods and turn off the exhaust fans in unoccupied periods and in the heating season. The hoods / exhaust fans appear old and in very poor condition. The dampers may be stuck open or not operational.

Exhaust System

Air is exhausted from the toilet rooms through the roof exhausters. The toilet room exhaust fans are operated manually by maintenance personnel and typically run 24/7. Many exhaust fans are manually disconnected from its electric supply, missing belts, and/or have burnt out motors. The ceiling plenum space is exhausted through large exhaust fans on the roof. Many of these units are not operating. It is unknown if the units include back draft dampers or motor operated dampers to prevent the loss of conditioned air in the heating season or unoccupied periods.

Domestic Hot Water

Domestic hot water for lavatories, office lounge, and kitchen facilities is provided by a dedicated gas fired hot water heater. The domestic hot water is independent of the central boiler system to avoid use of the heating boilers in the non heating season. The domestic hot water heater has a capacity of 71 gallons and input rating of 120 MBH. The domestic hot water is circulated throughout the building by a hot water re-circ pump. The circulation pump is controlled by an aqua stat. The set-point of the domestic hot water re-circ pump is set to 125°F which keeps the hot water circulating 24/7. The domestic hot water piping insulation appeared to be in good condition.

Lighting

Typical lighting throughout building is fluorescent tube lay-in fixtures with T-12 lamps and magnetic ballasts. Storage rooms and closets lit with a mixture of incandescent lamps and compact fluorescent lamps. The parking lot is lit with light poles and metal halide lamps. All interior lighting is manually controlled by the building occupants by wall switches. The gym is lit with high ceiling metal halide fixtures, and the auditorium is lit with high pressure sodium fixtures.

VI. MAJOR EQUIPMENT LIST

The equipment list is considered major energy consuming equipment and through replacement could yield substantial energy savings. The list shows the major equipment in the facility and all pertinent information utilized in energy savings calculations. An approximate age was assigned to the equipment if a manufactures date was not shown on the equipment's nameplate. The ASHRAE service life for the equipment along with the remaining useful life is also shown in the Appendix.

Refer to the Major Equipment List Appendix for this facility.

VII. ENERGY CONSERVATION MEASURES

ECM #1: Lighting Upgrade – General

Description:

The lighting in Riverview elementary school is primarily made up of fluorescent fixtures with T-12 lamps and magnetic ballasts. There are a few storage rooms and closets with incandescent lighting and compact fluorescent fixtures.

This ECM includes replacement of the existing fixtures containing T12 lamps and magnetic ballasts with fixtures containing T8 lamps and electronic ballasts. The new energy efficient, T8 fixtures will provide adequate lighting and will save the owner on electrical costs due to the better performance of the lamp and ballasts. This ECM will also provide maintenance savings through the reduced number of lamps replaced per year. The expected lamp life of a T8 lamp is approximately 30,000 burn-hours, in comparison to the existing T12 lamps which is approximately 20,000 burn-hours. The facility will need 33% less lamps replaced per year.

This ECM also includes replacement of all incandescent fixtures to compact fluorescent fixtures. The energy usage of an incandescent compared to a compact fluorescent approximately 3 to 4 times greater. In addition to the energy savings, compact fluorescent fixtures burn-hours are 8 to 15 times longer than incandescent fixtures ranging from 6,000 to 15,000 burn-hours compared to incandescent fixtures ranging from 750 to 1000 burn-hours.

Hours of Operation:

Classrooms, Hallways, Gym, Offices, Library, etc:
8 Hrs per day, 5 days per week, 47 weeks per year – 1880 Hrs per year.

Hallways:
10 Hrs per day, 5 days per week, 47 weeks per year – 2350 Hrs per year.

Storage rooms, Boiler room:
24% of normal hours (above) – 470 Hrs per year.

Outdoor Lighting:
10 Hrs per day, 7 days per week, 52 weeks per year – 3640 Hrs per year.

Energy Savings Calculations:

The Investment Grade Lighting Audit appendix outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start® Program Incentives are calculated as follows:

From the Smart Start Incentive appendix, the replacement of a T-12 fixture to a T-5 or T-8 fixture warrants the following incentive: T-5 or T-8 (1-2 lamp) = $10 per fixture; T-5 or T-8 (3-4 lamp) = $20 per fixture.

$$\text{Smart Start® } Incentive = (\#\, of\ 1-2\ lamp\ \ fixtures \times\ \$10) + (\#\, of\ 3-4\ lamp\ \ fixtures \times\ \$20)$$

$$\text{Smart Start® } Incentive = (407 \times\ \$10) + (57 \times\ \$20) = \underline{\$5{,}210}$$

Replacement and Maintenance Savings are calculated as follows:

$$Savings = (reduction\ in\ lamps\ replaced\ \ per\ \ year) \times (repacment\ \$\ per\ lamp + Labor\ \$\ per\ lamp)$$

$$Savings = (37\ lamps\ \ per\ \ year) \times (\$2.00 + \$5.00) = \underline{\$259}$$

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$47,638
NJ Smart Start Equipment Incentive ($):	($5,210)
Net Installation Cost ($):	$42,428
Maintenance Savings ($ / yr):	*$259*
Energy Savings ($ / yr):	*$5,266*
Net Savings ($ / yr):	*$5,525*
Simple Payback (yrs):	*7.7*
Simple Return On Investment (%):	*13.0%*
Estimated ECM Lifetime (Yr)	*25*
Simple Lifetime Savings ($)	*$138,125*

* ECM#1 Calculations <u>DO NOT</u> include lighting control changes implemented in ECM#2. If ECM#1 and #2 are implemented together the savings will be relatively lower than shown above.

ECM #2: Lighting Controls

Description:

In some areas the lighting is left on unnecessarily. In many cases the lights are left on because of the inconvenience to manually switch lights off when a room is left or on when a room is first occupied. This is common in storage rooms that are occupied for only short periods and only a few times per day. In some instances lights are left on due to the misconception that it is better to keep the lights on rather than to continuously switch lights on and off. Although increased switching reduces lamp life, the energy savings outweigh the lamp replacement costs. The payback timeframe for when to turn the lights off is approximately two minutes. If the lights are off for at least a two minute interval, then it pays to shut them off.

Lighting controls come in many forms. Sometimes an additional switch is adequate to provide reduced lighting levels when full light output is not needed. Occupancy sensors detect motion and will switch the lights on when the room is occupied. Occupancy sensors can either be mounted in place of a current wall switch, or on the ceiling to cover large areas. Photocell control senses light levels and turn off or reduce lights when there is adequate daylight. Photocells are mostly used outside, but are becoming more popular in energy-efficient interior lighting designs as well.

ASHRAE Standard 90.1-2004 - Appendix G is a reference standard for modeling building efficiency. The standard estimates that lighting controls provide a 10% reduction in lighting power usage for daytime occupancies in buildings over 5,000 SF, and 15% reduction in buildings under 5,000 SF. This ECM includes dual technology occupancy sensors in each private office / faculty room, restrooms, classroom, and hallways.

The ECM includes replacement of standard wall switches with sensors wall switches for individual classrooms and offices. Sensors shall be manufactured by Sensorswitch, Watt Stopper or equivalent. See the “Investment Grade Lighting Audit” appendix for details.

The “Investment Grade Lighting Audit” appendix of this report includes the summary of lighting controls implemented in this ECM and outlines the proposed controls, costs, savings, and payback periods. The calculations adjust the lighting power usage by 10% for all areas that include occupancy sensor lighting controls.

Light Energy = 106,731 kWh/Yr. occupancy sensor controlled lighting

Energy Savings Calculations:

$$Energy\ Savings = 10\% \times Occuapancy\ Sensored\ Light\ Energy\ (kWh/Yr)$$

$$Energy\ Savings = 10\% \times 106{,}731\,(kWh) = 10{,}673\,(kWh)$$

$$Savings. = Energy\ Savings\ (kWh) \times Ave\ Elec\ Cost\left(\frac{\$}{kWh}\right)$$

$$Savings. = 10{,}673\ (kWh) \times 0.167\left(\frac{\$}{kWh}\right) = \$1{,}782$$

Installation cost per dual-technology sensor (Basis: Sensor switch or equivalent) is $75/unit including material and labor.

Installation Cost = $75 x 73 motion sensors = $5,475

From the NJ Smart Start appendix, the installation of a lighting control device warrants the following incentive: occupancy = $20 per fixture.

$$\text{Smart Start® } Incentive = (\#\ of\ \ wall\ mount\ devices \times\ \$\ 20) = (73 \times \$20) = \$1460$$

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY*	
Installation Cost ($):	$5,475
NJ Smart Start Equipment Incentive ($):	$1,460
Net Installation Cost ($):	*$4,015*
Maintenance Savings ($ / yr):	*$0*
Energy Savings ($ / yr):	*$1,782*
Total Energy Savings ($ / yr):	*$1,782*
Simple Payback (yrs):	*2.3*
Simple Return On Investment (%)	*44.4%*
Estimated ECM Lifetime (Yr)	*15*
Simple Lifetime Savings ($)	*$26,730*

* ECM#2 Calculations DO NOT include lighting changes implemented in ECM#1. If ECM#1 and #2 are implemented together the savings will be relatively lower than shown above.

ECM #3: HVAC System Controls

Description:

The existing control system is an outdated pneumatic control system. The zone thermostats are manually set pneumatic actuators controlling local control valves within the space. The system is original to the building's heating system installed in 1963. The space thermostats are inaccurate due to temperature drift over time, leakage, or frozen actuators. The thermostats do not have programmability such as night set back, or morning warm-up features. Modern thermostats and control systems have the capability of saving siginificant energy as well as improve occupant comfort.

This ECM includes installing a Building Automation system through Direct Digital Controls (DDC) wired through an Ethernet backbone and front end controller. The system will include new thermostat controllers for terminal unit ventilators, baseboard zones, and air handling units, wired back to a front end controller with computer interface. The front end device will provide communication between the devices and the main boilers. The system will respond to the overall building's needs and operating schedules as defined by the building operator. The DDC system will provide features such as space averaging, temperature override control, night set-back, morning warm-up mode, heating water loop temperature re-set, etc.

The U.S. Department of Energy sponsored a study to analyze energy savings achieved through various types of building system controls. The referenced savings is based on the "Advanced Sensors and Controls for Building Applications: Market Assessment and Potential R&D Pathways," document posted for public use April 2005. The study has found that commercial buildings have the potential to achieve significant energy savings through the use of building controls. The average energy savings are as follows based on the report:

- Energy Management and Control System Savings - 5%-15%.
- Commissioning - 5%-15%.
- Automatic Fault Detection and Diagnostics - 5%-15%.
- Occupancy Sensors for Lighting Control - 20%-28%.
- Photosensor-Based Lighting Control -20%-60%.
- Demand Controlled Ventilation (DCV) -10%-15%.

Energy savings achieved for "Energy Management and Control Systems," average 5%-15%. Savings resulting from the implementation of this ECM for energy management controls are estimated to be 10% of the total energy cost for the facility.

The cost of a full DDC system with new field devices, controllers, computer, software, programming, etc. is approximately $4.00 per SF. Savings from the implementation of this ECM will be primarily achieved through natural gas savings from reduced heating energy. A small portion of savings will result from the cooling system management for the central AC systems

Cost of complete DDC System = ($4.00/SF x 47,421 SF) = $189,684.

Total Gas usage = 38,892 Therms

Estimated non-Heat gas usage (kitchen & HW) (*Averaged from May & June gas usage)	= 140 Therms*
Average Cost of Gas	= $1.73/Therm
Cooling Capacity (Office, Librayr, Comp Rm)	= 26 tons
Cooling Season Full Load Cooling Hrs.	= 800 hrs/yr.
Average Cooling Equipment EER	= 11.0 EER
Average Cost of Electricity	= $0.167/kWh

Energy Savings Calculations:

Heating Savings Calculations

$$Heating\ Gas\ Input = Total\ Cons.\ (Therms) - \left(Est.\ HW\ /\ Kitchen\ Use\left(\frac{Therms}{Month}\right) \times Use\left(\frac{Months}{Yr}\right)\right)$$

$$Heating\ Gas\ Input = 38{,}892\ (Therms) - \left(140\left(\frac{Therms}{Month}\right) \times 10\left(\frac{Months}{Yr}\right)\right) = 37{,}492 (Therms)$$

$$Savings. = Heating\ Gas\ Input (Therms) \times 10\%\ Savings \times Ave\ Gas\ Cost\left(\frac{\$}{Therm}\right)$$

$$Savings. = 37{,}492\ (Therms) \times 10\% \times 1.73\left(\frac{\$}{Therm}\right) = \$6{,}486$$

Cooling Savings Calculations

$$Est\ Cool\ Cons. = \frac{Cool\ Load\ (Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times Full\ Load\ Cooling\ Hrs.}{Ave\ Energy\ Efficiency\ Ratio\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)}$$

$$Est\ Cool\ Cons. = \frac{26\ (Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times 800\ Hrs.}{11.0\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)} = 22{,}691\ (kWh)$$

$$Savings. = Cool\ Cons. (kWh) \times 10\%\ Savings \times Ave\ Elec\ Cost\left(\frac{\$}{kWh}\right)$$

$$Savings. = 22{,}691\,(kWh) \times 10\% \times 0.167\left(\frac{\$}{kWh}\right) = \$379$$

$$Total\ ECM\ Savings = \$6{,}486 + \$379 = \$6{,}865$$

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY*	
Installation Cost ($):	$189,684
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$189,684
Maintenance Savings ($ / yr):	*$0*
Energy Savings ($ / yr):	*$6,865*
Total Energy Savings ($ / yr):	*$6,865*
Simple Payback (yrs):	*27.6*
Simple Return On Investment (%)	*3.6%*
Estimated ECM Lifetime (Yr)	*15*
Simple Lifetime Savings ($)	*$102,975*

ECM #4: Hot Water Reset Controller

Description:

The existing control system is an outdated pneumatic control system. The space thermostats are inaccurate and therefore overheat many spaces throughout the building. A hot water temperature re-set controller adjusts the heating hot water loop temperature based on the outdoor temperature. If the ambient conditions are warmer, the boiler controller decreases the heating water supply temperature to match the skin load. This reduces standby losses in the heating water piping system as well as minimizes overshooting of space temperatures by old thermostats with poor control.

This ECM includes installing a heating water temperature re-set controller on the heating hot water portion of the building. The controller would be mounted in the boiler room with a remote outside air temperature sensor. The controller would be connected to the steam control valve to the heating hot water loop which feeds approximately 50% of the building. This ECM only applies to the heating system energy usage

The U.S. Department of Energy sponsored a study to analyze energy savings achieved through various types of building system controls. The referenced savings is based on the “Advanced Sensors and Controls for Building Applications: Market Assessment and Potential R&D Pathways,” document posted for public use April 2005. The study has found that commercial buildings have the potential to achieve significant energy savings through the use of building controls. The average energy savings are as follows based on the report:

- Energy Management and Control System Savings - 5%-15%.
- Commissioning - 5%-15%.
- Automatic Fault Detection and Diagnostics - 5%-15%.
- Occupancy Sensors for Lighting Control - 20%-28%.
- Photosensor-Based Lighting Control -20%-60%.
- Demand Controlled Ventilation (DCV) -10%-15%.

Energy savings achieved for “Energy Management and Control Systems,” average 5%-15%. Savings resulting from the implementation of this ECM for energy management controls are estimated to be 10% of the heating energy for the facility.

The cost of a temperature re-set controller with the associated temperature sensors and field devices including labor is estimated at $4,275

Total Gas usage	= 38,892 Therms
Estimated non-Heat gas usage (kitchen & HW)	= 140 Therms*
(*Averaged from May & June gas usage)	
Average Cost of Gas	= $1.73/Therm

Heating Savings Calculations

$$Heating\ Gas\ Input = Total\ Cons.\ (Therms) - \left(Est.\ HW\ /\ Kitchen\ Use\left(\frac{Therms}{Month}\right) \times Use\ \left(\frac{Months}{Yr}\right)\right)$$

$$Heating\ Gas\ Input = 38{,}892\ (Therms) - \left(140\left(\frac{Therms}{Month}\right) \times 10\ \left(\frac{Months}{Yr}\right)\right) = 37{,}492(Therms)$$

$$Hot\ Water\ Portion\ of\ \ Building = Heating\ Gas\ Input\ (Therms) \times 50\%$$

$$Hot\ Water\ Portion\ of\ \ Building = 37{,}492\ (Therms) \times 50\% = 18{,}746(Therms)$$

$$Savings. = Heating\ Gas\ Input(Therms) \times 10\%\ Savings \times Ave\ Gas\ Cost\left(\frac{\$}{Therm}\right)$$

$$Savings. = 18{,}746\ (Therms) \times 10\% \times 1.73\ \left(\frac{\$}{Therm}\right) = \$3{,}243$$

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY*	
Installation Cost ($):	$4,275
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$4,275
Maintenance Savings ($ / yr):	*$0*
Energy Savings ($ / yr):	*$3,243*
Total Energy Savings ($ / yr):	*$3,243*
Simple Payback (yrs):	*1.3*
Simple Return On Investment (%)	*75.9%*
Estimated ECM Lifetime (Yr)	*15*
Simple Lifetime Savings ($)	*$64,125*

VIII. RENEWABLE/DISTRIBUTED ENERGY MEASURES

Globally, renewable energy has become a priority affecting international and domestic energy policy. The State of New Jersey has taken a proactive approach, and has recently adopted in its Energy Master Plan a goal of 30% renewable energy by 2020. To help reach this goal New Jersey created the Office of Clean Energy under the direction of the Board of Public Utilities and instituted a Renewable Energy Incentive Program to provide additional funding to private and public entities for installing qualified renewable technologies. A renewable energy source can greatly reduce a building's operating expenses while producing clean environmentally friendly energy. CEG has assessed the feasibility of installing renewable energy technologies for Branchburg NJ, and concluded that there is potential for solar energy generation.

Solar energy produces clean energy and reduces a building's carbon footprint. This is accomplished via photovoltaic panels which will be mounted on all south and southwestern facades of the building. Flat roof, as well as sloped areas can be utilized; flat areas will have the panels turned to an optimum solar absorbing angle. (A structural survey of the roof would be necessary before the installation of PV panels is considered). The state of NJ has instituted a program in which one Solar Renewable Energy Certificate (SREC) is given to the Owner for every 1000 kWh of generation. SREC's can be sold anytime on the market at their current market value. The value of the credit varies upon the current need of the power companies. The average value per credit is around $350, this value was used in our financial calculations. This equates to $0.35 per kWh generated.

CEG has reviewed the existing roof area of the building being audited for the purposes of determining a potential for a roof mounted photovoltaic system. A roof area of 7020 S.F. can be utilized for a PV system. A depiction of the area utilized is shown in Renewable / Distributed Energy Measures Calculation appendix. Using this square footage it was determined that a system size of 110 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 171,566 KWh annually, reducing the overall utility bill by approximately 51.8% percent. A detailed financial analysis can be found in the Renewable / Distributed Energy Measures Calculation appendix. This analysis illustrates the payback of the system over a 25 year period. The eventual degradation of the solar panels and the price of accumulated SREC's are factored into the payback.

CEG has reviewed financing options for the owner. Two options were studied and they are as follows: Self-financed and direct purchase without finance. Self-finance was calculated with 95% of the total project cost financed at a 7% interest rate over 25 years. Direct purchase involves the local government paying for 100% of the total project cost upfront via one of the methods noted in the Installation Funding Options section below. Both of these calculations include a utility inflation rate as well as the degradation of the solar panels over time. Based on our calculations the following are the payback periods for the respective method of payment:

PAYMENT TYPE	SIMPLE PAYBACK	SIMPLE ROI	INTERNAL RATE OF RETURN
Self-Finance	11.2 Years	8.9%	13.4%
Direct Purchase	11.3 Years	8.9%	8.1%

The resultant Internal Rate of Return indicates that if the Owner was able to “self-finance” the solar project, the project would be slightly more beneficial to the Owner. However, if the Owner was able to work out a Power Purchase Agreement with a third-party and agree upon a decent base energy rate for kilowatt hour production, the “direct purchase” option could also, prove to be a beneficial route.

In addition to the Solar Analysis, CEG also conducted a review of the applicability of wind energy for the facility. Wind energy production is another option available through the Renewable Energy Incentive Program. Wind turbines of various types can be utilized to produce clean energy on a per building basis. Cash incentives are available per kWh of electric usage. Based on CEG’s review of the applicability of wind energy for this facility, it was determined that the average wind speed is not adequate, and the kilowatt demand for the building is below the threshold (200 kW) for purchase of a commercial wind turbine. Therefore, wind energy is not a viable option.

IX. ENERGY PURCHASING AND PROCUREMENT STRATEGY

Load Profile:

Load Profile analysis was performed to determine the seasonal energy usage of the facility. Irregularities in the load profile will indicate potential problems within the facility. Consequently based on the profile a recommendation will be made to remedy the irregularity in energy usage. For this report, the facility's energy consumption data was gathered in table format and plotted in graph form to create the load profile. Refer to the Electric and Natural Gas Usage Profiles included within this report to reference the respective electricity and natural gas usage load profiles.

<u>Electricity:</u>

The Electric Usage Profile demonstrates a fairly flat (consistent) load shape throughout the year. There is some increased consumption in the winter period (November-March), with a slightly lower but very consistent usage April through October. This summer-time consumption is typically caused by air-conditioner load (cooling load). And in this case the cooling load is supplied by window units and packaged rooftop units. A flatter load profile of this type, will allow for more competitive energy prices when shopping for alternative suppliers.

<u>Natural Gas:</u>

The Natural Gas Usage Profile demonstrates a very typical natural gas (heat load) profile. The summer months (May – September) demonstrate extremely low consumption (complimenting the winter heating load). There is an increase in winter consumption (November – March). The increased winter load is caused by heating demand. In this facility the heat is supplied by 3 large natural gas fired boilers. Also adding to the natural gas demand is the presence of a natural gas fired hot water heater, which is independent of the central boiler system. A base-load shaping (flat) will secure more competitive energy prices when procuring energy through an alternative energy source.

Tariff Analysis:

<u>Electricity:</u>

This facility receives electrical service through Jersey Central Power & Light (JCP&L) on a GSS (General Service Secondary – 1 Phase) rate. Service classification GS is available for general service purposes on secondary voltages not included under Service Classifications RS, RT, RGT or GST. This facility's rate is a single or three phase service at secondary voltages. For electric supply (generation), the customer will use the utilities Basic Generation Service (BGS) or a Third Party Supplier (TPS). This facility uses Basic Generation service from the utility. Therefore, they will pay according to the BGS default service. The Delivery Service includes the following charges: Customer Charge, Supplemental Customer Charge, Distribution Charge (kW

Demand), kWh Charge, Non-utility Generation Charge, TEFA, SBC, SCC, Standby Fee and RGGI.

Natural Gas:

This facility receives natural gas Delivery Service through New Jersey Natural Gas Company on a GSL (General Service Large) tariff rate schedule. The GSL rate is available to any Customer in the entire territory served by the Company who uses 5,000 therms or more annually and uses gas for all purposes other than residential and interruptible service. Where the customer uses the Cooling, Air Conditioning and Pool Heating Service (CAC) under Special Provision 1 applicable to customers purchasing gas supply under Rider "A", the Company will, upon application of the Customer, meter the space heating and the "CAC" separately.

This service is considered a "firm" service, where the customer may either purchase gas from Company's Rider "A", for Basic Gas Supply Service (BGSS) or from a Marketer or Broker. A "firm service" is a higher priority of delivery on the natural gas pipeline. Typically the firm users do not have the capability of being interrupted by the utility, so the utility must provide a higher level of service. Much like the telecom industry, the natural gas pipelines were deregulated and various levels of delivery service were created. The "firm service" was the most reliable because it is last on the pecking order for interruption.

The basic charges under this tariff are for: Customer Charge, Demand Charge, Delivery Charge and if the customer elects, the BGSS Supply Charge. The customer can elect to have the Commodity Charge serviced through the utility or by a Third Party Supplier (TPS). Currently Denville is using the services of a TPS, Pepco Energy Services. Note: Should the TPS not deliver, then the customer will receive replacement service from the utility which carries an extremely high penalty cost of service, and is automatically delivered.

Imbalances can occur when Third Party Suppliers are used to supply natural gas and when full delivery is not made, and when a new supplier is contracted or the customer returns to the utility. It is important when utilizing a Third Party Supplier, that an experienced regional supplier is used, otherwise, under delivery can occur, jeopardizing economics and scheduling.

The information provided by Denville states that they are currently utilizing the service of a Third Party Supplier, Pepco Energy Services. CEG believes there is room within these energy costs, for improvement (please see comments under recommendations).

Recommendations:

CEG recommends a global approach that will be consistent with all facilities within the BOE. The primary area for potential improvement is seen in the electric costs. The average price per kWh (kilowatt hour) for all buildings based on 1-year historical average price is $.1388/kWh (this is the average "price to compare" if the client intends to shop for energy). The average price per decatherm for natural gas is $ 12.11 / dth (dth, is the common unit of measure). Energy commodities are among the most volatile of all commodities, however at this point and time, energy is extremely competitive. The BOE could see improvement in its energy costs if it were to take advantage of these current market prices quickly, before energy prices increase. Based on annual historical consumption (July 2008 through June 2009) and current electric rates, the BOE could see an improvement in its electric costs of up to 35% annually. (Note: Savings were calculated using Average Annual Consumption and a variance to a Fixed Average One-Year commodity contract). CEG recommends aggregating the entire electric load to gain the most optimal energy costs. CEG recommends advisement for alternative sourcing and supply of energy on a "managed approach".

CEG's secondary recommendation coincides with the natural gas costs. Based on the current market, Denville could improve its natural gas costs by up to 24%. Currently the BOE is utilizing the services of a Third Party Supplier, Pepco Energy Services. CEG recommends the BOE receive further advisement on these prices through an energy advisor. They should also consider procuring energy (natural gas) through an alternative supply source.

CEG also recommends scheduling a meeting with the current utility providers to review their utility charges and current tariff structures for electricity and natural gas. This meeting would provide insight regarding alternative procurement options that are currently available. Through its meeting with the Local Distribution Company (LDC), the municipality can learn more about the competitive supply process. The BOE can acquire a list of approved Third Party Suppliers from the New Jersey Board of Public Utilities website at www.nj.gov/bpu. They should also consider using a billing-auditing service to further analyze the utility invoices, manage the data and use the information for ongoing demand-side management projects. Furthermore, special attention should be given to credit mechanisms, imbalances, balancing charges and commodity charges when meeting with the utility representative. The Denville BOE should ask the utility representative about alternative billing options, such as consolidated billing when utilizing the service of a Third Party Supplier. Finally, if the supplier for energy (natural gas) is changed, closely monitor balancing, particularly when the contract is close to termination. This could be performed with the aid of an "energy advisor".

X. INSTALLATION FUNDING OPTIONS

CEG has reviewed various funding options for the facility owner to utilize in subsidizing the costs for installing the energy conservation measures noted within this report. Below are a few alternative funding methods:

i. *Energy Savings Improvement Program (ESIP)* – Public Law 2009, Chapter 4 authorizes government entities to make energy related improvements to their facilities and par for the costs using the value of energy savings that result from the improvements. The "Energy Savings Improvement Program (ESIP)" law provides a flexible approach that can allow all government agencies in New Jersey to improve and reduce energy usage with minimal expenditure of new financial resources.

ii. *Municipal Bonds* – Municipal bonds are a bond issued by a city or other local government, or their agencies. Potential issuers of municipal bonds include cities, counties, redevelopment agencies, school districts, publicly owned airports and seaports, and any other governmental entity (or group of governments) below the state level. Municipal bonds may be general obligations of the issuer or secured by specified revenues. Interest income received by holders of municipal bonds is often exempt from the federal income tax and from the income tax of the state in which they are issued, although municipal bonds issued for certain purposes may not be tax exempt.

iii. *Power Purchase Agreement* – Public Law 2008, Chapter 3 authorizes contractor of up to fifteen (15) years for contracts commonly known as "power purchase agreements." These are programs where the contracting unit (Owner) procures a contract for, in most cases, a third party to install, maintain, and own a renewable energy system. These renewable energy systems are typically solar panels, windmills or other systems that create renewable energy. In exchange for the third party's work of installing, maintaining and owning the renewable energy system, the contracting unit (Owner) agrees to purchase the power generated by the renewable energy system from the third party at agreed upon energy rates.

CEG recommends the Owner review the use of the above-listed funding options in addition to utilizing their standard method of financing for facilities upgrades in order to fund the proposed energy conservation measures.

XI. ADDITIONAL RECOMMENDATIONS

The following recommendations include no cost/low cost measures, Operation & Maintenance (O&M) items, and water conservation measures with attractive paybacks. These measures are not eligible for the Smart Start Buildings incentives from the office of Clean Energy but save energy none the less.

A. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.

B. Maintain all weather stripping on windows and doors.

C. Clean all light fixtures to maximize light output.

D. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.

E. Recalibrate existing temperature sensors serving the existing hot water portion of the building.

F. Confirm that outside air dampers on the rooftop units are functioning properly to take advantage of free cooling for AC unit and avoid excessive outside air on AC and heating unit in unoccupied periods.

G. Set hot water re-circ pump temperature set-point below the domestic hot water supply temperature setting to avoid 24/7 re-circ pumping.

H. Set computers to run in sleep mode when not in use.

I. Repair leaking faucets to avoid domestic water waste and maintain plumbing fixture life.

J. Confirm dampers are functioning properly in all exhaust fans and ventilation hoods throughout the building.

In addition to the recommendations above, implementing Retro-Commissioning would be beneficial for this facility. Retro-Commissioning is a means to verify your current equipment is operating at its designed efficiency, capacity, airflow, and overall performance. Retro-Commissioning provides valuable insight into systems or components not performing correctly or efficiently. The commissioning process defines the original system design parameters and recommends revisions to the current system operating characteristics.

INSTALLATION COST AND REBATES

CONCORD ENGINEERING GROUP

Denville - Riverview Elementary School

ECM 1: LIGHTING UPGRADE

	Qty	Unit Cost $	Material $	Labor $	Total $
Lighting Fixture Replacement	LS	$47,638	-	-	$47,638
Utility Incentive - NJ Smart Start (1-2) lamp fixture	407	$10.00			($4,070)
Utility Incentive - NJ Smart Start (3-4) lamp fixture	57	$20.00			($1,140)
Total Cost Less Incentive					$42,428

ECM 2: LIGHTING CONTROLS

	Qty	Unit Cost $	Material $	Labor $	Total $
Dual - Technology Sensor	73	$75	$1,095	$4,380	$5,475
Utility Incentive - NJ Smart Start	73	$20			($1,460)
Total Cost Less Incentive					$4,015

ECM 3: HVAC SYSTEM CONTROLS

	SF	Unit Cost $	Material $	Labor $	Total $
DDC Automation System	47421	$4	-	-	$189,684
Utility Incentive - NJ Smart Start					$0
Total Cost Less Incentive					$189,684

ECM 4: HOT WATER RESET CONTROLLER

	Qty	Unit Cost $	Material $	Labor $	Total $
Hot Water Reset Controller	1	$4,275	$3,250	$1,025	$4,275
Utility Incentive - NJ Smart Start					$0
Total Cost Less Incentive					$4,275

ECM 5: BOILER REPLACEMENT

	Qty	Unit Cost $	Material $	Labor $	Total $
2887 MBH High Eff Boiler	3	$34,100	$86,550	$15,750	$102,300
Old Boiler Demolition	2	$10,800		$21,600	$21,600
Utility Incentive - NJ Smart Start (8,661 MBH	8,661	$1			($8,661)
Total Cost Less Incentive					$115,239

ECM 6: SOLAR PV SYSTEM

	Qty	Unit Cost $	Material $	Labor $	Total $
Solar PV System	1	$989,460			$989,460
Utility Incentive - (see Renewable Energy Measures appendix for details)					-
Total Cost Less Incentive					$989,460

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SmartStart Building Incentives

The NJ SmartStart Buildings Program offers financial incentives on a wide variety of building system equipment. The incentives were developed to help offset the initial cost of energy-efficient equipment. The following tables show the current available incentives as of January, 2009:

Electric Chillers

Water-Cooled Chillers	\$12 - \$170 per ton
Air-Cooled Chillers	\$8 - \$52 per ton

Gas Cooling

Gas Absorption Chillers	\$185 - \$400 per ton
Gas Engine-Driven Chillers	Calculated through custom measure path)

Desiccant Systems

Desiccant Systems	\$1.00 per cfm – gas or electric

Electric Unitary HVAC

Unitary AC and Split Systems	\$73 - \$93 per ton
Air-to-Air Heat Pumps	\$73 - \$92 per ton
Water-Source Heat Pumps	\$81 per ton
Packaged Terminal AC & HP	\$65 per ton
Central DX AC Systems	\$40- \$72 per ton
Dual Enthalpy Economizer Controls	\$250

Ground Source Heat Pumps

Closed Loop & Open Loop	\$370 per ton

Gas Heating

Gas Fired Boilers < 300 MBH	\$300 per unit
Gas Fired Boilers ≥ 300 - 1500 MBH	\$1.75 per MBH
Gas Fired Boilers ≥1500 - ≤ 4000 MBH	\$1.00 per MBH
Gas Fired Boilers > 4000 MBH	(Calculated through Custom Measure Path)
Gas Furnaces	\$300 - \$400 per unit

Variable Frequency Drives

Variable Air Volume	$65 - $155 per hp
Chilled-Water Pumps	$60 per hp
Compressors	$5,250 to $12,500 per drive

Natural Gas Water Heating

Gas Water Heaters ≤ 50 gallons	$50 per unit
Gas-Fired Water Heaters >50 gallons	$1.00 - $2.00 per MBH
Gas-Fired Booster Water Heaters	$17 - $35 per MBH

Premium Motors

Three-Phase Motors	$45 - $700 per motor

Prescriptive Lighting

T-5 and T-8 Lamps w/Electronic Ballast in Existing Facilities	$10 - $30 per fixture, (depending on quantity)
Hard-Wired Compact Fluorescent	$25 - $30 per fixture
Metal Halide w/Pulse Start	$25 per fixture
LED Exit Signs	$10 - $20 per fixture
T-5 and T-8 High Bay Fixtures	$16 - $284 per fixture

Lighting Controls – Occupancy Sensors

Wall Mounted	$20 per control
Remote Mounted	$35 per control
Daylight Dimmers	$25 per fixture
Occupancy Controlled hi-low Fluorescent Controls	$25 per fixture controlled

Lighting Controls – HID or Fluorescent Hi-Bay Controls

Occupancy hi-low	$75 per fixture controlled
Daylight Dimming	$75 per fixture controlled

Other Equipment Incentives

Performance Lighting	$1.00 per watt per SF below program incentive threshold, currently 5% more energy efficient than ASHRAE 90.1-2004 for New Construction and Complete Renovation
Custom Electric and Gas Equipment Incentives	not prescriptive

MAJOR EQUIPMENT LIST

Concord Engineering Group

"Denville Riverview Elementary School"

Domestic Hot Water Heater

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Input	Recovery (gal/h)	Capacity (gal)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life
Building HW	Boiler Room	A.O. Smith	Gas Fired	1	BTR-120-110	9280725002	120 MBH	116.36	71	-	Nat Gas	5	10	5

AC Units

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Cooling Type	Cooling Capacity	EER	Heating Type	Heating Capacity (Input)	Heating Capacity (Output)	Efficiency (%)	Fan HP	Volts	Phase	Approx. Age	ASHRAE Service Life	Remaining Life
Office	Roof	Trane	Packaged CV	1	YCH061C3HBBE	L491032370	DX R-22	60 MBH	11.3	Gas	120 MBH	97.2 MBH	81%	-	208	3	13	15	2
Library	Roof	Trane	Packaged CV	1	YCH151C3H0AA	L50101928D	DX R-22	150 MBH	11.3	Gas	250 MBH	203 MBH	81%	-	208	3	13	15	-
Computer Room	Roof	Trane	Packaged CV	1	YCH103C3L0AA	L49100101D	DX R-22	102 MBH	11.3	Gas	150 MBH	122 MBH	81%	-	208	3	13	15	-
GYM	Roof	AAON	Packaged CV	1	40 Ton Nom Frame	-	None	-	-	Gas	-	-	-	-	208	3	Unknown	15	-
Auditorium	Roof	AAON	Packaged CV	1	15 Ton Nom Frame	-	None	-	-	Gas	-	-			208	3	Unknown	15	-

*Equipment efficiencies listed above are based on new equipment product data.

Boilers

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Heating Type	Input Capacity	Output Capacity	Efficiency (approx)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
Heating Water Loop	Bsmt Boiler Room	Weil McLain	Dual Fuel - Steam	3	88 Series, Size 1288		Gas	3753 MBH	2329 MBH	62%	Gas	3	25	22	Gas Fired, Generating Steam

Boiler Pumps

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Flow	Head	RPM	HP	Volts	Phase	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
Heating Water Loop	Bsmt Boiler Room	Bell & Gossett	End Suction Cons Volume	2	-	-	-	-		3		-	4	20	16	WEG electric motor

Split Systems

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Cooling Type	Cooling Capacity	EER	Heating Type	Heating Capacity (Approx)	Eff	Fan HP	Motor RPM	Volts	Phase	Approx. Age	ASHRAE Service Life	Remaining Life
IT closet	AHU - IT Rm	Carrier	Ductless Split System Heat Pump	1	40QAE048320	-	DX R-22	48 MBH	-	None	48 MBH	-	-	-	208	1	Unknown	15	-
	CU - Roof			1	38QR048C500	-							-	-	208	1	Unknown	15	-

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Riverview Elementary School

Building ID: 1802628
For 12-month Period Ending: May 31, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: September 04, 2009

Facility
Riverview Elementary School
33 St. Mary's Place
Denville, NJ 07834

Facility Owner
Denville Board of Education
501 Openaki Road
Denville, NJ 07834

Primary Contact for this Facility
John Serapiglia
501 Openaki Road
Denville, NJ 07834

Year Built: 1951
Gross Floor Area (ft²): 47,421

Energy Performance Rating[2] (1-100) 32

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	1,146,456
Natural Gas (kBtu)[4]	3,891,519
Total Energy (kBtu)	5,037,975
Energy Intensity[5]	
Site (kBtu/ft²/yr)	106
Source (kBtu/ft²/yr)	167
Emissions (based on site energy use)	
Greenhouse Gas Emissions (MtCO_2e/year)	382
Electric Distribution Utility	
Jersey Central Power & Lt Co	
National Average Comparison	
National Average Site EUI	91
National Average Source EUI	142
% Difference from National Average Source EUI	17%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards[6] **for Indoor Environmental Conditions:**

Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Certifying Professional
Ray Johnson
520 South Burnt Mill Road
Voorhees, NJ 08043

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Natural Gas values in units of volume (e.g. cubic feet) are converted to kBtu with adjustments made for elevation based on Facility zip code.
5. Values represent energy intensity, annualized to a 12-month period.
6. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

ENERGY STAR® Data Checklist
for Commercial Buildings

In order for a building to qualify for the ENERGY STAR, a Professional Engineer (PE) must validate the accuracy of the data underlying the building's energy performance rating. This checklist is designed to provide an at-a-glance summary of a property's physical and operating characteristics, as well as its total energy consumption, to assist the PE in double-checking the information that the building owner or operator has entered into Portfolio Manager.

Please complete and sign this checklist and include it with the stamped, signed Statement of Energy Performance.
NOTE: You must check each box to indicate that each value is correct, OR include a note.

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Riverview Elementary School	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	K-12 School	Is this an accurate description of the space in question?		☐
Location	33 St. Mary's Place, Denville, NJ 07834	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of acute care or children's hospitals) nor can they be submitted as representing only a portion of a building		☐
Riverview Elementary School (K-12 School)				
CRITERION	**VALUE AS ENTERED IN PORTFOLIO MANAGER**	**VERIFICATION QUESTIONS**	**NOTES**	☑
Gross Floor Area	47,421 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Open Weekends?	No	Is this building normally open at all on the weekends? This includes activities beyond the work conducted by maintenance, cleaning, and security personnel. Weekend activity could include any time when the space is used for classes, performances or other school or community activities. If the building is open on the weekend as part of the standard schedule during one or more seasons, the building should select ?yes? for open weekends. The ?yes? response should apply whether the building is open for one or both of the weekend days.		☐
Number of PCs	130	Is this the number of personal computers in the K12 School?		☐
Number of walk-in refrigeration/freezer units	0	Is this the total number of commercial walk-in type freezers and coolers? These units are typically found in storage and receiving areas.		☐
Presence of cooking facilities	Yes	Does this school have a dedicated space in which food is prepared and served to students? If the school has space in which food for students is only kept warm and/or served to students, or has only a galley that is used by teachers and staff then the answer is "no".		☐
Percent Cooled	50 %	Is this the percentage of the total floor space within the facility that is served by mechanical cooling equipment?		☐
Percent Heated	100 %	Is this the percentage of the total floor space within the facility that is served by mechanical heating equipment?		☐
Months	N/A(Optional)	Is this school in operation for at least 8 months of the year?		☐

High School?	No	Is this building a high school (teaching grades 10, 11, and/or 12)? If the building teaches to high school students at all, the user should check 'yes' to 'high school'. For example, if the school teaches to grades K-12 (elementary/middle and high school), the user should check 'yes' to 'high school'.		☐

Energy Consumption

Power Generation Plant or Distribution Utility: Jersey Central Power & Lt Co

Fuel Type: Electricity		
Meter: Electricity (kWh (thousand Watt-hours)) **Space(s):** Entire Facility **Generation Method:** Grid Purchase		
Start Date	**End Date**	**Energy Use (kWh (thousand Watt-hours))**
05/01/2009	05/31/2009	24,640.00
04/01/2009	04/30/2009	32,800.00
03/01/2009	03/31/2009	32,390.00
02/01/2009	02/28/2009	30,560.00
01/01/2009	01/31/2009	31,840.00
12/01/2008	12/31/2008	29,120.00
11/01/2008	11/30/2008	25,440.00
10/01/2008	10/31/2008	25,920.00
09/01/2008	09/30/2008	27,840.00
08/01/2008	08/31/2008	26,080.00
07/01/2008	07/31/2008	21,760.00
Electricity Consumption (kWh (thousand Watt-hours))		**308,390.00**
Electricity Consumption (kBtu (thousand Btu))		**1,052,226.68**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**1,052,226.68**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Natural Gas		
Meter: Natural Gas (therms) **Space(s):** Entire Facility		
Start Date	**End Date**	**Energy Use (therms)**
05/01/2009	05/31/2009	151.84
04/01/2009	04/30/2009	151.84
03/01/2009	03/31/2009	1,642.54
02/01/2009	02/28/2009	4,653.33
01/01/2009	01/31/2009	8,368.26
12/01/2008	12/31/2008	8,996.22
11/01/2008	11/30/2008	7,968.89
10/01/2008	10/31/2008	4,671.59
09/01/2008	09/30/2008	2,015.82
08/01/2008	08/31/2008	97.07
07/01/2008	07/31/2008	108.93

06/01/2008	06/30/2008	88.86
Natural Gas Consumption (therms)		**38,915.19**
Natural Gas Consumption (kBtu (thousand Btu))		**3,891,519.00**
Total Natural Gas Consumption (kBtu (thousand Btu))		**3,891,519.00**
Is this the total Natural Gas consumption at this building including all Natural Gas meters?		☐

Additional Fuels	
Do the fuel consumption totals shown above represent the total energy use of this building? Please confirm there are no additional fuels (district energy, generator fuel oil) used in this facility.	☐

On-Site Solar and Wind Energy	
Do the fuel consumption totals shown above include all on-site solar and/or wind power located at your facility? Please confirm that no on-site solar or wind installations have been omitted from this list. All on-site systems must be reported.	☐

Certifying Professional

(When applying for the ENERGY STAR, the Certifying Professional must be the same as the PE that signed and stamped the SEP.)

Name: ____ Date: ____________

Signature: ____________________________________

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
Riverview Elementary School
33 St. Mary's Place
Denville, NJ 07834

Facility Owner
Denville Board of Education
501 Openaki Road
Denville, NJ 07834

Primary Contact for this Facility
John Serapiglia
501 Openaki Road
Denville, NJ 07834

General Information

Riverview Elementary School	
Gross Floor Area Excluding Parking: (ft²)	47,421
Year Built	1951
For 12-month Evaluation Period Ending Date:	May 31, 2009

Facility Space Use Summary

Riverview Elementary School	
Space Type	K-12 School
Gross Floor Area(ft²)	47,421
Open Weekends?	No
Number of PCs	130
Number of walk-in refrigeration/freezer units	0
Presence of cooking facilities	Yes
Percent Cooled	50
Percent Heated	100
Months[o]	N/A
High School?	No
School District[o]	N/A

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 05/31/2009)	**Baseline** (Ending Date 05/31/2009)	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	32	32	75	N/A	50
Energy Intensity					
Site (kBtu/ft²)	106	106	71	N/A	91
Source (kBtu/ft²)	167	167	111	N/A	142
Energy Cost					
$/year	$ 75,808.80	$ 75,808.80	$ 50,498.76	N/A	$ 64,577.34
$/ft²/year	$ 1.60	$ 1.60	$ 1.07	N/A	$ 1.36
Greenhouse Gas Emissions					
$MtCO_2e$/year	382	382	254	N/A	325
$kgCO_2e$/ft²/year	8	8	5	N/A	7

More than 50% of your building is defined as K-12 School. Please note that your rating accounts for all of the spaces listed. The National Average column presents energy performance data your building would have if your building had an average rating of 50.

Notes:
o - This attribute is optional.
d - A default value has been supplied by Portfolio Manager.

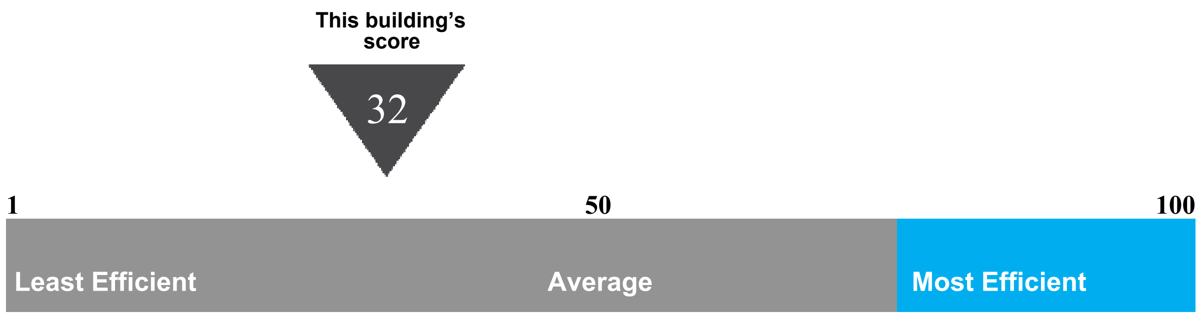
Statement of Energy Performance

2009

Riverview Elementary School
33 St. Mary's Place
Denville, NJ 07834

Portfolio Manager Building ID: 1802628

The energy use of this building has been measured and compared to other similar buildings using the Environmental Protection Agency's (EPA's) Energy Performance Scale of 1–100, with 1 being the least energy efficient and 100 the most energy efficient. For more information, visit energystar.gov/benchmark.



This building uses 167 kBtu per square foot per year.*

*Based on source energy intensity for the 12 month period ending May 2009

Buildings with a score of 75 or higher may qualify for EPA's ENERGY STAR.

I certify that the information contained within this statement is accurate and in accordance with U.S. Environmental Protection Agency's measurement standards, found at energystar.gov

Date of certification

EPA United States Environmental Protection Agency

Date Generated: 09/04/2009

CEG Job #: 9C09080
Project: Denville Riverview ES
Address: 33 St. Mary's Place
Denville, NJ 07834
Building SF: 47,421

"Denville Riverview Elementary School"

KWH COST: $0.167

ECM #1: Lighting Upgrade - General

EXISTING LIGHTING										PROPOSED LIGHTING									SAVINGS			
CEG Type	Fixture Location	Yearly Usage	No. Fixts	No. Lamps	Fixture Type	Fixt Watts	Total kW	kWh/Yr Fixtures	Yearly $ Cost	No. Fixts	No. Lamps	Retro-Unit Description	Watts Used	Total kW	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
1	Classroom 17	1880	10	4	4-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens (only 2 bulbs in)	94	0.94	1,767.2	$295.12	10	2	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.61	1146.8	$191.52	$120.00	$1,200.00	0.33	620.4	$103.61	11.58
1	Classroom 19	1880	10	4	4-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens (only 2 bulbs in)	94	0.94	1,767.2	$295.12	10	2	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.61	1146.8	$191.52	$120.00	$1,200.00	0.33	620.4	$103.61	11.58
2	Boys Bathroom	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.19	353.4	$59.02	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$34.54	$100.00	$200.00	0.08	146.64	$24.49	8.17
2	Girls Bathroom	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.19	353.4	$59.02	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$34.54	$100.00	$200.00	0.08	146.64	$24.49	8.17
1	Classroom 21	1880	10	4	4-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens (only 2 bulbs in)	94	0.94	1,767.2	$295.12	10	2	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.61	1146.8	$191.52	$120.00	$1,200.00	0.33	620.4	$103.61	11.58
3	Faculty Room	1880	6	4	4-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens (only 2 bulbs in)	94	0.56	1,060.3	$177.07	6	2	2'X4' 2-Lamp 32W T-8 Parabolic Lens/Elect Ballast; Metalux M/N 2GC8	61	0.37	688.08	$114.91	$120.00	$720.00	0.20	372.24	$62.16	11.58
2		1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.09	176.7	$29.51	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$17.27	$100.00	$100.00	0.04	73.32	$12.24	8.17
4	Faculty Bathroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.09	176.7	$29.51	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$17.27	$100.00	$100.00	0.04	73.32	$12.24	8.17
4	Classroom 24	1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.19	353.4	$59.02	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$34.54	$100.00	$200.00	0.08	146.64	$24.49	8.17
4	Classroom 23	1880	9	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.85	1,590.5	$265.61	9	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.50	930.6	$155.41	$100.00	$900.00	0.35	659.88	$110.20	8.17
4	Office 23	1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic	94	0.19	353.4	$59.02	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$34.54	$100.00	$200.00	0.08	146.64	$24.49	8.17
4	Classroom 22	1880	14	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.32	2,474.1	$413.17	14	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.77	1447.6	$241.75	$100.00	$1,400.00	0.55	1026.48	$171.42	8.17
5	Computer Lab 20	1880	30	0	2-Lamp, T8, Electronic Ballast, Pendant Mounted, Parabolic Lens	58	1.74	3,271.2	$546.29	30	0	No Change	58	1.74	3271.2	$546.29	$0.00	$0.00	0.00	0	$0.00	0.00
4	Communications Closet	470	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.09	44.2	$7.38	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	25.85	$4.32	$100.00	$100.00	0.04	18.33	$3.06	32.67

5	Library	1880	60	0	2-Lamp, T8, Electronic Ballast, Pendant Mounted, Parabolic Lens	58	3.48	6,542.4	$1,092.58	60	0	No Change	58	3.48	6542.4	$1,092.58	$0.00	$0.00	0.00	0	$0.00	0.00
6	Conference Room	1880	3	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	151	0.45	851.6	$142.22	3	3	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.27	513.24	$85.71	$120.00	$360.00	0.18	338.4	$56.51	6.37
5	Librarian's Office	1880	4	0	2-Lamp, T8, Electronic Ballast, Pendant Mounted, Parabolic Lens	58	0.23	436.2	$72.84	4	0	No Change	58	0.23	436.16	$72.84	$0.00	$0.00	0.00	0	$0.00	0.00
4	Hallway 1	2350	11	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.03	2,429.9	$405.79	11	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.61	1421.75	$237.43	$100.00	$1,100.00	0.43	1008.15	$168.36	6.53
4	Classroom 25	1880	14	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.32	2,474.1	$413.17	14	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.77	1447.6	$241.75	$100.00	$1,400.00	0.55	1026.48	$171.42	8.17
4	Boys Bathroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.09	176.7	$29.51	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$17.27	$100.00	$100.00	0.04	73.32	$12.24	8.17
4	Classroom 26	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.47	879.84	$146.93	8.17
4	Boys Bathroom	1880	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.28	530.2	$88.54	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	310.2	$51.80	$100.00	$300.00	0.12	219.96	$36.73	8.17
4	Janitor's Closet	1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.09	176.7	$29.51	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$17.27	$100.00	$100.00	0.04	73.32	$12.24	8.17
4	Girls Bathroom	1880	4	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.38	706.9	$118.05	4	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.22	413.6	$69.07	$100.00	$400.00	0.16	293.28	$48.98	8.17
4	Classroom 27	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.47	879.84	$146.93	8.17
4	Classroom 28	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.47	879.84	$146.93	8.17
4	Classroom 29	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.47	879.84	$146.93	8.17
4	Classroom 30	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.47	879.84	$146.93	8.17
4	Classroom 31	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.47	879.84	$146.93	8.17
4	Classroom 32	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.47	879.84	$146.93	8.17
4	Hallway 2	2350	9	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.85	1,988.1	$332.01	9	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.50	1163.25	$194.26	$100.00	$900.00	0.35	824.85	$137.75	6.53

2	Classroom 16	1880	3	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.28	530.2	$88.54	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	310.2	$51.80	$100.00	$300.00	0.12	219.96	$36.73	8.17
2	Copy Room	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.19	353.4	$59.02	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$34.54	$100.00	$200.00	0.08	146.64	$24.49	8.17
4	Hallway 3	2350	5	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.47	1,104.5	$184.45	5	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.28	646.25	$107.92	$100.00	$500.00	0.20	458.25	$76.53	6.53
14	Custodial Closet	470	2	0	1 Lamp Incandscents, Surface Mount	52	0.10	48.9	$8.16	2	0	18 W CFL Lamp	18	0.04	16.92	$2.83	$5.75	$11.50	0.07	31.96	$5.34	2.15
7	Cafeteria Girls' Room	1880	2	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic	58	0.12	218.1	$36.42	2	0	No Change	58	0.12	218.08	$36.42	$0.00	$0.00	0.00	0	$0.00	0.00
7	Cafeteria Boys' Room	1880	2	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.12	218.1	$36.42	2	0	No Change	58	0.12	218.08	$36.42	$0.00	$0.00	0.00	0	$0.00	0.00
15	Auditorium	1880	12	0	High Pressure Sodium Lights (GE Mercurt H400DX33-1)	464	5.57	10,467.8	$1,748.13	12	0	No Change	464	5.57	10467.84	$1,748.13	$0.00	$0.00	0.00	0	$0.00	0.00
2	Kitchen	1880	3	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.28	530.2	$88.54	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	310.2	$51.80	$100.00	$300.00	0.12	219.96	$36.73	8.17
16	Custodial Closet	470	1	0	13 Watt CFL, Surface Mount	13	0.01	6.1	$1.02	1	0	No Change	13	0.01	6.11	$1.02	$0.00	$0.00	0.00	0	$0.00	0.00
17	Custodial Closet	470	1	0	1 Lamp Flood Light	90	0.09	42.3	$7.06	1	0	26 W CFL Lamp	26	0.03	12.22	$2.04	$5.75	$5.75	0.06	30.08	$5.02	1.14
8	Stage	1880	12	0	2-Lamp, T8, Electronic Ballast, Pendant Mounted, Prismatic Lens	58	0.70	1,308.5	$218.52	12	0	No Change	58	0.70	1308.48	$218.52	$0.00	$0.00	0.00	0	$0.00	0.00
16		1880	8	0	13 Watt CFL, Surface Mount	13	0.10	195.5	$32.65	8	0	No Change	13	0.10	195.52	$32.65	$0.00	$0.00	0.00	0	$0.00	0.00
9	Gym Foyer	1880	3	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	0.39	733.2	$122.44	3	3	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.27	513.24	$85.71	$120.00	$360.00	0.12	219.96	$36.73	9.80
18	Gym	1880	24	0	1 Lamp Metal Halide	295	7.08	13,310.4	$2,222.84	24	0	No Change	295	7.08	13310.4	$2,222.84	$0.00	$0.00	0.00	0	$0.00	0.00
10	Gym Storage	1880	7	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	80	0.56	1,052.8	$175.82	7	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.39	723.8	$120.87	$100.00	$700.00	0.18	329	$54.94	12.74
9	Gym Office	1880	2	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	0.26	488.8	$81.63	2	3	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.18	342.16	$57.14	$120.00	$240.00	0.08	146.64	$24.49	9.80
10	Custodial Office	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	80	0.08	150.4	$25.12	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$17.27	$100.00	$100.00	0.03	47	$7.85	12.74
10	Hallyway 4	2350	8	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	80	0.64	1,504.0	$251.17	8	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.44	1034	$172.68	$100.00	$800.00	0.20	470	$78.49	10.19
11		2350	7	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.56	1,316.0	$219.77	7	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.39	904.75	$151.09	$100.00	$700.00	0.18	411.25	$68.68	10.19
11	Classroom 15	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	300.8	$50.23	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$34.54	$100.00	$200.00	0.05	94	$15.70	12.74
11	Classroom 14	1880	6	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.48	902.4	$150.70	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$103.61	$100.00	$600.00	0.15	282	$47.09	12.74

11	Classroom 13	1880	6	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.48	902.4	$150.70	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$103.61	$100.00	$600.00	0.15	282	$47.09	12.74
12	Storage	1880	2	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, No Lens	80	0.16	300.8	$50.23	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$34.54	$100.00	$200.00	0.05	94	$15.70	12.74
16		1880	5	0	13 Watt CFL, Surface Mount	13	0.07	122.2	$20.41	5	0	No Change	13	0.07	122.2	$20.41	$0.00	$0.00	0.00	0	$0.00	0.00
11	Hallway 5	1880	10	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.80	1,504.0	$251.17	10	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.55	1034	$172.68	$100.00	$1,000.00	0.25	470	$78.49	12.74
11	Science Lab	1880	19	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	1.52	2,857.6	$477.22	19	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	1.05	1964.6	$328.09	$100.00	$1,900.00	0.48	893	$149.13	12.74
17		1880	1	0	1 Lamp Flood Light	90	0.09	169.2	$28.26	1	0	26 W CFL Lamp	26	0.03	48.88	$8.16	$5.75	$5.75	0.06	120.32	$20.09	0.29
11	Classroom 11	1880	17	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	1.36	2,556.8	$426.99	17	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.94	1757.8	$293.55	$100.00	$1,700.00	0.43	799	$133.43	12.74
11	Communications Room	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	300.8	$50.23	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$34.54	$100.00	$200.00	0.05	94	$15.70	12.74
11	Classroom 10	1880	17	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	1.36	2,556.8	$426.99	17	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.94	1757.8	$293.55	$100.00	$1,700.00	0.43	799	$133.43	12.74
16		1880	1	0	13 Watt CFL, Surface Mount	13	0.01	24.4	$4.08	1	0	No Change	13	0.01	24.44	$4.08	$0.00	$0.00	0.00	0	$0.00	0.00
11	Classroom 8	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.30	564	$94.19	12.74
11	Classroom 9	1880	20	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	1.60	3,008.0	$502.34	20	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	1.10	2068	$345.36	$100.00	$2,000.00	0.50	940	$156.98	12.74
16	Stairwell	8760	4	0	13 Watt CFL, Surface Mount	13	0.05	455.5	$76.07	4	0	No Change	13	0.05	455.52	$76.07	$0.00	$0.00	0.00	0	$0.00	0.00
11	Hallway 6	2350	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	2,256.0	$376.75	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1551	$259.02	$100.00	$1,200.00	0.30	705	$117.74	10.19
11	Classroom 1	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.30	564	$94.19	12.74
19	Bathroom	1880	1	0	2-Lamp 13 Watt CFL, Surface Mount	30	0.03	56.4	$9.42	1	0	No Change	30	0.03	56.4	$9.42	$0.00	$0.00	0.00	0	$0.00	0.00
11	Classtoom 2	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.30	564	$94.19	12.74
19	Bathroom	1880	2	0	2-Lamp 13 Watt CFL, Surface Mount	30	0.06	112.8	$18.84	2	0	No Change	30	0.06	112.8	$18.84	$0.00	$0.00	0.00	0	$0.00	0.00
11	Classroom 3	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.30	564	$94.19	12.74
11	Classroom 4	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.30	564	$94.19	12.74

11	Classroom 5	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.30	564	$94.19	12.74
11	Classroom 6	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.30	564	$94.19	12.74
11	Classroom 7	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$207.21	$100.00	$1,200.00	0.30	564	$94.19	12.74
11	Custodial Restroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$25.12	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$17.27	$100.00	$100.00	0.03	47	$7.85	12.74
20	Main Stairwell	8760	4	0	2-Lamp 20 Watt CFL, Surface Mount	42	0.17	1,471.7	$245.77	4	0	No Change	42	0.17	1471.68	$245.77	$0.00	$0.00	0.00	0	$0.00	0.00
9	Main Office	1880	9	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	1.17	2,199.6	$367.33	9	3	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.82	1539.72	$257.13	$120.00	$1,080.00	0.35	659.88	$110.20	9.80
9	Main Office Offices	1880	4	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	0.52	977.6	$163.26	4	3	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.36	684.32	$114.28	$120.00	$480.00	0.16	293.28	$48.98	9.80
13	Trailer 1	1880	10	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.09	2,049.2	$342.22	10	0	No Change	109	1.09	2049.2	$342.22	$0.00	$0.00	0.00	0	$0.00	0.00
13	Trailer 2	1880	10	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.09	2,049.2	$342.22	10	0	No Change	109	1.09	2049.2	$342.22	$0.00	$0.00	0.00	0	$0.00	0.00
13	Outside Trailers	1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.22	409.8	$68.44	2	0	No Change	109	0.22	409.84	$68.44	$0.00	$0.00	0.00	0	$0.00	0.00
21	Outside Lighting	3640	10	0	1-Lamp Metal Halide	455	4.55	16,562.0	$2,765.85	10	0	No Change	455	4.55	16562	$2,765.85	$0.00	$0.00	0.00	0	$0.00	0.00
22		3640	16	0	1-Lamp Metal Halide	240	3.84	13,977.6	$2,334.26	16	0	No Change	240	3.84	13977.6	$2,334.26	$0.00	$0.00	0.00	0	$0.00	0.00
23		3640	3	0	1-Lamp Metal Halide	125	0.38	1,365.0	$227.96	3	0	No Change	125	0.38	1365	$227.96	$0.00	$0.00	0.00	0	$0.00	0.00
24		3640	9	0	18 Watt CFL, Surface Mount	18	0.16	589.7	$98.48	9	0	No Change	18	0.16	589.68	$98.48	$0.00	$0.00	0.00	0	$0.00	0.00
17		3640	13	0	1 Lamp Flood Light	90	1.17	4,258.8	$711.22	13	0	26 W CFL Lamp	26	0.34	1230.32	$205.46	$5.75	$74.75	0.83	3028.48	$505.76	0.15
	Totals		713	133			73.49	159,131.4	$26,574.95	713	125			57.776	127599.78	########		$47,637.75	15.71	31531.6	$5,265.78	9.05

NOTES: 1. Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.
2. Lamp totals only include T-12 tube replacment calculations

CEG Job #: 9C09080
Project: Denville Riverview ES
Address: 33 St. Mary's Place
Denville, NJ 07834
Building SF: 47,421

"Denville Riverview Elementary School"

KWH COST: $0.167

ECM #2: Lighting Controls

EXISTING LIGHTING										PROPOSED LIGHTING											SAVINGS			
CEG Type	Fixture Location	Yearly Usage	No. Fixts	No. Lamps	Fixture Type	Fixt Watts	Total kW	kWh/Yr Fixtures	Yearly $ Cost	No. Fixts	No. Lamps	Controls Description	Watts Used	Total kW	Reduction (%)	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
1	Classroom 17	1880	10	4	4-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens (only 2 bulbs in)	94	0.94	1,767.2	$295.12	10	4	Dual Technology Occupancy Sensor	94	0.94	10%	1590.48	$265.61	$75.00	$75.00	0.00	176.72	$29.51	2.54
1	Classroom 19	1880	10	4	4-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens (only 2 bulbs in)	94	0.94	1,767.2	$295.12	10	4	Dual Technology Occupancy Sensor	94	0.94	10%	1590.48	$265.61	$75.00	$75.00	0.00	176.72	$29.51	2.54
2	Boys Bathroom	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.19	353.4	$59.02	2	2	Dual Technology Occupancy Sensor	94	0.19	10%	318.096	$53.12	$75.00	$75.00	0.00	35.344	$5.90	12.71
2	Girls Bathroom	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.19	353.4	$59.02	2	2	Dual Technology Occupancy Sensor	94	0.19	10%	318.096	$53.12	$75.00	$75.00	0.00	35.344	$5.90	12.71
1	Classroom 21	1880	10	4	4-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens (only 2 bulbs in)	94	0.94	1,767.2	$295.12	10	4	Dual Technology Occupancy Sensor	94	0.94	10%	1590.48	$265.61	$75.00	$75.00	0.00	176.72	$29.51	2.54
3	Faculty Room	1880	6	4	4-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens (only 2 bulbs in)	94	0.56	1,060.3	$177.07	6	4	Dual Technology Occupancy Sensor	94	0.56	10%	954.288	$159.37	$75.00	$75.00	0.00	106.032	$17.71	4.24
2		1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.09	176.7	$29.51	1	2		94	0.09	10%	159.048	$26.56	$0.00	$0.00	0.00	17.672	$2.95	0.00
4	Faculty Bathroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.09	176.7	$29.51	1	2	Dual Technology Occupancy Sensor	94	0.09	10%	159.048	$26.56	$75.00	$75.00	0.00	17.672	$2.95	25.41
4	Classroom 24	1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.19	353.4	$59.02	2	2	Dual Technology Occupancy Sensor	94	0.19	10%	318.096	$53.12	$75.00	$75.00	0.00	35.344	$5.90	12.71
4	Classroom 23	1880	9	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.85	1,590.5	$265.61	9	2	Dual Technology Occupancy Sensor	94	0.85	10%	1431.432	$239.05	$75.00	$75.00	0.00	159.048	$26.56	2.82
4	Office 23	1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic	94	0.19	353.4	$59.02	2	2	Dual Technology Occupancy Sensor	94	0.19	10%	318.096	$53.12	$75.00	$75.00	0.00	35.344	$5.90	12.71
4	Classroom 22	1880	14	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.32	2,474.1	$413.17	14	2	Dual Technology Occupancy Sensor	94	1.32	10%	2226.672	$371.85	$75.00	$75.00	0.00	247.408	$41.32	1.82
5	Computer Lab 20	1880	30	0	2-Lamp, T8, Electronic Ballast, Pendant Mounted, Parabolic Lens	58	1.74	3,271.2	$546.29	30	0	Dual Technology Occupancy Sensor	58	1.74	10%	2944.08	$491.66	$75.00	$75.00	0.00	327.12	$54.63	1.37
4	Communications Closet	470	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.09	44.2	$7.38	1	2	Dual Technology Occupancy Sensor	94	0.09	10%	39.762	$6.64	$75.00	$75.00	0.00	4.418	$0.74	101.65

5	Library	1880	60	0	2-Lamp, T8, Electronic Ballast, Pendant Mounted, Parabolic Lens	58	3.48	6,542.4	$1,092.58	60	0	Dual Technology Occupancy Sensor	58	3.48	10%	5888.16	$983.32	$75.00	$75.00	0.00	654.24	$109.26	0.69
6	Conference Room	1880	3	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	151	0.45	851.6	$142.22	3	3	Dual Technology Occupancy Sensor	151	0.45	10%	766.476	$128.00	$75.00	$75.00	0.00	85.164	$14.22	5.27
5	Librarian's Office	1880	4	0	2-Lamp, T8, Electronic Ballast, Pendant Mounted, Parabolic Lens	58	0.23	436.2	$72.84	4	0	Dual Technology Occupancy Sensor	58	0.23	10%	392.544	$65.55	$75.00	$75.00	0.00	43.616	$7.28	10.30
4	Hallway 1	2350	11	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.03	2,429.9	$405.79	11	2	Dual Technology Occupancy Sensor	94	1.03	10%	2186.91	$365.21	$75.00	$75.00	0.00	242.99	$40.58	1.85
4	Classroom 25	1880	14	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.32	2,474.1	$413.17	14	2	Dual Technology Occupancy Sensor	94	1.32	10%	2226.672	$371.85	$75.00	$75.00	0.00	247.408	$41.32	1.82
4	Boys Bathroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.09	176.7	$29.51	1	2	Dual Technology Occupancy Sensor	94	0.09	10%	159.048	$26.56	$75.00	$75.00	0.00	17.672	$2.95	25.41
4	Classroom 26	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	Dual Technology Occupancy Sensor	94	1.13	10%	1908.576	$318.73	$75.00	$75.00	0.00	212.064	$35.41	2.12
4	Boys Bathroom	1880	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.28	530.2	$88.54	3	2	Dual Technology Occupancy Sensor	94	0.28	10%	477.144	$79.68	$75.00	$75.00	0.00	53.016	$8.85	8.47
4	Janitor's Closet	1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.09	176.7	$29.51	1	2	Dual Technology Occupancy Sensor	94	0.09	10%	159.048	$26.56	$75.00	$75.00	0.00	17.672	$2.95	25.41
4	Girls Bathroom	1880	4	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.38	706.9	$118.05	4	2	Dual Technology Occupancy Sensor	94	0.38	10%	636.192	$106.24	$75.00	$75.00	0.00	70.688	$11.80	6.35
4	Classroom 27	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	Dual Technology Occupancy Sensor	94	1.13	10%	1908.576	$318.73	$75.00	$75.00	0.00	212.064	$35.41	2.12
4	Classroom 28	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	Dual Technology Occupancy Sensor	94	1.13	10%	1908.576	$318.73	$75.00	$75.00	0.00	212.064	$35.41	2.12
4	Classroom 29	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	Dual Technology Occupancy Sensor	94	1.13	10%	1908.576	$318.73	$75.00	$75.00	0.00	212.064	$35.41	2.12
4	Classroom 30	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	Dual Technology Occupancy Sensor	94	1.13	10%	1908.576	$318.73	$75.00	$75.00	0.00	212.064	$35.41	2.12
4	Classroom 31	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	Dual Technology Occupancy Sensor	94	1.13	10%	1908.576	$318.73	$75.00	$75.00	0.00	212.064	$35.41	2.12
4	Classroom 32	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	1.13	2,120.6	$354.15	12	2	Dual Technology Occupancy Sensor	94	1.13	10%	1908.576	$318.73	$75.00	$75.00	0.00	212.064	$35.41	2.12
4	Hallway 2	2350	9	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.85	1,988.1	$332.01	9	2	Dual Technology Occupancy Sensor	94	0.85	10%	1789.29	$298.81	$75.00	$75.00	0.00	198.81	$33.20	2.26

2	Classroom 16	1880	3	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.28	530.2	$88.54	3	2	Dual Technology Occupancy Sensor	94	0.28	10%	477.144	$79.68	$75.00	$75.00	0.00	53.016	$8.85	8.47
2	Copy Room	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.19	353.4	$59.02	2	2	Dual Technology Occupancy Sensor	94	0.19	10%	318.096	$53.12	$75.00	$75.00	0.00	35.344	$5.90	12.71
4	Hallway 3	2350	5	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	94	0.47	1,104.5	$184.45	5	2	Dual Technology Occupancy Sensor	94	0.47	10%	994.05	$166.01	$75.00	$75.00	0.00	110.45	$18.45	4.07
14	Custodial Closet	470	2	0	1 Lamp Incandscents, Surface Mount	52	0.10	48.9	$8.16	2	0	Dual Technology Occupancy Sensor	52	0.10	10%	43.992	$7.35	$75.00	$75.00	0.00	4.888	$0.82	91.88
7	Cafeteria Girls' Room	1880	2	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic	58	0.12	218.1	$36.42	2	0	Dual Technology Occupancy Sensor	58	0.12	10%	196.272	$32.78	$75.00	$75.00	0.00	21.808	$3.64	20.59
7	Cafeteria Boys' Room	1880	2	0	2-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	58	0.12	218.1	$36.42	2	0	Dual Technology Occupancy Sensor	58	0.12	10%	196.272	$32.78	$75.00	$75.00	0.00	21.808	$3.64	20.59
15	Auditorium	1880	12	0	1-Lamp, High Pressure Sodium	464	5.57	10,467.8	$1,748.13	12	0	Dual Technology Occupancy Sensor	464	5.57	10%	9421.056	$1,573.32	$75.00	$75.00	0.00	1046.784	$174.81	0.43
2	Kitchen	1880	3	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.28	530.2	$88.54	3	2	Dual Technology Occupancy Sensor	94	0.28	10%	477.144	$79.68	$75.00	$75.00	0.00	53.016	$8.85	8.47
16	Custodial Closet	470	1	0	13 Watt CFL, Surface Mount	13	0.01	6.1	$1.02	1	0	Dual Technology Occupancy Sensor	13	0.01	10%	5.499	$0.92	$75.00	$75.00	0.00	0.611	$0.10	735.03
17	Custodial Closet	470	1	0	1 Lamp Flood Light	90	0.09	42.3	$7.06	1	0	Dual Technology Occupancy Sensor	90	0.09	10%	38.07	$6.36	$75.00	$75.00	0.00	4.23	$0.71	106.17
8	Stage	1880	12	0	2-Lamp, T8, Electronic Ballast, Pendant Mounted, Prismatic Lens	58	0.70	1,308.5	$218.52	12	0	None	58	0.70	0%	1308.48	$218.52	$0.00	$0.00	0.00	0	$0.00	0.00
16		1880	8	0	13 Watt CFL, Surface Mount	13	0.10	195.5	$32.65	8	0	None	13	0.10	0%	195.52	$32.65	$0.00	$0.00	0.00	0	$0.00	0.00
9	Gym Foyer	1880	3	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	0.39	733.2	$122.44	3	3	Dual Technology Occupancy Sensor	130	0.39	10%	659.88	$110.20	$75.00	$75.00	0.00	73.32	$12.24	6.13
18	Gym	1880	24	0	1 Lamp Metal Halide	295	7.08	13,310.4	$2,222.84	24	0	None	295	7.08	0%	13310.4	$2,222.84	$0.00	$0.00	0.00	0	$0.00	0.00
10	Gym Storage	1880	7	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	80	0.56	1,052.8	$175.82	7	2	Dual Technology Occupancy Sensor	80	0.56	10%	947.52	$158.24	$75.00	$75.00	0.00	105.28	$17.58	4.27
9	Gym Office	1880	2	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	0.26	488.8	$81.63	2	3	Dual Technology Occupancy Sensor	130	0.26	10%	439.92	$73.47	$75.00	$75.00	0.00	48.88	$8.16	9.19
10	Custodial Office	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	80	0.08	150.4	$25.12	1	2	Dual Technology Occupancy Sensor	80	0.08	10%	135.36	$22.61	$75.00	$75.00	0.00	15.04	$2.51	29.86
10	Hallyway 4	2350	8	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	80	0.64	1,504.0	$251.17	8	2	Dual Technology Occupancy Sensor	80	0.64	10%	1353.6	$226.05	$75.00	$75.00	0.00	150.4	$25.12	2.99
11		2350	7	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.56	1,316.0	$219.77	7	2	Dual Technology Occupancy Sensor	80	0.56	10%	1184.4	$197.79	$75.00	$75.00	0.00	131.6	$21.98	3.41
11	Classroom 15	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	300.8	$50.23	2	2	Dual Technology Occupancy Sensor	80	0.16	10%	270.72	$45.21	$75.00	$75.00	0.00	30.08	$5.02	14.93
11	Classroom 14	1880	6	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.48	902.4	$150.70	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$135.63	$75.00	$75.00	0.00	90.24	$15.07	4.98

11	Classroom 13	1880	6	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.48	902.4	$150.70	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$135.63	$75.00	$75.00	0.00	90.24	$15.07	4.98
12	Storage	1880	2	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, No Lens	80	0.16	300.8	$50.23	2	2	None	80	0.16	0%	300.8	$50.23	$0.00	$0.00	0.00	0	$0.00	0.00
16		1880	5	0	13 Watt CFL, Surface Mount	13	0.07	122.2	$20.41	5	0	None	13	0.07	0%	122.2	$20.41	$0.00	$0.00	0.00	0	$0.00	0.00
11	Hallway 5	1880	10	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.80	1,504.0	$251.17	10	2	Dual Technology Occupancy Sensor	80	0.80	10%	1353.6	$226.05	$75.00	$75.00	0.00	150.4	$25.12	2.99
11	Science Lab	1880	19	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	1.52	2,857.6	$477.22	19	2	Dual Technology Occupancy Sensor	80	1.52	10%	2571.84	$429.50	$75.00	$75.00	0.00	285.76	$47.72	1.57
17		1880	1	0	1 Lamp Flood Light	90	0.09	169.2	$28.26	1	0		90	0.09	10%	152.28	$25.43	$0.00	$0.00	0.00	16.92	$2.83	0.00
11	Classroom 11	1880	17	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	1.36	2,556.8	$426.99	17	2	Dual Technology Occupancy Sensor	80	1.36	10%	2301.12	$384.29	$75.00	$75.00	0.00	255.68	$42.70	1.76
11	Communications Room	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	300.8	$50.23	2	2	Dual Technology Occupancy Sensor	80	0.16	10%	270.72	$45.21	$75.00	$75.00	0.00	30.08	$5.02	14.93
11	Classroom 10	1880	17	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	1.36	2,556.8	$426.99	17	2	Dual Technology Occupancy Sensor	80	1.36	10%	2301.12	$384.29	$75.00	$75.00	0.00	255.68	$42.70	1.76
16		1880	1	0	13 Watt CFL, Surface Mount	13	0.01	24.4	$4.08	1	0		13	0.01	10%	21.996	$3.67	$0.00	$0.00	0.00	2.444	$0.41	0.00
11	Classroom 8	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$271.26	$75.00	$75.00	0.00	180.48	$30.14	2.49
11	Classroom 9	1880	20	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	1.60	3,008.0	$502.34	20	2	Dual Technology Occupancy Sensor	80	1.60	10%	2707.2	$452.10	$75.00	$75.00	0.00	300.8	$50.23	1.49
16	Stairwell	8760	4	0	13 Watt CFL, Surface Mount	13	0.05	455.5	$76.07	4	0	Dual Technology Occupancy Sensor	13	0.05	10%	409.968	$68.46	$75.00	$75.00	0.00	45.552	$7.61	9.86
11	Hallway 6	2350	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	2,256.0	$376.75	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	2030.4	$339.08	$75.00	$75.00	0.00	225.6	$37.68	1.99
11	Classroom 1	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$271.26	$75.00	$75.00	0.00	180.48	$30.14	2.49
19	Bathroom	1880	1	0	2-Lamp 13 Watt CFL, Surface Mount	30	0.03	56.4	$9.42	1	0	Dual Technology Occupancy Sensor	30	0.03	10%	50.76	$8.48	$75.00	$75.00	0.00	5.64	$0.94	79.63
11	Classtoom 2	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$271.26	$75.00	$75.00	0.00	180.48	$30.14	2.49
19	Bathroom	1880	2	0	2-Lamp 13 Watt CFL, Surface Mount	30	0.06	112.8	$18.84	2	0	Dual Technology Occupancy Sensor	30	0.06	10%	101.52	$16.95	$75.00	$75.00	0.00	11.28	$1.88	39.81
11	Classroom 3	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$271.26	$75.00	$75.00	0.00	180.48	$30.14	2.49
11	Classroom 4	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$271.26	$75.00	$75.00	0.00	180.48	$30.14	2.49

11	Classroom 5	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$271.26	$75.00	$75.00	0.00	180.48	$30.14	2.49
11	Classroom 6	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$271.26	$75.00	$75.00	0.00	180.48	$30.14	2.49
11	Classroom 7	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$301.40	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$271.26	$75.00	$75.00	0.00	180.48	$30.14	2.49
11	Custodial Restroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$25.12	1	2	Dual Technology Occupancy Sensor	80	0.08	10%	135.36	$22.61	$75.00	$75.00	0.00	15.04	$2.51	29.86
20	Main Stairwell	8760	4	0	2-Lamp 20 Watt CFL, Surface Mount	42	0.17	1,471.7	$245.77	4	0	Dual Technology Occupancy Sensor	42	0.17	10%	1324.512	$221.19	$75.00	$75.00	0.00	147.168	$24.58	3.05
9	Main Office	1880	9	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	1.17	2,199.6	$367.33	9	3	Dual Technology Occupancy Sensor	130	1.17	10%	1979.64	$330.60	$75.00	$75.00	0.00	219.96	$36.73	2.04
9	Main Office Offices	1880	4	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	0.52	977.6	$163.26	4	3	Dual Technology Occupancy Sensor	130	0.52	10%	879.84	$146.93	$75.00	$75.00	0.00	97.76	$16.33	4.59
13	Trailer 1	1880	10	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.09	2,049.2	$342.22	10	0	Dual Technology Occupancy Sensor	109	1.09	10%	1844.28	$307.99	$75.00	$75.00	0.00	204.92	$34.22	2.19
13	Trailer 2	1880	10	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	1.09	2,049.2	$342.22	10	0	Dual Technology Occupancy Sensor	109	1.09	10%	1844.28	$307.99	$75.00	$75.00	0.00	204.92	$34.22	2.19
13	Outside Trailers	1880	2	0	4-Lamp, T8, Electronic Ballast, Recessed Mount, Prismatic Lens	109	0.22	409.8	$68.44	2	0	None	109	0.22	0%	409.84	$68.44	$0.00	$0.00	0.00	0	$0.00	0.00
21	Outside Lighting	3640	10	0	1-Lamp Metal Halide	455	4.55	16,562.0	$2,765.85	10	0	None	455	4.55	0%	16562	$2,765.85	$75.00	$0.00	0.00	0	$0.00	0.00
22		3640	16	0	1-Lamp Metal Halide	240	3.84	13,977.6	$2,334.26	16	0	None	240	3.84	0%	13977.6	$2,334.26	$75.00	$0.00	0.00	0	$0.00	0.00
23		3640	3	0	1-Lamp Metal Halide	125	0.38	1,365.0	$227.96	3	0	None	125	0.38	0%	1365	$227.96	$75.00	$0.00	0.00	0	$0.00	0.00
24		3640	9	0	18 Watt CFL, Surface Mount	18	0.16	589.7	$98.48	9	0	None	18	0.16	0%	589.68	$98.48	$75.00	$0.00	0.00	0	$0.00	0.00
17		3640	13	0	1 Lamp Flood Light	90	1.17	4,258.8	$711.22	13	0	None	90	1.17	0%	4258.8	$711.22	$75.00	$0.00	0.00	0	$0.00	0.00
	Totals		713	133			73.49	159,131.4	$26,574.95	713	133			73.485		148458.3	########		$5,475.00	0.00	10673.1	$1,782.41	3.07

NOTES: 1. Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.
2. Lamp totals only include T-12 tube replacment calculations

Project Name: **LGEA Solar PV Project - Denville Riverview Elementary School**
Location: **Denville, NJ**
Description: **Photovoltaic System 95% Financing - 25 year**

Simple Payback Analysis

	Photovoltaic System 95% Financing - 25 year
Total Construction Cost	$989,460
Annual kWh Production	171,566
Annual Energy Cost Reduction	$28,652
Annual SREC Revenue	$60,048
First Cost Premium	**$989,460**
Simple Payback:	**11.16** Years

Life Cycle Cost Analysis

Analysis Period (years):	25	Financing %:	95%
Financing Term (mths):	240	Maintenance Escalation Rate:	3.0%
Average Energy Cost ($/kWh)	**$0.167**	Energy Cost Escalation Rate:	3.0%
Financing Rate:	7.00%	SREC Value ($/kWh)	$0.350

Period	Additional Cash Outlay	Energy kWh Production	Energy Cost Savings	Additional Maint Costs	SREC Revenue	Interest Expense	Loan Principal	Net Cash Flow	Cumulative Cash Flow
0	$49,473	0	0	0	$0	0	0	(49,473)	0
1	$0	171,566	$28,652	$0	$60,048	$65,091	$22,362	$1,247	($48,226)
2	$0	170,709	$29,511	$0	$59,748	$63,474	$23,978	$1,807	($46,419)
3	$0	169,855	$30,396	$0	$59,449	$61,741	$25,712	$2,393	($44,026)
4	$0	169,006	$31,308	$0	$59,152	$59,882	$27,570	$3,008	($41,018)
5	$0	168,161	$32,248	$1,732	$58,856	$57,889	$29,564	$1,919	($39,099)
6	$0	167,320	$33,215	$1,723	$58,562	$55,752	$31,701	$2,601	($36,497)
7	$0	166,483	$34,212	$1,715	$58,269	$53,460	$33,992	$3,313	($33,184)
8	$0	165,651	$35,238	$1,706	$57,978	$51,003	$36,450	$4,057	($29,127)
9	$0	164,823	$36,295	$1,698	$57,688	$48,368	$39,085	$4,833	($24,294)
10	$0	163,999	$37,384	$1,689	$57,399	$45,542	$41,910	$5,642	($18,653)
11	$0	163,179	$38,505	$1,681	$57,112	$42,513	$44,940	$6,485	($12,168)
12	$0	162,363	$39,661	$1,672	$56,827	$39,264	$48,188	$7,363	($4,806)
13	$0	161,551	$40,850	$1,664	$56,543	$35,781	$51,672	$8,277	$3,471
14	$0	160,743	$42,076	$1,656	$56,260	$32,045	$55,407	$9,228	$12,699
15	$0	159,939	$43,338	$1,647	$55,979	$28,040	$59,413	$10,217	$22,916
16	$0	159,140	$44,638	$1,639	$55,699	$23,745	$63,708	$11,245	$34,161
17	$0	158,344	$45,977	$1,631	$55,420	$19,139	$68,313	$12,314	$46,476
18	$0	157,552	$47,357	$1,623	$55,143	$14,201	$73,251	$13,425	$59,900
19	$0	156,765	$48,777	$1,615	$54,868	$8,906	$78,547	$14,578	$74,478
20	$0	155,981	$50,241	$1,607	$54,593	$3,228	$84,225	$15,775	$90,253
21	$0	155,201	$51,748	$1,599	$54,320	$2,736	$77,429	$24,305	$114,558
22	$0	154,425	$53,300	$1,591	$54,049	$1,873	$63,717	$40,169	$154,727
23	$0	153,653	$54,899	$1,583	$53,778	$0	$0	$107,095	$261,822
24	$0	152,884	$56,546	$1,575	$53,510	$0	$0	$108,481	$370,303
25	$0	152,120	$58,243	$1,567	$53,242	$0	$0	$109,918	$480,221
	Totals:	3,273,128	$769,879	$26,698	$1,145,595	$809,063	$939,987	$1,081,132	$1,348,470

Net Present Value (NPV)	**$75,630**
Internal Rate of Return (IRR)	**13.4%**

Project Name: **LGEA Solar PV Project - Denville Riverview Elementary School**
Location: **Denville, NJ**
Description: **Photovoltaic System - Direct Purchase**

Simple Payback Analysis

	Photovoltaic System - Direct Purchase
Total Construction Cost	$989,460
Annual kWh Production	171,566
Annual Energy Cost Reduction	$28,652
Annual SREC Revenue	$60,048
First Cost Premium	**$989,460**
Simple Payback:	**11.16** **Years**

Life Cycle Cost Analysis

Analysis Period (years):	25	Financing %:	0%
Financing Term (mths):	0	Maintenance Escalation Rate:	3.0%
Average Energy Cost ($/kWh)	**$0.167**	Energy Cost Escalation Rate:	3.0%
Financing Rate:	0.00%	SREC Value ($/kWh)	$0.350

Period	Additional Cash Outlay	Energy kWh Production	Energy Cost Savings	Additional Maint Costs	SREC Revenue	Net Cash Flow	Cumulative Cash Flow
0	$989,460	0	0	0	$0	(989,460)	0
1	$0	171,566	$28,652	$0	$60,048	$88,700	($900,760)
2	$0	170,709	$29,511	$0	$59,748	$89,259	($811,501)
3	$0	169,855	$30,396	$0	$59,449	$89,846	($721,655)
4	$0	169,006	$31,308	$0	$59,152	$90,460	($631,195)
5	$0	168,161	$32,248	$1,732	$58,856	$89,372	($541,823)
6	$0	167,320	$33,215	$1,723	$58,562	$90,054	($451,769)
7	$0	166,483	$34,212	$1,715	$58,269	$90,766	($361,004)
8	$0	165,651	$35,238	$1,706	$57,978	$91,509	($269,494)
9	$0	164,823	$36,295	$1,698	$57,688	$92,285	($177,209)
10	$0	163,999	$37,384	$1,689	$57,399	$93,094	($84,115)
11	$0	163,179	$38,505	$1,681	$57,112	$93,937	$9,822
12	$0	162,363	$39,661	$1,672	$56,827	$94,815	$104,638
13	$0	161,551	$40,850	$1,664	$56,543	$95,729	$200,367
14	$0	160,743	$42,076	$1,656	$56,260	$96,680	$297,047
15	$0	159,939	$43,338	$1,647	$55,979	$97,670	$394,716
16	$0	159,140	$44,638	$1,639	$55,699	$98,698	$493,414
17	$0	158,344	$45,977	$1,631	$55,420	$99,767	$593,181
18	$0	157,552	$47,357	$1,623	$55,143	$100,877	$694,059
19	$0	156,765	$48,777	$1,615	$54,868	$102,030	$796,089
20	$0	155,981	$50,241	$1,607	$54,593	$103,227	$899,316
21	$1	155,201	$51,748	$1,599	$54,320	$104,470	$1,003,786
22	$2	154,425	$53,300	$1,591	$54,049	$105,759	$1,109,544
23	$3	153,653	$54,899	$1,583	$53,778	$107,095	$1,216,640
24	$4	152,884	$56,546	$1,575	$53,510	$108,481	$1,325,121
25	$5	152,120	$58,243	$1,567	$53,242	$109,918	$1,435,039
	Totals:	3,273,128	$769,879	$26,698	$1,145,595	$2,424,499	$1,888,776
				Net Present Value (NPV)		**$1,435,064**	
				Internal Rate of Return (IRR)		**8.1%**	

Building	Roof Area (sq ft)	Panel	Qty	Panel Sq Ft	Panel Total Sq Ft	Total KW	Total Annual kWh	Panel Weight (33 lbs)	W/SQFT
Denville Riverview Elementary School	7020	Sunpower SPR230	478	14.7	7,029	109.94	171,566	15,774	15.64

.= Proposed PV Layout

Notes:
1. Estimated kWH based on 4.68 hours full output per day per 365 day year. Actual kWH will vary day to day.

ENERGY AUDIT – FINAL REPORT

VALLEYVIEW MIDDLE SCHOOL
320 DIAMOND SPRING ROAD
DENVILLE, NJ 07834
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CEG PROJECT NO. 9C09080

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I. EXECUTIVE SUMMARY

This report presents the findings of the energy audit conducted for:

Denville Board of Education
Valleyview Middle School
320 Diamond Spring Road
Denville, NJ 07834

Municipal Contact Person: John Serapiglia
Facility Contact Person:

This audit is performed in connection with the New Jersey Clean Energy - Local Government Energy Audit Program. The energy audit is conducted to promote the mission of the office of Clean Energy, which is to use innovation and technology to solve energy and environmental problems in a way that improves the State's economy. This can be achieved through the wiser and more efficient use of energy.

The annual energy costs at this facility are as follows:

Electricity	$ 112,173
Natural Gas	$ 53,239
Total	$ 165,413

The potential annual energy cost savings for each energy conservation measure (ECM) are shown below in Table 1. Be aware that the ECM's are not additive because of the interrelation of some of the measures. This audit is consistent with an ASHRAE level 2 audit. The cost and savings for each measure is ± 20%. The evaluations are based on engineering estimations and industry standard calculation methods. More detailed analyses would require engineering simulation models, hard equipment specifications, and contractor bid pricing.

Table 1
Energy Conservation Measures (ECM's)

ECM NO.	DESCRIPTION	COST[A]	ANNUAL SAVINGS[B]	SIMPLE PAYBACK (YEARS)	SIMPLE ROI
1	Lighting Upgrade – General	$60,037	$6,294	9.5	10.5%
2	Lighting Controls	$5,335	$2,203	2.4	41.3%
3	HVAC System Controls	$331,728	$4,967	66.8	1.5%
4	Computer Room Ductless Split System	$9,612	$1,419	6.8	14.8%
5	Boiler Replacement	$115,239	$6,662	17.3	5.8%

6	Solar PV – Direct Purchase	$726,570	$64,503	11.26	8.9%

Notes: A. Cost takes into consideration applicable NJ Smart Start™ incentives and maintenance savings.
B. Savings takes into consideration applicable maintenance savings.

The estimated demand and energy savings for each ECM is shown below in Table 2. The information in this table corresponds to the ECM's in Table 1.

Table 2
Estimated Energy Savings

ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELEC. DEMAND (KW)	ELEC. CONSUMPTION (KWH)	NAT GAS (THERMS)
1	Lighting Upgrade – General	20.3	36,950	-
2	Lighting Controls	-	13,763	-
3	HVAC System Controls	-	17,320	3,043
4	Computer Room Ductless Split System	4.0	8,763	-
5	Boiler Replacement			4,326
6	Solar PV – Direct Purchase	80.7	125,583	-

*Elec. Demand Savings are calculated for cooling season only. Elec. consumption savings are totaled annually.

Concord Engineering Group (CEG) recommends proceeding with the implementation of all ECM's that provide a calculated simple payback at or under ten (10) years. The following Energy Conservation Measures are recommended for the municipal building:

- **ECM #1:** Lighting Upgrade
- **ECM #2:** Lighting Controls
- **ECM #4:** Computer Room Ductless Split System

Although ECM #5 does not provide a payback less than 10 years, it is recommended to utilize a high efficiency boiler as suggested in ECM #3 (or equal) when the boiler is replaced. A boiler system replacement should be considered since the existing boiler is past its lifespan.

In addition to the ECMs, there are maintenance and operational measures that can provide significant energy savings and provide immediate benefit. The ECMs listed above represent investments that can be made to the facility which are justified by the savings seen overtime. However, the maintenance items and small operational improvements below are typically achievable with on site staff or maintenance contractors and in turn have the potential to provide substantial operational savings compared to the costs associated. The following are recommendations which should be considered a priority in achieving an energy efficient building:

1. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%. Condenser coils at window level such as window air conditioners are particularly susceptible to dust and dirt created from landscaping and people activity.
2. Maintain all weather stripping on entrance doors. The majority of the entrance doors in the facility have significant leakage area around the doors which increases infiltration into the building.
3. Clean all light fixtures to maximize light output. Cleaned light fixtures providing full light output, may prevent added task lighting from being turned on and left on.
4. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.
5. Set hot water re-circ pump temperature set-point below the domestic hot water supply temperature setting. This will avoid continuous operation of the hot water re-circ pump while still providing the benefit of on demand hot water to the remote fixtures in the facility. Provide a time clock in addition to hot water re-circ aqua stat to stop hot water circulation during unoccupied periods. Keeping the hot water piping hot 24/7 is unnecessary when fixtures will not be used and adds energy consumption in the cooling season due to added cooling load in the building.
6. Set all computers and computer monitors to run in power saving (standby or sleep) mode when not in use. Added heat output from computers compounds the work that air conditioners have to do to remove the heat.
7. Repair leaking faucets in janitorial closets, bathrooms, and maintenance rooms. Although this is not associated with direct energy savings, dripping faucets will corrode and cause calcification on plumbing fixtures resulting in pre-mature replacement.

II. INTRODUCTION

The comprehensive energy audit covers the 82,932 square foot Valleyview Middle School that includes classrooms, faculty rooms, a gymnasium, cafeteria, science lab, woodshop, and administrative offices.

Electrical and natural gas utility information is collected and analyzed for one full year's energy use of the building. The utility information allows for analysis of the building's operational characteristics; calculate energy benchmarks for comparison to industry averages, estimated savings potential, and baseline usage/cost to monitor the effectiveness of implemented measures. A computer spreadsheet is used to calculate benchmarks and to graph utility information (see the utility profiles below).

The Energy Use Index (EUI) is established for the building. Energy Use Index (EUI) is expressed in British Thermal Units/square foot/year (BTU/ft^2/yr), which is used to compare energy consumption to similar building types or to track consumption from year to year in the same building. The EUI is calculated by converting the annual consumption of all energy sources to BTU's and dividing by the area (gross square footage) of the building. Blueprints (where available) are utilized to verify the gross area of the facility. The EUI is a good indicator of the relative potential for energy savings. A low EUI indicates less potential for energy savings, while a high EUI indicates poor building performance therefore a high potential for energy savings.

Existing building architectural and engineering drawings (where available) are utilized for additional background information. The building envelope, lighting systems, HVAC equipment, and controls information gathered from building drawings allow for a more accurate and detailed review of the building. The information is compared to the energy usage profiles developed from utility data. Through the review of the architectural and engineering drawings a building profile can be defined that documents building age, type, usage, major energy consuming equipment or systems, etc.

The preliminary audit information is gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is spent and opportunities exist within a facility. The entire site is surveyed to inventory the following to gain an understanding of how each facility operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Facility-specific equipment

The building site visit is performed to survey all major building components and systems. The site visit includes detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs

provided by the building manager are collected along with the system and components to determine a more accurate impact on energy consumption.

III. METHOD OF ANALYSIS

Post site visit work includes evaluation of the information gathered, researching possible conservation opportunities, organizing the audit into a comprehensive report, and making recommendations on HVAC, lighting and building envelope improvements. Data collected is processed using energy engineering calculations to anticipate energy usage for each of the proposed energy conservation measures (ECMs). The actual building's energy usage is entered directly from the utility bills provided by the owner. The anticipated energy usage is compared to the historical data to determine energy savings for the proposed ECMs.

It is pertinent to note, that the savings noted in this report are not additive. The savings for each recommendation is calculated as standalone energy conservation measures. Implementation of more than one ECM may in some cases affect the savings of each ECM. The savings may in some cases be relatively higher if an individual ECM is implemented in lieu of multiple recommended ECMs. For example implementing reduced operating schedules for inefficient lighting will result in a greater relative savings. Implementing reduced operating schedules for newly installed efficient lighting will result in a lower relative savings, because there is less energy to be saved. If multiple ECM's are recommended to be implemented, the combined savings is calculated and identified appropriately.

ECMs are determined by identifying the building's unique properties and deciphering the most beneficial energy saving measures available that meet the specific needs of the facility. The building construction type, function, operational schedule, existing conditions, and foreseen future plans are critical in the evaluation and final recommendations. Energy savings are calculated base on industry standard methods and engineering estimations. Energy consumption is calculated based on manufacturer's cataloged information when new equipment is proposed.

Cost savings are calculated based on the actual historical energy costs for the facility. Installation costs include labor and equipment to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers. The NJ SmartStart Building® program incentives savings (where applicable) are included for the appropriate ECM's and subtracted from the installed cost. Maintenance savings are calculated where applicable and added to the energy savings for each ECM. The costs and savings are applied and a simple payback and simple return on investment (ROI) is calculated. The simple payback is based on the years that it takes for the savings to pay back the net installation cost (Net Installation divided by Net Savings.) A simple return on investment is calculated as the percentage of the net installation cost that is saved in one year (Net Savings divided by Net Installation.)

A simple life-time calculation is shown for each ECM. The life-time for each ECM is estimated based on the typical life of the equipment being replaced or altered. The energy savings is extrapolated throughout the life-time of the ECM. The total energy savings is calculated as the total life-time multiplied by the yearly savings.

IV. HISTORIC ENERGY CONSUMPTION/COST

A. Energy Usage / Tariffs

The electric usage profile (below) represents the actual electrical usage for the facility. Jersey Central Power and Light (JCP&L) provides electricity to the facility under their General Service Secondary Three-Phase rate structure. The electric utility measures consumption in kilowatt-hours (KWH) and maximum demand in kilowatts (KW). One KWH usage is equivalent to 1000 watts running for one hour. One KW of electric demand is equivalent to 1000 watts running at any given time. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges. Rates used in this report reflect the historical data received for the facility.

The gas usage profile shows the actual natural gas energy usage for the facility. New Jersey Natural Gas (NJN) provides natural gas to the facility along with a third party provider Pepco Energy Services. NJN provides natural gas under the General Supply Large (GSL) rate structure. The gas utility measures consumption in cubic feet x 100 (CCF), and converts the quantity into Therms of energy. One Therm is equivalent to 100,000 BTUs of energy.

The overall cost for utilities is calculated by dividing the total cost by the total usage. Based on the utility history provide, the average cost for utilities at this facility is as follows:

Description	Average
Electricity	16.2¢ / kWh
Natural Gas	$1.54 / Therm

Table 3
Electricity Billing Data

Utility Provider: JCP&L, General Service Secondary 3 Phase (Meter # G17995355)			
MONTH OF USE	**CONSUMPTION KWH**	**DEMAND**	**TOTAL BILL**
Jul-08	67,520	102.6	$11,523
Aug-08	33,760	101.3	$6,108
Sep-08	41,280	157.1	$7,582
Oct-08	48,320	160.5	$7,608
Nov-08	52,800	152.5	$8,200
Dec-08	65,600	173.1	$10,295
Jan-09	75,680	182.6	$12,126
Feb-09	69,600	177.6	$11,253
Mar-09	71,840	177.1	$11,415
Apr-09	57,760	168.6	$9,255
May-09	60,960	159.0	$9,332
Jun-09	46,720	160.0	$7,475
Totals	**691,840**	**182.6 Max**	**$112,173**
AVERAGE DEMAND 156.0 KW average			
AVERAGE RATE $0.162 $/kWh			

Figure 1
Electricity Usage Profile

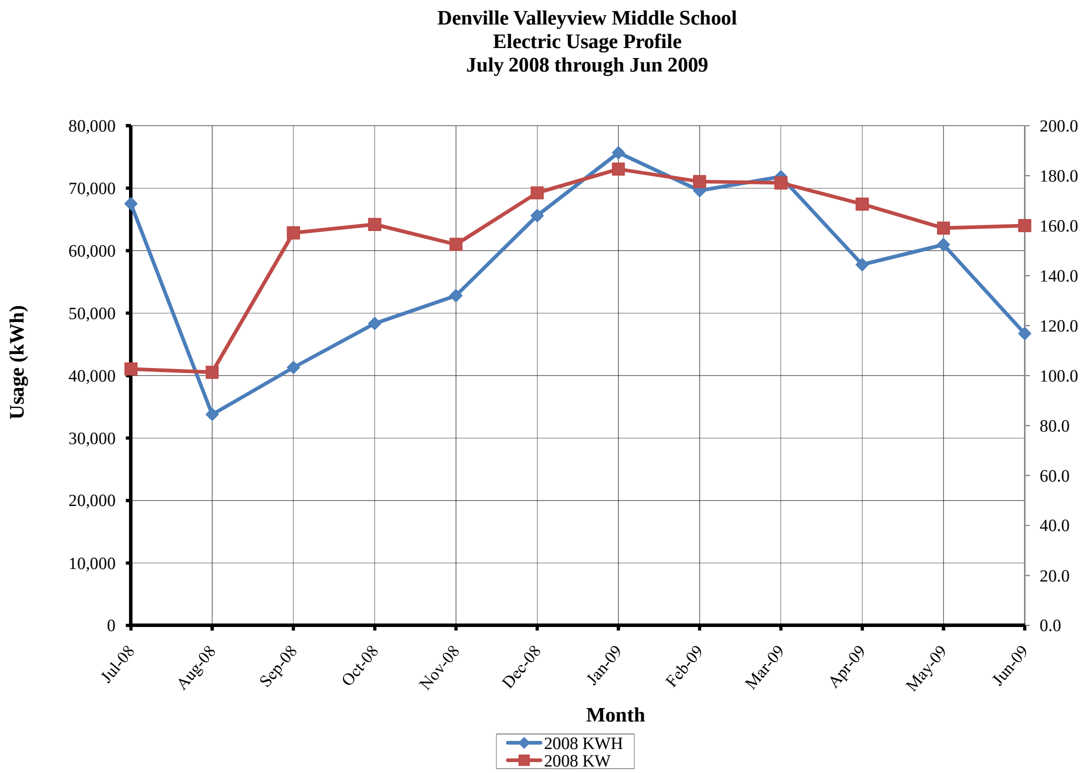
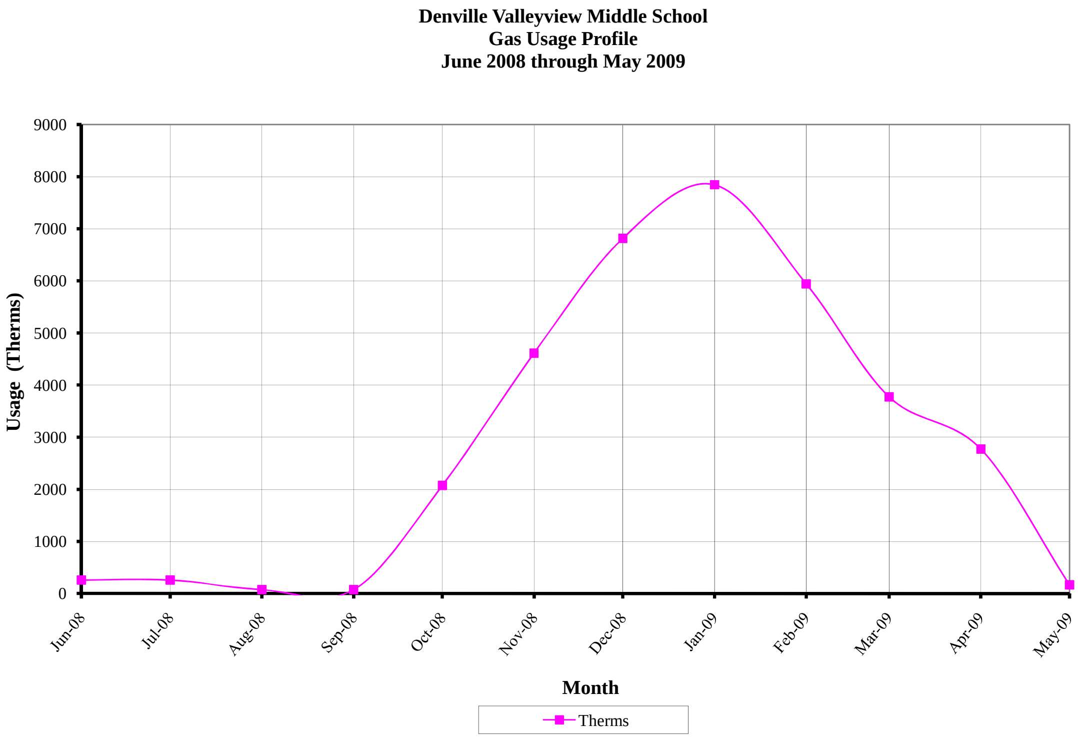


Table 4
Natural Gas Billing Data

Utility Provider: NJN, Rate - GSL, (Meter # 00746530)		
MONTH OF USE	**CONSUMPTION (THERMS)**	**TOTAL BILL**
Jun-08	259	$564.02
Jul-08	259	$564.02
Aug-08	75	$173.78
Sep-08	75	$299.36
Oct-08	2,074	$3,172.04
Nov-08	4,612	$7,053.43
Dec-08	6,816	$10,401.10
Jan-09	7,843	$11,916.56
Feb-09	5,942	$8,714.28
Mar-09	3,774	$5,691.99
Apr-09	2,773	$4,369.07
May-09	165	$319.83
TOTALS	**34666**	**$53,239.48**
AVERAGE RATE:	**$1.54**	**$/THERM**

Figure 2
Natural Gas Usage Profile



B. Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (BTU) and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.

The site and source EUI for this facility is calculated as follows:

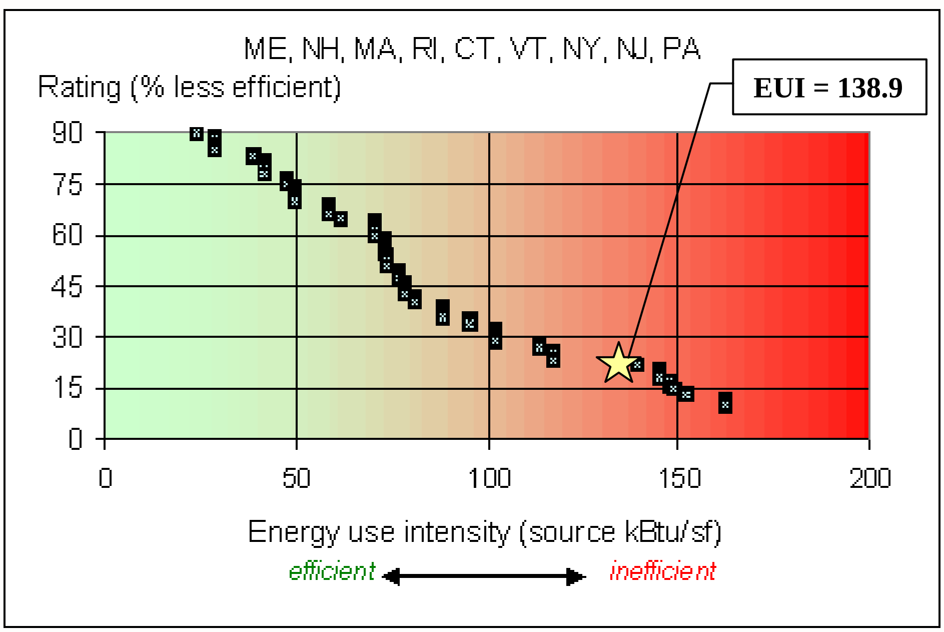
$$Building\ Site\ EUI = \frac{(Electric\ Usage\ in\ kBtu + Gas\ Usage\ in\ kBtu)}{Building\ Square\ Footage}$$

$$Building\ Source\ EUI = \frac{(Electric\ Usage\ in\ kBtu\ X\ SS\ Ratio + Gas\ Usage\ in\ kBtu\ X\ SS\ Ratio)}{Building\ Square\ Footage}$$

Table 5
Denville Valleyview Middle School EUI Calculations

ENERGY TYPE	BUILDING USE			SITE ENERGY	SITE-SOURCE	SOURCE ENERGY
	kWh	Therms	Gallons	kBtu	RATIO	kBtu
ELECTRIC	691,840			2,361,942	3.340	7,888,885
NATURAL GAS		34,665.67		3,466,567	1.047	3,629,496
FUEL OIL			0.00	0	1.010	0
PROPANE			0.00	0	1.010	0
TOTAL				5,828,509		11,518,381
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
BUILDING AREA		82,932		SQUARE FEET		
BUILDING SITE EUI		70.28		kBtu/SF/YR		
BUILDING SOURCE EUI		**138.89**		**kBtu/SF/YR**		

Figure 3
Source Energy Use Intensity Distributions: Schools



C. EPA Energy Benchmarking System

The United States Environmental Protection Agency (EPA) in an effort to promote energy management has created a system for benchmarking energy use amongst various end users. The benchmarking tool utilized for this analysis is entitled Portfolio Manager. The Portfolio Manager tool allows tracking and assessment of energy consumption via the template forms located on the ENERGY STAR website (www.energystar.gov). The importance of benchmarking for local government municipalities is becoming more important as utility costs continue to increase and emphasis is being placed on carbon reduction, greenhouse gas emissions and other environmental impacts.

Based on information gathered from the ENERGY STAR website, Government agencies spend more than $10 billion a year on energy to provide public services and meet constituent needs. Furthermore, energy use in commercial buildings and industrial facilities is responsible for more than 50 percent of U.S. carbon dioxide emissions. It is vital that local government municipalities assess facility energy usage, benchmark energy usage utilizing Portfolio Manager, set priorities and goals to lessen energy usage and move forward with priorities and goals.

In accordance with the Local Government Energy Audit Program, CEG has created an ENERGY STAR account for the municipality to access and monitoring the facility's yearly energy usage as it compares to facilities of similar type. The following is the user name and password for this account:

https://www.energystar.gov/istar/pmpam/index.cfm?fuseaction=login.login

User Name: denvilleboe
Password: lgeaceg2009

Security Question: What is your birth city?
Security Answer: "Denville"

The utility bills and other information gathered during the energy audit process are entered into the Portfolio Manager. The following is a summary of the results for the facility:

Table 6
ENERGY STAR Performance Rating

FACILITY DESCRIPTION	ENERGY PERFORMANCE RATING	NATIONAL AVERAGE
Denville Valleyview MS	36	50

See the Statement of Energy Performance appendix for the detailed energy summary.

V. FACILITY DESCRIPTION

The 82,932 SF Middle School is a two story facility comprised of classrooms, offices, cafeteria, kitchen, gymnasium, and library on the first floor, and classrooms, offices, and science and art rooms on the ground floor. The building was built in 1963. C-wing was added to the building in 1975, which includes classrooms, science rooms, and art room. The typical school hours are between 7:40 am and 2:20 pm. The building construction is CMU block with face brick. The exterior walls have minimal insulation typical of the time period. It is unknown if the CMU blocks are filled. The windows throughout the facility are in good condition and appear to be maintained. The window type throughout the facility is double pane, clear glass with aluminum frames. Blinds are internal to the window construction and are utilized through the facility per occupant comfort. The blinds are valuable because they help to reduce solar heat gain in the summer. The roof is a single ply flat roofing system supported by a metal deck. Roof insulation is above the metal deck. The amount of insulation below the roof membrane is unknown. Most doorways into the school are double doors with weather stripping either missing or in poor condition. The main entrance to the school does not have a vestibule.

HVAC Heating System

The School is heated by two industrial hot water boilers. The boilers have been converted to gas approximately 3 years agao, but maintain the capability to run on oil. The boilers were built in 1963 with an input capacity of 7071 MBH each. The boilers require constant maintenance and cleaning of the tubes due to its age. The heating water loop is circulated with two 7.5 HP base mounted pumps (operating and standby). The pumps are manually turned on in the heating season. The heating water is circulated throughout the building to baseboards, unit ventilators, air handling units with hot water coils. The unit ventilators are operated manually and the blower typically runs 24/7. The heating equipment is controlled by a pneumatic system. The baseboards and hot water coil water flow is regulated by old pneumatic driven actuators. Some components in the pneumatic system do not respond and leak. Space temperatures are over / under heating in some areas in the heating season. Many control valves are corroded significantly with mineral deposits due to poor water treatment and leakage.

HVAC Cooling System

The building does not have a central cooling system. A few spaces are air conditioned by either window air conditioners, split systems, or packaged rooftop air conditioners. Window air conditioners are installed throughout the building for perimeter offices, support spaces, and classrooms as needed such as the library, music room, life skills class, and computer room. The window AC unit are of various size, age, and capacity, however the range of efficiencies for the window AC units is 8.6 – 11.0 energy efficiency ratio (EER). The Packaged rooftop units provide conditioned air for offices without operable windows, and the two new science rooms. Approximately 50% - 75% of the school has some form of air conditioning.

Exhaust System

Air is exhausted from the toilet rooms through the roof exhausters. The toilet room exhaust fans are operated manually by maintenance personnel. Some spaces such as the nurse's toilet room are without any means of exhaust air.

Domestic Hot Water

Domestic hot water for lavatories, office lounge, locker room showers, and kitchen facilities is provided by a dedicated hot water heater system. The domestic hot water is independent of the central boiler system to avoid use of the industrial boilers in the non heating season. The domestic hot water system is made up of a 200 gallon hot water storage tank and a dedicated 315 MBH domestic water boiler. The domestic hot water is circulated throughout the building by a hot water re-circ pump. The circulation pump is controlled by an aqua stat. The domestic hot water piping insulation appeared to be in good condition.

Lighting

Typical lighting throughout building is fluorescent tube lay-in fixtures with T-12 lamps and magnetic ballasts. Storage rooms and closets lit with a mixture of incandescent lamps and compact fluorescent lamps. The parking lot is lit with light poles and high pressure sodium lamps. All interior lighting is manually controlled by the building occupants by wall switches. The gym is lit with high ceiling metal halide fixtures.

VI. MAJOR EQUIPMENT LIST

The equipment list is considered major energy consuming equipment and through replacement could yield substantial energy savings. The list shows the major equipment in the facility and all pertinent information utilized in energy savings calculations. An approximate age was assigned to the equipment if a manufactures date was not shown on the equipment's nameplate. The ASHRAE service life for the equipment along with the remaining useful life is also shown in the Appendix.

Refer to the Major Equipment List Appendix for this facility.

VII. ENERGY CONSERVATION MEASURES

ECM #1: Lighting Upgrade – General

Description:

The lighting in Valleyview middle school is primarily made up of fluorescent fixtures with T-12 lamps and magnetic ballasts. There are a few storage rooms and closets with incandescent lighting and compact fluorescent fixtures.

This ECM includes replacement of the existing fixtures containing T12 lamps and magnetic ballasts with fixtures containing T8 lamps and electronic ballasts. The new energy efficient, T8 fixtures will provide adequate lighting and will save the owner on electrical costs due to the better performance of the lamp and ballasts. This ECM will also provide maintenance savings through the reduced number of lamps replaced per year. The expected lamp life of a T8 lamp is approximately 30,000 burn-hours, in comparison to the existing T12 lamps which is approximately 20,000 burn-hours. The facility will need 33% less lamps replaced per year.

This ECM also includes replacement of all incandescent fixtures to compact fluorescent fixtures. The energy usage of an incandescent compared to a compact fluorescent approximately 3 to 4 times greater. In addition to the energy savings, compact fluorescent fixtures burn-hours are 8 to 15 times longer than incandescent fixtures ranging from 6,000 to 15,000 burn-hours compared to incandescent fixtures ranging from 750 to 1000 burn-hours.

Hours of Operation:

Classrooms, Hallways, Gym, Offices, Library, etc:
8 Hrs per day, 5 days per week, 47 weeks per year – 1880 Hrs per year.

Hallways:
10 Hrs per day, 5days per week, 47 weeks per year – 2350 Hrs per year.

Storage rooms, Boiler room:
24% of normal hours (above) – 470 Hrs per year.

Outdoor Lighting:
10 Hrs per day, 7 days per week, 52 weeks per year – 3640 Hrs per year.

Energy Savings Calculations:

The Investment Grade Lighting Audit appendix outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start® Program Incentives are calculated as follows:

From the Smart Start Incentive appendix, the replacement of a T-12 fixture to a T-5 or T-8 fixture warrants the following incentive: T-5 or T-8 (1-2 lamp) = $10 per fixture; T-5 or T-8 (3-4 lamp) = $20 per fixture.

$$\text{Smart Start® } Incentive = (\#\,of\ 1-2\ lamp\ \ fixtures \times\ \$10) + (\#\,of\ 3-4\ lamp\ \ fixtures \times\ \$20)$$

$$\text{Smart Start® } Incentive = (630 \times\ \$10) + (27 \times\ \$20) = \underline{\$6{,}840}$$

Replacement and Maintenance Savings are calculated as follows:

$$Savings = (reduction\ in\ lamps\ replaced\ \ per\ \ year) \times (repacment\ \$\ per\ lamp + Labor\ \$\ per\ lamp)$$

$$Savings = (44\ lamps\ \ per\ \ year) \times (\$2.00 + \$5.00) = \underline{\$308}$$

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY*	
Installation Cost ($):	$66,877
NJ Smart Start Equipment Incentive ($):	($6,840)
Net Installation Cost ($):	$60,037
Maintenance Savings ($ / yr):	*$308*
Energy Savings ($ / yr):	*$5,986*
Total Energy Savings ($ / yr):	*$6,294*
Simple Payback (yrs):	*9.5*
Simple Return On Investment (%):	*10.5%*
Estimated ECM Lifetime (yr):	*25*
Simple Lifetime Savings ($):	*$157,350*

* ECM#1 Calculations DO NOT include lighting control changes implemented in ECM#2. If ECM#1 and #2 are implemented together the savings will be relatively lower than shown above.

ECM #2: Lighting Controls

Description:

In some areas the lighting is left on unnecessarily. In many cases the lights are left on because of the inconvenience to manually switch lights off when a room is left or on when a room is first occupied. This is common in storage rooms that are occupied for only short periods and only a few times per day. In some instances lights are left on due to the misconception that it is better to keep the lights on rather than to continuously switch lights on and off. Although increased switching reduces lamp life, the energy savings outweigh the lamp replacement costs. The payback timeframe for when to turn the lights off is approximately two minutes. If the lights are off for at least a two minute interval, then it pays to shut them off.

Lighting controls come in many forms. Sometimes an additional switch is adequate to provide reduced lighting levels when full light output is not needed. Occupancy sensors detect motion and will switch the lights on when the room is occupied. Occupancy sensors can either be mounted in place of a current wall switch, or on the ceiling to cover large areas. Photocell control senses light levels and turn off or reduce lights when there is adequate daylight. Photocells are mostly used outside, but are becoming more popular in energy-efficient interior lighting designs as well.

ASHRAE Standard 90.1-2004, Appendix G is a reference standard for modeling building efficiency. The standard estimates that lighting controls provide a 10% reduction in lighting power usage for daytime occupancies in buildings over 5,000 SF, and 15% reduction in buildings under 5,000 SF. This ECM includes dual technology occupancy sensors in the courthouse, each private office, open office, conference room, restrooms, lunch room, storage rooms, and file room, as well as a photocell daylight sensor controlling the 1st floor rotunda lighting.

The ECM includes replacement of standard wall switches with sensors wall switches for individual classrooms and offices. Sensors shall be manufactured by Sensorswitch, Watt Stopper or equivalent. See the “Investment Grade Lighting Audit” appendix for details.

The “Investment Grade Lighting Audit” appendix of this report includes the summary of lighting controls implemented in this ECM and outlines the proposed controls, costs, savings, and payback periods. The calculations adjust the lighting power usage by 10% for all areas that include occupancy sensor lighting controls.

Light Energy = 137,628 kWh/Yr. occupancy sensor controlled lighting

Energy Savings Calculations:

$$Energy\ Savings = 10\% \times Occuapancy\ Sensored\ Light\ Energy\ (kWh/Yr)$$

$$Energy\ Savings = 10\% \times 137{,}628\ (kWh) = 13{,}763\ (kWh)$$

$$Savings. = Energy\ Savings\ (kWh) \times Ave\ Elec\ Cost\left(\frac{\$}{kWh}\right)$$

$$Savings. = 13{,}763\ (kWh) \times 0.162\left(\frac{\$}{kWh}\right) = \$2{,}230$$

Installation cost per dual-technology sensor (Basis: Sensor switch or equivalent) is $75/unit including material and labor.

Installation Cost = $75 x 97 motion sensors = $7,275

From the NJ Smart Start appendix, the installation of a lighting control device warrants the following incentive: occupancy = $20 per fixture, daylight = $25 per fixture.

$$\text{Smart Start® } Incentive = (\#\ of\ \ wall\ mount\ devices \times\ \$\ 20) = (97 \times \$20) = \$1940$$

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY*	
Installation Cost ($):	$7,275
NJ Smart Start Equipment Incentive ($):	($1,940)
Net Installation Cost ($):	$5,335
Maintenance Savings ($ / yr):	*$0*
Energy Savings ($ / yr):	*$2,203*
Total Energy Savings ($ / yr):	*$2,203*
Simple Payback (yrs):	*2.4*
Simple Return On Investment (%):	*41.3%*
Estimated ECM Lifetime (yr):	*15*
Simple Lifetime Savings ($):	*$33,045*

* ECM#2 Calculations DO NOT include lighting changes implemented in ECM#1. If ECM#1 and #2 are implemented together the savings will be relatively lower than shown above.

ECM #3: HVAC System Controls

Description:

The existing control system is an outdated pneumatic control system. The zone thermostats are manually set pneumatic actuators controlling local control valves within the space. The system is original to the building's heating system installed in 1963. The space thermostats are inaccurate due to temperature drift over time, leakage, or frozen actuators. The thermostats do not have programmability such as night set back, or morning warm-up features. Modern thermostats and control systems have the capability of saving significant energy as well as improve occupant comfort.

This ECM includes installing a Building Automation system through Direct Digital Controls (DDC) wired through an Ethernet backbone and front end controller. The system will include new thermostat controllers for terminal unit ventilators, baseboard zones, air handling units, and packaged AC equipment wired back to a front end controller with computer interface. The front end device will provide communication between the devices as well as the main boilers. The system will respond to the overall building's needs and operating schedules as defined by the building operator. The DDC system will provide features such as space averaging, temperature override control, night set-back, morning warm-up mode, heating water loop temperature re-set, etc.

The U.S. Department of Energy sponsored a study to analyze energy savings achieved through various types of building system controls. The referenced savings is based on the "Advanced Sensors and Controls for Building Applications: Market Assessment and Potential R&D Pathways," document posted for public use April 2005. The study has found that commercial buildings have the potential to achieve significant energy savings through the use of building controls. The average energy savings are as follows based on the report:

- Energy Management and Control System Savings - 5%-15%.
- Commissioning - 5%-15%.
- Automatic Fault Detection and Diagnostics - 5%-15%.
- Occupancy Sensors for Lighting Control - 20%-28%.
- Photosensor-Based Lighting Control -20%-60%.
- Demand Controlled Ventilation (DCV) -10%-15%.

Energy savings achieved for "Energy Management and Control Systems," average 5%-15%. Savings resulting from the implementation of this ECM for energy management controls are estimated to be 10% of the total energy cost for the facility.

The cost of a full DDC system with new field devices, controllers, computer, software, programming, etc. is approximately $4.00 per SF. Savings from the implementation of this ECM will be primarily achieved through natural gas savings from reduced heating energy. A small portion of savings will result from the cooling system management for the central AC systems in C-wing.

Cost of complete DDC System = ($4.00/SF x 82,932 SF) = $331,728.

Total Gas usage	= 34,666 Therms
Estimated non-Heat gas usage (kitchen & HW)	= 424 Therms*
(*Averaged from May & June gas usage)	
Average Cost of Gas	= $1.53/Therm
Cooling Capacity (Science, Workshop, Comp)	= 17.5 tons
Cooling Season Full Load Cooling Hrs.	= 800 hrs/yr.
Average Cooling Equipment EER	= 9.7 EER
Average Cost of Electricity	= $0.162/kWh

Energy Savings Calculations:

Heating Savings Calculations

$$Heating\ Gas\ Input = Total\ Cons.\ (Therms) - \left(Est.\ HW\ /\ Kitchen\ Use \left(\frac{Therms}{Month} \right) \times Use \left(\frac{Months}{Yr} \right) \right)$$

$$Heating\ Gas\ Input = 34{,}666\ (Therms) - \left(424 \left(\frac{Therms}{Month} \right) \times 10 \left(\frac{Months}{Yr} \right) \right) = 30{,}426 (Therms)$$

$$Savings. = Heating\ Gas\ Input (Therms) \times 10\%\ Savings \times Ave\ Gas\ Cost \left(\frac{\$}{Therm} \right)$$

$$Savings. = 30{,}426\ (Therms) \times 10\% \times 1.54 \left(\frac{\$}{Therm} \right) = \$4{,}686$$

Cooling Savings Calculations

$$Est\ Cool\ Cons. = \frac{Cool\ Load\ (Tons) \times 12{,}000 \left(\frac{Btu}{Ton\ Hr} \right) \times Full\ Load\ Cooling\ Hrs.}{Ave\ Energy\ Efficiency\ Ratio \left(\frac{Btu}{Wh} \right) \times 1000 \left(\frac{Wh}{kWh} \right)}$$

$$Est\ Cool\ Cons. = \frac{17.5\ (Tons) \times 12{,}000 \left(\frac{Btu}{Ton\ Hr} \right) \times 800\ Hrs.}{9.7 \left(\frac{Btu}{Wh} \right) \times 1000 \left(\frac{Wh}{kWh} \right)} = 17{,}320\ (kWh)$$

$$Savings. = Cool\ Cons.(kWh) \times 10\%\ Savings \times Ave\ Elec\ Cost\left(\frac{\$}{kWh}\right)$$

$$Savings. = 17{,}320\ (kWh) \times 10\% \times 0.162\left(\frac{\$}{kWh}\right) = \$281$$

$$Total\ ECM\ Savings = \$4{,}686 + \$281 = \$4{,}967$$

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY*	
Installation Cost ($):	$331,728
NJ Smart Start Equipment Incentive ($):	-
Net Installation Cost ($):	$331,728
Maintenance Savings ($ / yr):	*$0*
Energy Savings ($ / yr):	*$4,967*
Total Energy Savings ($ / yr):	*$4,967*
Simple Payback (yrs):	*66.8*
Simple Return On Investment (%):	*1.5%*
Estimated ECM Lifetime (yr):	*15*
Simple Lifetime Savings ($):	*$74,505*

ECM #4: Computer Room Ductless Split System

Description:

The Computer Room is currently conditioned by a single zone cooling only rooftop unit. The unit's cooling efficiency was 9.1 SEER when new. Due to the age and wear, the estimated cooling efficiency is 8.2 SEER today.

This ECM includes installation of two energy efficient cooling ductless split systems. The ECM calculations are based on two 3 ton Mitsubishi Electric ductless split systems model MSY-D36NA and MUY-D36NA or equal. Cooling efficiency of 15.1 SEER

Computer Room Full Load Cooling Hrs. (6 equivalent full load hrs. per day.)	= 2184 hrs/yr.
Average Cost of Electricity	= $0.162/kWh
Total Rated Cooling Capacity	= 6 Tons
Existing System Efficiency	= 8.2 SEER
Proposed System Efficiency	= 15.1 SEER

Energy Savings Calculations:

Cooling Savings Calculation:

$$EnergySavings = \frac{Cooling(Tons) \times 12{,}000 \left(\frac{Btu}{Ton\ hr}\right)}{1000\left(\frac{Wh}{kWh}\right)} \times \left(\frac{1}{EER_{OLD}} - \frac{1}{EER_{NEW}}\right) \times Full\ Load\ Hrs.$$

$$EnergySavings = \frac{6\,(Tons) \times 12{,}000 \left(\frac{Btu}{Ton\ hr}\right)}{1000\left(\frac{Wh}{kWh}\right)} \times \left(\frac{1}{8.2\left(\frac{Btu}{W}\right)} - \frac{1}{15.1\left(\frac{Btu}{W}\right)}\right) \times 2184\ hours$$

$$= 8{,}763\,kWh$$

$$Demand\ Savings = \frac{Energy\ Savings\,(kWh)}{Hrs\ of\ Cooling}$$

$$Demand\ Savings = \frac{8{,}763\,(kWh)}{2184\ Hrs.} = 4.01\,KW$$

$$Cooling\ Cost\ Savings = 8{,}763\,(kWh) \times 0.162\left(\frac{\$}{kWh}\right) = \$1{,}419$$

Installation cost for the two 3 ton ductless split systems is estimated at $10,050.

From the NJ Smart Start® Program appendix, the split system replacement falls under the category "Unitary AC" and warrants an incentive based on efficiency (EER) at a certain cooling tonnage. The program incentives are calculated as follows:

$$\text{Smart Start® } Incentive = (Cooling\ Tons \times \ \$/Ton\ Incentive)$$
$$= (6\,Tons \times \$73/Ton) = \$438$$

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY*	
Installation Cost ($):	$10,050
NJ Smart Start Equipment Incentive ($):	($438)
Net Installation Cost ($):	$9,612
Maintenance Savings ($ / yr):	*$0*
Energy Savings ($ / yr):	*$1,419*
Total Energy Savings ($ / yr):	*$1,419*
Simple Payback (yrs):	*6.8*
Simple Return On Investment (%):	*14.8%*
Estimated ECM Lifetime (yr):	*15*
Simple Lifetime Savings ($):	*$21,285*

ECM #5: Boiler Replacement

Description:

Valleyview middle school is heated by two (2) Superior Gas-fired, sectional boilers. The boilers are original to the building, 46 years old. The input capacity for each boiler is 7,071 MBH. The original steam boiler efficiency is approximately 70%, however the boiler has been converted to hot water with approximate efficiency of 78%.

This ECM includes replacing the two gas fired hot water boilers with high efficiency boilers. The basis of this ECM is three (3) Weil – McLain sectional hot water boilers or equivalent with an efficiency of 85.6%.

Existing Heating Hot Water Boiler:

Rated Input Capacity = 7,071 MBh (Each)

Combustion Efficiency = 78%
Radiation Losses = 5%
Thermal Efficiency = 73%

Replacement Boiler:

High-Efficiency Boiler

Rated Capacity = 2,887 MBh (Each)

Combustion Efficiency = 85.6%
Radiation Losses = 0.5%
Thermal Efficiency = 85.1%

Operating Data:

Heating Season Fuel Consumption = 34,666 Therms (based on Natural. Gas billing data)
Average Cost of Natural Gas = $1.53/Therm

Energy Savings Calculations:

$$Heating\ Gas\ Input = Total\ Cons.\left(Therms\right) - \left(Est.\ HW / Kitchen\ Use\left(\frac{Therms}{Month}\right) \times Use\left(\frac{Months}{Yr}\right)\right)$$

$$Heating\ Gas\ Input = 34{,}666\left(Therms\right) - \left(424\left(\frac{Therms}{Month}\right) \times 10\left(\frac{Months}{Yr}\right)\right) = 30{,}426\left(Therms\right)$$

$$Building\ Heat\ Cons. = Heating\ Gas\ Input(Therms) \times Old\ Heating\ Efficiency(\%)$$

$$Building\ Heat\ Cons. = 30{,}426\ (Therms) \times 73\% = 22{,}211\ (Therms)$$

$$EnergySavings. = Heat\ Cons.\ (Therms) \times \left(\frac{1}{Efficiency_{OLD}} - \frac{1}{Efficiency_{NEW}} \right)$$

$$EnergySavings = 22{,}211\ (Therms) \times \left(\frac{1}{73\%} - \frac{1}{85.1\%} \right) = 4{,}326\ (Therms)$$

$$Savings. = Heat\ Cons.(Therms) \times Ave\ Gas\ Cost\left(\frac{\$}{Therm} \right)$$

$$Savings. = 4{,}326\ (Therms) \times 1.54 \left(\frac{\$}{Therm} \right) = \$6{,}662$$

Installed cost of the Weil McLain sectional boilers including removal of existing unit, all piping changes and controls is estimated to be $123,900.
Smart Start Incentive = $1.00/MBh x 8,661/installed MBh = $8,661

Energy Savings Summary:

ECM #5 - ENERGY SAVINGS SUMMARY*	
Installation Cost ($):	$123,900
NJ Smart Start Equipment Incentive ($):	($8,661)
Net Installation Cost ($):	$115,239
Maintenance Savings ($ / yr):	*$0*
Energy Savings ($ / yr):	*$6,662*
Total Energy Savings ($ / yr):	*$6,662*
Simple Payback (yrs):	*17.3*
Simple Return On Investment (%):	*5.8%*
Estimated ECM Lifetime (yr):	*35*
Simple Lifetime Savings ($):	*$233,170*

VIII. RENEWABLE/DISTRIBUTED ENERGY MEASURES

Globally, renewable energy has become a priority affecting international and domestic energy policy. The State of New Jersey has taken a proactive approach, and has recently adopted in its Energy Master Plan a goal of 30% renewable energy by 2020. To help reach this goal New Jersey created the Office of Clean Energy under the direction of the Board of Public Utilities and instituted a Renewable Energy Incentive Program to provide additional funding to private and public entities for installing qualified renewable technologies. A renewable energy source can greatly reduce a building's operating expenses while producing clean environmentally friendly energy. CEG has assessed the feasibility of installing renewable energy technologies for Branchburg NJ, and concluded that there is potential for solar energy generation.

Solar energy produces clean energy and reduces a building's carbon footprint. This is accomplished via photovoltaic panels which will be mounted on all south and southwestern facades of the building. Flat roof, as well as sloped areas can be utilized; flat areas will have the panels turned to an optimum solar absorbing angle. (A structural survey of the roof would be necessary before the installation of PV panels is considered). The state of NJ has instituted a program in which one Solar Renewable Energy Certificate (SREC) is given to the Owner for every 1000 kWh of generation. SREC's can be sold anytime on the market at their current market value. The value of the credit varies upon the current need of the power companies. The average value per credit is around $350, this value was used in our financial calculations. This equates to $0.35 per kWh generated.

CEG has reviewed the existing roof area of the building being audited for the purposes of determining a potential for a roof mounted photovoltaic system. A roof area of 5160 S.F. can be utilized for a PV system. A depiction of the area utilized is shown in Renewable / Distributed Energy Measures Calculation appendix. Using this square footage it was determined that a system size of 80.73 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 125,983 KWh annually, reducing the overall utility bill by approximately 18.2% percent. A detailed financial analysis can be found in the Renewable / Distributed Energy Measures Calculation appendix. This analysis illustrates the payback of the system over a 25 year period. The eventual degradation of the solar panels and the price of accumulated SREC's are factored into the payback.

CEG has reviewed financing options for the owner. Two options were studied and they are as follows: Self-financed and direct purchase without finance. Self-finance was calculated with 95% of the total project cost financed at a 7% interest rate over 25 years. Direct purchase involves the local government paying for 100% of the total project cost upfront via one of the methods noted in the Installation Funding Options section below. Both of these calculations include a utility inflation rate as well as the degradation of the solar panels over time. Based on our calculations the following are the payback periods for the respective method of payment:

PAYMENT TYPE	SIMPLE PAYBACK	SIMPLE ROI	INTERNAL RATE OF RETURN
Self-Finance	11.3 Years	8.9%	12.3%
Direct Purchase	11.3 Years	8.9%	8.0%

The resultant Internal Rate of Return indicates that if the Owner was able to “self-finance” the solar project, the project would be slightly more beneficial to the Owner. However, if the Owner was able to work out a Power Purchase Agreement with a third-party and agree upon a decent base energy rate for kilowatt hour production, the “direct purchase” option could also, prove to be a beneficial route.

In addition to the Solar Analysis, CEG also conducted a review of the applicability of wind energy for the facility. Wind energy production is another option available through the Renewable Energy Incentive Program. Wind turbines of various types can be utilized to produce clean energy on a per building basis. Cash incentives are available per kWh of electric usage. Based on CEG’s review of the applicability of wind energy for this facility, it was determined that the average wind speed is not adequate, and the kilowatt demand for the building is below the threshold (200 kW) for purchase of a commercial wind turbine. Therefore, wind energy is not a viable option.

IX. ENERGY PURCHASING AND PROCUREMENT STRATEGY

Load Profile:

Load Profile analysis was performed to determine the seasonal energy usage of the facility. Irregularities in the load profile will indicate potential problems within the facility. Consequently based on the profile a recommendation will be made to remedy the irregularity in energy usage. For this report, the facility's energy consumption data was gathered in table format and plotted in graph form to create the load profile. Refer to the Electric and Natural Gas Usage Profiles included within this report to reference the respective electricity and natural gas usage load profiles.

Electricity:

The Electric Usage Profile demonstrates a fairly atypical load shape. There is increased consumption in the winter period (November -March), with a continuation of April through July. The later summer-time load can be described as air-conditioning load. The air conditioning is supplied by window units, split units and packaged rooftop units. There is also an obvious drop in usage July going into August. A flatter load profile of this type, will allow for more competitive energy prices when shopping for alternative suppliers.

Natural Gas:

The Natural Gas Usage Profile demonstrates a very typical natural gas (heat load) profile. The summer months (May – September) demonstrate extremely low consumption (complimenting the winter heating load). There is an increase in winter consumption (November – March). The increased winter load is caused by heating demand. In this facility the heat is supplied by 2 large industrial natural gas fired boilers. Also adding to the natural gas demand is the presence of a natural gas fired hot water system, which is independent of the central boiler system. A base-load shaping (flat) will secure more competitive energy prices when procuring energy through an alternative energy source.

Tariff Analysis:

Electricity:

This facility receives electrical service through Jersey Central Power & Light (JCP&L) on a GSS (General Service Secondary – 3 Phase) rate. Service classification GS is available for general service purposes on secondary voltages not included under Service Classifications RS, RT, RGT or GST. This facility's rate is a single or three phase service at secondary voltages. For electric supply (generation), the customer will use the utilities Basic Generation Service (BGS) or a Third Party Supplier (TPS). This facility uses Basic Generation service from the utility. Therefore, they will pay according to the BGS default service. The Delivery Service includes the following charges: Customer Charge, Supplemental Customer Charge, Distribution Charge (kW

Demand), kWh Charge, Non-utility Generation Charge, TEFA, SBC, SCC, Standby Fee and RGGI.

Natural Gas:

This facility receives natural gas Delivery Service through New Jersey Natural Gas Company on a GSL (General Service Large) tariff rate schedule. The GSL rate is available to any Customer in the entire territory served by the Company who uses 5,000 therms or more annually and uses gas for all purposes other than residential and interruptible service. Where the customer uses the Cooling, Air Conditioning and Pool Heating Service (CAC) under Special Provision 1 applicable to customers purchasing gas supply under Rider “A”, the Company will, upon application of the Customer, meter the space heating and the “CAC” separately.

This service is considered a “firm” service, where the customer may either purchase gas from Company’s Rider “A”, for Basic Gas Supply Service (BGSS) or from a Marketer or Broker. A “firm service” is a higher priority of delivery on the natural gas pipeline. Typically the firm users do not have the capability of being interrupted by the utility, so the utility must provide a higher level of service. Much like the telecom industry, the natural gas pipelines were deregulated and various levels of delivery service were created. The “firm service” was the most reliable, because it is last on the pecking order for interruption.

The basic charges under this tariff are for: Customer Charge, Demand Charge, Delivery Charge and if the customer elects, the BGSS Supply Charge. The customer can elect to have the Commodity Charge serviced through the utility or by a Third Party Supplier (TPS). Currently Denville is using the services of a TPS, Pepco Energy Services. Note: Should the TPS not deliver, then the customer will receive replacement service from the utility which carries an extremely high penalty cost of service, which is automatically supplied.

Imbalances can occur when Third Party Suppliers are used to supply natural gas when full delivery is not made, or when a new supplier is contracted or the customer returns to the utility. It is important when utilizing a Third Party Supplier that an experienced regional supplier is used, otherwise “under delivery” can occur, jeopardizing economics and scheduling.

The information provided by Denville states that they are currently utilizing the service of a Third Party Supplier Pepco Energy Services. CEG believes there is room within these energy costs, for improvement (please see comments under recommendations).

Recommendations:

CEG recommends a global approach that will be consistent with all facilities within the BOE. The primary area for potential improvement is seen in the electric costs. The average price per kWh (kilowatt hour) for all buildings based on 1-year historical average price is $.1388/kWh (this is the average “price to compare” if the client intends to shop for energy). The average price per decatherm for natural gas is $ 12.11 / dth (dth, is the common unit of measure). Energy commodities are among the most volatile of all commodities, however at this point and time, energy is extremely competitive. The BOE could see improvement in its energy costs if it were to take advantage of these current market prices quickly, before energy prices increase. Based on annual historical consumption (May 2008 through April 2009) and current electric rates, the BOE could see an improvement in its electric costs of up to 35% annually. (Note: Savings were calculated using Average Annual Consumption and a variance to a Fixed Average One-Year commodity contract). CEG recommends aggregating the entire electric load to gain the most optimal energy costs. CEG recommends advisement for alternative sourcing and supply of energy on a "managed approach".

CEG's secondary recommendation coincides with the natural gas costs. Based on the current market, Denville could improve its natural gas costs by up to 24%. Currently the BOE is utilizing the services of a Third Party Supplier, Pepco Energy Services. CEG recommends the BOE receive further advisement on these prices through an energy advisor. They should also consider procuring energy (natural gas) through an alternative supply source.

CEG also recommends scheduling a meeting with the current utility providers to review their utility charges and current tariff structures for electricity and natural gas. This meeting would provide insight regarding alternative procurement options that are currently available. Through its meeting with the Local Distribution Company (LDC), the municipality can learn more about the competitive supply process. The BOE can acquire a list of approved Third Party Suppliers from the New Jersey Board of Public Utilities website at www.nj.gov/bpu. They should also consider using a billing-auditing service to further analyze the utility invoices, manage the data and use the information for ongoing demand-side management projects. Furthermore, special attention should be given to credit mechanisms, imbalances, balancing charges and commodity charges when meeting with the utility representative. The Denville BOE should ask the utility representative about alternative billing options, such as consolidated billing when utilizing the service of a Third Party Supplier. Finally, if the supplier for energy (natural gas) is changed, closely monitor balancing, particularly when the contract is close to termination. This could be performed with the aid of an "energy advisor".

X. INSTALLATION FUNDING OPTIONS

CEG has reviewed various funding options for the facility owner to utilize in subsidizing the costs for installing the energy conservation measures noted within this report. Below are a few alternative funding methods:

i. *Energy Savings Improvement Program (ESIP)* – Public Law 2009, Chapter 4 authorizes government entities to make energy related improvements to their facilities and par for the costs using the value of energy savings that result from the improvements. The "Energy Savings Improvement Program (ESIP)" law provides a flexible approach that can allow all government agencies in New Jersey to improve and reduce energy usage with minimal expenditure of new financial resources.

ii. *Municipal Bonds* – Municipal bonds are a bond issued by a city or other local government, or their agencies. Potential issuers of municipal bonds include cities, counties, redevelopment agencies, school districts, publicly owned airports and seaports, and any other governmental entity (or group of governments) below the state level. Municipal bonds may be general obligations of the issuer or secured by specified revenues. Interest income received by holders of municipal bonds is often exempt from the federal income tax and from the income tax of the state in which they are issued, although municipal bonds issued for certain purposes may not be tax exempt.

iii. *Power Purchase Agreement* – Public Law 2008, Chapter 3 authorizes contractor of up to fifteen (15) years for contracts commonly known as "power purchase agreements." These are programs where the contracting unit (Owner) procures a contract for, in most cases, a third party to install, maintain, and own a renewable energy system. These renewable energy systems are typically solar panels, windmills or other systems that create renewable energy. In exchange for the third party's work of installing, maintaining and owning the renewable energy system, the contracting unit (Owner) agrees to purchase the power generated by the renewable energy system from the third party at agreed upon energy rates.

CEG recommends the Owner review the use of the above-listed funding options in addition to utilizing their standard method of financing for facilities upgrades in order to fund the proposed energy conservation measures.

XI. ADDITIONAL RECOMMENDATIONS

The following recommendations include no cost/low cost measures, Operation & Maintenance (O&M) items, and water conservation measures with attractive paybacks. These measures are not eligible for the Smart Start Buildings incentives from the office of Clean Energy but save energy none the less. As stated in the executive summary these items should be considered the first form of action for this facility.

A. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.

B. Maintain all weather stripping on windows and doors.

C. Clean all light fixtures to maximize light output.

D. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.

E. Confirm that outside air economizers on the rooftop units are functioning properly to take advantage of free cooling.

F. Set hot water re-circ pump temperature set-point below hot water supply temperature setting to avoid continuous operation. Provide time clock in addition to hot water re-circ aqua stat to stop hot water circulation during unoccupied periods.

G. Set all computers to sleep or hibernate to conserve energy when not in use.

H. Repair leaking faucets in janitorial closets, bathrooms, and maintenance rooms. Although not a associated with direct energy savings, dripping faucets will corrode and cause calcification on plumbing fixtures resulting in pre-mature replacement.

In addition to the recommendations above, implementing Retro-Commissioning would be beneficial for this facility. Retro-Commissioning is a means to verify your current equipment is operating at its designed efficiency, capacity, airflow, and overall performance. Retro-Commissioning provides valuable insight into systems or components not performing correctly or efficiently. The US department of energy reports that commissioning for buildings on average save 5%-15% savings on energy usage.

INSTALLATION COST AND REBATES

CONCORD ENGINEERING GROUP

Denville - Valleyview Middle School

ECM 1: LIGHTING UPGRADE

	Qty	Unit Cost $	Material $	Labor $	Total $
Lighting Fixture Replacement	LS	$66,877	-	-	$66,877
Utility Incentive - NJ Smart Start (1-2) lamp fixture	598	$10.00			($5,980)
Utility Incentive - NJ Smart Start (3-4) lamp fixture	23	$20.00			($460)
Total Cost Less Incentive					$60,437

ECM 2: LIGHTING CONTROLS

	Qty	Unit Cost $	Material $	Labor $	Total $
Dual - Technology Sensor	97	$75	$1,455	$5,820	$7,275
Utility Incentive - NJ Smart Start	97	$20			($1,940)
Total Cost Less Incentive					$5,335

ECM 4: HVAC SYSTEM CONTROLS

	SF	Unit Cost $	Material $	Labor $	Total $
DDC Automation System	82932	$4	-	-	$331,728
Utility Incentive - NJ Smart Start					$0
Total Cost Less Incentive					$331,728

ECM 4: COMPUTER ROOM DUCTLESS SPLIT SYSTEM

	Qty	Unit Cost $	Material $	Labor $	Total $
3 Ton Ductless Split System	2	$5,025	$7,800	$880	$10,050
Utility Incentive - NJ Smart Start (6 tons total)	6	$73			($438)
Total Cost Less Incentive					$9,612

ECM 5: BOILER REPLACEMENT

	Qty	Unit Cost $	Material $	Labor $	Total $
2887 MBH High Eff Boiler	3	$34,100	$86,550	$15,750	$102,300
Old Boiler Demolition	2	$10,800		$21,600	$21,600
Utility Incentive - NJ Smart Start (11,548 MBH	8,661	$1			($8,661)
Total Cost Less Incentive					$115,239

ECM 6: SOLAR PV SYSTEM

	Qty	Unit Cost $	Material $	Labor $	Total $
Solar PV System	1	$726,570			$726,570
Utility Incentive - (see Renewable Energy Measures appendix for details)					-
Total Cost Less Incentive					$726,570

Concord Engineering Group, Inc.

520 BURNT MILL ROAD
VOORHEES, NEW JERSEY 08043
PHONE: (856) 427-0200
FAX: (856) 427-6508

SmartStart Building Incentives

The NJ SmartStart Buildings Program offers financial incentives on a wide variety of building system equipment. The incentives were developed to help offset the initial cost of energy-efficient equipment. The following tables show the current available incentives as of January, 2009:

Electric Chillers

Water-Cooled Chillers	\$12 - \$170 per ton
Air-Cooled Chillers	\$8 - \$52 per ton

Gas Cooling

Gas Absorption Chillers	\$185 - \$400 per ton
Gas Engine-Driven Chillers	Calculated through custom measure path)

Desiccant Systems

Desiccant Systems	\$1.00 per cfm – gas or electric

Electric Unitary HVAC

Unitary AC and Split Systems	\$73 - \$93 per ton
Air-to-Air Heat Pumps	\$73 - \$92 per ton
Water-Source Heat Pumps	\$81 per ton
Packaged Terminal AC & HP	\$65 per ton
Central DX AC Systems	\$40- \$72 per ton
Dual Enthalpy Economizer Controls	\$250

Ground Source Heat Pumps

Closed Loop & Open Loop	\$370 per ton

Gas Heating

Gas Fired Boilers < 300 MBH	\$300 per unit
Gas Fired Boilers ≥ 300 - 1500 MBH	\$1.75 per MBH
Gas Fired Boilers ≥1500 - ≤ 4000 MBH	\$1.00 per MBH
Gas Fired Boilers > 4000 MBH	(Calculated through Custom Measure Path)
Gas Furnaces	\$300 - \$400 per unit

Variable Frequency Drives

Variable Air Volume	$65 - $155 per hp
Chilled-Water Pumps	$60 per hp
Compressors	$5,250 to $12,500 per drive

Natural Gas Water Heating

Gas Water Heaters ≤ 50 gallons	$50 per unit
Gas-Fired Water Heaters >50 gallons	$1.00 - $2.00 per MBH
Gas-Fired Booster Water Heaters	$17 - $35 per MBH

Premium Motors

Three-Phase Motors	$45 - $700 per motor

Prescriptive Lighting

T-5 and T-8 Lamps w/Electronic Ballast in Existing Facilities	$10 - $30 per fixture, (depending on quantity)
Hard-Wired Compact Fluorescent	$25 - $30 per fixture
Metal Halide w/Pulse Start	$25 per fixture
LED Exit Signs	$10 - $20 per fixture
T-5 and T-8 High Bay Fixtures	$16 - $284 per fixture

Lighting Controls – Occupancy Sensors

Wall Mounted	$20 per control
Remote Mounted	$35 per control
Daylight Dimmers	$25 per fixture
Occupancy Controlled hi-low Fluorescent Controls	$25 per fixture controlled

Lighting Controls – HID or Fluorescent Hi-Bay Controls

Occupancy hi-low	$75 per fixture controlled
Daylight Dimming	$75 per fixture controlled

Other Equipment Incentives

Performance Lighting	$1.00 per watt per SF below program incentive threshold, currently 5% more energy efficient than ASHRAE 90.1-2004 for New Construction and Complete Renovation
Custom Electric and Gas Equipment Incentives	not prescriptive

MAJOR EQUIPMENT LIST

Concord Engineering Group

"Denville Valleyview Middle School"

Domestic Hot Water Heater

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Input	Recovery (gal/h)	Capacity (gal)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life
Building HW	Bsmt Boiler Room	Lochinvar	Indirect Storage	1	RJA200	-	-	-	200	-	-	3	10	7
Kitchen	Kitchen closet	A.O. Smith	Electric	1	-	-	4.5 KW	-	30	100%	Elec	Unknown	10	-

Dedicated Domestic Hot Water Boiler

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Input	Recovery (gal/h)	Capacity (gal)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life
Dom Hot Water Heater	Bsmt Boiler Room	Lochinvar	Gas fired	1	CWN315PM	-	315 MBH	313	-	-	Nat Gas	3	10	7

AC Units

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Cooling Type	Cooling Capacity	EER	Heating Type	Heating Capacity (Input)	COP	Fan HP	Motor RPM	Volts	Phase	Approx. Age	ASHRAE Service Life	Remaining Life
Computer Room	Roof	Carrier	Packaged CV	1	50TJ007511	Q497920782	DX R-22	72 MBH	8.9	None	-	-	2.4 BHP	-	208	3	12	15	3
POD A1A	Side of POD	Carrier	Packaged CV	1	38HDCQ48510	4196X34147	DX R-22	48 MBH	10.8	None	-	-	-	-	208	3	13	15	2
POD A1A	Side of POD	Carrier	Packaged CV	1	38HDRQ48501	2806X92428	DX R-22	48 MBH	12.5	None	-	-	-	-	208	3	3	15	12
Workshop	Roof	Carrier	Condensing Unit	1	38QRQ182331	32Q3X72740	DX R-22	18 MBH	10.8	Heat Pump	16	3.1	-	-	208	3	6	15	9
Science Room	Roof	Carrier	Packaged CV	1	Not Accessible	-	DX R-22	Est. 60 MBH	Est. 10								34	15	(19)
Science Room	Roof	Carrier	Packaged CV	1	Not Accessible	-	DX R-22	Est. 60 MBH	Est. 10								34	15	(19)

*Equipment efficiencies listed above are based on new equipment product data.

Boilers

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Heating Type	Input Capacity	Output Capacity (Approx)	Efficiency (approx)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
Heating Water Loop	Bsmt Boiler Room	Superior	Dual Fuel - Hot Water	2	GCR4RB150B	4396-10110	Gas	7,071 MBH	5,445 MBH	70%	Gas	46	25	(21)	Burner: Power flame burner model: C4-C0-30, Serial: 089155076

* 5% efficiency degradation from manufacture data assumed in calculation.

Boiler Pumps

Service	Location	Manufacturer	Type	Qty.	Model #	Serial #	Flow	Head	RPM	HP	Volts	Phase	Approx. Age	ASHRAE Service Life	Remaining Life
Heating Water Loop	Bsmt Boiler Room	Armstrong	End Suction Cons Volume	2	819359002	-	-	-	-	7.5	208	-	Unknown	20	-

Unit Ventilators

Location	Area Served	Manufacturer	Type	Qty	Model #	Serial #	Heating Type	Heating Capacity	RPM	HP	GPM	Phase	Approx. Age	ASHRAE Service Life	Remaining Life	
Classrooms	Classroom	Veahitt	Hot Water Coil Ventilator	1*			Hot Water	-	-	-	-	-	Unknown	20	-	

* Typically 1 unit ventilator per classroom / space.

STATEMENT OF ENERGY PERFORMANCE
Valleyview Middle School

Building ID: 1810434
For 12-month Period Ending: June 30, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: September 04, 2009

Facility
Valleyview Middle School
320 Diamond Spring Rd.
Denville, NJ 07834

Facility Owner
Denville Board of Education
501 Openaki Road
Denville, NJ 07834

Primary Contact for this Facility
John Serapiglia
501 Openaki Road
Denville, NJ 07834

Year Built: 1963
Gross Floor Area (ft²): 82,932

Energy Performance Rating[2] (1-100) 36

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	2,360,558
Natural Gas (kBtu)[4]	3,533,686
Total Energy (kBtu)	5,894,244

Energy Intensity[5]	
Site (kBtu/ft²/yr)	71
Source (kBtu/ft²/yr)	140

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	547

Electric Distribution Utility
Jersey Central Power & Lt Co

National Average Comparison	
National Average Site EUI	63
National Average Source EUI	124
% Difference from National Average Source EUI	13%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards[6] **for Indoor Environmental Conditions:**	
Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Certifying Professional
Ray Johnson
520 South Burnt Mill Road
Voorhees, NJ 08043

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Natural Gas values in units of volume (e.g. cubic feet) are converted to kBtu with adjustments made for elevation based on Facility zip code.
5. Values represent energy intensity, annualized to a 12-month period.
6. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

ENERGY STAR® Data Checklist for Commercial Buildings

In order for a building to qualify for the ENERGY STAR, a Professional Engineer (PE) must validate the accuracy of the data underlying the building's energy performance rating. This checklist is designed to provide an at-a-glance summary of a property's physical and operating characteristics, as well as its total energy consumption, to assist the PE in double-checking the information that the building owner or operator has entered into Portfolio Manager.

Please complete and sign this checklist and include it with the stamped, signed Statement of Energy Performance.
NOTE: You must check each box to indicate that each value is correct, OR include a note.

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Valleyview Middle School	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	K-12 School	Is this an accurate description of the space in question?		☐
Location	320 Diamond Spring Rd., Denville, NJ 07834	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of acute care or children's hospitals) nor can they be submitted as representing only a portion of a building		☐

Valleyview Middle School (K-12 School)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	82,932 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Open Weekends?	No	Is this building normally open at all on the weekends? This includes activities beyond the work conducted by maintenance, cleaning, and security personnel. Weekend activity could include any time when the space is used for classes, performances or other school or community activities. If the building is open on the weekend as part of the standard schedule during one or more seasons, the building should select ?yes? for open weekends. The ?yes? response should apply whether the building is open for one or both of the weekend days.		☐
Number of PCs	163	Is this the number of personal computers in the K12 School?		☐
Number of walk-in refrigeration/freezer units	0	Is this the total number of commercial walk-in type freezers and coolers? These units are typically found in storage and receiving areas.		☐
Presence of cooking facilities	Yes	Does this school have a dedicated space in which food is prepared and served to students? If the school has space in which food for students is only kept warm and/or served to students, or has only a galley that is used by teachers and staff then the answer is "no".		☐
Percent Cooled	50 %	Is this the percentage of the total floor space within the facility that is served by mechanical cooling equipment?		☐
Percent Heated	100 %	Is this the percentage of the total floor space within the facility that is served by mechanical heating equipment?		☐
Months	10 (Optional)	Is this school in operation for at least 8 months of the year?		☐

High School?	No	Is this building a high school (teaching grades 10, 11, and/or 12)? If the building teaches to high school students at all, the user should check 'yes' to 'high school'. For example, if the school teaches to grades K-12 (elementary/middle and high school), the user should check 'yes' to 'high school'.		☐

Energy Consumption

Power Generation Plant or Distribution Utility: Jersey Central Power & Lt Co

Fuel Type: Electricity		
Meter: Electric (kWh (thousand Watt-hours)) **Space(s):** Entire Facility **Generation Method:** Grid Purchase		
Start Date	**End Date**	**Energy Use (kWh (thousand Watt-hours))**
06/01/2009	06/30/2009	46,720.00
05/01/2009	05/31/2009	60,960.00
04/01/2009	04/30/2009	57,760.00
03/01/2009	03/31/2009	71,840.00
02/01/2009	02/28/2009	69,600.00
01/01/2009	01/31/2009	75,680.00
12/01/2008	12/31/2008	65,600.00
11/01/2008	11/30/2008	52,800.00
10/01/2008	10/31/2008	48,320.00
09/01/2008	09/30/2008	41,280.00
08/01/2008	08/31/2008	33,760.00
07/01/2008	07/31/2008	67,520.00
Electric Consumption (kWh (thousand Watt-hours))		**691,840.00**
Electric Consumption (kBtu (thousand Btu))		**2,360,558.08**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**2,360,558.08**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Natural Gas		
Meter: Gas (therms) **Space(s):** Entire Facility		
Start Date	**End Date**	**Energy Use (therms)**
06/01/2009	06/30/2009	828.65
05/01/2009	05/30/2009	165.35
04/01/2009	04/30/2009	2,772.52
03/01/2009	03/31/2009	3,773.78
02/01/2009	02/28/2009	5,942.04
01/01/2009	01/31/2009	7,843.46
12/01/2008	12/31/2008	6,815.50
11/01/2008	11/30/2008	4,612.48
10/01/2008	10/31/2008	2,074.08
09/01/2008	09/30/2008	175.00

08/01/2008	08/31/2008	75.00
07/01/2008	07/31/2008	259.00
Gas Consumption (therms)		**35,336.86**
Gas Consumption (kBtu (thousand Btu))		**3,533,686.00**
Total Natural Gas Consumption (kBtu (thousand Btu))		**3,533,686.00**
Is this the total Natural Gas consumption at this building including all Natural Gas meters?		☐

Additional Fuels	
Do the fuel consumption totals shown above represent the total energy use of this building? Please confirm there are no additional fuels (district energy, generator fuel oil) used in this facility.	☐

On-Site Solar and Wind Energy	
Do the fuel consumption totals shown above include all on-site solar and/or wind power located at your facility? Please confirm that no on-site solar or wind installations have been omitted from this list. All on-site systems must be reported.	☐

Certifying Professional

(When applying for the ENERGY STAR, the Certifying Professional must be the same as the PE that signed and stamped the SEP.)

Name: ____ Date: _____________

Signature: _____________________________________

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
Valleyview Middle School
320 Diamond Spring Rd.
Denville, NJ 07834

Facility Owner
Denville Board of Education
501 Openaki Road
Denville, NJ 07834

Primary Contact for this Facility
John Serapiglia
501 Openaki Road
Denville, NJ 07834

General Information

Valleyview Middle School	
Gross Floor Area Excluding Parking: (ft^2)	82,932
Year Built	1963
For 12-month Evaluation Period Ending Date:	June 30, 2009

Facility Space Use Summary

Valleyview Middle School	
Space Type	K-12 School
Gross Floor Area(ft^2)	82,932
Open Weekends?	No
Number of PCs	163
Number of walk-in refrigeration/freezer units	0
Presence of cooking facilities	Yes
Percent Cooled	50
Percent Heated	100
Months^o	10
High School?	No
School District^o	N/A

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 06/30/2009)	**Baseline** (Ending Date 06/30/2009)	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	36	36	75	N/A	50
Energy Intensity					
Site (kBtu/ft^2)	71	71	49	N/A	63
Source (kBtu/ft^2)	140	140	97	N/A	124
Energy Cost					
$/year	$ 112,176.00	$ 112,176.00	$ 77,767.15	N/A	$ 99,438.41
$/ft^2/year	$ 1.35	$ 1.35	$ 0.94	N/A	$ 1.20
Greenhouse Gas Emissions					
$MtCO_2e$/year	547	547	379	N/A	485
$kgCO_2e/ft^2$/year	7	7	5	N/A	6

More than 50% of your building is defined as K-12 School. Please note that your rating accounts for all of the spaces listed. The National Average column presents energy performance data your building would have if your building had an average rating of 50.

Notes:
o - This attribute is optional.
d - A default value has been supplied by Portfolio Manager.

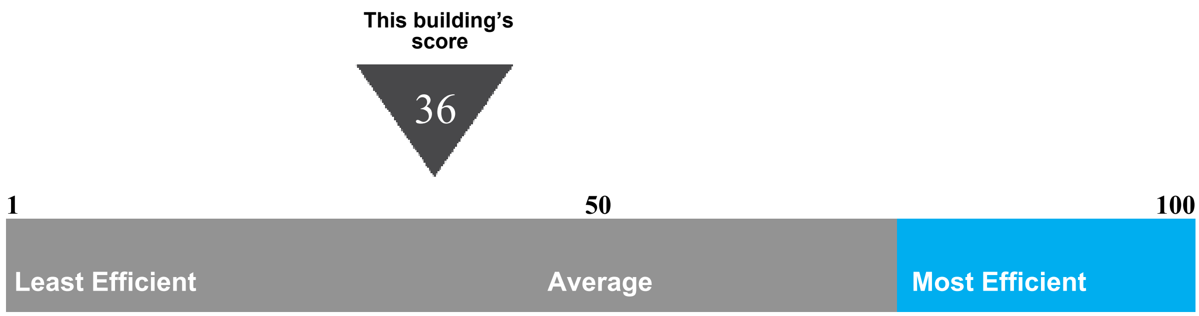
Statement of Energy Performance

2009

Valleyview Middle School
320 Diamond Spring Rd.
Denville, NJ 07834

Portfolio Manager Building ID: 1810434

The energy use of this building has been measured and compared to other similar buildings using the Environmental Protection Agency's (EPA's) Energy Performance Scale of 1–100, with 1 being the least energy efficient and 100 the most energy efficient. For more information, visit energystar.gov/benchmark.



This building uses 140 kBtu per square foot per year.*

*Based on source energy intensity for the 12 month period ending June 2009

Buildings with a score of 75 or higher may qualify for EPA's ENERGY STAR.

I certify that the information contained within this statement is accurate and in accordance with U.S. Environmental Protection Agency's measurement standards, found at energystar.gov

Date of certification

EPA United States Environmental Protection Agency

Date Generated: 09/04/2009

CEG Job #: 9C09080
Project: Denville Valleyview MS
Address: 320 Diamond Spring Road
Denville, NJ 07834
Building SF: 82,932

"Denville Valleyview Middle School"

KWH COST: $0.162

ECM #1: Lighting Upgrade - General

EXISTING LIGHTING										PROPOSED LIGHTING									SAVINGS			
CEG Type	Fixture Location	Yearly Usage	No. Fixts	No. Lamps	Fixture Type	Fixt Watts	Total kW	kWh/Yr Fixtures	Yearly $ Cost	No. Fixts	No. Lamps	Retro-Unit Description	Watts Used	Total kW	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
1	Dellala's Back left	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.75	$100.00	$100.00	0.03	47	$7.61	13.13
1	Dellala's Front Office	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	300.8	$48.73	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$33.50	$100.00	$200.00	0.05	94	$15.23	13.13
1	Nurse's Side Room	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	300.8	$48.73	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$33.50	$100.00	$200.00	0.05	94	$15.23	13.13
4	Faculty Bathroom	1880	1	0	2-Lamp, Incandescent, 75 Watt Bulbs, Surface Mounted, Direct	150	0.15	282.0	$45.68	1	0	(2) 18 W CFL Lamp	36	0.04	67.68	$10.96	$11.50	$11.50	0.11	214.32	$34.72	0.33
2		1880	4	4	4-Lamp, T12, Magnetic Ballast, Recessed Mount, Parabolic Lens	160	0.64	1,203.2	$194.92	4	3	2'x4' 3-Lamp 32W T-8 Parabolic Lens/Elect Ballast; Metalux M/N 2GC8	91	0.36	684.32	$110.86	$140.00	$560.00	0.28	518.88	$84.06	6.66
3	Faculty Room	1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	80	0.08	150.4	$24.36	1	2	1'X4' 2-Lamp 32W T-8 Parabolic Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.75	$100.00	$100.00	0.03	47	$7.61	13.13
1		1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.75	$100.00	$100.00	0.03	47	$7.61	13.13
5	Faculty Toilet	1880	1	0	2-Lamp, Compact Flourescent, Vanity Light	36	0.04	67.7	$10.96	1	0	No Change	36	0.04	67.68	$10.96	$0.00	$0.00	0.00	0	$0.00	0.00
6	Gym Foyer	1880	1	4	2 Foot, 4-Lamp, T12, Magnetic Ballast, Recessed Mount, Parabolic Lens	94	0.09	176.7	$28.63	1	3	3 Lamp T-8 GE-332	47	0.05	88.36	$14.31	$29.36	$29.36	0.05	88.36	$14.31	2.05
3		1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	80	0.08	150.4	$24.36	1	2	1'X4' 2-Lamp 32W T-8 Parabolic Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.75	$100.00	$100.00	0.03	47	$7.61	13.13
7	Gym	1880	17	0	1-Lamp Metal Halides	455	7.74	14,541.8	$2,355.77	17	0	No Change	455	7.74	14541.8	$2,355.77	$0.00	$0.00	0.00	0	$0.00	0.00
8	Stage	260	28	0	1-Lamp Halogens, Direct Lighting	75	2.10	546.0	$88.45	28	0	No Change	75	2.10	546	$88.45	$0.00	$0.00	0.00	0	$0.00	0.00
9		1880	6	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
1	Boys Lockerroom	1880	10	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.80	1,504.0	$243.65	10	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.55	1034	$167.51	$100.00	$1,000.00	0.25	470	$76.14	13.13
10	Boys Locker Room Shower	1880	2	0	1-Lamp Incandescents	75	0.15	282.0	$45.68	2	0	18 W CFL Lamp	18	0.04	67.68	$10.96	$5.75	$11.50	0.11	214.32	$34.72	0.33
11	Cafeteria Storage	470	1	0	4-Lamp Incandescent	300	0.30	141.0	$22.84	1	0	(4) 18 W CFL Lamp	72	0.07	33.84	$5.48	$23.00	$23.00	0.23	107.16	$17.36	1.32

1	Copy Room	1880	3	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.24	451.2	$73.09	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	310.2	$50.25	$100.00	$300.00	0.08	141	$22.84	13.13
10	A-Hall Custodial Closet	470	1	0	1-Lamp Incandescents	75	0.08	35.3	$5.71	1	0	18 W CFL Lamp	18	0.02	8.46	$1.37	$5.75	$5.75	0.06	26.79	$4.34	1.32
1	Incinerator	470	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	75.2	$12.18	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	51.7	$8.38	$100.00	$200.00	0.05	23.5	$3.81	52.53
1	Boys A-hall Bathroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.75	$100.00	$100.00	0.03	47	$7.61	13.13
1	Girls A-hall Bathroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.75	$100.00	$100.00	0.03	47	$7.61	13.13
1	General Storage	470	5	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.40	188.0	$30.46	5	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.28	129.25	$20.94	$100.00	$500.00	0.13	58.75	$9.52	52.53
10		470	2	0	1-Lamp Incandescents	75	0.15	70.5	$11.42	2	0	18 W CFL Lamp	18	0.04	16.92	$2.74	$5.75	$11.50	0.11	53.58	$8.68	1.32
12		470	1	0	1-Lamp Compact Flourescent	13	0.01	6.1	$0.99	1	0	No Change	13	0.01	6.11	$0.99	$0.00	$0.00	0.00	0	$0.00	0.00
12	Boiler Room	470	11	0	1-Lamp Compact Flourescent	13	0.14	67.2	$10.89	11	0	No Change	13	0.14	67.21	$10.89	$0.00	$0.00	0.00	0	$0.00	0.00
1		470	4	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.32	150.4	$24.36	4	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.22	103.4	$16.75	$100.00	$400.00	0.10	47	$7.61	52.53
3	A-Hall Main Entrance	2350	6	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	80	0.48	1,128.0	$182.74	6	2	1'X4' 2-Lamp 32W T-8 Parabolic Lens/Elect Ballast; Metalux M/N GC	55	0.33	775.5	$125.63	$100.00	$600.00	0.15	352.5	$57.11	10.51
13	A-Hall Communications Closet	470	4	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	0.52	244.4	$39.59	4	3	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.36	171.08	$27.71	$120.00	$480.00	0.16	73.32	$11.88	40.41
9	A-Hall Room Storage	470	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	80	0.08	37.6	$6.09	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	25.85	$4.19	$100.00	$100.00	0.03	11.75	$1.90	52.53
1	A-Hall Room Foyer	1880	7	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.56	1,052.8	$170.55	7	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.39	723.8	$117.26	$100.00	$700.00	0.18	329	$53.30	13.13
1	Office Rooms	1880	6	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
13	Server Room	470	4	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	0.52	244.4	$39.59	4	3	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.36	171.08	$27.71	$120.00	$480.00	0.16	73.32	$11.88	40.41
1	Computer Lab	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$201.01	$100.00	$1,200.00	0.30	564	$91.37	13.13
1	Library Storage	1880	3	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.24	451.2	$73.09	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	310.2	$50.25	$100.00	$300.00	0.08	141	$22.84	13.13
1	Library Office	1880	3	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.24	451.2	$73.09	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	310.2	$50.25	$100.00	$300.00	0.08	141	$22.84	13.13

1	Library Study	1880	6	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-24	1880	18	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	1.44	2,707.2	$438.57	18	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.99	1861.2	$301.51	$100.00	$1,800.00	0.45	846	$137.05	13.13
14	Classroom B-23	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-22	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-21	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-28	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-27	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-26	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
12	B Stairwell	8760	4	0	1-Lamp Compact Flourescent	13	0.05	455.5	$73.79	4	0	No Change	13	0.05	455.52	$73.79	$0.00	$0.00	0.00	0	$0.00	0.00
14	Classroom B-11	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-18	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-12	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-17	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-13	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-16	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-14	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
14	Classroom B-15	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13

15	Life Skills 2	1880	10	2	8 Foot, 2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic	253	2.53	4,756.4	$770.54	10	2	8' 2-Lamp T-8 Cooper Metalux, Electronic Ballast M/N 8TDIM-232-UNV-EB81-U	118	1.18	2218.4	$359.38	$207.00	$2,070.00	1.35	2538	$411.16	5.03
14	Life Skills 1	1880	24	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	1.92	3,609.6	$584.76	24	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	1.32	2481.6	$402.02	$100.00	$2,400.00	0.60	1128	$182.74	13.13
1	C-Hall Girls	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	300.8	$48.73	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$33.50	$100.00	$200.00	0.05	94	$15.23	13.13
1	C- Hall Guys	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	300.8	$48.73	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$33.50	$100.00	$200.00	0.05	94	$15.23	13.13
16	Classroom C-4	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$201.01	$100.00	$1,200.00	0.30	564	$91.37	13.13
17	Men's Faculty	1880	1	0	2-Lamp, Compact Flourescent, Vanity Light	26	0.03	48.9	$7.92	1	0	No Change	26	0.03	48.88	$7.92	$0.00	$0.00	0.00	0	$0.00	0.00
17	Women's Faculty	1880	1	0	2-Lamp, Compact Flourescent, Vanity Light	26	0.03	48.9	$7.92	1	0	No Change	26	0.03	48.88	$7.92	$0.00	$0.00	0.00	0	$0.00	0.00
16	Classroom C-3	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$201.01	$100.00	$1,200.00	0.30	564	$91.37	13.13
16	Classroom C-2	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$201.01	$100.00	$1,200.00	0.30	564	$91.37	13.13
16	Classroom C-1	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$201.01	$100.00	$1,200.00	0.30	564	$91.37	13.13
16	Classroom C-6	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$201.01	$100.00	$1,200.00	0.30	564	$91.37	13.13
16	Classroom C-8	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$201.01	$100.00	$1,200.00	0.30	564	$91.37	13.13
17	Custodial Closet	470	1	0	2-Lamp, Compact Flourescent, Vanity Light	26	0.03	12.2	$1.98	1	0	No Change	26	0.03	12.22	$1.98	$0.00	$0.00	0.00	0	$0.00	0.00
4		470	1	0	2-Lamp, Incandescent, 75 Watt Bulbs, Surface Mounted, Direct	150	0.15	70.5	$11.42	1	0	(2) 18 W CFL Lamp	36	0.04	16.92	$2.74	$11.50	$11.50	0.11	53.58	$8.68	1.32
16		1880	18	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.44	2,707.2	$438.57	18	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.99	1861.2	$301.51	$100.00	$1,800.00	0.45	846	$137.05	13.13
10	Art-C	1880	3	0	1-Lamp Incandescents	75	0.23	423.0	$68.53	3	0	18 W CFL Lamp	18	0.05	101.52	$16.45	$5.75	$17.25	0.17	321.48	$52.08	0.33
1		1880	4	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.32	601.6	$97.46	4	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.22	413.6	$67.00	$100.00	$400.00	0.10	188	$30.46	13.13
18	Classroom C-12	1880	30	0	2-Lamp, T8, Electronic Ballast, Pendant Mounted, Parabolic Lens	58	1.74	3,271.2	$529.93	30	0	No Change	58	1.74	3271.2	$529.93	$0.00	$0.00	0.00	0	$0.00	0.00

18	Classroom C-13	1880	29	0	2-Lamp, T8, Electronic Ballast, Pendant Mounted, Parabolic Lens	58	1.68	3,162.2	$512.27	29	0	No Change	58	1.68	3162.16	$512.27	$0.00	$0.00	0.00	0	$0.00	0.00
19	Classroom C-15	1880	12	0	2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	58	0.70	1,308.5	$211.97	12	0	No Change	58	0.70	1308.48	$211.97	$0.00	$0.00	0.00	0	$0.00	0.00
20		1880	2	0	1 Lamp Incandescents	60	0.12	225.6	$36.55	2	0	18 W CFL Lamp	18	0.04	67.68	$10.96	$5.75	$11.50	0.08	157.92	$25.58	0.45
19	C-17	1880	12	0	2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	58	0.70	1,308.5	$211.97	12	0	No Change	58	0.70	1308.48	$211.97	$0.00	$0.00	0.00	0	$0.00	0.00
20		1880	2	0	1 Lamp Incandescents	60	0.12	225.6	$36.55	2	0	18 W CFL Lamp	18	0.04	67.68	$10.96	$5.75	$11.50	0.08	157.92	$25.58	0.45
19	C-16	1880	12	0	2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	58	0.70	1,308.5	$211.97	12	0	No Change	58	0.70	1308.48	$211.97	$0.00	$0.00	0.00	0	$0.00	0.00
20		1880	2	0	1 Lamp Incandescents	60	0.12	225.6	$36.55	2	0	18 W CFL Lamp	18	0.04	67.68	$10.96	$5.75	$11.50	0.08	157.92	$25.58	0.45
8	Outside Trailer Doors	1880	8	0	1-Lamp Halogens, Direct Lighting	75	0.60	1,128.0	$182.74	8	0	No Change	75	0.60	1128	$182.74	$0.00	$0.00	0.00	0	$0.00	0.00
9	Industrial Room	1880	38	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	80	3.04	5,715.2	$925.86	38	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	2.09	3929.2	$636.53	$100.00	$3,800.00	0.95	1786	$289.33	13.13
21	Industrial Computer Room	1880	2	0	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	82	0.16	308.3	$49.95	2	0	No Change	82	0.16	308.32	$49.95	$0.00	$0.00	0.00	0	$0.00	0.00
1	Dellala's Back Right Room	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.75	$100.00	$100.00	0.03	47	$7.61	13.13
1	Nurse's Office	1880	8	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.64	1,203.2	$194.92	8	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.44	827.2	$134.01	$100.00	$800.00	0.20	376	$60.91	13.13
10	Nurse's Bathroom	1880	1	0	1-Lamp Incandescents	75	0.08	141.0	$22.84	1	0	18 W CFL Lamp	18	0.02	33.84	$5.48	$5.75	$5.75	0.06	107.16	$17.36	0.33
16	Corridor Between Gym and Admin	1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.16	300.8	$48.73	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$33.50	$100.00	$200.00	0.05	94	$15.23	13.13
10	Gym Storage Room	1880	2	0	1-Lamp Incandescents	75	0.15	282.0	$45.68	2	0	18 W CFL Lamp	18	0.04	67.68	$10.96	$5.75	$11.50	0.11	214.32	$34.72	0.33
1	Girls Locker Room	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$201.01	$100.00	$1,200.00	0.30	564	$91.37	13.13
10	Girls Locker Room Shower	1880	2	0	1-Lamp Incandescents	75	0.15	282.0	$45.68	2	0	18 W CFL Lamp	18	0.04	67.68	$10.96	$5.75	$11.50	0.11	214.32	$34.72	0.33
11	Gym Storage Room	470	2	0	4-Lamp Incandescent	300	0.60	282.0	$45.68	2	0	(4) 18 W CFL Lamp	72	0.14	67.68	$10.96	$23.00	$46.00	0.46	214.32	$34.72	1.32
16	Cafeteria	1880	30	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	2.40	4,512.0	$730.94	30	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	1.65	3102	$502.52	$100.00	$3,000.00	0.75	1410	$228.42	13.13
22	Kitchen	1880	3	4	4-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	160	0.48	902.4	$146.19	3	3	2'x4' 3-Lamp 32W T-8 Prismatic Lens / Elect Ballast; Metalux M/N 2GC8	91	0.27	513.24	$83.14	$140.00	$420.00	0.21	389.16	$63.04	6.66
1	Music Classroom	1880	27	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	2.16	4,060.8	$657.85	27	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	1.49	2791.8	$452.27	$100.00	$2,700.00	0.68	1269	$205.58	13.13
1	Music Room Storage	470	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	75.2	$12.18	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	51.7	$8.38	$100.00	$200.00	0.05	23.5	$3.81	52.53

1	Corridor Trophy Case	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.75	$100.00	$100.00	0.03	47	$7.61	13.13
23	Main Entracne Corridor	2350	8	4	2 Foot, 4-Lamp, T12, Magnetic Ballast, Recessed Mount, Prismatic Lens	94	0.75	1,767.2	$286.29	8	3	3 Lamp T-8 GE-332	47	0.38	883.6	$143.14	$29.36	$234.88	0.38	883.6	$143.14	1.64
1	Classroom A1A	1880	8	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.64	1,203.2	$194.92	8	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.44	827.2	$134.01	$100.00	$800.00	0.20	376	$60.91	13.13
1	Classroom A1B	1880	8	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.64	1,203.2	$194.92	8	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.44	827.2	$134.01	$100.00	$800.00	0.20	376	$60.91	13.13
1	Main Office	2350	11	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.88	2,068.0	$335.02	11	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.61	1421.75	$230.32	$100.00	$1,100.00	0.28	646.25	$104.69	10.51
24	Bridge Corridor	2350	10	1	3 Foot, 1-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	47	0.47	1,104.5	$178.93	10	0	3' - 1-Lamp 25W T-8 Prismatic Lens / Elect Ballast; Metalux M/N SNF125	23	0.23	540.5	$87.56	$119.00	$1,190.00	0.24	564	$91.37	13.02
6	Elevator Area	1880	3	4	2 Foot, 4-Lamp, T12, Magnetic Ballast, Recessed Mount, Parabolic Lens	94	0.28	530.2	$85.89	3	3	3 Lamp T-8 GE-332	47	0.14	265.08	$42.94	$29.36	$88.08	0.14	265.08	$42.94	2.05
25		1880	2	0	1-Lamp Compact Flourescent	28	0.06	105.3	$17.06	2	0	No Change	28	0.06	105.28	$17.06	$0.00	$0.00	0.00	0	$0.00	0.00
1	Library	1880	52	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	4.16	7,820.8	$1,266.97	52	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	2.86	5376.8	$871.04	$100.00	$5,200.00	1.30	2444	$395.93	13.13
16		1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.16	300.8	$48.73	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	206.8	$33.50	$100.00	$200.00	0.05	94	$15.23	13.13
16	Corridor B21 to B28	2350	8	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.64	1,504.0	$243.65	8	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.44	1034	$167.51	$100.00	$800.00	0.20	470	$76.14	10.51
26	Girl's Bathroom	1880	6	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	0.44	823.4	$133.40	6	0	No Change	73	0.44	823.44	$133.40	$0.00	$0.00	0.00	0	$0.00	0.00
26	Co-Ed Bathroom	1880	1	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	0.07	137.2	$22.23	1	0	No Change	73	0.07	137.24	$22.23	$0.00	$0.00	0.00	0	$0.00	0.00
26	Boys Bathroom	1880	7	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	0.51	960.7	$155.63	7	0	No Change	73	0.51	960.68	$155.63	$0.00	$0.00	0.00	0	$0.00	0.00
16	Corridor	2350	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	2,256.0	$365.47	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1551	$251.26	$100.00	$1,200.00	0.30	705	$114.21	10.51
12	Elevator Entrance	1880	2	0	1-Lamp Compact Flourescent	13	0.03	48.9	$7.92	2	0	No Change	13	0.03	48.88	$7.92	$0.00	$0.00	0.00	0	$0.00	0.00
1	Trophy Case	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.75	$100.00	$100.00	0.03	47	$7.61	13.13
26	Boys Bathroom	1880	7	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	0.51	960.7	$155.63	7	0	No Change	73	0.51	960.68	$155.63	$0.00	$0.00	0.00	0	$0.00	0.00

26	Gils Bathroom	1880	6	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	0.44	823.4	$133.40	6	0	No Change	73	0.44	823.44	$133.40	$0.00	$0.00	0.00	0	$0.00	0.00
26	Co-Ed Bathroom	1880	1	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	0.07	137.2	$22.23	1	0	No Change	73	0.07	137.24	$22.23	$0.00	$0.00	0.00	0	$0.00	0.00
16	Corridor C1-C9	2350	7	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.56	1,316.0	$213.19	7	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.39	904.75	$146.57	$100.00	$700.00	0.18	411.25	$66.62	10.51
16	Corridor C Bathroom Area	1880	6	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	620.4	$100.50	$100.00	$600.00	0.15	282	$45.68	13.13
16	Corridor C1-C3	1880	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.24	451.2	$73.09	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	310.2	$50.25	$100.00	$300.00	0.08	141	$22.84	13.13
16		1880	18	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.44	2,707.2	$438.57	18	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.99	1861.2	$301.51	$100.00	$1,800.00	0.45	846	$137.05	13.13
27	Science C	1880	1	0	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, No Lens	94	0.09	176.7	$28.63	1	0	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	103.4	$16.75	$100.00	$100.00	0.04	73.32	$11.88	8.42
16		1880	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.24	451.2	$73.09	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	310.2	$50.25	$100.00	$300.00	0.08	141	$22.84	13.13
16	Classroom C-5	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$201.01	$100.00	$1,200.00	0.30	564	$91.37	13.13
16	Classroom C-7	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$201.01	$100.00	$1,200.00	0.30	564	$91.37	13.13
16	Classroom C-9	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.66	1240.8	$201.01	$100.00	$1,200.00	0.30	564	$91.37	13.13
16	Corridor C9 - C7	2350	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.24	564.0	$91.37	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	387.75	$62.82	$100.00	$300.00	0.08	176.25	$28.55	10.51
28	Corridor C12	2350	8	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.66	1,541.6	$249.74	8	0	No Change	82	0.66	1541.6	$249.74	$0.00	$0.00	0.00	0	$0.00	0.00
19	Trailer C14	1880	12	0	2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	58	0.70	1,308.5	$211.97	12	0	No Change	58	0.70	1308.48	$211.97	$0.00	$0.00	0.00	0	$0.00	0.00
19	Exterior Lighting	3640	15	0	2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	58	0.87	3,166.8	$513.02	15	0	No Change	58	0.87	3166.8	$513.02	$0.00	$0.00	0.00	0	$0.00	0.00
28	Industrial Arts Office	1880	2	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.16	308.3	$49.95	2	0	No Change	82	0.16	308.32	$49.95	$0.00	$0.00	0.00	0	$0.00	0.00
16	Guidance Office	1880	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.24	451.2	$73.09	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	310.2	$50.25	$100.00	$300.00	0.08	141	$22.84	13.13
29		3640	16	0	1-Lamp Metal Halide	94	1.50	5,474.6	$886.88	16	0	No Change	94	1.50	5474.56	$886.88	$0.00	$0.00	0.00	0	$0.00	0.00
30	Outside Lighting	3640	12	0	1-Lamp Compact Flourescent	20	0.24	873.6	$141.52	12	0	No Change	20	0.24	873.6	$141.52	$1.00	$12.00	0.00	0	$0.00	0.00

8	Outside Lighting	3640	3	0	1-Lamp Halogens, Direct Lighting	75	0.23	819.0	$132.68	3	0	No Change	75	0.23	819	$132.68	$0.00	$0.00	0.00	0	$0.00	0.00
31		3640	2	0	1 Lamp Incandescents	100	0.20	728.0	$117.94	2	0	26 W CFL Lamp	26	0.05	189.28	$30.66	$5.75	$11.50	0.15	538.7	$87.27	0.13
	Totals		954	179			80.83	151,812.8	$24,593.68	954	173			60.538	114863.19	########		$66,877.07	20.29	36949.6	$5,985.84	11.17

NOTES: 1. Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.
2. Lamp totals only include T-12 tube replacment calculations

CEG Job #: 9C09080
Project: Denville Valleyview MS
Address: 320 Diamond Spring Road
Denville, NJ 07834
Building SF: 82,932

"Denville Valleyview Middle School"

KWH COST: $0.162

ECM #2: Lighting Controls

EXISTING LIGHTING										PROPOSED LIGHTING CONTROLS										SAVINGS			
CEG Type	Fixture Location	Yearly Usage	No. Fixts	No. Lamps	Fixture Type	Fixt Watts	Total kW	kWh/Yr Fixtures	Yearly $ Cost	No. Fixts	No. Lamps	Controls Description	Watts Used	Total kW	Reduction (%)	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
1	Dellala's Back left	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	Dual Technology Occupancy Sensor	80	0.08	10%	135.36	$21.93	$75.00	$75.00	0.00	15.04	$2.44	30.78
1	Dellala's Front Office	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	300.8	$48.73	2	2	Dual Technology Occupancy Sensor	80	0.16	10%	270.72	$43.86	$75.00	$75.00	0.00	30.08	$4.87	15.39
1	Nurse's Side Room	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	300.8	$48.73	2	2	Dual Technology Occupancy Sensor	80	0.16	10%	270.72	$43.86	$75.00	$75.00	0.00	30.08	$4.87	15.39
4	Faculty Bathroom	1880	1	0	2-Lamp, Incandescent, 75 Watt Bulbs, Surface Mounted, Direct	150	0.15	282.0	$45.68	1	0	Dual Technology Occupancy Sensor	150	0.15	10%	253.8	$41.12	$75.00	$75.00	0.00	28.2	$4.57	16.42
2	Faculty Room	1880	4	4	4-Lamp, T12, Magnetic Ballast, Recessed Mount, Parabolic Lens	160	0.64	1,203.2	$194.92	4	3	Dual Technology Occupancy Sensor	160	0.64	10%	1082.88	$175.43	$75.00	$75.00	0.00	120.32	$19.49	3.85
3		1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	80	0.08	150.4	$24.36	1	2		80	0.08	10%	135.36	$21.93	$0.00	$0.00	0.00	15.04	$2.44	0.00
1		1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2		80	0.08	10%	135.36	$21.93	$0.00	$0.00	0.00	15.04	$2.44	0.00
5	Faculty Toilet	1880	1	0	2-Lamp, Compact Flourescent, Vanity Light	36	0.04	67.7	$10.96	1	0	None	36	0.04	0%	67.68	$10.96	$0.00	$0.00	0.00	0	$0.00	0.00
6	Gym Foyer	1880	1	4	2 Foot, 4-Lamp, T12, Magnetic Ballast, Recessed Mount, Parabolic Lens	94	0.09	176.7	$28.63	1	3	Dual Technology Occupancy Sensor	94	0.09	10%	159.048	$25.77	$75.00	$75.00	0.00	17.672	$2.86	26.20
3		1880	1	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	80	0.08	150.4	$24.36	1	2		80	0.08	10%	135.36	$21.93	$0.00	$0.00	0.00	15.04	$2.44	0.00
7	Gym	1880	17	0	1-Lamp Metal Halides	455	7.74	14,541.8	$2,355.77	17	0	Dual Technology Occupancy Sensor	455	7.74	10%	13087.62	$2,120.19	$75.00	$150.00	0.00	1454.18	$235.58	0.64
8	Stage	260	28	0	1-Lamp Halogens, Direct Lighting	75	2.10	546.0	$88.45	28	0	None	75	2.10	0%	546	$88.45	$0.00	$0.00	0.00	0	$0.00	0.00
9		1880	6	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	80	0.48	902.4	$146.19	6	2	None	80	0.48	0%	902.4	$146.19	$0.00	$0.00	0.00	0	$0.00	0.00
1	Boys Lockerroom	1880	10	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.80	1,504.0	$243.65	10	2	Dual Technology Occupancy Sensor	80	0.80	10%	1353.6	$219.28	$75.00	$75.00	0.00	150.4	$24.36	3.08
10	Boys Locker Room Shower	1880	2	0	1-Lamp Incandescents	75	0.15	282.0	$45.68	2	0	Dual Technology Occupancy Sensor	75	0.15	10%	253.8	$41.12	$75.00	$75.00	0.00	28.2	$4.57	16.42
11	Cafeteria Storage	470	1	0	4-Lamp Incandescent	300	0.30	141.0	$22.84	1	0	Dual Technology Occupancy Sensor	300	0.30	10%	126.9	$20.56	$75.00	$75.00	0.00	14.1	$2.28	32.83

1	Copy Room	1880	3	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.24	451.2	$73.09	3	2	Dual Technology Occupancy Sensor	80	0.24	10%	406.08	$65.78	$75.00	$75.00	0.00	45.12	$7.31	10.26
10	A-Hall Custodial Closet	470	1	0	1-Lamp Incandescents	75	0.08	35.3	$5.71	1	0	None	75	0.08	0%	35.25	$5.71	$0.00	$0.00	0.00	0	$0.00	0.00
1	Incinerator	470	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	75.2	$12.18	2	2	None	80	0.16	0%	75.2	$12.18	$0.00	$0.00	0.00	0	$0.00	0.00
1	Boys A-hall Bathroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	Dual Technology Occupancy Sensor	80	0.08	10%	135.36	$21.93	$75.00	$75.00	0.00	15.04	$2.44	30.78
1	Girls A-hall Bathroom	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	Dual Technology Occupancy Sensor	80	0.08	10%	135.36	$21.93	$75.00	$75.00	0.00	15.04	$2.44	30.78
1	General Storage	470	5	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.40	188.0	$30.46	5	2	Dual Technology Occupancy Sensor	80	0.40	10%	169.2	$27.41	$75.00	$75.00	0.00	18.8	$3.05	24.63
10		470	2	0	1-Lamp Incandescents	75	0.15	70.5	$11.42	2	0		75	0.15	10%	63.45	$10.28	$0.00	$0.00	0.00	7.05	$1.14	0.00
12		470	1	0	1-Lamp Compact Flourescent	13	0.01	6.1	$0.99	1	0		13	0.01	10%	5.499	$0.89	$0.00	$0.00	0.00	0.611	$0.10	0.00
12	Boiler Room	470	11	0	1-Lamp Compact Flourescent	13	0.14	67.2	$10.89	11	0	None	13	0.14	0%	67.21	$10.89	$0.00	$0.00	0.00	0	$0.00	0.00
1		470	4	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.32	150.4	$24.36	4	2	None	80	0.32	0%	150.4	$24.36	$0.00	$0.00	0.00	0	$0.00	0.00
3	A-Hall Main Entrance	2350	6	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	80	0.48	1,128.0	$182.74	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	1015.2	$164.46	$75.00	$75.00	0.00	112.8	$18.27	4.10
13	A-Hall Communications Closet	470	4	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	0.52	244.4	$39.59	4	3	Dual Technology Occupancy Sensor	130	0.52	10%	219.96	$35.63	$75.00	$75.00	0.00	24.44	$3.96	18.94
9	A-Hall Room Storage	470	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	80	0.08	37.6	$6.09	1	2	None	80	0.08	0%	37.6	$6.09	$0.00	$0.00	0.00	0	$0.00	0.00
1	A-Hall Room Foyer	1880	7	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.56	1,052.8	$170.55	7	2	Dual Technology Occupancy Sensor	80	0.56	10%	947.52	$153.50	$75.00	$75.00	0.00	105.28	$17.06	4.40
1	Office Rooms	1880	6	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
13	Server Room	470	4	3	3-Lamp, T12, Magnetic Ballast, Recessed Mounted, Parabolic Lens	130	0.52	244.4	$39.59	4	3	Dual Technology Occupancy Sensor	130	0.52	10%	219.96	$35.63	$75.00	$75.00	0.00	24.44	$3.96	18.94
1	Computer Lab	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$263.14	$75.00	$75.00	0.00	180.48	$29.24	2.57
1	Library Storage	1880	3	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.24	451.2	$73.09	3	2	Dual Technology Occupancy Sensor	80	0.24	10%	406.08	$65.78	$75.00	$75.00	0.00	45.12	$7.31	10.26
1	Library Office	1880	3	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.24	451.2	$73.09	3	2	Dual Technology Occupancy Sensor	80	0.24	10%	406.08	$65.78	$75.00	$75.00	0.00	45.12	$7.31	10.26

1	Library Study	1880	6	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-24	1880	18	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	1.44	2,707.2	$438.57	18	2	Dual Technology Occupancy Sensor	80	1.44	10%	2436.48	$394.71	$75.00	$75.00	0.00	270.72	$43.86	1.71
14	Classroom B-23	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-22	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-21	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-28	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-27	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-26	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
12	B Stairwell	8760	4	0	1-Lamp Compact Flourescent	13	0.05	455.5	$73.79	4	0	Dual Technology Occupancy Sensor	13	0.05	10%	409.968	$66.41	$75.00	$75.00	0.00	45.552	$7.38	10.16
14	Classroom B-11	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-18	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-12	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-17	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-13	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-16	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-14	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
14	Classroom B-15	1880	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13

15	Life Skills 2	1880	10	2	8 Foot, 2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic	253	2.53	4,756.4	$770.54	10	2	Dual Technology Occupancy Sensor	253	2.53	10%	4280.76	$693.48	$75.00	$75.00	0.00	475.64	$77.05	0.97
14	Life Skills 1	1880	24	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	80	1.92	3,609.6	$584.76	24	2	Dual Technology Occupancy Sensor	80	1.92	10%	3248.64	$526.28	$75.00	$75.00	0.00	360.96	$58.48	1.28
1	C-Hall Girls	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	300.8	$48.73	2	2	Dual Technology Occupancy Sensor	80	0.16	10%	270.72	$43.86	$75.00	$75.00	0.00	30.08	$4.87	15.39
1	C- Hall Guys	1880	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	300.8	$48.73	2	2	Dual Technology Occupancy Sensor	80	0.16	10%	270.72	$43.86	$75.00	$75.00	0.00	30.08	$4.87	15.39
16	Classroom C-4	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$263.14	$75.00	$75.00	0.00	180.48	$29.24	2.57
17	Men's Faculty	1880	1	0	2-Lamp, Compact Flourescent, Vanity Light	26	0.03	48.9	$7.92	1	0	None	26	0.03	0%	48.88	$7.92	$0.00	$0.00	0.00	0	$0.00	0.00
17	Women's Faculty	1880	1	0	2-Lamp, Compact Flourescent, Vanity Light	26	0.03	48.9	$7.92	1	0	None	26	0.03	0%	48.88	$7.92	$0.00	$0.00	0.00	0	$0.00	0.00
16	Classroom C-3	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$263.14	$75.00	$75.00	0.00	180.48	$29.24	2.57
16	Classroom C-2	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$263.14	$75.00	$75.00	0.00	180.48	$29.24	2.57
16	Classroom C-1	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$263.14	$75.00	$75.00	0.00	180.48	$29.24	2.57
16	Classroom C-6	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$263.14	$75.00	$75.00	0.00	180.48	$29.24	2.57
16	Classroom C-8	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$263.14	$75.00	$75.00	0.00	180.48	$29.24	2.57
17	Custodial Closet	470	1	0	2-Lamp, Compact Flourescent, Vanity Light	26	0.03	12.2	$1.98	1	0	None	26	0.03	0%	12.22	$1.98	$0.00	$0.00	0.00	0	$0.00	0.00
4		470	1	0	2-Lamp, Incandescent, 75 Watt Bulbs, Surface Mounted, Direct	150	0.15	70.5	$11.42	1	0	None	150	0.15	0%	70.5	$11.42	$0.00	$0.00	0.00	0	$0.00	0.00
16	Art-C	1880	18	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.44	2,707.2	$438.57	18	2	Dual Technology Occupancy Sensor	80	1.44	10%	2436.48	$394.71	$75.00	$75.00	0.00	270.72	$43.86	1.71
10		1880	3	0	1-Lamp Incandescents	75	0.23	423.0	$68.53	3	0		75	0.23	10%	380.7	$61.67	$75.00	$0.00	0.00	42.3	$6.85	0.00
1		1880	4	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.32	601.6	$97.46	4	2		80	0.32	10%	541.44	$87.71	$75.00	$0.00	0.00	60.16	$9.75	0.00
18	Classroom C-12	1880	30	0	2-Lamp, T8, Electronic Ballast, Pendant Mounted, Parabolic Lens	58	1.74	3,271.2	$529.93	30	0	Dual Technology Occupancy Sensor	58	1.74	10%	2944.08	$476.94	$75.00	$75.00	0.00	327.12	$52.99	1.42

18	Classroom C-13	1880	29	0	2-Lamp, T8, Electronic Ballast, Pendant Mounted, Parabolic Lens	58	1.68	3,162.2	$512.27	29	0	Dual Technology Occupancy Sensor	58	1.68	10%	2845.944	$461.04	$75.00	$75.00	0.00	316.216	$51.23	1.46
19	Classroom C-15	1880	12	0	2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	58	0.70	1,308.5	$211.97	12	0	Dual Technology Occupancy Sensor	58	0.70	10%	1177.632	$190.78	$75.00	$75.00	0.00	130.848	$21.20	3.54
20		1880	2	0	1 Lamp Incandescents	60	0.12	225.6	$36.55	2	0		60	0.12	10%	203.04	$32.89	$0.00	$0.00	0.00	22.56	$3.65	0.00
19	C-17	1880	12	0	2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	58	0.70	1,308.5	$211.97	12	0	Dual Technology Occupancy Sensor	58	0.70	10%	1177.632	$190.78	$75.00	$75.00	0.00	130.848	$21.20	3.54
20		1880	2	0	1 Lamp Incandescents	60	0.12	225.6	$36.55	2	0		60	0.12	10%	203.04	$32.89	$0.00	$0.00	0.00	22.56	$3.65	0.00
19	C-16	1880	12	0	2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	58	0.70	1,308.5	$211.97	12	0	Dual Technology Occupancy Sensor	58	0.70	10%	1177.632	$190.78	$75.00	$75.00	0.00	130.848	$21.20	3.54
20		1880	2	0	1 Lamp Incandescents	60	0.12	225.6	$36.55	2	0		60	0.12	10%	203.04	$32.89	$0.00	$0.00	0.00	22.56	$3.65	0.00
8	Outside Trailer Doors	1880	8	0	1-Lamp Halogens, Direct Lighting	75	0.60	1,128.0	$182.74	8	0	Dual Technology Occupancy Sensor	75	0.60	10%	1015.2	$164.46	$75.00	$75.00	0.00	112.8	$18.27	4.10
9	Industrial Room	1880	38	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	80	3.04	5,715.2	$925.86	38	2	Dual Technology Occupancy Sensor	80	3.04	10%	5143.68	$833.28	$75.00	$75.00	0.00	571.52	$92.59	0.81
21	Industrial Computer Room	1880	2	0	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	82	0.16	308.3	$49.95	2	0	Dual Technology Occupancy Sensor	82	0.16	10%	277.488	$44.95	$75.00	$75.00	0.00	30.832	$4.99	15.02
1	Dellala's Back Right Room	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	Dual Technology Occupancy Sensor	80	0.08	10%	135.36	$21.93	$75.00	$75.00	0.00	15.04	$2.44	30.78
1	Nurse's Office	1880	8	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.64	1,203.2	$194.92	8	2	Dual Technology Occupancy Sensor	80	0.64	10%	1082.88	$175.43	$75.00	$75.00	0.00	120.32	$19.49	3.85
10	Nurse's Bathroom	1880	1	0	1-Lamp Incandescents	75	0.08	141.0	$22.84	1	0	Dual Technology Occupancy Sensor	75	0.08	10%	126.9	$20.56	$75.00	$75.00	0.00	14.1	$2.28	32.83
16	Corridor Between Gym and Admin	1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.16	300.8	$48.73	2	2	Dual Technology Occupancy Sensor	80	0.16	10%	270.72	$43.86	$75.00	$75.00	0.00	30.08	$4.87	15.39
10	Gym Storage Room	1880	2	0	1-Lamp Incandescents	75	0.15	282.0	$45.68	2	0	Dual Technology Occupancy Sensor	75	0.15	10%	253.8	$41.12	$75.00	$75.00	0.00	28.2	$4.57	16.42
1	Girls Locker Room	1880	12	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$263.14	$75.00	$75.00	0.00	180.48	$29.24	2.57
10	Girls Locker Room Shower	1880	2	0	1-Lamp Incandescents	75	0.15	282.0	$45.68	2	0	Dual Technology Occupancy Sensor	75	0.15	10%	253.8	$41.12	$75.00	$75.00	0.00	28.2	$4.57	16.42
11	Gym Storage Room	470	2	0	4-Lamp Incandescent	300	0.60	282.0	$45.68	2	0	Dual Technology Occupancy Sensor	300	0.60	10%	253.8	$41.12	$75.00	$75.00	0.00	28.2	$4.57	16.42
16	Cafeteria	1880	30	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	2.40	4,512.0	$730.94	30	2	Dual Technology Occupancy Sensor	80	2.40	10%	4060.8	$657.85	$75.00	$75.00	0.00	451.2	$73.09	1.03
22	Kitchen	1880	3	4	4-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	160	0.48	902.4	$146.19	3	3	Dual Technology Occupancy Sensor	160	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
1	Music Classroom	1880	27	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	2.16	4,060.8	$657.85	27	2	Dual Technology Occupancy Sensor	80	2.16	10%	3654.72	$592.06	$75.00	$75.00	0.00	406.08	$65.78	1.14

1	Music Room Storage	470	2	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.16	75.2	$12.18	2	2	None	80	0.16	0%	75.2	$12.18	$0.00	$0.00	0.00	0	$0.00	0.00
1	Corridor Trophy Case	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	None	80	0.08	0%	150.4	$24.36	$0.00	$0.00	0.00	0	$0.00	0.00
23	Main Entracne Corridor	2350	8	4	2 Foot, 4-Lamp, T12, Magnetic Ballast, Recessed Mount, Prismatic Lens	94	0.75	1,767.2	$286.29	8	3	Dual Technology Occupancy Sensor	94	0.75	10%	1590.48	$257.66	$75.00	$75.00	0.00	176.72	$28.63	2.62
1	Classroom A1A	1880	8	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.64	1,203.2	$194.92	8	2	Dual Technology Occupancy Sensor	80	0.64	10%	1082.88	$175.43	$75.00	$75.00	0.00	120.32	$19.49	3.85
1	Classroom A1B	1880	8	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.64	1,203.2	$194.92	8	2	Dual Technology Occupancy Sensor	80	0.64	10%	1082.88	$175.43	$75.00	$75.00	0.00	120.32	$19.49	3.85
1	Main Office	2350	11	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.88	2,068.0	$335.02	11	2	Dual Technology Occupancy Sensor	80	0.88	10%	1861.2	$301.51	$75.00	$75.00	0.00	206.8	$33.50	2.24
24	Bridge Corridor	2350	10	1	3 Foot, 1-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	47	0.47	1,104.5	$178.93	10	0	Dual Technology Occupancy Sensor	47	0.47	10%	994.05	$161.04	$75.00	$75.00	0.00	110.45	$17.89	4.19
6	Elevator Area	1880	3	4	2 Foot, 4-Lamp, T12, Magnetic Ballast, Recessed Mount, Parabolic Lens	94	0.28	530.2	$85.89	3	3	None	94	0.28	0%	530.16	$85.89	$0.00	$0.00	0.00	0	$0.00	0.00
25		1880	2	0	1-Lamp Compact Flourescent	28	0.06	105.3	$17.06	2	0	None	28	0.06	0%	105.28	$17.06	$0.00	$0.00	0.00	0	$0.00	0.00
1	Library	1880	52	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	4.16	7,820.8	$1,266.97	52	2	Dual Technology Occupancy Sensor	80	4.16	10%	7038.72	$1,140.27	$75.00	$150.00	0.00	782.08	$126.70	1.18
16		1880	2	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.16	300.8	$48.73	2	2		80	0.16	10%	270.72	$43.86	$0.00	$0.00	0.00	30.08	$4.87	0.00
16	Corridor B21 to B28	2350	8	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.64	1,504.0	$243.65	8	2	Dual Technology Occupancy Sensor	80	0.64	10%	1353.6	$219.28	$75.00	$75.00	0.00	150.4	$24.36	3.08
26	Girl's Bathroom	1880	6	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	0.44	823.4	$133.40	6	0	Dual Technology Occupancy Sensor	73	0.44	10%	741.096	$120.06	$75.00	$75.00	0.00	82.344	$13.34	5.62
26	Co-Ed Bathroom	1880	1	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	0.07	137.2	$22.23	1	0	Dual Technology Occupancy Sensor	73	0.07	10%	123.516	$20.01	$75.00	$75.00	0.00	13.724	$2.22	33.73
26	Boys Bathroom	1880	7	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	0.51	960.7	$155.63	7	0	Dual Technology Occupancy Sensor	73	0.51	10%	864.612	$140.07	$75.00	$75.00	0.00	96.068	$15.56	4.82
16	Corridor	2350	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	2,256.0	$365.47	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	2030.4	$328.92	$75.00	$75.00	0.00	225.6	$36.55	2.05
12	Elevator Entrance	1880	2	0	1-Lamp Compact Flourescent	13	0.03	48.9	$7.92	2	0	None	13	0.03	0%	48.88	$7.92	$0.00	$0.00	0.00	0	$0.00	0.00
1	Trophy Case	1880	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	80	0.08	150.4	$24.36	1	2	None	80	0.08	0%	150.4	$24.36	$0.00	$0.00	0.00	0	$0.00	0.00

26	Boys Bathroom	1880	7	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	0.51	960.7	$155.63	7	0	Dual Technology Occupancy Sensor	73	0.51	10%	864.612	$140.07	$75.00	$75.00	0.00	96.068	$15.56	4.82
26	Gils Bathroom	1880	6	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	0.44	823.4	$133.40	6	0	Dual Technology Occupancy Sensor	73	0.44	10%	741.096	$120.06	$75.00	$75.00	0.00	82.344	$13.34	5.62
26	Co-Ed Bathroom	1880	1	0	2-Lamp, T8, U-Lamp, Electronic Ballast, Recessed Mounted, Prismatic Lens	73	0.07	137.2	$22.23	1	0	Dual Technology Occupancy Sensor	73	0.07	10%	123.516	$20.01	$75.00	$75.00	0.00	13.724	$2.22	33.73
16	Corridor C1-C9	2350	7	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.56	1,316.0	$213.19	7	2	Dual Technology Occupancy Sensor	80	0.56	10%	1184.4	$191.87	$75.00	$75.00	0.00	131.6	$21.32	3.52
16	Corridor C Bathroom Area	1880	6	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.48	902.4	$146.19	6	2	Dual Technology Occupancy Sensor	80	0.48	10%	812.16	$131.57	$75.00	$75.00	0.00	90.24	$14.62	5.13
16	Corridor C1-C3	1880	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.24	451.2	$73.09	3	2	Dual Technology Occupancy Sensor	80	0.24	10%	406.08	$65.78	$75.00	$75.00	0.00	45.12	$7.31	10.26
16		1880	18	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	1.44	2,707.2	$438.57	18	2		80	1.44	10%	2436.48	$394.71	$75.00	$75.00	0.00	270.72	$43.86	1.71
27	Science C	1880	1	0	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, No Lens	94	0.09	176.7	$28.63	1	0	Dual Technology Occupancy Sensor	94	0.09	10%	159.048	$25.77	$0.00	$0.00	0.00	17.672	$2.86	0.00
16		1880	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.24	451.2	$73.09	3	2		80	0.24	10%	406.08	$65.78	$0.00	$0.00	0.00	45.12	$7.31	0.00
16	Classroom C-5	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$263.14	$75.00	$75.00	0.00	180.48	$29.24	2.57
16	Classroom C-7	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$263.14	$75.00	$75.00	0.00	180.48	$29.24	2.57
16	Classroom C-9	1880	12	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.96	1,804.8	$292.38	12	2	Dual Technology Occupancy Sensor	80	0.96	10%	1624.32	$263.14	$75.00	$75.00	0.00	180.48	$29.24	2.57
16	Corridor C9 - C7	2350	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.24	564.0	$91.37	3	2	Dual Technology Occupancy Sensor	80	0.24	10%	507.6	$82.23	$75.00	$75.00	0.00	56.4	$9.14	8.21
28	Corridor C12	2350	8	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.66	1,541.6	$249.74	8	0	Dual Technology Occupancy Sensor	82	0.66	10%	1387.44	$224.77	$75.00	$75.00	0.00	154.16	$24.97	3.00
19	Trailer C14	1880	12	0	2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	58	0.70	1,308.5	$211.97	12	0	Dual Technology Occupancy Sensor	58	0.70	10%	1177.632	$190.78	$75.00	$75.00	0.00	130.848	$21.20	3.54
19	Exterior Lighting	3640	15	0	2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	58	0.87	3,166.8	$513.02	15	0	None	58	0.87	0%	3166.8	$513.02	$0.00	$0.00	0.00	0	$0.00	0.00
28	Industrial Arts Office	1880	2	0	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	82	0.16	308.3	$49.95	2	0	Dual Technology Occupancy Sensor	82	0.16	10%	277.488	$44.95	$75.00	$75.00	0.00	30.832	$4.99	15.02

16	Guidance Office	1880	3	2	2-Lamp, T12, Magnetic Ballast, Recessed Mounted, Prismatic Lens	80	0.24	451.2	$73.09	3	2	Dual Technology Occupancy Sensor	80	0.24	10%	406.08	$65.78	$75.00	$75.00	0.00	45.12	$7.31	10.26
29	Outside Lighting	3640	16	0	1-Lamp Metal Halide	94	1.50	5,474.6	$886.88	16	0	None	94	1.50	0%	5474.56	$886.88	$0.00	$0.00	0.00	0	$0.00	0.00
30		3640	12	0	1-Lamp Compact Flourescent	20	0.24	873.6	$141.52	12	0	None	20	0.24	0%	873.6	$141.52	$0.00	$0.00	0.00	0	$0.00	0.00
8		3640	3	0	1-Lamp Halogens, Direct Lighting	75	0.23	819.0	$132.68	3	0	None	75	0.23	0%	819	$132.68	$0.00	$0.00	0.00	0	$0.00	0.00
31		3640	2	0	1 Lamp Incandescents	100	0.20	728.0	$117.94	2	0	None	100	0.20	0%	728	$117.94	$0.00	$0.00	0.00	0.0	$0.00	0.00
	Totals		954	179			80.83	151,812.8	$24,593.68	954	173			80.829		138049.98	########		$7,275.00	0.00	13762.8	$2,229.58	3.26

NOTES: 1. Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.

2. Lamp totals only include T-12 tube replacment calculations

Project Name: LGEA Solar PV Project - Denville Valleyview Middle School
Location: Denville, NJ
Description: Photovoltaic System 95% Financing - 25 year

Simple Payback Analysis

	Photovoltaic System 95% Financing - 25 year
Total Construction Cost	$726,570
Annual kWh Production	125,983
Annual Energy Cost Reduction	$20,409
Annual SREC Revenue	$44,094
First Cost Premium	**$726,570**
Simple Payback:	**11.26** Years

Life Cycle Cost Analysis

Analysis Period (years):	25	Financing %:	95%
Financing Term (mths):	240	Maintenance Escalation Rate:	3.0%
Average Energy Cost ($/kWh)	**$0.162**	Energy Cost Escalation Rate:	3.0%
Financing Rate:	7.00%	SREC Value ($/kWh)	$0.350

Period	Additional Cash Outlay	Energy kWh Production	Energy Cost Savings	Additional Maint Costs	SREC Revenue	Interest Expense	Loan Principal	Net Cash Flow	Cumulative Cash Flow
0	$36,329	0	0	0	$0	0	0	(36,329)	0
1	$0	125,983	$20,409	$0	$44,094	$47,797	$16,421	$286	($36,042)
2	$0	125,353	$21,022	$0	$43,874	$46,610	$17,608	$678	($35,365)
3	$0	124,726	$21,652	$0	$43,654	$45,337	$18,880	$1,089	($34,276)
4	$0	124,103	$22,302	$0	$43,436	$43,972	$20,245	$1,520	($32,755)
5	$0	123,482	$22,971	$1,272	$43,219	$42,508	$21,709	$700	($32,055)
6	$0	122,865	$23,660	$1,266	$43,003	$40,939	$23,278	$1,180	($30,875)
7	$0	122,250	$24,370	$1,259	$42,788	$39,256	$24,961	$1,681	($29,194)
8	$0	121,639	$25,101	$1,253	$42,574	$37,452	$26,765	$2,204	($26,990)
9	$0	121,031	$25,854	$1,247	$42,361	$35,517	$28,700	$2,751	($24,239)
10	$0	120,426	$26,629	$1,240	$42,149	$33,442	$30,775	$3,321	($20,918)
11	$0	119,824	$27,428	$1,234	$41,938	$31,218	$33,000	$3,915	($17,003)
12	$0	119,224	$28,251	$1,228	$41,729	$28,832	$35,385	$4,534	($12,469)
13	$0	118,628	$29,099	$1,222	$41,520	$26,274	$37,943	$5,180	($7,289)
14	$0	118,035	$29,972	$1,216	$41,312	$23,531	$40,686	$5,851	($1,438)
15	$0	117,445	$30,871	$1,210	$41,106	$20,590	$43,627	$6,550	$5,112
16	$0	116,858	$31,797	$1,204	$40,900	$17,436	$46,781	$7,276	$12,388
17	$0	116,274	$32,751	$1,198	$40,696	$14,054	$50,163	$8,032	$20,420
18	$0	115,692	$33,733	$1,192	$40,492	$10,428	$53,789	$8,817	$29,236
19	$0	115,114	$34,745	$1,186	$40,290	$6,540	$57,678	$9,632	$38,869
20	$0	114,538	$35,788	$1,180	$40,088	$2,370	$61,847	$10,479	$49,348
21	$0	113,965	$36,861	$1,174	$39,888	$2,009	$56,857	$16,710	$66,057
22	$0	113,396	$37,967	$1,168	$39,688	$1,375	$46,788	$28,325	$94,382
23	$0	112,829	$39,106	$1,162	$39,490	$0	$0	$77,434	$171,816
24	$0	112,264	$40,279	$1,156	$39,293	$0	$0	$78,416	$250,232
25	$0	111,703	$41,488	$1,151	$39,096	$0	$0	$79,433	$329,665
	Totals:	2,403,489	$548,404	$19,604	$841,221	$594,103	$690,241	$793,886	$726,616
				Net Present Value (NPV)				**$47,094**	
				Internal Rate of Return (IRR)				**12.3%**	

Project Name: LGEA Solar PV Project - Denville Valleyview Middle School
Location: Denville, NJ
Description: Photovoltaic System - Direct Purchase

Simple Payback Analysis

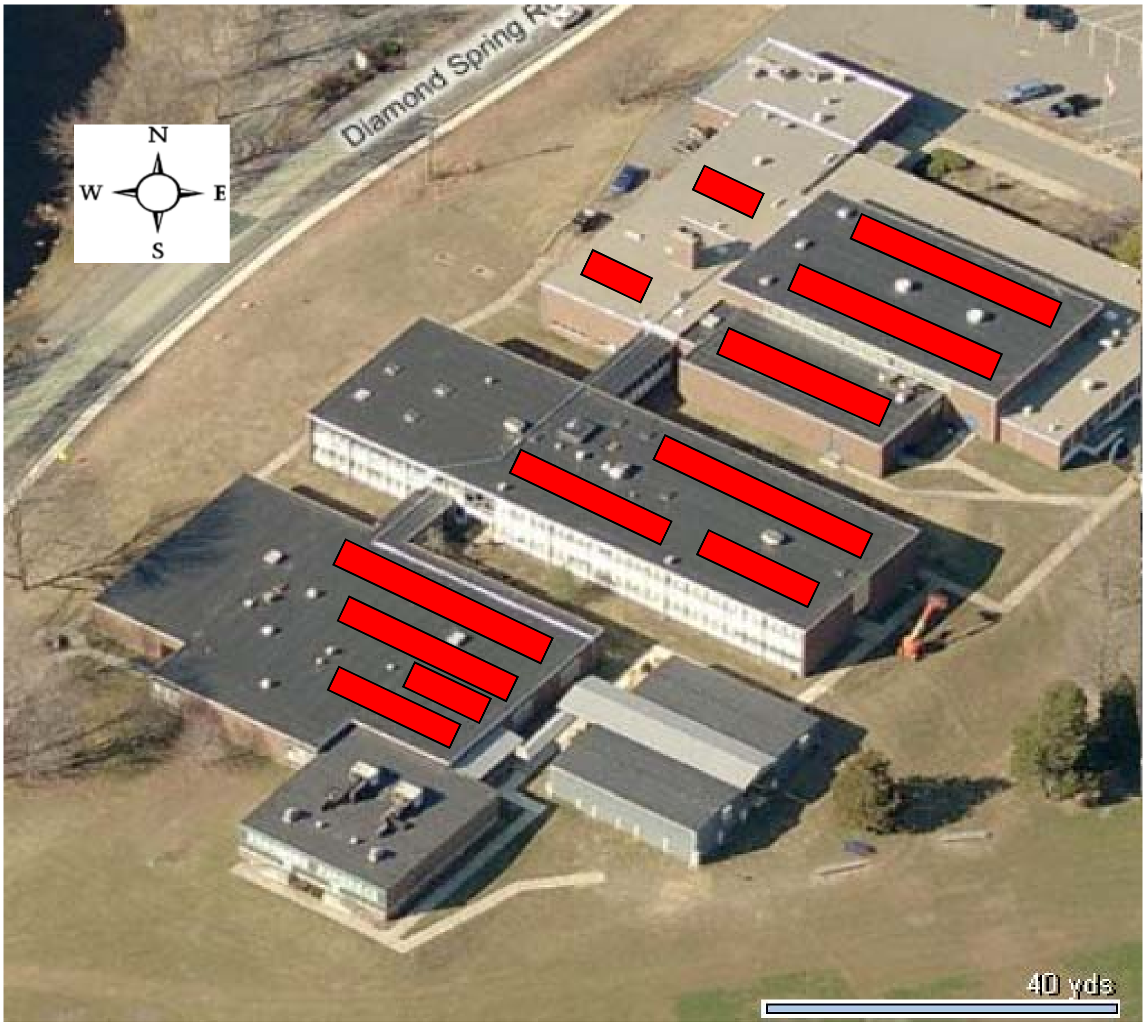
	Photovoltaic System - Direct Purchase
Total Construction Cost	$726,570
Annual kWh Production	125,983
Annual Energy Cost Reduction	$20,409
Annual SREC Revenue	$44,094
First Cost Premium	**$726,570**
Simple Payback:	**11.26** Years

Life Cycle Cost Analysis

Analysis Period (years):	25	Financing %:	0%
Financing Term (mths):	0	Maintenance Escalation Rate:	3.0%
Average Energy Cost ($/kWh)	**$0.162**	Energy Cost Escalation Rate:	3.0%
Financing Rate:	0.00%	SREC Value ($/kWh)	$0.350

Period	Additional Cash Outlay	Energy kWh Production	Energy Cost Savings	Additional Maint Costs	SREC Revenue	Net Cash Flow	Cumulative Cash Flow
0	$726,570	0	0	0	$0	(726,570)	0
1	$0	125,983	$20,409	$0	$44,094	$64,503	($662,067)
2	$0	125,353	$21,022	$0	$43,874	$64,895	($597,172)
3	$0	124,726	$21,652	$0	$43,654	$65,306	($531,865)
4	$0	124,103	$22,302	$0	$43,436	$65,738	($466,128)
5	$0	123,482	$22,971	$1,272	$43,219	$64,918	($401,210)
6	$0	122,865	$23,660	$1,266	$43,003	$65,397	($335,813)
7	$0	122,250	$24,370	$1,259	$42,788	$65,898	($269,915)
8	$0	121,639	$25,101	$1,253	$42,574	$66,422	($203,493)
9	$0	121,031	$25,854	$1,247	$42,361	$66,968	($136,526)
10	$0	120,426	$26,629	$1,240	$42,149	$67,538	($68,987)
11	$0	119,824	$27,428	$1,234	$41,938	$68,132	($855)
12	$0	119,224	$28,251	$1,228	$41,729	$68,752	$67,897
13	$0	118,628	$29,099	$1,222	$41,520	$69,397	$137,293
14	$0	118,035	$29,972	$1,216	$41,312	$70,068	$207,362
15	$0	117,445	$30,871	$1,210	$41,106	$70,767	$278,128
16	$0	116,858	$31,797	$1,204	$40,900	$71,494	$349,622
17	$0	116,274	$32,751	$1,198	$40,696	$72,249	$421,871
18	$0	115,692	$33,733	$1,192	$40,492	$73,034	$494,905
19	$0	115,114	$34,745	$1,186	$40,290	$73,849	$568,754
20	$0	114,538	$35,788	$1,180	$40,088	$74,696	$643,451
21	$1	113,965	$36,861	$1,174	$39,888	$75,575	$719,026
22	$2	113,396	$37,967	$1,168	$39,688	$76,488	$795,514
23	$3	112,829	$39,106	$1,162	$39,490	$77,434	$872,948
24	$4	112,264	$40,279	$1,156	$39,293	$78,416	$951,363
25	$5	111,703	$41,488	$1,151	$39,096	$79,433	$1,030,797
	Totals:	2,403,489	$548,404	$19,604	$841,221	$1,757,367	$1,370,021
				Net Present Value (NPV)		**$1,030,822**	
				Internal Rate of Return (IRR)		**8.0%**	

Building	Roof Area (sq ft)	Panel	Qty	Panel Sq Ft	Panel Total Sq Ft	Total KW	Total Annual kWh	Panel Weight (33 lbs)	W/SQFT
Denville Valleyview Middle School	5160	Sunpower SPR230	351	14.7	5,161	80.73	125,983	11,583	15.64



.= Proposed PV Layout

Notes:
1. Estimated kWH based on 4.68 hours full output per day per 365 day year. Actual kWH will vary day to day.

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Denville Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty

ECM DESCRIPTION

Retrofit existing lighting fixtures with new energy efficient lighting fixtures, install motion sensors and implement daylight harvesting in selected areas

DATA / ASSUMPTIONS

* Heating Season	20	Weeks
** Fraction of heat to be made-up	40.0%	
Heating Hours (Weather Data)	3,948	Hours

** Fraction of the Year Representing the Cooling Season Liberal estimate of the heating season, as there are times during the year when the building is neither heated nor cooled.
*** Fraction of the Lighting Reduction that Has to Be Made Up by Heating a portion of the lighting heat is released at night plus interior zones will have limited heating loads

MEASUREMENT AND VERIFICATION

Option
A - The
Enginee

COMMISSIONING

Confirm lighting operation and occupancy sensors functions

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	0%

Relatively high safety factor is used for this ECM because of direct measurements are proven over the time and savings are stipulated

CALCULATIONS

Detailed energy savings calculations are in the line-by-line calculation sheet

Denville Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty
*Inputs are blue

Building	Lighting Savings (kWh)	Lighting Savings (kW)	Lighting Hours Check (hrs)
Valleyview Middle School	178,576	49.80	3,586
Lakeview Elementary School	228,848	74.00	3,093
Riverview Elementary School	105,040	41.62	2,524
Bus Garage	7,358	1.89	3,893
Totals	519,823	167	

CALCULATIONS

	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
Lighting Derate	0%	0%	0%	0%
Lighting Savings	178,576	228,848	105,040	7,358
kW Savings	49.80	74.00	41.62	1.89
Heating Season	20	20	20	20
** % of Heating Season	38%	38%	38%	38%
***Fraction of Heat to be Made-up	40%	40%	40%	40%
****Annual Equivalent of Lighting kWh Saved in Therms	6,093	7,808	3,584	251
Current Boiler Efficiency	89.0%	77.0%	73.7%	80.0%
Heating Penalty (Therms)	(1,053)	(1,560)	(748)	(48)

Denville Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty

School	Location	Current Hours	Current Qty	Current Watts	Total Current Watts	Current KwH	Current kW	Current Lighting Description	Proposed Hours	Proposed Qty	Proposed Watts	Total Proposed Watts	Proposed KwH	Proposed kW	Proposed Lighting Description	KwH Reduction	kW Reduction
Valleyview	MAIN OFFICE	3650	16	64	1024	3737.6	1.02	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	32	12	384	1401.6	0.38	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2336	0.64
Valleyview	PRINC BR	3650	2	23	46	167.9	0.05	1 - 23 WATT CFL	3650	2	9.5	19	69.35	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	98.55	0.03
Valleyview	PRINC OFFICE	3650	1	23	23	83.95	0.02	1 - 23 WATT CFL	3650	1	9.5	9.5	34.67	0.01	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	49.27	0.01
Valleyview	A1A/A1B HALL	3650	2	23	46	167.9	0.05	1 - 23 WATT CFL	3650	2	9.5	19	69.35	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	98.55	0.03
Valleyview	A1A/A1B HALL	3650	6	64	384	1401.6	0.38	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	12	12	144	525.6	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	876	0.24
Valleyview	A1A/A1B HALL	3650	1	96	96	350.4	0.1	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	3	12	36	131.4	0.04	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	219	0.06
Valleyview	A1A/A1B OFFICE	3650	1	72	72	262.8	0.07	4' FIXTURE, 2-F34/T12 LAMPS, ENERGY SAVING MAGNETIC BALLAST	3650	2	12	24	87.6	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	175.2	0.05
Valleyview	TECH OFFICE	2607.14	4	64	256	667.43	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	2607.14	8	12	96	250.29	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	417.14	0.16
Valleyview	TECH SERVER RM	1303.57	2	64	128	166.86	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1303.57	4	12	48	62.57	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	104.29	0.08
Valleyview	A1A	3650	8	64	512	1868.8	0.51	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	16	12	192	700.8	0.19	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1168	0.32
Valleyview	A1B	3650	8	64	512	1868.8	0.51	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	16	12	192	700.8	0.19	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1168	0.32
Valleyview	MAIN HALL DISPLAY	1303.57	1	64	64	83.43	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1303.57	2	12	24	31.29	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	52.14	0.04
Valleyview	MAIN HALL	3650	9	64	576	2102.4	0.58	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3650	27	9	243	886.95	0.24	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	1215.45	0.33
Valleyview	MAIN HALL KITS	4380	0	0	0	0	0	0 - N/A	4380	9	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (3) SOCKETS)	0	0
Valleyview	MAIN HALL	3650	9	128	1152	4204.8	1.15	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	36	12	432	1576.8	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2628	0.72
Valleyview	GYM	3650	17	128	2176	7942.4	2.18	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	68	18	1224	4467.6	1.22	G3 HP 4 FOOT 18W 5000K CLEAR LENS SEP LED TUBE - DLC LISTED	3474.8	0.95
Valleyview	GYM PARS	3650	9	90	810	2956.5	0.81	PAR 38 FLOOD 90 WATT	3650	9	18.5	166.5	607.72	0.17	PAR38, E26 BASE, 18.5 WATT, 120V 25°, 2700K, HIGH CRI, DIMMABLE - ENERGY STAR	2348.77	0.64
Valleyview	GYM STAGE	3650	6	64	384	1401.6	0.38	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	12	12	144	525.6	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	876	0.24
Valleyview	GYM STAGE HIGH BAY	3650	2	100	200	730	0.2	A LAMP 100 WATT INCANDESCENT	3650	2	17	34	124.1	0.03	LED A21 17 WATT, FULLY OMNI E26 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	605.9	0.17
Valleyview	GUIDANCE KANE	3650	4	64	256	934.4	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	8	12	96	350.4	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	584	0.16
Valleyview	CONF RM	3650	2	64	128	467.2	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	4	12	48	175.2	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	292	0.08
Valleyview	NURSE OFFICE	3650	8	64	512	1868.8	0.51	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	16	12	192	700.8	0.19	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1168	0.32
Valleyview	NURSE LOUNGE	3650	1	64	64	233.6	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	2	12	24	87.6	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	146	0.04
Valleyview	MENS BR	3650	2	23	46	167.9	0.05	1 - 23 WATT CFL	3650	2	9.5	19	69.35	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	98.55	0.03
Valleyview	FACULTY RM	3650	6	64	384	1401.6	0.38	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	12	12	144	525.6	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	876	0.24
Valleyview	FACULTY RM	3650	1	72	72	262.8	0.07	4' FIXTURE, 2-F34/T12 LAMPS, ENERGY SAVING MAGNETIC BALLAST	3650	2	12	24	87.6	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	175.2	0.05
Valleyview	FACULTY LADIES RM	3650	2	23	46	167.9	0.05	1 - 23 WATT CFL	3650	2	9.5	19	69.35	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	98.55	0.03
Valleyview	HALL NEAR PHYS ED	3650	1	74	74	270.1	0.07	*2' FIXTURE, 4-F17/T8/STD LAMPS, ELECTRONIC BALLAST	3650	4	9	36	131.4	0.04	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	138.7	0.04
Valleyview	PHYS EDS	3650	4	64	256	934.4	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	8	12	96	350.4	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	584	0.16
Valleyview	PHYS ED BR'S	3650	2	23	46	167.9	0.05	1 - 23 WATT CFL	3650	2	9.5	19	69.35	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	98.55	0.03
Valleyview	STEM LAB	3650	38	64	2432	8876.8	2.43	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	76	12	912	3328.8	0.91	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	5548	1.52
Valleyview	STEM LAB FIXTURES	4380	0	0	0	0	0	0 - N/A	4380	38	0	0	0	0	4FT 2 LAMP INDUSTRIAL HOOD	0	0
Valleyview	STEM PC RMS	3650	4	96	384	1401.6	0.38	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	12	12	144	525.6	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	876	0.24
Valleyview	GENERAL SUPLY	3650	5	64	320	1168	0.32	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	10	12	120	438	0.12	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	730	0.2
Valleyview	GENERAL SUPLY	3650	4	32	128	467.2	0.13	1 - 32 WATT CFL	3650	4	9.5	38	138.7	0.04	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	328.5	0.09
Valleyview	BOILER RM STAIRS	1303.57	6	32	192	250.29	0.19	1 - 32 WATT CFL	1303.57	6	9.5	57	74.3	0.06	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	175.98	0.14
Valleyview	BOILER RM	1303.57	14	64	896	1168	0.9	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1303.57	28	12	336	438	0.34	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	730	0.56
Valleyview	ELEV RM	1303.57	1	64	64	83.43	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1303.57	2	12	24	31.29	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	52.14	0.04
Valleyview	WOMENS BR	3650	4	34	136	496.4	0.14	*2' FIXTURE, 2-F17/T8/STD LAMPS, ELECTRONIC BALLAST	3650	8	9	72	262.8	0.07	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	233.6	0.06
Valleyview	MENS BR	3650	4	34	136	496.4	0.14	*2' FIXTURE, 2-F17/T8/STD LAMPS, ELECTRONIC BALLAST	3650	8	9	72	262.8	0.07	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	233.6	0.06
Valleyview	HALL	3650	6	128	768	2803.2	0.77	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	INCINERATOR RM	3650	2	64	128	467.2	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	4	12	48	175.2	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	292	0.08
Valleyview	CUST CLOSET	1303.57	1	32	32	41.71	0.03	1 - 32 WATT CFL	1303.57	1	9.5	9.5	12.38	0.01	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	29.33	0.02
Valleyview	CAFETERIA	3650	31	128	3968	14483.2	3.97	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	124	12	1488	5431.2	1.49	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	9052	2.48
Valleyview	CAFETERIA CLOSET	1303.57	4	23	92	119.93	0.09	1 - 23 WATT CFL	1303.57	4	22	88	114.71	0.09	ETI-ROUND FLUSH MOUNT-16"-22W-4000K-1700L	5.21	0
Valleyview	CAFETERIA ST	1303.57	3	128	384	500.57	0.38	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	1303.57	12	12	144	187.71	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	312.86	0.24
Valleyview	MUSIC	3650	27	64	1728	6307.2	1.73	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	54	12	648	2365.2	0.65	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	3942	1.08
Valleyview	MUSIC ST	3650	2	64	128	467.2	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	4	12	48	175.2	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	292	0.08
Valleyview	HALL	3650	5	96	480	1752	0.48	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	15	12	180	657	0.18	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1095	0.3
Valleyview	HALL	3650	3	64	192	700.8	0.19	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3650	9	9	81	295.65	0.08	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	405.15	0.11
Valleyview	HALL KITS	4380	0	0	0	0	0	0 - N/A	4380	3	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (3) SOCKETS)	0	0
Valleyview	HALL ELEV ENTRY	3650	4	23	92	335.8	0.09	1 - 23 WATT CFL	3650	4	11	44	160.6	0.04	PL STAB-IN BALLAST BYPASS, HORIZONTAL, G24Q/G24D 11W, 4000K	175.2	0.05
Valleyview	ELEVATOR	3650	2	64	128	467.2	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	4	12	48	175.2	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	292	0.08
Valleyview	COMMUNICATION EQUIP RM	3650	4	96	384	1401.6	0.38	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	12	12	144	525.6	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	876	0.24
Valleyview	B25	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	LIBRARY	3650	52	64	3328	12147.2	3.33	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	104	12	1248	4555.2	1.25	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	7592	2.08
Valleyview	LIBRARY ENTRY	3650	2	64	128	467.2	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	4	12	48	175.2	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	292	0.08
Valleyview	LIBRARY OFFICE	3650	3	64	192	700.8	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	6	12	72	262.8	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	438	0.12
Valleyview	LIBRARY LEZGUS OFFICE	3650	3	64	192	700.8	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	6	12	72	262.8	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	438	0.12
Valleyview	LIBRARY FARLEYY OFFICE	3650	6	64	384	1401.6	0.38	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	12	12	144	525.6	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	876	0.24
Valleyview	HALL NEAR LIBRARY	3650	9	128	1152	4204.8	1.15	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	36	12	432	1576.8	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2628	0.72
Valleyview	KORMAN OFFICE	3650	1	64	64	233.6	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	2	12	24	87.6	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	146	0.04
Valleyview	KORMAN	3650	1	23	23	83.95	0.02	1 - 23 WATT CFL	3650	1	9.5	9.5	34.67	0.01	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	49.27	0.01
Valleyview	GIRLS BR	3650	5	64	320	1168	0.32	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3650	15	9	135	492.75	0.13	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	675.25	0.19
Valleyview	GIRLS BR KITS	4380	0	0	0	0	0	0 - N/A	4380	5	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (3) SOCKETS)	0	0
Valleyview	B24 MS WORTS	3650	18	64	1152	4204.8	1.15	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	36	12	432	1576.8	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2628	0.72
Valleyview	BOYS BATHRM	3650	7	64	448	1635.2	0.45	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3650	21	9	189	689.85	0.19	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	945.35	0.26
Valleyview	BOYS KITS	4380	0	0	0	0	0	0 - N/A	4380	7	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (3) SOCKETS)	0	0
Valleyview	BOYS CLOSETS	1303.57	1	32	32	41.71	0.03	1 - 32 WATT CFL	1303.57	1	11	11	14.34	0.01	PL STAB-IN BALLAST BYPASS, VERTICAL, G24O/G24D 11W, 3500K	27.37	0.02
Valleyview	B23	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	B26	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	B22	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	B27	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	B21	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	B28	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	STAIRS	3650	2	128	256	934.4	0.26	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	8	12	96	350.4	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	584	0.16
Valleyview	STAIRS	3650	1	64	64	233.6	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	2	12	24	87.6	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	146	0.04
Valleyview	STAIRS	3650	1	32	32	116.8	0.03	1 - 32 WATT CFL	3650	1	9.5	9.5	34.67	0.01	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	82.12	0.02
Valleyview	B11	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	B18	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	HALL	3650	13	128	1664	6073.6	1.66	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	52	12	624	2277.6	0.62	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	3796	1.04
Valleyview	B12	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	B17	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	B13	3650	14	64	896	3270.4	0.9	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	28	12	336	1226.4	0.34	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2044	0.56
Valleyview	B13 ST	1303.57	2	72	144	187.71	0.14	4' FIXTURE, 2-F34/T12 LAMPS, ENERGY SAVING MAGNETIC BALLAST	1303.57	4	12	48	62.57	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	125.14	0.1
Valleyview	B14	3650	14	64	896	3270.4	0.9	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	28	12	336	1226.4	0.34	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2044	0.56
Valleyview	HALL DISPLAY	1303.57	1	64	64	83.43	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1303.57	2	12	24	31.29	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	52.14	0.04
Valleyview	B16	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	BOYS BATHRM	3650	7	64	448	1635.2	0.45	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3650	21	9	189	689.85	0.19	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	945.35	0.26
Valleyview	BOYS KITS	4380	0	0	0	0	0	0 - N/A	4380	7	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (3) SOCKETS)	0	0
Valleyview	BOYS CLOSET	1303.57	1	32	32	41.71	0.03	1 - 32 WATT CFL	1303.57	1	11	11	14.34	0.01	PL STAB-IN BALLAST BYPASS, VERTICAL, G24O/G24D 11W, 3500K	27.37	0.02
Valleyview	STAFF BR	3650	1	64	64	233.6	0.06	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3650	3	9	27	98.55	0.03	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	135.05	0.04
Valleyview	STAFF KITS	4380	0	0	0	0	0	0 - N/A	4380	1	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (3) SOCKETS)	0	0
Valleyview	GIRLS BATHRM	3650	6	64	384	1401.6	0.38	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3650	18	9	162	591.3	0.16	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	810.3	0.22
Valleyview	GIRLS KITS	4380	0	0	0	0	0	0 - N/A	4380	6	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (3) SOCKETS)	0	0
Valleyview	B14	3650	14	64	896	3270.4	0.9	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	28	12	336	1226.4	0.34	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2044	0.56
Valleyview	HALL NEAR ELEV	3650	4	32	128	467.2	0.13	1 - 32 WATT CFL	3650	4	11	44	160.6	0.04	PL STAB-IN BALLAST BYPASS, HORIZONTAL, G24Q/G24D 11W, 4000K	306.6	0.08
Valleyview	BOOK RM	4380	3	64	192	840.96	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	4380	6	12	72	315.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	525.6	0.12
Valleyview	B15	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	STAIRS	3650	3	128	384	1401.6	0.38	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	12	12	144	525.6	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	876	0.24
Valleyview	STAIRS	3650	1	32	32	116.8	0.03	1 - 32 WATT CFL	3650	1	9.5	9.5	34.67	0.01	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	82.12	0.02
Valleyview	B19	3650	4	237	948	3460.2	0.95	8' FIXTURE, 2-F96/T12/HO 110 WATT LAMPS, MAGNETIC ES BALLAST	3650	16	12	192	700.8	0.19	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2759.4	0.76
Valleyview	B19 PENDANTS	4380	0	0	0	0	0	0 - N/A	4380	8	0	0	0	0	EMPTY LED READY 4' PENDANT FIXTURE (2 LAMP)	0	0
Valleyview	LIFE SKILLS	3650	24	64	1536	5606.4	1.54	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	48	12	576	2102.4	0.58	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	3504	0.96
Valleyview	B20	3650	4	237	948	3460.2	0.95	8' FIXTURE, 2-F96/T12/HO 110 WATT LAMPS, MAGNETIC ES BALLAST	3650	16	12	192	700.8	0.19	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2759.4	0.76
Valleyview	B20 PENDANTS	4380	0	0	0	0	0	0 - N/A	4380	8	0	0	0	0	EMPTY LED READY 4' PENDANT FIXTURE (2 LAMP)	0	0
Valleyview	HALL ST	1303.57	2	32	64	83.43	0.06	1 - 32 WATT CFL	1303.57	2	9.5	19	24.77	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	58.66	0.05

Denville Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty

School	Location	Current Hours	Current Qty	Current Watts	Total Current Watts	Current KwH	Current kW	Current Lighting Description	Proposed Hours	Proposed Qty	Proposed Watts	Total Proposed Watts	Proposed KwH	Proposed kW	Proposed Lighting Description	KwH Reduction	kW Reduction
Valleyview	HALL TO C WING	3650	3	128	384	1401.6	0.38	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	12	12	144	525.6	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	876	0.24
Valleyview	HALL TO C WING	3650	1	128	128	467.2	0.13	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	4	12	48	175.2	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	292	0.08
Valleyview	HALL TO C WING	3650	2	64	128	467.2	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	4	12	48	175.2	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	292	0.08
Valleyview	C4	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	LC MENS BR	3650	2	23	46	167.9	0.05	1 - 23 WATT CFL	3650	2	9.5	19	69.35	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	98.55	0.03
Valleyview	LC WOMENS BR	3650	2	23	46	167.9	0.05	1 - 23 WATT CFL	3650	2	9.5	19	69.35	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	98.55	0.03
Valleyview	C3	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	C2	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	C1	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	LC HALL	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	SCIENCE C	3650	18	64	1152	4204.8	1.15	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	36	12	432	1576.8	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2628	0.72
Valleyview	SCIENCE C CLOSET	1303.57	3	64	192	250.29	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1303.57	6	12	72	93.86	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	156.43	0.12
Valleyview	LC CUST CLOSET	1303.57	4	23	92	119.93	0.09	1 - 23 WATT CFL	1303.57	4	9.5	38	49.54	0.04	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	70.39	0.05
Valleyview	LCL GIRLS BR	3650	5	34	170	620.5	0.17	*2' FIXTURE, 2-F17/T8/STD LAMPS, ELECTRONIC BALLAST	3650	10	9	90	328.5	0.09	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	292	0.08
Valleyview	LC MEN BR	3650	5	34	170	620.5	0.17	*2' FIXTURE, 2-F17/T8/STD LAMPS, ELECTRONIC BALLAST	3650	10	9	90	328.5	0.09	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	292	0.08
Valleyview	C10	3650	6	64	384	1401.6	0.38	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	12	12	144	525.6	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	876	0.24
Valleyview	LC OFFICE	3650	3	64	192	700.8	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	6	12	72	262.8	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	438	0.12
Valleyview	C5	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	C6	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	C11	3650	3	64	192	700.8	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	6	12	72	262.8	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	438	0.12
Valleyview	C7	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	DISPLAY CASE	1303.57	1	50	50	65.18	0.05	4' FIXTURE, 1-F34/T12 LAMP, STANDARD MAGNETIC BALLAST	1303.57	1	12	12	15.64	0.01	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	49.54	0.04
Valleyview	C8	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	ART C	3650	18	96	1728	6307.2	1.73	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	54	12	648	2365.2	0.65	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	3942	1.08
Valleyview	ART C ST	1303.57	4	64	256	333.71	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1303.57	8	12	96	125.14	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	208.57	0.16
Valleyview	C9	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Valleyview	LC HALL	3650	8	64	512	1868.8	0.51	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	16	12	192	700.8	0.19	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1168	0.32
Valleyview	C12	3650	30	64	1920	7008	1.92	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	60	12	720	2628	0.72	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	4380	1.2
Valleyview	C12 OFFICE PREP RM	3650	4	64	256	934.4	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	8	12	96	350.4	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	584	0.16
Valleyview	C13	3650	32	64	2048	7475.2	2.05	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	64	12	768	2803.2	0.77	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	4672	1.28
Valleyview	C13 OFFICE PREP RM	3650	6	64	384	1401.6	0.38	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	12	12	144	525.6	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	876	0.24
Valleyview	GYM ST	1303.57	2	32	64	83.43	0.06	1 - 32 WATT CFL	1303.57	2	17	34	44.32	0.03	LED A21 17 WATT, FULLY OMNI E26 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	39.11	0.03
Valleyview	GYM LOCKER	3650	11	64	704	2569.6	0.7	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	22	12	264	963.6	0.26	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1606	0.44
Valleyview	GYM SHOWER	3650	2	32	64	233.6	0.06	1 - 32 WATT CFL	3650	2	17	34	124.1	0.03	LED A21 17 WATT, FULLY OMNI E26 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	109.5	0.03
Valleyview	LOCKER ST	1303.57	1	64	64	83.43	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1303.57	2	12	24	31.29	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	52.14	0.04
Valleyview	GYM ST	1303.57	2	32	64	83.43	0.06	1 - 32 WATT CFL	1303.57	2	17	34	44.32	0.03	LED A21 17 WATT, FULLY OMNI E26 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	39.11	0.03
Valleyview	GYM LOCKER	3650	11	64	704	2569.6	0.7	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	22	12	264	963.6	0.26	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1606	0.44
Valleyview	GYM ST	1303.57	2	32	64	83.43	0.06	1 - 32 WATT CFL	1303.57	2	17	34	44.32	0.03	LED A21 17 WATT, FULLY OMNI E26 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	39.11	0.03
Valleyview	GYM	3650	17	458	7786	28418.9	7.79	METAL HALIDE, 1-400 WATT LAMP - OVER 15'	3650	17	240	4080	14892	4.08	JP HIGHBAY,240W,24,000 LM,50K,120-277V, 0-10V DIMMING (REFLECTOR NOT INCLUDED)	13526.9	3.71
Valleyview	GYM CONES	4380	0	0	0	0	0	0 - N/A	4380	17	0	0	0	0	CREE ALUMINUM REFLECTOR 16"	0	0
Valleyview	EXT FLOOD	4380	1	458	458	2006.04	0.46	METAL HALIDE, 1-400 WATT LAMP - OVER 15'	4380	1	150	150	657	0.15	FLEXFLOOD 150W COOL LED SLIPFITTER + 277V PCS BRONZE - DLC LISTED	1349.04	0.31
Valleyview	PARKING LOT FLOOD	4380	4	458	1832	8024.16	1.83	METAL HALIDE, 1-400 WATT LAMP - OVER 15'	4380	4	150	600	2628	0.6	FLEXFLOOD 150W COOL LED SLIPFITTER + 277V PCS BRONZE - DLC LISTED	5396.16	1.23
Valleyview	EXT WP 250	4380	1	295	295	1292.1	0.3	METAL HALIDE, 1-250 WATT LAMP	4380	1	150	150	657	0.15	LPACK WALLPACK 150W TYPE IV COOL LED + 277V PC BZ - DLC LISTED	635.1	0.15
Valleyview	EXT WP 150	4380	2	190	380	1664.4	0.38	METAL HALIDE, 1-150 WATT LAMP	4380	2	55	110	481.8	0.11	WALLPACK 55W COOL LED BRONZE - DLC LISTED	1182.6	0.27
Valleyview	EXT PAR 30	4380	4	90	360	1576.8	0.36	PAR 38 FLOOD 90 WATT	4380	4	18.5	74	324.12	0.07	PAR38, E26 BASE, 18.5 WATT, 120V 25°, 2700K, HIGH CRI, DIMMABLE - ENERGY STAR	1252.68	0.29
Valleyview	DOOR 18, 16	4380	6	100	600	2628	0.6	A LAMP 100 WATT INCANDESCENT	4380	6	17	102	446.76	0.1	LED A21 17 WATT, FULLY OMNI E26 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	2181.24	0.5
Valleyview	DOOR 18	4380	6	140	840	3679.2	0.84	METAL HALIDE, 1-120 WATT LAMP	4380	6	39	234	1024.92	0.23	FUTURE FLOOD 39W COOL LED + 277V PC BRONZE - DLC LISTED	2654.28	0.61
Valleyview	CANOPY	4380	3	32	96	420.48	0.1	1 - 32 WATT CFL	4380	3	17	51	223.38	0.05	LED A21 17 WATT, FULLY OMNI E26 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	197.1	0.05
Valleyview	PAR 30 DOORS	4380	1	60	60	262.8	0.06	PAR 30 - 60 WATT FLOOD	4380	1	17	17	74.46	0.02	LED A21 17 WATT, FULLY OMNI E26 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	188.34	0.04
Valleyview	C13,C14	4380	6	32	192	840.96	0.19	1 - 32 WATT CFL	4380	6	17	102	446.76	0.1	LED A21 17 WATT, FULLY OMNI E26 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	394.2	0.09
Valleyview	WP 100 W	4380	2	140	280	1226.4	0.28	METAL HALIDE, 1-120 WATT LAMP	4380	2	26	52	227.76	0.05	SLIM 26W COOL LED 277V PC WALLMOUNT BRONZE - DLC LISTED	998.64	0.23
Valleyview	WALKWAY TP C14,15,16,17	4380	21	32	672	2943.36	0.67	1 - 32 WATT CFL	4380	21	17	357	1563.66	0.36	LED A21 17 WATT, FULLY OMNI E26 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	1379.7	0.32
Valleyview	70 HAL WP	4380	1	95	95	416.1	0.1	METAL HALIDE, 1-70 WATT LAMP	4380	1	39	39	170.82	0.04	FUTURE FLOOD 39W COOL LED + 277V PC BRONZE - DLC LISTED	245.28	0.06
Valleyview	AREA	4380	1	295	295	1292.1	0.3	METAL HALIDE, 1-250 WATT LAMP	4380	1	78	78	341.64	0.08	ALED78 TYPE IV 8 POLE ARM WARM LED 120 277V PCT RD GRAY - DLC LISTED	950.46	0.22
Valleyview	SOCKETS	4380	0	0	0	0	0	0 - N/A	4380	1	0	0	0	0	NON-SHUNTED SOCKET, 600V, 660W	0	0
Valleyview	2L HARNESSES	4380	0	0	0	0	0	0 - N/A	4380	781	0	0	0	0	2 LAMP UNIVERSAL TOMBSTONE KIT WITH BALLAST DISCONNECT	0	0
Valleyview	3L THARNESSES	4380	0	0	0	0	0	0 - N/A	4380	32	0	0	0	0	3 LAMP UNIVERSAL TOMBSTONE KIT WITH BALLAST DISCONNECT	0	0
Valleyview	4L HARNESSES	4380	0	0	0	0	0	0 - N/A	4380	98	0	0	0	0	4 LAMP UNIVERSAL TOMBSTONE KIT WITH BALLAST DISCONNECT	0	0
	CLOSET STOCK	4380	0	0	0	0	0	0 - N/A	4380	200	12	2400	10512	2.4	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	-10512	-2.4
		Existing:	1108	12,667.00	88,349.00	320,619.01	88.3488		New:	3572	2,964.00	36,713.00	134,684.18	36.712848		178,576.39	49.8
																185,934.82	51.64
Bus Garage	BUS DEPOT EXT	4380	2	465	930	4073.4	0.93	HIGH PRESSURE SODIUM, 1-400 WATT LAMP	4380	2	150	300	1314	0.3	FLEXFLOOD 150W COOL LED TRUNNION BRONZE - DLC LISTED	2759.4	0.63
Bus Garage	BUS DEPOT	3650	12	64	768	2803.2	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	24	12	288	1051.2	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1752	0.48
Bus Garage	BUS DEPOT	3650	4	295	1180	4307	1.18	METAL HALIDE, 1-250 WATT LAMP	3650	4	160	640	2336	0.64	JP HIGHBAY,160W,18,000 LM,50K,120-277V, 0-10V DIMMING (REFLECTOR NOT INCLUDED)	1971	0.54
Bus Garage	BUS DEPOT	4380	0	0	0	0	0	0 - N/A	4380	4	0	0	0	0	CREE ALUMINUM REFLECTOR 16"	0	0
Bus Garage	BUS DEPOT OFFICES	3650	6	64	384	1401.6	0.38	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3650	12	12	144	525.6	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	876	0.24
																7358.4	1.89

Denville Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty

School	Location	Current Hours	Current Qty	Current Watts	Total Current Watts	Current KwH	Current kW	Current Lighting Description	Proposed Hours	Proposed Qty	Proposed Watts	Total Proposed Watts	Proposed KwH	Proposed kW	Proposed Lighting Description	KwH Reduction	kW Reduction
Riverview	Classroom 17	1880	8	96	768	1443.84	0.77	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	24	12	288	541.44	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	902.4	0.48
Riverview	Classroom 19	1880	9	96	864	1624.32	0.86	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	27	12	324	609.12	0.32	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1015.2	0.54
Riverview	Classroom 21	1880	9	96	864	1624.32	0.86	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	27	12	324	609.12	0.32	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1015.2	0.54
Riverview	Faculty Room	1880	7	64	448	842.24	0.45	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	14	12	168	315.84	0.17	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	526.4	0.28
Riverview	Faculty Room	1880	1	94	94	176.72	0.09	4' FIXTURE, 2-F40/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	2	12	24	45.12	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	131.6	0.07
Riverview	Faculty Bathroom	1880	2	128	256	481.28	0.26	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	300.8	0.16
Riverview	Classroom 24	1880	2	94	188	353.44	0.19	4' FIXTURE, 2-F40/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	263.2	0.14
Riverview	Classroom 23	1880	9	96	864	1624.32	0.86	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	27	12	324	609.12	0.32	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1015.2	0.54
Riverview	Office 23	1880	2	64	128	240.64	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	150.4	0.08
Riverview	Classroom 22	1880	6	96	576	1082.88	0.58	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	18	12	216	406.08	0.22	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	676.8	0.36
Riverview	Computer Lab 20	1880	30	58	1740	3271.2	1.74	4' FIXTURE, 2-F32/T8/32 WATT LAMPS, ELECT BALLAST .85-.95, 58 WATTS	1880	60	12	720	1353.6	0.72	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1917.6	1.02
Riverview	A Communications Closet	470	1	64	64	30.08	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	470	2	12	24	11.28	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	18.8	0.04
Riverview	Library	1880	60	58	3480	6542.4	3.48	4' FIXTURE, 2-F32/T8/32 WATT LAMPS, ELECT BALLAST .85-.95, 58 WATTS	1880	120	12	1440	2707.2	1.44	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	3835.2	2.04
Riverview	Conference Room	1880	4	64	256	481.28	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	300.8	0.16
Riverview	Librarian's Office	1880	4	58	232	436.16	0.23	4' FIXTURE, 2-F32/T8/32 WATT LAMPS, ELECT BALLAST .85-.95, 58 WATTS	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	255.68	0.14
Riverview	Classroom 25	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Boys Bathroom	1880	1	64	64	120.32	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	2	12	24	45.12	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	75.2	0.04
Riverview	Classroom 26	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Janitor's Closet	1880	1	64	64	120.32	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	2	12	24	45.12	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	75.2	0.04
Riverview	Classroom 27	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Classroom 28	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Classroom 29	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Classroom 30	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Classroom 31	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Classroom 32	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Classroom 16	1880	3	94	282	530.16	0.28	4' FIXTURE, 2-F40/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	6	12	72	135.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	394.8	0.21
Riverview	Custodial Closet	470	2	18	36	16.92	0.04	1 - 18 WATT CFL	470	2	6.5	13	6.11	0.01	A19 LAMP, E26 BASE, 6.5 WATT, 120V, 4000K, NON-DIMMABLE	10.81	0.02
Riverview	Cafeteria Girls' Room	1880	2	58	116	218.08	0.12	4' FIXTURE, 2-F32/T8/32 WATT LAMPS, ELECT BALLAST .85-.95, 58 WATTS	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	127.84	0.07
Riverview	Cafeteria Boys' Room	1880	2	58	116	218.08	0.12	4' FIXTURE, 2-F32/T8/32 WATT LAMPS, ELECT BALLAST .85-.95, 58 WATTS	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	127.84	0.07
Riverview	Multipurpose	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Kitchen	1880	3	64	192	360.96	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	6	12	72	135.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	225.6	0.12
Riverview	Custodial Closet	470	1	13	13	6.11	0.01	1 - 13W CFL	470	1	6.5	6.5	3.05	0.01	A19 LAMP, E26 BASE, 6.5 WATT, 120V, 4000K, NON-DIMMABLE	3.06	0.01
Riverview	Custodial Closet	470	1	26	26	12.22	0.03	1 - 26 WATT CFL SCREW-IN	470	1	9.5	9.5	4.46	0.01	A19 LAMP, E26 BASE, 9.5W, WIDE BEAM, 120V, 4000K, DIM - ENERGY STAR	7.76	0.02
Riverview	Stage	1880	12	58	696	1308.48	0.7	4' FIXTURE, 2-F32/T8/32 WATT LAMPS, ELECT BALLAST .85-.95, 58 WATTS	1880	24	12	288	541.44	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	767.04	0.41
Riverview	Stage	1880	8	13	104	195.52	0.1	1 - 13W CFL	1880	8	6.5	52	97.76	0.05	A19 LAMP, E26 BASE, 6.5 WATT, 120V, 4000K, NON-DIMMABLE	97.76	0.05
Riverview	Gym Foyer	1880	3	151	453	851.64	0.45	4' FIXTURE, 3-F40/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	9	12	108	203.04	0.11	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	648.6	0.35
Riverview	Gym	1880	24	96	2304	4331.52	2.3	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	72	18	1296	2436.48	1.3	G3 HP 4 FOOT 18W 5000K CLEAR LENS SEP LED TUBE - DLC LISTED	1895.04	1.01
Riverview	Gym Storage	1880	7	80	560	1052.8	0.56	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	14	12	168	315.84	0.17	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	736.96	0.39
Riverview	Gym Office	1880	2	130	260	488.8	0.26	4' FIXTURE, 3-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	6	12	72	135.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	353.44	0.19
Riverview	Custodial Office	1880	1	80	80	150.4	0.08	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	2	12	24	45.12	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	105.28	0.06
Riverview	Hallway 4	2350	8	80	640	1504	0.64	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	2350	16	12	192	451.2	0.19	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1052.8	0.45
Riverview	Hallway 5	2350	7	80	560	1316	0.56	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	2350	14	12	168	394.8	0.17	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	921.2	0.39
Riverview	Classroom 15	1880	9	96	864	1624.32	0.86	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	27	12	324	609.12	0.32	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1015.2	0.54
Riverview	Classroom 14	1880	6	96	576	1082.88	0.58	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	18	12	216	406.08	0.22	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	676.8	0.36
Riverview	Classroom 13	1880	6	80	480	902.4	0.48	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	12	12	144	270.72	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	631.68	0.34
Riverview	Storage	1880	2	80	160	300.8	0.16	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	210.56	0.11
Riverview	Storage	1880	7	13	91	171.08	0.09	1 - 13W CFL	1880	5	6.5	32.5	61.1	0.03	A19 LAMP, E26 BASE, 6.5 WATT, 120V, 4000K, NON-DIMMABLE	109.98	0.06
Riverview	12 Science Lab	1880	19	96	1824	3429.12	1.82	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	57	12	684	1285.92	0.68	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2143.2	1.14
Riverview	Science Lab	1880	1	26	26	48.88	0.03	1 - 26 WATT CFL SCREW-IN	1880	1	9.5	9.5	17.86	0.01	A19 LAMP, E26 BASE, 9.5W, WIDE BEAM, 120V, 4000K, DIM - ENERGY STAR	31.02	0.02
Riverview	Classroom 11	1880	15	96	1440	2707.2	1.44	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	45	12	540	1015.2	0.54	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1692	0.9
Riverview	Classroom 10	1880	15	96	1440	2707.2	1.44	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	45	12	540	1015.2	0.54	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1692	0.9
Riverview	Classroom 11	1880	1	13	13	24.44	0.01	1 - 13W CFL	1880	1	6.5	6.5	12.22	0.01	A19 LAMP, E26 BASE, 6.5 WATT, 120V, 4000K, NON-DIMMABLE	12.22	0.01
Riverview	Classroom 8	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Classroom 9	1880	20	80	1600	3008	1.6	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	40	12	480	902.4	0.48	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2105.6	1.12
Riverview	Stairwell	8760	4	13	52	455.52	0.05	1 - 13W CFL	8760	4	6.5	26	227.76	0.03	A19 LAMP, E26 BASE, 6.5 WATT, 120V, 4000K, NON-DIMMABLE	227.76	0.03
Riverview	Hallway 6	2350	12	96	1152	2707.2	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	2350	36	12	432	1015.2	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1692	0.72
Riverview	Classroom 1	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Classtoom 2	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Bathroom	1880	2	13	26	48.88	0.03	1 - 13W CFL	1880	4	6.5	26	48.88	0.03	A19 LAMP, E26 BASE, 6.5 WATT, 120V, 4000K, NON-DIMMABLE	0	0
Riverview	Classroom 3	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Classroom 4	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Classroom 5	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Classroom 6	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Classroom 7	1880	12	96	1152	2165.76	1.15	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1353.6	0.72
Riverview	Custodial Restroom	1880	1	80	80	150.4	0.08	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	2	12	24	45.12	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	105.28	0.06
Riverview	Main Stairwell	8760	4	40	160	1401.6	0.16	2 20W CFL SCREW IN FIXTURE	8760	8	9.5	76	665.76	0.08	A19 LAMP, E26 BASE, 9.5W, WIDE BEAM, 120V, 4000K, DIM - ENERGY STAR	735.84	0.08
Riverview	Main Office	1880	9	96	864	1624.32	0.86	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	27	12	324	609.12	0.32	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1015.2	0.54
Riverview	Princ Office	1880	4	64	256	481.28	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	300.8	0.16
Riverview	LC 1 TRAILER EXT	1880	2	64	128	240.64	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	150.4	0.08
Riverview	LC2 Trailer	1880	10	107	1070	2011.6	1.07	4' FIXTURE, 4-F32/T8/32 WATTS, ELECT BALLAST .84-.95, 107 WATTS	1880	40	12	480	902.4	0.48	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1109.2	0.59
Riverview	LC1 TRAILER	1880	10	128	1280	2406.4	1.28	*4' FIXTURE, 4-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	40	12	480	902.4	0.48	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1504	0.8
Riverview	2L RETRO KIT	1	0	0	0	0	0	0 - N/A	1	268	0	0	0	0	2 LAMP UNIVERSAL TOMBSTONE KIT WITH BALLAST DISCONNECT	0	0
Riverview	3L RETRO KIT	1	0	0	0	0	0	0 - N/A	1	409	0	0	0	0	3 LAMP UNIVERSAL TOMBSTONE KIT WITH BALLAST DISCONNECT	0	0
Riverview	4L RETRO KIT	1	0	0	0	0	0	0 - N/A	1	22	0	0	0	0	4 LAMP UNIVERSAL TOMBSTONE KIT WITH BALLAST DISCONNECT	0	0
Riverview	STORAGE	1	0	0	0	0	0	0 - N/A	1	60	12	720	0.72	0.72	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	-0.72	-0.72
Riverview	MAIN OFFICE	3640	1	78	78	283.92	0.08	2' FIXTURE, 2-F34/T12/U6 LAMPS, ELECTRONIC BALLAST	3640	3	9	27	98.28	0.03	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	185.64	0.05
Riverview	MAIN OFFICE BR	3640	1	78	78	283.92	0.08	2' FIXTURE, 2-F34/T12/U6 LAMPS, ELECTRONIC BALLAST	3640	3	9	27	98.28	0.03	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	185.64	0.05
Riverview	MAIN OFFICE KITS	1880	0	0	0	0	0	0 - N/A	1880	2	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (3) SOCKETS)	0	0
Riverview	MAIN OFFICE CONFN RM	3640	3	64	192	698.88	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3640	6	12	72	262.08	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	436.8	0.12
Riverview	OFFICE	3640	2	96	192	698.88	0.19	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	3640	6	12	72	262.08	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	436.8	0.12
Riverview	16	3640	8	96	768	2795.52	0.77	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	3640	24	12	288	1048.32	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1747.2	0.48
Riverview	HEALTH RM	3640	13	64	832	3028.48	0.83	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3640	26	12	312	1135.68	0.31	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1892.8	0.52
Riverview	BOILER RM STAIRS	2350	1	26	26	61.1	0.03	1 - 26 WATT CFL SCREW-IN	2350	1	9.5	9.5	22.32	0.01	A19 LAMP, E26 BASE, 9.5W, WIDE BEAM, 120V, 4000K, DIM - ENERGY STAR	38.77	0.02
Riverview	BOILER RM	2350	9	64	576	1353.6	0.58	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	2350	18	12	216	507.6	0.22	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	846	0.36
Riverview	MENS BR	3640	7	34	238	866.32	0.24	*2' FIXTURE, 2-F17/T8/STD LAMPS, ELECTRONIC BALLAST	3640	14	9	126	458.64	0.13	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	407.68	0.11
Riverview	MENS BR EM	1880	1	34	34	63.92	0.03	*2' FIXTURE, 2-F17/T8/STD LAMPS, ELECTRONIC BALLAST	1880	2	7.5	15	28.2	0.01	7.5W 2FT G2 ALL-PLASTIC BALLAST-READY FROSTED 4000K TUBE	35.72	0.02
Riverview	WOMENS BR	3640	5	34	170	618.8	0.17	*2' FIXTURE, 2-F17/T8/STD LAMPS, ELECTRONIC BALLAST	3640	10	9	90	327.6	0.09	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	291.2	0.08
Riverview	WOMENS BR EM	3640	1	34	34	123.76	0.03	*2' FIXTURE, 2-F17/T8/STD LAMPS, ELECTRONIC BALLAST	3640	2	7.5	15	54.6	0.01	7.5W 2FT G2 ALL-PLASTIC BALLAST-READY FROSTED 4000K TUBE	69.16	0.02
Riverview	MENS BR	3640	7	34	238	866.32	0.24	*2' FIXTURE, 2-F17/T8/STD LAMPS, ELECTRONIC BALLAST	3640	14	9	126	458.64	0.13	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	407.68	0.11
Riverview	MENS BR EM	3640	1	34	34	123.76	0.03	*2' FIXTURE, 2-F17/T8/STD LAMPS, ELECTRONIC BALLAST	3640	2	7.5	15	54.6	0.01	7.5W 2FT G2 ALL-PLASTIC BALLAST-READY FROSTED 4000K TUBE	69.16	0.02
Riverview	WOMENS BR	3640	6	34	204	742.56	0.2	*2' FIXTURE, 2-F17/T8/STD LAMPS, ELECTRONIC BALLAST	3640	12	9	108	393.12	0.11	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	349.44	0.1
Riverview	WOMENS BR EM	3640	1	34	34	123.76	0.03	*2' FIXTURE, 2-F17/T8/STD LAMPS, ELECTRONIC BALLAST	3640	2	7.5	15	54.6	0.01	7.5W 2FT G2 ALL-PLASTIC BALLAST-READY FROSTED 4000K TUBE	69.16	0.02
Riverview	HALLS	3640	26	96	2496	9085.44	2.5	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	3640	78	12	936	3407.04	0.94	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	5678.4	1.56
Riverview	CUST CL	470	1	64	64	30.08	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	470	2	12	24	11.28	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	18.8	0.04
Riverview	SCHIMPF OFFICE	3640	2	64	128	465.92	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3640	4	12	48	174.72	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	291.2	0.08
Riverview	MILK RM	2350	3	26	78	183.3	0.08	1 - 26 WATT CFL SCREW-IN	2350	3	9.5	28.5	66.97	0.03	A19 LAMP, E26 BASE, 9.5W, WIDE BEAM, 120V, 4000K, DIM - ENERGY STAR	116.32	0.05
Riverview	CUSTODIAN OFFICE	2350	1	64	64	150.4	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	2350	2	12	24	56.4	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	94	0.04
Riverview	COMMUNICATION EQUIP OFF	1880	2	64	128	240.64	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	150.4	0.08

Denville Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty

School	Location	Current Hours	Current Qty	Current Watts	Total Current Watts	Current KwH	Current kW	Current Lighting Description	Proposed Hours	Proposed Qty	Proposed Watts	Total Proposed Watts	Proposed KwH	Proposed kW	Proposed Lighting Description	KwH Reduction	kW Reduction
Riverview	11	3640	2	64	128	465.92	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3640	4	12	48	174.72	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	291.2	0.08
Riverview	10	3640	2	64	128	465.92	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3640	4	12	48	174.72	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	291.2	0.08
Riverview	10 CLOSET	470	1	26	26	12.22	0.03	1 - 26 WATT CFL SCREW-IN	470	1	9.5	9.5	4.46	0.01	A19 LAMP, E26 BASE, 9.5W, WIDE BEAM, 120V, 4000K, DIM - ENERGY STAR	7.76	0.02
Riverview	BOYS BR	3640	1	26	26	94.64	0.03	1 - 26 WATT CFL SCREW-IN	3640	1	9.5	9.5	34.58	0.01	A19 LAMP, E26 BASE, 9.5W, WIDE BEAM, 120V, 4000K, DIM - ENERGY STAR	60.06	0.02
Riverview	GIRLS BATHRM	3640	1	26	26	94.64	0.03	1 - 26 WATT CFL SCREW-IN	3640	1	9.5	9.5	34.58	0.01	A19 LAMP, E26 BASE, 9.5W, WIDE BEAM, 120V, 4000K, DIM - ENERGY STAR	60.06	0.02
Riverview	MAAG OFFICE	3640	14	96	1344	4892.16	1.34	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	3640	42	12	504	1834.56	0.5	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	3057.6	0.84
Riverview	MAAG BR	3640	2	64	128	465.92	0.13	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3640	6	9	54	196.56	0.05	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	269.36	0.07
Riverview	MAAG CL	470	1	64	64	30.08	0.06	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	470	3	9	27	12.69	0.03	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	17.39	0.04
Riverview	MAAG KITS	1880	0	0	0	0	0	0 - N/A	1880	3	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (3) SOCKETS)	0	0
Riverview	CLOSET	470	1	64	64	30.08	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	470	2	12	24	11.28	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	18.8	0.04
Riverview	STAIRS	8760	4	64	256	2242.56	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	8760	8	12	96	840.96	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1401.6	0.16
Riverview	GIRLS BATHRM	3640	1	64	64	232.96	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3640	2	12	24	87.36	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	145.6	0.04
Riverview	GIRLS BATHRM	3640	2	26	52	189.28	0.05	1 - 26 WATT CFL SCREW-IN	3640	2	9.5	19	69.16	0.02	A19 LAMP, E26 BASE, 9.5W, WIDE BEAM, 120V, 4000K, DIM - ENERGY STAR	120.12	0.03
Riverview	BOYS BATHRM	3640	2	26	52	189.28	0.05	1 - 26 WATT CFL SCREW-IN	3640	2	9.5	19	69.16	0.02	A19 LAMP, E26 BASE, 9.5W, WIDE BEAM, 120V, 4000K, DIM - ENERGY STAR	120.12	0.03
Riverview	BOYS BATHRM	3640	1	64	64	232.96	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3640	2	12	24	87.36	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	145.6	0.04
Riverview	STAIRS	8760	4	64	256	2242.56	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	8760	8	12	96	840.96	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1401.6	0.16
Riverview	WP 150 W	4380	10	190	1900	8322	1.9	METAL HALIDE, 1-150 WATT LAMP	4380	10	26	260	1138.8	0.26	SLIM 26W COOL LED 277V PC WALLMOUNT BRONZE - DLC LISTED	7183.2	1.64
Riverview	CANOPY	4380	3	26	78	341.64	0.08	1 - 26 WATT CFL SCREW-IN	4380	3	9.5	28.5	124.83	0.03	A19 LAMP, E26 BASE, 9.5W, WIDE BEAM, 120V, 4000K, DIM - ENERGY STAR	216.81	0.05
Riverview	DOOR 8 EXT	4380	1	128	128	560.64	0.13	METAL HALIDE, 1-100 WATT LAMP	4380	1	16	16	70.08	0.02	DOWNLIGHT RETROFIT 6", 16W, HIGH CRI, 120V, 2700K, DIM - ENERGY STAR	490.56	0.11
Riverview	ENTRY CANOPY	4380	8	26	208	911.04	0.21	1 - 26 WATT CFL SCREW-IN	4380	8	9.5	76	332.88	0.08	A19 LAMP, E26 BASE, 9.5W, WIDE BEAM, 120V, 4000K, DIM - ENERGY STAR	578.16	0.13
Riverview	WP 400W	4380	3	458	1374	6018.12	1.37	METAL HALIDE, 1-400 WATT LAMP - OVER 15'	4380	3	150	450	1971	0.45	LPACK WALLPACK 150W TYPE IV COOL LED + 277V PC BZ - DLC LISTED	4047.12	0.92
Riverview	WP 250W	4380	5	295	1475	6460.5	1.48	METAL HALIDE, 1-250 WATT LAMP	4380	5	78	390	1708.2	0.39	LPACK WALLPACK 78W TYPE IV COOL LED + 120V PC BRONZE - DLC LISTED	4752.3	1.09
Riverview	WP NEAR GYM	4380	2	190	380	1664.4	0.38	METAL HALIDE, 1-150 WATT LAMP	4380	2	55	110	481.8	0.11	WALLPACK 55W COOL LED BRONZE - DLC LISTED	1182.6	0.27
Riverview	EXT FLOOD	4380	1	458	458	2006.04	0.46	METAL HALIDE, 1-400 WATT LAMP - OVER 15'	4380	1	150	150	657	0.15	FLEXFLOOD 150W COOL LED SLIPFITTER + 277V PCS BRONZE - DLC LISTED	1349.04	0.31
Riverview	EXT PAR	4380	3	90	270	1182.6	0.27	PAR 38 FLOOD 90 WATT	4380	3	18.5	55.5	243.09	0.06	PAR38, E26 BASE, 18.5 WATT, 120V 25°, 2700K, HIGH CRI, DIMMABLE - ENERGY STAR	939.51	0.21
Riverview	WP CFL	4380	3	42	126	551.88	0.13	1-42 WATT CFL	4380	3	11	33	144.54	0.03	PL STAB-IN BALLAST BYPASS, HORIZONTAL, G24Q/G24D 11W, 4000K	407.34	0.09
Riverview	CANOPY VANDALPROOF	4380	5	128	640	2803.2	0.64	METAL HALIDE, 1-100 WATT LAMP	4380	5	52	260	1138.8	0.26	VANDALPROOF CANOPY 52W COOL LED 120-277 WITH DROP LENS	1664.4	0.38
Riverview	CANOPY	4380	1	128	128	560.64	0.13	METAL HALIDE, 1-100 WATT LAMP	4380	1	75	75	328.5	0.07	VANDALPROOF CANOPY 75W COOL LED 120-277V WITH DROP LENS	232.14	0.05
Riverview	LC1 TRAILER	8760	1	64	64	560.64	0.06	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	8760	3	9	27	236.52	0.03	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	324.12	0.04
Riverview	LC2 TRAILER	8760	1	64	64	560.64	0.06	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	8760	3	9	27	236.52	0.03	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	324.12	0.04
Riverview	LC1/LC2 KITS	1880	0	0	0	0	0	0 - N/A	1880	2	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (3) SOCKETS)	0	0
		Existing:	793	9,863.00	#######	164,683.96	67.2109		New:	2729	1,877.00	25,633.00	59,643.78	25.6329		105040.19	41.62

Denville Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty

School	Location	Current Hours	Current Qty	Current Watts	Total Current Watts	Current KwH	Current kW	Current Lighting Description	Proposed Hours	Proposed Qty	Proposed Watts	Total Proposed Watts	Proposed KwH	Propose d kW	Proposed Lighting Description	KwH Reduction	kW Reduction
Lakeview	Stage	1880	1	75	75	141	0.08	A LAMP 75 WATT INCANDESCENT	1880	1	9.5	9.5	17.86	0.01	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	123.14	0.07
Lakeview	Stage	1880	2	90	180	338.4	0.18	PAR 38 FLOOD 90 WATT	1880	2	18.5	37	69.56	0.04	PAR38, E26 BASE, 18.5 WATT, 120V 25°, 2700K, HIGH CRI, DIMMABLE - ENERGY STAR	268.84	0.14
Lakeview	Classroom A1	1880	17	80	1360	2556.8	1.36	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	34	12	408	767.04	0.41	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1789.76	0.95
Lakeview	A1 Closet	1880	2	75	150	282	0.15	A LAMP 75 WATT INCANDESCENT	1880	2	9.5	19	35.72	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	246.28	0.13
Lakeview	A1 Closet communication	1880	1	80	80	150.4	0.08	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	2	12	24	45.12	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	105.28	0.06
Lakeview	Classroom A2	1880	17	80	1360	2556.8	1.36	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	34	12	408	767.04	0.41	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1789.76	0.95
Lakeview	A2 Closet	1880	2	75	150	282	0.15	A LAMP 75 WATT INCANDESCENT	1880	2	9.5	19	35.72	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	246.28	0.13
Lakeview	A2 Closet	1880	1	80	80	150.4	0.08	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	2	12	24	45.12	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	105.28	0.06
Lakeview	Principals Office	1880	4	80	320	601.6	0.32	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	421.12	0.22
Lakeview	Principal Bathroom	1880	1	130	130	244.4	0.13	4' FIXTURE, 3-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	3	14	42	78.96	0.04	14W 4FT G2 ALL-PLASTIC BALLAST-READY FROSTED 4000K TUBE - DLC LISTED	165.44	0.09
Lakeview	Communication Closet	1880	3	75	225	423	0.23	A LAMP 75 WATT INCANDESCENT	1880	3	9.5	28.5	53.58	0.03	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	369.42	0.2
Lakeview	Communication Closet	1880	2	80	160	300.8	0.16	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	210.56	0.11
Lakeview	A1-A6 Hall	2350	14	96	1344	3158.4	1.34	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	2350	42	12	504	1184.4	0.5	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1974	0.84
Lakeview	Conference Room A	1880	6	64	384	721.92	0.38	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	12	12	144	270.72	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	451.2	0.24
Lakeview	Conference room A bathroom	1880	1	96	96	180.48	0.1	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	3	12	36	67.68	0.04	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	112.8	0.06
Lakeview	Classroom A25	1880	2	64	128	240.64	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	150.4	0.08
Lakeview	Classroom A3	1880	16	154	2464	4632.32	2.46	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	64	12	768	1443.84	0.77	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	3188.48	1.7
Lakeview	Classroom A4	1880	15	154	2310	4342.8	2.31	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	60	12	720	1353.6	0.72	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2989.2	1.59
Lakeview	Classroom A5	1880	12	154	1848	3474.24	1.85	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	48	12	576	1082.88	0.58	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2391.36	1.27
Lakeview	Classroom A6	1880	12	154	1848	3474.24	1.85	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	48	12	576	1082.88	0.58	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2391.36	1.27
Lakeview	Classroom A7	1880	12	154	1848	3474.24	1.85	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	48	12	576	1082.88	0.58	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2391.36	1.27
Lakeview	A halls Girls Bathroom	1880	2	80	160	300.8	0.16	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	210.56	0.11
Lakeview	Janitors Closet	470	2	50	100	47	0.1	A LAMP 50 WATT INCANDESCENT	470	2	9.5	19	8.93	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	38.07	0.08
Lakeview	A8-A29 Hall	2350	9	80	720	1692	0.72	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	2350	18	12	216	507.6	0.22	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1184.4	0.5
Lakeview	Classroom A8	1880	12	154	1848	3474.24	1.85	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	48	12	576	1082.88	0.58	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2391.36	1.27
Lakeview	Classroom A29	1880	17	80	1360	2556.8	1.36	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	34	12	408	767.04	0.41	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1789.76	0.95
Lakeview	Classroom A29 Bathroom	1880	2	80	160	300.8	0.16	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	210.56	0.11
Lakeview	Boiler Bathroom	1880	1	80	80	150.4	0.08	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	2	12	24	45.12	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	105.28	0.06
Lakeview	Classroom A9	1880	12	154	1848	3474.24	1.85	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	48	12	576	1082.88	0.58	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2391.36	1.27
Lakeview	Classroom A10	1880	12	154	1848	3474.24	1.85	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	48	12	576	1082.88	0.58	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2391.36	1.27
Lakeview	Garage	470	2	80	160	75.2	0.16	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	470	4	12	48	22.56	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	52.64	0.11
Lakeview	Garage	470	3	50	150	70.5	0.15	A LAMP 50 WATT INCANDESCENT	470	3	9.5	28.5	13.39	0.03	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	57.1	0.12
Lakeview	Storage	470	4	80	320	150.4	0.32	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	470	8	12	96	45.12	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	105.28	0.22
Lakeview	Storage	470	2	50	100	47	0.1	A LAMP 50 WATT INCANDESCENT	470	2	9.5	19	8.93	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	38.07	0.08
Lakeview	A11	1880	12	154	1848	3474.24	1.85	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	48	12	576	1082.88	0.58	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2391.36	1.27
Lakeview	A12	1880	12	154	1848	3474.24	1.85	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	48	12	576	1082.88	0.58	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2391.36	1.27
Lakeview	Small hall foyer	1880	6	56	336	631.68	0.34	2' FIXTURE, 2-F20/T12/STD LAMPS, STANDARD MAGNETIC BALLAST	1880	12	9	108	203.04	0.11	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	428.64	0.23
Lakeview	Show Case	1880	2	40	80	150.4	0.08	A LAMP 40 WATT INCANDESCENT	1880	2	9.5	19	35.72	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	114.68	0.06
Lakeview	Lunch room	1880	50	80	4000	7520	4	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	100	12	1200	2256	1.2	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	5264	2.8
Lakeview	Storage	470	4	40	160	75.2	0.16	A LAMP 40 WATT INCANDESCENT	470	4	9.5	38	17.86	0.04	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	57.34	0.12
Lakeview	Tolerance Hall	2350	8	80	640	1504	0.64	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	2350	16	12	192	451.2	0.19	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1052.8	0.45
Lakeview	B Hall	2350	20	80	1600	3760	1.6	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	2350	40	12	480	1128	0.48	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2632	1.12
Lakeview	Classroom B1	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B2	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B3	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B4	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B5	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B6	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B7	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B8	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B9	1880	15	80	1200	2256	1.2	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	30	12	360	676.8	0.36	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1579.2	0.84
Lakeview	Classroom B10	1880	9	80	720	1353.6	0.72	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	18	12	216	406.08	0.22	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	947.52	0.5
Lakeview	Classroom B11	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B12	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B14	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B15	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B16	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Classroom B17	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Storage B13	1880	3	50	150	282	0.15	A LAMP 50 WATT INCANDESCENT	1880	3	9.5	28.5	53.58	0.03	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	228.42	0.12
Lakeview	B halls boys bathroom	1880	3	80	240	451.2	0.24	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	6	12	72	135.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	315.84	0.17
Lakeview	Custodial closet	470	1	50	50	23.5	0.05	A LAMP 50 WATT INCANDESCENT	470	1	9.5	9.5	4.46	0.01	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	19.03	0.04
Lakeview	B hall girls bathroom	1880	2	56	112	210.56	0.11	2' FIXTURE, 2-F20/T12/STD LAMPS, STANDARD MAGNETIC BALLAST	1880	4	9	36	67.68	0.04	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	142.88	0.08
Lakeview	Hall between A and B	2350	10	80	800	1880	0.8	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	2350	20	12	240	564	0.24	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1316	0.56
Lakeview	health room	1880	18	64	1152	2165.76	1.15	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	1880	54	9	486	913.68	0.49	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	1252.08	0.67
Lakeview	health room	1880	1	18	18	33.84	0.02	1 - 18 WATT CFL	1880	1	12	12	22.56	0.01	DOWNLIGHT RETROFIT 6", 12 WATT, 120V, 2700K, DIMMABLE - ENERGY STAR	11.28	0.01
Lakeview	Faculty room	1880	1	50	50	94	0.05	4' FIXTURE, 1-F40/T12 LAMP, ENERGY SAVING MAGNETIC BALLAST	1880	1	12	12	22.56	0.01	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	71.44	0.04
Lakeview	Faculty kithcen	1880	2	64	128	240.64	0.13	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	1880	6	9	54	101.52	0.05	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	139.12	0.07
Lakeview	Faculity room	1880	8	64	512	962.56	0.51	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	16	12	192	360.96	0.19	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	601.6	0.32
Lakeview	Mens room	1880	1	50	50	94	0.05	4' FIXTURE, 1-F40/T12 LAMP, ENERGY SAVING MAGNETIC BALLAST	1880	1	12	12	22.56	0.01	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	71.44	0.04
Lakeview	Courage Court	1880	16	64	1024	1925.12	1.02	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	32	12	384	721.92	0.38	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1203.2	0.64
Lakeview	Vice Principal Office	1880	4	64	256	481.28	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	300.8	0.16
Lakeview	Break room	1880	2	96	192	360.96	0.19	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	6	12	72	135.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	225.6	0.12
Lakeview	Room B29	1880	8	96	768	1443.84	0.77	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	24	12	288	541.44	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	902.4	0.48
Lakeview	Staff bathroom	1880	1	64	64	120.32	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	2	12	24	45.12	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	75.2	0.04
Lakeview	Exit hall	1880	2	18	36	67.68	0.04	1 - 18 WATT CFL	1880	2	11	22	41.36	0.02	PL STAB-IN BALLAST BYPASS, HORIZONTAL, G24Q/G24D 11W, 4000K	26.32	0.01
Lakeview	Room B23	1880	3	96	288	541.44	0.29	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	9	12	108	203.04	0.11	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	338.4	0.18
Lakeview	Room B25	1880	9	96	864	1624.32	0.86	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	27	12	324	609.12	0.32	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1015.2	0.54
Lakeview	Room B26	1880	6	96	576	1082.88	0.58	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	18	12	216	406.08	0.22	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	676.8	0.36
Lakeview	B24 Office	1880	2	96	192	360.96	0.19	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	6	12	72	135.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	225.6	0.12
Lakeview	Testing office	1880	3	96	288	541.44	0.29	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	9	12	108	203.04	0.11	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	338.4	0.18
Lakeview	New hallway	2350	3	154	462	1085.7	0.46	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	2350	12	12	144	338.4	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	747.3	0.32
Lakeview	Near courage hall	2350	19	64	1216	2857.6	1.22	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	2350	38	12	456	1071.6	0.46	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1786	0.76
Lakeview	C1	1880	2	64	128	240.64	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	150.4	0.08
Lakeview	C2.1	1880	2	64	128	240.64	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	150.4	0.08
Lakeview	Boys bathroom	1880	1	154	154	289.52	0.15	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	199.28	0.11
Lakeview	Girls bathroom	1880	1	154	154	289.52	0.15	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	199.28	0.11
Lakeview	Girls bathroom	1880	12	32	384	721.92	0.38	*4' FIXTURE, 1-F32/T8 LAMP, ELECTRONIC BALLAST	1880	12	12	144	270.72	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	451.2	0.24
Lakeview	Library	1880	58	64	3712	6978.56	3.71	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	116	12	1392	2616.96	1.39	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	4361.6	2.32
Lakeview	Library	1880	2	18	36	67.68	0.04	1 - 18 WATT CFL	1880	2	11	22	41.36	0.02	PL STAB-IN BALLAST BYPASS, VERTICAL, G24O/G24D 11W, 4000K	26.32	0.01
Lakeview	Library office	1880	2	64	128	240.64	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	4	12	48	90.24	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	150.4	0.08
Lakeview	Work room	1880	4	64	256	481.28	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	300.8	0.16
Lakeview	Storage	1880	2	154	308	579.04	0.31	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	398.56	0.21
Lakeview	Computer room	1880	30	64	1920	3609.6	1.92	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	60	12	720	1353.6	0.72	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2256	1.2
Lakeview	Trailer 1	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Trailer 1	1880	2	154	308	579.04	0.31	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	398.56	0.21
Lakeview	Trailer 1	1880	3	64	192	360.96	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	6	12	72	135.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	225.6	0.12
Lakeview	Trailer 2	1880	9	154	1386	2605.68	1.39	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	36	12	432	812.16	0.43	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1793.52	0.95
Lakeview	Trailer 2	1880	2	154	308	579.04	0.31	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	398.56	0.21
Lakeview	Trailer 2	1880	3	64	192	360.96	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	6	12	72	135.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	225.6	0.12
Lakeview	Trailer 3A	1880	4	64	256	481.28	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	300.8	0.16
Lakeview	Trailer 3B	1880	4	64	256	481.28	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	300.8	0.16
Lakeview	Trailer 4C	1880	5	64	320	601.6	0.32	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	10	12	120	225.6	0.12	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	376	0.2
Lakeview	C-hall	2350	15	64	960	2256	0.96	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	2350	30	12	360	846	0.36	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1410	0.6
Lakeview	Trailer 2	2350	21	18	378	888.3	0.38	1 - 18 WATT CFL	2350	21	9.5	199.5	468.82	0.2	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	419.47	0.18
Lakeview	Communications closet	1880	2	154	308	579.04	0.31	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	398.56	0.21
Lakeview	Classroom 21	1880	18	154	2772	5211.36	2.77	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	72	12	864	1624.32	0.86	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	3587.04	1.91
Lakeview	Classroom C5	1880	18	154	2772	5211.36	2.77	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	72	12	864	1624.32	0.86	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	3587.04	1.91
Lakeview	ST Prep room	1880	4	64	256	481.28	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	300.8	0.16
Lakeview	Classroom C6	1880	18	154	2772	5211.36	2.77	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	72	12	864	1624.32	0.86	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	3587.04	1.91
Lakeview	Classroom C20	1880	8	154	1232	2316.16	1.23	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	32	12	384	721.92	0.38	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1594.24	0.85

Denville Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty

School	Location	Current Hours	Current Qty	Current Watts	Total Current Watts	Current KwH	Current kW	Current Lighting Description	Proposed Hours	Proposed Qty	Proposed Watts	Total Proposed Watts	Proposed KwH	Proposed kW	Proposed Lighting Description	KwH Reduction	kW Reduction
Lakeview	Classroom C19	1880	8	154	1232	2316.16	1.23	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	32	12	384	721.92	0.38	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1594.24	0.85
Lakeview	Classroom C18	1880	8	154	1232	2316.16	1.23	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	32	12	384	721.92	0.38	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1594.24	0.85
Lakeview	Classroom C7	1880	14	154	2156	4053.28	2.16	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	56	12	672	1263.36	0.67	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2789.92	1.48
Lakeview	Classroom C8	1880	14	154	2156	4053.28	2.16	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	56	12	672	1263.36	0.67	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2789.92	1.48
Lakeview	Classroom C9	1880	14	154	2156	4053.28	2.16	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	56	12	672	1263.36	0.67	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2789.92	1.48
Lakeview	Classroom C10	1880	14	154	2156	4053.28	2.16	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	56	12	672	1263.36	0.67	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2789.92	1.48
Lakeview	Classroom C11	1880	14	154	2156	4053.28	2.16	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	56	12	672	1263.36	0.67	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2789.92	1.48
Lakeview	Classroom C12	1880	16	154	2464	4632.32	2.46	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	64	12	768	1443.84	0.77	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	3188.48	1.7
Lakeview	Classroom C13	1880	14	154	2156	4053.28	2.16	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	56	12	672	1263.36	0.67	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2789.92	1.48
Lakeview	Classroom C14	1880	14	154	2156	4053.28	2.16	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	56	12	672	1263.36	0.67	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2789.92	1.48
Lakeview	Classroom C15	1880	14	154	2156	4053.28	2.16	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	56	12	672	1263.36	0.67	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2789.92	1.48
Lakeview	Classrooms C16	1880	14	154	2156	4053.28	2.16	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	56	12	672	1263.36	0.67	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2789.92	1.48
Lakeview	Classroom C17	1880	14	154	2156	4053.28	2.16	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	56	12	672	1263.36	0.67	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	2789.92	1.48
Lakeview	Girls Bathroom	1880	3	64	192	360.96	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	6	12	72	135.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	225.6	0.12
Lakeview	Girls bathroom	1880	2	154	308	579.04	0.31	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	398.56	0.21
Lakeview	Girls bathroom	1880	3	154	462	868.56	0.46	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	12	12	144	270.72	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	597.84	0.32
Lakeview	Girls bathroom	1880	2	154	308	579.04	0.31	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	398.56	0.21
Lakeview	Hall between C wing and new Gym	2350	20	64	1280	3008	1.28	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	2350	40	12	480	1128	0.48	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1880	0.8
Lakeview	Gym	1880	24	465	11160	20980.8	11.16	HIGH PRESSURE SODIUM, 1-400 WATT LAMP	1880	24	240	5760	10828.8	5.76	HH HIGHBAY,240W,24,000 LM,40K,120-277V, MULTI LEVEL,15 AMP 120V TWIST LOCK PLUG (REFLECTOR NOT INCLUDED)	10152	5.4
Lakeview	Gym Office	1880	2	154	308	579.04	0.31	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	1880	8	12	96	180.48	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	398.56	0.21
Lakeview	Gym Storage	1880	7	64	448	842.24	0.45	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	14	12	168	315.84	0.17	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	526.4	0.28
Lakeview	Boys bathroom	1880	3	64	192	360.96	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	6	12	72	135.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	225.6	0.12
Lakeview	Girls Bathroom	1880	3	64	192	360.96	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	6	12	72	135.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	225.6	0.12
Lakeview	Boiler room	470	12	64	768	360.96	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	470	24	12	288	135.36	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	225.6	0.48
Lakeview	Main Office	1880	10	64	640	1203.2	0.64	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	1880	20	12	240	451.2	0.24	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	752	0.4
Lakeview	Lobby	1880	8	80	640	1203.2	0.64	4' FIXTURE, 2-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	1880	16	12	192	360.96	0.19	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	842.24	0.45
Lakeview	Bathroom	1880	4	180	720	1353.6	0.72	INCANDESCENT 3 BULB 60 WATT	1880	12	9.5	114	214.32	0.11	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	1139.28	0.61
Lakeview	Bathrooms	1880	1	120	120	225.6	0.12	2 - 60W A LAMP	1880	2	9.5	19	35.72	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	189.88	0.1
Lakeview	2 ft tube retro kits	1	0	0	0	0	0	0 - N/A	1	28	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (4) SOCKETS)	0	0
Lakeview	2 tube retro kits	1	0	0	0	0	0	0 - N/A	1	575	0	0	0	0	2 LAMP UNIVERSAL TOMBSTONE KIT WITH BALLAST DISCONNECT	0	0
Lakeview	3 tube retro kit	1	0	0	0	0	0	0 - N/A	1	51	0	0	0	0	3 LAMP UNIVERSAL TOMBSTONE KIT WITH BALLAST DISCONNECT	0	0
Lakeview	4 Tube retro	1880	0	0	0	0	0	0 - N/A	1880	533	0	0	0	0	4 LAMP UNIVERSAL TOMBSTONE KIT WITH BALLAST DISCONNECT	0	0
Lakeview	Emergency Tubes	1	0	0	0	0	0	0 - N/A	1	142	14	1988	1.99	1.99	14W 4FT G2 ALL-PLASTIC BALLAST-READY FROSTED 4000K TUBE - DLC LISTED	-1.99	-1.99
Lakeview	Emergency tubes	1	0	0	0	0	0	0 - N/A	1	4	7.5	30	0.03	0.03	7.5W 2FT G2 ALL-PLASTIC BALLAST-READY FROSTED 4000K TUBE	-0.03	-0.03
Lakeview	GYM REFLECTORS	1	0	0	0	0	0	0 - N/A	1	24	0	0	0	0	CREE ALUMINUM REFLECTOR 16"	0	0
Lakeview	GYM WIRE GUARDS	1	0	0	0	0	0	0 - N/A	1	24	0	0	0	0	CREE 16" WIRE GUARD FOR PRISMATIC & ACRYLIC REFLECTOR	0	0
Lakeview	BOYS BATHRM	3228.85	2	154	308	994.48	0.31	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	3228.85	8	12	96	309.97	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	684.52	0.21
Lakeview	GYM ALL P[URPOSE	3228.85	8	295	2360	7620.08	2.36	HIGH PRESSURE SODIUM, 1-250 WATT LAMP	3228.85	8	160	1280	4132.92	1.28	JP HIGHBAY,160W,18,000 LM,50K,120-277V, 0-10V DIMMING (REFLECTOR NOT INCLUDED)	3487.15	1.08
Lakeview	ALL PURPOSE CONES	1880	0	0	0	0	0	0 - N/A	1880	8	0	0	0	0	CREE 16" WIRE GUARD FOR PRISMATIC & ACRYLIC REFLECTOR	0	0
Lakeview	ALL PURPOSE WIRE GUARDS	1880	0	0	0	0	0	0 - N/A	1880	8	0	0	0	0	CREE 16" WIRE GUARD FOR PRISMATIC & ACRYLIC REFLECTOR	0	0
Lakeview	COMM CL 1A EM	3228.85	1	64	64	206.65	0.06	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3228.85	3	7.5	22.5	72.65	0.02	7.5W 2FT G2 ALL-PLASTIC BALLAST-READY FROSTED 4000K TUBE	134	0.04
Lakeview	COMM CL 1A EM	1880	0	0	0	0	0	0 - N/A	1880	1	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (4) SOCKETS)	0	0
Lakeview	A1 TO A2 HALL TO BR	3228.85	1	96	96	309.97	0.1	*4' FIXTURE, 3-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	3	12	36	116.24	0.04	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	193.73	0.06
Lakeview	A3 BR	3228.85	1	64	64	206.65	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	2	12	24	77.49	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	129.15	0.04
Lakeview	A4 BR	3228.85	1	64	64	206.65	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	2	12	24	77.49	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	129.15	0.04
Lakeview	1ST FL GIRLS BR	3228.85	2	60	120	387.46	0.12	A LAMP 60 WATT INCANDESCENT	3228.85	2	9.5	19	61.35	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	326.11	0.1
Lakeview	HALL NEAR COURAGE COURT	3228.85	3	64	192	619.94	0.19	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3228.85	9	9	81	261.54	0.08	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	358.4	0.11
Lakeview	HALL NEAR COURAGE COURT KITS	1880	0	0	0	0	0	0 - N/A	1880	3	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (4) SOCKETS)	0	0
Lakeview	1ST FL FACULTY	3228.85	1	96	96	309.97	0.1	*2' FIXTURE, 3-F32/T8/U3 LAMPS, ELECTRONIC BALLAST	3228.85	4	9	36	116.24	0.04	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	193.73	0.06
Lakeview	1ST FL FACULTY KITS	1880	0	0	0	0	0	0 - N/A	1880	1	0	0	0	0	RETROFIT KIT FOR 2' U-TUBE (INCLUDES (4) SOCKETS)	0	0
Lakeview	A HALL TO NURSE	3228.85	2	64	128	413.29	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	4	12	48	154.98	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	258.31	0.08
Lakeview	1ST FL STAFF BR	3228.85	1	154	154	497.24	0.15	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	3228.85	4	12	48	154.98	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	342.26	0.11
Lakeview	C3	3228.85	30	64	1920	6199.38	1.92	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	60	12	720	2324.77	0.72	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	3874.62	1.2
Lakeview	LIBRARYST	470	2	154	308	144.76	0.31	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	470	8	12	96	45.12	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	99.64	0.21
Lakeview	C2.3	3228.85	4	64	256	826.58	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	8	12	96	309.97	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	516.62	0.16
Lakeview	C2.2	3228.85	2	64	128	413.29	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	4	12	48	154.98	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	258.31	0.08
Lakeview	LIBRARY UPLIGHT	3228.85	8	188	1504	4856.18	1.5	HIGH PRESSURE SODIUM, 1-150 WATT LAMP	3228.85	8	78	624	2014.8	0.62	LPACK WALLPACK 78W TYPE IV WARM LED WHITE - DLC LISTED	2841.38	0.88
Lakeview	LIBRARY	3228.85	74	18	1332	4300.82	1.33	1 - 18 WATT CFL	3228.85	74	11	814	2628.28	0.81	PL STAB-IN BALLAST BYPASS, HORIZONTAL, G24Q/G24D 11W, 4000K	1672.54	0.52
Lakeview	C HALL STAFF BR	3228.85	1	154	154	497.24	0.15	4' FIXTURE, 4-F32/T8/LAMPS, ELEC. HBF BALLAST	3228.85	4	12	48	154.98	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	342.26	0.11
Lakeview	C HALL	3228.85	8	18	144	464.95	0.14	1 - 18 WATT CFL	3228.85	8	11	88	284.14	0.09	PL STAB-IN BALLAST BYPASS, HORIZONTAL, G24Q/G24D 11W, 4000K	180.82	0.06
Lakeview	C5 BR	3228.85	1	56	56	180.82	0.06	2' FIXTURE, 2-F20/T12/STD LAMPS, STANDARD MAGNETIC BALLAST	3228.85	2	9	18	58.12	0.02	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	122.7	0.04
Lakeview	C5 ST	470	1	56	56	26.32	0.06	2' FIXTURE, 2-F20/T12/STD LAMPS, STANDARD MAGNETIC BALLAST	470	2	9	18	8.46	0.02	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	17.86	0.04
Lakeview	C HALL	3228.85	12	64	768	2479.75	0.77	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	24	12	288	929.91	0.29	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1549.85	0.48
Lakeview	C6 ST	470	1	56	56	26.32	0.06	2' FIXTURE, 2-F20/T12/STD LAMPS, STANDARD MAGNETIC BALLAST	470	2	9	18	8.46	0.02	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	17.86	0.04
Lakeview	C6 BR	470	1	56	56	26.32	0.06	2' FIXTURE, 2-F20/T12/STD LAMPS, STANDARD MAGNETIC BALLAST	470	2	9	18	8.46	0.02	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	17.86	0.04
Lakeview	C AREA CLASS ENTRY	3228.85	18	18	324	1046.15	0.32	1 - 18 WATT CFL	3228.85	18	11	198	639.31	0.2	PL STAB-IN BALLAST BYPASS, HORIZONTAL, G24O/G24D 11W, 4000K	406.83	0.13
Lakeview	C GIRLS BR	3228.85	1	64	64	206.65	0.06	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3228.85	3	9	27	87.18	0.03	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	119.47	0.04
Lakeview	C GIRLS TEACHER BR	3228.85	1	64	64	206.65	0.06	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3228.85	3	9	27	87.18	0.03	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	119.47	0.04
Lakeview	C CUST CLOSET	470	1	64	64	30.08	0.06	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	470	3	9	27	12.69	0.03	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	17.39	0.04
Lakeview	C BOYS BR	3228.85	3	64	192	619.94	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	6	12	72	232.48	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	387.46	0.12
Lakeview	C BOYS BR	3228.85	1	64	64	206.65	0.06	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3228.85	3	9	27	87.18	0.03	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	119.47	0.04
Lakeview	C STAFF BR	3228.85	1	64	64	206.65	0.06	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	3228.85	3	9	27	87.18	0.03	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	119.47	0.04
Lakeview	C ST	470	3	64	192	90.24	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	470	6	12	72	33.84	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	56.4	0.12
Lakeview	C HALL	3228.85	4	64	256	826.58	0.26	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	8	12	96	309.97	0.1	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	516.62	0.16
Lakeview	1ST FL CLOSET	470	2	60	120	56.4	0.12	A LAMP 60 WATT INCANDESCENT	470	2	9.5	19	8.93	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	47.47	0.1
Lakeview	HALLS 8-12	3228.85	9	64	576	1859.82	0.58	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	18	12	216	697.43	0.22	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1162.38	0.36
Lakeview	1ST FL BOYS	2350	2	64	128	300.8	0.13	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	2350	4	12	48	112.8	0.05	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	188	0.08
Lakeview	1ST FL BOYS	2350	2	60	120	282	0.12	A LAMP 60 WATT INCANDESCENT	2350	2	9.5	19	44.65	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	237.35	0.1
Lakeview	A 29 HALL	3228.85	1	64	64	206.65	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	2	12	24	77.49	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	129.15	0.04
Lakeview	A 29 CLOSET	470	2	60	120	56.4	0.12	A LAMP 60 WATT INCANDESCENT	470	2	9.5	19	8.93	0.02	LED A19 9.5 WATT, FULLY OMNI G24 BASE, 120V, 4000K, DIMMABLE - ENERGY STAR	47.47	0.1
Lakeview	1ST FL STAFF BR	3228.85	1	64	64	206.65	0.06	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	3228.85	2	12	24	77.49	0.02	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	129.15	0.04
Lakeview	1ST FL CUSTODIAN	470	6	64	384	180.48	0.38	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	470	12	12	144	67.68	0.14	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	112.8	0.24
Lakeview	EM COMMUNICATION A37 CLOSET	470	1	130	130	61.1	0.13	4' FIXTURE, 3-F34/T12 LAMPS, STANDARD MAGNETIC BALLAST	470	3	14	42	19.74	0.04	14W 4FT G2 ALL-PLASTIC BALLAST-READY FROSTED 4000K TUBE - DLC LISTED	41.36	0.09
Lakeview	EXT CANOPY COURTYARD	4380	1	188	188	823.44	0.19	HIGH PRESSURE SODIUM, 1-150 WATT LAMP	4380	1	52	52	227.76	0.05	GARAGE CEILING 52W COOL LED W/ PRISMATIC LENS BILEVEL BRONZE - DLC LISTED	595.68	0.14
Lakeview	MEZZ MECH RM	2350	13	64	832	1955.2	0.83	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	2350	26	12	312	733.2	0.31	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	1222	0.52
Lakeview	B13 COMM CLOSET EM	470	1	64	64	30.08	0.06	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	470	3	7.5	22.5	10.57	0.02	7.5W 2FT G2 ALL-PLASTIC BALLAST-READY FROSTED 4000K TUBE	19.5	0.04
Lakeview	L BR HALL	3228.85	2	56	112	361.63	0.11	2' FIXTURE, 2-F20/T12/STD LAMPS, STANDARD MAGNETIC BALLAST	3228.85	4	9	36	116.24	0.04	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	245.39	0.08
Lakeview	L MENS BR	3228.85	6	56	336	1084.89	0.34	2' FIXTURE, 2-F20/T12/STD LAMPS, STANDARD MAGNETIC BALLAST	3228.85	12	9	108	348.72	0.11	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	736.18	0.23
Lakeview	L GIRLS BR	3228.85	6	56	336	1084.89	0.34	2' FIXTURE, 2-F20/T12/STD LAMPS, STANDARD MAGNETIC BALLAST	3228.85	12	9	108	348.72	0.11	G3 SP 2 FOOT 9W NW MILKY LENS SEP LED TUBE - DLC LISTED	736.18	0.23
Lakeview	EXT WP 150W	4380	7	295	2065	9044.7	2.07	HIGH PRESSURE SODIUM, 1-250 WATT LAMP	4380	7	62	434	1900.92	0.43	SLIM WALLPACK 62W COOL LED 277V PC BRONZE WP3 - DLC LISTED	7143.78	1.63
Lakeview	EXT FLOOD	4380	1	465	465	2036.7	0.47	HIGH PRESSURE SODIUM, 1-400 WATT LAMP	4380	1	150	150	657	0.15	FLEXFLOOD 150W COOL LED SLIPFITTER + 277V PCS BRONZE - DLC LISTED	1379.7	0.32
Lakeview	EXT PAR 38	4380	2	90	180	788.4	0.18	PAR 38 FLOOD 90 WATT	4380	2	18.5	37	162.06	0.04	PAR38, E26 BASE, 18.5 WATT, 120V 25°, 2700K, HIGH CRI, DIMMABLE - ENERGY STAR	626.34	0.14
Lakeview	CANOPY	4380	2	188	376	1646.88	0.38	HIGH PRESSURE SODIUM, 1-150 WATT LAMP	4380	2	52	104	455.52	0.1	GARAGE CEILING 52W COOL LED W/ PRISMATIC LENS BILEVEL BRONZE - DLC LISTED	1191.36	0.27
Lakeview	CANOPY RECESSED	4380	2	100	200	876	0.2	A LAMP 100 WATT INCANDESCENT	4380	2	17	34	148.92	0.03	LED A21 17 WATT, FULLY OMNI E26 BASE, 120V, 2700K, DIMMABLE - ENERGY STAR	727.08	0.17
Lakeview	PARKING LOT	4380	4	465	1860	8146.8	1.86	HIGH PRESSURE SODIUM, 1-400 WATT LAMP	4380	4	150	600	2628	0.6	FLEXFLOOD 150W COOL LED SLIPFITTER + 277V PCS BRONZE - DLC LISTED	5518.8	1.26
Lakeview	SHOEBOX	4380	2	295	590	2584.2	0.59	HIGH PRESSURE SODIUM, 1-250 WATT LAMP	4380	2	78	156	683.28	0.16	ALED78 TYPE IV 8 POLE ARM COOL LED + 277V PC BRONZE - DLC LISTED	1900.92	0.43
Lakeview	EXT WP	4380	10	295	2950	12921	2.95	HIGH PRESSURE SODIUM, 1-250 WATT LAMP	4380	10	150	1500	6570	1.5	LPACK WALLPACK 150W TYPE IV COOL LED + 277V PC BZ - DLC LISTED	6351	1.45
Lakeview	ENTRY 70W	4380	16	70	1120	4905.6	1.12	1-70 WATT MH	4380	16	12	192	840.96	0.19	ENTRA 12W COOL LED 277V PC WALLMOUNT BRONZE - DLC LISTED	4064.64	0.93
Lakeview	FLOOD 400W	4380	2	465	930	4073.4	0.93	HIGH PRESSURE SODIUM, 1-400 WATT LAMP	4380	2	150	300	1314	0.3	FLEXFLOOD 150W COOL LED TRUNNION BRONZE - DLC LISTED	2759.4	0.63
Lakeview	POLE	4380	2	465	930	4073.4	0.93	HIGH PRESSURE SODIUM, 1-400 WATT LAMP	4380	2	150	300	1314	0.3	FLEXFLOOD 150W COOL LED TRUNNION BRONZE - DLC LISTED	2759.4	0.63
Lakeview	TRAILER AREA WALKWAYS	4380	3	64	192	840.96	0.19	*4' FIXTURE, 2-F32/T8 LAMPS, ELECTRONIC BALLAST	4380	6	12	72	315.36	0.07	G4 SP 4 FOOT 12W 4000K FROSTED LENS SEP LED TUBE - DLC LISTED	525.6	0.12
Lakeview	SOCKETS	1880	0	0	0	0	0	0 - N/A	1880	14	0	0	0	0	NON-SHUNTED SOCKET, 600V, 660W	0	0
		Existing:	1461	#######	#######	#######	161.406		New:	5225	3,634.50	57,461.00	121,658.77	57.4608		228,848.38	103.95

Denville Board of Education
Exhibit D
ECM 1B Vending Misers
Vending Mizers

ECM DESCRIPTION

Install vending machines with vending misers, mounted on the respective vending machine.

DATA / ASSUMPTIONS

Cold Drink Run Hour Reduction	34%	
Snack Machine Run Hour Reduction	40%	
Typical Cold Drink Wattage	0.339	Watts
Typical Snack Machine Wattage	0.041	Watts

MEASUREMENT AND VERIFICATION

Option A - The Engineering Calculations are based on 5% of the retrofitted lighting fixtures direct kW measurements and operating hours. The kW Measurements are taken for existing lighting fixtures before removal and for new installed lighting fixtures. Lighting operating hours are agreed by client basis from the audit, logging data, and operating personal input. The occupancy sensors savings are calculated as % of operating hours basebd on logging data and historical statistical data.

COMMISSIONING

Confirm vending miser operation

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	10%

Relatively high safety factor is used for this ECM because of direct measurements are proven over the time and savings are stipulated

CALCULATIONS

Detailed energy savings calculations are in the line-by-line calculation sheet

Denville Board of Education
Exhibit D
ECM 1B Vending Misers
Vending Mizers
*Inputs are blue

Building	Label	Type	Qty	Location
Valleyview Middle School	VM-1-1	Cold Beverage	1	Cafeteria
Valleyview Middle School	VM-1-2	Cold Beverage	1	Faculty Room
Lakeview Elementary School	VM-2-1	Snack	1	Faculty Room
Riverview Elementary School	VM-3-1	Cold Beverage	1	Faculty Room
Riverview Elementary School	VM-4-1	Snack	1	Faculty Room
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
Totals	-	-	5	-

CALCULATION

	Valleyview Middle School	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Riverview Elementary School
Label	VM-1-1	VM-1-2	VM-2-1	VM-3-1	VM-4-1
Type	Cold Beverage	Cold Beverage	Snack	Cold Beverage	Snack
Location	Cafeteria	Faculty Room	Faculty Room	Faculty Room	Faculty Room
Quantity	1	1	1	1	1
Run Hours	8,760	8,760	8,760	8,760	8,760
Existing kWh Consumption	2,970	2,970	359	2,970	359
Proposed kWh Consumption	1,960	1,960	215	1,960	215
Safety Factor	0%	0%	0%	0%	0%
kWh Savings	1,010	1,010	144	1,010	144

Denville Board of Education
Exhibit D
ECM 1C De-stratification Fans
De-stratifcation Fans

ECM DESCRIPTION

Install de-stratification fans in large open ares. Fans will push and hold hot air down to reduce heating losses through the roof and upper section of the outside walls due to reducing the indoor temperature in these sections above the fan.

DATA / ASSUMPTIONS

Heating Hours 3,948 Hours

*Heating efficiency of de-stratification fans assumed at 60%

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify that the installed fans operate. Install clock meter on fans to verify that fans are running 24/7 during heating season

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	0%

Fuel savings recovery factor is conservatively set for 0 for the ECM due to the uncertainity in consistency of temperature difference between room and upper level temperatures, electric penalties recovery factor is at 0.

FORMULA

$W_{TOTAL} = W_{FAN} \cdot q \cdot t_{FAN}$

$Q_{SAVINGS} = Q_{TOTAL} \cdot \mu$

$Q_{TOTAL} = Q_{WALL} + Q_{ROOF} + Q_{WIN}$

$Q_{WALL} = \sum^{60}_{-5} ((T_{OCC} - T_{BIN}) \cdot A_{WALL} \cdot U_{WALL} \cdot t_{OCC)} + ((T_{UNOCC} - T_{BIN}) \cdot A_{WALL} \cdot U_{WALL} \cdot t_{UNOCC})$
$Q_{WIN} = \sum^{60}_{-5} ((T_{OCC} - T_{BIN}) \cdot A_{WIN} \cdot U_{WIN} \cdot t_{OCC)} + ((T_{UNOCC} - T_{BIN}) \cdot A_{WIN} \cdot U_{WIN} \cdot t_{UNOCC})$
$Q_{ROOF} = \sum^{60}_{-5} ((T_{OCC} - T_{BIN}) \cdot A_{ROOF} \cdot U_{ROOF} \cdot t_{OCC)} + ((T_{UNOCC} - T_{BIN}) \cdot A_{ROOF} \cdot U_{ROOF} \cdot t_{UNOCC})$

Variable	Units	Description
$Q_{SAVINGS}$	Therms	Annual thermal savings
$\sum^{60}_{-5}$	-	Summation of all bins from -5°F to 60°F
μ	%	Diversity factor of de-stratification fans (25% - 50%)
Q_{TOTAL}	btu	Total heat loss
Q_{WALL}	btu	Heat loss through wall (above de-stratification fan)
Q_{ROOF}	btu	Heat loss through roof
Q_{WIN}	btu	Heat loss through windows (above de-stratification fan)
T_{BIN}	°F	Temperature of respective bin
T_{OCC}	°F	Existing temperature of space during occupied hours
T_{UNOCC}	°F	Existing temperature of space during unoccupied hours
t_{OCC}	Hrs	Occupied Bin Hours in respective temperature bin
t_{UNOCC}	Hrs	Unoccupied Bin Hours in respective temperature bin
A_{WALL}	ft^2	Exposed wall area adove de-stratification fan
A_{ROOF}	ft^2	Exposed roof area adove de-stratification fan
A_{WINDOW}	ft^2	Exposed window area adove de-stratification fan
U_{WALL}	btu / ft^2 / °F	U-factor of wall
U_{ROOF}	btu / ft^2 / °F	U-factor of roof
U_{WIN}	btu / ft^2 / °F	U-factor of windows
W_{TOTAL}	kWh	Annual electrical consumption of fans
q	-	Quantity of fans
W_{FAN}	kW	Input kW of fan
t_{FAN}	Hrs	Annual run time of de-stratification fan (annual heating hours)

Denville Board of Education
Exhibit D
ECM 1C De-stratification Fans
De-stratifcation Fans

ASSUMPTIONS / DATA

* Inputs are in blue

Building	Location	Wall Length Perimeter (ft)	Wall Width Perimeter (ft)	Ceiling Height (ft)	Exposed Wall Height above Fan (ft)	Ceiling Type	Roof Area (ft^2)	Window Area (ft^2 - above Fan)	Roof U-Factor	Window U-Factor	Wall U-Factor
Valleyview Middle School	Cafeteria	70	37	11	-	Drop	2,590		0.28	0.60	0.22
Valleyview Middle School	Gym	94	64	21	3.0	I-Beam	6,016	600	0.28	0.60	0.22
Lakeview Elementary School	Multipurpose Room	70	44	18	-	Drop	3,045		0.28	0.60	0.22
Lakeview Elementary School	Cafeteria	60	58	14	3.0	I-Beam	3,480		0.28	0.60	0.22
Lakeview Elementary School	Gym	80	70	20	-	Drop	5,600	240	0.28	0.60	0.22
Riverview Elementary School	Gym	80	70	20	-	Drop	5,600	180	0.28	0.60	0.22
Riverview Elementary School	Multipurpose Room	66	57	15	-	Drop	3,762		0.28	0.60	0.22
Totals											

CALCULATIONS

	Valleyview Middle School	Valleyview Middle School	Lakeview Elementary School	Lakeview Elementary School	Lakeview Elementary School	Riverview Elementary School	Riverview Elementary School
Location #1	Cafeteria	Gym	Multipurpose Room	Cafeteria	Gym	Gym	Multipurpose Room
Wall Length	70	94	70	60	80	80	66
Wall Width	37	64	44	58	70	70	57
Wall Height Above Fan	-	3.0	-	3.0	-	-	-
Roof Area	2,590	6,016	3,045	3,480	5,600	5,600	3,762
Window Area	-	600	-	-	240	180	-
Wall Exposed Area	-	(126)	-	354	(240)	(180)	-
Roof U-Factor	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Window U-Factor	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Wall U-Factor	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Fan Model	Air Pear 10	Air Pear 25	Air Pear 15	Air Pear 15	Air Pear 25	Air Pear 25	Air Pear 15
Total run hours	3,948	3,948	3,948	3,948	3,948	3,948	3,948
Fan Input watts	15	35	17	17	35	35	17
kwh consumed by fan	59	138	67	67	138	138	67
SF per Fan	500	1,200	800	800	1,200	1,200	800
Total Fans	5	6	4	4	5	6	6
Total Kwh Consumed	296	829	268	268	691	829	403
Existing Occupied Heating Setpoint	74.0	74.0	74.0	74	74	74	74
Existing Unoccup. Heating Setpoint	70.0	70.0	70.0	70	70	70	70
Diversity Factor	50%	50%	50%	50%	50%	50%	50%
Boiler Efficiency	89.0%	89.0%	77.0%	77.0%	77.0%	73.7%	73.7%
Additional Electric Usage	(296)	(829)	(268)	(268)	(691)	(829)	(403)
Calculated Fuel Savings Therms	578	1,608	748	923	1,456	1,501	966
Safety Factor Electric	0%	0%	0%	0%	0%	0%	0%
Safety Factor Thermal	0%	0%	0%	0%	0%	0%	0%
Additional Electric usage	(296)	(829)	(268)	(268)	(691)	(829)	(403)
Calculated Fuel Savings	578	1,608	748	923	1,456	1,501	966

VALLEYVIEW MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	btu/ft^2/°F	btu/ft^2/°F	btu/ft^2/°F	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	315	12	-	2,590	0	0.22	0.28	0.60	-	3,877,644	-	3,877,644
50 to 55	52.5	109	182	172	463	442	22	-	2,590	0	0.22	0.28	0.60	-	7,156,636	-	7,156,636
45 to 50	47.5	105	119	142	366	348	18	-	2,590	0	0.22	0.28	0.60	-	6,982,226	-	6,982,226
40 to 45	42.5	185	155	177	517	495	22	-	2,590	0	0.22	0.28	0.60	-	11,746,064	-	11,746,064
35 to 40	37.5	236	200	241	677	647	30	-	2,590	0	0.22	0.28	0.60	-	17,832,668	-	17,832,668
30 to 35	32.5	237	202	198	637	612	25	-	2,590	0	0.22	0.28	0.60	-	19,099,230	-	19,099,230
25 to 30	27.5	121	115	113	349	335	14	-	2,590	0	0.22	0.28	0.60	-	11,727,934	-	11,727,934
20 to 25	22.5	149	68	97	314	302	12	-	2,590	0	0.22	0.28	0.60	-	11,692,037	-	11,692,037
15 to 20	17.5	95	40	46	181	175	6	-	2,590	0	0.22	0.28	0.60	-	7,399,578	-	7,399,578
10 to 15	12.5	39	9	28	76	73	4	-	2,590	0	0.22	0.28	0.60	-	3,379,432	-	3,379,432
5 to 10	7.5	21	5	5	31	30	1	-	2,590	0	0.22	0.28	0.60	-	1,493,187	-	1,493,187
0 to 5	2.5	4	2	-	6	6	-	-	2,590	0	0.22	0.28	0.60	-	311,111	-	311,111
-5 to 0	-2.5	4	-	-	4	4	-	-	2,590	0	0.22	0.28	0.60	-	221,911	-	221,911
-10 to -5	-7.5	-	-	-	-	-	-	-	2,590	0	0.22	0.28	0.60	-	-	-	-
-15 to -10	-12.5	-	-	-	-	-	-	-	2,590	0	0.22	0.28	0.60	-	-	-	-
Total		1,391	1,241	1,316	3,948	3,784	165							-	102,919,659	-	102,919,659

Denville Board of Education
Exhibit D
ECM 1C De-stratification Fans
De-stratifcation Fans

VALLEYVIEW MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	btu/ft^2/°F	btu/ft^2/°F	btu/ft^2/°F	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	315	12	(126)	6,016	600	0.22	0.28	0.60	(148,219)	9,006,915	1,924,920	10,783,616
50 to 55	52.5	109	182	172	463	442	22	(126)	6,016	600	0.22	0.28	0.60	(273,555)	16,623,291	3,552,660	19,902,396
45 to 50	47.5	105	119	142	366	348	18	(126)	6,016	600	0.22	0.28	0.60	(266,888)	16,218,173	3,466,080	19,417,365
40 to 45	42.5	185	155	177	517	495	22	(126)	6,016	600	0.22	0.28	0.60	(448,981)	27,283,523	5,830,920	32,665,462
35 to 40	37.5	236	200	241	677	647	30	(126)	6,016	600	0.22	0.28	0.60	(681,635)	41,421,363	8,852,400	49,592,128
30 to 35	32.5	237	202	198	637	612	25	(126)	6,016	600	0.22	0.28	0.60	(730,048)	44,363,308	9,481,140	53,114,400
25 to 30	27.5	121	115	113	349	335	14	(126)	6,016	600	0.22	0.28	0.60	(448,288)	27,241,411	5,821,920	32,615,043
20 to 25	22.5	149	68	97	314	302	12	(126)	6,016	600	0.22	0.28	0.60	(446,916)	27,158,029	5,804,100	32,515,213
15 to 20	17.5	95	40	46	181	175	6	(126)	6,016	600	0.22	0.28	0.60	(282,841)	17,187,592	3,673,260	20,578,011
10 to 15	12.5	39	9	28	76	73	4	(126)	6,016	600	0.22	0.28	0.60	(129,175)	7,849,677	1,677,600	9,398,102
5 to 10	7.5	21	5	5	31	30	1	(126)	6,016	600	0.22	0.28	0.60	(57,075)	3,468,344	741,240	4,152,509
0 to 5	2.5	4	2	-	6	6	-	(126)	6,016	600	0.22	0.28	0.60	(11,892)	722,642	154,440	865,190
-5 to 0	-2.5	4	-	-	4	4	-	(126)	6,016	600	0.22	0.28	0.60	(8,482)	515,451	110,160	617,129
-10 to -5	-7.5	-	-	-	-	-	-	(126)	6,016	600	0.22	0.28	0.60	-	-	-	-
-15 to -10	-12.5	-	-	-	-	-	-	(126)	6,016	600	0.22	0.28	0.60	-	-	-	-
Total		1,391	1,241	1,316	3,948	3,784	165							(3,933,995)	239,059,717	51,090,840	286,216,562

LAKEVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	btu/ft^2/°F	btu/ft^2/°F	btu/ft^2/°F	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	201	127	-	3,045	0	0.22	0.28	0.60	-	4,168,788	-	4,168,788
50 to 55	52.5	109	182	172	463	266	197	-	3,045	0	0.22	0.28	0.60	-	7,814,932	-	7,814,932
45 to 50	47.5	105	119	142	366	194	172	-	3,045	0	0.22	0.28	0.60	-	7,682,352	-	7,682,352
40 to 45	42.5	185	155	177	517	269	248	-	3,045	0	0.22	0.28	0.60	-	13,037,959	-	13,037,959
35 to 40	37.5	236	200	241	677	349	328	-	3,045	0	0.22	0.28	0.60	-	19,948,709	-	19,948,709
30 to 35	32.5	237	202	198	637	340	297	-	3,045	0	0.22	0.28	0.60	-	21,527,297	-	21,527,297
25 to 30	27.5	121	115	113	349	189	160	-	3,045	0	0.22	0.28	0.60	-	13,289,476	-	13,289,476
20 to 25	22.5	149	68	97	314	148	166	-	3,045	0	0.22	0.28	0.60	-	13,221,695	-	13,221,695
15 to 20	17.5	95	40	46	181	87	94	-	3,045	0	0.22	0.28	0.60	-	8,398,963	-	8,398,963
10 to 15	12.5	39	9	28	76	31	45	-	3,045	0	0.22	0.28	0.60	-	3,830,306	-	3,830,306
5 to 10	7.5	21	5	5	31	14	17	-	3,045	0	0.22	0.28	0.60	-	1,700,084	-	1,700,084
0 to 5	2.5	4	2	-	6	4	3	-	3,045	0	0.22	0.28	0.60	-	357,239	-	357,239
-5 to 0	-2.5	4	-	-	4	2	3	-	3,045	0	0.22	0.28	0.60	-	252,370	-	252,370
-10 to -5	-7.5	-	-	-	-	-	-	-	3,045	0	0.22	0.28	0.60	-	-	-	-
-15 to -10	-12.5	-	-	-	-	-	-	-	3,045	0	0.22	0.28	0.60	-	-	-	-
Total		1,391	1,241	1,316	3,948	2,092	1,856							-	115,230,169	-	115,230,169

LAKEVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	btu/ft^2/°F	btu/ft^2/°F	btu/ft^2/°F	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	201	127	354	3,480	0	0.22	0.28	0.60	380,794	4,764,329	-	5,145,123
50 to 55	52.5	109	182	172	463	266	197	354	3,480	0	0.22	0.28	0.60	713,848	8,931,350	-	9,645,198
45 to 50	47.5	105	119	142	366	194	172	354	3,480	0	0.22	0.28	0.60	701,738	8,779,831	-	9,481,569
40 to 45	42.5	185	155	177	517	269	248	354	3,480	0	0.22	0.28	0.60	1,190,941	14,900,525	-	16,091,466
35 to 40	37.5	236	200	241	677	349	328	354	3,480	0	0.22	0.28	0.60	1,822,197	22,798,524	-	24,620,721
30 to 35	32.5	237	202	198	637	340	297	354	3,480	0	0.22	0.28	0.60	1,966,392	24,602,626	-	26,569,018
25 to 30	27.5	121	115	113	349	189	160	354	3,480	0	0.22	0.28	0.60	1,213,916	15,187,973	-	16,401,888
20 to 25	22.5	149	68	97	314	148	166	354	3,480	0	0.22	0.28	0.60	1,207,724	15,110,508	-	16,318,232
15 to 20	17.5	95	40	46	181	87	94	354	3,480	0	0.22	0.28	0.60	767,196	9,598,814	-	10,366,010
10 to 15	12.5	39	9	28	76	31	45	354	3,480	0	0.22	0.28	0.60	349,876	4,377,492	-	4,727,368
5 to 10	7.5	21	5	5	31	14	17	354	3,480	0	0.22	0.28	0.60	155,293	1,942,954	-	2,098,246
0 to 5	2.5	4	2	-	6	4	3	354	3,480	0	0.22	0.28	0.60	32,632	408,274	-	440,905
-5 to 0	-2.5	4	-	-	4	2	3	354	3,480	0	0.22	0.28	0.60	23,052	288,422	-	311,475
-10 to -5	-7.5	-	-	-	-	-	-	354	3,480	0	0.22	0.28	0.60	-	-	-	-
-15 to -10	-12.5	-	-	-	-	-	-	354	3,480	0	0.22	0.28	0.60	-	-	-	-
Total		1,391	1,241	1,316	3,948	2,092	1,856							10,525,599	131,691,622	-	142,217,220

Denville Board of Education
Exhibit D
ECM 1C De-stratification Fans
De-stratifcation Fans

LAKEVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	btu/ft^2/°F	btu/ft^2/°F	btu/ft^2/°F	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	201	127	(240)	5,600	240	0.22	0.28	0.60	(258,166)	7,666,736	704,088	8,112,658
50 to 55	52.5	109	182	172	463	266	197	(240)	5,600	240	0.22	0.28	0.60	(483,965)	14,372,288	1,319,904	15,208,227
45 to 50	47.5	105	119	142	366	194	172	(240)	5,600	240	0.22	0.28	0.60	(475,754)	14,128,464	1,297,512	14,950,222
40 to 45	42.5	185	155	177	517	269	248	(240)	5,600	240	0.22	0.28	0.60	(807,418)	23,977,856	2,202,048	25,372,486
35 to 40	37.5	236	200	241	677	349	328	(240)	5,600	240	0.22	0.28	0.60	(1,235,388)	36,687,280	3,369,240	38,821,132
30 to 35	32.5	237	202	198	637	340	297	(240)	5,600	240	0.22	0.28	0.60	(1,333,147)	39,590,432	3,635,856	41,893,141
25 to 30	27.5	121	115	113	349	189	160	(240)	5,600	240	0.22	0.28	0.60	(822,994)	24,440,416	2,244,528	25,861,950
20 to 25	22.5	149	68	97	314	148	166	(240)	5,600	240	0.22	0.28	0.60	(818,796)	24,315,760	2,233,080	25,730,044
15 to 20	17.5	95	40	46	181	87	94	(240)	5,600	240	0.22	0.28	0.60	(520,133)	15,446,368	1,418,544	16,344,779
10 to 15	12.5	39	9	28	76	31	45	(240)	5,600	240	0.22	0.28	0.60	(237,204)	7,044,240	646,920	7,453,956
5 to 10	7.5	21	5	5	31	14	17	(240)	5,600	240	0.22	0.28	0.60	(105,283)	3,126,592	287,136	3,308,445
0 to 5	2.5	4	2	-	6	4	3	(240)	5,600	240	0.22	0.28	0.60	(22,123)	656,992	60,336	695,205
-5 to 0	-2.5	4	-	-	4	2	3	(240)	5,600	240	0.22	0.28	0.60	(15,629)	464,128	42,624	491,123
-10 to -5	-7.5	-	-	-	-	-	-	(240)	5,600	240	0.22	0.28	0.60	-	-	-	-
-15 to -10	-12.5	-	-	-	-	-	-	(240)	5,600	240	0.22	0.28	0.60	-	-	-	-
Total		1,391	1,241	1,316	3,948	2,092	1,856							(7,135,999)	211,917,552	19,461,816	224,243,369

RIVERVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	btu/ft^2/°F	btu/ft^2/°F	btu/ft^2/°F	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	201	127	(180)	5,600	180	0.22	0.28	0.60	(193,624)	7,666,736	528,066	8,001,178
50 to 55	52.5	109	182	172	463	266	197	(180)	5,600	180	0.22	0.28	0.60	(362,974)	14,372,288	989,928	14,999,242
45 to 50	47.5	105	119	142	366	194	172	(180)	5,600	180	0.22	0.28	0.60	(356,816)	14,128,464	973,134	14,744,782
40 to 45	42.5	185	155	177	517	269	248	(180)	5,600	180	0.22	0.28	0.60	(605,563)	23,977,856	1,651,536	25,023,829
35 to 40	37.5	236	200	241	677	349	328	(180)	5,600	180	0.22	0.28	0.60	(926,541)	36,687,280	2,526,930	38,287,669
30 to 35	32.5	237	202	198	637	340	297	(180)	5,600	180	0.22	0.28	0.60	(999,860)	39,590,432	2,726,892	41,317,464
25 to 30	27.5	121	115	113	349	189	160	(180)	5,600	180	0.22	0.28	0.60	(617,245)	24,440,416	1,683,396	25,506,567
20 to 25	22.5	149	68	97	314	148	166	(180)	5,600	180	0.22	0.28	0.60	(614,097)	24,315,760	1,674,810	25,376,473
15 to 20	17.5	95	40	46	181	87	94	(180)	5,600	180	0.22	0.28	0.60	(390,100)	15,446,368	1,063,908	16,120,176
10 to 15	12.5	39	9	28	76	31	45	(180)	5,600	180	0.22	0.28	0.60	(177,903)	7,044,240	485,190	7,351,527
5 to 10	7.5	21	5	5	31	14	17	(180)	5,600	180	0.22	0.28	0.60	(78,962)	3,126,592	215,352	3,262,982
0 to 5	2.5	4	2	-	6	4	3	(180)	5,600	180	0.22	0.28	0.60	(16,592)	656,992	45,252	685,652
-5 to 0	-2.5	4	-	-	4	2	3	(180)	5,600	180	0.22	0.28	0.60	(11,722)	464,128	31,968	484,374
-10 to -5	-7.5	-	-	-	-	-	-	(180)	5,600	180	0.22	0.28	0.60	-	-	-	-
-15 to -10	-12.5	-	-	-	-	-	-	(180)	5,600	180	0.22	0.28	0.60	-	-	-	-
Total		1,391	1,241	1,316	3,948	2,092	1,856							(5,351,999)	211,917,552	14,596,362	221,161,915

RIVERVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	btu/ft^2/°F	btu/ft^2/°F	btu/ft^2/°F	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	201	127	-	3,762	0	0.22	0.28	0.60	-	5,150,404	-	5,150,404
50 to 55	52.5	109	182	172	463	266	197	-	3,762	0	0.22	0.28	0.60	-	9,655,098	-	9,655,098
45 to 50	47.5	105	119	142	366	194	172	-	3,762	0	0.22	0.28	0.60	-	9,491,300	-	9,491,300
40 to 45	42.5	185	155	177	517	269	248	-	3,762	0	0.22	0.28	0.60	-	16,107,981	-	16,107,981
35 to 40	37.5	236	200	241	677	349	328	-	3,762	0	0.22	0.28	0.60	-	24,645,991	-	24,645,991
30 to 35	32.5	237	202	198	637	340	297	-	3,762	0	0.22	0.28	0.60	-	26,596,287	-	26,596,287
25 to 30	27.5	121	115	113	349	189	160	-	3,762	0	0.22	0.28	0.60	-	16,418,722	-	16,418,722
20 to 25	22.5	149	68	97	314	148	166	-	3,762	0	0.22	0.28	0.60	-	16,334,980	-	16,334,980
15 to 20	17.5	95	40	46	181	87	94	-	3,762	0	0.22	0.28	0.60	-	10,376,649	-	10,376,649
10 to 15	12.5	39	9	28	76	31	45	-	3,762	0	0.22	0.28	0.60	-	4,732,220	-	4,732,220
5 to 10	7.5	21	5	5	31	14	17	-	3,762	0	0.22	0.28	0.60	-	2,100,400	-	2,100,400
0 to 5	2.5	4	2	-	6	4	3	-	3,762	0	0.22	0.28	0.60	-	441,358	-	441,358
-5 to 0	-2.5	4	-	-	4	2	3	-	3,762	0	0.22	0.28	0.60	-	311,795	-	311,795
-10 to -5	-7.5	-	-	-	-	-	-	-	3,762	0	0.22	0.28	0.60	-	-	-	-
-15 to -10	-12.5	-	-	-	-	-	-	-	3,762	0	0.22	0.28	0.60	-	-	-	-
Total		1,391	1,241	1,316	3,948	2,092	1,856							-	142,363,184	-	142,363,184

Denville Board of Education
Exhibit D
ECM 1D Plug Load Management
Smart Strips and Smart Board Projectors

ECM DESCRIPTION

Install BERT plug load management plug on the various plug loads throughout the district. Integrate equipment onto a central wifi network to schedule these pieces of equipment

DATA / ASSUMPTIONS

Electrical Power Draw When OFF		
Classroom Amplifiers (Front Row)	21	W
Soda Machines	350	W
H/C Water Dispenser	50	W
Lab Monitors Combo	12	W
Laptop Charging Carts	35	W
Large Printer/Copiers	60	W
Medium Printer/Copiers	25	W
Netbook Charging Stations	50	W
Printer/Monitor Combo	20	W
Projector	10	W
Small Printers	10	W
Smartboard (plug-in)	8	W
Smartboard/Projector Combo	18	W
Snack Machines	50	W
Televisions	20	W
AC Units 220 (INLINE)	0	W
AC Units 110 15A	0	W
Water Fountains (outside plug)	7	W

Annual Savings for smart strips and smart board projectors are based on logging results for the various pieces of equipment

MEASUREMENT AND VERIFICATION

Option A - The engineering calculations are based on direct kW measurements over a defined time period of the existing plug load and post BERT device. A population will be measured before the switch to the BERT devices to determine a baseline usage during a defined time period.

COMMISSIONING

Review installation and network integration with the IT department

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) = **0%**

The safety factor for this ECM is taken at 0 due to conservative run hours based on data logging results.

FORMULAE

$W_{TOTAL} = (W_{STRIPS} \cdot Strips_{\#}) + (W_{PROJECTORS} \cdot Projectors_{\#})$

Variable	Units	Description
W_{TOTAL}	kWh	Total Electrical Savings associated with this measure
W_{STRIPS}	kWh	Electrical Savings associated with smart strips
$W_{PROJECTORS}$	kWh	Electrical Savings associated with smart boards projectors
$Strips_{\#}$	-	Numbers of Electrical Strips
$Projectors_{\#}$	-	Numbers of Projectors

Denville Board of Education
Exhibit D
ECM 1D Plug Load Management
Smart Strips and Smart Board Projectors

* Inputs are in blue

Building	Classroom Amplifiers (Front Row)	Soda Machines	H/C Water Dispenser	Lab Monitors Combo	Laptop Charging Carts	Large Printer/Copiers	Medium Printer/Copiers	Netbook Charging Stations	Printer/Monitor Combo	Projector	Small Printers	Smartboard (plug-in)	Smartboard/Projector Combo	Snack Machines	Televisions	AC Units 220 (INLINE)	AC Units 110 15A	Water Fountains (outside plug)
Lakeview Elementary School	20		1	30	6	2	7		3				35		5			
Riverview Elementary School	20		1	24	10	2	6			30	2	27	1		3	1	12	
Valleyview Middle School	19		1	18	6	1	5	4	13	34	4	1	2		27	6	22	5
Totals	59	-	3	72	22	5	18	4	16	64	6	28	38	-	35	7	34	5

CALCULATIONS

		Lakeview Elementary School	Riverview Elementary School	Valleyview Middle School
1				
2	Classroom Amplifiers (Front Row)	20	20	19
3	Soda Machines	-	-	-
4	H/C Water Dispenser	1	1	1
5	Lab Monitors Combo	30	24	18
6	Laptop Charging Carts	6	10	6
7	Large Printer/Copiers	2	2	1
8	Medium Printer/Copiers	7	6	5
9	Netbook Charging Stations	-	-	4
10	Printer/Monitor Combo	3	-	13
11	Projector	-	30	34
12	Small Printers	-	2	4
13	Smartboard (plug-in)	-	27	1
14	Smartboard/Projector Combo	35	1	2
15	Snack Machines	-	-	-
16	Televisions	5	3	27
17	AC Units 220 (INLINE)	-	1	6
18	AC Units 110 15A	-	12	22
19	Water Fountains (outside plug)	-	-	5
20	Total Devices	109	139	168
21	Total BERTs	89	123	168
22	kW Electrical Draw	1.950	1.842	2.294
23	Unoccupied Hours / Day	16	16	17
24	Unoccupied Hours / Yr	5,699	5,761	6,188
25	kWh Savings	11,114	10,613	14,195
26	Safety Factor	0%	0%	0%
27	kWh Savings	11,114	10,613	14,195

Denville Board of Education
Exhibit D
ECM 2A Boiler Replacements
Boiler Replacement Calculation

ECM DESCRIPTION

Replace boilers in respective buildings with new high efficiency condensing boilers

DATA / ASSUMPTIONS

Typical Condensing Boiler Seasonal Efficiency =	**91.0%**	
Heating Hours	3,948	Hours

* Utility baseline reduced by 10.5% to account for domestic hot water, science labs, and kitchen usage
* An adjusted baseline is used for the boiler baseline usage as to not double-dip on savings

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify all functions of the boiler control system, safety and operation. Verify air/fuel ratio is consistent through firing range. Provide training of the boiler operators

RECOVERY/SAFETY FACTOR

Safety Factor (Thermal) = **0%**

A safety factor of 0 is used due to minimal variables and the proven results of this measure

FORMULAE

$Q_{savings} = ((\eta_{NEW} - \eta_{OLD}) / \eta_{NEW}) \cdot Fuel_{ADJ}$

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
η_{NEW}	**%**	Efficiency of New Boiler
η_{OLD}	**%**	Efficiency of Old Boiler
$Fuel_{ADJ}$	Therms	Adjusted Boiler Fuel Usage

Denville Board of Education
Exhibit D
ECM 2A Boiler Replacements
Boiler Replacement Calculation

*Inputs are blue

Building	Label	Boilers to be Replaced
Lakeview Elementary School	BLR-2-2	2
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
Totals		**2**

CALCULATIONS

	Lakeview Elementary School
Label	BLR-2-2
No. of Units to be Replaced	2
Fuel Switch	N
Existing Fuel	Natural Gas
Proposed Fuel	Natural Gas
Current Boiler Efficiency	77.0%
Proposed Boiler Efficiency	91.0%
Improvement in Boiler Efficiency	14.0%
Annual Boiler Fuel Use	15,855
Adjusted Boiler Usage	15,855
Percentage of Building Load	33%
Safety Factor	**0%**
Natural Gas Savings	2,439
Fuel Oil #2 Savings	-
Fuel Oil #4 Savings	-
Fuel Oil #6 Savings	-
Propane Savings	-

Denville Board of Education
Exhibit D
ECM 2A Boiler Replacements
Boiler Replacement Calculation

Notes:
Replacing the existing boiler with a new, high efficiency unit will reduce operating costs at this location.
Improving the air/fuel ratio will increase overall boiler combustion efficiency.
Note that the boiler efficiency discussed here is the overall boiler thermal efficiency, not just its combustion efficiency. The value of this number will be much lower than for combustion efficiency alone as it includes losses from radiation, blowdown, and other related losses. The value for annual boiler fuel has been adjusted for the effect of other ECMs.
New Non -Condensing Boilers will be Equiped with Control Links

Denville Board of Education
Exhibit D5
ECM 2B Boiler Burner Controls
Burner ControLinks

ECM DESCRIPTION

Install burner controls on existing burners which optimize fuel to air ratio instantaneously

DATA / ASSUMPTIONS

Heating Hours	3,948	Hours
Controlinks improvement in boiler efficiency:	5.0%	
Intellidyne improvement in boiler efficiency:	4.0%	

* Utility baseline reduced by 10.5% to account for domestic hot water, science labs, and kitchen usage
* An adjusted baseline is used for the boiler baseline usage as to not double-dip on savings

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify all functions of the boiler control system, safety and operation. Verify air/fuel ratio is consistent through firing range. Provide training of the boiler operators

RECOVERY/SAFETY FACTOR

Safety Factor (Thermal) = 0%

There is no safety factor as improvement in efficiency is conservative

FORMULAE

$Q_{savings} = (\eta_{BOILER} / (\eta_{BOILER} + \eta_{IMP})) \cdot Fuel_{ADJ}$

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
η_{BOILER}	%	Efficiency of Existing Boiler
η_{IMP}	%	Improvement in Efficiency
$Fuel_{ADJ}$	Therms	Adjusted Boiler Fuel Usage

Denville Board of Education
Exhibit D5
ECM 2B Boiler Burner Controls
Burner ControLinks

*Inputs are blue

Building	Label	Units to be Installed	Burner Upgrade Type	Fuel Type
Riverview Elementary School	BLR-3-1	3	**Control Links**	**Natural Gas**
-	-	-		
-	-	-		
Totals		**3**		

CALCULATIONS

	Riverview Elementary School
Label	BLR-3-1
No. of Units to be Installed	3
Burner Upgrade	Control Links
Fuel Type	Natural Gas
Current Boiler Efficiency	73.7%
Improvement in Boiler Efficiency	5%
Percentage of Load	100.0%
Annual Boiler Fuel Use	37,172
Adjusted Boiler Usage	37,172
Safety Factor	**0%**
Annual Energy Savings	2,362

Notes:
Replacing the existing boiler with a new, high efficiency unit will reduce operating costs at this location.
Improving the air/fuel ratio will increase overall boiler combustion efficiency.
New Boiler will be Natural Gas
Note that the boiler efficiency discussed here is the overall boiler thermal efficiency, not just its combustion efficiency. The value of this number will be much lower than for combustion efficiency alone as it includes losses from radiation, blowdown, and other related losses. The value for annual boiler fuel has been adjusted for the effect of other ECMs.
New Non -Condensing Boilers will be Equiped with Control Links

Denville Board of Education
Exhibit D
ECM 2D Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

ECM DESCRIPTION

There are standard efficiency motors and motors that need to be replaced due to poor condition throughout the district. These motors will be replaced with premium high efficiency motors to save electrical energy. In addition some new motors will be equipped with variable frequency drives (VFDs) for additional savings.

DATA / ASSUMPTIONS

Load Factor	**Varies by Building**

*VFD run speed percentages are based on typical VFD curves for hot water / chilled water loops
*Run hours are based on the audit, data logging, and through interviews with facility staff

MEASUREMENT AND VERIFICATION

Option A - The engineering calculations are based on direct kW measurements of the existing and installed motors and operating hours. All existing motors will be measured before removal and new motors after the installation. VFD kW will be measured through the load range and selected motors with VFDs will be monitored for the time period using kW loggers. Equipment operating hours are based on the audit, logging and operating personnel input.

COMMISSIONING

Review installation documents for alignments and vibrations. Start up equipment and measure vibration through the load range along with motor kW. Verify that VFDs are capable of operating in full design range upon the control signal demand.

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	**0%**

The safety factor for this ECM is taken at 0 due to some unknown data such as actual existing motor kW loads and operation hours.

Denville Board of Education
Exhibit D
ECM 2D Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

FORMULAE

VFD

$W_{SAVINGSVFD} = W_{PROPOSED} - W_{VFD}$

$W_{VFD} = \sum^{60}_{0} Hp \cdot Lf \cdot \eta \cdot f^{\wedge 2.8} \cdot t_f$

MOTOR

$W_{SAVINGS} = W_{EXISTING} - W_{PROPOSED}$

$W_{EXISTING} = Hp \cdot Lf \cdot \eta \cdot t$
$W_{PROPOSED} = Hp \cdot Lf \cdot \eta \cdot t$

Variable	Units	Description
$W_{savingsVFD}$	kWh	Electrical Savings associated with VFD
$W_{savings}$	kWh	Electrical Savings for Motor Replacement
Hp	HP	Horsepower of motor
t	Hrs	Existing Run Hours
t	Hrs	Proposed Run Hours
Lf	-	Load Factor of motor
η	-	Existing efficiency of motor
η	-	Proposed efficiency of motor
$\sum^{60}_{0}$	-	Summation of all frequences (0 Hz to 60 Hz)
f	-	Frequency of drive, as a percentage of full frequency (60 Hz)
t_f	Hrs	Percentage of time motor will run at a particular frequency
W_{VFD}	kWh	Electrical consumption with VFD
$W_{EXISTING}$	kWh	Existing electrical consumption of motor
$W_{PROPOSED}$	kWh	Proposed electrical consumption of motor

Denville Board of Education
Exhibit D
ECM 2D Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

ASSUMPTIONS / INPUTS

* Inputs are in blue

Building	Equipment Label	Configuration	Qty	HP	Existing Efficiency	Replace Motor	Add VFD
Lakeview Elementary School	LV-P-1	Primary/Standby	1	7.5	89.5%	Y	Y
Lakeview Elementary School	LV-P-2	Primary/Standby	1	7.5	89.5%	Y	Y
Lakeview Elementary School	LV-P-3	Primary/Standby	1	7.5	89.5%	Y	Y
Lakeview Elementary School	LV-P-4	Primary/Standby	1	7.5	89.5%	Y	Y
Riverview Elementary School	RV-P-1	Primary/Standby	1	3.0	87.5%	Y	Y
Riverview Elementary School	RV-P-2	Primary/Standby	1	3	87.5%	Y	Y
-	-	-	-	-	-	-	-
Total							

Lakeview Elementary Scho	eview Elementary Sc	eview Elementary Sc	eview Elementary Sc	rview Elementary Sc	rview Elementary Sc	-
LV-P-1	LV-P-2	LV-P-3	LV-P-4	RV-P-1	RV-P-2	-
Primary/Standby	Primary/Standby	Primary/Standby	Primary/Standby	Primary/Standby	Primary/Standby	-
1	1	1	1	1	1	-
7.5	7.5	7.5	7.5	3.0	3.0	-
0.895	0.895	0.895	0.895	0.875	0.875	-
Y	Y	Y	Y	Y	Y	-
Y	Y	Y	Y	Y	Y	-

CALCULATIONS (MOTOR)

	Lakeview Elementary School	**Lakeview Elementary School**	**Lakeview Elementary School**	**Lakeview Elementary School**	**Riverview Elementary School**	**Riverview Elementary School**
Equipment Label	LV-P-1	LV-P-2	LV-P-3	LV-P-4	RV-P-1	RV-P-2
Equipment Configuration	Primary/Standby	Primary/Standby	Primary/Standby	Primary/Standby	Primary/Standby	Primary/Standby
Replace Motor	Y	Y	Y	Y	Y	Y
VFD to be Installed	Y	Y	Y	Y	Y	Y
Qty	1	1	1	1	1	1
HP	7.5	7.5	7.5	7.5	3.0	3.0
Run Hours	**1,974**	**1,974**	**1,974**	**1,974**	**1,974**	**1,974**
Load Factor	0.65	0.65	0.65	0.65	0.65	0.65
Existing Motor Efficiency	0.895	0.895	0.895	0.895	0.875	0.875
Proposed Motor Efficiency	0.910	0.910	0.910	0.910	0.900	0.900
Existing kW	4.1	4.1	4.1	4.1	1.7	1.7
Proposed kW	4.0	4.0	4.0	4.0	1.6	1.6
Existing Motor kWh Consumption	8,021	8,021	8,021	8,021	3,282	3,282
Proposed Motor kWh Consumption	7,889	7,889	7,889	7,889	3,191	3,191
Proposed Motor kWh Consumption w/ VFD	3,612	3,612	3,612	3,612	1,461	1,461
Safety Factor	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
kW Savings	0.1	0.1	0.1	0.1	0.0	0.0
kWh Savings	4,409	4,409	4,409	4,409	1,821	1,821

Denville Board of Education
Exhibit D
ECM 2D Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

MOTOR RUN PERCENTAGES AT RESPECTIVE SPEED

30%	0.01	0.01	0.01	0.01	0.01	0.01
40%	0.03	0.03	0.03	0.03	0.03	0.03
50%	0.08	0.08	0.08	0.08	0.08	0.08
60%	0.12	0.12	0.12	0.12	0.12	0.12
70%	0.22	0.22	0.22	0.22	0.22	0.22
80%	0.29	0.29	0.29	0.29	0.29	0.29
90%	0.2	0.2	0.2	0.2	0.2	0.2
100%	0.05	0.05	0.05	0.05	0.05	0.05
Total	1	1	1	1	1	1

KWH CONSUMPTION W/ VFD

30%	2	2	2	2	1	1
40%	15	15	15	15	6	6
50%	79	79	79	79	32	32
60%	204	204	204	204	83	83
70%	595	595	595	595	241	241
80%	1,171	1,171	1,171	1,171	474	474
90%	1,150	1,150	1,150	1,150	465	465
100%	394	394	394	394	160	160

30%	0.11	0.11	0.11	0.11	0.04	0.04
40%	0.26	0.26	0.26	0.26	0.10	0.10
50%	0.50	0.50	0.50	0.50	0.20	0.20
60%	0.86	0.86	0.86	0.86	0.35	0.35
70%	1.37	1.37	1.37	1.37	0.55	0.55
80%	2.05	2.05	2.05	2.05	0.83	0.83
90%	2.91	2.91	2.91	2.91	1.18	1.18
100%	4.00	4.00	4.00	4.00	1.62	1.62

Motor Cost	$ 2,135	$ 2,135	$ 2,135	$ 2,135	$ 1,461	$ 1,461
VFD Cost	$ 5,534	$ 5,534	$ 5,534	$ 5,534	$ -	$ -

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Exhibit D
ECM 2E Steam Trap Replacements
Steam Trap Retrofit

ECM DESCRIPTION

Steam trap audit identified that there are steam traps that are not currently working or are partially working. Faulty steam traps will be either replaced or repaired.

DATA / ASSUMPTIONS

* Percentage of failed steam traps based on audit	**0.270**	Btu / ft^2 / °F / hr. / inch
*Respective boiler efficiencies are used		
Heating Hours	3,948	Hours

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify function of all steam traps per scope of work

RECOVERY/SAFETY FACTOR

Diversity Factor =	**75%**	Percentage of "lost" steam from orifice size from a failed trap (i.e. Not all all steam will flow through open orifice)
Safety Factor (Thermal) =	**0%**	

The safety factor for this ECM is taken at 0 due to exactness of the existing trap losses

FORMULAE

$Q_{savings} = (q_{loss} \cdot 1{,}194/100{,}000) / \eta$

$q_{loss} = \sum^{TRAPS} q_{trap} \cdot st_{fail\%} \cdot t$

$q_{trap} = 10.1 \cdot d^2 \cdot (p + 14.7)$

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
$\sum^{TRAPS}$	-	Summation of all steam traps
q_{loss}	lb / yr	Annual steam loss through failed office
q_{trap}	lb / hr	Steam loss through failed office
$st_{fail\%}$	%	Percentage of failed steam traps
t	hrs	Annual heating system run hours
p	psig	Pressure of steam through respective system
d	inches	Orifice Diameter
η	**%**	Boiler Efficiency

* Inputs are in blue

Building	% of Population Failed
Riverview Elementary School	**16%**

Denville Board of Education

Exhibit D

ECM 2E Steam Trap Replacements

Steam Trap Retrofit

CALCULATIONS

Hours / Yr	Equipment	Steam Trap Type	Steam Pressure (Psi)	Orifice Diameter (inches)	Failed Loss/hr	Riverview Elementary School Qty
3621	Drip	Thermo.	5.0	0.250	9.3	
3621	Drip	F&T	5.0	0.188	5.3	
3621	Hvac	Thermo.	2.0	0.218	6.0	
4380	Hvac	1" F&T	5.0	0.218	7.1	3
4380	Hvac	1-1/4" F&T	5.0	0.312	14.5	2
3621	Hvac	1-1/2" F&T	2.0	0.390	19.2	
3621	Hvac	2" F&T	2.0	0.500	31.6	
800	UV	Thermo.	5.0	0.250	9.3	30
3621	Rad	Thermo.	2.0	0.250	7.9	
1000	Drip	Thermo.	2.0	0.250	7.9	27
3621	Drip	F&T	2.0	0.188	4.5	
1000	Hvac	Thermo.	2.0	0.218	6.0	4
					Total Traps	66
					% of Population Failed	16%
					Failed Strem Traps	11
					Steam Loss	111,679
					Safety Factor	0%
					Annual Steam Losses	1,333
					Boiler Efficency	73.7%
					Annual Heat Input Losses	1,810

Denville Board of Education
Exhibit D
ECM 2F Pipe Insulation
Piping Insulation

ECM DESCRIPTION

Insulate bare hot water, steam and condensate piping located in boiler rooms and in transition areas. Repair damaged insulation on piping. Insulate condensate storage tanks where applicable. Insulate steam heat exchangers where applicable.

DATA / ASSUMPTIONS

Run Hours	Varies by building	
* Insulation "k" Factor of New Piping Insulation	0.270	Btu / ft^2 / °F / hr. / inch
*Respective boiler efficiencies are used		

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Visual inspection per scope of work from subcontractor.

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	5%

The safety factor for this ECM is taken at 0.05 due to uncertainty of on going steam and hot water piping temperatures incorporated in the savings calculation.

FORMULAE

Detailed energy savings calculations are in the Piping Insulation calculation sheet

* Inputs are in blue

Subcontractor Calculations N * If Yes - Please Refer to tab 'Sub Pipe Insulation' for details

Diameter (in) of Pipe - Input linear feet per diameter

Building	14+	10.00	8.00	6.00	5.00	4.00	3.00	2.50	2.00	1.50	1.00	0.75	0.50
Riverview Elementary School						10.0	20.0	60.0	40.0	201.0	175.0		
Totals	-	-	-	-	-	10.0	20.0	60.0	40.0	201.0	175.0	-	-

CALCULATIONS

	Riverview Elementary School
Total Linear Feet of Insulation	506.0
Losses from Bare Pipe	52,784
Losses from Insulated Pipe	24,794
Boiler Efficiency	73.7%
Thermal Savings (Therms/hr)	0.38
Safety Factor	5%
Thermal Savings	1,377

Denville Board of Education
Exhibit D
ECM 2F Pipe Insulation
Piping Insulation

Nominal Pipe Size (inches)	14.00	10.00	8.00	6.00	5.00	4.00	3.00	2.50	2.00	1.50	1.00	0.75	0.50
Contact Temperature of Bare Pipe (baseline)	**155**	**155**	**155**	**155**	**155**	**155**	**155**	**155**	**155**	**155**	**155**	**155**	**155**
Thickness of Insulation (inches)	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.0**	**2.0**	**2.0**	**2.0**	**1.5**	**1.5**	**1.5**	**1.5**
Insulation "k" Factor	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270
Pipe Length	1	1	1	1	1	1	1	1	1	1	1	1	1
Hours of Operation	3,814	3,814	3,814	3,814	3,814	3,814	3,814	3,814	3,814	3,814	3,814	3,814	3,814
Temperature of Environment	70	70	70	70	70	70	70	70	70	70	70	70	70
Contact Temperature of Floor	60	60	60	60	60	60	60	60	60	60	60	60	60
Contact Temperature of Ceiling	90	90	90	90	90	90	90	90	90	90	90	90	90
Contact Temperature of walls	75	75	75	75	75	75	75	75	75	75	75	75	75
Initial Insulation Fim Coefficient Estimate	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Emissivity of Bare Pipe	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Emissivity of Insulated Pipe	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Outside Diameter of Bare Pipe (inches)	14.000	10.750	8.625	6.625	5.563	4.500	3.500	2.875	2.375	1.900	1.315	1.050	0.840
Outside Diameter of Insulated Pipe (inches)	19.000	15.750	13.625	11.625	10.563	8.500	7.500	6.875	6.375	4.900	4.315	4.050	3.840
Characteristic Length of Bare Pipe (feet)	1.167	0.896	0.719	0.552	0.464	0.375	0.292	0.240	0.198	0.158	0.110	0.088	0.070
Characteristic Length of Insulated Pipe (feet)	1.583	1.313	1.135	0.969	0.880	0.708	0.625	0.573	0.531	0.408	0.360	0.338	0.320
Average Film Temp. For Bare Pipe (deg. F)	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5
Average Film Temp. For Insulated Pipe (deg. F)	97	96	95	95	94	96	95	94	94	96	95	94	93
Film Coefficient for Bare Pipe (BTU/hr.F.sqft)	0.789	0.843	0.890	0.951	0.994	1.048	1.116	1.172	1.229	1.300	1.425	1.507	1.594
Film Coefficient for Insulated Pipe (BTU/hr.F.sqft)	0.55	0.57	0.59	0.61	0.62	0.66	0.68	0.69	0.70	0.76	0.78	0.78	0.79
Convective Losses for Bare Pipe (BTU/hr.)	245.85	201.67	170.96	140.27	123.04	104.95	86.92	75.00	64.99	54.97	41.71	35.23	29.80
Convective Losses for Insulated Pipe (BTU/hr.)	115.87	99.95	89.09	78.45	72.59	62.68	56.61	52.69	49.45	41.52	37.30	35.29	33.64
Radiant Losses for Bare Pipe (BTU/hr.)	346	265	213	164	137	111	86	71	59	47	32	26	21
Radiant Losses for Insulated Pipe (BTU/hr.)	22	18	16	13	12	10	9	8	7	6	5	5	4
Total Losses for Bare Pipe (BTU/hr.)	591	467	384	304	260	216	173	146	124	102	74	61	51
Total Losses for Insulated Pipe (BTU/hr.)	138	118	105	92	85	72	65	61	57	47	42	40	38
Savings (BTU/hr.) With Boiler Eff. =	**454**	**349**	**279**	**212**	**176**	**144**	**108**	**85**	**67**	**55**	**32**	**21**	**13**
Savings (MMBTU)	**1.56**	**1.20**	**0.96**	**0.73**	**0.60**	**0.49**	**0.37**	**0.29**	**0.23**	**0.19**	**0.11**	**0.07**	**0.04**

SURFACE TEMPERATURE CALCULATION		First Iteration Heat Loss	282
14.0 inch pipe		First Iteration Insulation Surface Temp.	104
		First Iteration Film Coefficient	0.621
		Second Iteration Heat Loss	169
NPS Pipe Size (inches)	14.00	Second Iteration Insulation Surface Temp.	125
Bare Pipe Surface Temperature	155	Second Iteration Film Coefficient	0.654
Initial Film Coefficient	1.65	Third Iteration Heat Loss	175
Insulation Thickness (inches)	2.5	Third Iteration Insulation Surface Temp.	124
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.651
Environment Temperature	70	Fourth Iteration Heat Loss	174
External Pipe Diameter	14	Fourth Iteration Insulation Surface Temp.	124
Insulation Surface Temp	**124**	Fourth Iteration Film Coefficient	0.652

SURFACE TEMPERATURE CALCULATION		First Iteration Heat Loss	112
3.0 inch pipe		First Iteration Insulation Surface Temp.	105
		First Iteration Film Coefficient	0.622
		Second Iteration Heat Loss	67
NPS Pipe Size (inches)	3.00	Second Iteration Insulation Surface Temp.	125
Bare Pipe Surface Temper	155	Second Iteration Film Coefficient	0.827
Initial Film Coefficient	1.65	Third Iteration Heat Loss	80
Insulation Thickness (inch	2.0	Third Iteration Insulation Surface Temp.	119
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.804
Environment Temperature	70	Fourth Iteration Heat Loss	79
External Pipe Diameter	3.5	Fourth Iteration Insulation Surface Temp.	120
Insulation Surface Te	**120**	Fourth Iteration Film Coefficient	0.806

SURFACE TEMPERATURE CALCULATION		First Iteration Heat Loss	229
10.0 inch pipe		First Iteration Insulation Surface Temp.	104
		First Iteration Film Coefficient	0.617
		Second Iteration Heat Loss	138
NPS Pipe Size (inches)	10.00	Second Iteration Insulation Surface Temp.	124
Bare Pipe Surface Temperature	155	Second Iteration Film Coefficient	0.684
Initial Film Coefficient	1.65	Third Iteration Heat Loss	147
Insulation Thickness (inches)	2.5	Third Iteration Insulation Surface Temp.	122
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.677
Environment Temperature	70	Fourth Iteration Heat Loss	146
External Pipe Diameter	10.75	Fourth Iteration Insulation Surface Temp.	122
Insulation Surface Temp	**122**	Fourth Iteration Film Coefficient	0.678

SURFACE TEMPERATURE CALCULATION		First Iteration Heat Loss	100
2.5 inch pipe		First Iteration Insulation Surface Temp.	104
		First Iteration Film Coefficient	0.618
		Second Iteration Heat Loss	60
NPS Pipe Size (inches)	2.50	Second Iteration Insulation Surface Temp.	124
Bare Pipe Surface Temper	155	Second Iteration Film Coefficient	0.842
Initial Film Coefficient	1.65	Third Iteration Heat Loss	72
Insulation Thickness (inch	2.0	Third Iteration Insulation Surface Temp.	118
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.816
Environment Temperature	70	Fourth Iteration Heat Loss	71
External Pipe Diameter	2.875	Fourth Iteration Insulation Surface Temp.	118
Insulation Surface Te	**118**	Fourth Iteration Film Coefficient	0.819

Denville Board of Education
Exhibit D
ECM 2F Pipe Insulation
Piping Insulation

SURFACE TEMPERATURE CALCULATION 8.0 inch pipe		First Iteration Heat Loss	194
		First Iteration Insulation Surface Temp.	103
		First Iteration Film Coefficient	0.614
		Second Iteration Heat Loss	117
NPS Pipe Size (inches)	8.00	Second Iteration Insulation Surface Temp.	123
Bare Pipe Surface Temperature	155	Second Iteration Film Coefficient	0.707
Initial Film Coefficient	1.65	Third Iteration Heat Loss	128
Insulation Thickness (inches)	2.5	Third Iteration Insulation Surface Temp.	121
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.698
Environment Temperature	70	Fourth Iteration Heat Loss	127
External Pipe Diameter	8.625	Fourth Iteration Insulation Surface Temp.	121
Insulation Surface Temp	**121**	Fourth Iteration Film Coefficient	0.699

SURFACE TEMPERATURE CALCULATION 6.0 inch pipe		First Iteration Heat Loss	160
		First Iteration Insulation Surface Temp.	102
		First Iteration Film Coefficient	0.609
		Second Iteration Heat Loss	98
NPS Pipe Size (inches)	6.00	Second Iteration Insulation Surface Temp.	123
Bare Pipe Surface Temperature	155	Second Iteration Film Coefficient	0.733
Initial Film Coefficient	1.65	Third Iteration Heat Loss	109
Insulation Thickness (inches)	2.5	Third Iteration Insulation Surface Temp.	119
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.720
Environment Temperature	70	Fourth Iteration Heat Loss	108
External Pipe Diameter	6.625	Fourth Iteration Insulation Surface Temp.	119
Insulation Surface Temp	**119**	Fourth Iteration Film Coefficient	0.721

SURFACE TEMPERATURE CALCULATION 5.0 inch pipe		First Iteration Heat Loss	142
		First Iteration Insulation Surface Temp.	101
		First Iteration Film Coefficient	0.606
		Second Iteration Heat Loss	87
NPS Pipe Size (inches)	5.00	Second Iteration Insulation Surface Temp.	122
Bare Pipe Surface Temperature	155	Second Iteration Film Coefficient	0.749
Initial Film Coefficient	1.65	Third Iteration Heat Loss	99
Insulation Thickness (inches)	2.5	Third Iteration Insulation Surface Temp.	118
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.732
Environment Temperature	70	Fourth Iteration Heat Loss	98
External Pipe Diameter	5.563	Fourth Iteration Insulation Surface Temp.	118
Insulation Surface Temp	**118**	Fourth Iteration Film Coefficient	0.734

SURFACE TEMPERATURE CALCULATION 4.0 inch pipe		First Iteration Heat Loss	131
		First Iteration Insulation Surface Temp.	106
		First Iteration Film Coefficient	0.627
		Second Iteration Heat Loss	78
NPS Pipe Size (inches)	4.00	Second Iteration Insulation Surface Temp.	126
Bare Pipe Surface Temperature	155	Second Iteration Film Coefficient	0.804
Initial Film Coefficient	1.65	Third Iteration Heat Loss	91
Insulation Thickness (inches)	2.0	Third Iteration Insulation Surface Temp.	121
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.786
Environment Temperature	70	Fourth Iteration Heat Loss	90
External Pipe Diameter	4.5	Fourth Iteration Insulation Surface Temp.	121
Insulation Surface Temp	**121**	Fourth Iteration Film Coefficient	0.788

SURFACE TEMPERATURE CALCULATION 2.0 inch pipe		First Iteration Heat Loss	90
		First Iteration Insulation Surface Temp.	103
		First Iteration Film Coefficient	0.613
		Second Iteration Heat Loss	55
NPS Pipe Size (inches)	2.00	Second Iteration Insulation Surface Temp.	123
Bare Pipe Surface Temper	155	Second Iteration Film Coefficient	0.854
Initial Film Coefficient	1.65	Third Iteration Heat Loss	66
Insulation Thickness (inch	2.0	Third Iteration Insulation Surface Temp.	116
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.826
Environment Temperature	70	Fourth Iteration Heat Loss	65
External Pipe Diameter	2.375	Fourth Iteration Insulation Surface Temp.	117
Insulation Surface Te	**117**	Fourth Iteration Film Coefficient	0.829

SURFACE TEMPERATURE CALCULATION 1.5 inch pipe		First Iteration Heat Loss	82
		First Iteration Insulation Surface Temp.	109
		First Iteration Film Coefficient	0.641
		Second Iteration Heat Loss	48
NPS Pipe Size (inches)	1.50	Second Iteration Insulation Surface Temp.	128
Bare Pipe Surface Temper	155	Second Iteration Film Coefficient	0.933
Initial Film Coefficient	1.65	Third Iteration Heat Loss	61
Insulation Thickness (inch	1.5	Third Iteration Insulation Surface Temp.	121
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.902
Environment Temperature	70	Fourth Iteration Heat Loss	60
External Pipe Diameter	1.9	Fourth Iteration Insulation Surface Temp.	122
Insulation Surface Te	**122**	Fourth Iteration Film Coefficient	0.905

SURFACE TEMPERATURE CALCULATION 1.0 inch pipe		First Iteration Heat Loss	69
		First Iteration Insulation Surface Temp.	107
		First Iteration Film Coefficient	0.632
		Second Iteration Heat Loss	40
NPS Pipe Size (inches)	1.00	Second Iteration Insulation Surface Temp.	127
Bare Pipe Surface Temper	155	Second Iteration Film Coefficient	0.957
Initial Film Coefficient	1.65	Third Iteration Heat Loss	52
Insulation Thickness (inch	1.5	Third Iteration Insulation Surface Temp.	118
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.920
Environment Temperature	70	Fourth Iteration Heat Loss	51
External Pipe Diameter	1.315	Fourth Iteration Insulation Surface Temp.	119
Insulation Surface Te	**119**	Fourth Iteration Film Coefficient	0.923

SURFACE TEMPERATURE CALCULATION 0.8 inch pipe		First Iteration Heat Loss	62
		First Iteration Insulation Surface Temp.	106
		First Iteration Film Coefficient	0.626
		Second Iteration Heat Loss	37
NPS Pipe Size (inches)	0.75	Second Iteration Insulation Surface Temp.	126
Bare Pipe Surface Temper	155	Second Iteration Film Coefficient	0.967
Initial Film Coefficient	1.65	Third Iteration Heat Loss	48
Insulation Thickness (inch	1.5	Third Iteration Insulation Surface Temp.	117
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.927
Environment Temperature	70	Fourth Iteration Heat Loss	47
External Pipe Diameter	1.05	Fourth Iteration Insulation Surface Temp.	118
Insulation Surface Te	**118**	Fourth Iteration Film Coefficient	0.931

SURFACE TEMPERATURE CALCULATION 0.5 inch pipe		First Iteration Heat Loss	57
		First Iteration Insulation Surface Temp.	104
		First Iteration Film Coefficient	0.620
		Second Iteration Heat Loss	34
NPS Pipe Size (inches)	0.50	Second Iteration Insulation Surface Temp.	125
Bare Pipe Surface Temper	155	Second Iteration Film Coefficient	0.976
Initial Film Coefficient	1.65	Third Iteration Heat Loss	44
Insulation Thickness (inch	1.5	Third Iteration Insulation Surface Temp.	115
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.931
Environment Temperature	70	Fourth Iteration Heat Loss	43
External Pipe Diameter	0.84	Fourth Iteration Insulation Surface Temp.	116
Insulation Surface Te	**116**	Fourth Iteration Film Coefficient	0.936

SURFACE TEMPERATURE CALCULATION		First Iteration Heat Loss	219
Use this section to find the expected insulation		First Iteration Insulation S	104
surface temperature if unknown or evaluating		First Iteration Film Coeffic	0.621
project potential		Second Iteration Heat Los	179
NPS Pipe Size (inches)	10	Second Iteration Insulatio	145
Bare Pipe Surface Temperature	325	Second Iteration Film Coe	0.754
Initial Film Coefficient	1.65	Third Iteration Heat Loss	189
Insulation Thickness (inches)	2	Third Iteration Insulation	135
Insulation "K" Factor	0.05	Third Iteration Film Coeffi	0.728
Environment Temperature	70	Fourth Iteration Heat Loss	187
External Pipe Diameter	10.75	Fourth Iteration Insulatior	137
Insulation Surface Temp	**137**	Fourth Iteration Film Coef	0.732

This spreadsheet calculates insulation performance and bare pipe thermal losses for schedule 40 steel horizontal pipes. The calculation computes natural convective and radiant losses based on actual conditions using the Stephan-Boltzmann, radial heat flow and Nusselt equations. This calculation does not depend on insulation "k" factors but rather actual measured temperature data.

To use this spreadsheet, simply fill in all the blue cells. The tan cells contain fixed data or calculations and should not normally require change. All temperatures are in degrees F. If the nominal pipe size (NPS) for an application is greater than 10 inches, or other than listed, use the "OTHER" column. Other parameters will then be calculated automatically. If the insulation temp is known, insert the figures in row 20, (this color) otherwise the program will calculate an estimated value for you.

0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00	10.00	12.00	14.00
0.84	1.05	1.32	1.66	1.90	2.38	2.88	3.50	4.00	4.50	5.56	6.63	8.63	10.75	12.75	14.00

Denville Board of Education
Exhibit D
ECM 2G Domestic Hot Water Replacements
Domestic Hot Water Upgrades

ECM DESCRIPTION

Replacement of Domestic Hot Water Heaters with high efficiency condensing Domestic Hot Water Heaters

DATA / ASSUMPTIONS

*Isolating a storage tank improves the DHW system efficiency by:	**3.0%**
Current DHW Heater Efficiency	**Varies**

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify all functions of the boiler control system, safety and operation. Verify air/fuel ratio is consistent through firing range. Provide training of the boiler operators

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	**0.0%**
Safety Factor (Thermal) =	**0.0%**

No Safety Factor is used because of a minimal of variables

DHW REPLACEMENT CALCULATION

$$Q_{savings} = ((\eta_{NEW} - \eta_{OLD}) / \eta_{NEW}) \cdot Fuel_{DHW}$$

Variable	Units	Description
$Q_{Savings}$	Therms	Thermal Savings
η_{NEW}	%	Efficiency of Existing DHW Heater
η_{OLD}	%	Efficiency of Proposed DHW Heater
$Fuel_{DHW}$	Therms	Annual DHW Fuel Consumption

Denville Board of Education
Exhibit D
ECM 2G Domestic Hot Water Replacements
Domestic Hot Water Upgrades

*Inputs are blue

A. DOMESTIC HOT WATER HEATER REPLACEMENT

	Valleyview Middle School
Label	DHW-1-1
Quantity	1
Fuel Switch	N
Existing Fuel	Natural Gas
Proposed Fuel	Natural Gas
Current DHW System Efficiency	80.0%
Proposed DHW System Efficiency	90.0%
Improvement DHW System Efficiency	10%
Annual DHW Heater Baseline	4,205
Percentage of DHW Building Load	95%
Safety Factor	0%
Electric Savings	-
Natural Gas Savings	499
Fuel Oil #2 Savings	-
Fuel Oil #4 Savings	-
Fuel Oil #6 Savings	-
Propane Savings	-

B. STORAGE TANK ISOLATION

Storage Tank Isolation	Y
Current DHW System Efficiency	77.0%
Improvement in System Efficiency	3.0%
New System Efficiency	80.0%
Safety Factor	0%
Electric Savings	-
Natural Gas Savings	80
Fuel Oil #2 Savings	-
Fuel Oil #4 Savings	-
Fuel Oil #6 Savings	-
Propane Savings	-

Denville Board of Education
Exhibit D
ECM 2H Split System Replacements
Condensing Unit Replacement

ECM DESCRIPTION

Replace existing low efficiency condensing units in respective buildings with new high efficiency condensing units with an EER of 12+

CLARIFICATIONS, DELETIONS

*Run Hours based on occupancy schedule
*Full Load is estimated at (unless stated otherwise) : 97.5 °F
*Run hours are based on chiller cutoff temperature and bin weather data

MEASUREMENT AND VERIFICATION

Option A - The engineering calculations are based on direct kW measurements of the existing and installed chillers and operating hours. All existing chillers will be measured before removal and new motors after the installation.

COMMISSIONING

Start up equipment ensure proper operation

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) = 0%

The safety factor for this ECM is taken at 0 due to some variances on the run hours and the estimated part load efficiencies of the existing chiller.

FORMULAE

OPTIMIZATION

$W_{SAVINGS} = W_C \cdot \eta_{\%}$

REPLACEMENT

$W_{SAVINGS} = W_C - W_C$

$W_C = (W_{C\text{-}OCC} + W_{C\text{-}UNOCC})$
$W_C = (W_{C\text{-}OCC} + W_{C\text{-}UNOCC})$

$W_{C\text{-}OCC} = \sum^{105}_{60} C \cdot (T_{BIN} - T_{OCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{OCC} \cdot \eta$
$W_{C\text{-}UNOCC} = \sum^{105}_{60} C \cdot (T_{BIN} - T_{UNOCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{UNOCC} \cdot \eta$

$W_{C\text{-}OCC} = \sum^{105}_{60} C \cdot (T_{BIN} - T_{OCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{OCC} \cdot \eta$
$W_{C\text{-}UNOCC} = \sum^{105}_{60} C \cdot (T_{BIN} - T_{UNOCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{UNOCC} \cdot \eta$

Variable	Units	Description
$W_{SAVINGS}$	kWh	Electrical Savings
W_C	kWh	Existing condensing unit Consumption
W_C	kWh	Proposed condensing unit Consumption
$\eta_{\%}$	%	Efficiency gain due to condensing unit optimization
$\sum^{105}_{60}$	-	Summation of all bins from 60°F to 105°F
C	Ton	Tonnage of condensing unit
η	-	Existing efficiency of condensing unit (EER)
η	-	Proposed efficiency of condensing unit (EER)
T_{DESIGN}	°F	Design Temperature of condensing unit (Usually 97.5°F)
T_{BIN}	°F	Bin Weather Temperature
T_{OCC}	°F	Temperature of building during occupied hours
T_{UNOCC}	°F	Temperature of building during unoccupied hours
t_{OCC}	Hrs	Existing occupied Bin Hours in respective temperature bin
t_{UNOCC}	Hrs	Existing unoccupied Bin Hours in respective temperature bin

* Inputs are in blue
*Checks against baseline are in purple

Denville Board of Education
Exhibit D
ECM 2H Split System Replacements
Condensing Unit Replacement

Building	Label	Tonnage	Current SEER	Proposed SEER	Area Serving
Riverview Elementary School	RCU-2-1	4.0	11.0	18.1	IT Closet
Valleyview Middle School	VCU-1-1	4.0	8.5	14.0	A01
Valleyview Middle School	VCU-1-2	4.0	8.5	14.0	A02
Valleyview Middle School	VCU-1-5	5.0	10.1	16.0	C-10,Guidance,C-11
Totals		**17.0**			

CALCULATIONS

	Riverview Elementary School	Valleyview Middle School	Valleyview Middle School	Valleyview Middle School
Label	RCU-2-1	VCU-1-1	VCU-1-2	VCU-1-5
Area Serving	IT Closet	A01	A02	C-10,Guidance,C-11
Condensing Unit Tonnage	4.0	4.0	4.0	5.0
Current EER	11.0	8.5	8.5	10.1
Proposed EER	18.1	14.0	14.0	16.0
Existing Occupied Cooling Setpoint	72.0	72.0	72.0	72.0
Existing Unoccupied Cooling Setpoint	76.0	76.0	76.0	76.0
Current Condensing Unit Consumption	2,200	3,209	3,209	3,376
Percent of Baseline Consumption	0.8%	0.6%	0.6%	0.6%
Proposed Condensing Unit Consumption	1,337	1,948	1,948	2,131
Safety Factor	0%	0%	0%	0%
Electrical Savings	865	1,263	1,263	1,247

RIVERVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	-	4.0	4.0	4	-	4	3	2
95 to 100	97.5	-	19	2	21	20	2	4.0	4.0	78	6	92	56	36
90 to 95	92.5	-	44	13	57	47	10	4.0	4.0	189	39	249	151	98
85 to 90	87.5	1	167	60	228	182	46	2.4	2.1	443	98	590	359	232
80 to 85	82.5	31	283	162	476	335	141	1.6	1.2	552	170	788	479	309
75 to 80	77.5	191	235	280	706	377	329	0.9	0.3	325	92	455	276	178
70 to 75	72.5	203	177	222	602	309	293	0.1	-	24	-	26	16	10
65 to 70	67.5	325	165	204	694	338	356	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	268	259	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,876	1,435	13.0	11.6	1,612	405	2,200	1,337	865

VALLEYVIEW MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	-	4.0	4.0	4	-	6	3	2
95 to 100	97.5	-	19	2	21	21	0	4.0	4.0	83	1	119	72	47
90 to 95	92.5	-	44	13	57	55	2	4.0	4.0	222	7	322	195	126
85 to 90	87.5	1	167	60	228	221	8	2.4	2.1	536	16	780	473	306
80 to 85	82.5	31	283	162	476	456	20	1.6	1.2	751	24	1,094	664	430
75 to 80	77.5	191	235	280	706	671	35	0.9	0.3	579	10	831	505	326
70 to 75	72.5	203	177	222	602	574	28	0.1	-	45	-	64	39	25
65 to 70	67.5	325	165	204	694	669	26	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	503	24	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	3,169	142	13.0	11.6	2,215	58	3,209	1,948	1,263

Denville Board of Education
Exhibit D
ECM 2H Split System Replacements
Condensing Unit Replacement

VALLEYVIEW MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	-	4.0	4.0	4	-	6	3	2
95 to 100	97.5	-	19	2	21	21	0	4.0	4.0	83	1	119	72	47
90 to 95	92.5	-	44	13	57	55	2	4.0	4.0	222	7	322	195	126
85 to 90	87.5	1	167	60	228	221	8	2.4	2.1	536	16	780	473	306
80 to 85	82.5	31	283	162	476	456	20	1.6	1.2	751	24	1,094	664	430
75 to 80	77.5	191	235	280	706	671	35	0.9	0.3	579	10	831	505	326
70 to 75	72.5	203	177	222	602	574	28	0.1	-	45	-	64	39	25
65 to 70	67.5	325	165	204	694	669	26	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	503	24	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	3,169	142	13.0	11.6	2,215	58	3,209	1,948	1,263

VALLEYVIEW MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	-	5.0	5.0	5	-	6	4	2
95 to 100	97.5	-	19	2	21	21	0	5.0	5.0	104	1	125	79	46
90 to 95	92.5	-	44	13	57	55	2	5.0	5.0	277	8	339	214	125
85 to 90	87.5	1	167	60	228	221	8	3.0	2.7	670	20	820	518	302
80 to 85	82.5	31	283	162	476	456	20	2.1	1.5	938	31	1,151	727	425
75 to 80	77.5	191	235	280	706	671	35	1.1	0.3	724	12	874	552	322
70 to 75	72.5	203	177	222	602	574	28	0.1	-	56	-	67	42	25
65 to 70	67.5	325	165	204	694	669	26	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	503	24	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	3,169	142	16.3	14.5	2,769	72	3,376	2,131	1,247

Denville Board of Education
Exhibit D
ECM 2I Window AC Unit Replacements
Window AC Replacement

ECM DESCRIPTION

Replace existing low efficiency window units in respective buildings with new high efficiency cooling units with an EER of 12+

DATA / ASSUMPTIONS

*Run Hours based on occupancy schedule
*Full Load is estimated at (unless stated otherwise) : 97.5 °F
*Run hours are based on chiller cutoff temperature and bin weather data

MEASUREMENT AND VERIFICATION

Option A - The engineering calculations are based on direct kW measurements of the existing and installed chillers and operating hours. All existing chillers will be measured before removal and new motors after the installation.

COMMISSIONING

Start up equipment ensure proper operation

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) = 0%

The safety factor for this ECM is taken at 0 due to some variances on the run hours and the estimated part load efficiencies of the existing chiller.

FORMULAE

OPTIMIZATION

$W_{SAVINGS} = W_C \cdot \eta_{\%}$

REPLACEMENT

$W_{SAVINGS} = W_C - W_C$

$W_C = (W_{C\text{-}OCC} + W_{C\text{-}UNOCC})$
$W_C = (W_{C\text{-}OCC} + W_{C\text{-}UNOCC})$

$W_{C\text{-}OCC} = \sum_{60}^{105} C \cdot (T_{BIN} - T_{OCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{OCC} \cdot \eta$
$W_{C\text{-}UNOCC} = \sum_{60}^{105} C \cdot (T_{BIN} - T_{UNOCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{UNOCC} \cdot \eta$

$W_{C\text{-}OCC} = \sum_{60}^{105} C \cdot (T_{BIN} - T_{OCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{OCC} \cdot \eta$
$W_{C\text{-}UNOCC} = \sum_{60}^{105} C \cdot (T_{BIN} - T_{UNOCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{UNOCC} \cdot \eta$

Variable	Units	Description
$W_{SAVINGS}$	kWh	Electrical Savings
W_C	kWh	Existing condensing unit Consumption
W_C	kWh	Proposed condensing unit Consumption
$\eta_{\%}$	%	Efficiency gain due to condensing unit optimization
$\sum_{60}^{105}$	-	Summation of all bins from 60°F to 105°F
C	Ton	Tonnage of condensing unit
η	-	Existing efficiency of condensing unit (EER)
η	-	Proposed efficiency of condensing unit (EER)
T_{DESIGN}	°F	Design Temperature of condensing unit (Usually 97.5°F)
T_{BIN}	°F	Bin Weather Temperature
T_{OCC}	°F	Temperature of building during occupied hours
T_{UNOCC}	°F	Temperature of building during unoccupied hours
t_{OCC}	Hrs	Existing occupied Bin Hours in respective temperature bin
t_{UNOCC}	Hrs	Existing unoccupied Bin Hours in respective temperature bin

* Inputs are in blue
*Checks against baseline are in purple

Denville Board of Education
Exhibit D
ECM 2I Window AC Unit Replacements
Window AC Replacement

Building	Label	Qty	Tonnage (Each)	Current EER	Proposed EER	Area Serving
Valleyview Middle School	VWU-1-1	7	1.7	9.5	21.4	Media Center
-	-	-	-	-	-	-
Totals			**1.7**			

CALCULATIONS

1		**Valleyview Middle School**
2	Label	VWU-1-1
3	Qty	7.00
4	Area Serving	Media Center
5	Existing Unit Tonnage	11.7
6	Proposed Unit Tonnage	12.0
7	Current EER	9.5
8	Proposed EER	21.4
9	Existing Occupied Cooling Setpoint	74.0
10	Existing Unoccupied Cooling Setpoint	76.0
11	Current Condensing Unit Consumption	7,104
12	Percent of Baseline Consumption	1.3%
13	Proposed Condensing Unit Consumption	3,153
15	Safety Factor	0%
16	Electrical Savings	3,958

VALLEYVIEW MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	-	11.7	11.7	12	-	15	7	8
95 to 100	97.5	-	19	2	21	21	0	11.7	11.7	242	3	309	137	172
90 to 95	92.5	-	44	13	57	55	2	11.7	11.7	646	19	840	373	467
85 to 90	87.5	1	167	60	228	221	8	6.7	6.2	1,478	47	1,926	855	1,071
80 to 85	82.5	31	283	162	476	456	20	4.2	3.5	1,923	71	2,520	1,118	1,401
75 to 80	77.5	191	235	280	706	671	35	1.7	0.8	1,166	28	1,509	670	839
70 to 75	72.5	203	177	222	602	574	28	-	-	-	-	-	-	-
65 to 70	67.5	325	165	204	694	669	26	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	503	24	-	-	-	-	-	-	-
													-	
Total		931	1,242	1,138	3,311	3,169	142	36.0	33.9	5,455	169	7,104	3,153	3,958

Denville Board of Education
Exhibit D
ECM 2J Unit Heater Replacements
Unit Heater Replacement Calculation

ECM DESCRIPTION

Replace Unit Heaters in respective buildings with new high efficiency condensing Unit Heaters

DATA / ASSUMPTIONS

Heating Hours 3,948 Hours

* Utility baseline reduced by 10.5% to account for domestic hot water, science labs, and kitchen usage
* An adjusted baseline is used for the Unit Heater baseline usage as to not double-dip on savings

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify all functions of the Unit Heater control system, safety and operation. Verify air/fuel ratio is consistent through firing range. Provide training of the Unit Heater operators

RECOVERY/SAFETY FACTOR

Safety Factor (Thermal) = **0%**

A safety factor of 0 is used due to minimal variables and the proven results of this measure

FORMULAE

$Q_{savings} = ((\eta_{NEW} - \eta_{OLD}) / \eta_{NEW}) \cdot Fuel_{ADJ}$

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
η_{NEW}	**%**	Efficiency of New Unit Heater
η_{OLD}	**%**	Efficiency of Old Unit Heater
$Fuel_{ADJ}$	Therms	Adjusted Unit Heater Fuel Usage

*Inputs are blue

Building	Label	Unit Heaters to be Replaced
Bus Garage	BUH-1	2
Totals		**2**

Denville Board of Education
Exhibit D
ECM 2J Unit Heater Replacements
Unit Heater Replacement Calculation

CALCULATIONS

	Bus Garage
Label	BUH-1
No. of Units to be Replaced	2
Fuel Switch	N
Existing Fuel	Natural Gas
Proposed Fuel	Natural Gas
Current Unit Heater Efficiency	77.0%
Proposed Unit Heater Efficiency	80.0%
Improvement in Unit Heater Efficiency	3.0%
Annual Unit Heater Fuel Use	2,786
Adjusted Unit Heater Usage	2,786
Percentage of Building Load	100%
Safety Factor	**0%**
Natural Gas Savings	104
Fuel Oil #2 Savings	-
Fuel Oil #4 Savings	-
Fuel Oil #6 Savings	-
Propane Savings	-

Denville Board of Education
Exhibit D
ECM 3A Building Management Systems
BMS Upgrades

ECM DESCRIPTION

The building managament system for the school district will be upgraded. Where the DDC system exists it will be incorporated into a web-based system. The pnaumatic control system in some buildings will be replaced with new DDC controls. The new DDC system will be a web based type that allows remote access to a personnel from any computer using a security password.

DATA / ASSUMPTIONS

Heating Hours 3,948 Hours

*Schedules and temperatures are based on data logging trends performed throughout the building

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify functions of all installed controllers. Verify that control loops work properly. Verify function of all alarms installed in the system. Verify that all installed control variables and set points can be set and managed remotely

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	0%

Savings calculations are based on weather bin data, fresh air flows and temperature setpoints. A more conservative of percent is used for this ECM due to the uncertainty of variables. The heating fuel savings calculations are based upon information provided by the equipment vendor.

FORMULAE

$Q_{SAVINGS} = (HD_{EXISTING} - HD_{PROPOSED} / HD_{EXISTING}) \cdot Fuel_{ADJUSTED}$

$HD_{EXISTING} = \sum^{60}_{-5} (T_{OCC} - T_{BIN}) \cdot t_{OCC} + (T_{UNOCC} - T_{BIN}) \cdot t_{UNOCC}$

$HD_{PROPOSED} = \sum^{60}_{-5} (T_{OCC} - T_{BIN}) \cdot t_{OCC} + (T_{UNOCC} - T_{BIN}) \cdot t_{UNOCC}$

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
$\sum^{60}_{-5}$	-	Summation of all bins from -5°F to 60°F
T_{BIN}	°F	Temperature of respective bin
t_{OCC}	Hrs	Existing occupied Bin Hours in respective temperature bin
t_{UNOCC}	Hrs	Existing unoccupied Bin Hours in respective temperature bin
t_{OCC}	Hrs	Proposed occupied Bin Hours in respective temperature bin
t_{UNOCC}	Hrs	Proposed unoccupied Bin Hours in respective temperature bin
T_{OCC}	°F	Existing temperature of space during occupied hours
T_{UNOCC}	°F	Existing temperature of space during unoccupied hours
T_{OCC}	°F	Proposed temperature of space during occupied hours
T_{UNOCC}	°F	Proposed temperature of space during unoccupied hours
$HD_{EXISTING}$	Hrs	Existing heating degree hours in space
$HD_{PROPOSED}$	Hrs	Proposed heating degree hours in space
$Fuel_{ADJUSTED}$	Therms	Adjusted Boiler Fuel Usage

* Inputs for Section 1 and Section 2 are in blue

	EXISTING					PROPOSED			
Building	**Percentage of Building**	**Occupied Heating Temperature (°F)**	**Unoccupied Heating Temperature (°F)**	**Occupied Cooling Temperature (°F)**	**Unoccupied Cooling Temperature (°F)**	**Occupied Heating Temperature (°F)**	**Unoccupied Heating Temperature (°F)**	**Occupied Cooling Temperature (°F)**	**Unoccupied Cooling Temperature (°F)**
Valleyview Middle School	100%	74.0	70.0	72.0	76.0	70.0	60.0	72.0	80.0
Lakeview Elementary School	100%	74.0	70.0	72.0	76.0	70.0	60.0	72.0	80.0

Denville Board of Education
Exhibit D
ECM 3A Building Management Systems
BMS Upgrades

Riverview Elementary School	100%	74.0	70.0	72.0	76.0	70.0	60.0	72.0	80.0
Bus Garage									
0									
0									
0									
0									
0									
0									

THERMAL NIGHT SETBACK SAVINGS CALCULATIONS

	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School	Bus Garage
Occupied Bin Hours	3,784	2,092	2,092	1,927
Occupied HD-hrs	136,758	73,989	73,989	-
Annual Fuel Usage	35,844	48,044	37,172	2,786
Annual Boiler Usage	35,844	48,044	37,172	2,786
Existing Heating Degree-Hrs	141,919	135,152	135,152	-
Proposed Heating Degree-Hrs	106,576	106,576	106,576	-
Safety Factor	0%	0%	0%	0%
Thermal Savings	24.9%	21.1%	21.1%	0.0%
Thermal Savings	8,926	10,158	7,859	-

ELECTRIC NIGHT SETBACK SAVINGS CALCULATIONS

Annual kWh Usage	563,040	655,520	278,880	59,107
Annual Cooling kWh Baseline	168,912	131,104	22,310	4,729
Existing Cooling Degree-Hrs	14,178	12,195	12,195	-
Proposed Cooling Degree-Hrs	10,467	10,467	10,467	-
Safety Factor	0%	0%	0%	0%
Electrical Savings	26.2%	14.2%	14.2%	0.0%
Electrical Savings	44,214	18,581	3,162	-

Denville Board of Education
Exhibit D
ECM 3A Building Management Systems
BMS Upgrades

VALLEYVIEW MIDDLE SCHOOL

							Current Operating Schedule							**Proposed Operating Schedule**						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. heating Deg-hours	Unocc. heating Deg-hours	Total heating Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. heating Deg-hours	Unocc. heating Deg-hours	Total heating Deg-hours
	COOLING																			
VALLEYVIEW	100 to 105	102.5	-	1	-	1	1	-	72.0	76.0	31	-	31	1	-	72.0	80.0	31	-	31
VALLEYVIEW	95 to 100	97.5	-	19	2	21	21	0	72.0	76.0	529	5	535	19	2	72.0	80.0	491	31	522
VALLEYVIEW	90 to 95	92.5	-	44	13	57	55	2	72.0	76.0	1,135	27	1,162	46	11	72.0	80.0	935	142	1,078
VALLEYVIEW	85 to 90	87.5	1	167	60	228	221	8	72.0	76.0	3,418	86	3,504	175	53	72.0	80.0	2,711	398	3,109
VALLEYVIEW	80 to 85	82.5	31	283	162	476	456	20	72.0	76.0	4,785	132	4,917	315	161	72.0	80.0	3,306	403	3,709
VALLEYVIEW	75 to 80	77.5	191	235	280	706	671	35	72.0	76.0	3,691	53	3,743	342	364	72.0	80.0	1,879	-	1,879
VALLEYVIEW	70 to 75	72.5	203	177	222	602	574	28	72.0	76.0	287	-	287	281	321	72.0	80.0	140	-	140
VALLEYVIEW	65 to 70	67.5	325	165	204	694	669	26	72.0	76.0	-	-	-	312	382	72.0	80.0	-	-	-
VALLEYVIEW	60 to 65	62.5	180	152	195	527	503	24	72.0	76.0	-	-	-	244	283	72.0	80.0	-	-	-
													14,178							**10,467**
	HEATING																			
VALLEYVIEW	55 to 60	57.5	86	144	97	327	315	12	74.0	70.0	5,195	152	5,347	188	139	70	60	2,355	347	2,701
VALLEYVIEW	50 to 55	52.5	109	182	172	463	442	22	74.0	70.0	9,492	376	9,869	244	219	70	60	4,277	1,640	5,916
VALLEYVIEW	45 to 50	47.5	105	119	142	366	348	18	74.0	70.0	9,229	399	9,628	176	190	70	60	3,963	2,373	6,336
VALLEYVIEW	40 to 45	42.5	185	155	177	517	495	22	74.0	70.0	15,589	608	16,197	247	271	70	60	6,779	4,734	11,513
VALLEYVIEW	35 to 40	37.5	236	200	241	677	647	30	74.0	70.0	23,611	979	24,590	319	358	70	60	10,355	8,063	18,419
VALLEYVIEW	30 to 35	32.5	237	202	198	637	612	25	74.0	70.0	25,408	928	26,337	316	321	70	60	11,836	8,838	20,674
VALLEYVIEW	25 to 30	27.5	121	115	113	349	335	14	74.0	70.0	15,572	600	16,172	175	175	70	60	7,416	5,671	13,088
VALLEYVIEW	20 to 25	22.5	149	68	97	314	302	12	74.0	70.0	15,547	576	16,123	136	178	70	60	6,460	6,675	13,135
VALLEYVIEW	15 to 20	17.5	95	40	46	181	175	6	74.0	70.0	9,902	302	10,204	81	100	70	60	4,272	4,234	8,506
VALLEYVIEW	10 to 15	12.5	39	9	28	76	73	4	74.0	70.0	4,459	201	4,660	27	49	70	60	1,560	2,322	3,881
VALLEYVIEW	5 to 10	7.5	21	5	5	31	30	1	74.0	70.0	2,020	39	2,059	14	18	70	60	844	919	1,763
VALLEYVIEW	0 to 5	2.5	4	2	-	6	6	-	74.0	70.0	429	-	429	4	3	70	60	236	144	380
VALLEYVIEW	-5 to 0	(2.5)	4	-	-	4	4	-	74.0	70.0	306	-	306	2	3	70	60	109	156	265
VALLEYVIEW	-10 to -5	(7.5)	-	-	-	-	-	-	74.0	70.0	-	-	-	-	-	70	60	-	-	-
VALLEYVIEW	-15 to -10	(12.5)	-	-	-	-	-	-	74.0	70.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	3,784	165			136,758	5,161	141,919	1,927	2,021			60,461	46,115	**106,576**

Denville Board of Education
Exhibit D
ECM 3A Building Management Systems
BMS Upgrades

LAKEVIEW ELEMENTARY SCHOOL

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. heating Deg-hours	Unocc. heating Deg-hours	Total heating Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. heating Deg-hours	Unocc. heating Deg-hours	Total heating Deg-hours
	COOLING																			
LAKEVIEW EL	100 to 105	102.5	-	1	-	1	1	-	72.0	76.0	31	-	31	1	-	72.0	80.0	31	-	31
LAKEVIEW EL	95 to 100	97.5	-	19	2	21	20	2	72.0	76.0	497	32	530	19	2	72.0	80.0	491	31	522
LAKEVIEW EL	90 to 95	92.5	-	44	13	57	47	10	72.0	76.0	969	161	1,130	46	11	72.0	80.0	935	142	1,078
LAKEVIEW EL	85 to 90	87.5	1	167	60	228	182	46	72.0	76.0	2,827	525	3,352	175	53	72.0	80.0	2,711	398	3,109
LAKEVIEW EL	80 to 85	82.5	31	283	162	476	335	141	72.0	76.0	3,519	916	4,435	315	161	72.0	80.0	3,306	403	3,709
LAKEVIEW EL	75 to 80	77.5	191	235	280	706	377	329	72.0	76.0	2,071	494	2,566	342	364	72.0	80.0	1,879	-	1,879
LAKEVIEW EL	70 to 75	72.5	203	177	222	602	309	293	72.0	76.0	154	-	154	281	321	72.0	80.0	140	-	140
LAKEVIEW EL	65 to 70	67.5	325	165	204	694	338	356	72.0	76.0	-	-	-	312	382	72.0	80.0	-	-	-
LAKEVIEW EL	60 to 65	62.5	180	152	195	527	268	259	72.0	76.0	-	-	-	244	283	72.0	80.0	-	-	-
													12,195							**10,467**
	HEATING																			
LAKEVIEW EL	55 to 60	57.5	86	144	97	327	201	127	74.0	70.0	3,308	1,581	4,890	188	139	70	60	2,355	347	2,701
LAKEVIEW EL	50 to 55	52.5	109	182	172	463	266	197	74.0	70.0	5,716	3,450	9,166	244	219	70	60	4,277	1,640	5,916
LAKEVIEW EL	45 to 50	47.5	105	119	142	366	194	172	74.0	70.0	5,138	3,873	9,011	176	190	70	60	3,963	2,373	6,336
LAKEVIEW EL	40 to 45	42.5	185	155	177	517	269	248	74.0	70.0	8,462	6,830	15,292	247	271	70	60	6,779	4,734	11,513
LAKEVIEW EL	35 to 40	37.5	236	200	241	677	349	328	74.0	70.0	12,729	10,668	23,398	319	358	70	60	10,355	8,063	18,419
LAKEVIEW EL	30 to 35	32.5	237	202	198	637	340	297	74.0	70.0	14,126	11,123	25,249	316	321	70	60	11,836	8,838	20,674
LAKEVIEW EL	25 to 30	27.5	121	115	113	349	189	160	74.0	70.0	8,771	6,816	15,587	175	175	70	60	7,416	5,671	13,088
LAKEVIEW EL	20 to 25	22.5	149	68	97	314	148	166	74.0	70.0	7,628	7,879	15,508	136	178	70	60	6,460	6,675	13,135
LAKEVIEW EL	15 to 20	17.5	95	40	46	181	87	94	74.0	70.0	4,923	4,928	9,851	81	100	70	60	4,272	4,234	8,506
LAKEVIEW EL	10 to 15	12.5	39	9	28	76	31	45	74.0	70.0	1,883	2,609	4,493	27	49	70	60	1,560	2,322	3,881
LAKEVIEW EL	5 to 10	7.5	21	5	5	31	14	17	74.0	70.0	939	1,055	1,994	14	18	70	60	844	919	1,763
LAKEVIEW EL	0 to 5	2.5	4	2	-	6	4	3	74.0	70.0	250	169	419	4	3	70	60	236	144	380
LAKEVIEW EL	-5 to 0	(2.5)	4	-	-	4	2	3	74.0	70.0	115	181	296	2	3	70	60	109	156	265
LAKEVIEW EL	-10 to -5	(7.5)	-	-	-	-	-	-	74.0	70.0	-	-	-	-	-	70	60	-	-	-
LAKEVIEW EL	-15 to -10	(12.5)	-	-	-	-	-	-	74.0	70.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	2,092	1,856			73,989	61,163	135,152	1,927	2,021			60,461	46,115	**106,576**

Denville Board of Education
Exhibit D
ECM 3A Building Management Systems
BMS Upgrades

RIVERVIEW ELEMENTARY SCHOOL

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. heating Deg-hours	Unocc. heating Deg-hours	Total heating Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. heating Deg-hours	Unocc. heating Deg-hours	Total heating Deg-hours
	COOLING																			
RIVERVIEW E	100 to 105	102.5	-	1	-	1	1	-	72.0	76.0	31	-	31	1	-	72.0	80.0	31	-	31
RIVERVIEW E	95 to 100	97.5	-	19	2	21	20	2	72.0	76.0	497	32	530	19	2	72.0	80.0	491	31	522
RIVERVIEW E	90 to 95	92.5	-	44	13	57	47	10	72.0	76.0	969	161	1,130	46	11	72.0	80.0	935	142	1,078
RIVERVIEW E	85 to 90	87.5	1	167	60	228	182	46	72.0	76.0	2,827	525	3,352	175	53	72.0	80.0	2,711	398	3,109
RIVERVIEW E	80 to 85	82.5	31	283	162	476	335	141	72.0	76.0	3,519	916	4,435	315	161	72.0	80.0	3,306	403	3,709
RIVERVIEW E	75 to 80	77.5	191	235	280	706	377	329	72.0	76.0	2,071	494	2,566	342	364	72.0	80.0	1,879	-	1,879
RIVERVIEW E	70 to 75	72.5	203	177	222	602	309	293	72.0	76.0	154	-	154	281	321	72.0	80.0	140	-	140
RIVERVIEW E	65 to 70	67.5	325	165	204	694	338	356	72.0	76.0	-	-	-	312	382	72.0	80.0	-	-	-
RIVERVIEW E	60 to 65	62.5	180	152	195	527	268	259	72.0	76.0	-	-	-	244	283	72.0	80.0	-	-	-
													12,195							**10,467**
	HEATING																			
RIVERVIEW E	55 to 60	57.5	86	144	97	327	201	127	74.0	70.0	3,308	1,581	4,890	188	139	70	60	2,355	347	2,701
RIVERVIEW E	50 to 55	52.5	109	182	172	463	266	197	74.0	70.0	5,716	3,450	9,166	244	219	70	60	4,277	1,640	5,916
RIVERVIEW E	45 to 50	47.5	105	119	142	366	194	172	74.0	70.0	5,138	3,873	9,011	176	190	70	60	3,963	2,373	6,336
RIVERVIEW E	40 to 45	42.5	185	155	177	517	269	248	74.0	70.0	8,462	6,830	15,292	247	271	70	60	6,779	4,734	11,513
RIVERVIEW E	35 to 40	37.5	236	200	241	677	349	328	74.0	70.0	12,729	10,668	23,398	319	358	70	60	10,355	8,063	18,419
RIVERVIEW E	30 to 35	32.5	237	202	198	637	340	297	74.0	70.0	14,126	11,123	25,249	316	321	70	60	11,836	8,838	20,674
RIVERVIEW E	25 to 30	27.5	121	115	113	349	189	160	74.0	70.0	8,771	6,816	15,587	175	175	70	60	7,416	5,671	13,088
RIVERVIEW E	20 to 25	22.5	149	68	97	314	148	166	74.0	70.0	7,628	7,879	15,508	136	178	70	60	6,460	6,675	13,135
RIVERVIEW E	15 to 20	17.5	95	40	46	181	87	94	74.0	70.0	4,923	4,928	9,851	81	100	70	60	4,272	4,234	8,506
RIVERVIEW E	10 to 15	12.5	39	9	28	76	31	45	74.0	70.0	1,883	2,609	4,493	27	49	70	60	1,560	2,322	3,881
RIVERVIEW E	5 to 10	7.5	21	5	5	31	14	17	74.0	70.0	939	1,055	1,994	14	18	70	60	844	919	1,763
RIVERVIEW E	0 to 5	2.5	4	2	-	6	4	3	74.0	70.0	250	169	419	4	3	70	60	236	144	380
RIVERVIEW E	-5 to 0	(2.5)	4	-	-	4	2	3	74.0	70.0	115	181	296	2	3	70	60	109	156	265
RIVERVIEW E	-10 to -5	(7.5)	-	-	-	-	-	-	74.0	70.0	-	-	-	-	-	70	60	-	-	-
RIVERVIEW E	-15 to -10	(12.5)	-	-	-	-	-	-	74.0	70.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	2,092	1,856			73,989	61,163	135,152	1,927	2,021			60,461	46,115	**106,576**

Denville Board of Education
Exhibit D
ECM 3A Building Management Systems
BMS Upgrades

BUS GARAGE

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. heating Deg-hours	Unocc. heating Deg-hours	Total heating Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. heating Deg-hours	Unocc. heating Deg-hours	Total heating Deg-hours
	COOLING																			
BUS GARAGE	100 to 105	102.5	-	1	-	1	1	-	-	-	-	-	-	1	-	-	-	-	-	-
BUS GARAGE	95 to 100	97.5	-	19	2	21	19	2	-	-	-	-	-	19	2	-	-	-	-	-
BUS GARAGE	90 to 95	92.5	-	44	13	57	46	11	-	-	-	-	-	44	13	-	-	-	-	-
BUS GARAGE	85 to 90	87.5	1	167	60	228	175	53	-	-	-	-	-	167	61	-	-	-	-	-
BUS GARAGE	80 to 85	82.5	31	283	162	476	315	161	-	-	-	-	-	295	181	-	-	-	-	-
BUS GARAGE	75 to 80	77.5	191	235	280	706	342	364	-	-	-	-	-	307	399	-	-	-	-	-
BUS GARAGE	70 to 75	72.5	203	177	222	602	281	321	-	-	-	-	-	253	349	-	-	-	-	-
BUS GARAGE	65 to 70	67.5	325	165	204	694	312	382	-	-	-	-	-	287	407	-	-	-	-	-
BUS GARAGE	60 to 65	62.5	180	152	195	527	244	283	-	-	-	-	-	220	308	-	-	-	-	-
													-							**-**
	HEATING																			
BUS GARAGE	55 to 60	57.5	86	144	97	327	188	139	-	-	-	-	-	176	151	-	-	-	-	-
BUS GARAGE	50 to 55	52.5	109	182	172	463	244	219	-	-	-	-	-	223	240	-	-	-	-	-
BUS GARAGE	45 to 50	47.5	105	119	142	366	176	190	-	-	-	-	-	158	208	-	-	-	-	-
BUS GARAGE	40 to 45	42.5	185	155	177	517	247	271	-	-	-	-	-	224	293	-	-	-	-	-
BUS GARAGE	35 to 40	37.5	236	200	241	677	319	358	-	-	-	-	-	289	389	-	-	-	-	-
BUS GARAGE	30 to 35	32.5	237	202	198	637	316	321	-	-	-	-	-	291	346	-	-	-	-	-
BUS GARAGE	25 to 30	27.5	121	115	113	349	175	175	-	-	-	-	-	160	189	-	-	-	-	-
BUS GARAGE	20 to 25	22.5	149	68	97	314	136	178	-	-	-	-	-	124	190	-	-	-	-	-
BUS GARAGE	15 to 20	17.5	95	40	46	181	81	100	-	-	-	-	-	76	105	-	-	-	-	-
BUS GARAGE	10 to 15	12.5	39	9	28	76	27	49	-	-	-	-	-	24	52	-	-	-	-	-
BUS GARAGE	5 to 10	7.5	21	5	5	31	14	18	-	-	-	-	-	13	18	-	-	-	-	-
BUS GARAGE	0 to 5	2.5	4	2	-	6	4	3	-	-	-	-	-	4	3	-	-	-	-	-
BUS GARAGE	-5 to 0	(2.5)	4	-	-	4	2	3	-	-	-	-	-	2	3	-	-	-	-	-
BUS GARAGE	-10 to -5	(7.5)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUS GARAGE	-15 to -10	(12.5)	-	-	-	-	-	-	-	-	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	1,927	2,021			0	0	0	1,763	2,185			0	0	**0**

Denville Board of Education
Exhibit D
ECM 3B Demand Control Ventilation
Demand Control Ventilation

ECM DESCRIPTION

Install CO2 sensors in large areas to control fresh air intake

DATA / ASSUMPTIONS

Heating Hours 3,948 Hours

*Schedules and temperatures are based on data logging trends performed throughout the building
* Proposed setpoints are used as to not capture thermal savings twice

MEASUREMENT AND VERIFICATION

Option A (Electric) -
Option C (Thermal) - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Simulate function of CO2 control signal. Test all equipment involved in DCV, which will include but not limited to testing function of fresh air damper response to the CO2 sensor signal and sequence of operation per design (Override CO2 signal during the building warm up, etc.).

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	0%

Savings calculations are based on weather bin data, fresh air flows and temperature setpoints. A more conservative of 0 percent is used for this ECM due to the uncertainty of variables.

FORMULAE

$W_{SAVINGS} = \sum^{60}_{-5} [(kW_{FAN} \cdot t_{OCC}) - (kW_{FAN} \cdot (1 - RPM_{-\%})^{2.8}) \cdot t_{OCC}]$

$Q_{SAVINGS} = \sum^{60}_{-5} \{ [Q_{LOAD} \cdot t_{OCC} \cdot (1 - OA_{\%OCC})] + [Q_{LOAD} \cdot t_{UNOCC} \cdot (1 - OA_{\%UNOCC})] \} / \eta_{BOILER}$

$Q_{LOAD} = 1.08 \cdot CFM_{OA} \cdot (T_{OCC} - T_{BIN}) / 1000$

Variable	Units	Description
$W_{SAVINGS}$	kWh	Annual kWh Savings
$Q_{SAVINGS}$	Therms	Annual Thermal Savings
Q_{LOAD}	Mmbtu	Thermal Load of unit at respective temperature bin
kW_{FAN}	kW	Total kW of Fan
$\sum^{60}_{-5}$	-	Summation of all bins from -5°F to 60°F
T_{BIN}	°F	Temperature of respective bin
t_{OCC}	Hrs	Proposed occupied Bin Hours in respective temperature bin
t_{UNOCC}	Hrs	Proposed unoccupied Bin Hours in respective temperature bin
$RPM_{-\%}$	%	Percentage of RPM fan will be reduced due to VFD
$OA_{\%OCC}$	%	Percentage Fresh Air Reduction during occupied hours
$OA_{\%UNOCC}$	%	Percentage Fresh Air Reduction during unoccupied hours
CFM_{SUPPLY}	CFM	Total supply CFM of units
CFM_{OA}	CFM	Total outside air CFM of units
T_{OCC}	°F	Proposed occupied Temperature
T_{UNOCC}	°F	Proposed unoccupied Temperature
$T_{OCC/UNOCC}$	°F	Proposed occupied/unoccupied Mode Temperature for controlled unit
η_{BOILER}	%	Boiler Efficiency

Denville Board of Education
Exhibit D
ECM 3B Demand Control Ventilation
Demand Control Ventilation

* Inputs are in blue

Building	Area Served	Qty	HP (Each)	Supply CFM (Each)	OA CFM (Each)
Lakeview Elementary School	2000 GYM	1	0.0	5,500	825
Lakeview Elementary School	2000 GYM	1	0.0	5,500	825
Lakeview Elementary School	Cafetorium	1	0.0	800	120
Lakeview Elementary School	GYM	1	0.0	5,500	825
Lakeview Elementary School	GYM	1	0.0	5,500	825
Lakeview Elementary School	A36/A37 Receiving	1	0.0	3,000	450
Riverview Elementary School	Cafetorium	1	0.0	8,000	1,200
Valleyview Middle School	Mutilpurpose Room	1	0.0	5,000	750
Valleyview Middle School	Mutilpurpose Room	1	0.0	5,000	750
Valleyview Middle School	Mutilpurpose Room	1	0.0	5,000	750
Valleyview Middle School	Cafeteria	1	0.0	8,000	1,200
Totals		11	0.0	56,800	8,520

	Lakeview Elementary School	Lakeview Elementary School	Lakeview Elementary School	Lakeview Elementary School	Lakeview Elementary School	Lakeview Elementary School	Riverview Elementary School	Valleyview Middle School	Valleyview Middle School	Valleyview Middle School	Valleyview Middle School
Location	2000 GYM	2000 GYM	Cafetorium	GYM	GYM	A36/A37 Receiving	Cafetorium	Mutilpurpose Room	Mutilpurpose Room	Mutilpurpose Room	Cafeteria
Quantity	1	1	1	1	1	1	1	1	1	1	1
HP Motor Total	0	0	0	0	0	0	0	0	0	0	0
Motor Load Factor	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
kW Motor Total	-	-	-	-	-	-	-	-	-	-	-
CFM Total	5,500	5,500	800	5,500	5,500	3,000	8,000	5,000	5,000	5,000	8,000
Outside Air Total	825	825	120	825	825	450	1,200	750	750	750	1,200
**Proposed Occupied Heating Setpoint	70.0	70	70	70	70	70	70	70	70	70	70
**Proposed Unoccup. Heating Setpoint	60.0	60	60	60	60	60	60	60	60	60	60
**Proposed Occupied Cooling Setpoint	72.0	72	72	72	72	72	72	72	72	72	72
**Proposed Unoccup. Cooling Setpoint	80.0	80	80	80	80	80	80	80	80	80	80
Existing Boiler Efficiency	77.0%	77.0%	77.0%	77.0%	77.0%	77.0%	73.7%	89.0%	89.0%	89.0%	89.0%
Average Fan Speed Reduction	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average Occupied Heating Reduction	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Average Unoccupied Heating Reduction	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Safety Factor	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Electrical Savings	-	-	-	-	-	-	-	-	-	-	-
Thermal Savings	103	103	15	103	103	56	157	153	153	153	244

Denville Board of Education
Exhibit D
ECM 3B Demand Control Ventilation
Demand Control Ventilation

CALCULATIONS

LAKEVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	201	127	825	2	0	0.1	0.0	1
50 to 55	52.5	109	182	172	463	266	197	825	7	0	0.4	0.0	5
45 to 50	47.5	105	119	142	366	194	172	825	11	0	0.4	0.0	6
40 to 45	42.5	185	155	177	517	269	248	825	16	0	0.8	0.0	11
35 to 40	37.5	236	200	241	677	349	328	825	20	0	1.4	0.0	18
30 to 35	32.5	237	202	198	637	340	297	825	25	0	1.7	0.0	22
25 to 30	27.5	121	115	113	349	189	160	825	29	0	1.1	0.0	14
20 to 25	22.5	149	68	97	314	148	166	825	33	0	1.0	0.0	13
15 to 20	17.5	95	40	46	181	87	94	825	38	0	0.7	0.0	9
10 to 15	12.5	39	9	28	76	31	45	825	42	0	0.3	0.0	3
5 to 10	7.5	21	5	5	31	14	17	825	47	0	0.1	0.0	2
0 to 5	2.5	4	2	-	6	4	3	825	51	0	0.0	0.0	0
-5 to 0	-2.5	4	-	-	4	2	3	825	56	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	825	60	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	825	65	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	2,092	1,856			-	8		103

LAKEVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	201	127	825	2	0	0.1	0.0	1
50 to 55	52.5	109	182	172	463	266	197	825	7	0	0.4	0.0	5
45 to 50	47.5	105	119	142	366	194	172	825	11	0	0.4	0.0	6
40 to 45	42.5	185	155	177	517	269	248	825	16	0	0.8	0.0	11
35 to 40	37.5	236	200	241	677	349	328	825	20	0	1.4	0.0	18
30 to 35	32.5	237	202	198	637	340	297	825	25	0	1.7	0.0	22
25 to 30	27.5	121	115	113	349	189	160	825	29	0	1.1	0.0	14
20 to 25	22.5	149	68	97	314	148	166	825	33	0	1.0	0.0	13
15 to 20	17.5	95	40	46	181	87	94	825	38	0	0.7	0.0	9
10 to 15	12.5	39	9	28	76	31	45	825	42	0	0.3	0.0	3
5 to 10	7.5	21	5	5	31	14	17	825	47	0	0.1	0.0	2
0 to 5	2.5	4	2	-	6	4	3	825	51	0	0.0	0.0	0
-5 to 0	-2.5	4	-	-	4	2	3	825	56	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	825	60	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	825	65	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	2,092	1,856			-	8		103

Denville Board of Education
Exhibit D
ECM 3B Demand Control Ventilation
Demand Control Ventilation

LAKEVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	201	127	120	0	0	0.0	0.0	0
50 to 55	52.5	109	182	172	463	266	197	120	1	0	0.1	0.0	1
45 to 50	47.5	105	119	142	366	194	172	120	2	0	0.1	0.0	1
40 to 45	42.5	185	155	177	517	269	248	120	2	0	0.1	0.0	2
35 to 40	37.5	236	200	241	677	349	328	120	3	0	0.2	0.0	3
30 to 35	32.5	237	202	198	637	340	297	120	4	0	0.2	0.0	3
25 to 30	27.5	121	115	113	349	189	160	120	4	0	0.2	0.0	2
20 to 25	22.5	149	68	97	314	148	166	120	5	0	0.1	0.0	2
15 to 20	17.5	95	40	46	181	87	94	120	6	0	0.1	0.0	1
10 to 15	12.5	39	9	28	76	31	45	120	6	0	0.0	0.0	0
5 to 10	7.5	21	5	5	31	14	17	120	7	0	0.0	0.0	0
0 to 5	2.5	4	2	-	6	4	3	120	7	0	0.0	0.0	0
-5 to 0	-2.5	4	-	-	4	2	3	120	8	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	120	9	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	120	9	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	2,092	1,856			-	1		15

LAKEVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	201	127	825	2	0	0.1	0.0	1
50 to 55	52.5	109	182	172	463	266	197	825	7	0	0.4	0.0	5
45 to 50	47.5	105	119	142	366	194	172	825	11	0	0.4	0.0	6
40 to 45	42.5	185	155	177	517	269	248	825	16	0	0.8	0.0	11
35 to 40	37.5	236	200	241	677	349	328	825	20	0	1.4	0.0	18
30 to 35	32.5	237	202	198	637	340	297	825	25	0	1.7	0.0	22
25 to 30	27.5	121	115	113	349	189	160	825	29	0	1.1	0.0	14
20 to 25	22.5	149	68	97	314	148	166	825	33	0	1.0	0.0	13
15 to 20	17.5	95	40	46	181	87	94	825	38	0	0.7	0.0	9
10 to 15	12.5	39	9	28	76	31	45	825	42	0	0.3	0.0	3
5 to 10	7.5	21	5	5	31	14	17	825	47	0	0.1	0.0	2
0 to 5	2.5	4	2	-	6	4	3	825	51	0	0.0	0.0	0
-5 to 0	-2.5	4	-	-	4	2	3	825	56	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	825	60	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	825	65	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	2,092	1,856			-	8		103

Denville Board of Education
Exhibit D
ECM 3B Demand Control Ventilation
Demand Control Ventilation

LAKEVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	201	127	825	2	0	0.1	0.0	1
50 to 55	52.5	109	182	172	463	266	197	825	7	0	0.4	0.0	5
45 to 50	47.5	105	119	142	366	194	172	825	11	0	0.4	0.0	6
40 to 45	42.5	185	155	177	517	269	248	825	16	0	0.8	0.0	11
35 to 40	37.5	236	200	241	677	349	328	825	20	0	1.4	0.0	18
30 to 35	32.5	237	202	198	637	340	297	825	25	0	1.7	0.0	22
25 to 30	27.5	121	115	113	349	189	160	825	29	0	1.1	0.0	14
20 to 25	22.5	149	68	97	314	148	166	825	33	0	1.0	0.0	13
15 to 20	17.5	95	40	46	181	87	94	825	38	0	0.7	0.0	9
10 to 15	12.5	39	9	28	76	31	45	825	42	0	0.3	0.0	3
5 to 10	7.5	21	5	5	31	14	17	825	47	0	0.1	0.0	2
0 to 5	2.5	4	2	-	6	4	3	825	51	0	0.0	0.0	0
-5 to 0	-2.5	4	-	-	4	2	3	825	56	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	825	60	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	825	65	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	2,092	1,856			-	8		103

LAKEVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	201	127	450	1	0	0.0	0.0	1
50 to 55	52.5	109	182	172	463	266	197	450	4	0	0.2	0.0	3
45 to 50	47.5	105	119	142	366	194	172	450	6	0	0.2	0.0	3
40 to 45	42.5	185	155	177	517	269	248	450	9	0	0.5	0.0	6
35 to 40	37.5	236	200	241	677	349	328	450	11	0	0.8	0.0	10
30 to 35	32.5	237	202	198	637	340	297	450	13	0	0.9	0.0	12
25 to 30	27.5	121	115	113	349	189	160	450	16	0	0.6	0.0	8
20 to 25	22.5	149	68	97	314	148	166	450	18	0	0.5	0.0	7
15 to 20	17.5	95	40	46	181	87	94	450	21	0	0.4	0.0	5
10 to 15	12.5	39	9	28	76	31	45	450	23	0	0.1	0.0	2
5 to 10	7.5	21	5	5	31	14	17	450	26	0	0.1	0.0	1
0 to 5	2.5	4	2	-	6	4	3	450	28	0	0.0	0.0	0
-5 to 0	-2.5	4	-	-	4	2	3	450	30	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	450	33	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	450	35	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	2,092	1,856			-	4		56

Denville Board of Education
Exhibit D
ECM 3B Demand Control Ventilation
Demand Control Ventilation

RIVERVIEW ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	201	127	1,200	3	0	0.1	0.0	2
50 to 55	52.5	109	182	172	463	266	197	1,200	10	0	0.5	0.0	7
45 to 50	47.5	105	119	142	366	194	172	1,200	16	0	0.6	0.0	9
40 to 45	42.5	185	155	177	517	269	248	1,200	23	0	1.2	0.0	17
35 to 40	37.5	236	200	241	677	349	328	1,200	29	0	2.0	0.0	28
30 to 35	32.5	237	202	198	637	340	297	1,200	36	0	2.4	0.0	33
25 to 30	27.5	121	115	113	349	189	160	1,200	42	0	1.6	0.0	22
20 to 25	22.5	149	68	97	314	148	166	1,200	49	0	1.4	0.0	20
15 to 20	17.5	95	40	46	181	87	94	1,200	55	0	1.0	0.0	13
10 to 15	12.5	39	9	28	76	31	45	1,200	62	0	0.4	0.0	5
5 to 10	7.5	21	5	5	31	14	17	1,200	68	0	0.2	0.0	3
0 to 5	2.5	4	2	-	6	4	3	1,200	75	0	0.1	0.0	1
-5 to 0	-2.5	4	-	-	4	2	3	1,200	81	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	1,200	87	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	1,200	94	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	2,092	1,856			-	12		157

VALLEYVIEW MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	315	12	750	2	0	0.1	0.0	1
50 to 55	52.5	109	182	172	463	442	22	750	6	0	0.5	0.0	6
45 to 50	47.5	105	119	142	366	348	18	750	10	0	0.7	0.0	8
40 to 45	42.5	185	155	177	517	495	22	750	14	0	1.4	0.0	16
35 to 40	37.5	236	200	241	677	647	30	750	18	0	2.4	0.0	26
30 to 35	32.5	237	202	198	637	612	25	750	22	0	2.7	0.0	31
25 to 30	27.5	121	115	113	349	335	14	750	26	0	1.8	0.0	20
20 to 25	22.5	149	68	97	314	302	12	750	30	0	1.8	0.0	21
15 to 20	17.5	95	40	46	181	175	6	750	34	0	1.2	0.0	14
10 to 15	12.5	39	9	28	76	73	4	750	38	0	0.6	0.0	6
5 to 10	7.5	21	5	5	31	30	1	750	43	0	0.3	0.0	3
0 to 5	2.5	4	2	-	6	6	-	750	47	0	0.1	0.0	1
-5 to 0	-2.5	4	-	-	4	4	-	750	51	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	750	55	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	750	59	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	3,784	165			-	14		153

Denville Board of Education
Exhibit D
ECM 3B Demand Control Ventilation
Demand Control Ventilation

VALLEYVIEW MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	315	12	750	2	0	0.1	0.0	1
50 to 55	52.5	109	182	172	463	442	22	750	6	0	0.5	0.0	6
45 to 50	47.5	105	119	142	366	348	18	750	10	0	0.7	0.0	8
40 to 45	42.5	185	155	177	517	495	22	750	14	0	1.4	0.0	16
35 to 40	37.5	236	200	241	677	647	30	750	18	0	2.4	0.0	26
30 to 35	32.5	237	202	198	637	612	25	750	22	0	2.7	0.0	31
25 to 30	27.5	121	115	113	349	335	14	750	26	0	1.8	0.0	20
20 to 25	22.5	149	68	97	314	302	12	750	30	0	1.8	0.0	21
15 to 20	17.5	95	40	46	181	175	6	750	34	0	1.2	0.0	14
10 to 15	12.5	39	9	28	76	73	4	750	38	0	0.6	0.0	6
5 to 10	7.5	21	5	5	31	30	1	750	43	0	0.3	0.0	3
0 to 5	2.5	4	2	-	6	6	-	750	47	0	0.1	0.0	1
-5 to 0	-2.5	4	-	-	4	4	-	750	51	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	750	55	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	750	59	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	3,784	165			-	14		153

VALLEYVIEW MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	315	12	750	2	0	0.1	0.0	1
50 to 55	52.5	109	182	172	463	442	22	750	6	0	0.5	0.0	6
45 to 50	47.5	105	119	142	366	348	18	750	10	0	0.7	0.0	8
40 to 45	42.5	185	155	177	517	495	22	750	14	0	1.4	0.0	16
35 to 40	37.5	236	200	241	677	647	30	750	18	0	2.4	0.0	26
30 to 35	32.5	237	202	198	637	612	25	750	22	0	2.7	0.0	31
25 to 30	27.5	121	115	113	349	335	14	750	26	0	1.8	0.0	20
20 to 25	22.5	149	68	97	314	302	12	750	30	0	1.8	0.0	21
15 to 20	17.5	95	40	46	181	175	6	750	34	0	1.2	0.0	14
10 to 15	12.5	39	9	28	76	73	4	750	38	0	0.6	0.0	6
5 to 10	7.5	21	5	5	31	30	1	750	43	0	0.3	0.0	3
0 to 5	2.5	4	2	-	6	6	-	750	47	0	0.1	0.0	1
-5 to 0	-2.5	4	-	-	4	4	-	750	51	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	750	55	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	750	59	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	3,784	165			-	14		153

Denville Board of Education
Exhibit D
ECM 3B Demand Control Ventilation
Demand Control Ventilation

VALLEYVIEW MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	315	12	1,200	3	0	0.2	0.0	2
50 to 55	52.5	109	182	172	463	442	22	1,200	10	0	0.9	0.0	10
45 to 50	47.5	105	119	142	366	348	18	1,200	16	0	1.1	0.0	13
40 to 45	42.5	185	155	177	517	495	22	1,200	23	0	2.2	0.0	25
35 to 40	37.5	236	200	241	677	647	30	1,200	29	0	3.8	0.0	42
30 to 35	32.5	237	202	198	637	612	25	1,200	36	0	4.4	0.0	49
25 to 30	27.5	121	115	113	349	335	14	1,200	42	0	2.8	0.0	32
20 to 25	22.5	149	68	97	314	302	12	1,200	49	0	2.9	0.0	33
15 to 20	17.5	95	40	46	181	175	6	1,200	55	0	1.9	0.0	22
10 to 15	12.5	39	9	28	76	73	4	1,200	62	0	0.9	0.0	10
5 to 10	7.5	21	5	5	31	30	1	1,200	68	0	0.4	0.0	5
0 to 5	2.5	4	2	-	6	6	-	1,200	75	0	0.1	0.0	1
-5 to 0	-2.5	4	-	-	4	4	-	1,200	81	0	0.1	0.0	1
-10 to -5	-7.5	-	-	-	-	-	-	1,200	87	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	1,200	94	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	3,784	165			-	22		244

Denville Board of Education
Exhibit D
ECM 3C Energy Monitoring and Education
Attune Energy Services

ECM DESCRIPTION

Attune Advisor Services provides advisory services to manage the buildings energy and operational efficiency, by analysing the building managament system, and remotely controlling events, trends and settings.

DATA / ASSUMPTIONS

Attune Energy Services Savings	1.0%

*A 3% reduction in energy is conservative to optimize the existing and/or proposed building management system. Typical case study reductions are between 6-10%.

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify transmission of data to Attune Advisory Services and remote control of building management settings through the service.

RECOVERY/SAFETY FACTOR

Safety Factor (Thermal) =	0%

Denville Board of Education
Exhibit D
ECM 3C Energy Monitoring and Education
Attune Energy Services

FORMULAE

$Q_{savings} = Fuel_{ADJ} \cdot Attune_{\%}$

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
$Attune_{\%}$	%	Percentage reduction of thermal consumption due to Attune Advisory Services
$Fuel_{ADJ}$	Therms	Adjusted Boiler Fuel Usage

* Inputs are in blue

Building	Implement Attune
Valleyview Middle School	Y
Lakeview Elementary School	Y
Riverview Elementary School	Y

CALCULATIONS

	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School
Attune Energy Services	Y	Y	Y
Annual Boiler Fuel Use	35,844	48,044	37,172
Adjusted Boiler Usage	35,844	48,044	37,172
Attune Energy Savings	1.0%	1.0%	1.0%
Thermal Savings	358	480	372
Safety Factor	0%	0%	0%
Thermal Savings	358	480	372

Denville Board of Education
Exhibit D
ECM 4A Building Envelope
Building Envelope Improvements

ECM DESCRIPTION

Reduce building infiltration by weather stripping doors, sealing roof & wall joints, duct & piping penetrations, skylight perimeters and window corners.

DATA / ASSUMPTIONS

*Crack area determined by survey team

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Visual inspection per scope of work from subcontractor. Inspection might include smoke test.

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	0%

Recovery factor taken at 10% due to the uncertainty of variables incorporated in the savings calculations

FORMULAE

$Q_{SAVINGS} = ((\ 1.08 \cdot Q_{INF} \cdot HD_{HRS}\ ) / \eta\ )_{/\ 100{,}000}$

$Q_{INF} = (A_{CRACK} \cdot \nu \cdot \delta \cdot \varsigma) / \eta$

$A_{CRACK} = A_{VENTS} + A_{WIN} + A_{RTV} + A_{DOORS} + A_{BULK} + A_{ROOF/WALL}$

Denville Board of Education
Exhibit D
ECM 4A Building Envelope
Building Envelope Improvements

Variable	Units	Description
$Q_{SAVINGS}$	kWh	Electrical Savings associated with VFD
Q_{INF}	kWh	Infiltration savings
A_{CRACK}	ft^2	Total square feet of infiltration spaces
v	ft/min	Average wind speed at building location
δ	%	Windspeed Diversity
ς	%	Percentage of crack area to be eliminated
η	%	Heating system efficiency
HD_{HRS}	(Hr-°F)/Yr	Annual heating degree hours
A_{VENTS}	ft^2	Total square feet of infiltration spaces with regards to vents
A_{WIN}	ft^2	Total square feet of infiltration spaces with regards to windows
A_{RTV}	ft^2	Total square feet of infiltration spaces with regards to RTV's
A_{DOORS}	ft^2	Total square feet of infiltration spaces with regards to doors
A_{BULK}	ft^2	Total square feet of infiltration spaces with regards to bulkheads
$A_{ROOF/WALL}$	ft^2	Total square feet of infiltration spaces with regards to the wall roof joint

Very Good
Good
Average
Poor
Loose

ASSUMPTIONS / DATA

Subcontractor Calculations | N | * If Yes - Please Refer to tab 'Sub BEI Calculation' for details

Building	Building Envelope Improvements (Y/N)	Envelope Tightness	Cooling Savings Applicable (Y/N)
Valleyview Middle School	Y	Loose	Y
Lakeview Elementary School	Y	Loose	y
Riverview Elementary School	Y	Loose	y

Denville Board of Education
Exhibit D
ECM 4A Building Envelope
Building Envelope Improvements

CALCULATIONS

	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School
Building Envelope Improvements	Y	Y	Y
Envelope Tightness	Loose	Loose	Loose
Tightness Multiplier	0.0006	0.0006	0.0006
Cooling Savings Applicable	Y	y	y
Heating Savings Diversity Factor	**95%**	**95%**	**95%**
Flow Factor	20	20	20
(AP)^n	5.16	5.16	5.16
Crack Area	**14.9**	**25**	**15.7**
Air Leakage (CFM)	1,538	2,580	1,620
Heating Degree Days	4,843	4,843	4,843
Heating Efficiency Factor	28,900	28,900	28,900
Cooling Savings Diversity Factor	**90%**	**90%**	**90%**
Constant	4.5	4.5	4.5
CFM	1,538	2,580	1,620
Enthalpy	16.0	16.0	16.0
Tons	9.2	15.5	9.7
Constant	1.2	1.2	1.2
CDD	1,242	1,242	1,242
Load factor	**90%**	**90%**	**90%**
kWh	11,138	18,688	11,736
Therms	2,448	4,107	2,579
Electric Safety Factor	**0%**	**0%**	**0%**
Thermal Safety Factor	**0%**	**0%**	**0%**
kWh Savings	11,138	18,688	11,736
Thermal Savings	2,448	4,107	2,579

		Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School
	Therms	2,740	4,050	2,550
SAVINGS SUM	kwh	6,958	10,643	6,694

Denville Board of Education
Exhibit D
ECM 4B Roof Upgrades
Roof Replacement

ECM DESCRIPTION

Furnish and install a PVC roofing system as manufactured by Sika Samafil or equal.

DATA / ASSUMPTIONS

Heating Hours 3,948 Hours

*U Factors for the new roof was obtained by manufacturer and product data. U Factors for the existing roof is based on construction type and material

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify area of new roof installed.

RECOVERY/SAFETY FACTOR

Recovery/Safety Factor (Electric) =	0%
Recovery/Safety Factor (Thermal) =	0%

Savings calculations are based on weather bin data, fresh air flows and temperature setpoints. A more conservative of 0 percent is used for this ECM due to the uncertainty of variables. The heating fuel savings calculations are based upon information provided by the equipment vendor.

FORMULAE

$Q_{SAVINGS} = (Q_C - Q_C) + Q_{INF}$

$Q_{INF} = \sum^{100}_{-5} \ (1.08 \cdot (i_{ROOF} - i_{ROOF}) \cdot (T_{W/S} - T_{BIN}) \cdot l_R \cdot t_{BIN}) / _{100,000}$

$Q_C = \sum^{100}_{-5} \ ((T_{W/S} - T_{BIN}) \cdot A_{ROOF} \cdot U_{ROOF} \cdot t_{BIN}) / _{100,000}$
$Q_C = \sum^{100}_{-5} \ ((T_{W/S} - T_{BIN}) \cdot A_{ROOF} \cdot U_{ROOF} \cdot t_{BIN}) / _{100,000}$

*Note W/S designates use of either winter building setpoint or summer building setpoint with the appropiate bin

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
Q_C	Therms	Conductive/convective cooling gain and heating loss with existing windows
Q_C	Therms	Conductive/convective cooling gain and heating loss with proposed windows
Q_{INF}	Therms	Infiltration savings with proposed windows
$\sum^{100}_{-5}$	-	Summation of all bins from -5°F to 100°F
T_W	°F	Winter building setpoint
T_S	°F	Summer building setpoint
T_{BIN}	°F	Temperature of respective bin
t_{BIN}	Hrs	Hrs in respective bin
A_{ROOF}	ft^2	Existing unoccupied Bin Hours in respective temperature bin
U_{ROOF}	btu / ft^2 / °F	Existing U-factor of roof
U_{ROOF}	btu / ft^2 / °F	Proposed U-factor of roof
i_{ROOF}	Cfm/ft	Infiltration constant for existing windows
i_{ROOF}	Cfm/ft	Infiltration constant for proposed windows
l_R	ft	Linear feet of curtain wall

* Inputs are in blue

Building	Roof ft^2 Audited	U Factor of Existing Roof	U Factor of Proposed Roof	Infiltration of Existing Roof (CFM / linear ft)	Infiltration of Proposed Roof (CFM / linear ft)	EER of Cooling System (Average)
Valleyview Middle School	19,754	0.22	0.10	0.25	0.10	10.0
Totals						

Denville Board of Education
Exhibit D
ECM 4B Roof Upgrades
Roof Replacement

	Valleyview Middle School	
Roof ft^2 Audited	19,754	ft^2
U of Existing Roof	0.22	btu/ft^2/°F
U of Proposed Roof	0.10	btu/ft^2/°F
Infiltration of Existing Roofs	0.25	CFM / ft
Infiltration of Proposed Roofs	0.10	CFM / ft
Total Linear Ft of Perimeter	562	ft
EER of Cooling System (Average)	10.0	
Existing Occupied Heating Setpoint	74.0	°F
Existing Unoccup. Heating Setpoint	70.0	°F
Existing Occupied Cooling Setpoint	72.0	°F
Existing Unoccup. Cooling Setpoint	76.0	°F
Boiler Efficiency	89.0%	%
Safety Factor	0%	%
Electrical Savings	11,552	kWh/Yr
Thermal Savings	3,839	Therms/Yr

CALCULATIONS

VALLEYVIEW MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	-	19,754	0.2	-	0.1	-	0.1	0.0	0.1	0%	26	
95 to 100	97.5	-	19	2	21	21	0	19,754	2.8	0.0	1.3	0.0	1.5	0.0	1.6	0%	458	
90 to 95	92.5	-	44	13	57	55	2	19,754	5.9	0.1	2.7	0.1	3.3	0.1	3.4	0%	994	
85 to 90	87.5	1	167	60	228	221	8	19,754	17.8	0.4	8.1	0.2	10.0	0.2	10.2	0%	2,991	
80 to 85	82.5	31	283	162	476	456	20	19,754	25.0	0.7	11.3	0.3	14.0	0.3	14.3	0%	4,181	
75 to 80	77.5	191	235	280	706	671	35	19,754	19.2	0.3	8.7	0.1	10.6	0.1	10.7	0%	3,148	
70 to 75	72.5	203	177	222	602	574	28	19,754	1.5	-	0.7	-	0.8	-	0.8	0%	239	
65 to 70	67.5	325	165	204	694	669	26	19,754	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	503	24	19,754	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	315	12	19,754	22.6	0.3	10.3	0.3	12.3	0.4	12.7	0%		143
50 to 55	52.5	109	182	172	463	442	22	19,754	41.3	0.6	18.8	0.7	22.7	0.7	23.4	0%		263
45 to 50	47.5	105	119	142	366	348	18	19,754	40.1	0.5	18.2	0.8	22.2	0.8	23.0	0%		258
40 to 45	42.5	185	155	177	517	495	22	19,754	67.7	0.6	30.8	1.2	37.6	1.3	38.9	0%		437
35 to 40	37.5	236	200	241	677	647	30	19,754	102.6	0.8	46.6	1.9	57.1	2.0	59.1	0%		664
30 to 35	32.5	237	202	198	637	612	25	19,754	110.4	0.6	50.2	1.8	61.4	2.2	63.6	0%		715
25 to 30	27.5	121	115	113	349	335	14	19,754	67.7	0.4	30.8	1.2	37.7	1.4	39.1	0%		439
20 to 25	22.5	149	68	97	314	302	12	19,754	67.6	0.3	30.7	1.1	37.7	1.4	39.0	0%		439
15 to 20	17.5	95	40	46	181	175	6	19,754	43.0	0.1	19.6	0.6	23.9	0.9	24.8	0%		278
10 to 15	12.5	39	9	28	76	73	4	19,754	19.4	0.1	8.8	0.4	10.9	0.4	11.3	0%		127
5 to 10	7.5	21	5	5	31	30	1	19,754	8.8	0.0	4.0	0.1	4.8	0.2	5.0	0%		56
0 to 5	2.5	4	2	-	6	6	-	19,754	1.9	-	0.8	-	1.0	0.0	1.1	0%		12
-5 to 0	-2.5	4	-	-	4	4	-	19,754	1.3	-	0.6	-	0.7	0.0	0.8	0%		8
-10 to -5	-7.5	-	-	-	-	-	-	19,754	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	19,754	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	6,953	307										11,552	3,839

Denville Board of Education
Exhibit D
ECM 5A Computer Power Management
Computer Power Management

ECM DESCRIPTION

Install a centralized personal computer power management system to control computers and monitors.

DATA / ASSUMPTIONS

* Annual Savings for Student Computers	120	kWh/Yr
* Annual Savings for Administrative Computers	110	kWh/Yr

	On		Sleep Mode	
* CRT wattage (Average)	70	W	15	W
* LCD wattage	18	W	5	W

Annual Savings for Administrative Computers and Student Computers are based on previous logging results for computers with similar usage types

MEASUREMENT AND VERIFICATION

Option A - The engineering calculations are based on direct kW measurements of the existing and post software installation computers. All existing computers will be measured before the installation of the computer management software.

COMMISSIONING

Review installation documents for alignments and vibrations. Start up equipment and measure vibration through the load range along with motor kW. Verify that VFDs are capable of operating in full design range upon the control signal demand.

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%

The safety factor for this ECM is taken at 0 due to some variability in schedule and load changes.

Denville Board of Education
Exhibit D
ECM 5A Computer Power Management
Computer Power Management

FORMULAE

$$W_{TOTAL} = (W_{CPU} \cdot CPU_{\#}) + (W_{LCD} \cdot CRT_{\#})$$

$$W_{LCD} = (CRT_{\#} \cdot Monitor_{hrs\text{-}SLEEP} \cdot (W_{CRT\text{-}SLEEP} - W_{LCD\text{-}SLEEP}) \cdot Monitor_{\%OFF}) + (CRT_{\#} \cdot Monitor_{hrs\text{-}ON} \cdot (W_{CRT\text{-}ON} - W_{LCD\text{-}ON}))$$

Variable	Units	Description
W_{TOTAL}	kWh	Total Electrical Savings associated with this measure
W_{CPU}	kWh	Electrical Savings associated with computer control
W_{LCD}	kWh	Electrical Savings associated with Monitor Replacement
$CPU_{\#}$	-	Numbers of Computers
$CRT_{\#}$	-	Numbers of CRTs
$W_{CRT\text{-}ON}$	kWh	Wattage of CRT Monitor when ON
$W_{CRT\text{-}SLEEP}$	kWh	Wattage of CRT Monitor when in sleep mode
$W_{LCD\text{-}ON}$	kWh	Wattage of LCD Monitor when ON
$W_{LCD\text{-}SLEEP}$	kWh	Wattage of LCD Monitor when in sleep mode
$Monitor_{hrs\text{-}ON}$	hrs	Annual hours monitor is ON
$Monitor_{hrs\text{-}SLEEP}$	hrs	Annual hours monitor is in sleep mode
$Monitor_{\%OFF}$	%	Percentage that monitor is off during sleep mode hours

* Inputs are in blue

Building	# of Student Computers	# of Administrative Computers	# of CRTs to be Replaced
Valleyview Middle School	630		
Lakeview Elementary School	500		
Riverview Elementary School	300		
Totals	**1,430**	**0**	**0**

Denville Board of Education
Exhibit D
ECM 5A Computer Power Management
Computer Power Management

CALCULATIONS

	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School
Number of Student Computers	630	500	300
Number of Administrative Computers	-	-	-
Total Number of Computers	630	500	300
Number of CRTs to be Replaced	-	-	-
Monitor On Run Hours	-	-	-
Monitor Sleep Mode Run Hours	-	-	-
Percentage of Monitors Turned off during Unoccupied Hours	0%	0%	0%
kWh Savings (Monitor)	-	-	-
kWh Savings (Computers)	75,600	60,000	36,000
kWh Savings	75,600	60,000	36,000
Recovery Factor	63%	63%	63%
kWh Savings	47,250	37,500	22,500

Denville Board of Education
Exhibit D
ECM 6A Water Conservation
Water Conservation

ECM DESCRIPTION

Reduce water consumption by replacing older less-efficient toilets, urinals, faucets, sinks and showerheads with more water efficient fixtures.

DATA / ASSUMPTIONS

* Existing flow rates were determined by flushometers during walk-throughs
*Proposed flow rates were determined by manufacturer data

MEASUREMENT AND VERIFICATION

Option C (Thermal)- Savings Calculations are based on regression analysis of utility billing meter data
Option C (Water) - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Ensure installation by testing for leaks and proper functionality.

RECOVERY/SAFETY FACTOR

Safety Factor (Thermal) =	0%
Safety Factor (Water) =	0%

Recovery factor taken at 10% due to the variability of fixture usage

FORMULAE

$$Q_{SAVINGS} = [(h_{SAVINGS} \cdot 8.34) \cdot (1000 / 100000)] / \eta_{BOILER}$$

$$h_{SAVINGS} = (h_{Toilet} - h_{Toilet}) + (h_{Urinal} - h_{Urinal}) + (h_{Sink} - h_{Sink}) + (h_{Shower} - h_{Shower})$$

$$h_{Toilet} = (Toilet_{RATE} \cdot Toilet_{USAGE} \cdot Occ_{\%}) / 1{,}000$$
$$h_{Toilet} = (Toilet_{RATE} \cdot Toilet_{USAGE} \cdot Occ_{\%}) / 1{,}000$$

$$h_{Urinal} = (Urinal_{RATE} \cdot Urinal_{USAGE} \cdot Occ_{\%}) / 1{,}000$$
$$h_{Urinal} = (Urinal_{RATE} \cdot Urinal_{USAGE} \cdot Occ_{\%}) / 1{,}000$$

$$h_{Sink} = (Sink_{RATE} \cdot Sink_{USAGE} \cdot Occ_{\%}) / 1{,}000$$
$$h_{Sink} = (Sink_{RATE} \cdot Sink_{USAGE} \cdot Occ_{\%}) / 1{,}000$$

$$h_{Shower} = (Shower_{RATE} \cdot Shower_{USAGE} \cdot Occ_{\%}) / 1{,}000$$
$$h_{Shower} = (Shower_{RATE} \cdot Shower_{USAGE} \cdot Occ_{\%}) / 1{,}000$$

Variable	Units	Description
$Q_{SAVINGS}$	Therms	Annual Thermal Savings
$h_{SAVINGS}$	kGal	Annual Water Savings
η_{BOILER}	%	Efficiency of Boiler
T_{SINK}	°F	Temperature of Sink Water
T_{SHOWER}	°F	Temperature of Shower Water
T_{CITY}	°F	Temperature of incoming city water
h_{TOILET}	kGal	Existing Toilet Water Usage
h_{TOILET}	kGal	Proposed Toilet Water Usage
h_{Urinal}	kGal	Existing Urinal Water Usage
h_{Urinal}	kGal	Proposed Urinal Water Usage
h_{Sink}	kGal	Existing Sink Water Usage
h_{Sink}	kGal	Proposed Sink Water Usage
h_{Shower}	kGal	Existing Shower Water Usage
h_{Shower}	kGal	Proposed Shower Water Usage
Occ_{DAYS}	-	Equivalent Days of occupied use
$Occ_{\%}$	%	Percentage of occupants that occupy the building daily
Ppl	-	Number of building occupants
$Ur_{\%}$	%	Urinal Usage Factor
$Toilet_{USAGE}$	-	Toilet Usage per day per occupant
$Urinal_{USAGE}$		Urinal Usage per day per occupant
$Sink_{USAGE}$		Sink Usage per day per occupant
$Shower_{USAGE}$		Shower Usage per day per occupant
$Toilet_{RATE}$	Gallons	Existing Gallons per Usage
$Toilet_{RATE}$	Gallons	Proposed Gallons per Usage
$Urinal_{RATE}$	Gallons	Existing Gallons per Usage
$Urinal_{RATE}$	Gallons	Proposed Gallons per Usage
$Sink_{RATE}$	Gallons	Existing Gallons per Usage
$Sink_{RATE}$	Gallons	Proposed Gallons per Usage
$Shower_{RATE}$	Gallons	Existing Gallons per Usage
$Shower_{RATE}$	Gallons	Proposed Gallons per Usage

Denville Board of Education
Exhibit D
ECM 6A Water Conservation
Water Conservation

* Inputs are in blue
*Checks against baseline are in purple

Subcontractor Calculations N * If Yes - Please Refer to tab 'Sub Water Conservation' for details

Building	Water Conservation	Daily Occupants	Occupied Days
Valleyview Middle School	Y	707	180
Lakeview Elementary School	Y	739	180
Riverview Elementary School	Y	451	180
Totals		1,897	540

CALCULATIONS

	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School
Water Conservation	Y	Y	Y
Item			
Daily Occupants	707	739	451
Area of Occupied Facilities	82,932	82,007	54,121
Occupancy Factor	70%	90%	90%
Occupied Days	180	200	180
Occupant Days	89,082	133,020	73,062
Toilet Consumption			
Toilet Usage Rate	0.8	0.85	0.85
Existing Toilet Flow Rate	2.36	1.89	2.43
Existing Annual Toilet Flow	168	214	151
Proposed Toilet Flow Rate	1.57	1.69	1.55
Proposed Annual Toilet Flow	112	191	96
Urinal Consumption			
Urinal Usage Rate	0.8	0.85	0.85
Urinal Usage Factor	50%	50%	50%
Existing Urinal Flow Rate	0.9	0.8	0.6
Existing Annual Urinal Flow	31	46	18
Proposed Urinal Flow Rate	0.5	0.5	0.5
Proposed Annual Urinal Flow	16	27	15
Lavatory/Sink Consumption			
Sink Usage Factor	80%	85%	85%
Existing Sink Flow Rate	2.1	1.27	2.01
Existing Annual Sink Flow	150	144	125
Proposed Sink Flow Rate	0.5	0.5	0.5
Proposed Annual Sink Flow	36	57	31
Shower Consumption			
Shower Usage Factor	-	-	-
Existing Shower Flow Rate	2.5	2.5	2.5
Existing Annual Shower Flow	-	-	-
Proposed Shower Flow Rate	1.5	1.5	1.5
Proposed Annual Shower Flow	-	-	-
Kitchen Consumption			
% Persons Eat Breakfast	0%	0%	0%
% Persons Eat Lunch	0%	0%	0%
% Persons Eat Dinner	0%	0%	0%
Breakfast Consumption	0.650	0.650	0.650
Lunch Consumption	0.950	0.950	0.950
Dinner Consumption	1.000	1.000	1.000
Total Meal Consumption	-	-	-
Miscellaneous			
Drinking Water	0.01	0.01	0.01
Cleaning	0.00	0.01	0.01
Campus Area	0	0	0
Garden Area	0.5	0.15	0.15
Total Irrigation	0	0	0
Vehicle Washing	0	0	0
Lab Equipment testing	0	0	0
Annual Cooling Load to tower		-	-
Cooling Tower M/U	-	-	-
Boiler Make-up	-	-	-
Total Misc. uses	1	209	127

Denville Board of Education
Exhibit D
ECM 6A Water Conservation
Water Conservation

Laundry			
Load person	0	0	0
% Occupant Laundry Done	0	0	0
Gal/Load	0	0	0
Annual Use	-	-	-
Leaks			
% Total Water Use	1%	1%	1%
Total Loss	3.43	6.29	4.28
% of Loss Repaired During Retrofit	10%	10%	10%
Retrofit Water Consumption	3	6	4
Baseline Water Consumption	343	629	428
Calculated Existing Water Usage	353	619	425
Water Usage Accounted for (Must be 70% to 100%)	**102.9%**	**98.4%**	**99.3%**
Calculated Proposed Water Usage	168	490	274
Water Savings	185	129	151
Thermal Savings			
City Water Temperature	60	60	60
Sink Water temperature	120	120	120
Shower Water Temperature	110	110	110
Boiler Efficiency	89.0%	77.0%	73.7%
Thermal Savings	570	435	469
Actual Thermal Savings	640	565	636
Safety Factor Water	**0%**	**0%**	**0%**
Safety Factor Thermal	**0%**	**0%**	**0%**
Water Savings	185	129	151
Thermal Savings	640	565	636

Denville Board of Education
Exhibit D
ECM 7A Demand Response/Permanent Load Reduction
Demand Response

ECM DESCRIPTION

PJM Demand Response Program based on Shedable Load on Peak Demand Curtailment Day

DATA / ASSUMPTIONS

Demand Response Revenue	$ 44,125	/ MW
Permanent Load Reduction	$ 15,000	/ MW
Customer Share (Typically between 60-70%)	70%	

*Demand Response Savings = Assumed between 1 - 4% Annual Electrical Load
*Assume 2% of Total District Load as Shedable
*Savings is not Guaranteed any savings from program will be considered operational savings only

MEASUREMENT AND VERIFICATION

None - Operational Savings

COMMISSIONING

N/A

RECOVERY/SAFETY FACTOR

N/A

Denville Board of Education
Exhibit D
ECM 7A Demand Response/Permanent Load Reduction
Demand Response

FORMULAE

$\$_{savings} = kWh_{ADJ} \cdot Cust_{\%} \cdot DM_{\%}$

Variable	Units	Description
$\$_{savings}$	Dollars	Dollar Savings from Demand Response
$DM_{\%}$	%	Demand Response Savings as a percentage of electric baseline
$Cust_{\%}$	**%**	Customer Percentage of Savings
kWh_{BASE}	kWh	Adjusted Boiler Fuel Usage

* Inputs are in blue

Building	**Demand Response Participation (Y/N)**
Valleyview Middle School	**Y**
Lakeview Elementary School	**Y**
Riverview Elementary School	**Y**

Denville Board of Education
Exhibit D
ECM 7A Demand Response/Permanent Load Reduction
Demand Response

CALCULATIONS

	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School
Demand Response Participation	Y	Y	Y
Average Monthly kW	139	186	88
Permanent Load Shed Reduction (kW)			
Sheddable Load (kW)	**50**	**74**	**42**
Percentage of Baseline Demand	**0.0%**	**0.0%**	**0.0%**
Demand Response $ / MW	$ 44,125	$ 44,125	$ 44,125
Permanent Load Shed Reduction $ / MW	$ 15,000	$ 15,000	$ 15,000
Demand Hours / Year	100	100	100
Cost to Run Generator / hr	$ -	$ -	$ -
Cost to Run Generator / yr	$ -	$ -	$ -
Safety Factor	**0%**	**0%**	**0%**
DR and PLR Savings	$ 2,197	$ 3,265	$ 1,836
Net Demand Response Savings	$ 1,538	$ 2,286	$ 1,286

Denville Board of Education
Exhibit D
ECM 8A Solar PPA System
Photovoltaic System

ECM DESCRIPTION

Installation of a photovoltaic array - reducing grid electricity with a reduction of greenhouse gas emissions.

DATA / ASSUMPTIONS

Solar PPA Rate	**$0.094**
*1-Axis Tracking System Collection Improvement:	**18.6%**

*Emperical studies show an that annual output increases 18.6% with use of one-axis sun tracking
**Assume two weeks of downtime for PV maintenance

Solar radiation at ground level was obtained using the data collected by the National Renewable Energy Laboratory (NREL) via the software Pvwatts.
Proposed technology is only able to convert 77% of the direct current produced at the panel to a usable alternative current for building consumption

MEASUREMENT AND VERIFICATION

Option C - Verification by dedicated electric meter.

COMMISSIONING

Test installed system - measuring the output and verify with calculations for weather conditions. Verify all electrical connections and tie-ins to the grid and the building power.

SAFETY FACTOR

Safety Factor (Electric) =	**0%**

FORMULAE

$$W_{PV} = \sum_{Jan}^{Dec} (Q_{RAD} \cdot A_{PV} \cdot t_{MONTH}) \cdot t_{\%}$$

Variable	Units	Description
W_{PV}	kWh	Electrical energy produced by PV array
$\sum_{Jan}^{Dec}$	-	Summation of months
Q_{RAD}	kWh/m^2/day	Solar radiation (averaged by month) capable of being collected with the proposed PV technology
A_{PV}	ft^2	Area of proposed system
t_{MONTH}	Days	Days in the month
$t_{\%}$	%	Percentage of operational time

Denville Board of Education
Exhibit D
ECM 8A Solar PPA System
Photovoltaic System

* Inputs are in blue

Building	DC Rating of System	Install 1-Axis Tracking System (Y/N)
Valleyview Middle School	226.0	N
Lakeview Elementary School	432.0	N
Riverview Elementary School	199.0	N
Totals	**857.0**	

Cell ID	Newark
State	New Jersey
Latitude	40.1 ° N
Longitude	74.3 ° W

Month	Days in Month	**Solar Radiation (kWh/m2/day)	Solar Radiation per 1-kW (kWh)
Jan	31	2.39	74.1
Feb	28	3.17	88.8
Mar	31	4.07	126.2
Apr	30	4.83	144.9
May	31	5.70	176.7
Jun	30	5.94	178.2
Jul	31	5.77	178.9
Aug	31	5.38	166.8
Sep	30	4.65	139.5
Oct	31	3.61	111.9
Nov	30	2.35	70.5
Dec	31	2.01	62.3
Total		**4.16**	**1,518.7**

CALCULATIONS

	Valleyview Middle School	Lakeview Elementary School	Riverview Elementary School
DC Rating of System	226.0	432.0	199.0
Install 1-Axis Tracking System	N	N	N
**Annual Operational Hours	8,424	8,424	8,424
DC to AC Safety Factor	0.72	0.72	0.72
*Efficiency gain with 1-Axis Tracking	0.0%	0.0%	0.0%
Total kWh AC per year Generated	238,329	455,808	209,856
Safety Factor	0%	0%	0%
kWh Savings	238,329	455,808	209,856

APPENDIX 3 DATA LOGGER GRAPHS

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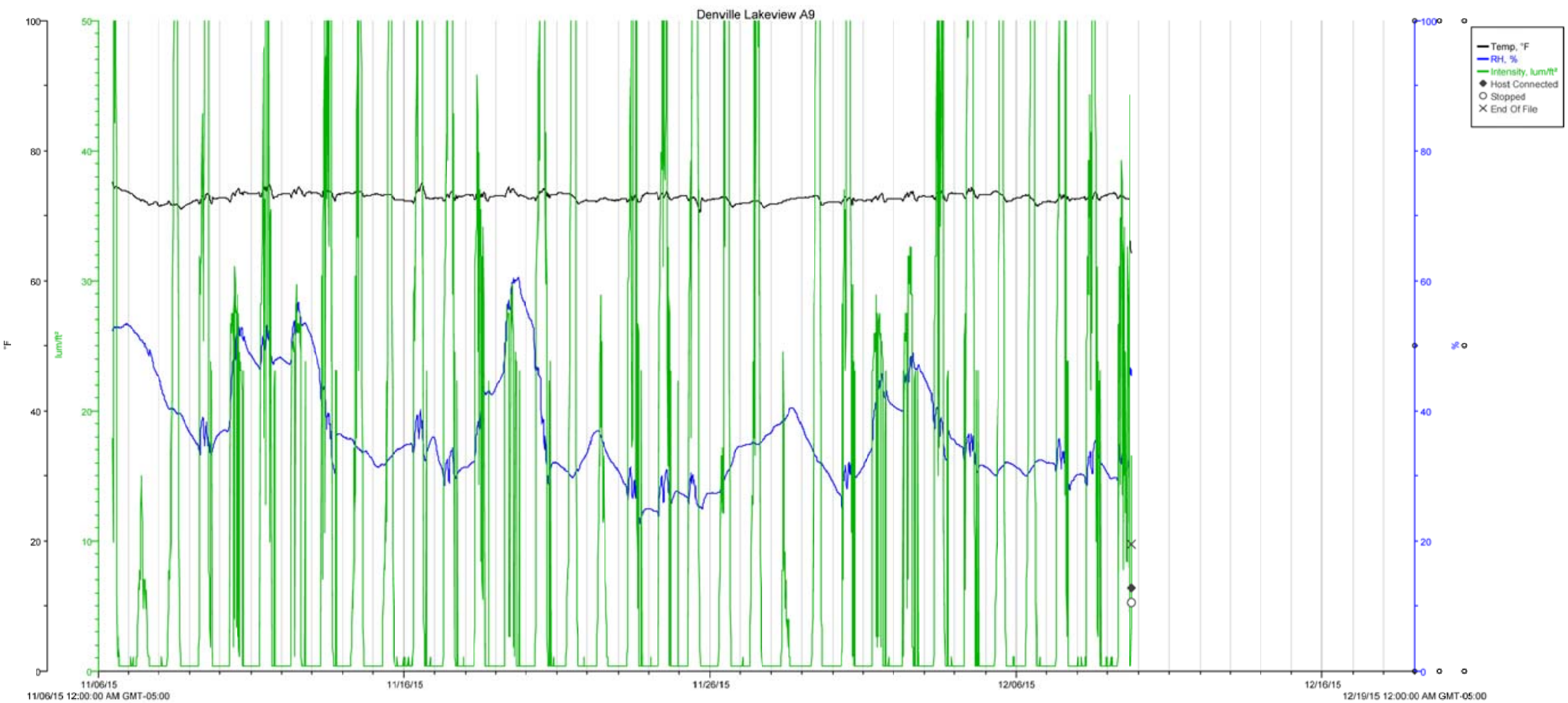

Denville Lakeview A9
°F
lum/ft²
%
100
80
60
40
20
0
50
40
30
20
10
0
11/06/15
11/16/15
11/26/15
12/06/15
12/16/15
11/06/15 12:00:00 AM GMT-05:00
12/19/15 12:00:00 AM GMT-05:00
Temp, °F
RH, %
Intensity, lum/ft²
Host Connected
Stopped
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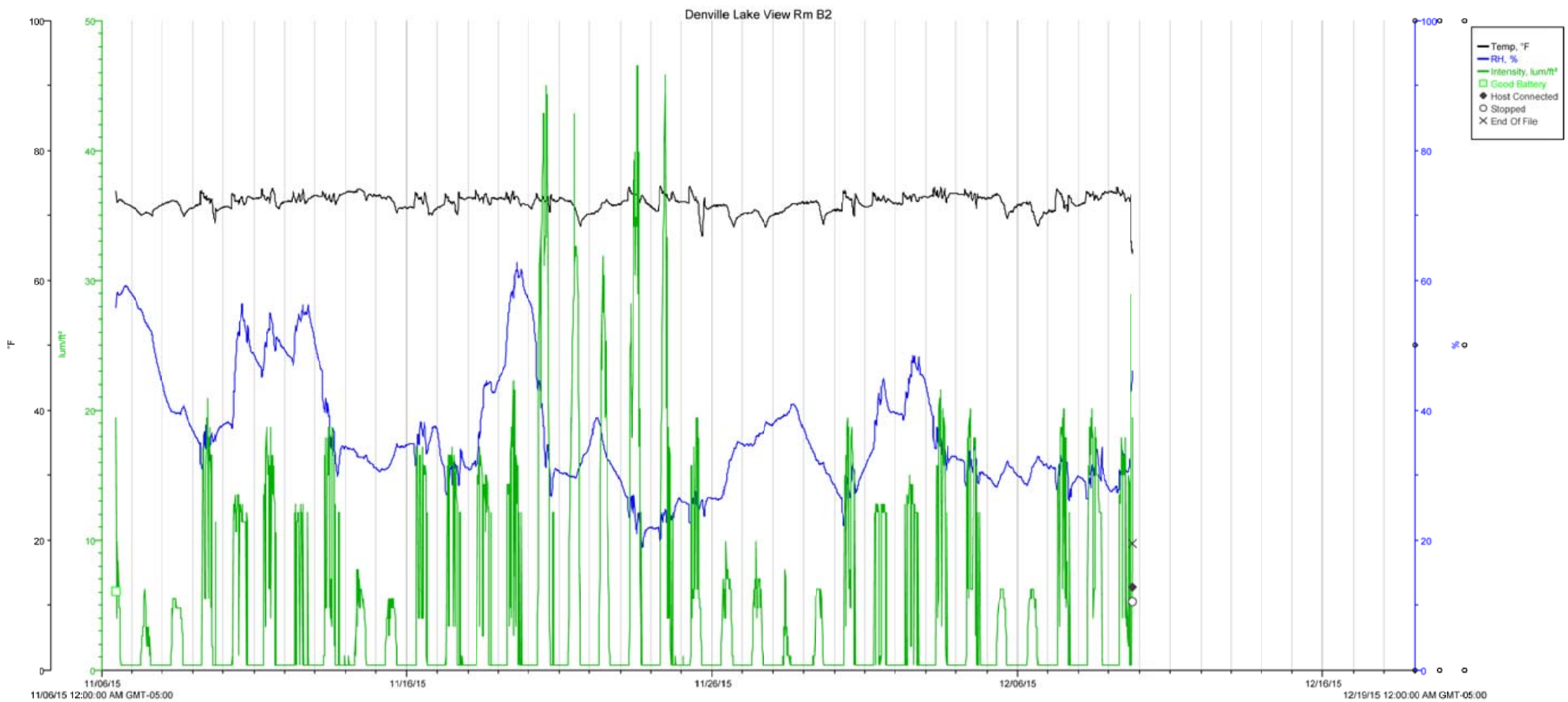

Denville Lake View Rm B2
Temp, °F
RH, %
Intensity, lum/ft²
Good Battery
Host Connected
Stopped
End Of File
°F
lum/ft²
%
11/06/15
11/16/15
11/26/15
12/06/15
12/16/15
11/06/15 12:00:00 AM GMT-05:00
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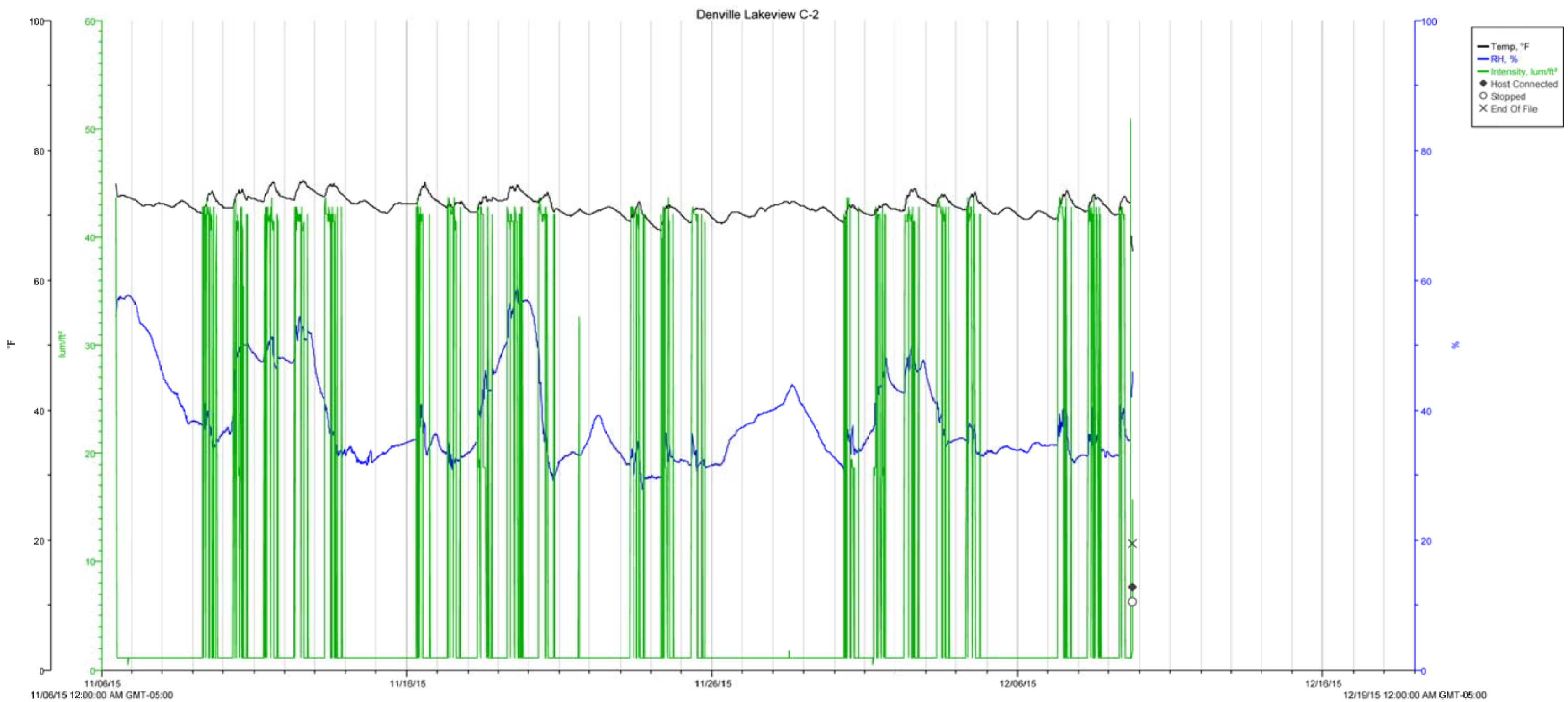

Denville Lakeview C-2
°F
lum/ft²
%
Temp, °F
RH, %
Intensity, lum/ft²
Host Connected
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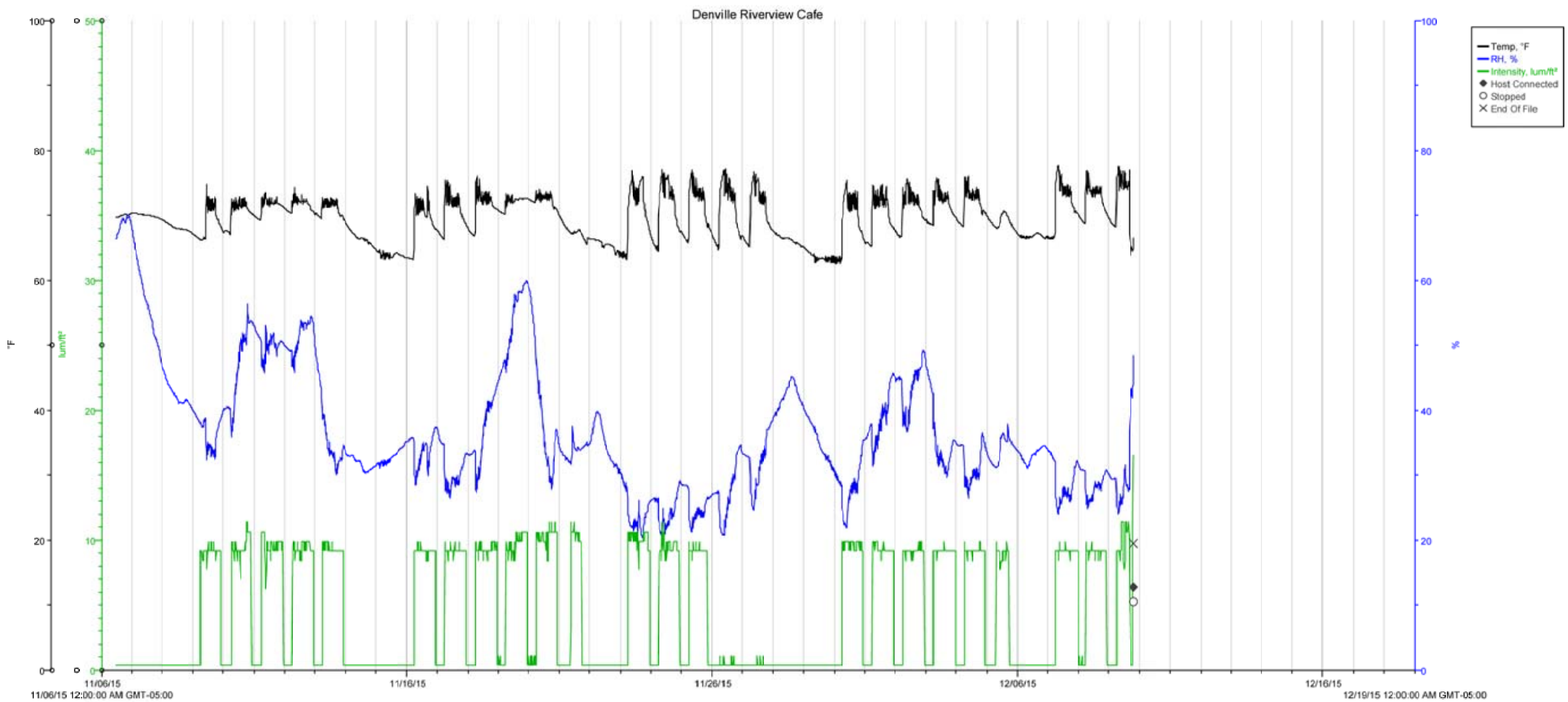
11/26/15
12/06/15
12/16/15
11/06/15 12:00:00 AM GMT-05:00
12/19/15 12:00:00 AM GMT-05:00



Denville Riverview Cafe
Temp, °F
RH, %
Intensity, lum/ft²
Host Connected
Stopped
End Of File
°F
lum/ft²
%
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11/16/15
11/26/15
12/06/15
12/16/15
11/06/15 12:00:00 AM GMT-05:00
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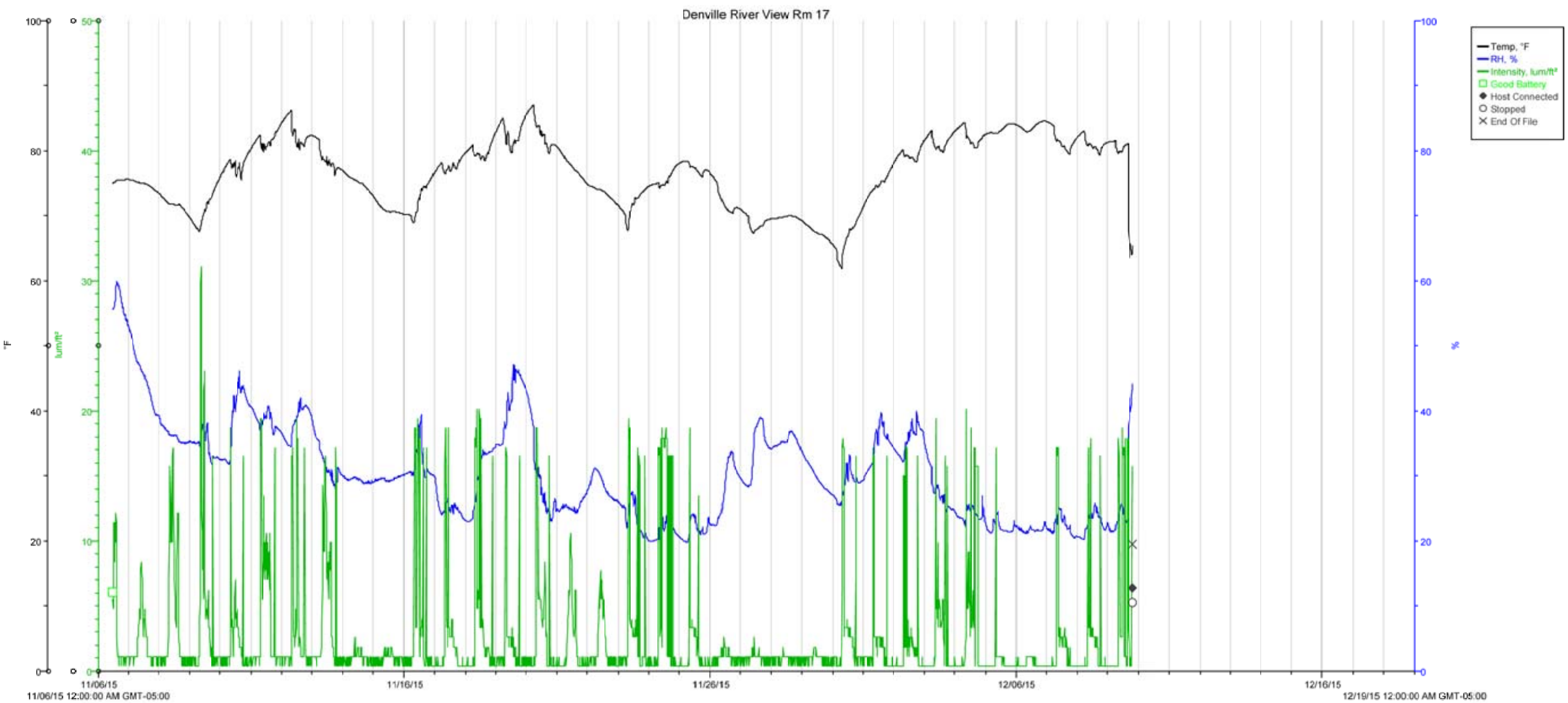

Denville River View Rm 17
Temp, °F
RH, %
Intensity, lum/ft²
Good Battery
Host Connected
Stopped
End Of File
°F
lum/ft²
%
11/06/15
11/16/15
11/26/15
12/06/15
12/16/15
11/06/15 12:00:00 AM GMT-05:00
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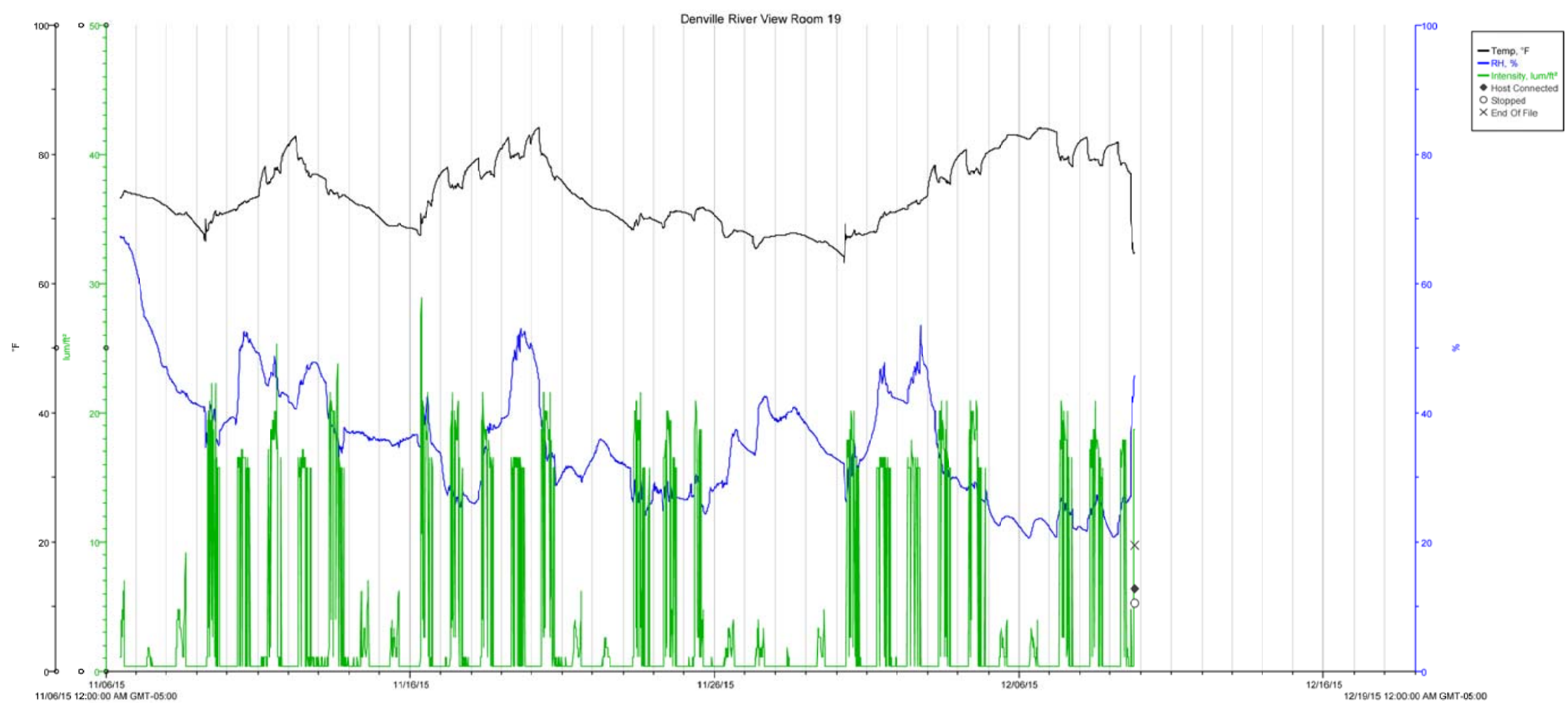

Denville River View Room 19
Temp, °F
RH, %
Intensity, lum/ft²
Host Connected
Stopped
End Of File
°F
lum/ft²
%
11/06/15
11/16/15
11/26/15
12/06/15
12/16/15
11/06/15 12:00:00 AM GMT-05:00
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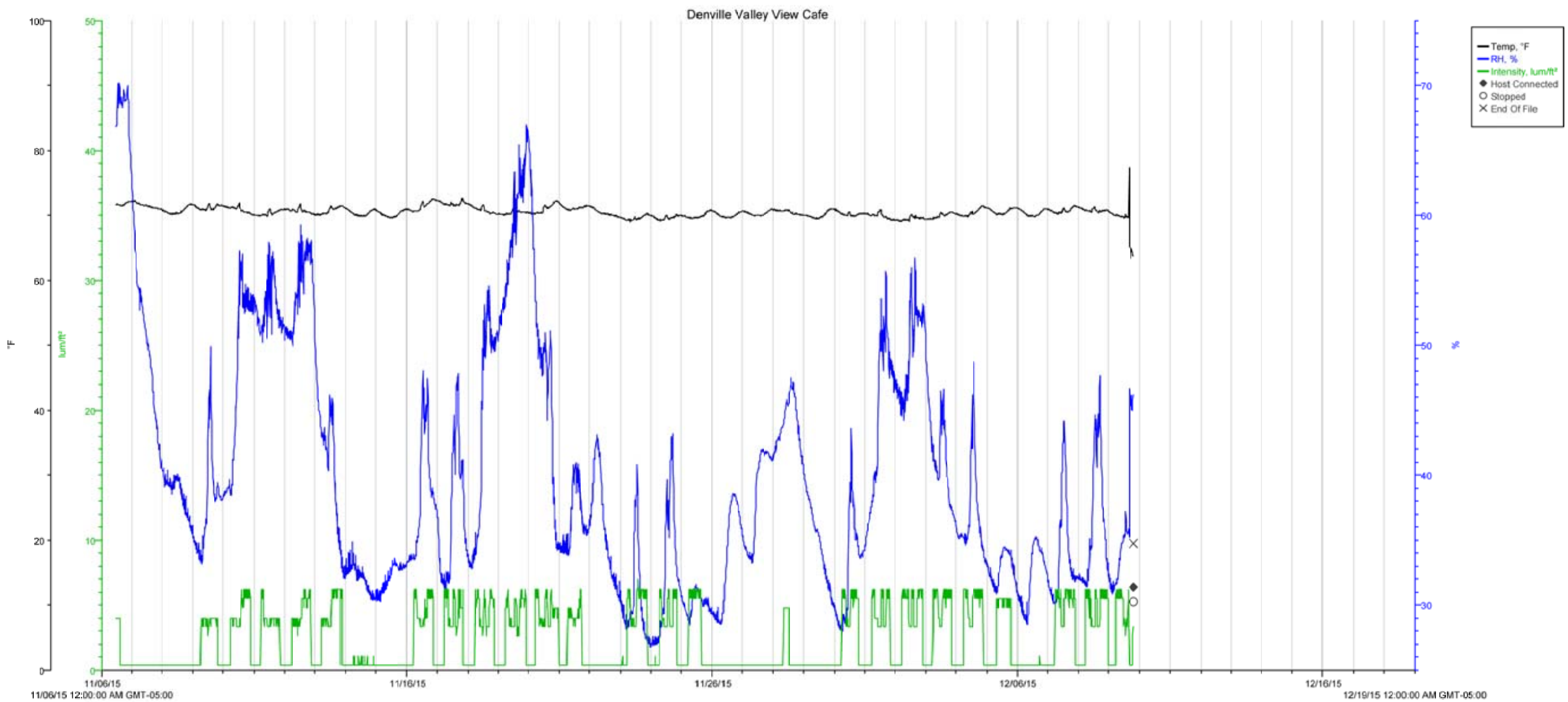
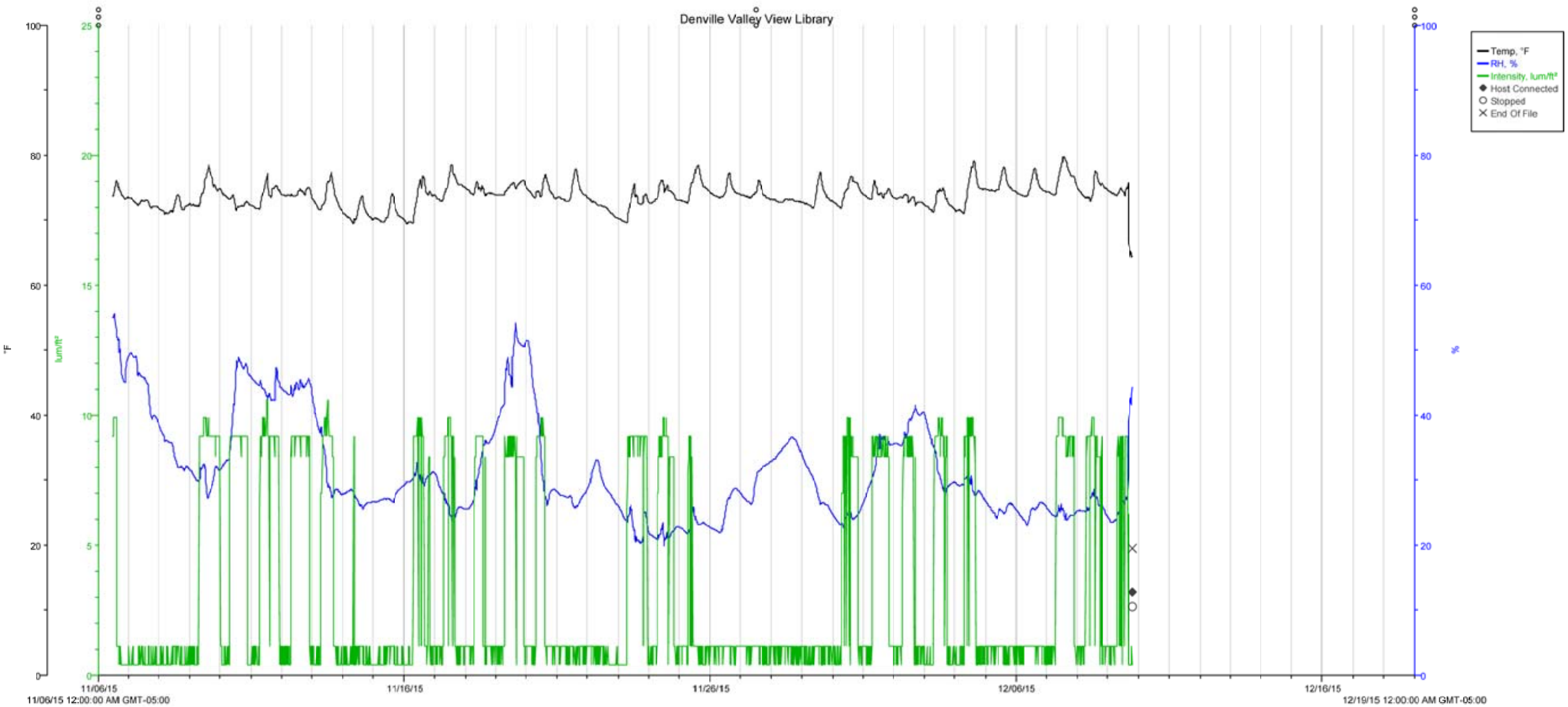
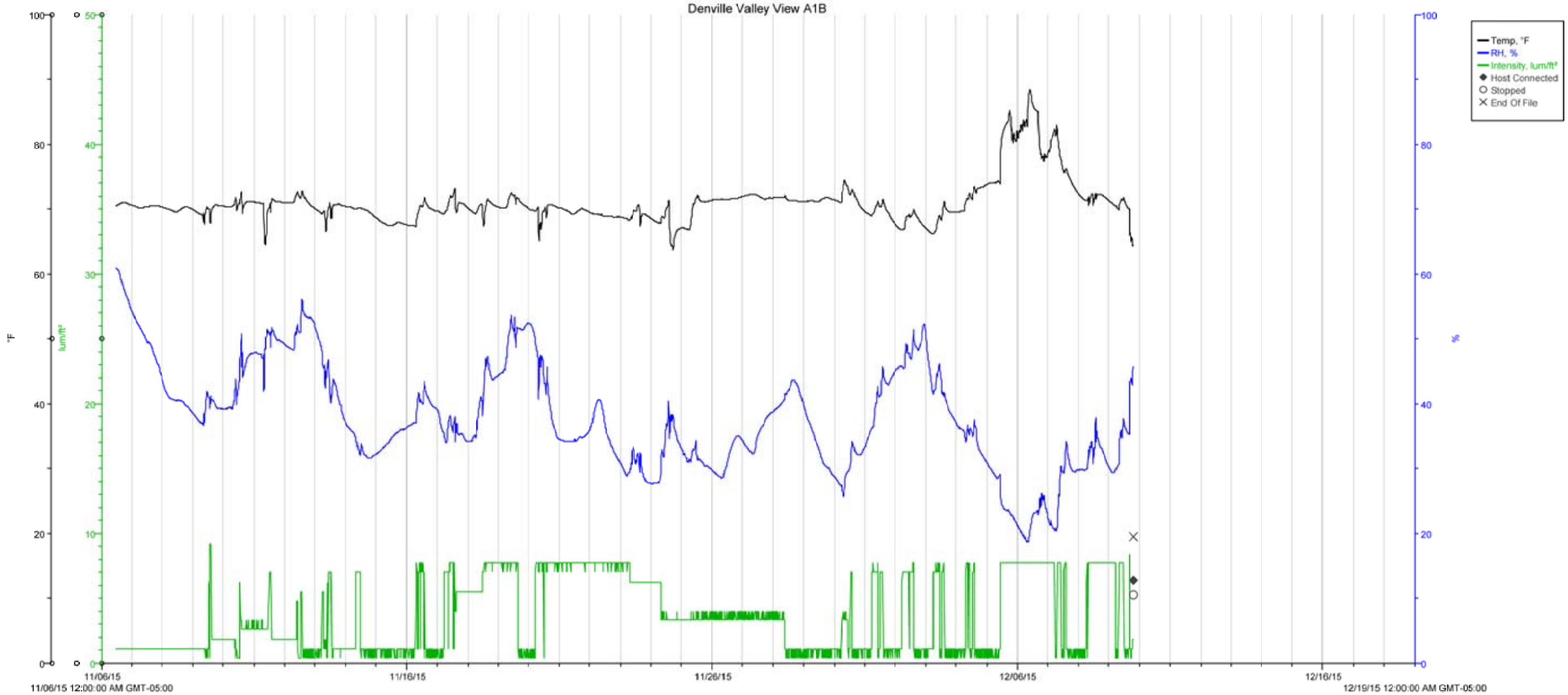


Denville Valley View Cafe
°F
lum/ft²
%
Temp, °F
RH, %
Intensity, lum/ft²
Host Connected
Stopped
End Of File
11/06/15
11/16/15
11/26/15
12/06/15
12/16/15
11/06/15 12:00:00 AM GMT-05:00
12/19/15 12:00:00 AM GMT-05:00



Denville Valley View Library
Temp, °F
RH, %
Intensity, lum/ft²
Host Connected
Stopped
End Of File
°F
lum/ft²
%
11/06/15
11/16/15
11/26/15
12/06/15
12/16/15
11/06/15 12:00:00 AM GMT-05:00
12/19/15 12:00:00 AM GMT-05:00

Denville Valley View A1B



APPENDIX 4 CUTSHEETS

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BENCHMARK SERIES High-Efficiency Boilers

Business/Residential/Hotels

Education

Government

The Benchmark: Unmatched Reliability and ROI

More than 25 years ago, AERCO introduced the Benchmark boiler - the first condensing and fully modulating boiler for the commercial market. Ever since, Benchmark boilers have been considered the gold standard in hydronic heating and have set the bar for high efficiency. More importantly, they continue to deliver significant ROI to thousands of customers including increased energy savings, reliable heat, and lower installation and operational costs -- all in a space-saving, compact footprint.

Saves Space, Easy to Install

The Benchmark is a powerful boiler packed into a small footprint. Each stainless steel unit fits through standard 30" doorways and can travel via elevators – no need to tear down walls, use cranes or other expensive tools. In fact, our Benchmark 6000 is the smallest of its kind – **a third the size of the competition.**

Simple to Service

Removable enclosure panels provide easy access to all piping making the Benchmark extremely easy to service which simplifies lifetime maintenance. It's also compatible with popular EMS software, and can be remotely controlled providing detailed LCD diagnostics that can help prevent any issues from developing.

Superior Construction for Greater Uptime Reliability

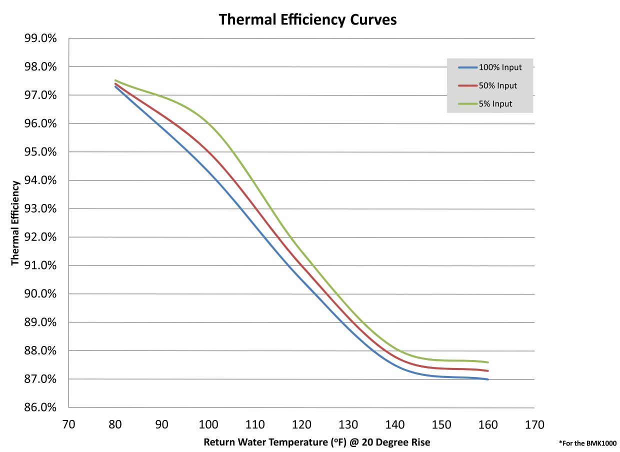
AERCO's 439 stainless steel heat exchanger delivers a longer life through a simplified design that has only two moving parts. The condensing heat exchanger design is built to withstand thermal shock and eliminates the need for boiler pumping equipment. The forced draft, modulating burners operate with unmatched turndown to minimize cycling and maximize seasonal efficiency while simplifying the venting system. AERCO's patented air/fuel delivery system and fully modulating burner reduces cycling losses, as well as wear and tear.

10-year Warranty

AERCO stands behind its products. The heat exchanger in the Benchmark boilers has a 10-year full (non-prorated) warranty.

High Efficiency, Increased Energy Savings

Benchmark Models as approved and listed on the AHRI Directory	Thermal Efficiency, 100% Input • (High Fire) 100°F Temperature Differential • (80°F-180°F)
BMK750	95.6%
BMK1000	96.8%
BMK1500	94.6%
BMK2000	94.6%
BMK2500	93.5%
BMK3000	93.5%
BMK6000	94.5%



Office Buildings

Education

Government

Multifamily Housing

Lodging

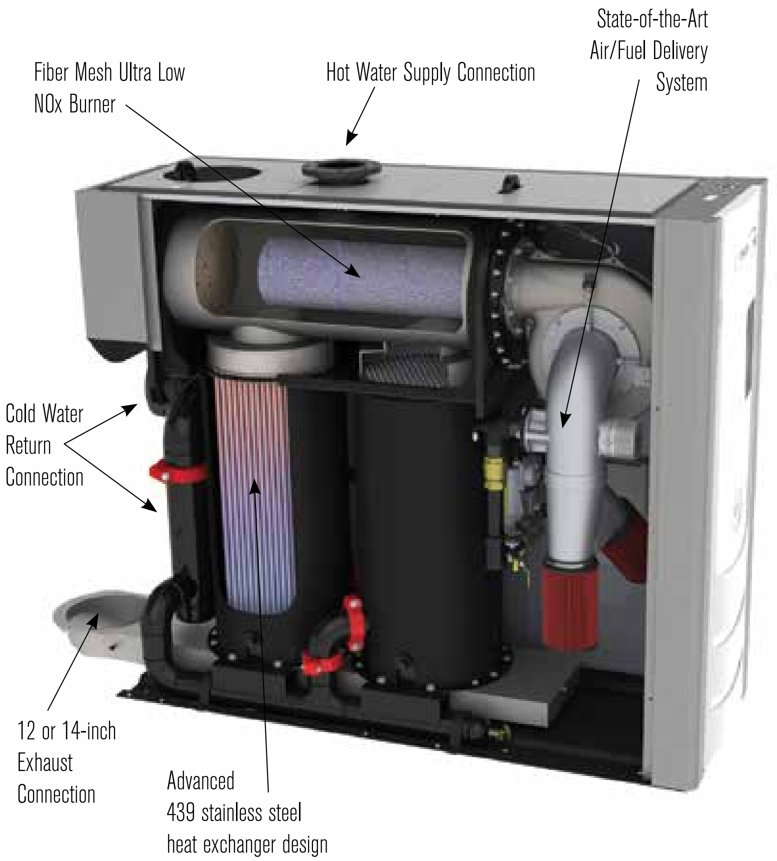
State of the Art Technology and Features

Benchmark 750, 1000, 1500, 2000, 2500, 3000

- 15:1-20.1 turndown
- Oxygen level (O2) monitoring
- Durable and reliable 439 Stainless Steel firetube heat exchanger
- Capable of variable primary flow installations
- Low NOx emissions (20 ppm or less at all firing rates)
- 9 ppm optional calibration
- Compact footprint – all models fit through standard doorway
- Dual return connections
- Ducted combustion air capable
- Venting versatility with AL29-4C, Polypropylene, CPVC, or PVC
- Available in Natural Gas, Propane, and Duel Fuel (1500, 2000, 2500, 3000)

Benchmark 6000

- 15:1 turndown
- Oxygen level (O2) monitoring
- Durable and reliable 439 Stainless Steel firetube heat exchanger
- Capable of variable primary flow installations
- Low NOx emissions (20 ppm or less at all firing rates)
- 9 ppm optional calibration (requires 14" exhaust venting)
- Compact footprint – a third the size of the competition
- Ducted combustion air capable
- Venting versatility with AL29-4C, Polypropylene, CPVC, or PVC
- Available in Natural Gas and Duel Fuel



Optimizing Your System

To optimize your system, Benchmark boilers come standard with Dual Return Connections and our Boiler Sequencing Technology (BST) which shares the load between a few units to maximize energy efficiency. An additional way to ensure your system operates at peak performance is through our OnAER Remote Monitoring Service detailed below.

Boiler Sequencing Technology (BST) - Load Sharing Strategy Maximizes Energy Efficiency

It requires less energy for a group of modulating boilers, each firing at "part load," to heat a building, than for a single boiler operating at "full fire" to carry the entire workload. To meet building demand, the BST employs as many boilers as available, each operating at its most efficient firing rate. Because the BST reacts in real-time (up to 8 boilers), users can take a unit offline for maintenance at any time or bring on back-up boilers for extremely cold conditions without changes to your system's performance. And as individual boilers are added or deleted, the energy delivered is automatically adjusted to prevent fluctuations in the header temperature of the plant.

Dual Returns

Dual Return Connections are standard in the Benchmark*. They provide optimal application flexibility and boost seasonal efficiency gains of up to 12%. The heat exchanger's maximum working temperature of 240°F allows for greater operating temperature range and meet the requirements of higher temperature applications when necessary, but also enables the building to reset water temperature for condensing in the shoulder months.

Installations with space heating or process heating along with the following applications that can take advantage of this feature include (but not limited to):

- Domestic hot water applications
- Higher ΔT zones with lower return temperatures
- Air preheat
- Heat pump injection

Rather than blend the separate zones, the lower return temperature zones/systems could be piped separately to the primary water connection, raising the overall thermal efficiency and allowing the boiler to be in condensing zone for longer periods throughout the year.

OnAER Remote Monitoring System

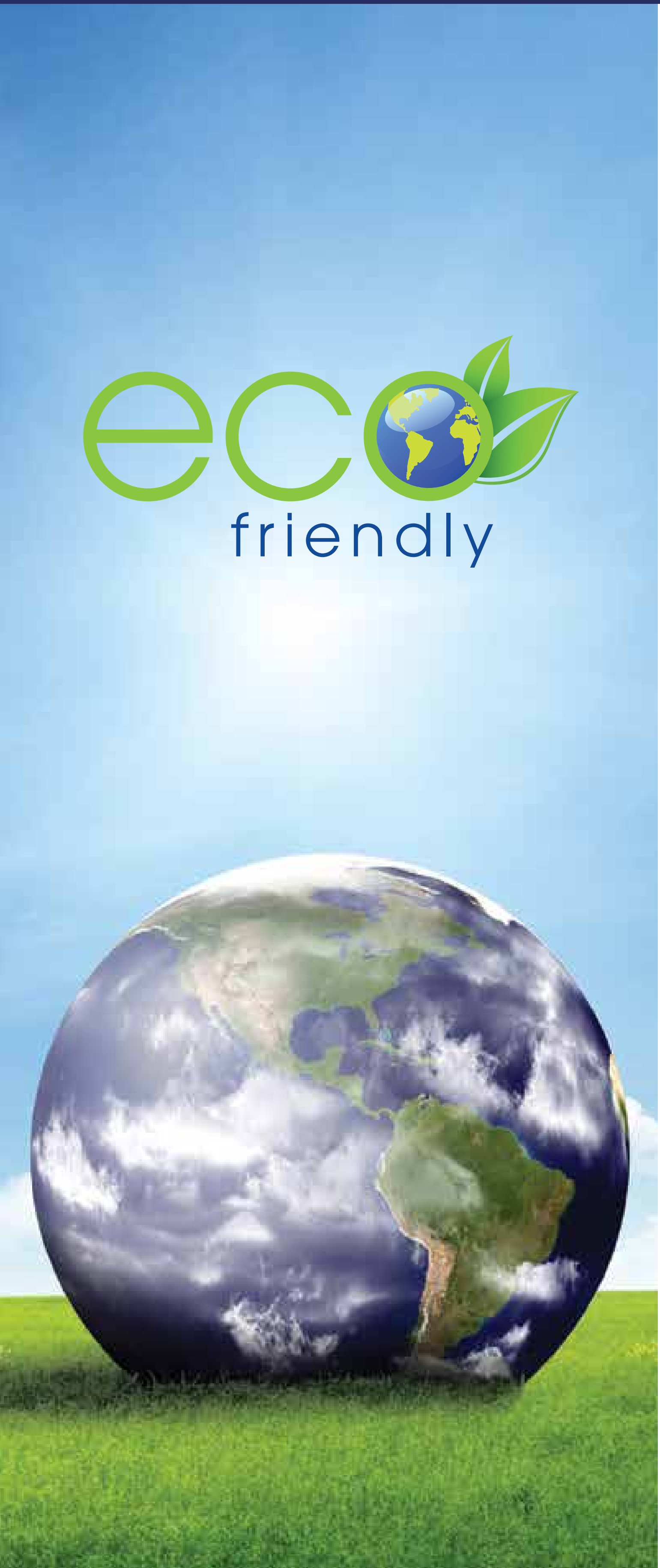
OnAER Remote Monitoring Service is a secure, low-cost, proactive tool that ensures your system operates at peak performance. Our state-of-the-art computers continuously monitor the health of your system and immediately alert you to a fault or decline in equipment performance, enabling you to resolve issues quickly and prevent more serious problems from developing. Benefits of OnAER:

- Increases productivity and efficiency
- Reduces energy waste
- Decreases cost of ownership
- Prevents lost revenue caused by unexpected downtime

Consult AERCO if you are interested in receiving the benefits of OnAER Remote Monitoring Service.

*Except Benchmark 6000.

Environmental Stewards



The Greenspec® Listed Benchmark boilers are perfect for "green" designs. Their small footprint, flexible venting/piping options, high efficiency and lower operating costs can help facilities earn LEED points. Benchmark has been designed with several environmental advantages:

O2 Monitoring System

Benchmark units are available with AERCO's proprietary O2 monitoring system, which displays the oxygen level directly on the C-More controller in real time. It can be monitored via Modbus, so customers can measure emission levels and fuel combustion efficiency to maximize fuel economy.

Low NOx Burner

Benchmark boilers are fitted with a low NOx burner whose emissions consistently meet the highest regulatory standards. Ultra low NOx (9 ppm or less) calibrations are available.*

C-More Advanced Controls

The C-More Control System optimizes the efficiency and operation of your system by combining temperature and operating controls, combustion safeguards and fault enunciator functions – all at your fingertips.
Benefits include:

- Simplifies diagnostic troubleshooting
- User-friendly intuitive control
- Full integration with BAS and EMS systems
- Supports remote data monitoring and control
- Integrated Boiler Sequencing Technology (BST)
- Ensures fail-safe boiler operation (if external building controls fail)

*See tech data sheets for model specs.

Sample Installations

Education

SUNY Cortland University, New York

The 60-year-old centralized heating plant at the State University of New York at Cortland was outdated and extremely inefficient. Heating costs accounted for more than 40 percent of the college's energy budget. The old plant allowed much heat go to waste as the steam traveled from the plant to dozens of campus buildings. To update their heating plant, the college decided to decentralize their old system and installed AERCO Benchmark boilers in each building across campus. The $12 million, two-year project replaced the old central steam heating plant and its three-pipe network with 42 individual boilers going into 21 buildings. This allowed the steam heat produced by each boiler to remain in that structure as well as reduced the amount of natural gas used and eliminated maintenance costs needed for previous steam leaks in the old pipe system. As a result of incorporating AERCO Benchmark boilers, SUNY Cortland expects to save nearly $600,000 in energy costs per year.

Healthcare

Massachusetts General Hospital, Massachusetts

The 95,000 square-foot Massachusetts General Hospital used a central steam plant to supply indirect heat exchangers for space heating and domestic hot water. The steam boilers also supplied primary energy for the facility's sterilization equipment. The building's single centralized steam system was meeting all the facility's needs, but it was far from efficient–coming in at a paltry 50 to 60%. To make matters more complicated, the final solution had to be small enough to make a six-flight elevator journey to a small mechanical room at the top of facility. The engineering firm hired to help the hospital upgrade the building, found that the plant had to operate continuously to meet the facility's domestic hot water and sterilization needs. The combination of piping losses and inefficient operation at low load times compounded the problem. Decentralizing the domestic hot water system and converting to hydronic space heating was the best answer. AERCO's 94% efficient Benchmark 3000 and 96% efficient Innovations are easily meeting all the facility's heating, domestic hot water and sterilization needs–but are reducing fuel operating costs from 30 to 40%.

Multifamily Housing

Luxury High Rise Apartment Building, New York City

The distinctive 12-story luxury rental residential building offers 199 units in a mix of studios and one-, two- and three-bedroom apartments; along with amenities that include a state-of-the-art fitness center, gaming lounge, clubroom and more. The building was designed for high efficiency, incorporating a water source heat pump loop for space heating–so low inlet water temperatures and condensing equipment was a given. But the current plans for the building called for three 2500 MBH water-tube boilers to provide supplemental heating for the loop, along with two 120-gallon tanks for domestic water heating. This meant a more expensive installation, high horsepower pumps and larger piping, valves, and fittings, along with a pricey induced draft fan. Since AERCO fire-tube condensing water heaters and boilers didn't have the limitations of the current specified water-tube system, three Benchmarks 3000 were recommended for the job, along with three Innovation 1060s for the heating plant. The 96% efficient Benchmark 3000s and tankless Innovation 1060s were exactly what this apartment building called for. This luxury high rise got a much more energy and space efficient system, with substantially lower installation costs and electrical operating requirements.

Installation Advantages

Venting Versatility for Easy Installation

Benchmark products provide numerous venting options including sidewall, through-the-roof, and ducted combustion capabilities (direct-vent). They're approved for venting with PVC, CPVC, Polypropylene, or AL29-4C materials are all available and provide broad installation flexibility and savings.

Due to its high efficiency and low flue gas temperatures, the Benchmark 6000 can be installed with 12" flue venting – **no other 6000 MBH boiler is able to use polypropylene venting under all operating conditions**. Not only does the ability to use polypropylene venting prove the Benchmark 6000's superior efficiency, but it also provides big savings on total cost, as well as the flexibility to customize its fit making the units even easier to install.

Space-saving Design

All Benchmark products are delivered as a single, fully assembled unit. Its small footprint, doorway size, and quiet operation make it ideal for both new construction and retrofit applications. The Benchmark 6000 is the most compactly designed 6 million BTU/hr boiler in the market – a third the size of the competition.

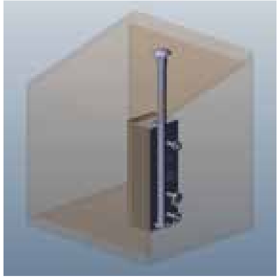
Zero Side Clearance for Easy Maintenance

The redesigned Benchmark can be serviced via the front or top of the boiler, as well as the side. This flexibility allows units to be configured side by side.

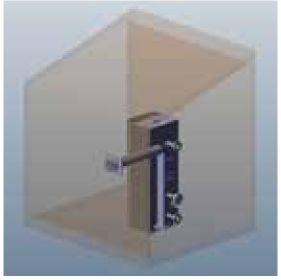
Consult an AERCO representative for additional venting configuration inquiries.

BMK 3000 Shown

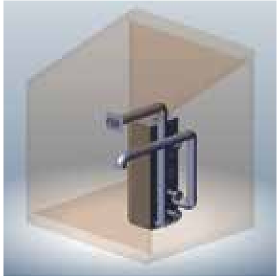
Vent Configurations



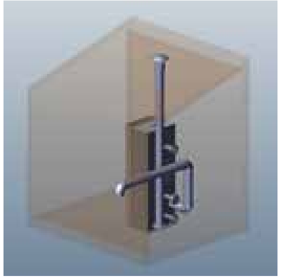
Vertical vent/room air



Sidewall vent/room air

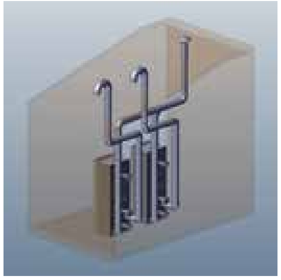


Direct-vent

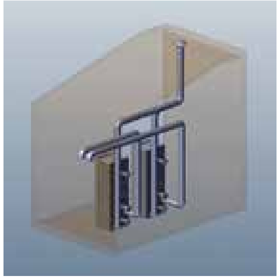


Vertical vent/sidewall air

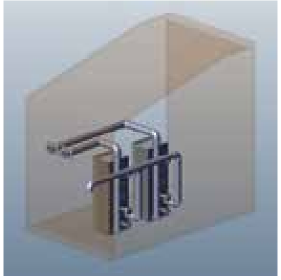
Common vertical vent/room air



Common vertical vent/ individual vertical air



Common vertical vent/ individual sidewall air



Individual sidewall vent/ common sidewall air

Venting

To ensure AERCO products operate as well as they are designed, it's vital they are paired with strong, high-quality venting that can match the Benchmark's durability and longevity. That's why AERCO has partnered with two leaders in the industry, DuraVent and Security Chimneys, to offer you superior venting alongside our trusted equipment, providing you with complete engineered systems for all your projects:

- Security Chimneys International SS and SSD/SSID venting systems are made from AL29-4C® super-ferritic stainless steel. The single- and double-wall SS and SSD/SSID install effortlessly, are highly reliable and meet industry specifications.
- DuraVent PolyPro® polypropylene vent pipe is for ANSI Category II and IV gas-burning appliances. The PolyPro vent system is suitable for exhaust temperatures up to 230°F/110°C and a maximum positive pressure of 15 in w.c. without the toxic risk associated with other plastic materials.

AERCO representatives can help size the venting for your specific job. AERCO guarantees the vented appliances will operate within the optimal outlet pressure range throughout the firing cycle if the venting is purchased through us.

Engineering support – Customers can also leverage the vast experience of AERCO engineers who have devoted their careers to developing cost- and space-saving solutions. Standard services available include:

- Engineering – AERCO engineers work with manufacturers to verify vent sizing/design for enhanced reliability
- AutoCAD drawings
- Submittal information
- Customer service

DuraVent PolyPro®

Security Chimneys SS and SSD/SSID Venting Systems

Accessories

AERCO Control System (ACS)

The ACS is the best choice for maximizing heating plant efficiency if your heating plant has more than eight boilers or if you are designing a combination control system. There is an ACS relay panel available to provide additional pump and valve control for several combination control configurations.

Motorized Valves

The Belimo F6...HDU Series 2-way butterfly valves are designed to meet the needs of HVAC and commercial application requiring bubble tight shut-off for liquids. Typical applications include boiler isolation, chiller isolation, cooling tower isolation, change-over systems, air handler coil control, bypass and process control applications. Valves specifically designed for easy installation on BST configured boiler plants are available as well.

Boiler Sequencing Technology (BST) Integration Panel

BST boiler plants have this option available to enable the BST Master to automatically switch a C-More Slave to the BST Master control if the currently designated master is not able to manage the boilers in the plant. The change is automatic so there is no need for a technician to intervene. The C-More may change from a slave to a master if a unit is taken down for service or if there is a fault that disables the C-More currently acting as the BST Master. The panel is the connection point for the Modbus sensors used by the BST Master Control. This allows the signal input of any sensors attached to the Integration Panel to be accessed at any node on the BST communication cables.

AERCO Protonode/Gateways

AERCO offers a multi-protocol, communications gateway to support integration with customers' building control and energy management systems. The plug-n-play package supports integration with BACnet/IP, BACnet MS/TP, LonWorks, and Johnson Controls Metasys N2 systems. AERCO's Communications Gateway is available for all AERCO boilers, water heaters and electronically controlled indirect systems.

Condensate Neutralizer Kit

AERCO Condensate Neutralizers are ideal for neutralizing condensate from condensing boilers and furnaces operating on natural gas or propane. The condensate is acidic and has the potential to harm the environment and the sewer system. The AERCO Condensate Neutralizer will raise the pH of the condensate to a more neutral level before it is discharged to drain.

Buffer Tanks

AERCO buffer tanks are ASME certified pressure vessels designed for use with high efficiency, low volume systems that incorporate low-mass condensing boilers. They add thermal mass, dampen fast transitions and minimize boiler cycling that occurs during zero or low domestic load conditions. The AERCO buffer tanks are available in two and four-port (Primary-Secondary) configurations.

Venting Mufflers

AERCO offers 6", 8", and 14" exhaust mufflers that are specifically designed with flanged ends to fit directly on the exhaust manifold of Benchmark boilers. The flanged-end design allows the muffler to be used with any venting system manufacturer – the only adapter required is an AERCO starter piece at one or both ends of the muffler.

Specifications and Dimensions

	750	1000	1500
Adjustable Temperature Control	50°F to 190°F	50°F to 190°F	50°F to 190°F
Ambient Temperature	0°F to 130°F	0°F to 130°F	0°F to 130°F
Accuracy	+/-4°F	+/-4°F	+/-4°F
Input	750,000 BTUH (Natural Gas)	1,000,000 BTUH (Natural Gas)	1,500,000 BTUH (Natural Gas)
Net Output	697,000 BTUH (Natural Gas)	930,000 BTUH (Natural Gas)	1,395,000 BTUH (Natural Gas)
Turndown Ratio	15:1	20:1	20:1
Flue Size	6" Diameter	6" Diameter	6" Diameter
Flue Material (per local code)	PVC, CPVC, PP or AL29-4C	PVC, CPVC, PP or AL29-4C	AL29-4C, PP
Water Inlet and Outlet	3" 150# Flange	3" 150# Flange	4" 150# Flange
Gas Connection	1" NPT Male	1" NPT Male	2" NPT Male
Gas Pressure Requirements*	14" WC Maximum, 4" WC Minimum at Full Load	14" WC Maximum, 4" WC Minimum at Full Load	14" WC Maximum, 4" WC Minimum at Full Load
Min/Max Water Flow	12-175 GPM	12-175 GPM	25-250 GPM
Condensate Connection	3/4" NPT Female	3/4" NPT Female	1.5" Tube
Maximum Condensate Flow	6 GPH	8 GPH	9 GPH
Pressure Rating	160 PSIG at 210°F	160 PSIG at 210°F	160 PSIG at 210°F
NOx Emissions Certifications	SCAQMD, TCEQ	SCAQMD, TCEQ	SCAQMD, TCEQ
Standard Listing and Approvals	UL, CUL, ASME	UL, CUL, ASME	UL, CUL, ASME
Gas Train Options	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)
Electrical Requirements	120/1/60 20 AMP (13 AMP FLA)	120/1/60 20 AMP (13 AMP FLA)	120/1/60 20 AMP (16 AMP FLA)
Water Pressure Drop at 20°ΔT	1.5 psi	3 psi	2.8 psi
Water Volume	16.25 gallons	14.25 gallons	44 gallons
Weight, Installed	669 lbs. (dry), 802 lbs. (wet)	700 lbs. (dry), 817 lbs. (wet)	1,406 lbs. (dry), 1,654 lbs. (wet)

Model	(Width) A	(Depth) B	(Height) C	D	E	F	G	H	I	J	K	L
BMK 750	28"	25"	78"	34"	10"	10"	53"	21"	17"	4"	5"	51.8"
BMK 1000	28"	25"	78"	34"	10"	10"	53"	21"	17"	4"	5"	51.8"
BMK 1500	28"	43.6"	78"	58.4"	7"	11.5"	57.8"	18"	22"	8.9"	4.7"	19.5"
BMK 2000	28"	43.6"	78"	58.4"	7"	11.5"	57.8"	18"	22"	8.9"	4.7"	19.5"
BMK 2500	28"	56"	78"	68.4"	5.4"	11.5"	57.8"	18"	22"	6.4"	3.6"	26"
BMK 3000	28"	56"	78"	68.4"	5.4"	11.5"	57.8"	18"	22"	6.4"	3.6"	26"
BMK 6000	34"	89.3"	79.4"	108.3"	6.2"	42.1"	N/A	15.6"	N/A	10"	28.7"	23.7"

Specifications and Dimensions

2000	2500	3000	6000
50°F to 190°F	50°F to 190°F	50°F to 190°F	50°F to 190°F
0°F to 130°F	0°F to 130°F	0°F to 130°F	0°F to 130°F
+/-4°F	+/-4°F	+/-4°F	+/-4°F
2,000,000 BTUH (Natural Gas)	2,500,000 BTUH (Natural Gas)	3,000,000 BTUH (Natural Gas)	6,000,000 BTUH (Natural Gas)
1,820,000 BTUH (Natural Gas)	2,325,000 BTUH (Natural Gas)	2,790,000 BTUH (Natural Gas)	5,580,000 BTUH (Natural Gas)
20:1	15:1	15:1	15:1
8" Diameter	8" Diameter	8" Diameter	12" or 14" Diameter
PP or AL29-4C	PP or AL29-4C	PP or AL29-4C	PP or AL29-4C
4" 150# Flange	4" 150# Flange	4" 150# Flange	6" 150# Flange
2" NPT Male	2" NPT Male	2" NPT Male	2" NPT Male
14" WC Maximum, 4" WC Minimum at Full Load	14" WC Maximum, 4" WC Minimum at Full Load	14" WC Maximum, 4" WC Minimum at Full Load	2" PSI Maximum, 14" WC Minimum at Full Load
25-350 GPM	25-350 GPM	25-350 GPM	75-600 GPM
1.5" Tube	1.5" Tube	1.5" Tube	1.5" Tube
10 GPH	17 GPH	20 GPH	40 GPH
160 PSIG at 210°F	160 PSIG at 210°F	160 PSIG at 210°F	80 PSIG at 210°F / 150 PSIG at 210°F
SCAQMD, TCEQ	SCAQMD, TCEQ	SCAQMD, TCEQ	SCAQMD, TCEQ
UL, CUL, ASME	UL, CUL, ASME	UL, CUL, ASME	UL, CUL, ASME
FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)
120/1/60 20 AMP (16 AMP FLA)	208-230/3/60 20 AMP (10 AMP FLA) 460-230/3/60 15 AMP (5 AMP FLA)	208-230/3/60 20 AMP (10 AMP FLA) 460-230/3/60 15 AMP (5 AMP FLA)	208-230V/3/60 30 AMP (19 AMP FLA) 460/3/60 15 AMP (12 AMP FLA) 575/3/60 15 AMP (9 AMP FLA)
3.4 psi	2.9 psi	4 psi	6.2 psi
40 gallons	58 gallons	55 gallons	110 gallons
1,500 lbs. (dry), 1,760 lbs. (wet)	2,000 lbs. (dry), 2,332 lbs. (wet)	2,170 lbs. (dry), 2,364 lbs. (wet)	3,000 lbs. (dry), 3,920 lbs. (wet)

*Values are for Natural Gas FM Compliant gas trains only. See Benchmark Gas Components & Supply Design Guide GF-2030 for Propane, DBB & Duel Fuel gas train gas pressure requirements.

Benchmark 750 / 1000 / 1500 / 2000 / 250 / 3000

Benchmark 6000

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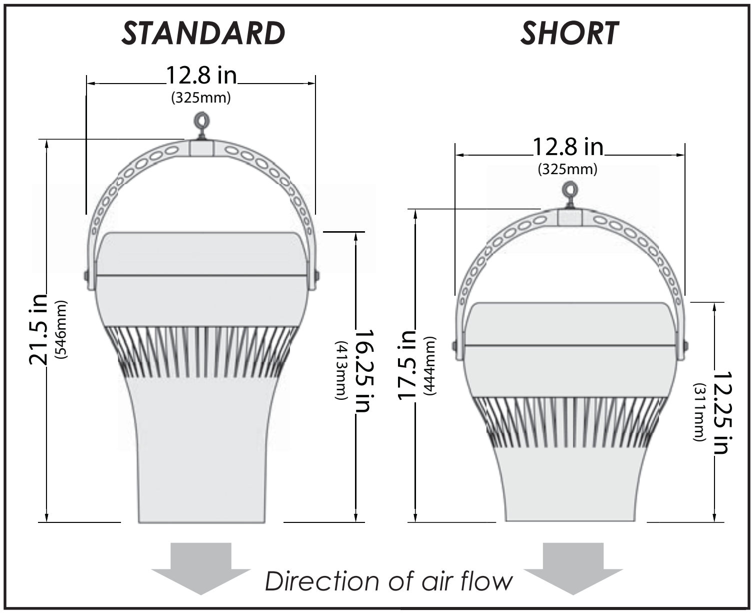
AIR PEAR 25 SUBMITTAL

UP TO 25 FT MOUNTING HEIGHT
MAX COVERAGE 1200 FT ²

Print Form

MODEL	VOLTS 1Ø	HZ	*AMPS	*WATTS	*MAX RPM	*MAX CFM	*dB(A)	WEIGHT	MOUNTING HEIGHT	COVERAGE AREA
25	120	50/60	0.30/0.32	30/35	1500/1650	459/547	50	7 lb/9 lb	Up to 25 ft.	Up to 1200 ft²
25	230	50/60	0.14/0.13	31/33	1450/1650	459/547	50	7 lb/9 lb	Up to 25 ft.	Up to 1200 ft²
25	277	50/60	0.13/0.17	35/45	1500/1650	459/547	50	7 lb/9 lb	Up to 25 ft.	Up to 1200 ft²

**0-static motor data supplied by fan manufacturer. Subject to change at any time.*



PROJECT	
ENGINEER	
ARCHITECT	
CONTRACTOR	
SUBMITTED BY	
DATE	
CONFIGURATION	
QUANTITY	

ORDERING LOGIC

Enter part number into the configuration field above

Style	Model	Motor Type	Nozzle Length	Voltage	Color
A (Air Pear)	25	SP (Shaded Pole)	**(Short) SH** **(Standard) STD**	**120** **230** **277**	**(Off White) W** **(Gray) G** **(Black) B**

EXAMPLE: A - 25 - SP - **STD - 120 - W**

- **Color**
- **Voltage (AC)**
- **Nozzle Length**
- Motor Type
- Model
- Style

DESTRATIFICATION FAN DESCRIPTION

The patented Air Pear Thermal Equalizer creates uniform air temperatures from floor to ceiling for maximum thermal comfort and energy savings up to 35% in the heating season and up to 25% in the cooling season. Conforms to UL-507, ACAN/CSA-IEC-E60335-1, UL 94 5VA and is ETL listed in USA and Canada.

HOUSING

- *PC/ABS resin*
- *5VA flame resistance rating*

MOTOR

- *Single phase, shaded pole, single speed (variable with optional speed control), axial motor.*
- *Motor is thermally protected. Shutoff is at 230˚ F (110˚ C) & reset is at 195˚ F (90˚ C).*
- *Operating temperature: -4˚ F (-20˚ C) to 158˚ F (70˚ C).*
- *No lubrication required. Bearings are sealed.*
- *6' cord and plug provided for 120V, no plug for 230/227V*

STATOR

- *PC/ABS resin, fixed blade stator*

SAFETY CABLE

- *6' length steel cable (fastened to body)*

WARRANTY

- *Warranty - 3-years parts and workmanship*
- *Money back guarantee - 30 days*
- *Refurbish program after 3-year warranty period*

ACCESSORIES *(additional costs apply)*

***Speed Control** (coordinate w/ electrical requirement)*

- ☐ ***TRIAC-120-1.5**: 1.5 Amp, 120V, Up to 3 fans*
- ☐ ***TRIAC-120-5**: 5 Amp, 120V, Up to 14 fans*
- ☐ ***TRIAC-120-15**: 15 Amp, 120V, Up to 45 fans*
- ☐ ***TRIAC-230-8**: 8 Amp, 230V, Up to 56 fans*
- ☐ ***TRIAC-277-5**: 5 Amp, 277V, Up to 28 fans*

Photohydroionization Cell

- ☐ ***PHI-5-C:** 5" (Short nozzle) - adds 9 watts*
- ☐ ***PHI-9-C:** 9" (Standard nozzle) - adds 10 watts*

PC/ABS

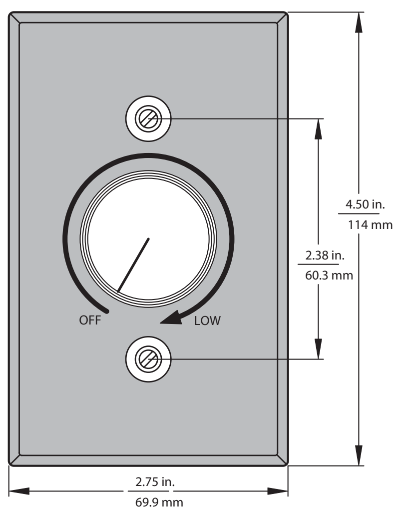
811 South Sherman Street, Longmont, Colorado 80501, Phone: 303.772.2633, Fax: 303.772.8276, info@theairpear.com, www.theairpear.com
May be covered by one or more of the following United States Patents: 7,381,129 B2; D514688 and other patents pending

TRIAC-120-5 SPEED CONTROL SUBMITTAL

FOR CONTROL OF SINGLE
OR MULTIPLE FANS

Print Form

MODEL	VOLTAGE	AMPS	FAN QUANTITY ON DEDICATED CIRCUIT					
			MODEL 10	MODEL 15	MODEL 25	MODEL 45-PSP4	MODEL 45-PSP2	MODEL 60-PSP4
TRIAC-120-5	120V	5	37	34	14	11	3	4



PROJECT	
ENGINEER	
ARCHITECT	
CONTRACTOR	
SUBMITTED BY	
DATE	
QUANTITY	

PART NUMBER & QUANTITY

☐ *TRIAC-120-5* *Qty.* _______

TRIAC SPEED CONTROL DESCRIPTION

Airius speed controls are used to vary the speed of shaded pole or permanent split capacitor (PSC) motors (Air Pear or Designer Series 10, 15, 25, 45-P4, 45-P2, or 60-P4). Speed controls for EC motors: refer to the potentiometer submittal. Speed control for EL fans: refer to the FanCenter submittal.

ATTRIBUTES AND CHARACTERISTICS

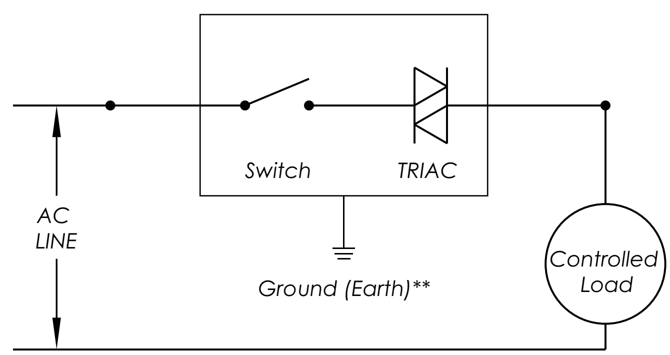
- *Built-in On/Off AC line switch*
- *Minimum speed trimpot*
- *RFI filter (provides RFI and EMI suppression)*
- *All models mount in a standard 2" x 4" electrical wall box*
- *Faceplate (4.5" x 2.75"), knob, screws and wire nuts included*
- *Simple installation by a qualified electrician*
- *Adjust top 50% RPM*
- *Can control multiple fans on a single dedicated circuit*

CODE APPROVAL

- *UL listing/recognition*
- *CSA certified*

WARRANTY

- *Warranty - 1 - years parts and workmanship*



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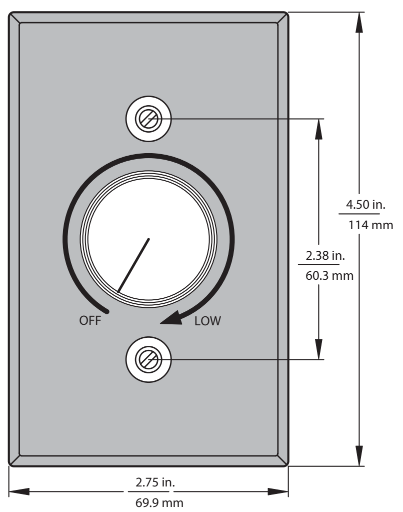
TRIAC-120-1.5 SPEED CONTROL SUBMITTAL

FOR CONTROL OF SINGLE
OR MULTIPLE FANS

Print Form

			FAN QUANTITY ON DEDICATED CIRCUIT					
MODEL	VOLTAGE	AMPS	MODEL 10	MODEL 15	MODEL 25	MODEL 45-PSP4	MODEL 45-PSP2	MODEL 60-PSP4
TRIAC-120-1.5	120V	1.5	10	9	4	3	1	1



TRIAC SPEED CONTROL DESCRIPTION

Airius speed controls are used to vary the speed of shaded pole or permanent split capacitor (PSC) motors (Air Pear or Designer Series 10, 15, 25, 45-P4, 45-P2, or 60-P4). Speed controls for EC motors: refer to the potentiometer submittal. Speed control for EL fans: refer to the FanCenter submittal.

ATTRIBUTES AND CHARACTERISTICS

- *Built-in On/Off AC line switch*
- *RFI filter (provides RFI and EMI suppression)*
- *All models mount in a standard 2" x 4" electrical wall box*
- *Faceplate (4.5" x 2.75"), knob, screws and wire nuts included*
- *Simple installation by a qualified electrician*
- *Off - Max - Hi - Med - Low speeds (4 step)*
- *Can control multiple fans on a single dedicated circuit*

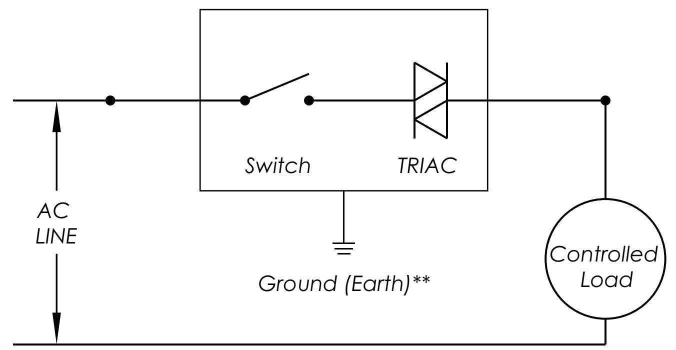
CODE APPROVAL

- *UL listing/recognition*
- *CSA certified*

WARRANTY

- *Warranty - 1 - years parts and workmanship*

PROJECT	
ENGINEER	
ARCHITECT	
CONTRACTOR	
SUBMITTED BY	
DATE	
QUANTITY	



PART NUMBER & QUANTITY

☐ *TRIAC-120-1.5* *Qty.* _______

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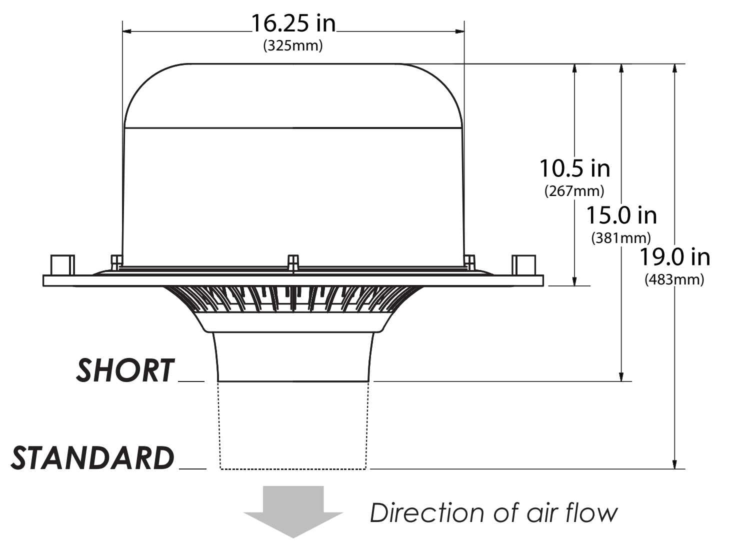
UP TO 18 FT MOUNTING HEIGHT
MAX COVERAGE 800 FT ²

Print Form

MODEL	VOLTS 1Ø	HZ	*AMPS	*WATTS	*MAX RPM	*MAX CFM	*dB(A)	WEIGHT	MOUNTING HEIGHT	COVERAGE AREA
15	120	50/60	0.11/0.14	13.5/17	1230/1260	406	36	16 lb	Up to 18 ft.	Up to 800 ft²
15	230	50/60	0.06/0.07	15/17	1230/1260	406	36	16 lb	Up to 18 ft.	Up to 800 ft²

*0-static motor data supplied by fan manufacturer. Subject to change at any time.



PROJECT	
ENGINEER	
ARCHITECT	
CONTRACTOR	
SUBMITTED BY	
DATE	
CONFIGURATION	
QUANTITY	

ORDERING LOGIC

Enter part number into the configuration field above

Style	Model	Motor Type	Nozzle Length	Voltage	Color
S (Suspended)	15	SP (Shaded Pole)	(Short) SH (Standard) STD	120 230	(Off White) W (Black) B

EXAMPLE: S - 15 - SP - **STD - 120 - W**

- **Color**
- **Voltage (AC)**
- **Nozzle Length**
- Motor Type
- Model
- Style

DESTRATIFICATION FAN/AIR TURBINE DESCRIPTION

The patented Air Pear Thermal Equalizer creates uniform air temperatures from floor to ceiling for maximum thermal comfort and energy savings up to 35% in the heating season and up to 25% in the cooling season. Conforms to UL-507, ACAN/CSA-IEC-E60335-1, UL 94 5VA and is ETL listed in USA and Canada.

HOUSING

- 23.8" x 23.8" lay-in ceiling mount
- PC/ABS resin
- 5VA flame resistance rating

MOTOR

- Single phase, shaded pole, single speed (variable with optional speed control), axial motor.
- Motor is thermally protected. Shutoff is at 230˚ F (110˚ C) & reset is at 195˚ F (90˚ C).
- Operating temperature: -4˚ F (-20˚ C) to 158˚ F (70˚ C).
- No lubrication required. Bearings are sealed.
- A junction box and receptacle are supplied. Electrical contractor will need to provide MC cable and wire directly to j-box/receptacle mounted to side of dome.

STATOR

- PC/ABS resin, fixed blade stator

WARRANTY

- Warranty - 3-years parts and workmanship
- Money back guarantee - 30 days
- Refurbish program after 3-year warranty period

ACCESSORIES (additional costs apply)

Speed Control (coordinate w/ electrical requirement)

- ☐ **TRIAC-120-1.5**:1.5 Amp, 120V, Up to 9 fans
- ☐ **TRIAC-120-5**: 5 Amp, 120V, Up to 34 fans
- ☐ **TRIAC-120-15**: 15 Amp, 120V, Up to 105 fans
- ☐ **TRIAC-230-8**: 8 Amp, 230V, Up to 113 fans

Photohydroionization Cell

- ☐ **PHI-5-C:** 5" (Short nozzle) - adds 9 watts
- ☐ **PHI-9-C:** 9" (Standard nozzle) - adds 10 watts

PC/ABS

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May be covered by one or more of the following United States Patents: 7,381,129 B2; D514688 and other patents pending

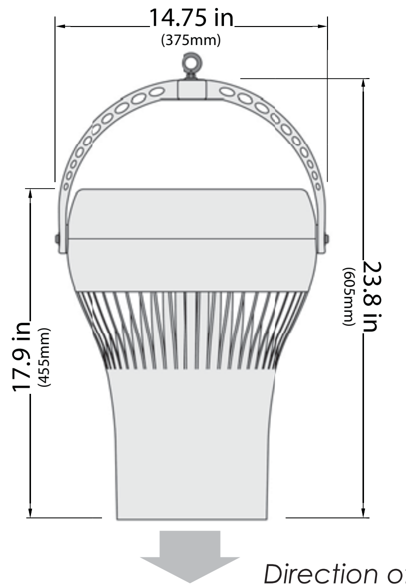
AIR PEAR 45-P4 SUBMITTAL

UP TO 38 FT MOUNTING HEIGHT
MAX COVERAGE 1200 FT ²

Print Form

MODEL	VOLTS 1Ø	HZ	*AMPS	*WATTS	*MAX RPM	*MAX CFM	*dB(A)	WEIGHT	MOUNTING HEIGHT	COVERAGE AREA
45-P4	120	50/60	0.40/0.41	44/46	1400/1650	595/715	58	14 lb	Up to 38 ft.	Up to 1200 ft²
45-P4	230	50/60	0.19/0.2	42/45	1450/1630	595/707	58	14 lb	Up to 38 ft.	Up to 1200 ft²
45-P4	277	50/60	0.19/0.2	42/45	1450/1630	595/707	58	14 lb	Up to 38 ft.	Up to 1200 ft²

*0-static motor data supplied by fan manufacturer. Subject to change at any time.



Direction of air flow

PROJECT	
ENGINEER	
ARCHITECT	
CONTRACTOR	
SUBMITTED BY	
DATE	
CONFIGURATION	
QUANTITY	

ORDERING LOGIC

Enter part number into the configuration field above

Style	Model	Motor Type	Nozzle Length	Voltage	Color
A (Air Pear)	45	P4 (permanent split capacitor)	(Standard) STD	**120 230 277**	**(Off White) W (Gray) G (Black) B**

EXAMPLE: A - 45 - P4 - STD - **120 - W**

- **Color**
- **Voltage (AC)**
- Nozzle Length
- Motor Type
- Model
- Style

DESTRATIFICATION FAN DESCRIPTION

The patented Air Pear Thermal Equalizer creates uniform air temperatures from floor to ceiling for maximum thermal comfort and energy savings up to 35% in the heating season and up to 25% in the cooling season. Conforms to UL-507, ACAN/CSA-IEC-E60335-1, UL 94 5VA and is ETL listed in USA and Canada.

HOUSING

- *PC/ABS resin*
- *5VA flame resistance rating*

MOTOR

- *Permanent Split Capacitor, single speed (variable with optional speed control), axial motor.*
- *Motor is thermally protected. Shutoff is at 275˚ F (135˚ C) & reset is at 255˚ F (125˚ C).*
- *Operating temperature: -13˚ F (-25˚ C) to 158˚ F (70˚ C).*
- *No lubrication required. Bearings are sealed.*
- *6' cord and plug provided for 120V, no plug for 230/277V*

STATOR

- *PC/ABS resin, fixed blade stator*

GUARD GRILLE

- *Steel, phosphated and coated in black plastic*

SAFETY CABLE

- *6' length steel cable (fastened to body)*

WARRANTY

- *Warranty - 3 - years parts and workmanship*
- *Money back guarantee - 30 days*
- *Refurbish program after 3-year warranty period*

ACCESSORIES *(additional costs apply)*

Speed Control (coordinate w/ electrical requirement)

- ☐ ***TRIAC-120-1.5**: 1.5 Amp, 120V, Up to 3 fan*
- ☐ ***TRIAC-120-5**: 5 Amp, 120V, Up to 11 fans*
- ☐ ***TRIAC-120-15**: 15 Amp, 120V, Up to 35 fans*
- ☐ ***TRIAC-230-8**: 8 Amp, 230V, Up to 39 fans*
- ☐ ***TRIAC-277-5**: 5 Amp, 277V, Up to 24 fans*

Photohydroionization Cell

- ☐ ***PHI-9-C:** 9" (Standard nozzle) - adds 10 watts*

PC/ABS

811 South Sherman Street, Longmont, Colorado 80501, Phone: 303.772.2633, Fax: 303.772.8276, info@theairpear.com, www.theairpear.com
May be covered by one or more of the following United States Patents: 7,381,129 B2; D514688 and other patents pending

Controlling Energy Costs With Best Energy Reduction Tools (BERT)

Executive Summary:

As companies, consumers and the country look for ways to save energy and reduce pollution, increased attention will be focused on new ways of controlling the energy use of the legion of smaller electrical loads which now represent the major source of growth in total energy use. While energy managers have been quick to identify and automate large sources of energy use (like HVAC), controlling many smaller devices spread throughout a building is difficult to do. The promotion of 'good habits' like turning off lights and computers may have short term impacts, but sustaining these types of activities over time has proven to be difficult. This paper describes a new approach to facility energy management that leverages a building's existing WiFi network to control end uses throughout a building. By connecting 'smart plugs' to a web-based software interface, energy managers can program schedules by end-use that control energy consumption during times when facilities are not being used. Case studies of university, office, restaurant and residential applications illustrate a range of ways in which the technology can be used. The end uses described in these cases average a 6 month payback. If widely adopted, the control of 'small use' devices could save approximately 461 million kWh and 632 million pounds of carbon annually.

Section 1: Introduction

As energy prices increase and companies and organizations place increased focus on the environment, facility energy managers are challenged to find ways of controlling the energy use of an ever-widening variety of electronic devices. While most managers have made significant strides increasing the efficiency and control of major end uses like HVAC, a large portion of each facility's bill is spent on 'the little stuff'—computers, lights, and other relatively new electronic devices. This paper describes and documents a new patented technology that utilizes the existing WiFi infrastructure to control devices throughout a facility. Section 2 describes the explosion of electronic devices, which represents both a significant growth area for energy demand as well as a new, untapped opportunity for savings. Section

A. O. Smith
Phone: 1.866.362.9898
www.hotwater.com

Pro-Size Selection Report

November 10, 2015

Project Information

Project #:		Prepared for:	ESP
Project Name:	Denville BOE		
Location:	Valeyview	Prepared by:	
Engineer:	Peters		
Contractor:			

Selected Product

BTH-120 Mxi

Cyclone® Mxi Modulating

# Heaters:	1	Heater Recovery:	276 USGPH @ 50 °F Rise
Model Number:	BTH-120 Mxi	1st Hour Delivery:	318 USGPH
Heater Storage (ea):	60 USG	3 Hour Average:	290 USGPH
Input (ea):	120,000 Btu/hr	Est. Storage Recovery:	13 min
New External Tanks:	0	% Of Demand:	NaN%
Tank Capacity (ea):	0 USG		
Total Usable Storage:	42 USG		

This model is iCOMM COMPATIBLE.
iCOMM
For info call: 1-888-WATER02

Model Number	Hi Cube Trailer Load Factor	Gallon Capacity	Recovery Capacity GPH 100 Degree Rise	Input BTU/HR	Height	Diameter	Approx. Shipping Weight (lbs.)
BTH-120 Mxi	2.78	60	138	120,000	55.5	27.75	460

- Standard and Low profile concentric vent available
- Vents with PVC, CPVC polypropylene and AL-29-4C Stainless steel
- Venting distances of up to 120' on all models
- Meets or exceed the thermal efficiency and /or standby loss requirements of the U.S. Department of Energy and current edition of ASHRAE/IESNA 90.1
- Meets NSF requirement's (no leg kit needed)
- Up to 98% Thermal Efficiency
- Down-Fired Low-NOx Powered-Burner Design
- Fully Submerged, Spiral-Shaped Condensing Heat Exchanger
- Complies with SCAQMD Rule 1146.2
- Sidewall and Vertical power vent and direct Vent Options
- Space-Saving Design, with Zero Clearance to Combustibles

Application Loads

Summary

Peak Demand:	650 USGPH	Temperature Rise:	50 °F

Sizing Notes

Hot water loads for pools, hot tubs, or other uses should be considered separately. Restaurant or food service loads should be considered separately if independent water heating equipment is to be used.

Application Settings

Type:	Schools

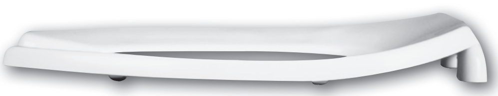
Building Use:	Elementary School	Cold Water Temp:	60 °F
Peak Demand Period:	0.00 Hours	Stored Water Temp:	110 °F
Equipment:	Water Heaters Only (no external storage)	Approx. Storage:	25%
		# Storage Tanks:	Not Specified
Fuel Type:	Natural Gas	Existing Storage:	None
Location:	Indoor		
LoNOx:	Not Required		
UltrasLowNOx:	Not Required		
ASME:	Not Required		
# Heaters:	Not Specified		
Altitude:	Less than 2000 ft		

Load Data

Shower Head Flowrate:	2.5 USGPM
Shower Demand Period:	10 min
Shower Recovery Time:	50 min
Students:	677
Bradley Washfountain (Full):	0
Bradley Washfountain (Half):	0
Private Lavatory:	0
Public Lavatory:	0
Dishwasher:	0 @ 100 USGPH
Foot Basin:	0
Kitchen Sink:	0
Pantry Sink:	0
Service Sink:	0
Additional Load:	0 USGPH
Design Oversize:	0%

BEMIS COMMERCIAL

COMMERCIAL HEAVY-DUTY PLASTIC TOILET SEAT



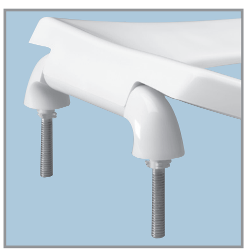
MODEL #	COLOR #
1955CT/1955SSCT	______

DESCRIPTION:

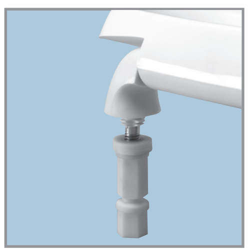
Open front less cover, elongated, heavy-duty, injection molded solid plastic toilet seat. Features four molded-in bumpers, non self-sustaining (1955CT) or self-sustaining (1955SSCT) check hinges with non-corrosive 300 Series stainless steel posts and pintles and STA-TITE® Commercial Fastening System™. This seat complies with IAPMO/ANSI Z124.5-2013 Plastic Toilet Seats as a class Commercial Heavy Duty.

SPECIFICATIONS:

Size:	Elongated
Material:	Plastic
Style:	Open Front less Cover
Bumpers:	Four
Hinges:	Plastic Non Self-Sustaining (1955CT) or Self-Sustaining (1955SSCT) with 300 Series Stainless Steel Posts and Pintles
Fastening System:	STA-TITE® Commercial Fastening System™



PLASTIC HINGES WITH STAINLESS STEEL POSTS AND PINTLES



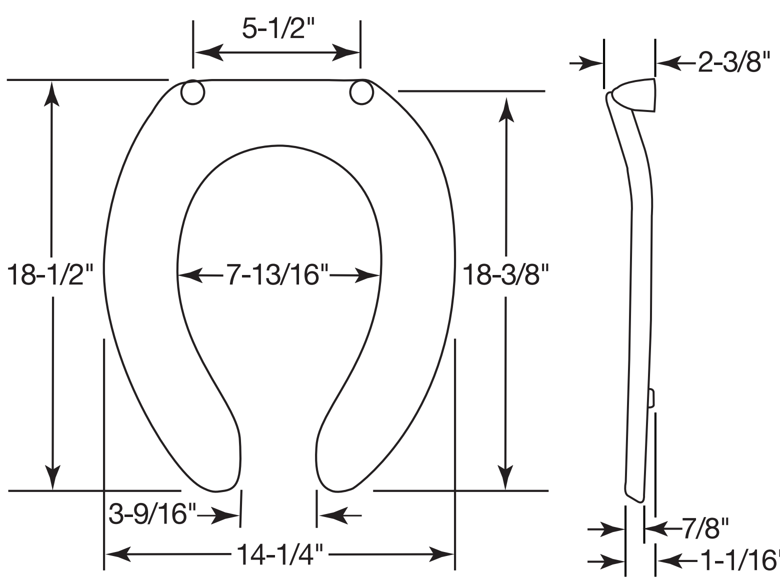
STA-TITE® COMMERCIAL FASTENING SYSTEM™

FEATURES:

STA-TITE® Commercial Fastening System™

Non-Corrosive 300 Series Stainless Steel Posts and Pintles

DIMENSIONS:



Proudly Made in the USA

Bemis Manufacturing Co., Sheboygan Falls, WI 53085
www.ToiletSeats.com

Phone: 800-558-7651 Fax: 800-292-3647

COMMERCIAL HEAVY-DUTY PLASTIC TOILET SEAT

MODEL #	COLOR #
BB955CT	________

DESCRIPTION:

Open front less cover, baby bowl, heavy-duty, injection molded solid plastic toilet seat. Features two molded-in bumpers, check hinges with non-corrosive 300 Series stainless steel posts and pintles and STA-TITE® Commercial Fastening System™. Seat contains DuraGuard® Antimicrobial Built-In Seat Protection™. This seat complies with American National Standard Z124.5 Toilet (Water Closet) Seats as a class Commercial Heavy Duty.

SPECIFICATIONS:

Size:	Toddler/Baby
Material:	Plastic
Style:	Open Front less Cover
Bumpers:	Two
Hinges:	Plastic with 300 Series Stainless Steel Posts and Pintles
Fastening System:	STA-TITE® Commercial Fastening System™

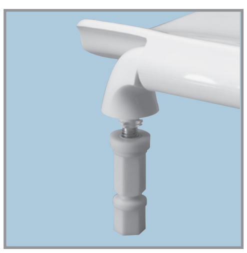
FEATURES:

STA-TITE® Commercial Fastening System™

DuraGuard® Antimicrobial Built-In Seat Protection™

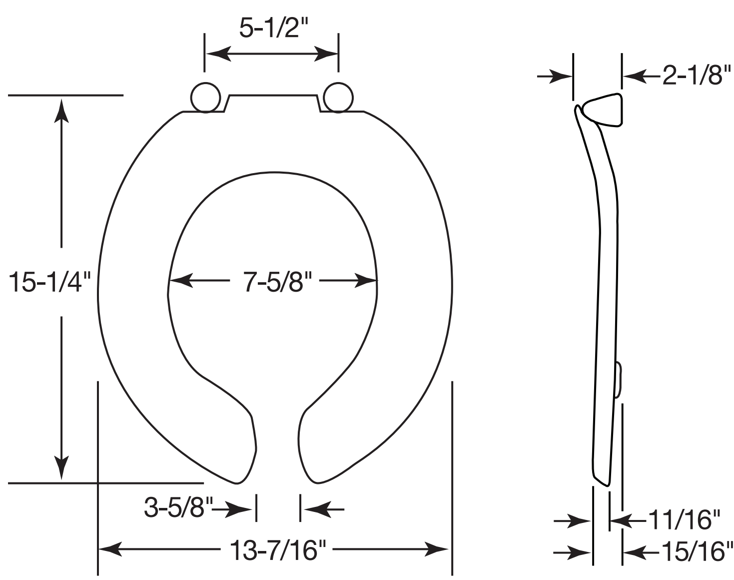
Non-Corrosive 300 Series Stainless Steel Posts and Pintles

PLASTIC HINGES WITH STAINLESS STEEL POSTS AND PINTLES



STA-TITE® COMMERCIAL FASTENING SYSTEM™

DIMENSIONS:



Proudly Made in the USA

Bemis Manufacturing Co., Sheboygan Falls, WI 53085
www.ToiletSeats.com
Phone: 920-467-4621 | 800-558-7651 Fax: 920-467-8573

Bert™
Your energy control freak

Controlling Energy Costs With Best Energy Reduction Tools (BERT)

Executive Summary:

As companies, consumers and the country look for ways to save energy and reduce pollution, increased attention will be focused on new ways of controlling the energy use of the legion of smaller electrical loads which now represent the major source of growth in total energy use. While energy managers have been quick to identify and automate large sources of energy use (like HVAC), controlling many smaller devices spread throughout a building is difficult to do. The promotion of 'good habits' like turning off lights and computers may have short term impacts, but sustaining these types of activities over time has proven to be difficult. This paper describes a new approach to facility energy management that leverages a building's existing WiFi network to control end uses throughout a building. By connecting 'smart plugs' to a web-based software interface, energy managers can program schedules by end-use that control energy consumption during times when facilities are not being used. Case studies of university, office, restaurant and residential applications illustrate a range of ways in which the technology can be used. The end uses described in these cases average a 6 month payback. If widely adopted, the control of 'small use' devices could save approximately 461 million kWh and 632 million pounds of carbon annually.

Section 1: Introduction

As energy prices increase and companies and organizations place increased focus on the environment, facility energy managers are challenged to find ways of controlling the energy use of an ever-widening variety of electronic devices. While most managers have made significant strides increasing the efficiency and control of major end uses like HVAC, a large portion of each facility's bill is spent on 'the little stuff'—computers, lights, and other relatively new electronic devices. This paper describes and documents a new patented technology that utilizes the existing WiFi infrastructure to control devices throughout a facility. Section 2 describes the explosion of electronic devices, which represents both a significant growth area for energy demand as well as a new, untapped opportunity for savings. Section

3 provides an overview of past attempts to control diffuse devices over networks, and provides a glimpse into the future of 'smart' appliances. Section 4 describes a new technology called "BERT", for Best Energy Reduction Technologies. Particular focus is placed on how the software interface allows for the individual control of virtually any device. Section 5 describes how the technology can operate within a university, office, restaurants and in residential applications. Section 6 concludes by documenting the savings potential of the technology in several key sectors, and illustrates the potential for this type of technology to transform how energy use is managed in homes and businesses.

Section 2: The Electronics Explosion: Growth and Savings Opportunity

Despite the increased efficiency of a wide variety of many electronic devices, efficiency gains for many facilities have been countered by a proliferation of new devices. Spending on PCs continues to be strong, growing 22.7% in 2010 according to iSuppli, a company that tracks technology sales. According to the Department of Energy's Building Data Book, total energy use for computers rose 43% between 2006 and 2010. Even more startling is the growth in uncategorized uses, which jumped 663% during the period[1]. The increasing number of peripheral devices, from iPhones, to video conferencing equipment and large format LED and plasma displays all add up. Energy use at work is clearly on the rise, despite the increased efficiency of new equipment. Similar growth is taking place residentially. According to the Nielsen Television Audience Report[2], the number of TV's per household is now 2.86, jumping 43% since 1990. In addition, 88% of homes have a DVD, over 80% of homes have a computer, and of those homes 92% had internet access[3].

A byproduct of the proliferation of devices is phantom load. Phantom load refers to energy that is used when a device is off. This includes energy used by TV's when they're in standby mode (i.e. when they can be turned on with a remote), and energy used by chargers or a laptop's AC adapter. Studies estimate that phantom load now accounts for 6% of all energy use.

This increase in energy consumption has been made worse by increases in price. Recent data from the Department of Energy shows that average electricity prices have increased in all three sectors (commercial, residential, industrial) between 2009-2010[4]. The lifting of rate caps in many states has already lead to dramatic price increases. Electricity rates have already increased 39% in Maryland, 21% in Illinois, and are projected to increase 40-70% in Pennsylvania.

With the increasing number of devices, many facilities managers must rely on people to remember to turn out the lights, or unplug their printers when not in use. However this is easier said than done. A

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[1] http://buildingsdatabook.eren.doe.gov/docs/DataBooks/2009_BEDB_Updated.pdf

[2] http://blog.nielsen.com/nielsenwire/wp-content/uploads/2009/07/tva_2008_071709.pdf

[3] http://blog.nielsen.com/nielsenwire/online_mobile/home-internet-access-continuing-to-grow-but-big-differences-among-demographics/

[4] http://www.eia.doe.gov/cneaf/electricity/epm/epm_sum.html

study conducted by the Alliance for Efficiency found that the impact of behaviorally-based conservation programs wanes within a year, even when education campaigns are ongoing[5].

Section 3: The Device Control Industry: Past, Present and Future

Home automation and control technologies have been around for years, and have the potential to reduce the energy used by a wide variety of devices. Pioneers such as X10 created a communications protocol that used in-home electric wiring to transmit commands to compatible devices. These technologies have advanced over the years to utilize wireless transmission (for example, X10 now uses 310 MHz radio frequency to transmit commands to specially equipped devices within the home.) While significant effort has been put behind these technologies a host of problems have hindered widespread adoption, including unreliability due to wiring impedance, slow response time, and interference with/from other household appliances and devices. Despite the apparent allure of ubiquitous electrical wiring, X10 lacked the ease, reliability and security needed for the product segment to grow.

Individual manufacturers, such as Lutron, have created proprietary high-end home control products intended to provide high levels of control, allowing the programming of lighting 'schemes', and the integrated control of equipment throughout the home. These high cost end-to-end solutions provide an interesting niche product for high end or specialty customers, but do not appeal to the mass market. At the other end of the market, products like Belkin's Conserve[6] Surge With Timer builds a timer into standard surge strip allowing an individual user to set the strip to turn off during select hours.

More recently, the Zigbee suite of proprietary communications protocols has made an appearance in the home control market. Under the Smart Energy 2.0 initiative, Zigbee proponents have created a data standard that they hope will be adopted by a potentially large AMI and Smart Metering industry. While the potential of this utility-driven segment is large, its success will rely on the installations of millions of Zigbee enabled electric meters and related devices.

Section 4: What Makes BERT different?

BERT provides a deceptively simple solution to the device control dilemma. First, BERT was built on a large, reliable, existing networking technology- WIFI. Building the control platform on the existing network has several key benefits:

1. Ubiquity: Virtually all homes and businesses are wifi-enabled. This means that any building that has wi-fi can easily utilize a "Plug and Play" BERT device.

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[5] http://www.allianceforwaterefficiency.org/public_education.aspx
[6] http://www.belkin.com/energy/conserve/default.aspx

2. Reliability: WiFi networks have achieved an amazingly high degree of reliability and security. This reliability meaning that the problems of cross-device interference and the lack of security are no longer issues.

3. Cost: Because the wifi network already exists, no special equipment needs to be purchased as would be with proprietary or other standards such as ZigBee. This allows for the lowest total cost solution in the marketplace.

4. Ease of installation and use: The computer-based control software allows devices to be easily programmed or controlled through any computer-enabled device. BERT does not rely on proprietary physical control panels, or specially-wired consoles. Instead BERT takes commands through common MAC, PC or Smart Phone devices consumers and businesses already use.

Figure 4-1 shows how the BERT device works. The Enterprise Application Program (EAP) is installed on one computer on the network, and is used to set schedules, group devices, and monitor activity. On/Off requests are sent through the existing network router using WiFi. Each BERT plug contains a microchip and antenna that communicates with the EAP on a periodic basis. The BERT EAP uses SNMP (Simple Network Management Protocol) to monitor the activity of connected devices (plugs). When a BERT plug receives an “off” command, the module turns off all power supplied to the plug.

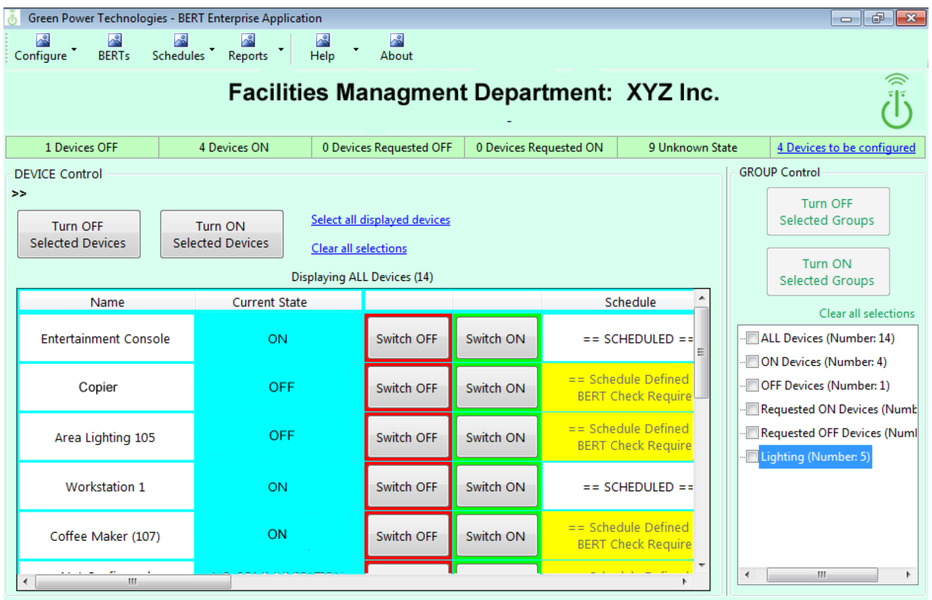
Figure 4-1: BERT System Schematic

The BERT EAP provides a set of tools to configure, schedule and monitor connected BERT devices. The windows based program is installed on a computer within the network (e.g. a facilities manager’s workstation). BERT plug contains a microchip and obtains an IP address from your network. Each BERT device appears on the interface, and individual schedules can be set with multiple on/off periods over a seven day schedule. For example, hallway TV monitors can be programmed to go off at midnight, and on again at 6 am. Multiple TV's can be grouped together to make control and reporting easier. The EAP tracks and reports the status of all devices on the system.

The energy use of each device can also be programmed into the EAP. For example, if the LCD hallway monitor consumes 225 watts of power, then BERT can use this information to track cumulative energy and dollar savings. The BERT reporting interface allows reports for individual devices, groups, or the entire portfolio of devices.

When deviations from standard building schedules occur, devices can be activated in several ways. Most simply, users approaching a BERT device that is it's off state can press a button on the side of the BERT plug and power will be restored to the device. This change of state will be recognized and recorded by the EAP. The device will remain on until the next programmed schedule change. If there are temporary schedule changes for multiple devices, for example if a building is open late for a special event, the facilities manager can turn on/off individual or groups of units remotely. The manager simply selects the designated groups, like Hallway LCD Monitors, and clicks on "Turn On Selected Groups".

Figure 4-2: The BERT EAP Interface



The microprocessors embedded in each BERT plug provide unique protection in the event of a WiFi outage, the shutdown of the management computer, or other interruption. Each BERT unit contains the programmed weekly schedule within the microchip, so if the plug loses contact with the EAP control software it will simply continue to execute its standard schedule.

Section 5: Sample Applications

BERT units can work in a wide variety of applications. This section describes how BERT can operate in university, office, restaurant and residential applications.

University Building:

Temple University's Speakman Hall is an academic building in the middle of campus, and contains a mix of classrooms, public spaces, study areas, and administrative services. The building includes a wide variety of devices that are on 24x7, including hallway announcement TVs, cooled water fountains, office equipment, vending machines, and computer monitors. The building is WiFi enabled. While the University prides itself on having a wide variety of amenities available for students, it also recognizes that many of these amenities use energy round the clock, even when the building is closed during nighttime hours.

Table 5-1: Sample BERT Installation in a University Building

Item Description	Watt Savings	Hours off per day	Number of devices	*Potential energy savings (kWh per year)*
Computer Monitors	65	8	30	5,694
Vending Machine	400	8	2	2,336
Water fountain (cooled)	60	8	24	4,205
Copier	5.26	10	2	38
LCD TV	225	10	12	9,855

Table 5-1 shows modeled energy savings for 70 BERT plugs installed in a single academic building over a 1 year period of time. This application saves 22,128 kWh and $3,983 per year.

Office

An office has 30 workstations (each with a computer, monitor, printer and cell phone charger), a water cooler, copier, and a TV screen in the company lobby. The office manager installs a BERT plug at each workstation, and various other devices. The manager schedules the BERT devices to go off for 12 hours each night, when the office is closed.

Table 5-2: Sample BERT Savings In A Small Office

Item Description	Watt Savings	Hours off per day	Number of devices	*Potential energy savings (kWh)*
Workstation	48.51	12	30	6,374

Water cooler	60	12	1	263
Copier	9.63	10	1	35
LCD TV	225	10	1	821

Table 5-2 shows modeled energy savings for 33 BERT plugs installed in a single office over a 1 year period of time. This application saves 7.493 kWh and $1,349 per year.

Restaurant:

A sports bar features a large number of flat screen TVs so that patrons can view their favorite sporting events from virtually any seat. The restaurant owner configures BERT so that the closing manager can turn off all BERT devices as part of the nightly shut down procedure. BERTS return to service when the opening manager returns in the morning.

Table 5-3: Sample BERT Applications In A Restaurant

Item Description	Watt Savings	Hours off per day	Number of devices	*Potential energy savings (kWh)*
Register Stations	48.51	14	3	744
Bar lighting	65	14	5	1,661
Vending Machines	400	14	4	8,176
LCD TV	225	14	20	22,995

Table 5-3 shows modeled energy savings for 33 BERT plugs installed in a single restaurant over a 1 year period of time. This application saves 33,882 kWh and $6,099 per year in energy.

Residential:

A homeowner buys four BERTS to control a computer workstation, entertainment center, area lighting, and kitchen appliances. The homeowner programs BERTS to be on during the times when family members are typically using the equipment; the coffee maker goes on in the morning, while the computer station is active in both morning and evening hours.

Table 5-4: Sample BERT Residential Application

Item Description	Watt Savings	Hours off per day	Number of devices	*Potential energy savings (kWh)*
Light	60	14	1	307
Entertainment Center	75	16	1	438
Workstation	48	14	1	245
Kitchen	8	20	1	58

Table 5-4 shows modeled energy savings for 4 BERT plugs installed in a single home over a 1 year period of time. This application saves 1,084 kWh and $189 per year in energy.

Section 6: Global Impacts:

The global impacts of the adoption of BERT plugs is significant. For example, one million plugs deployed in applications similar to the ones described above saves 461 million kilowatt hours and over 632 million pounds of carbon per year.

Table 6-1: Potential Energy and Environmental Savings

Number of plugs	1,000,000
Average KWH Savings	461.34
Total KWH Savings	461,335,714
Total Dollar savings	$ 83,040,428
Annual Carbon Savings:	632,029,928 pounds per year

In contrast to existing and emerging technologies described in Section 3, WiFi based devices like BERT provide an immediate opportunity to leverage an enormous existing technology infrastructure to save money, energy and the environment by turning off devices on a controlled, scheduled basis while they are not in use.

Blended Air Seal Master Specification (Revised 4-22-13)

POLYURETHANE FOAM SEALANTS/CAULKING/DOOR WEATHERSTRIPPING

SPECIFICATION GUIDE NOTE: *This specification combines all air sealing products into one specification. It includes one- component and two- component polyurethane foam sealants, exterior and interior caulks/joint sealants and exterior and interior door weather-stripping (doorsets, door sweeps and astragals). The product line goes a long way to improving the energy efficiency, durability and comfort of existing buildings, or providing continuity of the primary air barrier in new construction.*

Studies show that the measures outlined in this specification can typically achieve heating and cooling energy savings of up to 20% to 30% over pre-retrofit energy usage. In buildings with greater levels of air leakage, savings may be much higher.

<u>Should constructability issues arise during actual installation, measures and product may be substituted but the end result will be the square footage listed above report.</u>

Blended Air Seal Master Specification (Revised 4-22-13)

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Supply and installation of polyurethane foam sealants, caulking/joint sealants and door weather-stripping.

1.02 RELATED REQUIREMENTS BY OTHERS

A. Section [04 05 13 – Mortar Restoration].

B. Section [07 27 00 – Primary Air Barrier].

C. Section [08 10 00 – Doors and Frames].

D. Section [08 30 00 – Specialty Doors and Frames].

E. Section [08 40 00 – Entrances, Storefronts, and Curtain Walls].

1.03 REFERENCES

A. One¬component foam sealant to be in compliance with:

1. ASTM E¬84 (12.5%) Standard Test Method of Surface Burning Characteristics of Building Materials.

2. NFPA 30B Classification – Level 2 Aerosol for standard and fire rated foam sealant, and Level 3 Aerosol for window and door foam sealant.

3. AAMA 812¬04 Standard Practice for Assessment of Single Component Aerosol Expanding Foams for Sealing Rough Openings of Fenestration Installations.

4. ASTM E¬2112 Standard Practice for Installation of Windows, Doors and Skylights, sec. 5.9.2.

5. CSA A440.4 Window and Door Installation Guidelines.

B. Two¬-component insulating foam sealant to be in compliance with:

1. ASTM E¬84 Standard Test Method of Surface Burning Characteristics of Building Materials, Class 1 material.

C. Acrylic latex caulks/joint sealants to be in compliance with:

1. ASTM C834¬05 Standard Specification for Latex Sealants.

2. ASTM E84¬09 Surface Burning Characteristics of Building Materials.

3. SWRI (Sealant, Waterproofing and Restoration Institute) – The Professionals' Guide.

4. ASTM C1330¬02 (R2007) Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.

D. Elastomeric fire barrier sealants to be in compliance with:

1. ASTM E814 (UL 1479) Standard Test Method for Fire Tests of penetration Fire stop Systems.

Blended Air Seal Master Specification (Cont'd)

E. Door weather-stripping to be in compliance with:

1. ASTM 283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows and Doors under Specified Pressure and Temperature Differences Across the Specimen.

2. ASTM E¬331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference.

3. ASTM D¬2565 Standard Practice for Xenon¬Arc Exposure of Plastics Intended for Outdoor Applications.

1.04 SUBMITTALS

A. Product Data: Manufacturer's printed technical data sheets or catalog pages for specified products to be incorporated into the project.

B. Shop Drawings/Schedules: Graphic line ¬type drawings, single ¬line diagrams, or schedules and list of products and their application.

C. Samples:

1. 6" x 6" (150 mm x 150 mm) size showing color and texture of both one ¬component and two component foam sealants.

2. Cured samples of exposed sealants showing 1/2" x 1/2" joint size x 3" long (13 mm x 13 mm x75 mm) in specified colors.

3. 6" (150 mm) long sections of [doorsets] [door sweeps] [and] [astragals].

D. LEED: Provide data substantiating this Section of Work contributes to LEED Credit EQ7 – Thermal Comfort.

E. Test and Evaluation Reports: Evaluation service reports documenting any manufacturer's tests.

F. Manufacturer's Instructions: Written installation instructions.

G. Manufacturer's Warranty: Standard warranty document.

1.05 QUALITY ASSURANCE

A. Installers: In¬field crew chiefs and/or foremen to be manufacturer ¬approved installers to BPI Building Envelope Institute Certification standards.

1.06 DELIVERY, STORAGE AND HANDLING

A. Delivery:

1. Deliver materials in manufacturer's original packaging with identification labels intact.

2. Store materials protected from exposure to harmful weather and at temperature conditions recommended by manufacturer.

Blended Air Seal Master Specification (Cont'd)

B. Packaging Waste Management:

1. Separate waste cardboard packaging, plastic nozzles and metal containers and remove from site for disposal at appropriate recycling facilities.

1.07 FIELD CONDITIONS

A. Ambient/Environmental Conditions:

1. Ensure manufacturer’s working chemical temperatures for polyurethane foams are maintained during installation.

2. Do not apply latex caulks/joint sealants when ambient and substrate temperatures are outside limits permitted by caulking/joint sealant manufacturer or are below 40°F (4.4°C), for latex and 50° F (10°C) for siliconized latex, or when joint substrates are wet.

B. Joint Width Conditions:

1. Do not proceed with installation of latex caulks/joint sealants where joint widths are outside of parameters allowed by manufacturer for applications indicated. Consult with manufacturer for resolution.

1.08 WARRANTY

A. At project close¬out, provide the Owner with manufacturer’s standard limited warranty document executed by authorized company official.

B. Warranty to commence on date of substantial completion.

C. Furnish manufacturer’s and applicator’s one [1] year warranty for latex caulks/joint sealants and related accessories that fail to provide air and water tight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.01 PRODUCTS AND SYSTEMS

A. Substitutions: NOT PERMITTED

B. Materials:

1. Interior one component polyurethane GREAT STUFF “Gaps & Cracks Foam Sealant”, in accordance with ASTM E¬84, E814, Flame Spread 25, Smoke Developed <450, color Cream.

Blended Air Seal Master Specification (Cont'd)

2. Exterior one component Window and Door polyurethane foam sealant: Dow GREAT STUFF PRO “Window and Door Foam Sealant” in accordance with AAMA 812¬04, ASTM E¬2112, E84, E283, UL 723.

3. Interior one ¬component Fire Rated sealant: 3M Fire Barrier elastomeric one component sealant fire-stop tested up to 3 hours in accordance with ASTM E 814 (UL1479).

4. Interior two ¬component Insulating Foam sealant: Dow FROTH-PAK polyurethane “Insulating Foam Sealant” in accordance with ASTM E¬84, E96, C518, CCMC 13074-R, UL 723, Flame Spread 25, Smoke Developed 105.

5. Interior /Exterior clear Siliconized Acrylic Latex Sealant: White Lighting “3006 Clear Siliconized Acrylic Latex Sealant in accordance with ASTM¬C834¬05.

6. Interior bright white Latex Sealant: White Lighting Bright White Latex Ultra Caulk.

7. Joint Backing:

a. ASTM C1330¬02 (R2007), closed cell polyethylene foam, preformed round joint filler, non-absorbing, non-¬staining, resilient, compatible with sealant and primer, and as recommended by sealant manufacturer for each sealant type.

b. Size: Minimum [1.25] times joint width.

c. Type C: Closed cell material with surface skin.

8. Bond Breaker Tape: Polyethylene or other plastic tape, for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self ¬adhesive tape where applicable.

9. Cleaners: Chemical cleaners free of oily residue and other substances capable of staining or harming joint substrates and adjacent surfaces, and formulated to promote adhesion of sealant and substrates.

10. Primers: Stain ¬free type.

11. Exterior-Door Weatherstrip Sets: Visco Weather Seal Products Model No. DS¬050 surface applied weather-stripping consisting of a 0.045” thickness AA6063 T5 extruded aluminum carrier with slotted holes and matching self-tapping screws, and UL Classified, Q¬Lon soft cell urethane foam insert with polyethylene clad thermoplastic cover in accordance to ASTM E¬331, ASTM¬283 and ASTM D¬2565.

a. Set Dimensions: 17’¬0” (5200 mm) set, including one 3’¬0” (915 mm) piece and two 7’¬0” (2134 mm) pieces.

b. Finish: [DS¬050AL Clear Anodized] [DS¬050BR Brown Enamel] [DS¬050WT White Enamel].

12. Exterior-Door Sweeps: Visco Weather Seal Products Model No. FS¬300 surface-¬applied brush/Finseal weather-stripping consisting of a 0.060” thickness AA6063 T5 extruded aluminum carrier with slotted holes and matching self-tapping screws, and 1/2” (13 mm) silicone treated woven pile with a 0.080” integral vinyl center fin.

Blended Air Seal Master Specification (Cont'd)

a. Dimensions: 3’¬0” (915 mm) long with single line 1/2” (13 mm) Finseal pile.

b. Finish: [FS¬300AL Clear anodized] [FS¬300BR Brown Enamel] [FS¬300WT White Enamel].

13. Exterior-Door Astragals: Visco Weather Seal Products Model No. FA¬325 surface applied brush/Finseal weather-stripping consisting of a 0.050” thickness AA6063 T5 extruded aluminum carrier, with slotted holes and matching self-¬tapping screws, and 1/2" (13 mm) silicone treated woven pile with .080” integral vinyl center fin.

a. Clear anodized finish: Class 1 (.0007”) clear anodic thickness.

b. Baked enamel FA325WT White finish.

14. Exterior/Interior Insulation Board: Dow “Thermax” exterior insulation board consists of a glass-fiber-reinforced polyisocyanurate foam core faced with 4 mil embossed BLUE acrylic-coated aluminum on one side and 1.25 mil embossed aluminum on the other, R-6.5 per inch. Meets ASHRAE 90.1-2007, ASTM C518, D1621, C203, C209, E96, E84 –UL723, NFPA 285, FM DS 1-12.

15. Air Conditioner Window/Wall Kit: Visco Weather Seal products “L Shaped Foam is uniquely designed to fit securely into most window frames.

16. Sectional Overhead Doors: Flat Style Aluminum bottom retainer with vinyl single T Style bottom seal inserts and Style 25 Jumbo aluminum extrusion with vinyl side and top seals by DDM Garage Door.

PART 3 - EXECUTION

3.01 INSTALLERS

A. Provide experienced and qualified installers to carry out installation by or under the supervision of manufacturer ¬approved BPI Certified personnel.

3.02 MANUFACTURER’S INSTRUCTIONS

A. Conformance: Comply with manufacturer’s written data and product catalog installation instructions.

3.03 EXAMINATION

A. Field Verification of Conditions:

1. Verify that substrates are acceptable for product installation in accordance with manufacturer’s instructions prior to installation of materials.

2. Ensure substrates to receive sealant materials are clean, dry, firm, and free of loose particles, dust, grease, mold release agents, frost, and similar deleterious substances.

3. Inform Owner of unacceptable conditions immediately upon discovery.

4. Coordinate for repair and resolution of unsound substrate materials.

Blended Air Seal Master Specification (Cont'd)

5. Proceed with installation only after unacceptable conditions have been remedied.

6. Inspect substrate surfaces to receive caulking for bond breaker contamination and unsound materials at adherent faces of sealant.

7. Coordinate for repair and resolution of unsound substrate materials.

8. Inspect caulking locations for uniform joint widths and that dimensions are within tolerances established by sealant manufacturer.

3.04 PREPARATION

A. Foam Sealants:

1. Read all foam sealant manufacturers' instructions for dispensing units and foam systems included with each product.

2. Protect adjacent surfaces from overspray.

B. Caulks/Joint Sealants:

1. Ensure surfaces to be caulked/sealed are clean, dry and free from oils, loose mortar, laitance, form release agents, old caulking, old paint, or other contaminants. Remove mildew with bleach and detergent that do not contain ammonia; rinse surfaces and allow drying.

2. Clean and prime joints in accordance with manufacturer's recommendations.

3. Remove loose or foreign matter that could impair adhesion. If surface has been subject to chemical contamination, contact sealant manufacturer for recommendations.

4. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate for optimum bond with joint sealants.

5. Remove loose particles remaining after above cleaning operations by vacuuming or blowing out joints with oil¬-free compressed air. Porous joint surfaces include the following:

a) Concrete

b) Masonry

c) Unglazed surfaces of ceramic tile

6. Remove laitance and form release agents from concrete.

7. Clean non¬porous surfaces with chemical cleaners or other means that will not stain, harm substrates, or leave residues capable of interfering with adhesion of sealants. Non¬porous surfaces include the following:

a) Metal

b) Glass

c) Porcelain enamel

8. Allow new concrete to cure for 30 days before caulking.

Blended Air Seal Master Specification (Cont'd)

9. Protect adjacent surfaces from caulking damage by masking, using masking tape, or protective covers. Remove masking immediately after tooling before skin has formed on caulk/sealant.

10. Sealant Dimensions: a) Minimum joint size: [1/4” x 1/4” (6 mm x 6 mm)]. b) Joints [1/4” x 1/2" (6 mm to 13 mm)] wide: Depth equal to width. c) Joints over 1/2” (13 mm) wide: Depth equal to one half of width.

C. Elastomeric Fire Barrier Sealant:

1. Clean surfaces thoroughly prior to installation .

2. Prepare surfaces according to manufacturer’s recommendations to achieve best result.

D. Door Weather-stripping:

3. Clean surfaces thoroughly prior to installation.

4. Prepare surfaces according to manufacturer’s recommendations to achieve best result.

3.05 INSTALLATION

A. Foam Sealants:

1. Install foam sealants strictly in accordance with manufacturer’s written installation instructions.

2. Special Techniques: Where required, apply foam in several stages to avoid overfilling of cavities or damaging non-¬rigid cavities.

3. Use only in well ventilated area or with certified respiratory protection and other manufacturer recommended protective devices.

4. Use one¬-component foam for smaller voids e.g. under 2” (50 mm) wide, and two component foam for larger voids e.g. over 2” (50 mm) wide.

5. Use ‘window and door foam’ grade of sealant for sealing within frames where sealant foam is required.

6. Protect foam from UV rays i.e. sunlight, by painting, covering or coating to prevent long term discoloration or degradation.

7. Special Handling: Foam propellants are extremely flammable during dispensing and cure; provide sufficient cross ¬ventilation to remove any build¬up of vapors. Keep away from heat, sparks and sources of ignition.

8. Provide tie-¬in with [adjacent construction] [existing wall and roof air barrier] to locations listed below:

Blended Air Seal Master Specification (Cont'd)

SPECIFICATION GUIDE NOTE: *The areas to be sealed are described in the site assessment. A general list may be specified as shown below:*

a) The roof to wall connection.

b) The wall to foundation connection.

c) The wall to window or door intersection.

d) Soffit connections and details.

e) Interior and exterior corner details.

f) Major connections between different types of exterior wall and roof systems such as curtain wall to precast, curtain wall to brick or steel siding, and curtain wall to brick veneer.

g) Mechanical, electrical and miscellaneous wall and roof penetrations.

h) At expansion joints.

i) Roof exhaust fans.

B. Caulks/Joint Sealants:

1. Apply sealants and accessories in accordance with manufacturer’s instructions.

2. Install joint backing to maintain required sealant dimensions. Compress backing approximately 25 percent without puncturing skin. Do not twist or stretch.

3. Use bond breaker tape where joint backing is not installed.

4. Fill joints full without air pockets, embedded materials, ridges, and sags.

5. Tool sealant to smooth profile.

6. Apply sealant within manufacturer’s recommended temperature range.

C. Elastomeric Fire Barrier Sealant:

1. Install sealant in accordance with manufacturer’s instructions.

2. Apply to the applicable depth into the opening flush with the surface of the substrate as detailed within the applicable listed system.

D. Door Weather-stripping:

3. Install weather-stripping in accordance with manufacturer’s instructions.

4. Install doorsets within recommended compression parameters established by manufacturer of from 50% to minimum 10% or maximum of 60%.

5. Using slotted holes in aluminum carriers, make any final adjustments to completely air seal doors.

Blended Air Seal Master Specification (Cont'd)

3.06 COLD WEATHER WORK

A. During colder months, ensure foam sealant chemicals are warmed to optimum temperature using manufacturer provided "hot box" used to store the refill systems at consistent, controlled temperature prior to and during use.

3.07 CLEANING

A. Remove fresh foam overspray using manufacturer recommended polyurethane foam cleaner or solvent such as acetone.

B. Remove cured foam overspray from substrates using mechanical means, by brushing, grinding, blast cleaning, abrading or combination of these methods to produce clean substrates.

C. Fresh caulking/joint sealant: Scrape off accidentally smeared sealant on adjoining surfaces and rub clean with proprietary cleaner or appropriate solvent.

D. After filling and tooling caulked joints, remove masking tape or other protective cover.

E. Leave surfaces adjacent to caulked joints in a clean and unstained condition.

F. Clean and make good any weather-stripping surfaces soiled or damaged by work of this Section.

G. Touch¬up, repair or replace any damaged weather-stripping before leaving site.

H. Remove debris upon completion of work.

I. Make good damage to adjacent construction caused by work of this Section.

3.08 CAULKING/JOINT SEALANT LOCATIONS

SPECIFICATION NOTE: *Sealant locations are described in the Honeywell "Building Envelope*

Blended Air Seal Master Specification (Cont'd)

B. Metal Reglets and Flashings:

1. Flashings to Wall.
2. Metal to Metal.

C. Sanitary Joints:

1. Walls to Plumbing Fixtures.
2. Counter Tops to Walls.
3. Pipe Penetrations.

D. Interior Caulking:

1. Typical Narrow Joint 1/4" (6 mm) or less at Walls and Adjacent Components.
2. Perimeter of Doors, Windows, Access Panels that adjoin Concrete or Masonry Surfaces.
   a. Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls.
1. Exposed Isolation Joints at Top of Full Height Walls.
2. Exposed Acoustical Joint at Sound Rated Partitions.
3. Concealed Acoustic Sealant.

ControLinks™ Fuel Air Control System

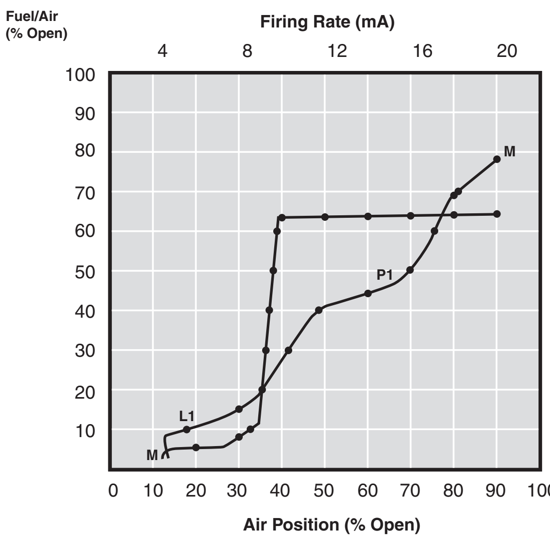
Honeywell

Get superior performance, improved accuracy and fuel efficiency with Honeywell ControLinks™ microprocessor-based fuel air ratio controls on your burner equipment. Control accuracy to 0.1 degrees provides accurate fuel air ratio curves and improves combustion efficiency, which means fuel savings for you. It all adds up to more accuracy and efficiency, as well as less service and downtime.

ControLinks™ Fuel Air Control System

ControLinks™ uses unique air curves and fuel curves, separate light-off points and different minimum and maximum modulation points. Innovative safety features include a unique potentiometer circuit, component anti-swap protection and curve verification algorithms.

Fuel/Air Profile Graph



One-fuel with FGR curve

The new S7999B system display allows you to commission the ControLinks Fuel Air Control System using the touchscreen with four color graphics. This eliminates the need for a laptop or PC for commissioning. Diagnostic information can be accessed for ControLinks and for 7800 SERIES Controls using this display.

To Learn More

For more information about ControLinks Fuel Air Control System, contact your Honeywell Representative, call 1-800-345-6770, ext. 423, or visit customer.honeywell.com.

Automation and Control Solutions

In the U.S.:
Honeywell
1985 Douglas Drive North
Golden Valley, MN 55422-3992

In Canada:
Honeywell Limited
35 Dynamic Drive
Toronto, Ontario M1V 4Z9
www.honeywell.com

63-9165
May 2006

Technical brochures, savings calculator and case studies are also available. Contact your local ControLinks rep for more details.

SYSTEM COMPONENTS:

R7999 FUEL AIR RATIO CONTROL

- Monitors and controls the burner fuel and air ratios to maintain proper combustion
- Provides LED status for power, alarm and motor drives
- Includes fault-annunciating LEDs

ML7999A UNIVERSAL PARALLEL-POSITION ACTUATOR

- Provides 100 lb./in. torque to control combustion air dampers, modulating fuel valves, oil modulation valves and flue gas recirculation (FGR) dampers
- Optimizes burner performance by providing precision potentiometer feedback to the R7999 control

S7999B SYSTEM DISPLAY

- Optional tool that provides an interface for the entire burner/boiler system
- Large, full color, touchscreen display module
- Two additional LEDs indicate CSD power and communications

V5197 Firing Rate Valve

- Accepts 4 – 20 mA signal for firing rate control
- More linear turndown

A7999 PORTABLE COMBUSTION ANALYZER

- Portable diagnostic tool (optional) expedites burner setup

ZM7999 COMMISSIONING SOFTWARE

- Commissioning software via laptop

Q7999 WIRING SUB-BASE

- For ease of installation, all wiring goes to this panel-mounted sub-base

The Following ControLinks Demos And Toolkits Are Also Available:	
Item #	
DSP3822	S7999B System Display Demo
DSP3564	ControLinks Demo
DSP3548	ControLinks Tool Kit

Honeywell

Produced on 11/20/2015 with Xpress Selection V7.0.2 - database Central_USA 9.8.5

Project name	Denville Schools
Reference	Valleyview Middle School
Client name	Honeywell
Revision	ECM.2.I.2

Selection parameters of the indoor units can be found under the chapter Indoor unit details
Selection parameters of the outdoor units can be found under the chapter Outdoor unit details
Only the data published in the data book are correct. This program uses close approximations of these data.

1. Material List

Model	Qty	Description
RXYQ120TTJU	1	Heat pump VRV-IV (208-230V)
FXMQ12PBVJU	2	VRV M (PB) - Ceiling Mounted Ducted (Medium Static)
FXMQ24PBVJU	3	VRV M (PB) - Ceiling Mounted Ducted (Medium Static)
FXMQ36PBVJU	1	VRV M (PB) - Ceiling Mounted Ducted (Medium Static)
KHRP26A22T9	2	Refnet branch piping kit
KHRP26A33T9	2	Refnet branch piping kit
KHRP26M72TU9	1	Refnet branch piping kit
DMS502B71	1	Interface for use in BACnet®
BRC1E73	6	new Navigation Remote Controller

2. Indoor Unit Details

2.1. Table of Abbreviations

Name	Logical name of the device
FCU	Device model name
Tmp C	Indoor conditions in cooling (dry bulb temp. / wet bulb temp.)
Rq TC	Required total cooling capacity
Max TC	Available total cooling capacity
Rq SC	Required sensible cooling capacity
Max SC	Available sensible cooling capacity
Tevap	Evaporating temperature of indoor unit coil
Tmp H	Indoor temperature in heating
Rq HC	Required heating capacity
Max HC	Available heating capacity
Airflow	Supplied airflow
Sound	Sound pressure low and high
PS	Power supply (voltage and phases)
MCA	Minimum Circuit Amps
Fuses	Fuses
WxHxD	WidthxHeightxDepth
Wght	Weight of the device

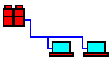
2.2. Out 1 - RXYQ120TTJU

Capacity data at conditions and connection ratio (110%) as entered

Name	FCU	Tmp C	Rq TC	Max TC	Rq SC	Max SC	Tevap	Tmp H	Rq HC	Max HC	Airflow
		°F	BTU/h	BTU/h	BTU/h	BTU/h	°F	°F	BTU/h	BTU/h	cfm
Library Univent	FXMQ24PBVJU	75.0 / 63.0	n/a	20642	n/a	16000	42.8	70.0	n/a	26989	688
Library Univent	FXMQ24PBVJU	75.0 / 63.0	n/a	20642	n/a	16000	42.8	70.0	n/a	26989	688
Library Univent	FXMQ24PBVJU	75.0 / 63.0	n/a	20642	n/a	16000	42.8	70.0	n/a	26989	688
Library Office # 1	FXMQ12PBVJU	75.0 / 63.0	n/a	10327	n/a	8213	42.8	70.0	n/a	13512	450
Library Office # 2	FXMQ12PBVJU	75.0 / 63.0	n/a	10327	n/a	8213	42.8	70.0	n/a	13512	450
Computer Lab	FXMQ36PBVJU	75.0 / 63.0	n/a	30946	n/a	24247	42.8	70.0	n/a	39989	1130
Σ			113525						147979		

The sum of the required indoor unit capacities is 113525BTU/h for cooling and 147979BTU/h for heating.
However, the outdoor unit selection uses reduced load values for cooling of 102172BTU/h (= -10%) and for heating of 88787BTU/h (= -40%).
Be aware that unrealistic reductions may lead to reduced comfort levels, different noise levels or increased wear and tear.

Name	Sound	PS	MCA	Fuses	WxHxD	Wght
	dBA		A		inch	lbs
Library Univent	38-42	230V 1ph	1.8	15A	39.4x11.8x27.6	79
Library Univent	38-42	230V 1ph	1.8	15A	39.4x11.8x27.6	79
Library Univent	38-42	230V 1ph	1.8	15A	39.4x11.8x27.6	79
Library Office # 1	35-39	230V 1ph	1.4	15A	27.6x11.8x27.6	62
Library Office # 2	35-39	230V 1ph	1.4	15A	27.6x11.8x27.6	62
Computer Lab	39-43	230V 1ph	2.9	15A	55.1x11.8x27.6	101



Outdoor unit placed 164.0ft above the indoor units.
The minimum connection ratio for this height difference is 50%.

3. Outdoor Unit Details

3.1. Table of Abbreviations

Name	Logical name of the device
Model	Device model name
Tmp C	Outdoor temperature in cooling
CC	Available cooling capacity
Rq CC	Required cooling capacity
Tmp H	Outdoor conditions in heating (dry bulb temp. / wet bulb temp.)
HC	Available heating capacity (integrated heating capacity)
Rq HC	Required heating capacity
Piping	Largest distance from indoor unit to outdoor unit
Bse Refr	Standard factory refrigerant charge (5m actual piping length) excluding extra refrigerant charge For calculation of extra refrigerant charge refer to the databook
PS	Power supply (voltage and phases)
MCA	Minimum Circuit Amps
MFA	Maximum Fuse Amps
Run Amps	Running Amps
St Curr	Starting current
Fuses	Fuses
WxHxD	WidthxHeightxDepth
Wght	Weight of the device
EER	EER value at nominal conditions
IEER	IEER value at nominal conditions
COP 47°F	COP value at nominal conditions and ambient temperature of 47°F
COP 17°F	COP value at nominal conditions and ambient temperature of 17°F

3.2. Outdoor Details

Name	Model	Comb	Tmp C	CC	Rq CC	Tmp H	HC	Rq HC	Piping
		%	°F	BTU/h	BTU/h	°F	BTU/h	BTU/h	ft
Out 1	RXYQ120TTJU	110	95.0	107679	102172	23.0 / 20.0	101308	88787	250.0

Name	Model	Refrigerant		
		Type	Bse Refr	Ex Refr
			lbs	lbs
Out 1	RXYQ120TTJU	R410A	22.9	n/a

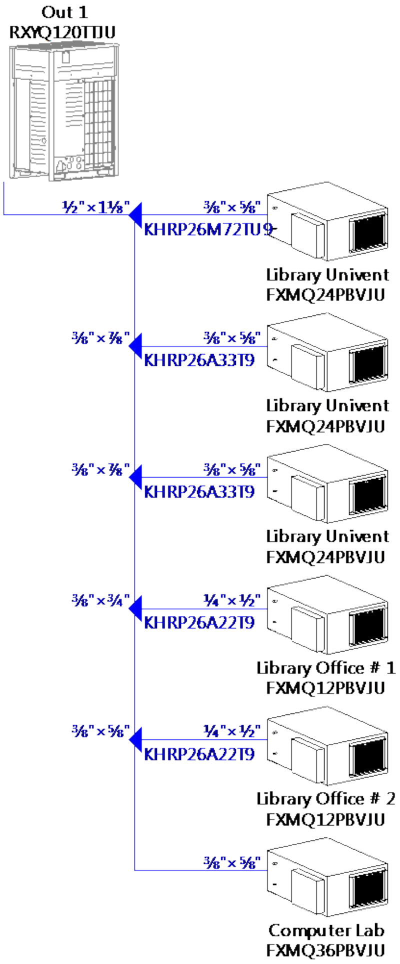
Name	Model	PS	MCA	MFA	Run Amps	St Curr	Fuses	WxHxD	Wght
			A	A	A	A		inch	lbs
Out 1	RXYQ120TTJU	230V 3ph	36.3	45	26.2		45A	48.9x66.7x30.2	527

Name	Ducted				Non-ducted			
	EER	IEER	COP 47°F	COP 17°F	EER	IEER	COP 47°F	COP 17°F
Out 1	12.1	21.4	3.46	2.58	14.1	25.8	4	2.65

4. Piping Diagrams

Pipes marked with * in the diagrams must be connected to the device with a reducing joint.

4.1. Piping Out 1

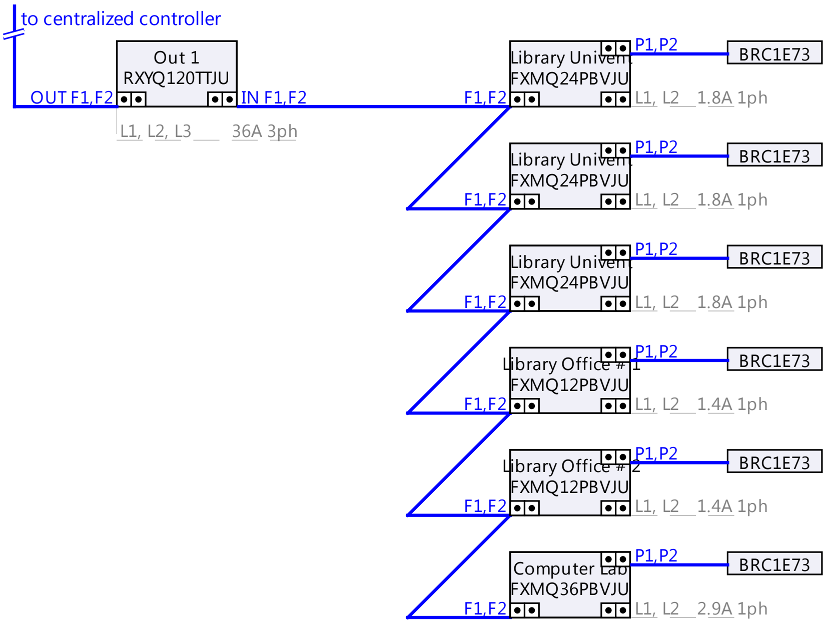


Warning: The pipe diameter values are purely indicative. Depending on the required pipe lengths, a different pipe diameter might be required.

5. Wiring Diagrams

P1P2 = Please select the cable type and size in accordance with the databook.
F1F2 = Please select the cable type and size in accordance with the databook.

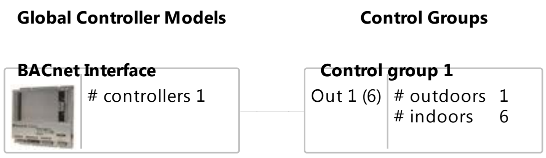
5.1. Wiring Out 1



6. Device Options

7. Centralized Controllers

7.1. Concept

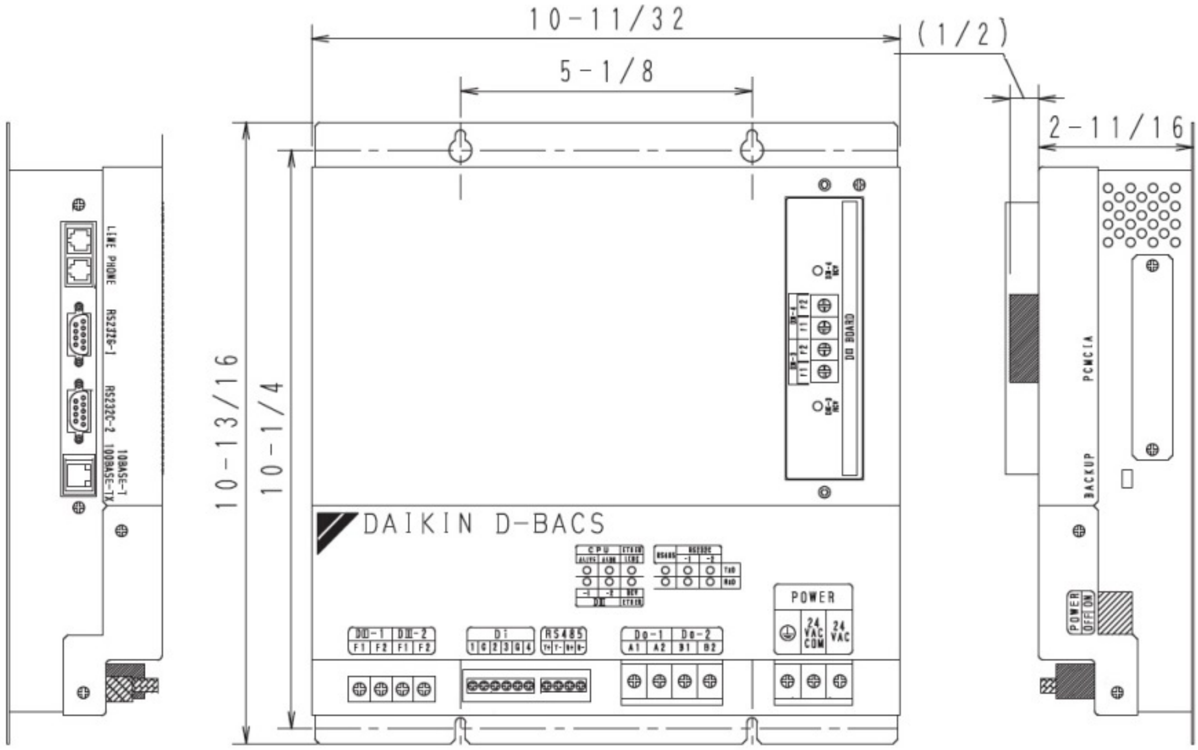


The Xpress Selection Program is property of Daikin Europe NV. Daikin Europe NV cannot be held liable for any inaccuracy, reliability of the outcome of the Xpress Selection Program.

7.2. Control group 1

7.3. Dimensional Drawings

BACnet Interface DMS502B71



Submittal Data Sheet

10-Ton VRV-IV Heat Pump Unit - 230V - RXYQ120TTJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

Tags: Out 1

FEATURES

- Variable Refrigerant Temperature (VRT) control allows the VRV IV to deliver up to 28% of improvement in seasonal cooling efficiency compared to previous Daikin VRV heat pump systems
- Same product structure for 230V and 460V simplifies ordering
- The rated seasonal cooling efficiency has been improved by an average of 11% compared to VRV III
- Improved efficiency with IEER values now up to 28
- Larger capacity single modules ranging up to 14 tons and systems up to 34 tons allow for a more flexible system design
- New configurator software designed to simplify the commissioning and maintenance of the system
- Larger capacity single modules allow for opportunity to reduce electrical connections, piping connections and outdoor unit mounting fixtures
- System wide auto-climate adjustment technology to increase the energy efficiency
- All inverter compressors to increase the efficiency and avoid starting current inrush
- Assembled in the US to increase flexibility and reduce lead times
- Standard Limited Warranty: 10-year warranty on compressor and all parts

BENEFITS

- 3 row 7mm heat exchanger coil improves efficiency
- Inverter control board cooled by refrigerant to avoid influence from abient temperatures
- Heat exchanger coil wraps around on all 4 sides of the unit to increase the surface area / efficiency
- Designed with reduced MOP to optimize installation cost
- Digital display on the unit for improved and faster configuration, commissioning, and trouble shooting.

DAIKIN

Submittal Data Sheet

10-Ton VRV-IV Heat Pump Unit - 230V - RXYQ120TTJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

Tags: Out 1

PERFORMANCE

Outdoor Unit Model No.	RXYQ120TTJU	Outdoor Unit Name:	10-Ton VRV-IV Heat Pump Unit - 230V
Type:	Heat Pump	Unit Combination:	
Rated Cooling Conditions:	Indoor (°F DB/WB): 80 / 67 Ambient (°F DB/WB): 95 / 75	Rated Heating Conditions:	Indoor (°F DB/WB): 70 / 70 Ambient (°F DB/WB): 47 / 43
Rated Piping Length(ft):			
Rated Height Difference (ft):	0.00		
Rated Cooling Capacity (Btu/hr):	114,000	Rated Heating Capacity (Btu/hr):	129,000
Nom Cooling Capacity (Btu/hr):		Nom Heating Capacity (Btu/hr):	
Cooling Input Power (kW):	9.00	Heating Input Power (kW):	9.92
EER (Non-Ducted/Ducted):	13.20 / 12.10	Heating COP (Non-Ducted/Ducted):	3.8 / 3.5
IEER (Non-Ducted/Ducted):	23.50 / 21.40	Heating COP 17F (Non-Ducted/Ducted):	2.6 / 2.6

OUTDOOR UNIT DETAILS

Power Supply (V/Hz/Ph):	208-230 / 60 / 3	Compressor Type	Inverter
Power Supply Connections:	L1, L2, L3 Ground	Capacity Control Range (%):	20 - 100
Min. Circuit Amps MCA (A):	36.3	Capacity Index Limit:	60.0 - 156.0
Max Overcurrent Protection (MOP) (A):	45.00	Airflow Rate (H) (CFM):	6,286
Max Starting Current MSC(A):		Gas Pipe Connection (inch):	1-1/8
Rated Load Amps RLA(A):	26.2	Liquid Pipe Connection (inch):	1/2
Dimensions (Height) (in):	66-11/16	H/L Pressure Connection (inch)	
Dimensions (Width) (in):	48-7/8	H/L Equalizing Connection (inch)	
Dimensions (Depth) (in):	30-3/16	Sound Pressure (H) (dBA):	61
Net Weight (lb):	528	Sound Power Level (dBA):	
		Max. No. of Indoor Units:	20

Submittal Data Sheet

10-Ton VRV-IV Heat Pump Unit - 230V - RXYQ120TTJU

Project: Denville Schools

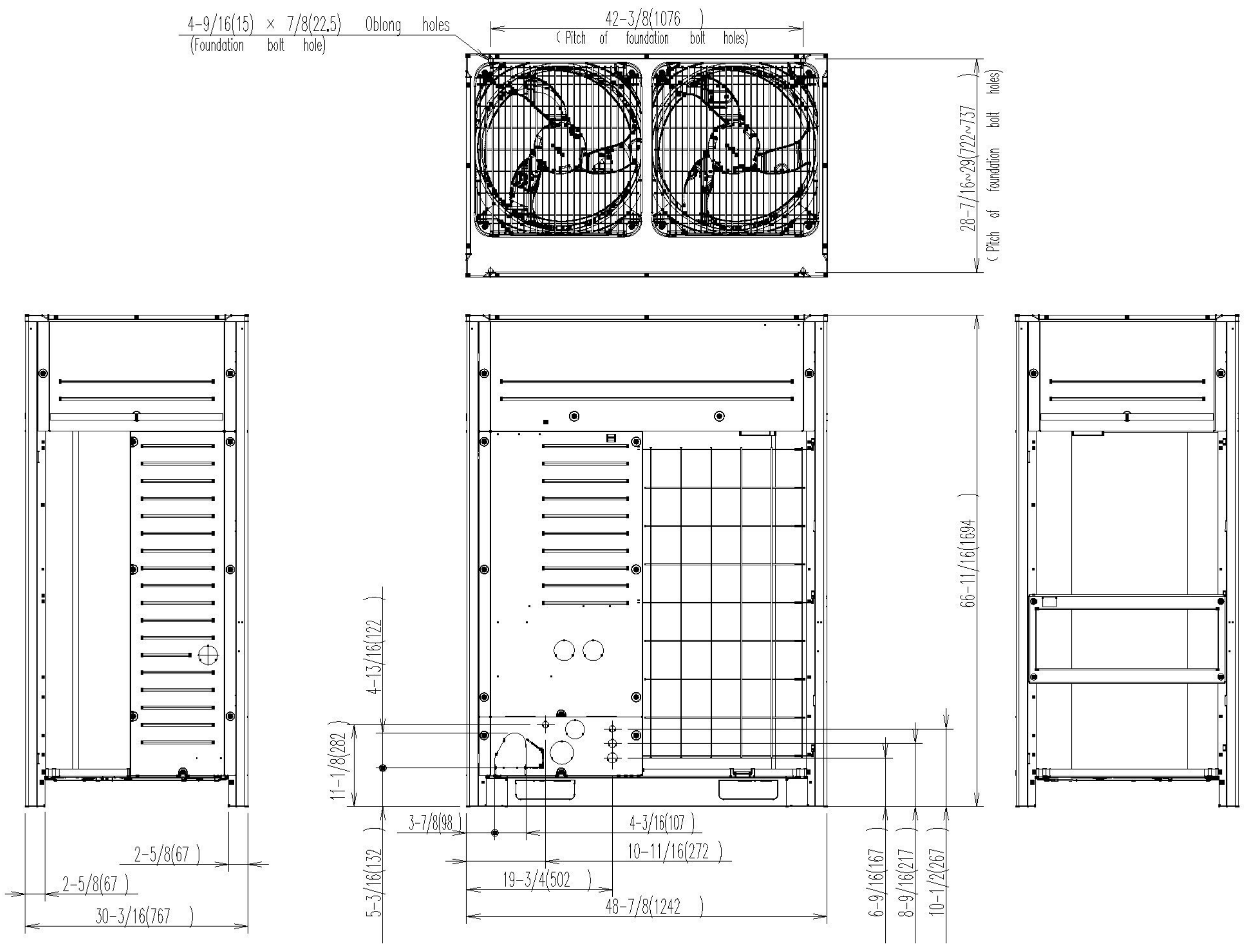
Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

Tags: Out 1

SYSTEM DETAILS			
Refrigerant Type:	R-410A	Cooling Operation Range (°F DB):	23 - 122
Holding Refrigerant Charge (lbs):	22.9	Heating Operation Range (°F WB):	-4 - 60
Additional Charge (lb/ft):		Max. Pipe Length (Vertical) (ft):	295
Pre-charge Piping (Length) (ft):		Cooling Range w/Baffle (°F DB):	-
Max. Pipe Length (Total) (ft):	540	Heating Range w/Baffle (°F WB):	-
Max Height Separation (Ind to Ind ft):	0		

DIMENSIONAL DRAWING



Submittal Data Sheet

1.0-Ton DC Ducted Concealed Ceiling - FXMQ12PBVJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

Tags: Library Office # 1, Library Office # 2

FEATURES

- Increased capacity range for increased flexibility
- Improved efficiency with DC fan motor
- Ease of installation with auto adjusting airflow at commissioning based on external static pressure
- Easy maintenance with service access from below
- Installation flexibility with a low profile, compact design at less than 12" in height
- Standard Limited Warranty: 10-year warranty on compressor and all parts

BENEFITS

- Enhanced indoor air quality and LEED ready with MERV 13 filter options
- Flexible ductwork design with ESP capabilities up to 0.54" W.G.
- New economizer control logic
- New configurable auxiliary heater control logic
- Design allows it to be completely concealed - perfect for retail, classrooms, offices, banks, restaurants, and hotels.

Submittal Data Sheet

1.0-Ton DC Ducted Concealed Ceiling - FXMQ12PBVJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

Tags: Library Office # 1, Library Office # 2

PERFORMANCE			
Indoor Unit Model No.	FXMQ12PBVJU	Indoor Unit Name:	1.0-Ton DC Ducted Concealed Ceiling
Type:	Ducted	Rated Cooling Conditions:	Indoor (°F DB/WB): 80 / 67 Ambient (°F DB/WB): 95 / 75
Rated Cooling Capacity (Btu/hr):	12,000	Rated Heating Conditions:	Indoor (°F DB/WB): 70 / 70 Ambient (°F DB/WB): 47 / 43
Sensible Capacity (Btu/hr):	9,700	Rated Piping Length(ft):	
Cooling Input Power (kW):	0.190	Rated Height Separation (ft):	
Rated Heating Capacity (Btu/hr):	13,500		
Heating Input Power (kW):	0.18		

INDOOR UNIT DETAILS			
Power Supply (V/Hz/Ph):	208-230 / 60 / 1	Airflow Rate (HH/H/M/L) (CFM):	450/450/410/388
Power Supply Connections:	L1, L2, Ground	Moisture Removal (Gal/hr):	
Min. Circuit Amps MCA (A):	1.40	Gas Pipe Connection (inch):	1/2
Max Overcurrent Protection (MOP) (A):	15.00	Liquid Pipe Connection (inch):	1/4
Dimensions (HxWxD) (in):	11-13/16 x 27-9/16 x 27-9/16	Condensate Connection (inch):	1-1/4
Panel (HxWxD) (in):		Sound Pressure (H/M/L) (dBA):	39/37/35
Net Weight (lb):	62	Sound Power Level (dBA):	
Panel Weight (lb):		Ext. Static Pressure (Rated/Max) (inWg):	0.20 / 0.40

Submittal Data Sheet

1.0-Ton DC Ducted Concealed Ceiling - FXMQ12PBVJU

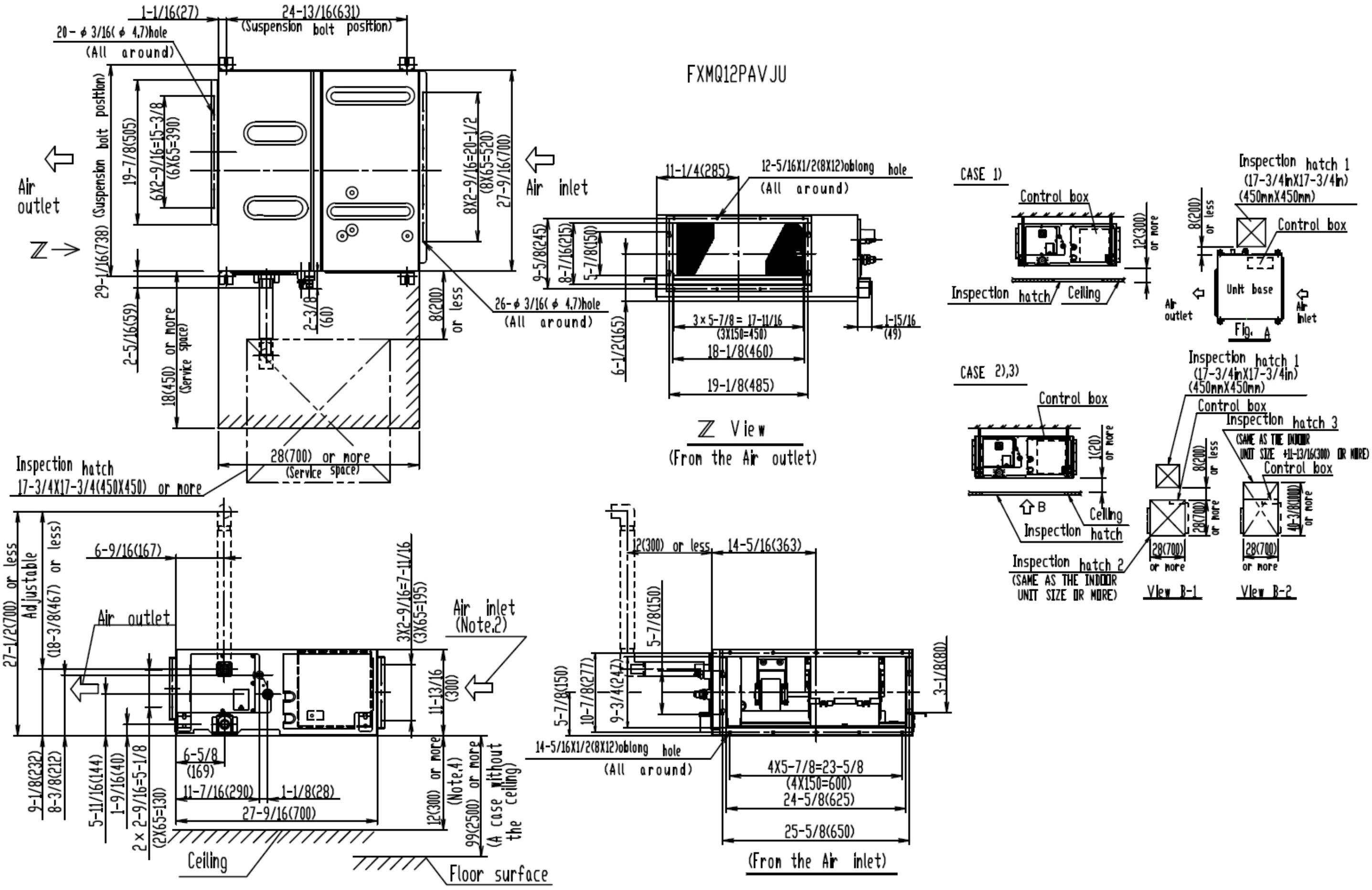
Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

Tags: Library Office # 1, Library Office # 2

DIMENSIONAL DRAWING



Submittal Data Sheet

2.0-Ton DC Ducted Concealed Ceiling - FXMQ24PBVJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

Tags: Library Univent

FEATURES

- Increased capacity range for increased flexibility
- Improved efficiency with DC fan motor
- Ease of installation with auto adjusting airflow at commissioning based on external static pressure
- Easy maintenance with service access from below
- Installation flexibility with a low profile, compact design at less than 12'' in height
- Standard Limited Warranty: 10-year warranty on compressor and all parts

BENEFITS

- Enhanced indoor air quality and LEED ready with MERV 13 filter options
- Flexible ductwork design with ESP capabilities up to 0.54'' W.G.
- New economizer control logic
- New configurable auxiliary heater control logic
- Design allows it to be completely concealed - perfect for retail, classrooms, offices, banks, restaurants, and hotels.

Submittal Data Sheet

2.0-Ton DC Ducted Concealed Ceiling - FXMQ24PBVJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

Tags: Library Univent

PERFORMANCE			
Indoor Unit Model No.	FXMQ24PBVJU	Indoor Unit Name:	2.0-Ton DC Ducted Concealed Ceiling
Type:	Ducted	Rated Cooling Conditions:	Indoor (°F DB/WB): 80 / 67 Ambient (°F DB/WB): 95 / 75
Rated Cooling Capacity (Btu/hr):	24,000	Rated Heating Conditions:	Indoor (°F DB/WB): 70 / 70 Ambient (°F DB/WB): 47 / 43
Sensible Capacity (Btu/hr):	15,600	Rated Piping Length(ft):	
Cooling Input Power (kW):	0.230	Rated Height Separation (ft):	
Rated Heating Capacity (Btu/hr):	27,000		
Heating Input Power (kW):	0.22		

INDOOR UNIT DETAILS			
Power Supply (V/Hz/Ph):	208-230 / 60 / 1	Airflow Rate (HH/H/M/L) (CFM):	688/688/618/565
Power Supply Connections:	L1, L2, Ground	Moisture Removal (Gal/hr):	
Min. Circuit Amps MCA (A):	1.80	Gas Pipe Connection (inch):	5/8
Max Overcurrent Protection (MOP) (A):	15.00	Liquid Pipe Connection (inch):	3/8
Dimensions (HxWxD) (in):	11-13/16 x 39-3/8 x 27-9/16	Condensate Connection (inch):	1-1/4
Panel (HxWxD) (in):		Sound Pressure (H/M/L) (dBA):	42/40/38
Net Weight (lb):	80	Sound Power Level (dBA):	
Panel Weight (lb):		Ext. Static Pressure (Rated/Max) (inWg):	0.40 / 0.80

DAIKIN

Submittal Data Sheet

2.0-Ton DC Ducted Concealed Ceiling - FXMQ24PBVJU

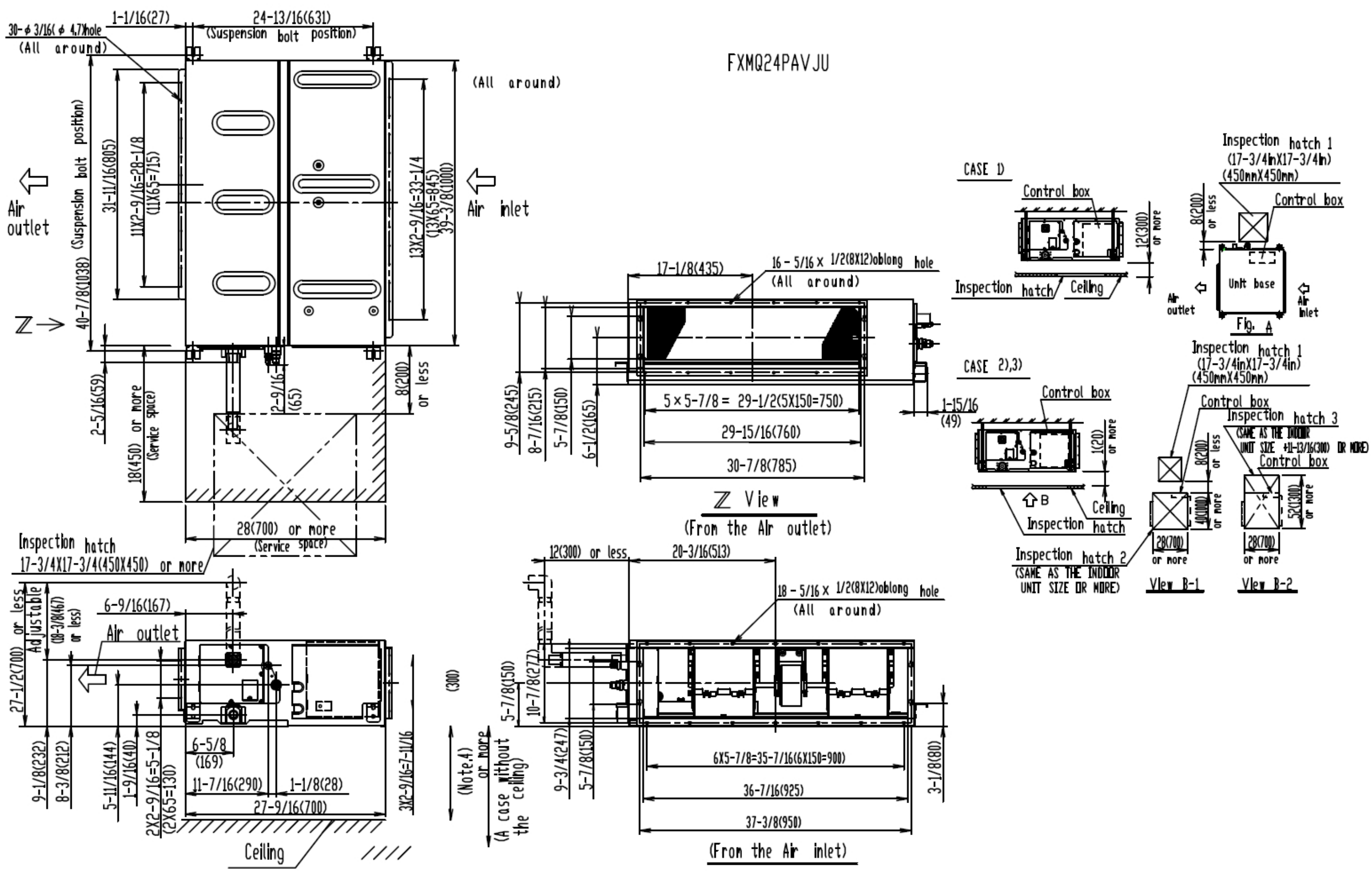
Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

Tags: Library Univent

DIMENSIONAL DRAWING



Submittal Data Sheet

3.0-Ton DC Ducted Concealed Ceiling - FXMQ36PBVJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

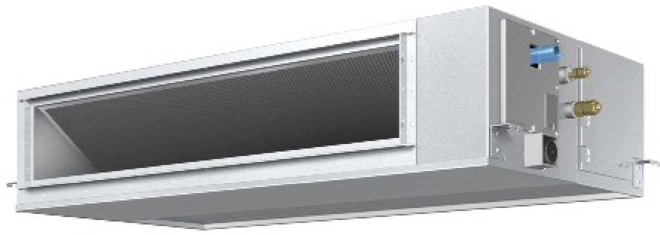
Tags: Computer Lab

FEATURES

- Increased capacity range for increased flexibility
- Improved efficiency with DC fan motor
- Ease of installation with auto adjusting airflow at commissioning based on external static pressure
- Easy maintenance with service access from below
- Installation flexibility with a low profile, compact design at less than 12'' in height
- Standard Limited Warranty: 10-year warranty on compressor and all parts

BENEFITS

- Enhanced indoor air quality and LEED ready with MERV 13 filter options
- Flexible ductwork design with ESP capabilities up to 0.54'' W.G.
- New economizer control logic
- New configurable auxiliary heater control logic
- Design allows it to be completely concealed - perfect for retail, classrooms, offices, banks, restaurants, and hotels.



Submittal Data Sheet

3.0-Ton DC Ducted Concealed Ceiling - FXMQ36PBVJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

Tags: Computer Lab

PERFORMANCE			
Indoor Unit Model No.	FXMQ36PBVJU	Indoor Unit Name:	3.0-Ton DC Ducted Concealed Ceiling
Type:	Ducted	Rated Cooling Conditions:	Indoor (°F DB/WB): 80 / 67 Ambient (°F DB/WB): 95 / 75
Rated Cooling Capacity (Btu/hr):	36,000	Rated Heating Conditions:	Indoor (°F DB/WB): 70 / 70 Ambient (°F DB/WB): 47 / 43
Sensible Capacity (Btu/hr):	28,800	Rated Piping Length(ft):	
Cooling Input Power (kW):	0.380	Rated Height Separation (ft):	
Rated Heating Capacity (Btu/hr):	40,000		
Heating Input Power (kW):	0.36		

INDOOR UNIT DETAILS			
Power Supply (V/Hz/Ph):	208-230 / 60 / 1	Airflow Rate (HH/H/M/L) (CFM):	1,130/1,130/953/812
Power Supply Connections:	L1, L2, Ground	Moisture Removal (Gal/hr):	
Min. Circuit Amps MCA (A):	2.90	Gas Pipe Connection (inch):	5/8
Max Overcurrent Protection (MOP) (A):	15.00	Liquid Pipe Connection (inch):	3/8
Dimensions (HxWxD) (in):	11-13/16 x 55-1/8 x 27-9/16	Condensate Connection (inch):	1-1/4
Panel (HxWxD) (in):		Sound Pressure (H/M/L) (dBA):	43/41/39
Net Weight (lb):	102	Sound Power Level (dBA):	
Panel Weight (lb):		Ext. Static Pressure (Rated/Max) (inWg):	0.40 / 0.80

DAIKIN

Submittal Data Sheet

3.0-Ton DC Ducted Concealed Ceiling - FXMQ36PBVJU

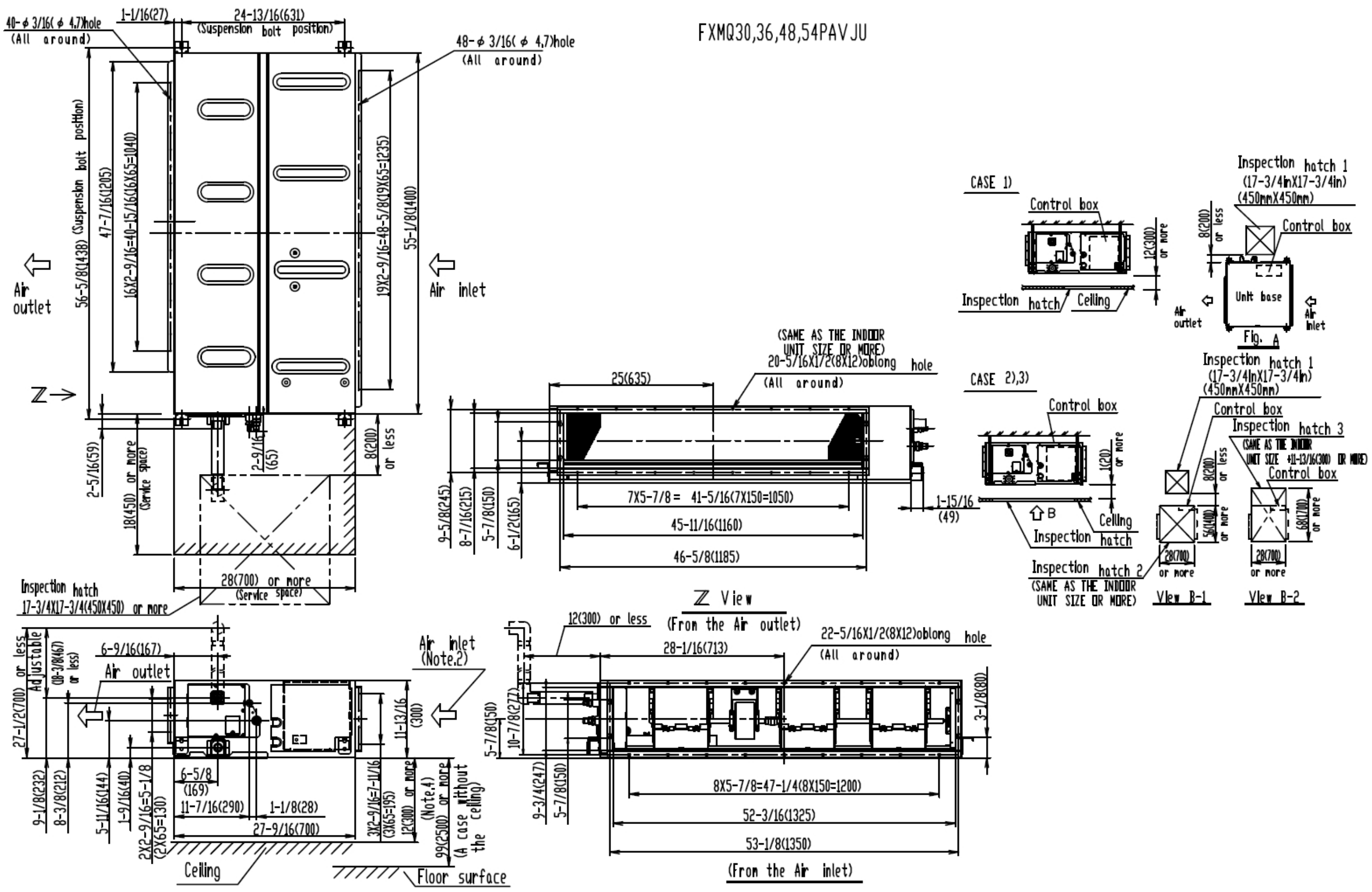
Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

Tags: Computer Lab

DIMENSIONAL DRAWING



Submittal Data: DMS502B71
BACnet® Interface

DAIKIN AC®
absolute comfort

Job Name:	Location:
Purchaser:	
Engineer:	
Submitted To:	For: ☐ Reference ☐ Approval ☐ Construction
Submitted By:	Date:
Unit Designation: Schedule #:	Model No.:

FEATURES / BENEFITS
• Integrate Daikin VRV, SkyAir and Duct-Free Split Systems with third party building automation systems supporting the BACnet protocol.
• BACnet Application Specific Controller (B-ASC) device profile compatible with BACnet (ANSI / ASHRAE-135)
• BACnet IP Data Link Layer (Annex J)
• Supports COV – Change of Value, Property Array Index and Segmented Requests
• IPV6 and Foreign Device Registration capability
• BTL Certification (Operating System Version 6.2 and Later)

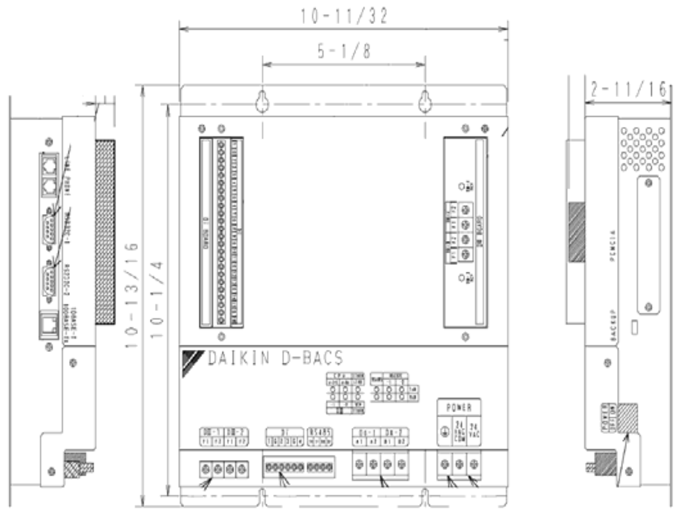
Power:

Power supply (externally supplied)	24VAC, 50/60Hz
Power consumption	20 Watts maximum (40 VA Transformer Recommended)

Operating conditions:

Surrounding temperature	14° F to 122° F
Storage temperature	5° F to 140° F
Humidity (% Relative)	0% to 98% (non-condensing)
Dimensions (H x W x D)	10-13/16" x 10-11/32" x 2-11/16"

Maximum number of outdoor units	20 (*40 with DAM411B51*)
Maximum number of indoor units	256 (*512 with DAM411B51*)
Temperature Unit	Degrees Fahrenheit or Celsius



Connectivity:

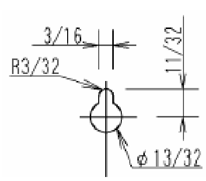
DIII-Net x 2	AC equip. communication line
10BASE-T or 100BASE-TX	Interface to BACnet network
Di (Digital Input) x 4	Forced Off Function
Do (Digital Output) x 2	A/C malfunction indication

Options:

DAM411B51	Adds (2) DIII-Net lines

Certifications: FCC Part 15 Subpart B Class A

Configuration and engineering for each project are necessary.



SPECIFICATIONS OF COMMUNICATIONS CABLING (DIII-NET)	
TYPE	2-conductor, stranded, non-shielded copper cable / PVC or vinyl jacket
SIZE	AWG18-2
TOTAL LENGTH	Maximum wiring distance between units: 3,280 ft Maximum wiring length: 6,550 ft

Submittal Data: DMS502B71
BACnet® Interface

Daikin indoor unit monitoring and control points accessible through the DMS502B71

Check the appropriate box indicating the required integrated points for this project.

		Function	Description
Monitoring points	☐	On / Off status	Monitors the On / Off status of the indoor unit.
	☐	Alarm	Monitors whether or not the indoor unit is operating normally, and issues an alarm if the indoor unit has a malfunction.
	☐	Malfunction code	Displays a malfunction code specified by Daikin if an indoor unit in the system has a malfunction.
	☐	Operation mode	Monitors if the indoor unit is in Cool, Heat, Fan, or Dry mode.
	☐	Room temperature (Note 1)	Monitors and displays the room temperature.
	☐	Filter sign	Monitors filter run time and provides service alert.
	☐	Thermo-on	Monitors whether or not the indoor unit is actively cooling or heating.
	☐	Compressor status	Monitors if the compressor of the outdoor unit connected to the indoor unit is properly operating.
	☐	Indoor fan status	Monitors if the indoor unit's fan is properly operating.
	☐	Heater operation status	Monitors if the indoor unit's heater is properly operating.
	☐	Communication status	Monitors the indoor unit's DIII-net communications status.
Operation, configuration, and monitoring points	☐	On / Off stop operation (Note 2)	Starts / stops the indoor unit and monitors the latest status.
	☐	Operation mode setting (Note 2)	Sets the Cool / Heat / Fan / Dry / Auto mode for the indoor unit and monitors the latest mode.
	☐	Setpoint setting (Note 2)	Sets the setpoint of the indoor unit and monitors the latest setpoint.
	☐	Filter sign and reset	Monitors the filter run time, provides service alert, and allows a manual reset of the status as required.
	☐	Remote permit / prohibit (Note 2)	Permits or prohibits the remote controller so that it can or cannot be used to control the indoor unit's On/Off / Operation mode / Setpoint.
	☐	Lower Centralized Controller operation enable / disable	Enables or disables operation of a Centralized Controller connected to the DIII network.
	☐	Fan speed setting (Note 2)	Sets the fan speed and monitors the latest setting.
	☐	Vane direction setting (Note 2)	Sets the vane direction and monitors the the latest setting.
	☐	Forced system stop	The forced system stop command will force the indoor unit to stop running based upons a received emergency alarm input. Remote controllers will be locked out from restarting indoor units during the forced system stop event.
	☐	Forced Thermo-off	In response to the forced thermo-off command, the indoor unit stops actively cooling or heating.
	☐	Energy saving	Offsets the internal setpoint +3.6°F (2°C)in cooling, and -3.6°F (-2°C) in heating in an indoor unit. The actual setpoint is not changed.

Application Notes

1. Room temperature data (BACnet object name RoomTemp_XXX) by default is reported from the Daikin indoor units return air thermistor. This applies to all VRV indoor units styles and capacities. During periods when the indoor unit is turned off or during certain operating modes that cycle the fan off including defrost operation, hot-start and system pressure equalization, the reported temperature may not accurately reflect the actual space temperature. For applications where this temperature value will be primary to system control including mode and temperature setpoint management, it is recommended that the Daikin remote temperature sensor (Part No. KRCS01-1B or 4B depending on model) is specified for each indoor unit and installed within the occupied space or unit be configured to be controlled from temperature sensor in BRC1E71 Navigation Controller if the unit is capable.

2. The Daikin indoor unit maintains the settings for temperature, on / off status, operating mode, vane direction and fan speed in non-volatile memory each time they are changed. These settings will not be lost upon a power loss event.

3. BACnet® is a registered trademark of ASHRAE.

Submittal Data Sheet

BRC1E73 - Navigation Remote Controller

Project Name:	
Location:	Approval:
Engineer:	Date:
Submitted to:	Construction:
Submitted by:	Unit #:
Reference:	Drawing #:

Model Compatibility:

For use with the following VRV indoor unit models: FXAQ, FXDQ, FXEQ, FXFQ, FXHQ, FXLQ, FXMQ, FXMQ_MF, FXNQ, FXTQ, FXUQ, FXZQ

For use with the following Daikin SkyAir indoor unit models: FAQ, FBQ, FCQ, FHQ, FTQ

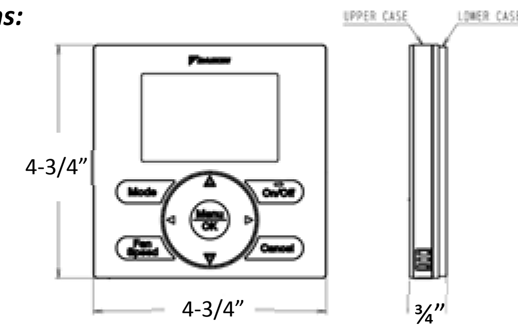
Product Image:

1 of 3 display options – Detailed display shown

Specifications:

Model	BRC1E73
Description	Navigation Remote Controller
Maximum Connections	16 indoor units
Communication Wire	18AWG-2, No polarity Stranded, Non-shielded
Total Wiring Length	1,640 ft. (500 m)
Communication Protocol	Daikin Proprietary P1P2 protocol
Power	16VDC supplied by Indoor unit (1.58VA maximum)
Comfort Setpoint Range	60 to 90 °F (16 to 32 °C)
Setback Setpoint Range	40 to 95 °F (5 to 35°C)
Operating Temp Range	14 to 122°F (-10 to 50°C)
Operating Humidity Range	75% or less (RH) (w/o condensation)
Dimensions (WxHxD)	4.72x4.72x0.75 inch (120x120x19 mm)
Weight (Mass)	0.42 lbs. (0.19 kg)

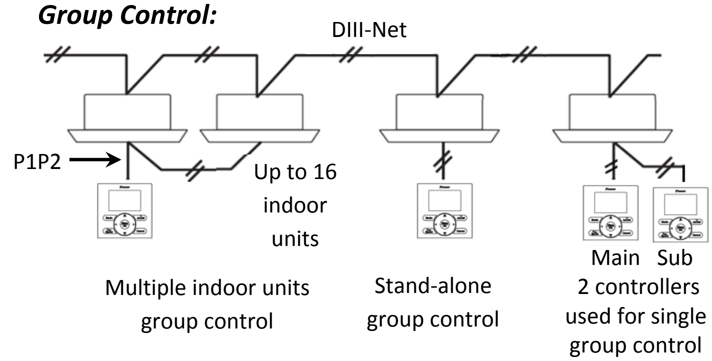
Dimensions:



Features/Benefits:

1. Up to 16 indoor units are controllable within one group
2. Within one group, up to 2 Navigation Remote Controllers can be used, one as a main and one as a sub
3. Backlit LCD displays in English, Spanish or French
4. Temperature sensor built-in with configurable offset
5. Display of Temperature and Setpoint in 1°F / °C increments
6. Three configurable display options: Detailed, Standard and Simple
7. Dual setpoints (independent cooling and heating setpoints) with configurable minimum setpoint differential or Single Setpoint (occupied period)
8. Setpoint range limit for cooling and heating modes
9. Independent cooling and heating setback setpoints (unoccupied period)
10. Auto changeover control with configurable Primary changeover at setpoint ±1° F with guard timer

Group Control:



Project Name:
Location: Approval:
Engineer: Date:
Submitted to: Construction:
Submitted by: Unit #:
Reference: Drawing #:

11. Airflow – Individual air flow direction, dual airflow and auto draft prevention (prevents air blowing directly on occupants)*
12. Built-in 7, 5+2, 5+1+1 and 1 (Everyday) schedules with up to 5 actions per day with independent cooling and heating or setback setpoints
13. Automatic Setback by occupancy sensor*
14. Automatic Off by occupancy sensor*
15. Configuration for Self-cleaning filter panel**
16. Automatic adjustment for Daylight Savings Time (DST)
17. 48 hour clock/calendar battery backup (protects schedule timing in cases of short term power loss from indoor unit)
18. Real-time monitoring of system malfunctions with immediate display of unit in error and error code
19. The buttons on the remote controller are selectable by locking out the unwanted buttons
20. The operation modes can be restricted to provide only the desired mode(s) of operation
21. Display can be configured to show “Off” and room temperature only when indoor unit is turned off
22. To prevent unwanted changes, fan speed selection and display may be hidden
23. Auto off timer configurable in 10 minute increments (range 30-180 minutes)
24. Can be used to replace earlier versions of remote controllers

* Available for FXFQ_TVJU and FXUQ_PVJU indoor units
**Available for FXTQ_TVJU indoor units

Auto changeover:
Automatic changeover is available for Heat Pump system and Heat Recovery systems. The setpoint for cooling and heating are configurable with a minimum differential of 0 to 7°F or single setpoint. The changeover is automatically controlled to happen in either of the following two cases:
Case 1: Changeover at the primary changeover temperature after the guard timer expires.

1. In default, the primary changeover setpoint is 1°F above cooling setpoint or 1°F below heating setpoint, which is configurable between 1°F – 4°F.
2. In default, the guard timer is 60 minutes, which is selectable among 15, 30, 60 (default) or 90 minutes.
3. The initiation of guard timer is built in to help prevent frequent changeover which may cause energy loss.

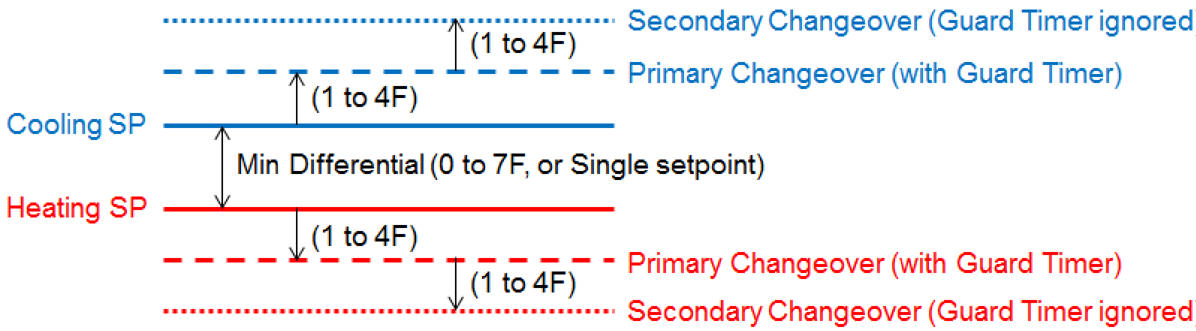
Case 2: Changeover at the secondary changeover temperature.

1. In default, the secondary changeover temperature is 1°F above the primary changeover temperature for cooling or 1°F below the primary changeover temperature for heating, which is configurable between 1°F – 4°F.
2. Case 2 will happen while the guard time is active in case 1.

Submittal Data Sheet

BRC1E73 - Navigation Remote Controller

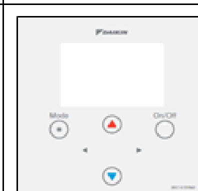
Project Name:	
Location:	Approval:
Engineer:	Date:
Submitted to:	Construction:
Submitted by:	Unit #:
Reference:	Drawing #:



Face Decal Options:

Face decal options to hide unnecessary buttons

1. The face decal is designed to adhere to the BRC1E faceplate
2. Hidden buttons can be used/accessed by service personnel without removing the face decal due to its flexibility

Used with	Single Setpoint mode			Dual Setpoint mode		
	BRC1E72RM	BRC1E72RF	BRC1E72RMF	BRC1E72RM2	BRC1E72RF2	BRC1E72RMF2
Model						
On/Off	X	X	X	X	X	X
Mode	X		X	X		X
Fan		X	X		X	X
Up, Down	X	X	X	X	X	X
Left, Right				X	X	X
Menu/Ok						
Cancel						

Submittal Data Sheet

BRC1E73 - Navigation Remote Controller

Project Name:	
Location:	Approval:
Engineer:	Date:
Submitted to:	Construction:
Submitted by:	Unit #:
Reference:	Drawing #:

Documentation:

Documentation available on www.daikincity.com or www.daikinac.com

- Installation Manual
- Operation Manual
- Submittal
- Guide Specifications

A	UPDATED DOCUMENT FORMAT AND STANDARDS. M.E.B. - 9/18/13	N/A	N/A	KDB 9/24/13	DGM 9/30/13	MEH 9/30/13
REV	REVISION DESCRIPTION	B.O.M.	ELEC. ENG	MECH. ENG	CHECKED	APPROVED

REVISION HISTORY

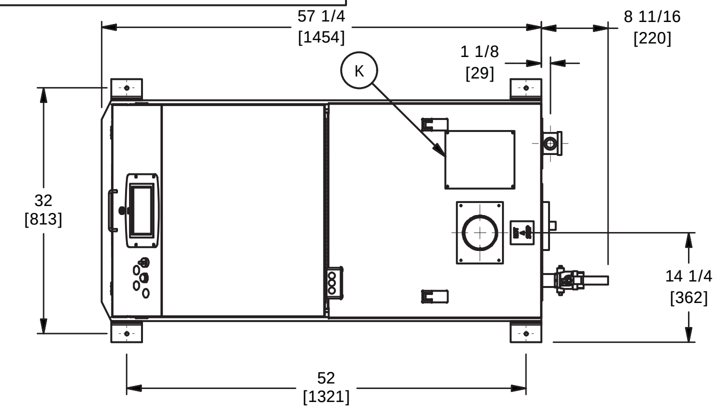
CUSTOMER CONNECTIONS			
ITEM	DESCRIPTION	SIZE	TYPE
A	WATER OUTLET	2"	N.P.T.
B	EXHAUST OUTLET	6"	-
C	AIR INLET	4"	-
D	CONDENSATE DRAIN	3/4"	N.P.T.
E	WATER INLET	2"	N.P.T.
F	FUEL INLET	1 1/4"	N.P.T.
G	CUSTOMER ELECTRICAL CONNECTION 120V/60HZ	-	-
H	CONTROL DISPLAY	-	-
J	SAFETY VALVE CONNECTION (SEE NOTE 3)	3/4"	N.P.T.
K	INSPECTION OPENING FOR FLOW SWITCH	-	-

NOTES:

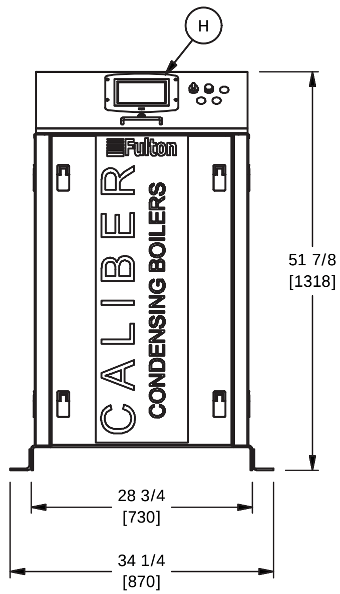
1. CONTROLS ACCESS HOOD REQUIRES A 28" RADIUS SWING HINGED FROM THE REAR OF TOP PANEL. FRONT AND REAR CLEARANCE MINIMUM IS 36". SIDE CLEARANCE MINIMUM BETWEEN ONE SET (2EA) OF BOILERS IS 6"; ALL OTHER SIDE CLEARANCE MINIMUM IS 24".
2. PRESSURE VESSEL IS BUILT TO COMPLY WITH ASME SECTION IV.
3. APPROPRIATE SAFETY RELIEF VALVE AND BUSHING ARE DETERMINED BY TRIM PRESSURE AND ARE SUPPLIED IN THE TRIM KIT TO BE INSTALLED BY OTHERS. INLET AND OUTLET SIZES ARE AS FOLLOWS:

   30# - 3/4" INLET X 1" OUTLET
   60# - 3/4" INLET X 1" OUTLET
   100# - 3/4" INLET X 1" OUTLET
   125# - 3/4" INLET X 1" OUTLET
   160# - 3/4" INLET X 1" OUTLET

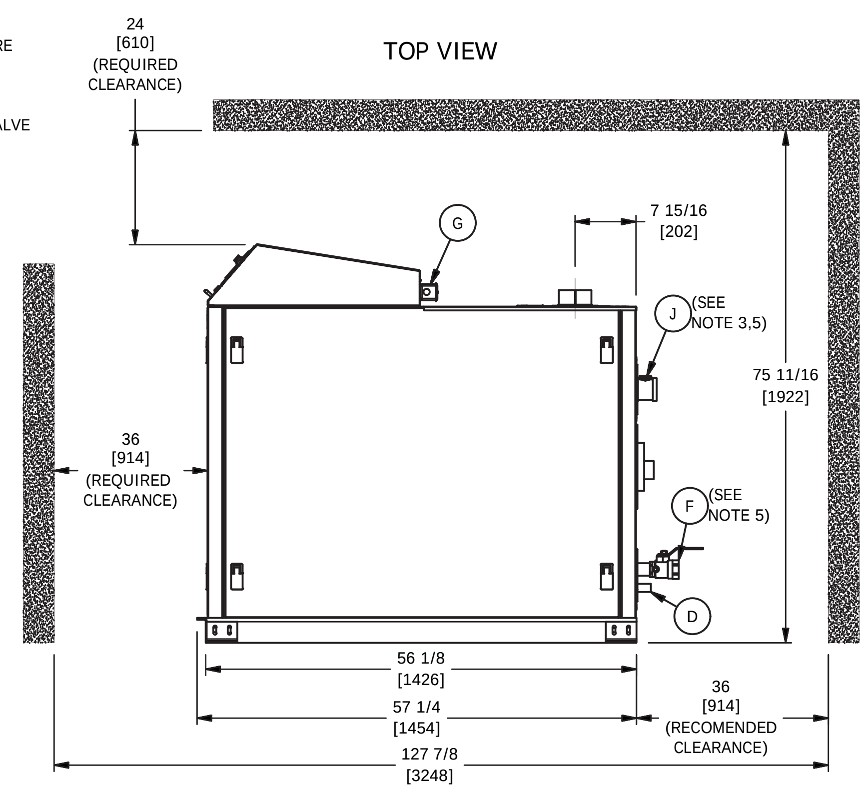
4. ALL DIMENSIONS ARE IN INCHES [MILLIMETERS] AND ARE FOR REFERENCE ONLY. THIS DRAWING IS NOT FOR CONSTRUCTION PURPOSES.
5. REDUCING TEE FOR OUTLET PIPE AND GAS SHUT OFF VALVE ARE SUPPLIED IN THE TRIM KIT TO BE INSTALLED BY OTHERS.



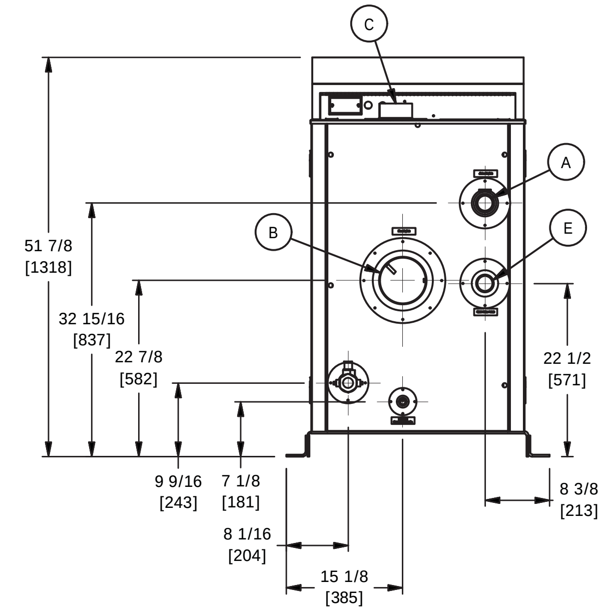
TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW



BACK VIEW

UNLESS OTHERWISE NOTED: DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/4; (2) PLACE DEC. ± .01; (3) PLACE DEC. ± .005; ANGLES ± 2 DEG. SURFACE FINISH 250 MICRO-INCHES	This design and drawings are proprietary and are the exclusive property of The Fulton Companies. The corporation does not permit their use except with prior written consent.	The items shown in this drawing may be covered by one or more patents of The Fulton Companies. THIRD ANGLE PROJECTION 1 OF 1	DRAWN BY: M.GIGLIOTTI 4/5/2012 CHECKED BY: B.O.M. REVIEW	MECH. ENG: ELEC. ENG: APPROVED BY:	JOB NUMBER: PROJECT NAME: PROJECT MANAGER:	DESCRIPTION: CAL-850 AHRI HYDRONIC BOILER WITH CSD-1 / CSA FUEL TRAIN (4-14" WC NATURAL GAS) PRODUCT DATA END ASSEMBLY DRAWING SHEET 1 OF 1

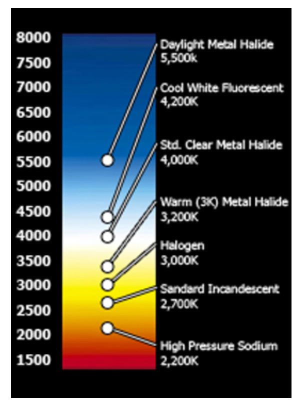
The Fulton Companies
972 Centerville Road
Pulaski, New York USA 13142

Fulton

DRAWING NUMBER C91-0008 | REV A

Spec Sheet

SKU#	120335
Product Name	HP 154W 4700K LED 120 Deg Aluminum Cone High Bay Light
Description	High Bay, 154W, Open, 4700K, 120-277VAC, 24LED, 120deg AL, HP
Estimated Energy Cost ($/yr)**	319.8
Watts (W)	154
Light Output (Lumens)	12300
Efficacy (Lumens/Watt)	79.87
Color Accuracy (CRI)	80
Color Temperature (K)	4700-4900
Lighting Angle/Type	120
Power Factor	0.95
Working Voltage	120-277VAC
LED Count/Type	24
Lens Reflector Style	Aluminum
Operating Temperature (F)	-22 to 158
Mount/Base Type	Hanging Hook
Dimensions (inches)	0.00 L x 0.00 W x 15.00 H x 20.00 DIA
Weight (pounds)	12
Typically Replaces	250-400W MH/HPS Fixture
Typical Life Expectancy (L70 Hours)	50,000
Approvals / Certifications	UL DLC
Photometric Data Available?	No
IES File Available?	No



Features

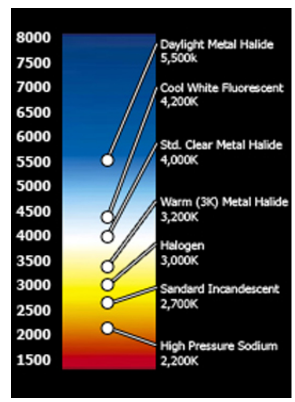
Traditional style aluminum housing with integrated ultra-efficient brass and thin-fin aluminum heat sink structure; open loop on top for hook for hanging mounting, can accomodate other mounting methods; anodized aluminum Parabolic reflector cone; constant current solid state long 50,000+ hour life; wide input voltage; high shock & vibration resistance; mercury-free; no noise; instant on/off great with occupancy sensors; IEC directives completed: IEC 60598, IEC 61000-3-2:2005, IEC 61347, UL8750; UL listed and DLC listed.

NOTE: The preliminary performance information provided in this notice is pending verification by an independent testing laboratory. Contact your Seesmart representative for more information about photometric and other performance testing information for this product.

** Calculation based on 3 hours/day, $0.11/kWh. Cost depends on rates and use.

Spec Sheet

SKU#	120346
Product Name	HP 200W 5500K LED 120 Deg Aluminum Cone High Bay Light
Description	High Bay, 200W, Open, 5500K, 120-277VAC, 32LED, 120deg AL, HP
Estimated Energy Cost ($/yr)**	383
Watts (W)	200
Light Output (Lumens)	16495
Efficacy (Lumens/Watt)	82.48
Color Accuracy (CRI)	78
Color Temperature (K)	5500-5900
Lighting Angle/Type	120
Power Factor	0.95
Working Voltage	120-277VAC
LED Count/Type	32
Lens Reflector Style	Aluminum
Operating Temperature (F)	-22 to 158
Mount/Base Type	Hanging Hook
Dimensions (inches)	0.00 L x 0.00 W x 18.00 H x 20.00 DIA
Weight (pounds)	16
Typically Replaces	250-400W MH/HPS Fixture
Typical Life Expectancy (L70 Hours)	50,000
Approvals / Certifications	UL DLC
Photometric Data Available?	No
IES File Available?	No



Features

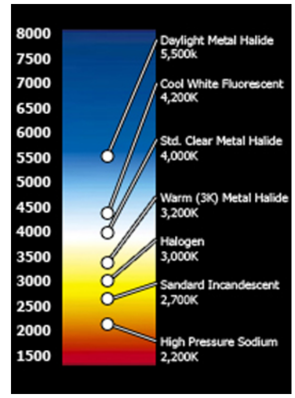
Traditional style aluminum housing with integrated ultra-efficient brass and thin-fin aluminum heat sink structure; open loop on top for hook for hanging mounting, can accomodate other mounting methods; anodized aluminum Parabolic reflector cone; constant current solid state long 50,000+ hour life; wide input voltage; high shock & vibration resistance; mercury-free; no noise; instant on/off great with occupancy sensors; IEC directives completed: IEC 60598, IEC 61000-3-2:2005, IEC 61347, UL8750; UL listed and DLC listed.

NOTE: The preliminary performance information provided in this notice is pending verification by an independent testing laboratory. Contact your Seesmart representative for more information about photometric and other performance testing information for this product.

** Calculation based on 3 hours/day, $0.11/kWh. Cost depends on rates and use.

Spec Sheet

SKU#	200732R
Product Name	G2 HP 4 Foot 15W NWC Rotatable SEP Rotatable LED Tube Light
Description	Tube Light, 4 Foot, 15 Watt, NWC, 120-277VAC, Rot, SEP, G2, HP
Estimated Energy Cost ($/yr)**	21.65
Watts (W)	15
Light Output (Lumens)	1800
Efficacy (Lumens/Watt)	120
Color Accuracy (CRI)	85
Color Temperature (K)	4000-4500
Lighting Angle/Type	120
Power Factor	0.98
Working Voltage	120-277VAC
LED Count/Type	64
Lens Reflector Style	Clear
Operating Temperature (F)	-20 to 122
Mount/Base Type	Med Bi-Pin
Dimensions (inches)	48.00 L x 0.00 W x 0.00 H x 1.11 DIA
Weight (pounds)	0.9
Typically Replaces	32-45W T8 Fluorescent
Typical Life Expectancy (L70 Hours)	50000
Approvals / Certifications	UL
Photometric Data Available?	No
IES File Available?	No



Features

Strong yet lightweight aluminum heat sink; ultra-bright, long-life 5630 SMD LEDs; polycarbonate lens; no UV, noise, or flickering; constant-current integrated driver; high shock and vibration resistance; mercury-free; single end power configuration; rotatable end cap; UL listed.

NOTE: The preliminary performance information provided in this notice is pending verification by an independent testing laboratory. Contact your Seesmart representative for more information about photometric and other performance testing information for this product.

** Calculation based on 3 hours/day, $0.11/kWh. Cost depends on rates and use.

Specifications are valid as of 010-11-19 08:58:30] , but are subject to change.
Confirm latest specifications prior to placing order.

CR22™

2′x2′ Architectural LED Troffer

Product Description

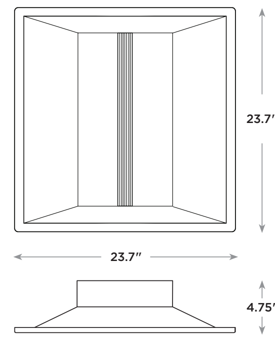
The CR22 Architectural LED troffer delivers up to 100 lumens per watt of exceptional 90 CRI light at both 2000 and 3200 lumen levels. This breakthrough performance is achieved by combining the high efficacy and high-quality light of Cree TrueWhite® Technology with a unique thermal management design. The CR22 High Definition (HD) option delivers enhanced spectrum 80+ CRI color quality. The CR22 product family is available in warm, neutral, cool, or daylight color temperatures and has step, 0-10V, or Lutron EcoSystem® Enabled dimming options. Its compact, lightweight design makes the CR22 perfect for use in commercial new construction or renovated spaces.

Performance Summary

Utilizes Cree TrueWhite® Technology or High Definition Color
Active Color Management
Room-Side Heat Sink
Assembled in the US & Mexico
Efficacy: 90-100 LPW
Delivered Light Output: 2000, 3200 lumens
Input Power: 22-35 watts
CRI: 90 CRI (Cree TrueWhite® Technology), 80+ CRI (High Definition)
CCT: 3000K, 3500K, 4000K, 5000K
Input Voltage: 120-277 VAC or 347 VAC*
Warranty: 10 Years
Lifetime: Designed to last from 50,000 hours (HD), 75,000 hours (Standard TW), and 100,000 hours (HE TW)
Controls: Step Level to 50%, 0-10V Dimming or Lutron EcoSystem® Enabled to 5%
Mounting: Recessed

*32L- 100 LPW 10V types only- other types require addition of a 347 accessory kit

CR22™



NOTE: Use of Expanded Junction Box will expand the depth to 6.67″ and Emergency Backup will expand the depth to 6.30″. Use of 347V will increase fixture height by 1.4”.

Housings & Accessories

Accessories			
CPLCR Chicago Plenum Field Kit **CPLCR-EM** Chicago Plenum Field Kit-Emergency	**CR-347V** 347 Volt **CR-347V-SD** Step Dimming to 50% **SMK-CR22** Surface Mount Kit	**PW-18/4-06-9T/SS-CR** Power Whip **AC5-18/4-72-PD8-JB** Adjustable Cable	**AC5-72-PD8-JB** Adjustable Cable **EJBCR-5PK** Expanded size junction box for through wiring (5 pack)

Ordering Information

Example: CR22-20L-35K-S

CR22					
Product	**Lumen Output**	**Color Temp**	**Voltage**	**Control**	**Options**
CR22	**20L** 22W 2000 lumens – 90 LPW **32L** 32W 3200 lumens – 100 LPW	**30K** 3000 Kelvin **35K** 3500 Kelvin **40K** 4000 Kelvin **50K** 5000 Kelvin	**Blank** 120-277 Volt (Standard) **34**[6] 347 Volt (Optional)	**S** Step Dimming to 50% **10V** 0-10V Dimming to 5% **LES** Lutron EcoSystem® Enabled to 5%	**HD**[7] High Definition Color - CRI 80+ (35W 3200 lumens - 90 LPW) **EB14**[2,4] Emergency Backup - 1400 lumens **EB14 SMK**[2,3,5] Emergency Backup with surface mount kit - 1400 lumens

1. Reference www.cree.com/lighting for recommended dimming control options. 2. Not available in LES types except 32L LES type. 3. Not available with EB14 option. Use EB14 SMK. 4. EB14 not for use with SMK Kits 5. Includes surface mount kit accessory (SMK-CR24). 6. 347V integrated option only available on 32L 100 LPW 10V fixtures. Wattage increases to 33.5W and fixture height increases by 1.4” over standard 120-277V fixtures. 7. HD only available in 32L. Suggested MSRP for the adder over the standard CR Series fixture for the Lutron EcoSystem® Enabled feature is $49. †See www.cree.com/lighting for warranty terms.

Rev. Date 9/17/2013

US: www.cree.com/lighting T (800) 236-6800 F (262) 504-5415
Canada: www.cree.com/canada T (800) 473-1234 F (800) 890-7507

Product Specifications

CREE TRUEWHITE® TECHNOLOGY
A revolutionary way to generate high-quality white light, Cree TrueWhite® Technology mixes the light from the highest performing red and unsaturated yellow LEDs. This patented approach delivers an exclusive combination of 90+ CRI, beautiful light characteristics, and lifelong color consistency, all while maintaining high luminous efficacy—a true no compromise solution.

HIGH DEFINITION COLOR
High Definition (HD) Color delivers enhanced spectrum 80+ CRI color quality. HD is derived from color mixed and tuned Cree TrueWhite® Technology.

ROOM-SIDE HEAT SINK
An innovative thermal management system designed to maximize cooling effectiveness by integrating a unique room-side heat sink into the diffusing lens. This breakthrough design creates a pleasing architectural aesthetic while conducting heat away from LEDs in a temperature-controlled environment. This enables the LEDs to consistently run cooler, providing significant boosts to lifetime, efficacy, and color consistency.

LUMEN MAINTENANCE FACTORS
- Reference www.cree.com/lighting for detailed lumen maintenance factors.

CONSTRUCTION & MATERIALS
- Durable 20-gauge steel housing with standard troffer access plate for electrical installation.
- Field replaceable light engine integrates LEDs, driver, power supply, thermal management, and optical mixing components.
- One-piece lower reflector finished with a textured high reflectance white polyester powder coating creates a comfortable visual transition from the lens to the ceiling plane.
- Provided t-bar clips and holes for mounting support wires enable recessed or suspended installation.
- Individual fixtures may be mounted end to end for a continuous row of illumination.

  NOTE: Reference www.cree.com/lighting for detailed instructions on field replacement of the light engine.

OPTICAL SYSTEM
- Unique combination of reflective and refractive optical components achieves a uniform, comfortable appearance while eliminating pixelation and color fringing.
- Components work together to optimize distribution, balancing the delivery of high illuminance levels on horizontal surfaces with an ideal amount of light on walls and vertical surfaces. This increases the perception of spaciousness.
- Diffusing lens integrated with upward-facing LED strip eliminates direct view of LEDs while lower reflector balances brightness of lens with the ceiling to create a low-glare high angle appearance.

ELECTRICAL SYSTEM
- Integral, high-efficiency driver and power supply.
- Power Factor = 0.9 nominal
- Input Power: Stays constant over life.
- Input Voltage: 120-277V, 347V- 50/60Hz
- Battery Backup: Consult factory.
- Temperature Rating: Designed to operate in temperatures 0-35 C and below room side and plenum side.
- Total Harmonic Distortion: < 20%

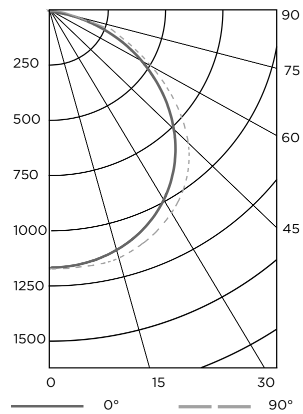
CONTROLS
- Step dimming to 50% comes standard.*
- Optional continuous dimming to 5% with 0-10V DC control protocol.*
- Optional Lutron EcoSystem® Enabled option allows seamless integration with Lutron EcoSystem controls.*

REGULATORY & VOLUNTARY QUALIFICATIONS
- UL924 (EB14 option).
- cULus Listed.
- DLC qualified.**
- Suitable for damp locations.
- Designed for Indoor use.

*Reference www.cree.com/lighting for recommended dimming controls and wiring diagrams.
**Please refer to DLC QPL list for most current information.

Photometry

CR22 BASED ON LTL REPORT TEST #: 24292



Coefficients Of Utilization

RCC %:	80			
RW %:	70	50	30	10
RCR: 0	119	119	119	119
1	110	105	101	98
2	100	92	85	80
3	91	81	73	67
4	84	72	63	57
5	77	64	55	49
6	71	58	49	43
7	66	52	44	38
8	61	48	39	33
9	57	44	36	30
10	53	40	32	27

Effective Floor Cavity Reflectance: 20%

Average Luminance Table (cd/m2)

Vertical Angle	Horizontal Angle 0°	45°	90°
0°	3864	3864	3864
45°	3575	3864	3972
55°	3164	3656	3758
65°	2498	3133	3347
75°	1620	2348	2051
85°	366	252	168

Zonal Lumen Summary

Zone	Lumens	% Lamp	Luminaire
0-30	923	N/A	28.1%
0-40	1527	N/A	46.5%
0-60	2704	N/A	82.5%
0-90	3280	N/A	100%

Reference www.cree.com/lighting for detailed photometric data.

Application Reference

Open Space					
Spacing	Lumens	Wattage	LPW	w/ft²	Average fc
8 x 8	2000L	22W	90	0.35	28
	3200L	32W	100	0.55	44
8 x 10	2000L	22W	90	0.28	23
	3200L	32W	100	0.44	37
10 x 10	2000L	22W	90	0.22	20
	3200L	32W	100	0.35	31
10 x 12	2000L	22W	90	0.19	16
	3200L	32W	100	0.29	25

9′ ceiling: 80/50/20 reflectances; 2.5′ workplane, open room LLF: 1.0 Initial.
Open Space: 50′ x 40′ x 10′

Rev. Date 9/17/2013

CR24™

2′x4′ Architectural LED Troffer

Product Description

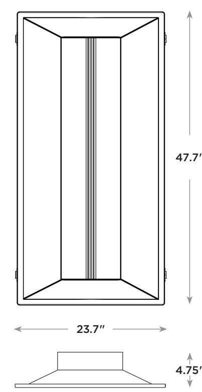
The CR24 Architectural LED High Efficiency (HE) troffer delivers up to 130 lumens per watt of exceptional 90 CRI light at 4000 lumens. This breakthrough performance is achieved by combining the high efficacy and high-quality light of Cree TrueWhite® Technology with a unique thermal management design. The CR24 High Definition (HD) option delivers enhanced spectrum 80+ CRI color quality. The CR24 product family is available in warm, neutral, cool, or daylight color temperatures and has step, 0-10V, or Lutron EcoSystem® Enabled dimming options. Its compact, lightweight design makes the CR24 perfect for use in commercial new construction or renovated spaces.

Performance Summary

- Utilizes Cree TrueWhite® Technology or High Definition Color Quality
- Active Color Management
- Room-Side Heat Sink
- Assembled in the US & Mexico
- **Efficacy**: 90-130 LPW
- **Delivered Light Output**: 2200, 3100, 4000, 5000 lumens
- **Input Power**: 22-50 watts
- **CRI**: 90 CRI (Cree TrueWhite® Technology), 80+ CRI (High Definition)
- **CCT**: 3000K, 3500K, 4000K, 5000K
- **Input Voltage**: 120-277 VAC or 347 VAC*
- **Warranty**: 10 years
- **Lifetime**: Designed to last from 50,000 hours (HD), 75,000 hours (Standard TW), and 100,000 hours (HE TW)
- **Controls**: Step Level to 50%, 0-10V Dimming or Lutron EcoSystem Enabled to 5%[1]
- **Mounting**: Recessed

*40L 100 LPW 10V types only - other types require addition of a 347 accessory kit

CR24™



NOTE: Use of Expanded Junction Box will expand the depth to 6.67″ and Emergency Backup will expand the depth to 6.30″. Use of 347V will increase fixture height by 1.4″.

Housings & Accessories

Accessories			
CPLCR Chicago Plenum Field Kit **CPLCR-EM** Chicago Plenum Field Kit-Emergency	**CR-347V** 347 Volt **CR-347V-SD** Step Dimming to 50% **SMK-24** Surface Mount Kit	**PW-18/4-06-9T/SS-CR** Power Whip **AC5-18/4-72-PD8-JB** Adjustable Cable	**AC5-72-PD8-JB** Adjustable Cable **EJBCR-5PK** Expanded size junction box for through wiring (5 pack)

Ordering Information

Example: CR24-40L-35K-S

CR24					
Product	**Lumen Output**	**Color Temp**	**Voltage**	**Control**	**Options**
CR24	**22L** 22W 2200 lumens – 100 LPW **31L** 34W 31L 3100 lumens – 90 LPW **40L** 40W 40L 4000 lumens – 100 LPW **40L HE** 40L HE 30.5W 4000 lumens – 130 LPW (30K) 32W 4000 lumens – 125 LPW (35K) 33W 4000 lumens – 120 LPW (40K) 34.5W 4000 lumens – 115 LPW (50K) **50L** 50L 50W 5000 lumens – 100 LPW	**30K** 3000 Kelvin **35K** 3500 Kelvin **40K** 4000 Kelvin **50K** 5000 Kelvin	**Blank** 120-277 Volt (Standard) **34**[6] 347 Volt (Optional)	**S** Step Dimming to 50% **10V** 0-10V Dimming to 5% **LES** Lutron EcoSystem® Enabled to 5%	**HD**[7] High Definition Color - CRI 80+ (44W 4000 lumens - 90 LPW) **EB14**[2,4] Emergency Backup - 1400 lumens **EB14 SMK**[2,3,5] Emergency Backup with surface mount kit - 1400 lumens

1. Reference www.cree.com/lighting for recommended dimming control options. 2. Not available in 50L. Not available in LES types except 40L LES type. 3. Not available with EB14 option. Use EB14 SMK. 4. EB14 not for use with SMK Kits 5. Includes surface mount kit accessory (SMK-CR24). 6. 347V integrated option only available on 40L 100 LPW 10V fixtures. Wattage increases to 42W and fixture height increases by 1.4″ over standard 120-277V fixtures. 7. HD only available in 40L.
†See www.cree.com/lighting for warranty terms.

Rev. Date 9/17/2013

Product Specifications

CREE TRUEWHITE® TECHNOLOGY
A revolutionary way to generate high-quality white light, Cree TrueWhite® Technology mixes the light from the highest performing red and unsaturated yellow LEDs. This patented approach delivers an exclusive combination of 90+ CRI, beautiful light characteristics, and lifelong color consistency, all while maintaining high luminous efficacy—a true no compromise solution.

HIGH DEFINITION COLOR
High Definition (HD) Color delivers enhanced spectrum 80+ CRI color quality. HD is derived from color mixed and tuned Cree TrueWhite® Technology.

ROOM-SIDE HEAT SINK
An innovative thermal management system designed to maximize cooling effectiveness by integrating a unique room-side heat sink into the diffusing lens. This breakthrough design creates a pleasing architectural aesthetic while conducting heat away from LEDs in a temperature-controlled environment. This enables the LEDs to consistently run cooler, providing significant boosts to lifetime, efficacy, and color consistency.

LUMEN MAINTENANCE FACTORS
- Reference www.cree.com/lighting for detailed lumen maintenance factors.

CONSTRUCTION & MATERIALS
- Durable 20-gauge steel housing with standard troffer access plate for electrical installation.
- Field replaceable light engine integrates LEDs, driver, power supply, thermal management, and optical mixing components.
- One-piece lower reflector finished with a textured high reflectance white polyester powder coating creates a comfortable visual transition from the lens to the ceiling plane.
- Provided t-bar clips and holes for mounting support wires enable recessed or suspended installation.
- Individual fixtures may be mounted end to end for a continuous row of illumination.

  NOTE: Reference www.cree.com/lighting for detailed instructions on field replacement of the light engine.

OPTICAL SYSTEM
- Unique combination of reflective and refractive optical components achieves a uniform, comfortable appearance while eliminating pixelation and color fringing.
- Components work together to optimize distribution, balancing the delivery of high illuminance levels on horizontal surfaces with an ideal amount of light on walls and vertical surfaces. This increases the perception of spaciousness.
- Diffusing lens integrated with upward-facing LED strip eliminates direct view of LEDs while lower reflector balances brightness of lens with the ceiling to create a low-glare high angle appearance.

ELECTRICAL SYSTEM
- Integral, high-efficiency driver and power supply.
- Power Factor = 0.9 nominal
- Input Power: Stays constant over life.
- Input Voltage: 120-277V, 347V- 50/60Hz
- Battery Backup: Consult factory.
- Temperature Rating: Designed to operate in temperatures 0-35 C and below room side and plenum side.
- Total Harmonic Distortion: < 20%

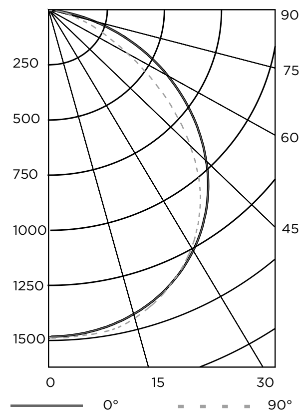
CONTROLS
- Step dimming to 50% comes standard.*
- Optional continuous dimming to 5% with 0-10V DC control protocol.*
- Optional Lutron EcoSystem® Enabled option allows seamless integration with Lutron EcoSystem controls.*

REGULATORY & VOLUNTARY QUALIFICATIONS
- UL924 (EB14 option).
- cULus Listed.
- DLC qualified.**
- Suitable for damp locations.
- Designed for Indoor use.

*Reference www.cree.com/lighting for recommended dimming controls and wiring diagrams.
**Please refer to DLC QPL list for most current information.

Photometry

CR24-4000L BASED ON LTL REPORT TEST #: 22421
Fixture photometry has been conducted by a NVLAP accredited testing laboratory in accordance with IESNA LM-79-08. IESNA LM-79-08 specifies the entire luminaire as the source resulting in a fixture efficiency of 100%.



Coefficients Of Utilization

RCC %:	80			
RW %:	70	50	30	0
RCR: 0	119	119	119	119
1	109	105	101	97
2	100	92	85	79
3	91	80	72	66
4	83	71	63	56
5	76	64	55	48
6	71	57	48	42
7	65	52	43	37
8	61	47	39	33
9	57	43	35	30
10	53	40	32	27

Effective Floor Cavity Reflectance: 20%

Average Luminance Table (cd/m2)

Vertical Angle	Horizontal Angle 0°	45°	90°
0°	2174	2174	2174
45°	1976	2116	2152
55°	1807	2018	2074
65°	1553	1889	1879
75°	1149	1501	1119
85°	424	62	62

Zonal Lumen Summary

Zone	Lumens	% Lamp	Luminaire
0-30	1,115	27.9%	27.9%
0-40	1,835	45.9%	45.9%
0-60	3,245	81.1%	81.1%
0-90	4,000	100%	100%

Reference www.cree.com/lighting for detailed photometric data.

Application Reference

Open Space					
Spacing	Lumens	Wattage	LPW	w/ft²	Average fc
8 x 8	2200L	22W	100	0.35	30
	4000L	40W	100	0.69	54
	4000L	30.5W	130	0.56	54
	5000L	50W	100	0.78	68
8 x 10	2200L	22W	100	0.28	25
	4000L	40W	100	0.55	45
	4000L	30.5W	130	0.45	45
	5000L	50W	100	0.62	57
10 x 10	2200L	22W	100	0.22	21
	4000L	40W	100	0.44	38
	4000L	30.5W	130	0.36	38
	5000L	50W	100	0.50	48
10 x 12	2200L	22W	100	0.19	17
	4000L	40W	100	0.37	30
	4000L	30.5W	130	0.30	30
	5000L	50W	100	0.42	38

9′ ceiling: 80/50/20 reflectances; 2.5′ workplane, open room. LLF: 1.0 Initial.
Open Space: 50′ x 40′ x 10′

Rev. Date 9/17/2013

CMG Lighting

Commercial Series

PAR30

Family	Product	Field	Color Temp	Finish
DL	P30F	38	27K	WH
		60	30K	BL

Beam Angle 50%	17º	35º
Field Angle 10%	38º	60º
Power Consumption	12 Watts	
Equivalent Source	75W	60W
Power Factor	>0.80	
Dimming Range*	20-100%	
Color Temperature	2700K (Warm White) 3000K (Natural White)	
CRI	80+	
Lumen Output	550 lm (2700K) 600 lm (3000K)	
Lumens/Watt (Typ)	54	
CBCP	5050	1400
Operating Temp	-20 ~ +40°C	
Storage Temp	-40 ~ +60°C	
AC Input Voltage	120 Volts 60Hz	
Lumen Maintenance	L70 >25,000 hrs	
LED	Lumileds	
Environmental	Contains no lead or mercury No UV or IR emissions	
Warranty	3 years	
Use	Indoor applications	
Weight	300 grams ±5	
Dimensions	3.75”W x 3.75”H	
Base	E26	

c UL us

ETL Intertek

RoHS

FC

ENERGY STAR

Architectural Grade High Power 12 Watt Dimmable Led Replacement Lamp

Produces 60-75 Watts of Incandescent Halogen Light

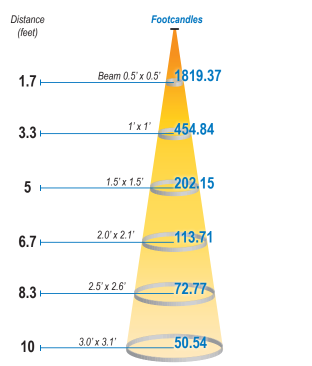
LM-79 and LM-80 Tested

- Robust electronics mounted to a layered (redundant) heat dissipation substrate
- Proprietary optics deliver light to the task
- **Finishes: White, Black, Custom**
- Instant On, No Warm Up, No Flicker
- May Be Controlled by Peripheral Systems and Sensors
- Reduced waste – contractor and earth-friendly packaging for roll-outs and projects

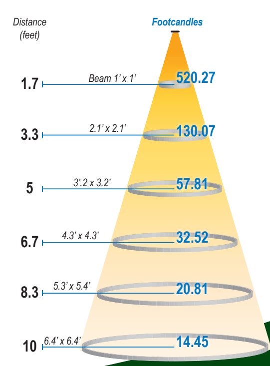
Life Rating Reduced +/- 15% When Used in IC Housings.

Do Not Use in Enclosed Fixtures. Not for use in damp locations.

*Compatible dimmer models:
Lutron TG-600PH-LA; S-600PE; S-600; TGLV-600PR-WH; CT-600PR; D-600PH; MRF2-6ELV; HW/LP-RPM-4A-120; HW/LP-RPM-4U-120; GP (Harrier) Card; HxD-5NE; RRD-6NA; PHPM-WBX with DVF-103P; PHPM-PA with QSG-6D; **Leviton** 6633-P; PRI06; **Legrand** LS1000PWV (consult factory for updated list)



17° beam angle



35° beam angle

1201 N. Fourth St., Watertown, WI 53098 • 1-877-260-6425 • www.CMGlighting.com

CMG Lighting

Commercial Series

PAR38

Family	Product	Field	Color Temp	Finish
DL	P38F	38 60	27K 30K	WH BL

Architectural Grade High Power
17 Watt Dimmable Led Replacement Lamp

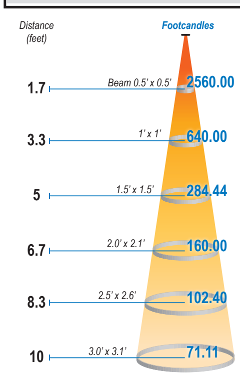
Produces 90 Watts of
Incandescent Halogen Light

LM-79 and LM-80 Tested

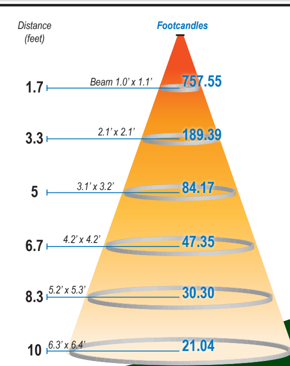
- Robust electronics mounted to a layered (redundant) heat dissipation substrate
- Proprietary optics deliver light to the task
- **Finishes: White, Black, Custom**
- Instant On, No Warm Up, No Flicker
- May Be Controlled by Peripheral Systems and Sensors
- Reduced waste – contractor and earth-friendly packaging for roll-outs and projects

Life Rating Reduced +/- 15% When Used in IC Housings.
Do Not Use in Enclosed Fixture. Not for use in damp locations.
*Compatible dimmer models:
Lutron TG-600PH-LA, S-600PE; S-600; CT-603PG; TGLV-600PR-WH; CT-600PR; D-600PH; MRF-2-6ELV; HW/LP-RPM-4A-120; HW/LP-RPM-4U-120; GP (Harrier) Card; HxD-5NE; **Grafik** Eye QS Main Unit Family; RRD-6NA; PHPM-PA with QSG-6D; **Leviton** 6633-P; PRI06; **Legrand** LS1000PWV (consult factory for updated list)

Beam Angle 50%	17º	35º
Field Angle 10%	38º	60º
Power Consumption	17 Watts	
Equivalent Source	90W	
Power Factor	>0.80	
Dimming Range*	20-100%	
Color Temperature	2700K (Warm White) 3000K (Natural White)	
CRI	80+	
Lumen Output	800 lm (2700K) 860 lm (3000K)	
Lumens/Watt (Typ)	57	54
CBCP	7100	1990
Operating Temp	-20 ~ +40°C	
Storage Temp	-40 ~ +60°C	
AC Input Voltage	120 Volts 60Hz	
Lumen Maintenance	L70 >25,000 hrs	
LED	Lumileds	
Environmental	Contains no lead or mercury No UV or IR emissions	
Warranty	3 years	
Use	Indoor applications	
Weight	500 grams ±5	
Dimensions	4.75"W x 4.75"H	
Base	E26	



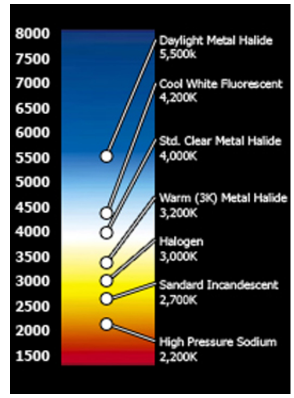
17° beam angle



35° beam angle

Spec Sheet

SKU#	200711
Product Name	G2 HP 2 Foot 8W NWM SEP LED Tube Light
Description	Tube Light, 2 Foot, 8 Watt, NWM, 120-277VAC, SEP, G2, HP
Estimated Energy Cost ($/yr)**	13.45
Watts (W)	8
Light Output (Lumens)	800
Efficacy (Lumens/Watt)	100
Color Accuracy (CRI)	87
Color Temperature (K)	4000-4500
Lighting Angle/Type	120
Power Factor	0.98
Working Voltage	120-277VAC
LED Count/Type	32
Lens Reflector Style	Milky
Operating Temperature (F)	-20 to 122
Mount/Base Type	Med Bi-Pin
Dimensions (inches)	24.00 L x 0.00 W x 0.00 H x 1.11 DIA
Weight (pounds)	0.4
Typically Replaces	20W T8 Fluorescent
Typical Life Expectancy (L70 Hours)	50,000
Approvals / Certifications	UL
Photometric Data Available?	No
IES File Available?	No



Features

Strong yet lightweight aluminum heat sink; ultra-bright, long-life 5630 SMD LEDs; polycarbonate lens; no UV, noise, or flickering; constant-current integrated driver; high shock and vibration resistance; mercury-free; single end power configuration; UL listed.

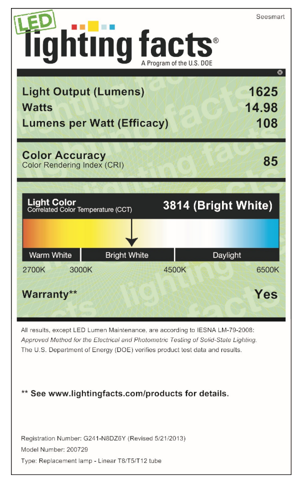
NOTE: The preliminary performance information provided in this notice is pending verification by an independent testing laboratory. Contact your Seesmart representative for more information about photometric and other performance testing information for this product.

** Calculation based on 3 hours/day, $0.11/kWh. Cost depends on rates and use.

SEESMART™
EARTH FRIENDLY LED SOLUTIONS

Spec Sheet

SKU#	200729
Product Name	G2 HP 4 Foot 15W NWM SEP LED Tube Light
Description	Tube Light, 4 Foot, 15 Watt, NWM, 120-277VAC, SEP, G2, HP
Estimated Energy Cost ($/yr)**	21.65
Watts (W)	15
Light Output (Lumens)	1625
Efficacy (Lumens/Watt)	108.33
Color Accuracy (CRI)	85
Color Temperature (K)	4000-4500
Lighting Angle/Type	120
Power Factor	0.98
Working Voltage	120-277VAC
LED Count/Type	64
Lens Reflector Style	Milky
Operating Temperature (F)	-20 to 122
Mount/Base Type	Med Bi-Pin
Dimensions (inches)	48.00 L x 0.00 W x 0.00 H x 1.11 DIA
Weight (pounds)	0.9
Typically Replaces	32-45W T8 Fluorescent
Typical Life Expectancy (L70 Hours)	50,000
Approvals / Certifications	UL DLC
Photometric Data Available?	Yes
IES File Available?	Yes



<u>Features</u>

Strong yet lightweight aluminum heat sink; ultra-bright, long-life 5630 SMD LEDs; polycarbonate lens; no UV, noise, or flickering; constant-current integrated driver; high shock and vibration resistance; mercury-free; single end power configuration; UL listed.

NOTE: The preliminary performance information provided in this notice is pending verification by an independent testing laboratory. Contact your Seesmart representative for more information about photometric and other performance testing information for this product.

** Calculation based on 3 hours/day, $0.11/kWh. Cost depends on rates and use.

ONLINE CERTIFICATIONS DIRECTORY

OOLV2.E350939
Lamps, Self-ballasted, Light-emitting-diode Type - Component

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Lamps, Self-ballasted, Light-emitting-diode Type - Component

See General Information for Lamps, Self-ballasted, Light-emitting-diode Type - Component

SEESMART INC E350939
4139 GUARDIAN ST
SIMI VALLEY, CA 93063 USA

LED Tube Lamps, Model(s) 200200-200205, 200212-200217

Self-Ballasted LED Tube Lamps, Model(s) 200124 (A), 200125 (A), 200126 (A), 200127 (A), 200128 (A), 200129 (A), 200130 (A), 200131 (A), 200132 (A), 200133 (A), 200134 (A), 200135 (A), 200136 (A), 200137 (A), 200138 (A), 200139 (A), 200140 (A), 200141 (A), 200142 (A), 200143 (A), 200144 (A), 200145 (A), 200146 (A), 200147 (A), 200148 (A), 200149 (A), 200150 (A), 200151 (A), 200152 (A), 200153 (A), 200154 (A), 200155 (A), 200156 (A), 200157 (A), 200158 (A), 200159 (A), 200160 (A), 200161 (A), 200162 (A), 200163 (A), 200164 (A), 200506 (A), 200507 (A), 200508 (A), 200509 (A), 200510 (A), 200511 (A), 200512 (A), 200513 (A), 200514 (A), 200515 (A), 200516 (A), 200517 (A), 200518 (A), 200519 (A), 200520 (A), 200521 (A), 200522 (A), 200523 (A), 200524 (A), 200525 (A), 200526 (A), 200527 (A), 200528 (A), 200529 (A), 200530 (A), 200531 (A), 200532 (A), 200533 (A), 200534 (A), 200535 (A), 200536 (A), 200537 (A), 200538 (A), 200539 (A), 200540 (A), 200541 (A), 200542 (A), 200543 (A), 200544 (A), 200545 (A), 200546 (A), 200547 (A), 200548 (A), 200549 (A), 200550 (A), 200551 (A), 200552 (A), 200553 (A), TP-Tube10-8FT

(A) - May end with the letter A-Z.

Marking: Company name and model designation.
Last Updated on 2012-09-18

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ONLINE CERTIFICATIONS DIRECTORY

OOLV8.E350939
Lamps, Self-ballasted, Light-emitting-diode Type Certified for Canada - Component

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Lamps, Self-ballasted, Light-emitting-diode Type Certified for Canada - Component

See General Information for Lamps, Self-ballasted, Light-emitting-diode Type Certified for Canada - Component

SEESMART INC
4139 GUARDIAN ST
SIMI VALLEY, CA 93063 USA

E350939

Self-Ballasted LED Tube Lamps, Model(s) 200124 (A), 200125 (A), 200126 (A), 200127 (A), 200128 (A), 200129 (A), 200130 (A), 200131 (A), 200132 (A), 200133 (A), 200134 (A), 200135 (A), 200136 (A), 200137 (A), 200138 (A), 200139 (A), 200140 (A), 200141 (A), 200142 (A), 200143 (A), 200144 (A), 200145 (A), 200146 (A), 200147 (A), 200148 (A), 200149 (A), 200150 (A), 200151 (A), 200152 (A), 200153 (A), 200154 (A), 200155 (A), 200156 (A), 200157 (A), 200158 (A), 200159 (A), 200160 (A), 200161 (A), 200162 (A), 200163 (A), 200164 (A), 200506 (A), 200507 (A), 200508 (A), 200509 (A), 200510 (A), 200511 (A), 200512 (A), 200513 (A), 200514 (A), 200515 (A), 200516 (A), 200517 (A), 200518 (A), 200519 (A), 200520 (A), 200521 (A), 200522 (A), 200523 (A), 200524 (A), 200525 (A), 200526 (A), 200527 (A), 200528 (A), 200529 (A), 200530 (A), 200531 (A), 200532 (A), 200533 (A), 200534 (A), 200535 (A), 200536 (A), 200537 (A), 200538 (A), 200539 (A), 200540 (A), 200541 (A), 200542 (A), 200543 (A), 200544 (A), 200545 (A), 200546 (A), 200547 (A), 200548 (A), 200549 (A), 200550 (A), 200551 (A), 200552 (A), 200553 (A), TP-Tube10-8FT

(A) - May end with the letter A-Z.

Marking: Company name, model designation and Recognized Component Mark for Canada, c .

Last Updated on 2012-09-18

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ONLINE CERTIFICATIONS DIRECTORY

OOQA2.E354920
Light-emitting-diode Arrays, Modules and Controllers - Component

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Light-emitting-diode Arrays, Modules and Controllers - Component

See General Information for Light-emitting-diode Arrays, Modules and Controllers - Component

SEESMART INC
4139 GUARDIAN ST
SIMI VALLEY, CA 93063 USA

E354920

LED modules, Models 270206, 270203, 270200, 270215.

Marking: Company name, model designation and the Recognized Component Mark .
Last Updated on 2012-04-27

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ONLINE CERTIFICATIONS DIRECTORY

OOQA8.E354920
Light-emitting-diode Arrays, Modules and Controllers Certified for Canada - Component

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Light-emitting-diode Arrays, Modules and Controllers Certified for Canada - Component

See General Information for Light-emitting-diode Arrays, Modules and Controllers Certified for Canada - Component

SEESMART INC
4139 GUARDIAN ST
SIMI VALLEY, CA 93063 USA

E354920

LED modules, Models 270206, 270203, 270200, 270215.

Marking: Company name, model designation and the Recognized Component Mark for Canada.

Last Updated on 2012-04-27

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ONLINE CERTIFICATIONS DIRECTORY

IFAR.E355293
Light-emitting-diode Retrofit Luminaire Conversion Kits

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Light-emitting-diode Retrofit Luminaire Conversion Kits

See General Information for Light-emitting-diode Retrofit Luminaire Conversion Kits

SEESMART INC E355293
4139 GUARDIAN ST
SIMI VALLEY, CA 93063 USA

Retrofit Kit Model/Part No.	Retrofitted Luminaire Type or Model/Part No.	Light Source	Rating
LED retrofit luminaire conversion kit			
Model 240001	Enclosed type IC Recessed or Surface Mounted 2'x4' or larger Fluorescent Luminaire	Replaceable-type T8 self-ballasted LED lamp	120 V ac, 0.23 A Max.
Model 200212-200217	Permanently-connected fluorescent	Replaceable-type T8 self-ballasted LED lamp	Rated 100-277 V, 47-63Hz, 0.16 A
Model 200200-200205	Permanently-connected fluorescent	Replaceable-type T8 self-ballasted LED lamp	Rated 100-277 V, 47-63Hz, 0.3 A
SKU #200704-200706	Recessed Type-IC or surface mounted, Max. 4 lamps per fluorescent luminaire	LED Tube Lamps	120-240V, 50/60Hz, 0.2A, 11W
SKU #200700-200703	Recessed Type-IC or surface mounted, Max. 4 lamps per fluorescent luminaire	LED Tube Lamps	120-240V, 50/60Hz, 0.3A, 22W
200722 200723 200724 200725 200726 200727	Permanently-connected fluorescent or incandescent	Non-replaceable type LED Array with driver	100~277Vac, 50/60 Hz, 110 mA,12 W
200728 200729 200730 200731 200732 200733 200734 200735 200736	Permanently-connected fluorescent or incandescent	Non-replaceable type LED Array with driver	100~277Vac, 50/60 Hz, 150 mA,15 W
200737 200738 200739 200740 200741 200742 200743 200744 200745	Permanently-connected fluorescent or incandescent	Non-replaceable type LED Array with driver	100~277Vac, 50/60 Hz, 180 mA,18 W
200746 200747 200748 200749 200750 200751 200752 200753	Permanently-connected fluorescent or incandescent	Non-replaceable type LED Array with driver	100~277Vac, 50/60 Hz, 220 mA,22 W

200754 200755 200756 200757 200758 200759 200760 200761 200762 200763			

Last Updated on 2012-12-19

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IFAM.E349191
Light-emitting-diode Surface-mounted Luminaires

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Light-emitting-diode Surface-mounted Luminaires

See General Information for Light-emitting-diode Surface-mounted Luminaires

SEESMART INC E349191
4139 GUARDIAN ST
SIMI VALLEY, CA 93063 USA

LED surface-mounted luminaire, Model(s) SKU #280065-280066, SKU #280067-280070, SKU #280071-280074

LED surface-mounted luminaires, Model(s) 190033, 190034, 190042, 190043, 190035, 190036, 190044, 190045, 190037, 190038, 190046, 190047, 190039, 190040, 190048, 190049, 190087 (A), 190088 (A), 190089 (A), 190090 (A), 190091 (A), 190092 (A), 190093 (A), 190094 (A), 190095 (A), 190096 (A), 190097 (A), 190098 (A), 190099 (A), 190100 (A), 190101 (A), 190102 (A), 190103 (A), 190104 (A), 190105 (A), 190106 (A), 190107 (A), 190108 (A), 190109 (A), 190110 (A), 190111 (A), 190112 (A), 190113 (A), SKU# 120001

Light-emitting-diode surface-mounted Luminaires, Model(s) SKU #120365-120370, SKU #120389-120400, SKU #120371-120376, SKU #120335-120343, SKU #120353-120358, SKU #120344-120352, SKU #120359-120364, SKU #120377-120388

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Last Updated on 2012-12-10

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ONLINE CERTIFICATIONS DIRECTORY

IFAM7.E349191
Light-emitting-diode Surface-mounted Luminaires Certified for Canada

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Light-emitting-diode Surface-mounted Luminaires Certified for Canada

See General Information for Light-emitting-diode Surface-mounted Luminaires Certified for Canada

SEESMART INC E349191
4139 GUARDIAN ST
SIMI VALLEY, CA 93063 USA

LED surface-mounted luminaire, Model(s) SKU #280065-280066, SKU #280067-280070, SKU #280071-280074

LED surface-mounted luminaires, Model(s) 190033, 190034, 190042, 190043, 190035, 190036, 190044, 190045, 190037, 190038, 190046, 190047, 190039, 190040, 190048, 190049, 190105 (A), 190106 (A), 190107 (A), 190108 (A), 190109 (A), 190110 (A), 190111 (A), 190112 (A), 190113 (A)

Light-emitting-diode surface-mounted Luminaires, Model(s) SKU #120365-120370, SKU #120389-120400, SKU #120371-120376, SKU #120335-120343, SKU #120353-120358, SKU #120344-120352, SKU #120359-120364, SKU #120377-120388

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Last Updated on 2012-12-10

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ONLINE CERTIFICATIONS DIRECTORY

IEUQ.E324248
Luminaire Conversions, Retrofit

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Luminaire Conversions, Retrofit

See General Information for Luminaire Conversions, Retrofit

SEESMART INC E324248

4139 GUARDIAN ST

SIMI VALLEY, CA 93063 USA

LED tube lamps, Cat. Nos. 200124 (A), 200125 (A), 200126 (A), 200127 (A), 200128 (A), 200129 (A), 200130 (A), 200131 (A), 200132 (A), 200133 (A), 200134 (A), 200135 (A), 200136 (A), 200137 (A), 200138 (A), 200139 (A), 200140 (A), 200141 (A), 200142 (A), 200143 (A), 200144 (A), 200145 (A), 200146 (A), 200147 (A), 200148 (A), 200149 (A), 200150 (A), 200151 (A), 200152 (A), 200153 (A), 200154 (A), 200155 (A), 200156 (A), 200157 (A), 200158 (A), 200159 (A), 200160 (A), 200161 (A), 200162 (A), 200163 (A), 200164 (A), TP-Tube10-8FT, 200506 (A), 200507 (A), 200508 (A), 200509 (A), 200510 (A), 200511 (A), 200512 (A), 200513 (A), 200514 (A), 200515 (A), 200516 (A), 200517 (A), 200518 (A), 200519 (A), 200520 (A), 200521 (A), 200522 (A), 200523 (A), 200524 (A), 200525 (A), 200526 (A), 200527 (A), 200528 (A), 200529 (A), 200530 (A), 200531 (A), 200532 (A), 200533 (A), 200534 (A), 200535 (A), 200536 (A), 200537 (A), 200538 (A), 200539 (A), 200540 (A), 200541 (A), 200542 (A), 200543 (A), 200544 (A), 200545 (A), 200546 (A), 200547 (A), 200548 (A), 200549 (A), 200550 (A), 200551 (A), 200552 (A), 200553 (A).

(A) May end with the letter A through Z.

Last Updated on 2012-11-16

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IEUQ7.E324248
Luminaire Conversions, Retrofit Certified for Canada

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Luminaire Conversions, Retrofit Certified for Canada

See General Information for Luminaire Conversions, Retrofit Certified for Canada

SEESMART INC E324248

4139 GUARDIAN ST

SIMI VALLEY, CA 93063 USA

LED tube lamps, Cat. Nos. 200124 (A), 200125 (A), 200126 (A), 200127 (A), 200128 (A), 200129 (A), 200130 (A), 200131 (A), 200132 (A), 200133 (A), 200134 (A), 200135 (A), 200136 (A), 200137 (A), 200138 (A), 200139 (A), 200140 (A), 200141 (A), 200142 (A), 200143 (A), 200144 (A), 200145 (A), 200146 (A), 200147 (A), 200148 (A), 200149 (A), 200150 (A), 200151 (A), 200152 (A), 200153 (A), 200154 (A), 200155 (A), 200156 (A), 200157 (A), 200158 (A), 200159 (A), 200160 (A), 200161 (A), 200162 (A), 200163 (A), 200164 (A), TP-Tube10-8FT, 200506 (A), 200507 (A), 200508 (A), 200509 (A), 200510 (A), 200511 (A), 200512 (A), 200513 (A), 200514 (A), 200515 (A), 200516 (A), 200517 (A), 200518 (A), 200519 (A), 200520 (A), 200521 (A), 200522 (A), 200523 (A), 200524 (A), 200525 (A), 200526 (A), 200527 (A), 200528 (A), 200529 (A), 200530 (A), 200531 (A), 200532 (A), 200533 (A), 200534 (A), 200535 (A), 200536 (A), 200537 (A), 200538 (A), 200539 (A), 200540 (A), 200541 (A), 200542 (A), 200543 (A), 200544 (A), 200545 (A), 200546 (A), 200547 (A), 200548 (A), 200549 (A), 200550 (A), 200551 (A), 200552 (A), 200553 (A).

(A) May end with the letter A through Z.

Last Updated on 2012-09-10

Questions? Print this page Terms of Use Page Top

XSP2™

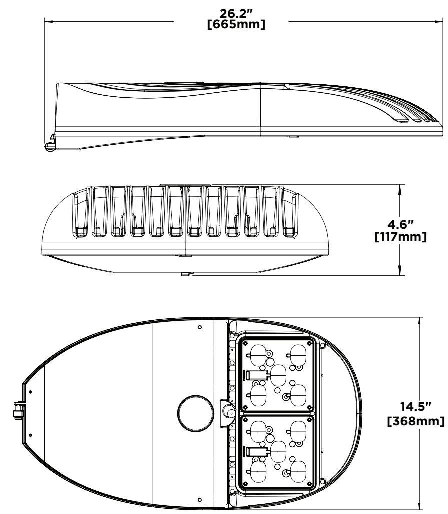
XSP Series LED Street Light – Horizontal Tenon – Type III

Product Description

Designed from the ground up as a totally optimized LED street light system, the XSP Series delivers incredible efficiency and is designed to provide L70 lifetime over 100,000 hours without sacrificing application performance. Beyond substantial energy savings and reduced maintenance, Cree achieves better optical control with our NanoOptic® Precision Delivery Grid™ optic than a traditional cobra head luminaire. The Cree XSP Series LED Street Light is the best alternative for traditional street lighting with better payback and better performance.

Performance Summary

Utilizes BetaLED® Technology
NanoOptic Precision Delivery Grid optic
CRI: Minimum 70 CRI
CCT: 4000K (+/- 300K), 5700K (+/- 500K)
Warranty: 10 years on luminaire/limited 10 years on Colorfast DeltaGuard® finish
Made in the U.S.A. of U.S. and imported parts



Accessories

Field Installed Accessories
XA-SP2BLS Backlight Control Shield - Provides 1/2 Mounting Height Cutoff **XA-SP2BRDSPK** Bird Spikes

Ordering Information

Example: BXSPA032A-USF

BXSP	A	0			A	–			
Product	**Version**	**Mounting**	**Optic**	**Modules**	**Input Power**	**–**	**Voltage**	**Color Options**	**Options**
BXSP	**A**	**0** Horizontal Tenon	**3** Type III **H** Type III w/ BLS	**2** Standard 4000K **B** Standard 5700K **H** High Efficacy 4000K* **P** High Efficacy 5700K*	**A** 101W	–	**U** Universal 120–277V **V** Universal 347–480V**	**S** Silver (Standard) **T** Black **Z** Bronze **B** Platinum Bronze **W** White	**A ROAM® Controls** - Installation of ROAM dimming control module only. Services provided by others. - Includes R option **F Fuse** - When code dictates fusing, use time delay fuse - Not available with V voltage **K Occupancy Control** - Refer to Occupancy Control spec sheet for details **N Utility Label and NEMA Photocell Receptacle** - Includes Q option - Refer to Field Adjustble Output spec sheet for details **Q Field Adjustable Output** - Refer to Field Adjustable Output spec sheet for details **R NEMA Photocell Receptacle** - Photocell by others **U Utility** - Includes exterior wattage label that indicates the maximum available wattage of the luminaire - Includes Q option - Refer to Field Adjustable Output spec sheet for details

* Available Q3 2012. Preliminary data shown.

** 347–480V utilizes magnetic step-down transformer. For input power for 347–480V, refer to the Lumen Output, Electrical, and Lumen Maintenance data table below.

Rev. Date: 9/14/2012

Product Specifications

CONSTRUCTION & MATERIALS

- Die cast aluminum housing
- Tool-less entry
- Mounts on 1.25" IP (1.66" [42mm] O.D.) or 2" IP (2.375" [60mm] O.D.) horizontal tenon (minimum 8" [203mm] in length) and is adjustable +/- 5˚ to allow for fixture leveling (includes two axis T-level to aid in leveling)
- Designed with 0–10V dimming capabilities. Controls by others
- Exclusive Colorfast DeltaGuard® finish features an E-Coat epoxy primer with an ultradurable powder topcoat, providing excellent resistance to corrosion, ultraviolet degradation and abrasion. Standard is silver. Black, bronze, platinum bronze and white are also available

ELECTRICAL SYSTEM

- **Input Voltage:** 120–277V or 347–480V, 50/60Hz
- Class 2 output
- **Power Factor:** > 0.9 at full load
- **Total Harmonic Distortion:** < 20% at full load
- Integral 10kV surge suppression protection standard
- To address inrush current, slow blow fuse or type C/D breaker should be used

REGULATORY & VOLUNTARY QUALIFICATIONS

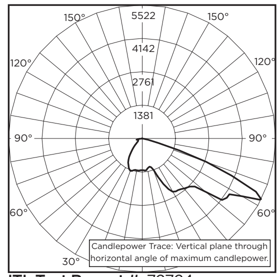
- cULus Listed
- Suitable for wet locations
- Product qualified on the DesignLights Consortium ("DLC") Qualified Products List ("QPL"). Exceptions apply when N, U, or Q options are ordered - see Field Adjustable Output spec sheet for details.
- Certified to ANSI C136.31-2001, 3G bridge and overpass vibration standards
- 10kV surge suppression protection tested in accordance with IEEE/ANSI C62.41.2
- Meets CALTrans 611 Vibration testing and GR-63-CORE Section 4.4.1/5.4.2 C62.41.2
- Luminaire and finish endurance tested to withstand 5,000 hours of elevated ambient salt fog conditions as defined in ASTM Standard B 117
- RoHS Compliant
- Meets Buy American requirements within ARRA

PATENTS

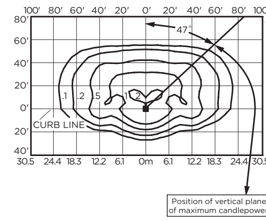
- Visit website for patents that cover these products: Patents http://www.cree.com/patents

Photometry

All published luminaire photometric testing performed to IESNA LM-79-08 standards by Independent Testing Laboratories, a NVLAP certified laboratory.



ITL Test Report #: 72724
BXSPA*32A-U
Initial Delivered Lumens: 7,406



BXSPA*32A-U
Mounting Height: 25' (7.6m)
Initial Delivered Lumens: 7,000
Initial FC at grade.

Lumen Output, Electrical, and Lumen Maintenance Data

Type 3 Distribution

Module	Input Power Designator	4000K Initial Delivered Lumens	4000K BUG Ratings** Per TM-15-11	5700K Initial Delivered Lumens	5700K BUG Ratings** Per TM-15-11	System Watts 120–277V	TOTAL CURRENT 120V	TOTAL CURRENT 208V	TOTAL CURRENT 240V	TOTAL CURRENT 277V	System Watts 347–480V	TOTAL CURRENT 347V	TOTAL CURRENT 480V	50K Hours Calculated Lumen Maintenance Factor @ 15˚C (59˚F)***
Standard	A	7,000	B2 U0 G1	7,700	B2 U0 G2	101	0.84	0.50	0.44	0.39	106	0.31	0.22	91%
High Efficacy*	A	9,612	B2 U0 G2	10,680	B2 U0 G2	101	0.84	0.50	0.44	0.39	106	0.31	0.22	91%

Type 3 Distribution w/ BLS

Module	Input Power Designator	4000K Initial Delivered Lumens	4000K BUG Ratings** Per TM-15-11	5700K Initial Delivered Lumens	5700K BUG Ratings** Per TM-15-11	System Watts 120–277V	TOTAL CURRENT 120V	TOTAL CURRENT 208V	TOTAL CURRENT 240V	TOTAL CURRENT 277V	System Watts 347–480V	TOTAL CURRENT 347V	TOTAL CURRENT 480V	50K Hours Calculated Lumen Maintenance Factor @ 15˚C (59˚F)***
Standard	A	6,130	TBD	6,742	TBD	101	0.84	0.50	0.44	0.39	106	0.31	0.22	91%
High Efficacy*	A	8,417	TBD	9,352	TBD	101	0.84	0.50	0.44	0.39	106	0.31	0.22	91%

* Available Q3 2012. Preliminary data shown.
** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit www.iesna.org/PDF/Erratas/TM-15-11BugRatingsAddendum.pdf
*** Projected L_{70} (6K) Hours: >36,000. For recommended lumen maintenance factor data see TD-13

EPA and Weight

Input Power Designator	Weight 120–277V	Weight 347–480V	EPA 1@90	EPA 2@90	EPA 2@180	EPA 3@90	EPA 4@90
A	26 lbs (12kg)	29 lbs (13.2kg)	0.692	1.140	1.384	1.832	2.280

sensorswitch®

WSD

WALL SWITCH DECORATOR SENSOR
LINE VOLTAGE • PASSIVE INFRARED (PIR)

SPECIFICATIONS

FEATURES
PIR Occupancy Detection
Self-Contained Relay - No Power Pack Needed
Interchangeable Hot & Load Wires - Impossible to Wire Backwards
No Neutral Connection Required
Small Motion Detection to 20 ft (6.10 m)
Self-Grounding Mounting Strap
No Minimum Load
Push-Button Programmable w/o Removing the Switch Plate
Adjustable Time Delay
3-way & 4-way Switching
Green LED Indicator

PHYSICAL SPECS
SIZE 4.2"H x 1.8"W x 1.5"D (10.67cm x 4.57cm x 3.81cm)
WEIGHT 5 oz
MOUNTING Single Gang Switch Box
MOUNTING HEIGHT 30-48 in (76.2-121.9 cm)
COLORS White, Ivory, Gray Almond, Black

ELECTRICAL SPECS
MAXIMUM LOAD
800 W @ 120 VAC
1200 W @ 277 VAC
1500 W @ 347 VAC
MINIMUM LOAD None
MOTOR LOAD 1/4 HP
FREQUENCY 50/60 Hz (timers are 1.2x for 50 Hz)

ENVIRONMENTAL SPECS
OPERATING TEMP
14º to 160º F (-10º to 71º C)
STORAGE TEMP
-14º to 160º F (-26º to 71º C)
RELATIVE HUMIDITY
20 to 90% non-condensing

OTHER
UL and CUL Listed
Title 24 Compliant
5 Year Warranty
Made in the U.S.A.

The **WSD** is a stylish, easy to install, and simple to use Wall Switch Decorator style Passive Infrared (PIR) sensor. It is ideal for private offices, copy rooms, closets, or any small enclosed space without obstructions. A user programmable time delay ensures that once the room is vacated the sensor will time out and turn off the lights. Additionally, the **WSD** sensor has several On Modes and Switch Modes that can be programmed using the front push-button. For rooms with obstructions, the Dual Technology **WSD PDT** Series sensor is recommended.

SENSOR OPERATION & MODES
The sensor detects changes in the infrared energy given off by occupants as they move within the field-of-view. When occupancy is detected, a self-contained relay switches the connected lighting load on. The sensor is line powered and switches line voltage (see specifications). A timer, factory set at 10 minutes, keeps the lights on during brief periods of inactivity. This timer is push-button programmable from 30 seconds to 20 minutes, and resets every time occupancy is re-detected. This state-of-the-art design requires no field calibration or sensitivity adjustments.

ON MODES
AUTOMATIC ON **(default)** - Lights come on when occupancy is detected.
MANUAL ON - Requires the occupant manually turn on lights via the push-button.
REDUCED TURN ON - Sensor is initially set to only detect large motions, effectively ignoring PIR signals reflected off of surfaces, while still sensing occupants when they enter the room. Once lights are on, the sensor returns to maximum sensitivity.

SWITCH MODES
PREDICTIVE OFF MODE **(default)** - This mode allows occupants to turn lights off via the switch without losing the convenience of having the lights automatically turn on when they re-enter the room. Pressing the switch turns the lights off and temporarily disables the occupancy detection in the sensor. After a short exit time delay, the occupancy detection reactivates and monitors for an additional grace period. If no occupancy is detected, the zone will remain in Automatic On operation. If occupancy is detected, the zone will go to a Permanent Off mode, requiring the switch to be pressed again in order to turn the lights on and restore the sensor to Automatic On operation.
PERMANENT OFF - Pressing the switch turns the lights and the sensor off. Lights will not come on until switch is pressed again.
SWITCH DISABLE - Prevents user from manually turning off the lights via the push-button. Button can still be utilized for programming.

OPTIONS

VANDAL-RESISTANT LENS (V)
- Ideal for high abuse or public areas, where occupants simply come and go
- Decreases detection range by 50%

INHIBIT PHOTOCELL (P)
- Auto set-point calibration
- Photocell prevents lights from turning on if adequate daylight is available, but does not turn lights off

347 VAC (347)
- Allows sensor to be powered from and switch 347 VAC
- Wall Plate Provided

COLOR
- White, Ivory, Gray, Almond, Black
- Wall Plate Provided

LOW TEMP/HIGH HUMIDITY (LT)
- Sensor is corrosion resistant
- Operates down to -40º F/C

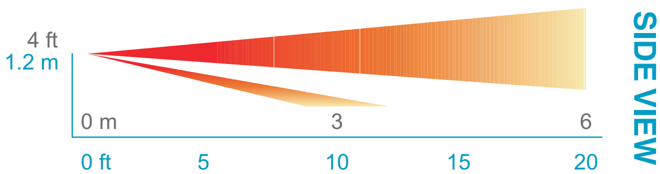
ORDERING INFO
WSD [LENS] [PHOTOCELL] [VOLTAGE] [COLOR] [TEMP/HUMIDITY]

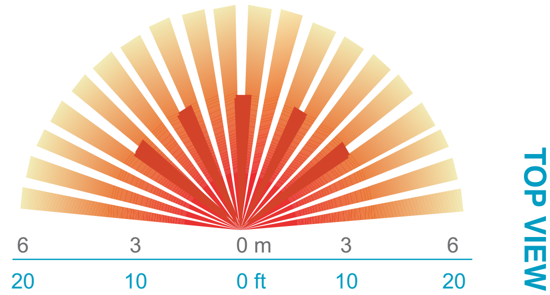
LENS	PHOTOCELL	VOLTAGE	COLOR	TEMP/HUMIDITY
Blank = None	**Blank = None**	**Blank = 120/277 VAC**	**WH = White**	**Blank = Standard**
V = Vandal Resistant	**P = Photocell**	**347 = 347 VAC**	**IV = Ivory**	**LT = Low Temp**
			GY = Gray	
			AL = Almond	
			BK = Black	

COVERAGE PATTERN

WSD WALL SWITCH DECORATOR LENS

- Small motion (e.g. hand movements) detection up to 20 ft (6.10 m)
- Large motion (e.g. walking) detection up to 50 ft (15.24 m)
- Wall-to-Wall coverage





WIRING (DO NOT WIRE HOT)

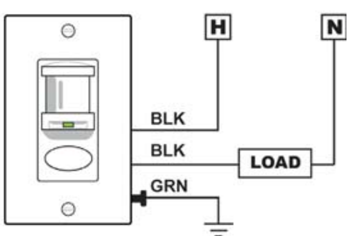
STANDARD WIRING

BLACK* - Line Input
BLACK* - Load Output
} *BLACK wires can be reversed
GREEN SCREW - Ground (required connection)

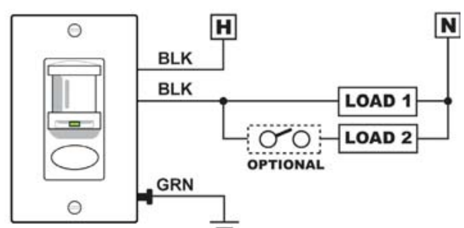
347 VAC OPTION (347)

Black wires are replaced w/ Red wires

STANDARD CONFIGURATION



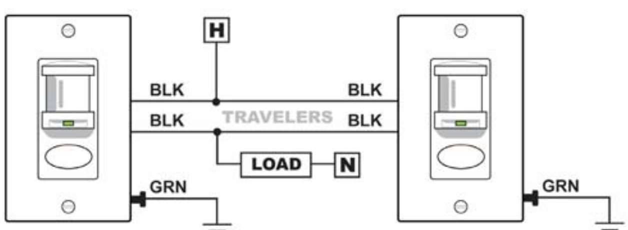
BI-LEVEL CONFIGURATION

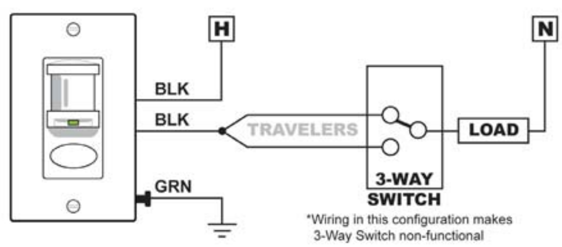


Note: Connection to Ground required for sensor to function

3-WAY CONFIGURATIONS

Travelers are used to wire sensors (or sensor and 3-way switch) i





Note: Connection to Ground required for sensor to function

WARNING

Fire Hazard Caution: Maximum Lamps 1500 Watts, Type 347 VAC.
Attention: Risque d'incendie : Pauissance Maximales Des Lampes 1500 Watts, Type 347 VAC.
Warning: The units are intended to be installed by a qualified person with properly rated branch circuit protectors as per applicable local and national regulations (CEC, NEC).

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WSD PDT

WALL SWITCH DECORATOR SENSOR
LINE VOLTAGE • PASSIVE DUAL TECHNOLOGY (PDT)

SPECIFICATIONS

FEATURES
- Patented Dual Technology with PIR / Microphonics™ Detection
- Self-Contained Relay - No Power Pack Needed
- Interchangeable Hot & Load Wires - Impossible to Wire Backwards
- No Neutral Connection Required
- Small Motion Detection to 20 ft (6.10 m)
- Self-Grounding Mounting Strap
- No Minimum Load
- Push-Button Programmable w/o Removing the Switch Plate
- Adjustable Time Delay
- 3-way & 4-way Switching
- Green LED Indicator

PHYSICAL SPECS
SIZE 4.2"H x 1.8"W x 1.5"D (10.67cm x 4.57cm x 3.81cm)
WEIGHT 5 oz
MOUNTING Single Gang Switch Box
MOUNTING HEIGHT 30-48 in (76.2-121.9 cm)
COLORS White, Ivory, Gray, Almond, Black

ELECTRICAL SPECS
MAXIMUM LOAD
800 W @ 120 VAC
1200 W @ 277 VAC
1500 W @ 347 VAC
MINIMUM LOAD None
MOTOR LOAD 1/4 HP
FREQUENCY 50/60 Hz (timers are 1.2x for 50 Hz)

ENVIRONMENTAL SPECS
OPERATING TEMP
14º to 160º F (-10º to 71º C)
STORAGE TEMP
-14º to 160º F (-26º to 71º C)
RELATIVE HUMIDITY
20 to 90% non-condensing

OTHER
UL and CUL Listed
Title 24 Compliant
5 Year Warranty
Made in the U.S.A.

The **WSD PDT** Series is a Wall Switch Decorator style Passive Dual Technology (PDT) occupancy sensor. The combination of Passive Infrared and patented Microphonics™ detection allows this sensor to literally see & hear occupants. It is ideal for restrooms with stalls, private offices where occupant turns their back to the sensor, or rooms with obstructions.

SENSOR OPERATION & MODES
Passive Dual Technology (PDT) sensors first see motion using Passive Infrared (PIR) and then engage Microphonics™ to hear sounds that indicate continued occupancy. This patented technology uses Automatic Gain Control (AGC) to dynamically self-adapt a sensor to its environment by filtering out constant background noise and detecting only noises typical of human activity. When occupancy is detected, a self-contained relay switches the connected lighting load on. The sensor is line powered and can switch line voltage (see specifications). A timer, factory set at 10 minutes, keeps the lights on during brief periods of inactivity. This timer is push-button programmable from 30 seconds to 20 minutes, and is reset every time occupancy is re-detected. If needed, a 10 second grace period also allows the lights to be voice reactivated after shutting off. This state-of-the-art design requires no field calibration or sensitivity adjustments.

ON MODES

AUTOMATIC ON **(default)** - Lights come on when occupancy is detected.

MANUAL ON - Requires the occupant manually turn on lights via the push-button.

REDUCED TURN ON - Sensor is initially set to only detect large motions, effectively ignoring PIR signals reflected off of surfaces, while still sensing occupants when they enter the room. Once lights are on, the sensor returns to maximum sensitivity.

SWITCH MODES

PREDICTIVE OFF MODE **(default)** - This mode allows occupants to turn lights off via the switch without losing the convenience of having the lights automatically turn on when they re-enter the room. Pressing the switch turns the lights off and temporarily disables the occupancy detection in the sensor. After a short exit time delay, the occupancy detection reactivates and monitors for an additional grace period. If no occupancy is detected, the zone will remain in Automatic On operation. If occupancy is detected, the zone will go to a Permanent Off mode, requiring the switch to be pressed again in order to turn the lights on and restore the sensor to Automatic On operation.

PERMANENT OFF - Pressing the switch turns the lights and the sensor off. Lights will not come on until switch is pressed again.

SWITCH DISABLE - Prevents user from manually turning off the lights via the push-button. Button can still be utilized for programming.

OPTIONS

VANDAL-RESISTANT LENS (V)
- Ideal for high abuse or public areas, where occupants simply come and go
- Decreases detection range by 50%

INHIBIT PHOTOCELL (P)
- Auto set-point calibration
- Photocell prevents lights from turning on if adequate daylight is available, but does not turn lights off

347 VAC (347)
- Allows sensor to be powered from and switch 347 VAC
- Wall Plate Included

COLOR
- White, Ivory, Gray, Almond, Black
- Wall Plate Included

LOW TEMP/HIGH HUMIDITY (LT)
- Sensor is corrosion resistant
- Operates down to -4º F(-20ºC)

ORDERING INFO

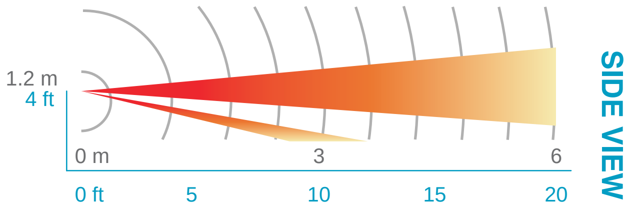
WSD PDT [LENS] [PHOTOCELL] [VOLTAGE] [COLOR] [TEMP/HUMIDITY]

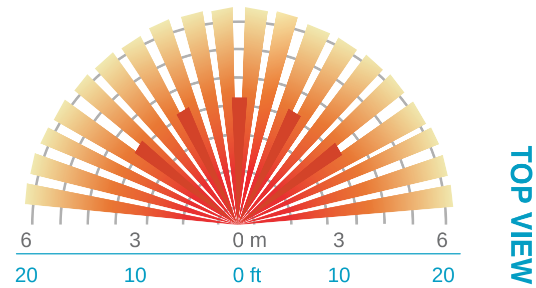
LENS	PHOTOCELL	VOLTAGE	COLOR	TEMP/HUMIDITY
Blank = None	**Blank = None**	**Blank = 120/277 VAC**	**WH = White**	**Blank = Standard**
V = Vandal Resistant	**P = Photocell**	**347 = 347 VAC**	**IV = Ivory**	**LT = Low Temp**
			GY = Gray	
			AL = Almond	
			BK = Black	

COVERAGE PATTERN

WSD WALL SWITCH DECORATOR LENS W/ MICROPHONICS™

- Small motion (e.g. hand movements) detection up to 20 ft (6.10 m)
- Large motion (e.g. walking) detection up to 50 ft (15.24 m)
- Wall-to-Wall coverage
- Microphonics™ provides overlapping detection of human activity over the complete PIR coverage area
- Advanced filtering is utilized to prevent non-occupant noises from keeping the lights on





WIRING (DO NOT WIRE HOT)

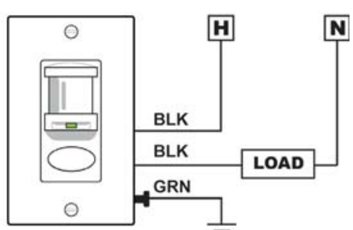
STANDARD WIRING

BLACK* - Line Input
BLACK* - Load Output
} *BLACK wires can be reversed
GREEN SCREW - Ground (required connection)

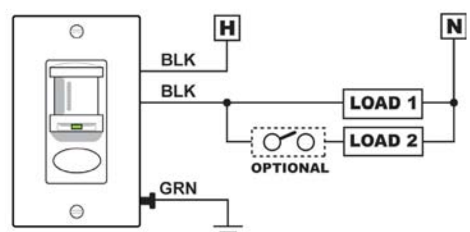
347 VAC OPTION (347)

Black wires are replaced w/ Red wires

STANDARD CONFIGURATION



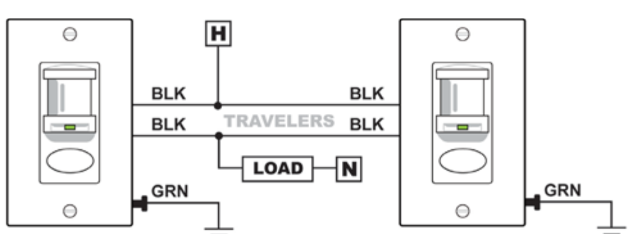
BI-LEVEL CONFIGURATION

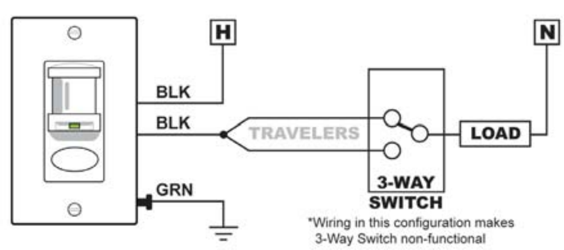


Note: Connection to Ground required for sensor to function

3-WAY WIRING CONFIGURATIONS

Travelers are used to wire sensors (or sensor and 3-way switch) in parallel.





Note: Connection to Ground required for sensor to function

WARNING

Fire Hazard Caution: Maximum Lamps 1500 Watts, Type 347 VAC.
Attention: Risque d'incendie : Pauissance Maximales Des Lampes 1500 Watts, Type 347 VAC.
Warning: The units are intended to be installed by a qualified person with properly rated branch circuit protectors as per applicable local and national regulations (CEC, NEC).

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WARRANTY: Sensor Switch, Inc. warrants these products to be free of defects in material and workmanship for a period of 60 months. Sensor Switch, Inc., upon prompt notice of such defect, will, at its option, provide a Returned Material Authorization number and repair or replace returned product.
LIMITATIONS AND EXCLUSIONS: This Warranty is in full lieu of all other representation and expressed and implied warranties (including the implied warranties of merchantability and fitness for use) and under no circumstances shall Sensor Switch, Inc. be liable for any incidental or consequential property damages or losses.

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sensorswitch®

CM 10

EXTENDED RANGE 360º SENSOR

CEILING MOUNT • LOW VOLTAGE • PASSIVE INFRARED (PIR)

SPECIFICATIONS

FEATURES

100% Digital PIR Detection,
Excellent RF Immunity
360º Coverage Pattern
Push-Button Programmable
Adjustable Time Delays
No Field Calibration or Sensitivity
Adjustments Required
Convenient Test Mode
100 hr Lamp Burn-in Timer
Green LED Indicator

LAMPMAXIMIZER® TECHNOLOGY
- Protects Lamp Life while Maximizing Energy Savings
- Minimum On Timer (15 min default)
- Occ. Time Delay (10 min defatult)
- LampMaximizer+ Mode - Optimizes Lamp Life & Energy Savings (disabled by default)
- Switch Counter (in 1000's)
- Total Lamp On Time (in khrs)

PHYSICAL SPECS

SIZE 4.55" Dia. (11.56 cm)
1.55" Deep (3.94 cm)
WEIGHT 6 oz
MOUNTING
Ceiling Tile Surface
3.5" Octagon Box
Single Gang Handy Box
COLOR White

ELECTRICAL SPECS

OPERATING VOLTAGE
12-24 VAC/VDC
CURRENT DRAW
Standard, 4 mA
w/ **R** option, 16 mA
DIMMING LOAD Sinks < 20mA;
~40 Ballasts @ .5mA each
RECOMMENDED POWER PACK
PP20

ENVIRONMENTAL SPECS

OPERATING TEMP
14º to 160º F (-10º to 71º C)
STORAGE TEMP
-14º to 160º F (-26º to 71º C)
RELATIVE HUMIDITY
20 to 90% non-condensing
SILICONE FREE
ROHS COMPLIANT

OVERVIEW

The **CM 10** Series Extended Range 360º occupancy sensor incorporates Passive Infrared (PIR) technology into an attractive and economical sensor to provide maximum viewing from the ceiling. When mounted at 9 ft (2.74 m), this sensor views up to 28 ft (8.53 m) in all directions. Its circular coverage pattern is designed for walking motions; making it ideal for T-shaped intersections in corridors, or other areas where wall mounting a sensor is not practical. A long hallway, for example, may require a **HW13** Series Hallway sensor at each end, with **CM 10**'s mounted in the center to fill in the distance. Low ceiling heights are also best covered by the **CM 10**. For example, when mounted at only 7 ft (2.13 m), the height of pick aisles in many distribution centers, the **CM 10** provides a 32 ft (9.75 m) diameter pattern of coverage. In applications where detection of minor motion is also required, use the **CM PDT 10** Series Dual Technology sensor.

SENSOR OPERATION

The sensor detects changes in the infrared energy given off by occupants as they move within the field-of-view. When occupancy is detected, a DC output goes high and can drive up to 200 mA of connected load. The sensor is powered with 12-24 VAC/VDC and typically operates with a **PP20** or **MP20** power pack, enabling complete 20 Amp circuits to be controlled. This innovative sensor requires no field calibration or sensitivity adjustments.

LAMPMAXIMIZER®

This sensor also contains patent pending LampMaximizer technology that allows users to aggressively target energy savings while still protecting lamp life. A minimum on timer, factory set at 15 minutes, helps preserve lamp life by eliminating all lamp cycles shorter than lamp warranties specify.

A standard occupancy time delay is also present that ensures lights turn off (assuming minimum on timer has elapsed) if no occupancy is detected. This timer is factory set at 10 minutes to promote energy savings, but is adjustable between 30 seconds and 20 minutes. These adjustments can be done manually, through the units push-button, or automatically every two weeks through an advanced mode, called LampMaximizer+, that determines the optimum time delay in order to maximize both lamp life and energy savings. Additionally, this sensor maintains statistics on total lamp on time and number of cycles.

OPTIONS

LOW VOLTAGE RELAY (R)
- Enables sensors to interface with other systems (e.g., BMS, lighting panels)
- Provides dry contact closure via a SPDT, 1 Amp, 40 Volt relay
- Only one relay needed per zone
- Changes state when all connected sensors register unoccupied
- Relay requires sensor power to function

OCCUPANCY CONTROLLED DIMMING (D)
- Provides dimming output to control 0-10 VDC dimmable ballasts
- Provides a second occupancy time-out period that enables the lights to go to a dim setting before turning off
- Adjustable max/min dim setting
- Only one sensor per zone needs to have dimming output

PHOTOCELL (P)
- Auto set-point calibration
- Two selectable modes of operation
- On/Off mode: Photocell has full control during periods of occupancy
- Inhibit mode: Photocell can prevent lights from turning on if adequate daylight is available, but cannot turn lights off

PHOTOCELL W/ DIMMING (ADC)
- Photocell within sensor maintains total room light level by controlling levels of 0-10 VDC dimmable ballasts
- Photocell also has full on/off control during periods of occupancy
- Provides a second occupancy time-out period that enables the lights to go to a dim setting before turning off

Note: LampMaximizer+ features not available with ADC option

LOW TEMP/HIGH HUMIDITY (LT)
- Sensor is corrosion resistant to moisture
- Operates down to -40º F/C

C UL US LISTED

TITLE 24
MADE in U.S.A.
5 YEAR WARRANTY

ORDERING INFO

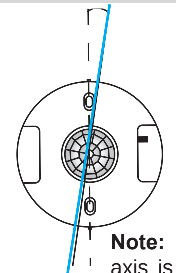
CM 10 [RELAY] [DIMMING/PHOTOCELL] [TEMP/HUMIDITY]

RELAY	DIMMING / PHOTOCELL *CHOOSE ONE ONLY*	TEMP/HUMIDITY
Blank = None	Blank = None	Blank = Standard
R = Low Voltage Relay	D = Occupancy Controlled Dimming	LT = Low Temp
	P = Photocell	
	ADC = Photocell w/ Dimming	

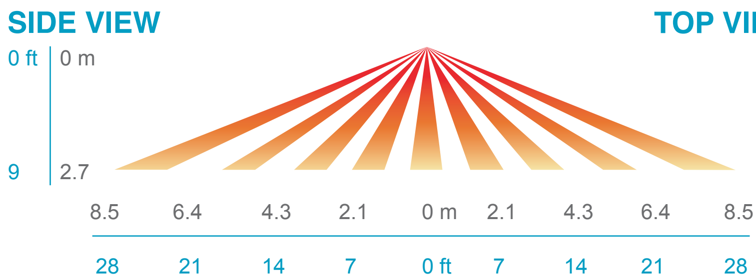
COVERAGE PATTERN

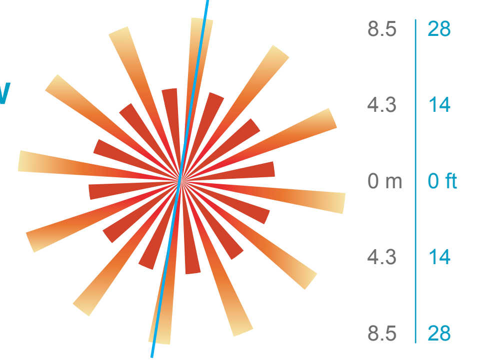
10 EXTENDED RANGE LENS

- Best choice for large motion (e.g. walking) detection
- Viewing angle of 67º in a 360º conical shaped pattern
- Provides 28 ft (8.53 m) radial coverage when mounted to standard 9 ft (2.74 m) ceiling
- 7 to 15 ft (2.13 to 4.57 m) mounting heights provide 16 to 36 ft (4.88 to 10.97 m) radial coverage



Note: Sensor's screw axis is offset 7.5º from a long detection segment





WIRING (DO NOT WIRE HOT)

STANDARD WIRING

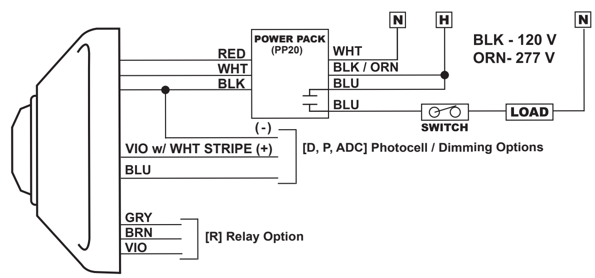
RED - Power Input (12-24 VAC/VDC)
BLACK - Common
WHITE - Occupancy State (high VDC for occupied)

PHOTOCELL/DIMMING OPTIONS (D, P, ADC)

BLUE - Direct output to power pack for providing photocell control and/or secondary dim time out. Output is high VDC with occupancy & low light. Output also held high during secondary dim time out. For multi-level control, use two power packs and connect White wire to primary load and Blue to daylight load.

VIOLET w/ WHITE STRIPE - Connect to 0-10 VDC control wire (typically Violet) from 0-10 VDC dimmable ballast

GRAY from Ballast - Connect to sensor Black wire

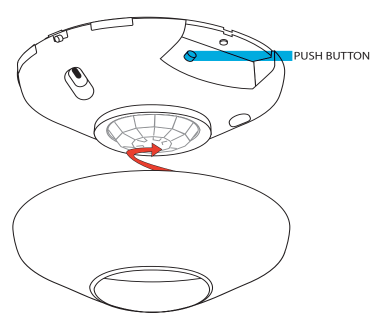


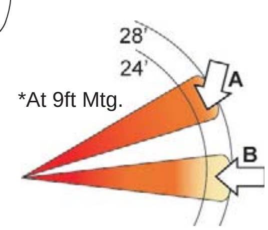
RELAY OPTION (R)

GRAY / BROWN - Connected during occupied state
VIOLET / BROWN - Connected during unoccupied state
Note: Relay is energized during unoccupied state

INSTALLATION

- Mount sensor directly to a ceiling tile or a metallic grid (two self-tapping screws provided).
- Sensor's mounting holes also align with 3.5" octagon or single gang handy box (screws not provided).
- Sensor will detect motions crossing segments more effectively than motions parallel to beams.
- For optimal detection, position sensor such that segments are crossed upon entrance and unable to view outside the space.





A: When walking across beam, detection will occur at approximately 28 feet. (8.53 m)
B: When walking into beam, detection will occur at approximately 24 feet. (7.32 m)

PROGRAMMING

Refer to instruction card IC7.001 for default settings and directions on programming the sensor via the push-button.

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sensorswitch®

WV PDT 16

WIDE VIEW SENSOR
CORNER MOUNT • LOW VOLTAGE • DUAL TECHNOLOGY (PDT)

SPECIFICATIONS

FEATURES
PIR Occupancy Detection
120º by 40 ft (12.19 m) Coverage for Small Motion
Adjustable Time Delay
100 Hr. Lamp Burn-In Timer Mode
Green LED Indicator

PHYSICAL SPECS
SIZE 3.0” H x 3.6” W x 1.75” D (7.62 cm x 9.14 cm x 4.45 cm)
WEIGHT 5 oz
MOUNTING Directly to corner or to ceiling using **WV BR** bracket
COLOR White

ELECTRICAL SPECS
OPERATING VOLTAGE
12-24 VAC/VDC
CURRENT DRAW
Standard, 4 mA
w/ **R** option, 16 mA
RECOMMENDED POWER PACK
PP20

ENVIRONMENTAL SPECS
OPERATING TEMP
14º to 160º F (-10º to 71º C)
STORAGE TEMP
-14º to 160º F (-26º to 71º C)
RELATIVE HUMIDITY
20 to 90% non-condensing

OTHER
UL and CUL Listed
Title 24 Compliant
5 Year Warranty
Made in the U.S.A.

Classrooms are the ideal application for the **WV PDT 16** Dual Technology Wide View Sensor. Installed in the corner of the room along the entrance wall, this inconspicuous sensor provides line of sight PIR detection of small movements up to 40 ft (12.19 m) away, and combines overlapping Microphonics™ for detection around obstructions. Many classrooms are filled with shelving, projects, or lab benches. Total coverage of the room is always maintained no matter how cluttered the space becomes. The **WV PDT 16** is also used in corridors due to its ability to view up to 70 ft (21.34 m) for walking motions, or large open storage areas where obstructions may block the PIR’s ability to view. For large lecture halls, multiple **WV PDT 16**s may be wired together, or along with any other low voltage sensors.

SENSOR OPERATION
The sensor has Passive Dual Technology (PDT), which first sees motion using Passive Infrared (PIR), and then engages Microphonics™ to hear sounds that indicate continued occupancy. This patented technology uses Automatic Gain Control (AGC) to dynamically self-adapt the sensor to its environment by filtering out constant background noise and detecting only noises typical of human activity. When occupancy is detected, a DC output goes high and can drive up to 200 mA of connected load. The sensor is powered with 12-24 VAC/VDC and typically operates with a **PP20** or **MP20** power pack, enabling complete 20 Amp circuits to be controlled. An internal timer, factory set at 10 minutes, keeps the lights on during brief periods of inactivity. This timer is push-button programmable from 30 seconds to 20 minutes, and is reset every time occupancy is re-detected. This state-of-the-art sensor requires no field calibration or adjustment.

OPTIONS

LOW VOLTAGE RELAY (R)
- Enables sensors to interface with other systems (e.g., BMS, lighting panels)
- Provides dry contact closure via a SPDT, 1 Amp, 40 Volt relay
- Only one relay needed per zone
- Changes state when all connected sensors register unoccupied
- Relay requires sensor power to function

PHOTOCELL (P)
- Auto set-point calibration
- Two selectable modes of operation
- On/Off mode: Photocell has full control during periods of occupancy
- Inhibit mode: Photocell can prevent lights from turning on if adequate daylight is available, but cannot turn lights off

LOW TEMP/HIGH HUMIDITY (LT)
- Sensor is corrosion resistant to moisture
- Operates down to -4º F/ 20º C

ORDERING INFO

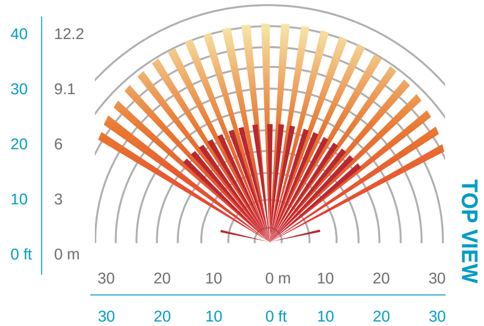
WV PDT 16 [RELAY] [PHOTOCELL] [TEMP/HUMIDITY]

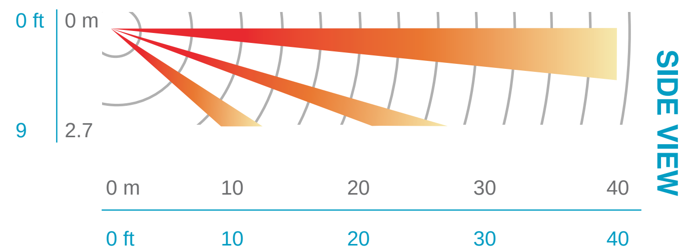
RELAY	PHOTOCELL	TEMP/HUMIDITY
Blank = None	**Blank = None**	**Blank = Standard**
R = Low Voltage Relay	**P = Photocell**	**LT = Low Temp**

COVERAGE PATTERN

16 WIDE VIEW LENS WITH MICROPHONICS™

- Small motion (e.g. hand movements) detection up to 40 ft (12.19 m).
- Large motion (e.g. walking) detection up to 70 ft (21.34 m).
- Designed for 8 to 10 ft (2.44 to 3.05 m) high mounting in room corner.
- Microphonics™ provides overlapping detection of human activity over the complete PIR coverage area. Advanced filtering is also utilized to prevent non-occupant noises from keeping the lights on.

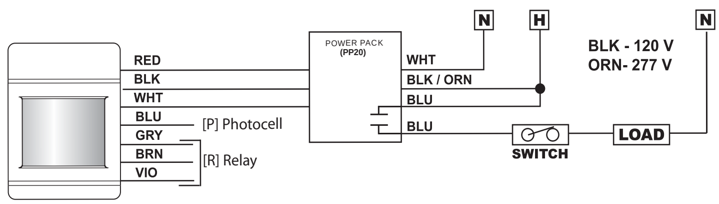




WIRING (DO NOT WIRE HOT)

STANDARD WIRING

RED - Power Input (12-24 VAC/VDC)
BLACK - Common
WHITE - Output (high VDC for occupancy)



RELAY OPTION (R)

GRAY/BROWN - Connected during occupied state
VIOLET/BROWN - Connected during unoccupied state
Note: Relay is energized during unoccupied state.

PHOTOCELL OPTION (P)

BLUE - Use in place of White ouput wire. Photocell output is high VDC with occupancy & low light. For multi-level control, use two power packs and connect White to primary load and Blue to daylight load.

INSTALLATION

- Sensor has rear enclosure, which is beveled so as to be corner mounted at 8-10 ft (2.44-3.05 m); see tilt settings below.
- Mount in corner above entrance door or in a corner along the same wall as the entrance. .
- For mounting heights above 10 ft (3.05 m), use the **WV BR** and mount sensor to angled side to provide an intial 30º look down.

TILT ADJUSTMENT

Mounting Height	Position
7' - 8'	Vertical
8' - 9'	Center
9' - 10'	Forward
Above 10'	Use **WV BR**

CEILING MOUNT BRACKET (WV BR)

The **WV BR** Ceiling Mount Bracket allows the **WV PDT 16** to be mounted in the corner of the area from the ceiling for conditions where mounting to the wall is not possible.

PROGRAMMING

Refer to included instruction card for default settings and directions on programming the sensor via the push-button.

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WARRANTY: Sensor Switch, Inc. warrants these products to be free of defects in manufacture and workmanship for a period of 60 months. Sensor Switch, Inc., upon prompt notice of such defect, will, at its option, provide a Returned Material Authorization number and repair or replace returned product.
LIMITATIONS AND EXCLUSIONS: This Warranty is in full lieu of all other representation and expressed and implied warranties (including the implied warranties of merchantability and fitness for use) and under no circumstances shall Sensor Switch, Inc. be liable for any incidental or consequential property damages or losses.

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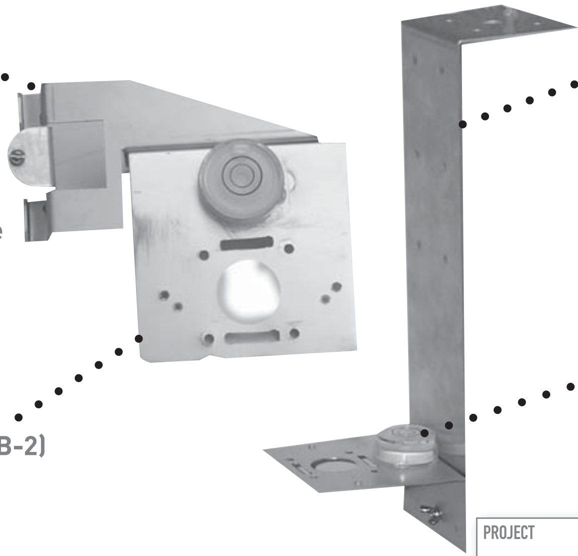
MB Sensor Mounting Brackets



PROJECT
LOCATION/TYPE

Product Overview

Description

The MB-1 and MB-2 are durable mounting brackets used to install occupancy sensors in a variety of settings. Both brackets include adjustable plates that allow sensor rotation to achieve the desired angle for optimal coverage. The brackets also include built-in bubble levels that afford the installer reliable guides to ensure the bracket is correctly positioned before adjusting the sensor. The MB-1 and MB-2 are constructed of aluminum with a clear powder coating finish.

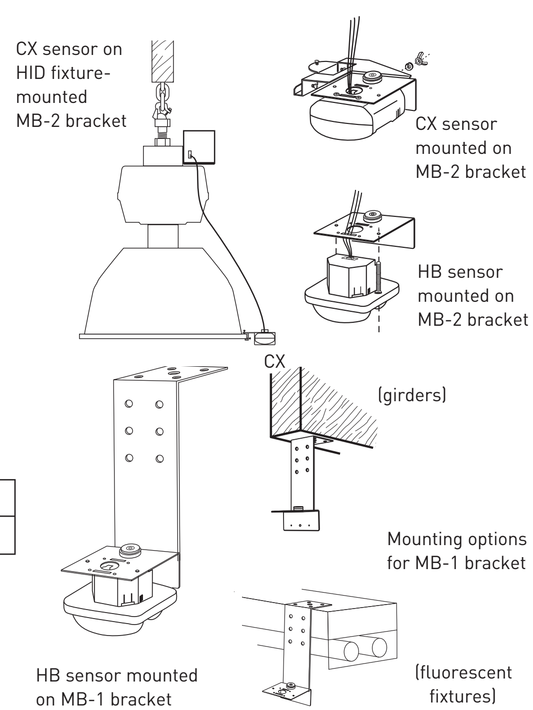
MB-1

The MB-1 bracket enables users to mount sensors to a variety of structures, including fluorescent fixtures, walls, shelves, and girders. Among the many sensors compatible for use with the MB-1 bracket are the WPIR, CX, CI, and HB sensors. The MB-1 features an L-shaped bracket and a sensor mounting plate. When installed, this mounting plate can be rotated to direct the sensor toward the floor or along an aisle way at up to a 33° angle. In addition, the L-shaped bracket can be molded or reshaped to provide other mounting options.

MB-2

With the MB-2, sensors can be attached directly to High Intensity Discharge (HID) fixtures, mounting to the bottom rim of the HID reflector bell and secured to the rim with three clamping screws. Sensors recommended for use with the MB-2 bracket include the CX, CI and HB sensors. The MB-2 includes a J-shaped bracket and a sensor mounting plate. The MB-2 also comes with extension wires that can be used, if needed, to connect the attached sensor to the DM HID controller.

Bracket Diagrams



Ordering Information

Catalog No.	Description
☐ MB-1	L-Plate Industrial Mounting Bracket
☐ MB-2	J-Plate HID Mounting Bracket

120/277 VOLT
POWER PACKS AND SLAVE PACKS

PP-20
PP-20-2P
SP-20
Plenum Rated

TYPICAL APPLICATIONS
- Used with Low Voltage Sensors
- Multiple Sensors
- Multiple Loads
- AC Switching Only

HIGHLIGHTS
- Dual Voltage Transformer
- Self-Contained Relay
- Patented Relay Circuit Protection (Tested to over 400,000 cycles)
- Powers up to 14 sensors

SPECIFICATIONS
- Size:(1/2" inch chase nipple not inc.)
  PP-20-2P: 4 1/8 x 3" x 1 7/8"
  PP-20 & SP-20: 3" x 2 1/4" x 1 7/8"
- Mounting: 1/2" inch chase nipple
- Operating Voltage: 120, 240, or 277 VAC (Single Phase only)
- Each Relay: 20 Amps
- 1 HP Motor Load
- Output Voltage: 15 VDC, 150 mA at 120 or 277 VAC
- Class II: 18 AWG, up to 2,000 ft.
- Plenum Rated
- Relative Humidity: 20 to 90% non-condensing
- Operating Temp: 14º to 160º F
- Storage Temp: -14º to 160º F
- UL and CUL Listed
- 5 Year Warranty
- Made in U.S.A.

LOW TEMP/HI HUMIDITY(-LT)
- Conformally Coated PCB
- Operates down to -40º F
- Corrosion resistant from moisture

PLENUM CONSIDERATIONS

Most local codes allow for small plastic controls in Return Air Plenums; *Some Do Not!* To meet local code, the Power Pack can be mounted inside an adjacent (Deep) junction box as shown below.

Power Packs are the heart of the Low Voltage Sensor System. The *PP-20* transforms 120, 240 or 277 Volts (single phase) to class II 15 VDC to power the remote sensors. Utilizing Patented Relay Circuit Protection the *PP-20* also switches the lighting load "On" and "Off": Tested to over 400,000 cycles at rated load! Although Plenum Rated, the elongated mounting nipple allows for the *PP-20* to be mounted either directly thru a 1/2" inch knockout in a junction box, or to be located inside an adjacent box for specific local code requirements. Up to 14 sensors may be connected to one *PP-20*. Multi-circuit control can be handled by multiple *PP-20's*, or 2-Pole Power Packs (*PP-20-2P*) and Slave Packs (*SP-20*) may be configured. *PP-20's* can be wired continuously hot (line side), or on the switch leg (load side) without nuisance delays upon turn "On".

LOW VOLTAGE OPERATION AND TEST

The Low Voltage Wires or Terminal is color coded Red (15 VDC), Black (Common), and White (Occupancy Signal). With no sensors connected, using a small wire, connect the Red terminal to the White. The lights should turn "On". Remove the connection and the lights should turn "Off". With the sensors connected, the Red and Black wires provide DC power to the remote sensors, and when there is occupancy detected, the White wire produces a 15 VDC signal from the sensor to the power pack initiating the lights to "On". Upon initial power up, the Sensors automatically send an "On" signal until the sensors have stabilized and "Timed Out".

SIZING OF THE SYSTEM - VARIOUS COMBINATIONS

Combining Power Packs provides for additional power to drive remote devices. Maximum numbers of remote sensors are shown below based on the Power Pack/Slave Pack being used. *Maximum number of "Relays" is 30.*

	Sensors	Sensors with Relay
1 PP-20	14	8
1 PP-20-2P	7	6
1 PP-20 w/SP-20	7	6
1 PP-20-2P w/SP-20	5	5
2 PP-20	28	16
2 PP-20-2P	14	12

Note 1: Only three relays may be controlled with one Power Pack. If more than three circuits are required, multiple Power Packs must be used.

Note 2: Only one "Sensor with Relay" is required in most cases. See Technical Datasheet on Low Voltage Sensors with -R Interface Option.

SYSTEMS CONSIDERATIONS

The local override switch may be upstream or downstream of a *PP-20*. However, if an *SP-20* Auxiliary Relay or a *PP-20-2P* controller is being used, the switch(es) should be downstream on the load side of the relay. If power is disconnected to the Power Pack all subsequent relays will open, turning off all of the loads. If wiring the local switches before the Power Pack and Slave Pack, use multiple *PP-20's*, one for each circuit. This will allow for one circuit to remain powered, keeping the system operational when the other is turned off. When controlling a dimming circuit, *PP-20* must be wired before dimmer, or *SP-20* may be wired after dimmer.

INTERFACING WITH ELECTRONIC CONTROL SYSTEMS

The Relay Switching System is designed to switch Alternating Currents Only. The relay will not switch DC signal inputs to EMS or Lighting Control Systems. Use model #MP-20, or "-R" for signal relay located in Low Voltage Sensor Heads.

CATALOG INFORMATION

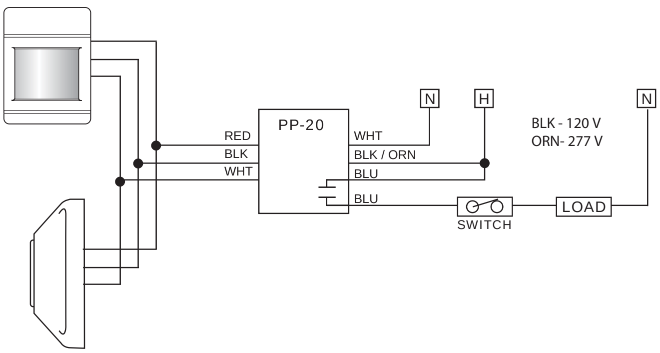
MODEL#	DESCRIPTION	OUTPUT VOLTAGE	OUTPUT CURRENT
PP-20	Power Pack with 20 Amp Relay	15 to 24 VDC	70 to 110 mA
PP-20-2P	Power Pack with two 20 Amp Relays	15 to 24 VDC	35 to 70 mA
SP-20	Slave Pack with 20 Amp Relay	N/A	40 mA (consumption)

**Add suffix -LT for Low Temp/Hi Humidity

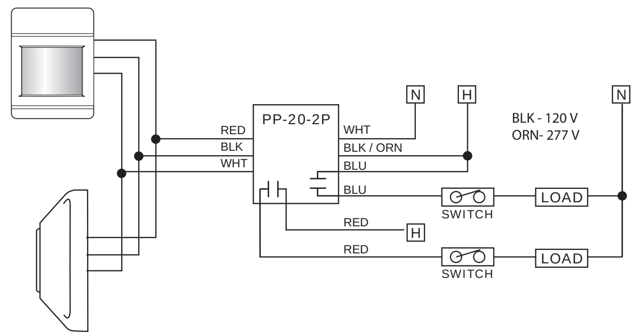
TYPICAL WIRING DIAGRAMS - DO NOT WIRE HOT

NOTE: The Power Pack must be connected to a single phase Hot and Neutral System. For 120 VAC, connect the Black wire to Hot, White wire to Neutral, and Cap off the Orange wire. For 240-277 VAC, connect the Orange to Hot, White to Neutral, and Cap off the Black wire. *Never connect both the Black and Orange wires!* Low Voltage wire can be 18 to 22 AWG; shielding is not necessary. Class II terminal Block on *PP-20-2P* only accepts one conductor per terminal of 18 AWG stranded or smaller.

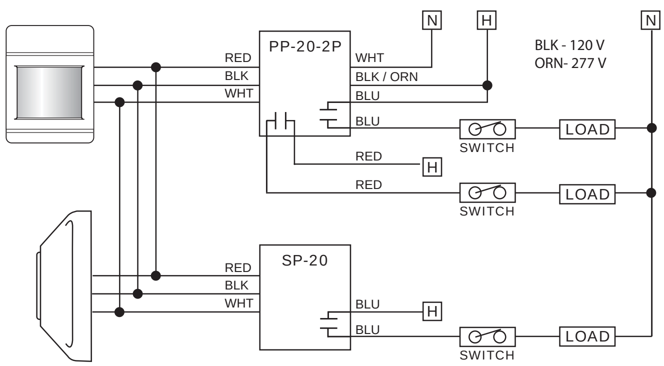
Multiple Sensors Controlling One Circuit



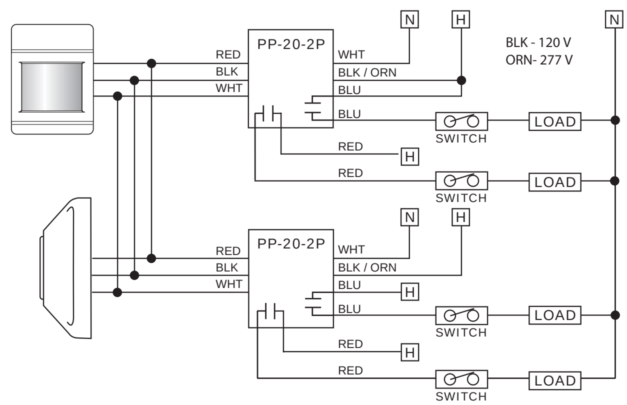
Multiple Sensors Controlling Two Circuits



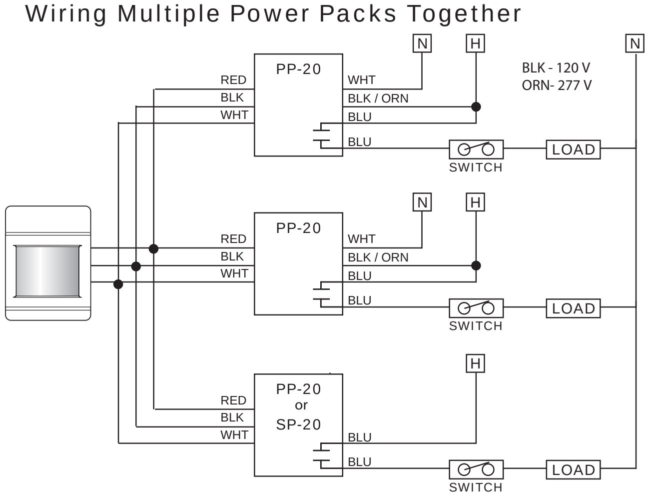
Multiple Sensors Controlling Three Circuits



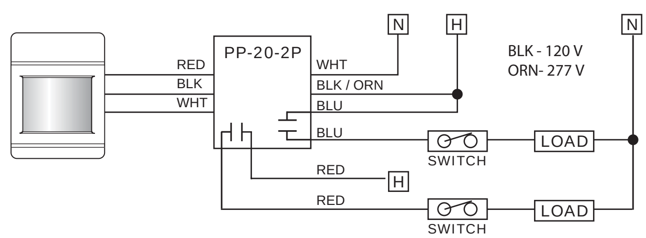
Multiple Sensors Controlling Four Circuits



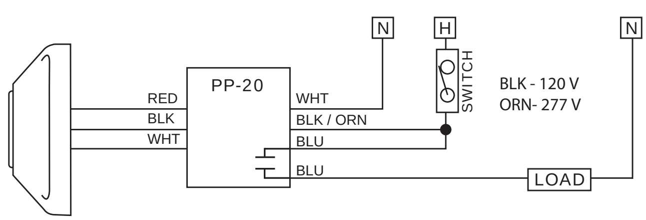
Wiring Multiple Power Packs Together



One Sensor Controlling Two Circuits



One Sensor Controlling One Circuit



WARRANTY: Sensor Switch, Inc. warrants these products to be free of defects in manufacture and workmanship for a period of sixty months. Sensor Switch, Inc., upon prompt notice of such defect will, at its option, provide a Returned Material Authorization number and repair or replace returned product.

LIMITATIONS AND EXCLUSIONS: This Warranty is in full lieu of all other representation and expressed and implied warranties (including the implied warranties of merchantability and fitness for use) and under no circumstances shall Sensor Switch, Inc. be liable for any incidental or consequential property damages or losses.

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www.sensorswitch.com

revised 09/06/2007

Honeywell Enovate® Blowing Agent

Spray Foam Roofing for Commercial Buildings

Honeywell

Protect Your Commercial Building With a Spray Foam Roof Formulated With Enovate® Blowing Agent

Insulate and Waterproof Using Advanced Wind Resistance and Energy-Efficient Technology

Roof insulation and waterproofing systems formulated with Enovate provide improved dimensional stability and compression strength when compared to other roof systems. The U.S. government's National Institute of Standards and Technology (NIST) agency documents spray foam roof systems' excellent performance compared to other type roof systems after hurricanes Katrina and Rita.*

Honeywell is a leading supplier of blowing agents for closed-cell spray foam. Blowing agents make foam expand during application. Trapped in the foam cells, they are the main factor in determining thermal insulation performance.

Spray foam roofing systems formulated with non-flammable, non-ozone depleting Honeywell Enovate® Blowing Agent (HFC-245fa) offer superior thermal performance and moisture protection. Spray foam roof systems are both FM (Factory Mutual) and UL (Underwriters Laboratory) listed.

Contractor Benefits

Polyurethane spray foam roofing systems that use Enovate blowing agent provide contractors with the highest quality roofing material and technology on the market today.

Both the NRCA (National Roofing Contractors Association) and SPFA (Spray Polyurethane Foam Alliance) feature spray foam roofs in their low-slope roofing design and application guidelines.

Spray foam roof systems are lightweight and adaptable to uniquely-shaped structures and difficult-to-flash penetrations. They can be finished in a variety of colors and textures.

A spray foam roof is watertight within 30 seconds of being applied to a dry, clean substrate. In addition, it is a monolithic seamless roof system, reducing the chance of leaks and contractor call-backs.

Spray foam roof systems are fully adhered, with no penetrating fasteners, therefore attaching easily to all types of decks and substrates.

Building Owner Benefits

Polyurethane spray foam roof systems that use Honeywell's Enovate blowing agent can save building owners both time and money.

Spray foam roof systems are backed by manufacturers' warranties for up to 20 years. Another beneficial feature of spray foam roofs is their sustainable nature; they can be re-coated at the end of their warranty period to extend the warranty and the life of the roof investment. Spray foam roofs are an excellent choice for those seeking Leadership in Energy and Environmental Design (LEED) Green Building Rating System certification.

Spray foam roofs are fast and easy to apply, allowing the building owner to experience minimal business interruption and inconvenience during installation.

The unique physical performance characteristics of polyurethane spray foam roof systems provide the building owner with added protection from severe weather, such as storms, hail, and high winds.

Polyurethane spray foam offers the highest performance of any roof system,

reducing both heating and cooling costs. Spray foam roofs also eliminate thermal transfer in and out of the building at insulation joints and mechanical fasteners.

The use of a highly reflective white coating in conjunction with closed-cell spray foam may save the building owner additional energy costs associated with heating and cooling. The improved reflectivity and emissivity properties of the roof insulation system can lower the surface temperature of the roof. This has the added benefit of reducing urban heat island effect. Spray foam roof manufacturers are listed on the ENERGYSTAR® Roof Products Program. Studies at Oak Ridge National Labs (ORNL) and Lawrence Berkeley National Laboratory (LBNL) document the energy and reflective performance and savings from spray foam roof systems.

NOTE: Because spray foam formulations vary from manufacturer to manufacturer, interested building designers, contractors and owners should consult the spray foam specification sheets to understand the exact properties. Savings vary. Find out why in the seller's fact sheet on R-values. Higher R-values mean greater insulating power.

* NIST Technical Note 1476 - Performance of Physical Structures in Hurricane Katrina and Hurricane Rita: A Reconnaissance Report - June 2006

Honeywell Performance Materials and Technologies

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Honeywell

Honeywell Enovate® 245fa

Technical information

Honeywell

Introduction

Honeywell Enovate® 245fa blowing agent (HFC-245fa, 1,1,1,3,3,-pentafluoropropane) is a liquid hydrofluorocarbon, which has been developed as a blowing agent for rigid insulating foams. It is a replacement for HCFC-141b and other fluorocarbon and non-fluorocarbon blowing agents. Enovate is a nonflammable liquid having a boiling point slightly below room temperature. It has a zero Ozone Depletion Potential (ODP) and it is not considered a Volatile Organic Compound (VOC) in the US. The physical properties of Enovate are summarized in Table 1 below.

Table 1: Physical Properties of Enovate.

Molecular Formula		$CF_3CH_2CHF_2$
Molecular Weight		134.0
Boiling Point	(°F)	59.5
	(°C)	15.3
Liquid Density	(g/cc) @ 20°C	1.32
Freezing Point	(°F)	<-160
	(°C)	<-107
Vapor Pressure:	(PSIA @ 68°F)	17.8
	(kPa @ 20°C)	123
Vapor Thermal Conductivity		@ 40°C
	(BTU in / $ft^2hr°F$)	0.097
	(mW/mK)	14.0
Water Solubility (in Enovate)		1600 ppm
Flash Point *		None
Vapor Flame Limits **		None

*Flashpoint by ASTM D 3828-87; ASTM D1310-86

**Flame Limits measured at ambient temperature and pressure using ASTME681-85 with electrically heated match ignition, spark ignition and fused wire ignition; ambient air.

Toxicity

Enovate® is currently listed on the US EPA TSCA Inventory, the European EINECS Inventory, and the Japanese MITI Inventory. Extensive toxicity testing indicates that Enovate is of low toxicity. Overall results from a series of genetic studies indicate that Enovate is non-mutagenic and non-teratogenic. The American Industrial Hygiene Association has established a Workplace Environmental Exposure Level (WEEL) of 300 ppm. Anyone who uses or handles Enovate should carefully review the MSDS and product label prior to use.

Table 2: Regulatory and Environmental Information on Enovate®

CAS Number	460-73-1
ELINCS Number	419-170-6
Ozone Depletion Potential	0
US VOC status	Exempt
Exposure guidelines	
ACGIH TLV	None
OSHA PEL	None
WEEL (AIHA) TWA 8 hrs	300 ppm
TSCA Inventory Status	Listed
SNAP Approval	All Foam Applications

Environmental

Enovate® blowing agent is a fluorinated hydrocarbon. Treatment or disposal of wastes generated by use of this product may be of concern depending on the nature of the wastes and the means of discharge, treatment or disposal. Enovate is not considered a "hazardous waste" by the Resource Conservation and Recovery Act if discarded unused. Care should be taken to avoid releases into the environment.

Applications

Enovate Enovate has been evaluated in a variety of foam systems and applications. Its superior thermal insulating characteristics, physical properties and compatibility with other materials make it ideal as a blowing agent for rigid polyurethane foams. Enovate replaces HCFC-141b in rigid polyurethane foam-blowing applications. Foams formulated with Enovate generally have thermal properties equivalent to those of HCFC-141b foams and better dimensional stability and compressive strength properties. The US EPA has given SNAP approval for the use of Enovate as a replacement in all foam applications.

Miscibility

As reflected in the statistics below, Enovate has exhibited acceptable miscibility in a wide range of polyols. To determine miscibility a mixture containing 40 wt. % Enovate and 60 wt.% polyol is prepared in a calibrated miscibility tube. The mixture is thoroughly mixed at an elevated temperature. The tube is then placed in a constant temperature bath for 24 hours. The height of the polyol and the Enovate is measured and the miscibility is calculated.

Miscibility of Enovate® in Polyols @70 °F (21 °C)

Polyol	% Miscible
POLYETHERS	
(Sucrose)	
Dow Voranol® 360	>40.0
(Sucrose- Amine)	
Huntsman Rubinol® R 170	>40
Huntsman Rubinol® P 180	>40
(Aromatic-Amine)	
Huntsman Rubinol® R 144	>40
Huntsman Rubinol® R159	21
(TDA)	
BASF Pluracol® -824	35.4
Dow Voranol® 490	>40
POLYESTER	
Invista Terate® 2541	23.3
Invista Terate® 2541L	27.9
Invista Terate® 2031	18.8
Invista Terate® 2542	21.5
Invista Terate® 5521	23.0
Invista Terate® 254	23.4
Stepan Stepanol® 2352	32.3
Great Lakes PHT 4 Diol®	6.2

Stability

Laboratory tests indicate that Enovate® blowing agent has a high degree of thermal and hydrolytic stability. In sealed tube studies the material showed no signs of decomposition after six (6) weeks of exposure to temperatures ranging from 75°C to 200°C in the presence and absence of water (at 300 ppm), and in the presence and absence of metals (3003 aluminum and/or 316 stainless steel). A separate study was also conducted with cold rolled steel rod exposed to Enovate in the presence and absence of air and water for a period of two (2) to six (6) weeks at temperatures ranging from 25°C to 100°C. Again, Enovate did not show any signs of decomposition.

Compatibility

Enovate blowing agent is non-reactive and non-corrosive toward all commonly used metals in polyurethane processing equipment. This includes carbon steel, stainless steel, copper and brass. There is a concern with use of aluminum in contact with any halogenated material, which includes Enovate, due to the reactive nature of aluminum, particularly if aluminum fines are present and if the oxide layer on the surface of the aluminum is removed.

In general, Enovate is less aggressive toward plastics and elastomers than is HCFC-141b. Gaskets and seals that were changed to accommodate HCFC-141b should be compatible with Enovate. Honeywell has evaluated plastics and elastomers for use with Enovate. Table 3 below reports the findings of this study. Elastomers that may find application in both static conditions (for example, gasketing between flanges) versus dynamic conditions (for example, seals on rotating shafts) may have varying degrees of suitability in use.

Table 3: Materials Compatibility

Plastics				
Application	**% Weight Delta**	**% Length Delta**	**% Width Delta**	**%Thickness Delta**
Acetal	Negligible	Negligible	Negligible	Negligible
Acrylic	Dissolving			
HDPE	Negligible	Negligible	Negligible	Negligible
Nylon	Negligible	Negligible	Negligible	Negligible
Polycarbonate	Negligible	Negligible	Negligible	Negligible
Polyetherimide	Negligible	Negligible	Negligible	Negligible
Polypropylene	Negligible	Negligible	Negligible	Negligible
PET	Negligible	Negligible	Negligible	Negligible
PVC	Negligible	Negligible	Negligible	Negligible
PVDF	Negligible	Negligible	Negligible	Negligible
PTFE	Negligible	Negligible	Negligible	Negligible

Elastomers				
Application	**% Weight Delta**	**% Length Delta**	**% Width Delta**	**% Thickness Delta**
Butyl Rubber	Negligible	Negligible	Negligible	Negligible
Fluoroelastomer	76.5	24.8	26.9	27.7
EPDM	Negligible	Negligible	Negligible	Negligible
Epichlorohydrin	10.4	3.7	3.4	2.5
EthylenePropylene	1.2	0.8	Negligible	Negligible
Neoprene	Negligible	Negligible	Negligible	Negligible
Nitrile Rubber	4.2	Negligible	Negligible	Negligible
Silicone	6.0	Negligible	Negligible	2.4
Urethane	20.5	2.3	5.0	9.1

Notes: Fluoroelastomer: "Viton A": Trademark of DuPont Dow Elastomers
Nitrile Rubber: "Buna N"
PTFE: "Teflon": Trademark of the E. I. du Pont de Nemours and Company
PVDF: "Kynar": Trademark of Arkema Inc.
Polyetherimide: "Ultem": Trademark of The General Electric Company

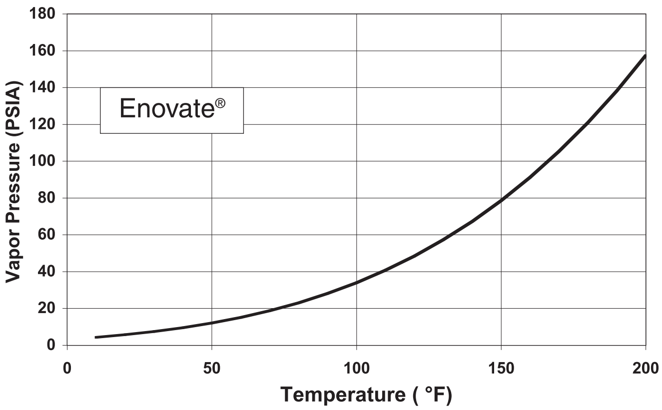
Storage & Handling

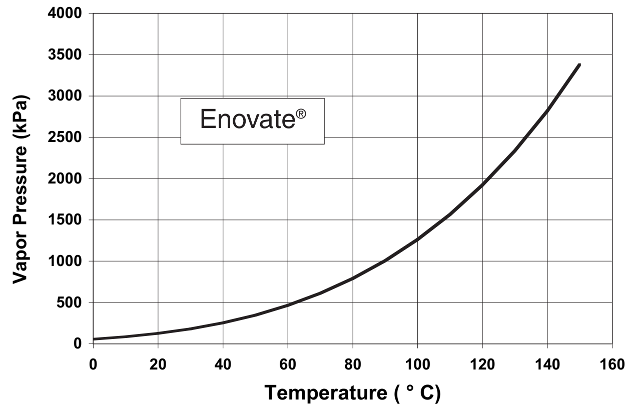
Enovate® should be stored in a cool, well-ventilated area. The material should only be stored in an approved cylinder. Please consult Honeywell's Technical Service Department prior to storage of the material in anything other than its original shipping cylinder to insure that the new container meets all safety requirements. The container and its fittings should be protected from physical damage. It should neither be punctured or dropped, nor exposed to open flames, excessive heat or direct sunlight. The container's valves should be tightly closed after use and when the container is empty.

Based on experience with other HFCs, Enovate should not be mixed with either air or oxygen at pressures above atmospheric pressure. If pressurization is required in your application, the use of nitrogen is recommended.

For additional information on use of cylinders please consult the appropriate handling, storage and unloading bulletin (available from a Honeywell Technical Service Representative)

Temperture vs. Pressure

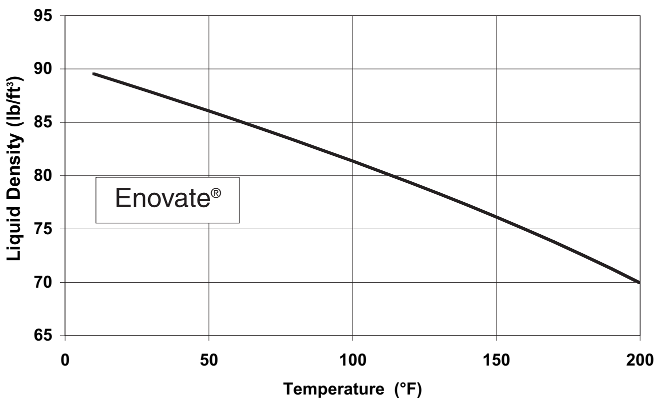


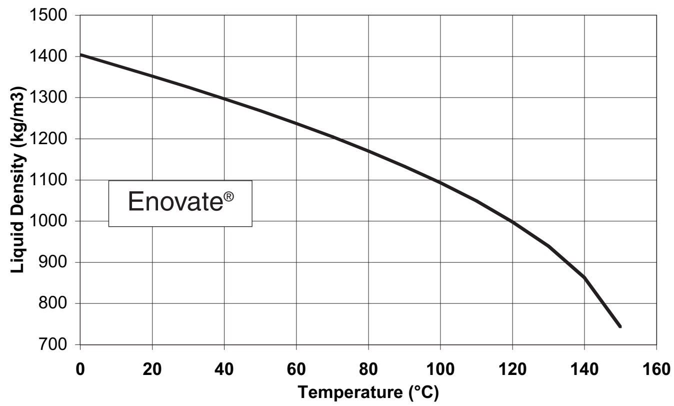


Temperature (°F)	Pressure (psia)	Temperature (°F)	Pressure (psia)
10	4.3	110	40.7
20	5.7	120	48.4
30	7.4	130	57.2
40	9.5	140	67.2
50	12	150	78.5
60	15.1	160	91.1
70	18.7	170	105.2
80	23	180	120.9
90	28.1	190	138.2
100	33.9	200	157.4

Temperature (°C)	Pressure (kPa)	Temperature (°C)	Pressure (kPa)
0	54	80	789
10	83	90	1004
20	124	100	1261
30	179	110	1565
40	252	120	1921
50	345	130	2335
60	464	140	2817
70	610	150	3380

Density vs. Temperture



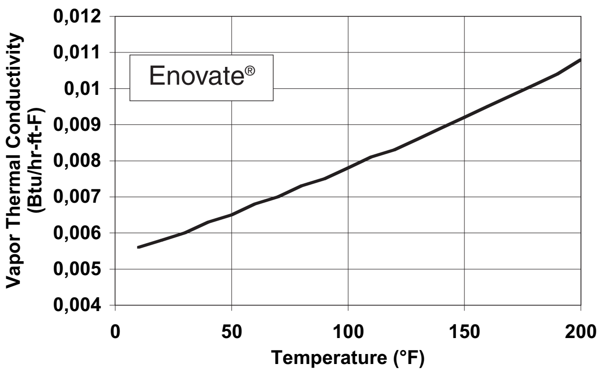


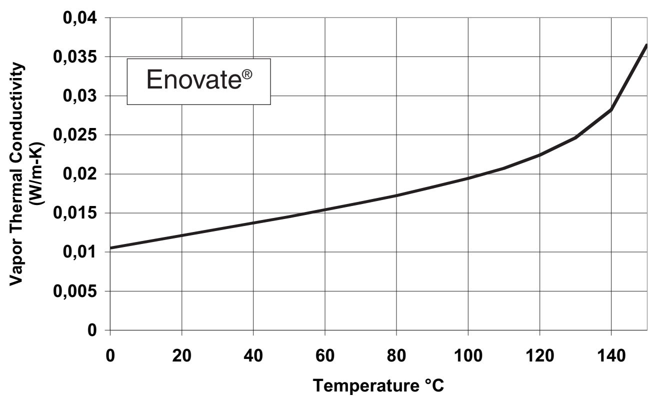
Density vs. Temperture (continued)

Temperature (°F)	Liquid Density (lb/ft³)	Temperature (°F)	Liquid Density (lb/ft³)
10	89.5	110	80.4
20	88.7	120	79.3
30	87.8	130	78.3
40	86.9	140	77.2
50	86.1	150	76.1
60	85.2	160	75.0
70	84.2	170	73.8
80	83.3	180	72.6
90	82.3	190	71.3
100	81.4	200	69.9

Temperature (°C)	Liquid Density (kg/m)	Temperature (°C)	Liquid Density (kg/m)
0	1404	100	1093
10	1378	110	1049
20	1352	120	998
30	1325	130	939
40	1297	140	863
50	1268	150	743
60	1237		
70	1205		
80	1170		
90	1133		

Vapor Thermal Conductivity vs. Temperature





Temperature (°F)	Vapor Thermal Conductivity (Btu/hr-ft-F)	Temperature (°F)	Vapor Thermal Conductivity (Btu/hr-ft-F)
10	0.0056	110	0.0081
20	0.0058	120	0.0083
30	0.0060	130	0.0086
40	0.0063	140	0.0089
50	0.0065	150	0.0092
60	0.0068	160	0.0095
70	0.0070	170	0.0098
80	0.0073	180	0.0101
90	0.0075	190	0.0104
100	0.0078	200	0.0108

Temperature (°C)	Vapor Thermal Conductivity (W/m-k)	Temperature (°C)	Vapor Thermal Conductivity (W/m-k)
0	0.0105	80	0.0172
10	0.0113	90	0.0183
20	0.0121	100	0.0194
30	0.0129	110	0.0207
40	0.0137	120	0.0224
50	0.0145	130	0.0246
60	0.0154	140	0.0282
70	0.0163	150	0.0365

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OUR COMMITMENT TO SUSTAINABILITY

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Honeywell

Table of Contents

System ID	Qty	Model	Description
RIVERVIEW ELEMENTARY SCH 5 TON	1	KGB060S4D	PKGGE/5TON/BTO
RIVERVIEW ELEMENTARY SCH 12TON	1	KGA150S4B	PKGGE/12.5TON/BTO
RIVERVIEW ELEMENTARY SCH 8 TON	1	KGA102H4B	PKGGE/8.5TON/BTO
LAKEVIEW ELEMENTARY SCH 4 TON	1	KCB048S4D	PKGEE/4TON/BTO
LAKEVIEW ELEMENTARY SCH 3 TON	2	KCB036S4D	PKGEE/3TON/BTO

Lennox Industries Inc. - Product Submittal

System ID: RIVERVIEW ELEMENTARY SCH 5 TON	
Package Model: KGB060S4D	**Description:** PKGGE/5TON/BTO

HEATING PERFORMANCE

Unit Type	Packaged Gas Electric	Gas Supply Connection	0.50 (in.)
H/E HighInput	150000 (Btuh)	H/E Heat Rise	55.6 (°F)
H/E HighOutput	120000 (Btuh)	AFUE/ ThermalEff	80
System HeatOutput	120000 (Btuh)	Number of Heating Stages	1
		Gas Supply Pressure	7 (in.WC)

COOLING PERFORMANCE

Refrigerant	R-410A	Number Compressors	1
ARI EER	11.8	Number of Cooling Stages	1
ARI SEER	14.0	Condensate Drain Size	1.00 (in.)
ARI Total Power	5000 (W)		
ARI GrossTotalCool	61900 (Btuh)		
ARI NetTotalCool	59500 (Btuh)		

SUPPLY FAN PERFORMANCE

SupplyFan Req'dPower	0.75 (hp)	TotalStaticPress	0.11 (in.WC)
SupplyFan NomPower	0.75 (hp)	Gas H/E Static Press	0.06 (in.WC)
Supply Fan Type	CAV Direct Drive	Economizer Static Press	0.05 (in.WC)
		Air Filter Qty	4
		Air Filter Length	20.0 (in.)
		Air Filter Width	20.0 (in.)
		Air Filter Thickness	2.0 (in.)

ELECTRICAL

Voltage	208V 3Ph	SupplyFan FLA	4.2 (amp)
Frequency	60 (Hz)	CondensingUnit FLA	2.4 (amp)
System MCA	25.0 (amp)	CondenserFan Power	370 (W)
System MOCP	35 (amp)		
Compressors RLA	13.5 (amp)		
Cooling FLA Total	20.1 (amp)		
Unit Oper Range-Nom Voltage	+/- 10%		

DIMENSIONS

Cabinet Width	47.0 (in.)	Horizontal Return Height	11.0 (in.)
Cabinet Length	83.3 (in.)	Horizontal Return Width	29.0 (in.)
Cabinet Height	43.4 (in.)		
Total Weight	799 (lb)		
Horizontal Supply Height	19.5 (in.)		
Horizontal Supply Width	20.0 (in.)		

SOUND

Outdoor Sound Rating	79 (db)

Lennox Industries Inc. - Product Submittal

System ID: RIVERVIEW ELEMENTARY SCH 5 TON
Package Model: KGB060S4D **Description:** PKGGE/5TON/BTO

SYSTEM FEATURES

Durable Outdoor Enamel Paint Finish	See Limited Warranty Certificate included with unit for details
Scroll Compressor	AGA-CGA Certified
High Capacity Driers	Redundant Comb. Gas Control Valve
Separate Compressor and Controls Compartment	Electronic Flame Sensor
Limited compressor warranty of 5 years	Direct Spark Ignition
Limited warranty on all other components of 1 year	

INCLUDED SYSTEM OPTIONS - FACTORY INSTALLED

SINGLE ENTHALPY ECONOMIZER
BAROMETRIC RELIEF DAMPERS
CONSTANT AIR VOLUME DIRECT DRIVE
BACNET CONTROL MODULE
GFCI - FACTORY INSTALLED/NON-POWERED
2 IN MERV4 FILTER
DISCONNECT - WEATHERPROOF
BAROMETRIC RELIEF DAMPERS

INCLUDED SYSTEM OPTIONS - FIELD INSTALLED

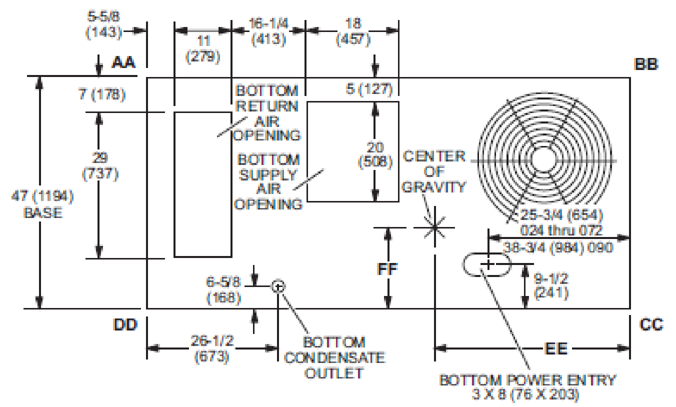
97W23	1	BACNET SENSOR WITH DISPLAY STE-8001
17W45	1	FDHECK00AN1 HORIZ. ECONO CONVERSION KT
77N39	1	EG T8100-D-LN CO2 DETECTOR/WHITE/WALL

DIMENSIONS - UNIT - INCHES (MM) - KGB

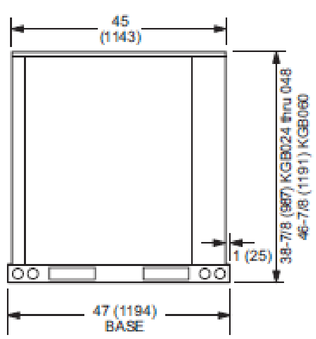
Model No.	CORNER WEIGHTS																CENTER OF GRAVITY							
	AA				BB				CC				DD				EE				FF			
	Base		Max.		Base		Max.		Base		Max.		Base		Max.		Base		Max.		Base		Max.	
	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	in.	mm	in.	mm	in.	mm	in.	mm
024	104	47	124	56	120	55	127	57	162	74	171	78	140	64	208	95	39-1/2	1003	45	1143	20	508	20	508
030	108	49	126	57	126	57	129	58	170	77	174	79	146	66	212	96	39-1/2	1003	45	1143	20	508	20	508
036	105	48	131	59	122	55	133	60	165	75	180	82	142	65	219	100	39-1/2	1003	45	1143	20	508	20	508
048	105	48	133	60	122	55	135	61	165	75	183	83	142	65	223	101	39-1/2	1003	45	1143	20	508	20	508
060	127	57	155	71	147	67	169	77	198	90	228	104	171	78	235	107	39-1/2	1003	42-1/4	1073	20	508	20	508

Base Unit - The unit with NO INTERNAL OPTIONS.

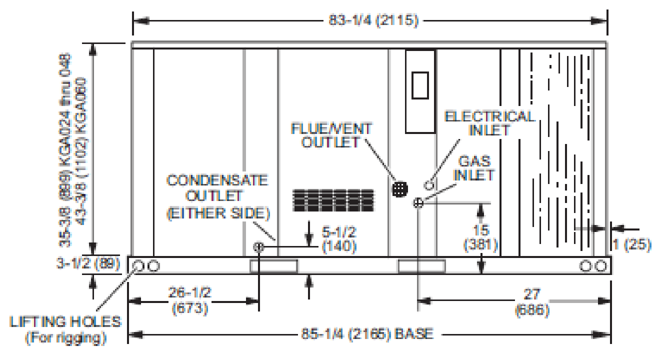
Max. Unit - The unit with ALL INTERNAL OPTIONS Installed. (Economizer, Standard Static Power Exhaust Fans, Controls, etc.). Does not include accessories external to unit or high static power exhaust.



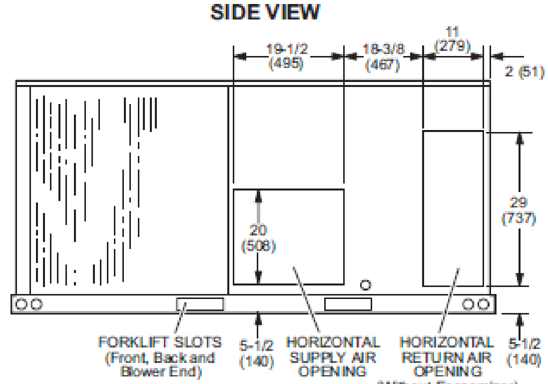
TOP VIEW (Base)



END VIEW

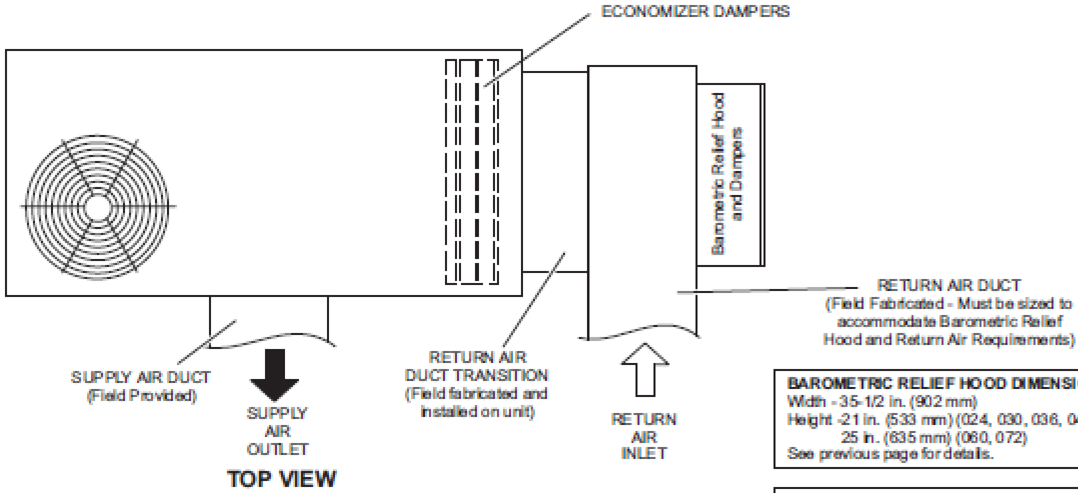


SIDE VIEW



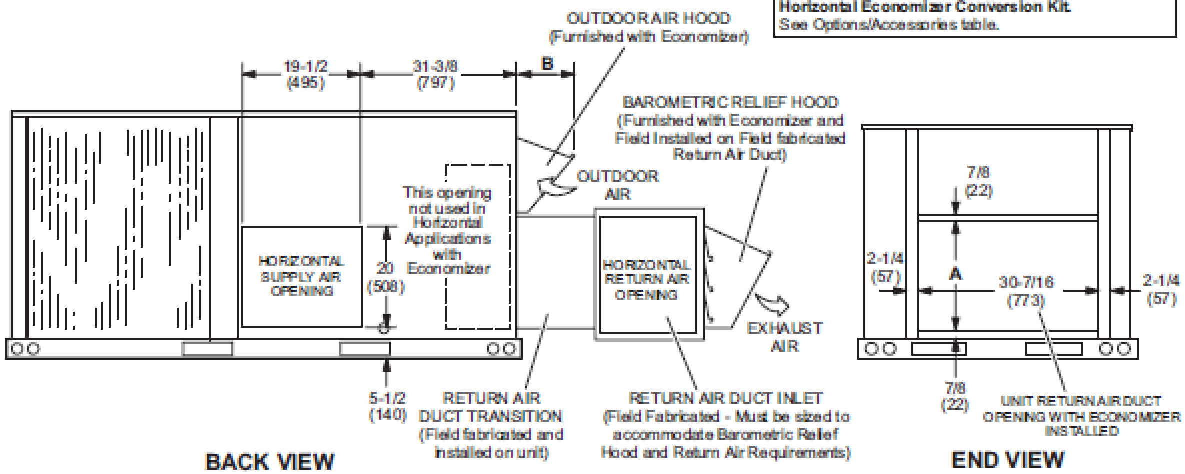
BACK VIEW

OUTDOOR AIR HOOD DETAIL WITH OPTIONAL ECONOMIZER AND BAROMETRIC RELIEF DAMPERS
(Horizontal Applications)



BAROMETRIC RELIEF HOOD DIMENSIONS
Width - 35-1/2 in. (902 mm)
Height -21 in. (533 mm) (024, 030, 036, 048)
25 in. (635 mm) (060, 072)
See previous page for details.

NOTE - Horizontal applications with Economizer require **Horizontal Economizer Conversion Kit.** See Options/Accessories table.



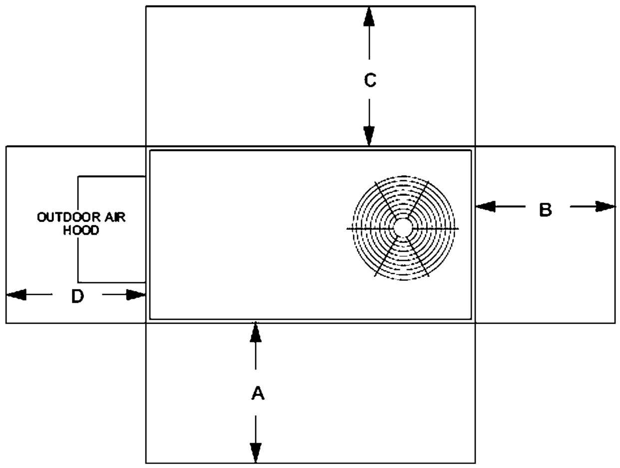
NOTE - Return Air Duct and Transition must be supported.

Model No.	A		B	
	in.	mm	in.	mm
024, 030, 036, 048	18-3/4	476	11-3/4	298
060, 072	22-1/2	572	15-3/4	400

Lennox Industries Inc. - Product Submittal

System ID: RIVERVIEW ELEMENTARY SCH 5 TON
Package Model: KGB060S4D **Description:** PKGGE/5TON/BTO

UNIT CLEARANCES - INCHES (MM)



1 Unit Clearance	A		B		C		D		Top Clearance
	in.	mm	in.	mm	in.	mm	in.	mm	
Service Clearance	48	1219	36	914	36	914	36	914	Unobstructed
Clearance to Combustibles	36	914	1	25	1	25	1	25	
Minimum Operation Clearance	36	914	36	914	36	914	36	914	

NOTE - Entire perimeter of unit base requires support when elevated above the mounting surface.
1 **Service Clearance** - Required for removal of serviceable parts.
Clearance to Combustibles - Required clearance to combustible material.
Minimum Operation Clearance - Required clearance for proper unit operation.

Lennox Industries Inc. - Product Submittal

System ID: RIVERVIEW ELEMENTARY SCH 12TON
Package Model: KGA150S4B **Description:** PKGGE/12.5TON/BTO

HEATING PERFORMANCE

Unit Type	Packaged Gas Electric	Gas Supply Connection	0.75 (in.)
H/E LowInput	156000 (Btuh)	H/E Heat Rise	35.6 (°F)
H/E LowOutput	124800 (Btuh)	AFUE/ ThermalEff	80
H/E HighInput	240000 (Btuh)	Number of Heating Stages	2
H/E HighOutput	192000 (Btuh)	Gas Supply Pressure	7 (in.WC)
System HeatOutput	192000 (Btuh)		

COOLING PERFORMANCE

Refrigerant	R-410A	Number Compressors	2
ARI EER	11.0	Number of Cooling Stages	2
ARI IEER	11.4	Condensate Drain Size	1.00 (in.)
ARI Total Power	12500 (W)		
ARI GrossTotalCool	142600 (Btuh)		
ARI NetTotalCool	138000 (Btuh)		

SUPPLY FAN PERFORMANCE

SupplyFan NomPower	2.00 (hp)	TotalStaticPress	0.72 (in.WC)
Supply Fan Type	CAV Belt Drive	Gas H/E Static Press	0.43 (in.WC)
SupplyDrive Min RPM	590 (rpm)	Economizer Static Press	0.29 (in.WC)
SupplyDrive Max RPM	890 (rpm)	Air Filter Qty	4
		Air Filter Length	20.0 (in.)
		Air Filter Width	25.0 (in.)
		Air Filter Thickness	2.0 (in.)

ELECTRICAL

Voltage	208V 3Ph	SupplyFan FLA	7.5 (amp)
Frequency	60 (Hz)	CondensingUnit FLA	4.8 (amp)
System MCA	58.0 (amp)	CondenserFan Power	1050 (W)
System MOCP	70 (amp)		
Compressors RLA	39.2 (amp)		
Cooling FLA Total	51.5 (amp)		
Unit Oper Range-Nom Voltage	+/- 10%		

DIMENSIONS

Cabinet Width	60.1 (in.)	Horizontal Return Height	15.5 (in.)
Cabinet Length	101.3 (in.)	Horizontal Return Width	30.0 (in.)
Cabinet Height	46.9 (in.)		
Total Weight	1172 (lb)		
Horizontal Supply Height	15.5 (in.)		
Horizontal Supply Width	30.0 (in.)		

SOUND

Outdoor Sound Rating	88 (db)

Lennox Industries Inc. - Product Submittal

System ID: RIVERVIEW ELEMENTARY SCH 12TON
Package Model: KGA150S4B **Description:** PKGGE/12.5TON/BTO

SYSTEM FEATURES

Durable Outdoor Enamel Paint Finish	See Limited Warranty Certificate included with unit for details
Scroll Compressor	AGA-CGA Certified
High Capacity Driers	Redundant Comb. Gas Control Valve
Separate Compressor and Controls Compartment	Electronic Flame Sensor
Limited compressor warranty of 5 years	Direct Spark Ignition
Limited warranty on all other components of 1 year	Limited warranty on Environ Coil System of 3 years

INCLUDED SYSTEM OPTIONS - FACTORY INSTALLED

SINGLE ENTHALPY ECONOMIZER
CONSTANT AIR VOLUME BELT DRIVE
BACNET CONTROL MODULE
GFCI - FACTORY INSTALLED/NON-POWERED
2 IN MERV4 FILTER
DISCONNECT - WEATHERPROOF

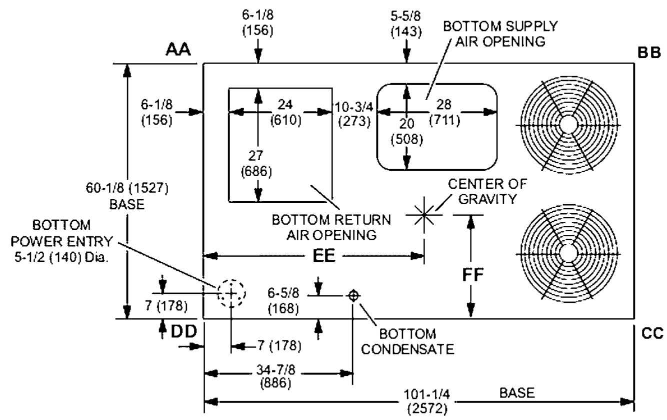
INCLUDED SYSTEM OPTIONS - FIELD INSTALLED

97W23	1	BACNET SENSOR WITH DISPLAY STE-8001
53K04	1	LAGEDH03/15 BAROMETRIC RELIEF DAMPER
51W25	1	K1HECK00B-01 HORIZONTAL DISCHARGE KIT
87N52	1	G T8200-DB-LN BLACK COMMERCIAL CO2 DET

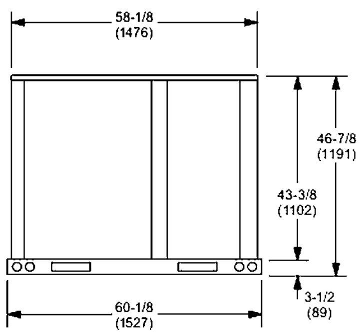
DIMENSIONS - INCHES (MM)

Model No.	CORNER WEIGHTS																CENTER OF GRAVITY							
	AA				BB				CC				DD				EE				FF			
	Base		Max.		Base		Max.		Base		Max.		Base		Max.		Base		Max.		Base		Max.	
	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	in.	mm	in.	mm	in.	mm	in.	mm
092	248	113	292	133	223	101	255	116	243	110	273	124	276	125	320	145	47	1181	46	1156	24.5	622	25.5	648
102	253	115	297	135	228	103	260	118	248	112	278	126	282	128	326	148	47	1181	46	1156	24.5	622	25.5	648
120	263	119	308	140	237	107	269	122	258	117	288	130	293	133	337	153	47	1181	46	1156	24.5	622	25.5	648
150	286	130	331	150	257	117	289	131	280	127	309	140	318	144	362	164	47	1181	46	1156	24.5	622	25.5	648

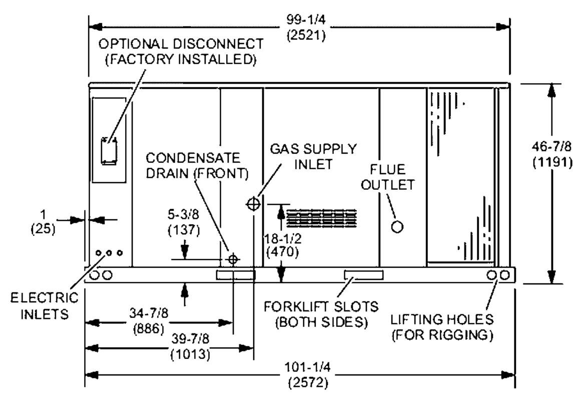
Base Unit - The unit with NO OPTIONS.
Max. Unit - The unit with ALL OPTIONS Installed. (Economizer, etc.)



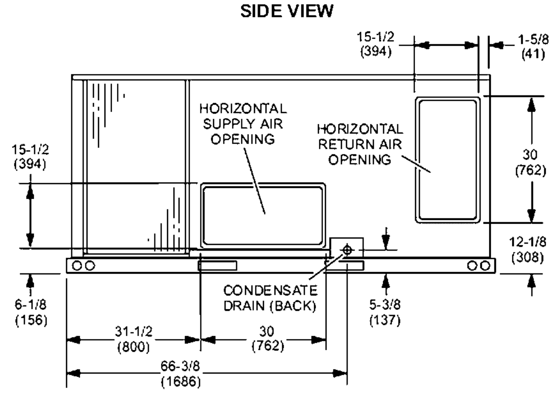
TOP VIEW



END VIEW



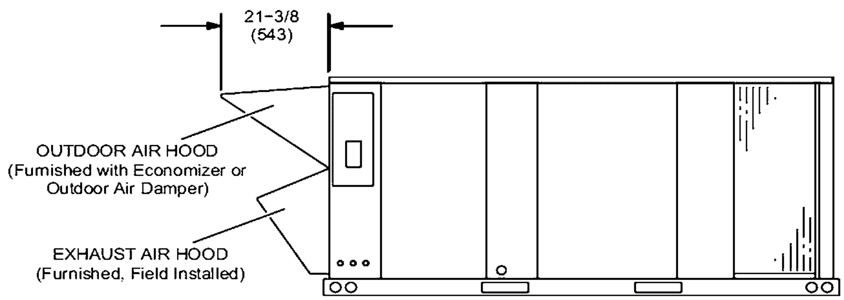
SIDE VIEW



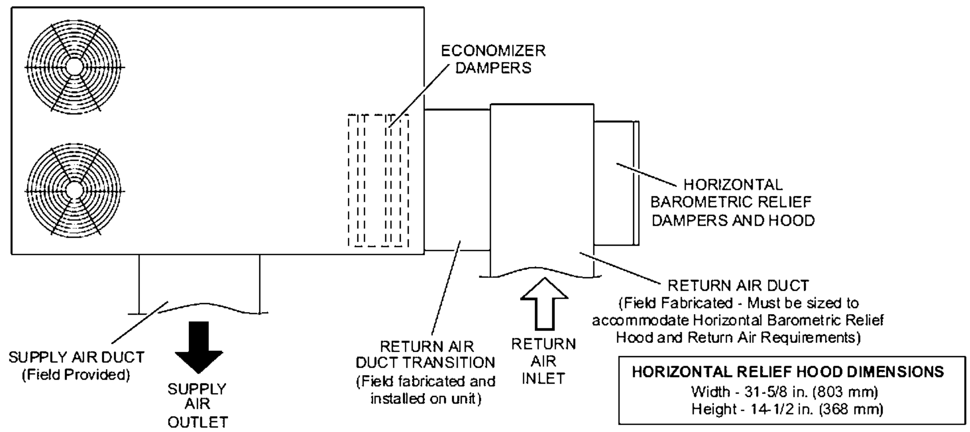
SIDE VIEW
(Horizontal Openings)

ACCESSORY DIMENSIONS - INCHES (MM)

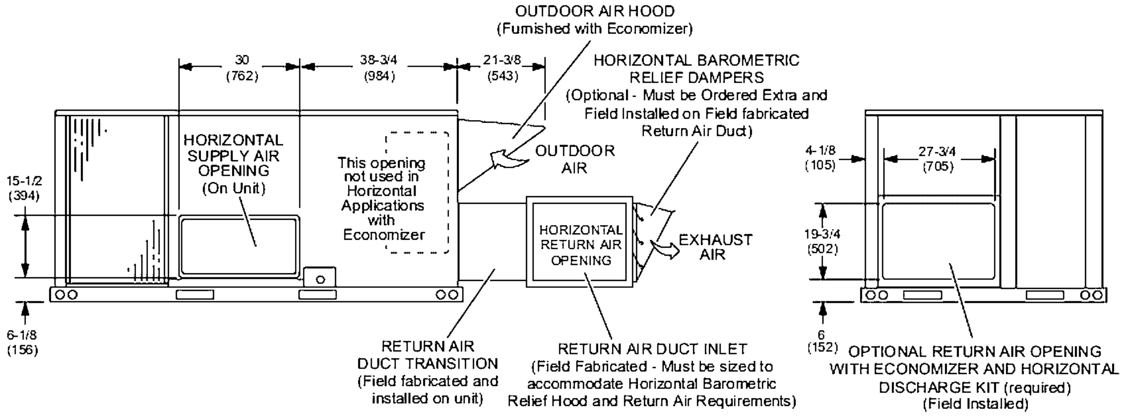
OUTDOOR AIR HOOD DETAIL



HORIZONTAL ECONOMIZER APPLICATION
(with Optional Horizontal Barometric Relief Dampers and Horizontal Discharge Kit)



TOP VIEW

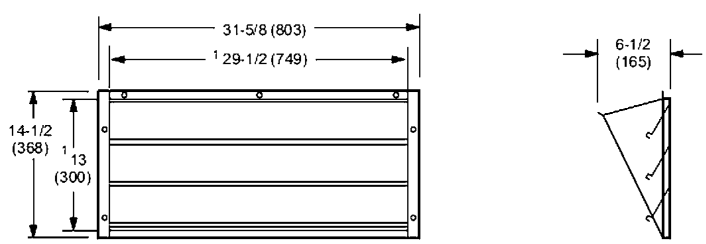


BACK VIEW

END VIEW

NOTE - Return Air Duct and Transition must be supported.

HORIZONTAL BAROMETRIC RELIEF DAMPERS
(Field installed in horizontal return air duct adjacent to unit)



FRONT VIEW

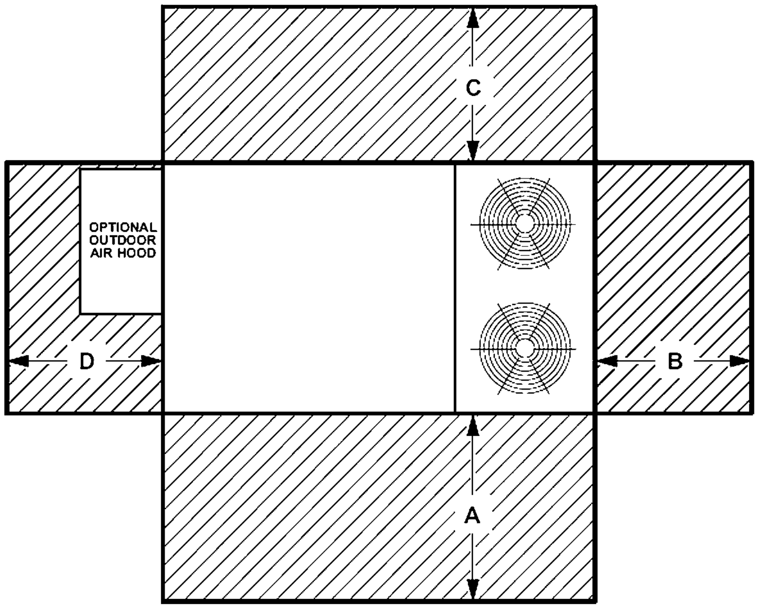
SIDE VIEW

[1] NOTE - Opening size required in return air duct.

Lennox Industries Inc. - Product Submittal

System ID: RIVERVIEW ELEMENTARY SCH 12TON
Package Model: KGA150S4B **Description:** PKGGE/12.5TON/BTO

UNIT CLEARANCES - INCHES (MM)



[1] Unit Clearance	A		B		C		D		Top Clearance
	in.	mm	in.	mm	in.	mm	in.	mm	
Service Clearance	60	1524	36	914	36	914	60	1524	Unobstructed
Clearance to Combustibles	36	914	1	25	1	25	1	25	
Minimum Operation Clearance	36	914	36	914	36	914	36	914	

NOTE - Entire perimeter of unit base requires support when elevated above the mounting surface.
[1] **Service Clearance** - Required for removal of serviceable parts.
Clearance to Combustibles - Required for clearance to combustible material.
Minimum Operation Clearance - Required clearance for proper unit operation.

Lennox Industries Inc. - Product Submittal

System ID: RIVERVIEW ELEMENTARY SCH 8 TON
Package Model: KGA102H4B **Description:** PKGGE/8.5TON/BTO

HEATING PERFORMANCE

Unit Type	Packaged Gas Electric	Gas Supply Connection	0.75 (in.)
H/E LowInput	156000 (Btuh)	H/E Heat Rise	52.3 (°F)
H/E LowOutput	124800 (Btuh)	AFUE/ ThermalEff	80
H/E HighInput	240000 (Btuh)	Number of Heating Stages	2
H/E HighOutput	192000 (Btuh)	Gas Supply Pressure	7 (in.WC)
System HeatOutput	192000 (Btuh)		

COOLING PERFORMANCE

Refrigerant	R-410A	Number Compressors	2
ARI EER	12.2	Number of Cooling Stages	2
ARI IEER	12.9	Condensate Drain Size	1.00 (in.)
ARI Total Power	8200 (W)		
ARI GrossTotalCool	103800 (Btuh)		
ARI NetTotalCool	100000 (Btuh)		

SUPPLY FAN PERFORMANCE

SupplyFan NomPower	2.00 (hp)	TotalStaticPress	0.32 (in.WC)
Supply Fan Type	CAV Belt Drive	Gas H/E Static Press	0.17 (in.WC)
SupplyDrive Min RPM	590 (rpm)	Economizer Static Press	0.15 (in.WC)
SupplyDrive Max RPM	890 (rpm)	Air Filter Qty	4
		Air Filter Length	20.0 (in.)
		Air Filter Width	25.0 (in.)
		Air Filter Thickness	2.0 (in.)

ELECTRICAL

Voltage	208V 3Ph	SupplyFan FLA	7.5 (amp)
Frequency	60 (Hz)	CondensingUnit FLA	4.8 (amp)
System MCA	44.0 (amp)	CondenserFan Power	800 (W)
System MOCP	50 (amp)		
Compressors RLA	27.4 (amp)		
Cooling FLA Total	39.7 (amp)		
Unit Oper Range-Nom Voltage	+/- 10%		

DIMENSIONS

Cabinet Width	60.1 (in.)	Horizontal Return Height	15.5 (in.)
Cabinet Length	101.3 (in.)	Horizontal Return Width	30.0 (in.)
Cabinet Height	46.9 (in.)		
Total Weight	1207 (lb)		
Horizontal Supply Height	15.5 (in.)		
Horizontal Supply Width	30.0 (in.)		

SOUND

Outdoor Sound Rating	88 (db)

Lennox Industries Inc. - Product Submittal

System ID: RIVERVIEW ELEMENTARY SCH 8 TON
Package Model: KGA102H4B **Description:** PKGGE/8.5TON/BTO

SYSTEM FEATURES

Durable Outdoor Enamel Paint Finish	See Limited Warranty Certificate included with unit for details
Scroll Compressor	AGA-CGA Certified
High Capacity Driers	Redundant Comb. Gas Control Valve
Separate Compressor and Controls Compartment	Electronic Flame Sensor
Limited compressor warranty of 5 years	Direct Spark Ignition
Limited warranty on all other components of 1 year	Limited warranty on Environ Coil System of 3 years

INCLUDED SYSTEM OPTIONS - FACTORY INSTALLED

SINGLE ENTHALPY ECONOMIZER
CONSTANT AIR VOLUME BELT DRIVE
BACNET CONTROL MODULE
GFCI - FACTORY INSTALLED/NON-POWERED
2 IN MERV4 FILTER
DISCONNECT - WEATHERPROOF

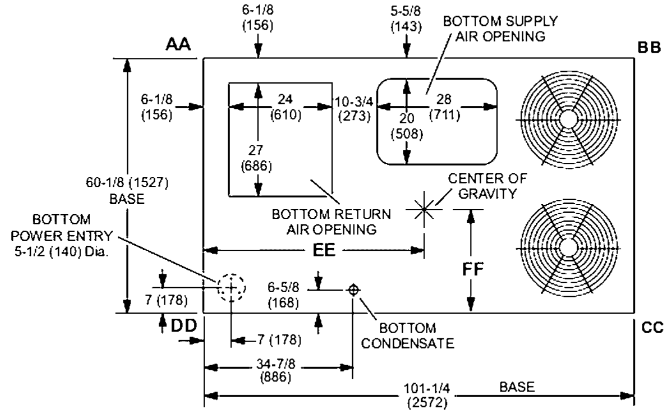
INCLUDED SYSTEM OPTIONS - FIELD INSTALLED

97W23	1	BACNET SENSOR WITH DISPLAY STE-8001
53K04	1	LAGEDH03/15 BAROMETRIC RELIEF DAMPER
51W25	1	K1HECK00B-01 HORIZONTAL DISCHARGE KIT
77N39	1	EG T8100-D-LN CO2 DETECTOR/WHITE/WALL

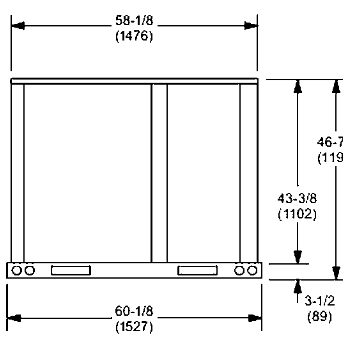
DIMENSIONS - INCHES (MM)

Model No.	CORNER WEIGHTS																CENTER OF GRAVITY							
	AA				BB				CC				DD				EE				FF			
	Base		Max.		Base		Max.		Base		Max.		Base		Max.		Base		Max.		Base		Max.	
	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	in.	mm	in.	mm	in.	mm	in.	mm
092	248	113	292	133	223	101	255	116	243	110	273	124	276	125	320	145	47	1181	46	1156	24.5	622	25.5	648
102	253	115	297	135	228	103	260	118	248	112	278	126	282	128	326	148	47	1181	46	1156	24.5	622	25.5	648
120	263	119	308	140	237	107	269	122	258	117	288	130	293	133	337	153	47	1181	46	1156	24.5	622	25.5	648
150	286	130	331	150	257	117	289	131	280	127	309	140	318	144	362	164	47	1181	46	1156	24.5	622	25.5	648

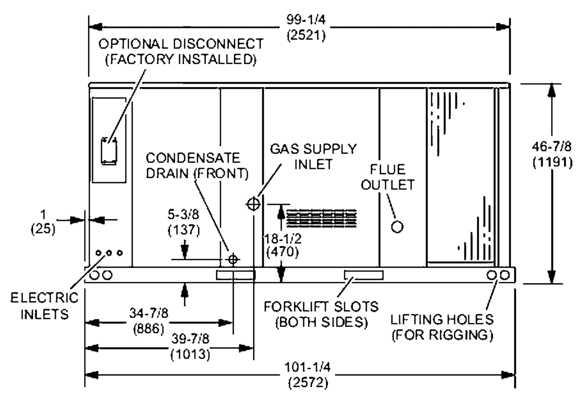
Base Unit - The unit with NO OPTIONS.
Max. Unit - The unit with ALL OPTIONS Installed. (Economizer, etc.)



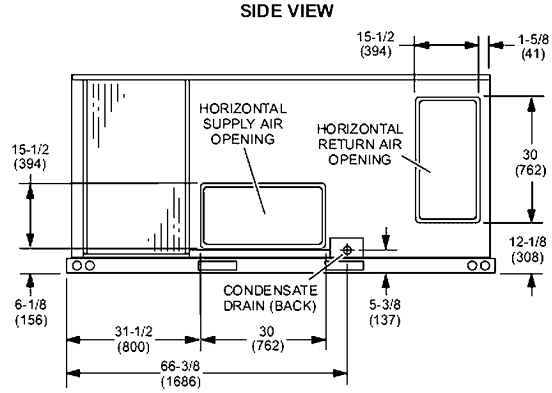
TOP VIEW



END VIEW



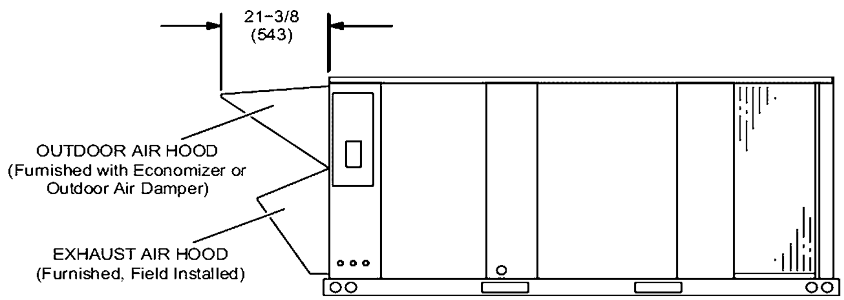
SIDE VIEW



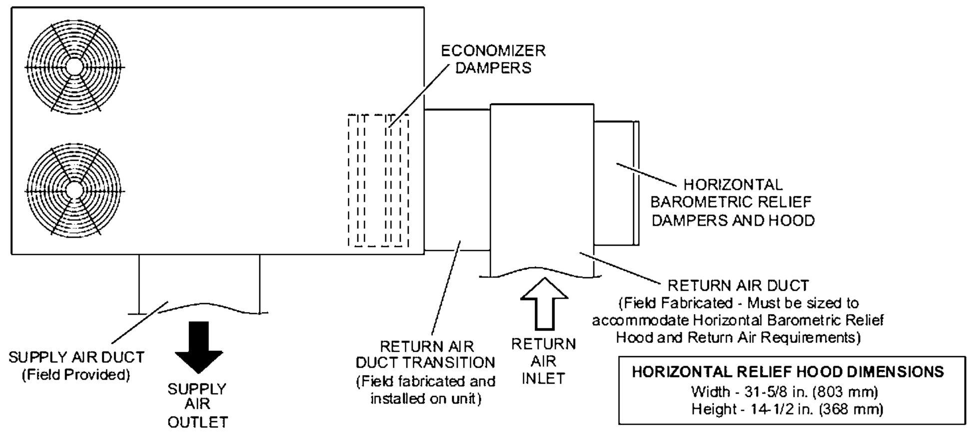
SIDE VIEW
(Horizontal Openings)

ACCESSORY DIMENSIONS - INCHES (MM)

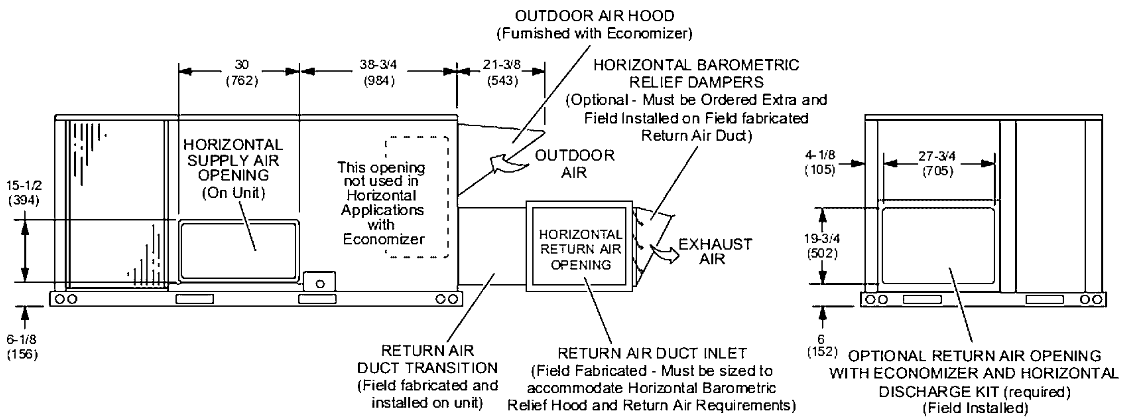
OUTDOOR AIR HOOD DETAIL



HORIZONTAL ECONOMIZER APPLICATION
(with Optional Horizontal Barometric Relief Dampers and Horizontal Discharge Kit)



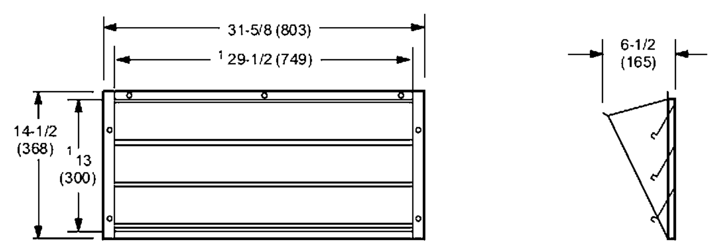
TOP VIEW



BACK VIEW **END VIEW**

NOTE - Return Air Duct and Transition must be supported.

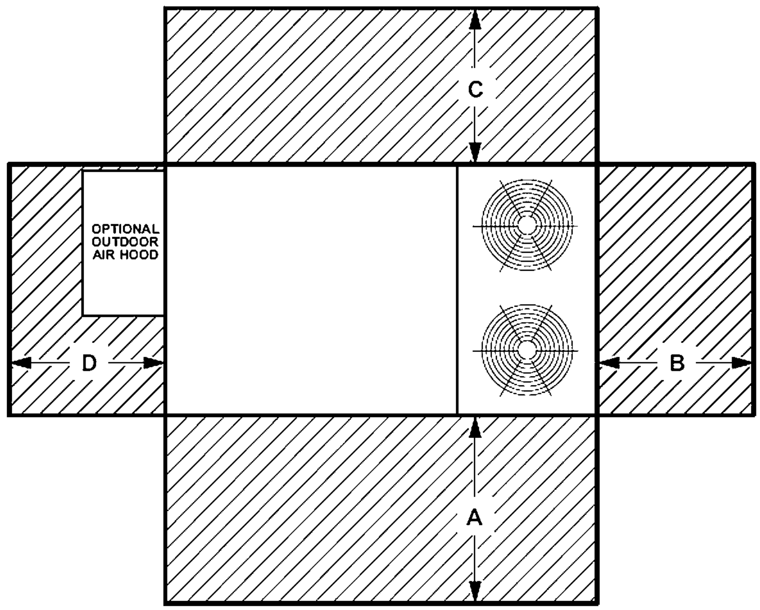
HORIZONTAL BAROMETRIC RELIEF DAMPERS
(Field installed in horizontal return air duct adjacent to unit)



FRONT VIEW **SIDE VIEW**

[1] NOTE - Opening size required in return air duct.

UNIT CLEARANCES - INCHES (MM)



[1] Unit Clearance	A		B		C		D		Top Clearance
	in.	mm	in.	mm	in.	mm	in.	mm	
Service Clearance	60	1524	36	914	36	914	60	1524	Unobstructed
Clearance to Combustibles	36	914	1	25	1	25	1	25	
Minimum Operation Clearance	36	914	36	914	36	914	36	914	

NOTE - Entire perimeter of unit base requires support when elevated above the mounting surface.
[1] **Service Clearance** - Required for removal of serviceable parts.
Clearance to Combustibles - Required for clearance to combustible material.
Minimum Operation Clearance - Required clearance for proper unit operation.

Lennox Industries Inc. - Product Submittal

System ID: LAKEVIEW ELEMENTARY SCH 4 TON
Package Model: KCB048S4D **Description:** PKGEE/4TON/BTO

HEATING PERFORMANCE

Unit Type	Packaged Electric/Electri

COOLING PERFORMANCE

Refrigerant	R-410A	Number Compressors	1
ARI EER	11.5	Number of Cooling Stages	1
ARI SEER	14.0	Condensate Drain Size	1.00 (in.)
ARI Total Power	4100 (W)		
ARI GrossTotalCool	49700 (Btuh)		
ARI NetTotalCool	47500 (Btuh)		

SUPPLY FAN PERFORMANCE

SupplyFan Req'dPower	0.50 (hp)	TotalStaticPress	0.04 (in.WC)
SupplyFan NomPower	0.50 (hp)	Economizer Static Press	0.04 (in.WC)
Supply Fan Type	CAV Direct Drive	Air Filter Qty	4
		Air Filter Length	16.0 (in.)
		Air Filter Width	20.0 (in.)
		Air Filter Thickness	2.0 (in.)

ELECTRICAL

Voltage	208V 3Ph	SupplyFan FLA	3.1 (amp)
Frequency	60 (Hz)	CondensingUnit FLA	1.7 (amp)
System MCA	20.0 (amp)	CondenserFan Power	250 (W)
System MOCP	30 (amp)		
Compressors RLA	11.0 (amp)		
Cooling FLA Total	15.8 (amp)		
Unit Oper Range-Nom Voltage	+/- 10%		

DIMENSIONS

Cabinet Width	47.0 (in.)	Horizontal Return Height	11.0 (in.)
Cabinet Length	83.3 (in.)	Horizontal Return Width	29.0 (in.)
Cabinet Height	36.4 (in.)		
Total Weight	658 (lb)		
Horizontal Supply Height	19.5 (in.)		
Horizontal Supply Width	20.0 (in.)		

SOUND

Outdoor Sound Rating	75 (db)

Lennox Industries Inc. - Product Submittal

System ID: LAKEVIEW ELEMENTARY SCH 4 TON	
Package Model: KCB048S4D	**Description:** PKGEE/4TON/BTO

SYSTEM FEATURES

Durable Outdoor Enamel Paint Finish	Limited compressor warranty of 5 years
Scroll Compressor	Limited warranty on all other components of 1 year
High Capacity Driers	See Limited Warranty Certificate included with unit for details
Separate Compressor and Controls Compartment	

INCLUDED SYSTEM OPTIONS - FACTORY INSTALLED

SINGLE ENTHALPY ECONOMIZER
BAROMETRIC RELIEF DAMPERS
CONSTANT AIR VOLUME DIRECT DRIVE
BACNET CONTROL MODULE
GFCI - FACTORY INSTALLED/NON-POWERED
2 IN MERV4 FILTER
DISCONNECT - WEATHERPROOF
BAROMETRIC RELIEF DAMPERS

INCLUDED SYSTEM OPTIONS - FIELD INSTALLED

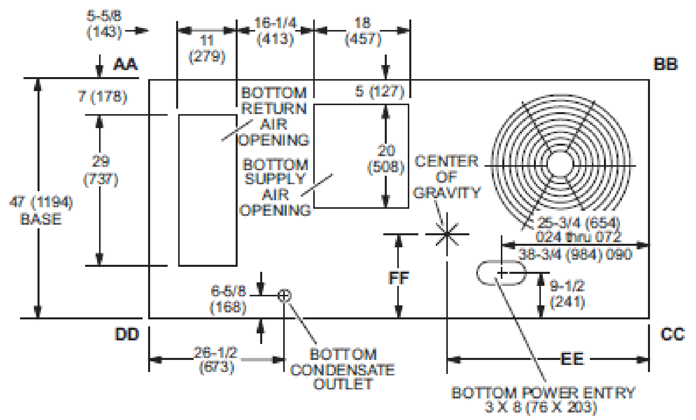
97W23	1	BACNET SENSOR WITH DISPLAY STE-8001
17W45	1	FDHECK00AN1 HORIZ. ECONO CONVERSION KT
77N39	1	EG T8100-D-LN CO2 DETECTOR/WHITE/WALL

DIMENSIONS - UNIT - INCHES (MM) KCB

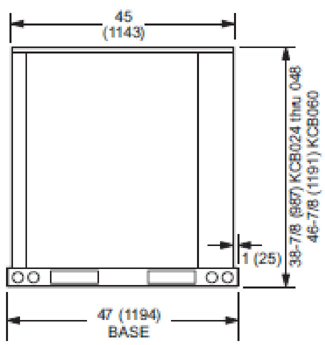
Model No.	CORNER WEIGHTS																CENTER OF GRAVITY							
	AA				BB				CC				DD				EE				FF			
	Base		Max.		Base		Max.		Base		Max.		Base		Max.		Base		Max.		Base		Max.	
	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	in.	mm	in.	mm	in.	mm	in.	mm
024	85	38	103	47	103	47	121	55	166	75	195	88	137	62	176	80	38-1/2	978	40	1016	18	457	18	457
030	89	40	106	48	108	49	124	56	174	79	200	91	143	65	181	82	38-1/2	978	40	1016	18	457	18	457
036	89	40	125	57	108	49	147	67	174	79	237	108	143	65	214	97	38-1/2	978	40	1016	18	457	18	457
048	91	42	125	57	111	50	147	67	179	81	237	107	147	67	214	97	38-1/2	978	40	1016	18	457	18	457
060	105	48	130	59	127	58	153	69	205	93	246	112	169	77	223	101	38-1/2	978	40	1016	18	457	18	457

Base Unit - The unit with NO INTERNAL OPTIONS.

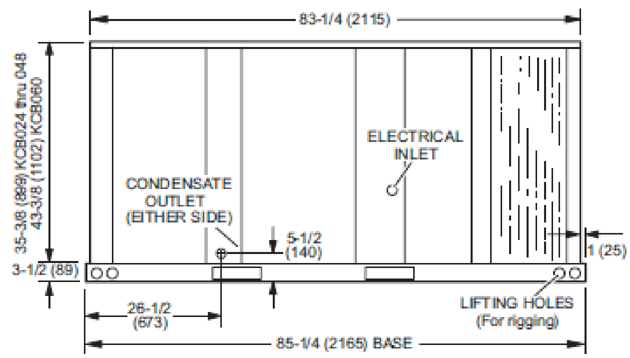
Max. Unit - The unit with ALL INTERNAL OPTIONS Installed. (Economizer, Standard Static Power Exhaust Fans, Controls, etc.). Does not include accessories external to unit or high static power exhaust.



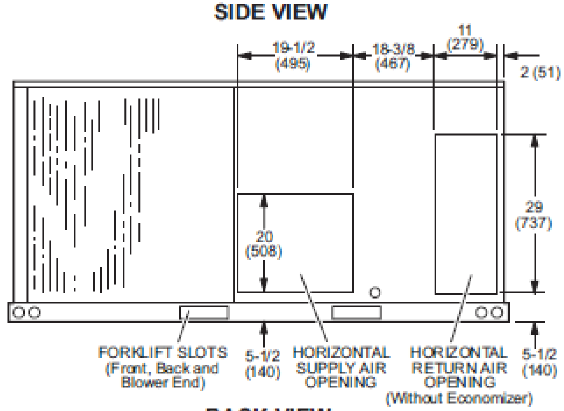
TOP VIEW (Base)



END VIEW

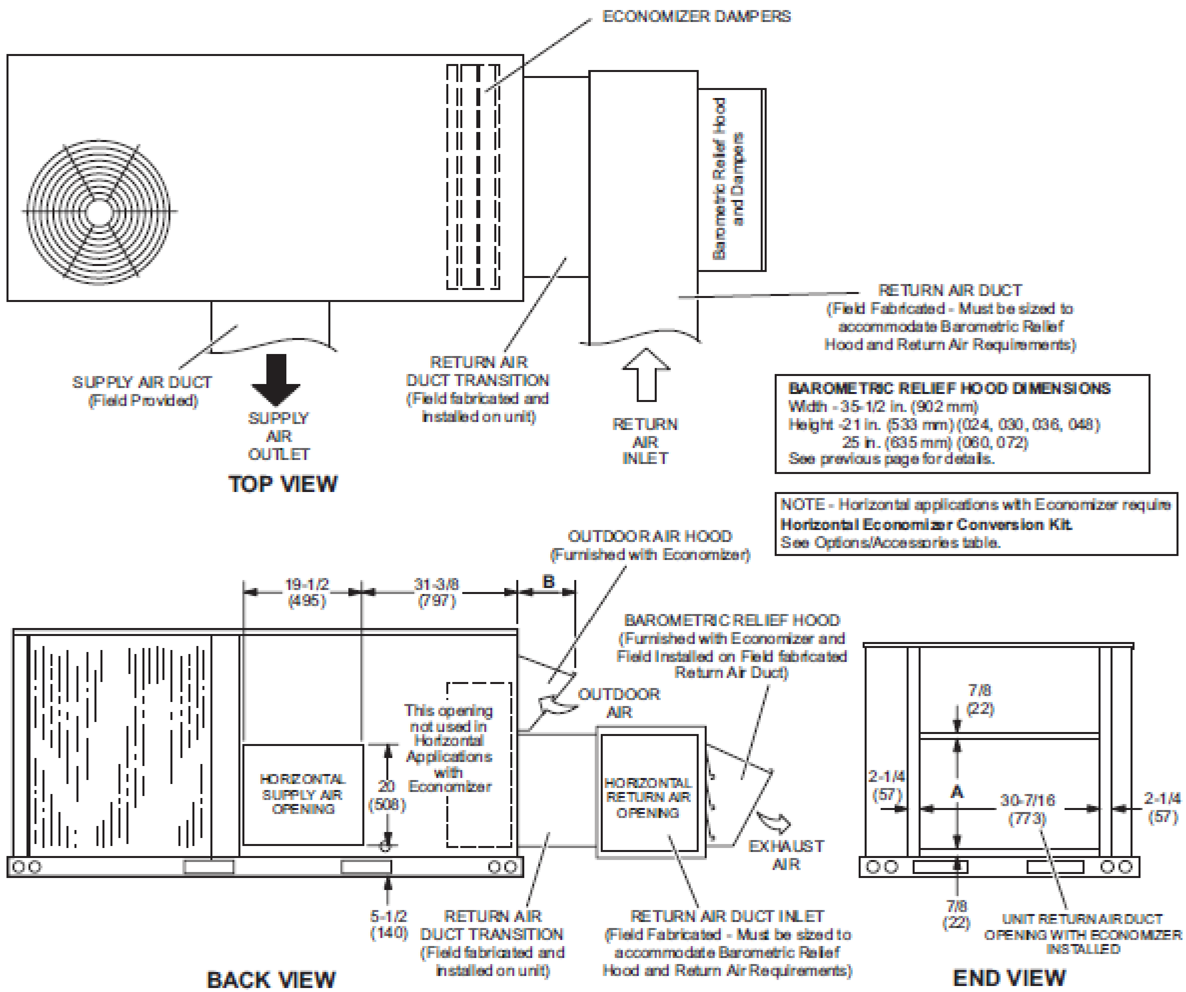


SIDE VIEW



BACK VIEW

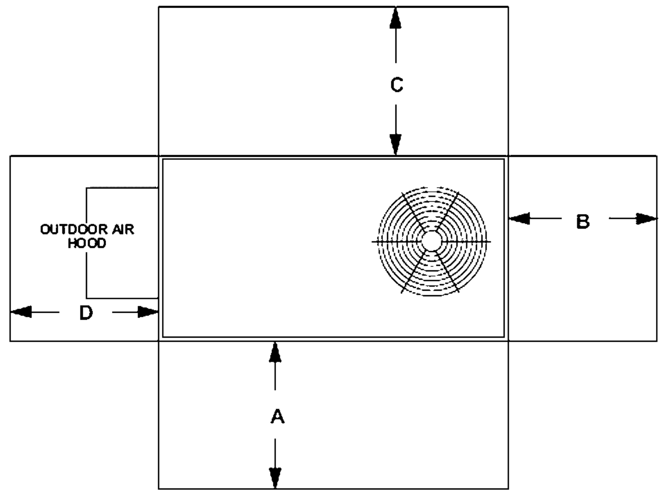
OUTDOOR AIR HOOD DETAIL WITH OPTIONAL ECONOMIZER AND BAROMETRIC RELIEF DAMPERS (Horizontal Applications)



NOTE - Return Air Duct and Transition must be supported.

Model No.	A		B	
	in.	mm	in.	mm
024, 030, 036, 048	18-3/4	476	11-3/4	298
060, 072	22-1/2	572	15-3/4	400

UNIT CLEARANCES - INCHES (MM)



[1] Unit Clearance	A		B		C		D		Top Clearance
	in.	mm	in.	mm	in.	mm	in.	mm	
Service Clearance	36	914	36	914	36	934	36	914	Unobstructed
Minimum Operation Clearance	36	914	36	914	36	914	36	914	

NOTE - Entire perimeter of unit base requires support when elevated above the mounting surface.
1 **Service Clearance** - Required for removal of serviceable parts.
Minimum Operation Clearance - Required clearance for proper unit operation.

Lennox Industries Inc. - Product Submittal

System ID: LAKEVIEW ELEMENTARY SCH 3 TON
Package Model: KCB036S4D **Description:** PKGEE/3TON/BTO

HEATING PERFORMANCE

Unit Type	Packaged Electric/Electri

COOLING PERFORMANCE

Refrigerant	R-410A	Number Compressors	1
ARI EER	12.5	Number of Cooling Stages	1
ARI SEER	14.0	Condensate Drain Size	1.00 (in.)
ARI Total Power	2900 (W)		
ARI GrossTotalCool	38500 (Btuh)		
ARI NetTotalCool	37200 (Btuh)		

SUPPLY FAN PERFORMANCE

SupplyFan Req'dPower	0.50 (hp)	TotalStaticPress	0.04 (in.WC)
SupplyFan NomPower	0.50 (hp)	Economizer Static Press	0.04 (in.WC)
Supply Fan Type	CAV Direct Drive	Air Filter Qty	4
		Air Filter Length	16.0 (in.)
		Air Filter Width	20.0 (in.)
		Air Filter Thickness	2.0 (in.)

ELECTRICAL

Voltage	208V 3Ph	SupplyFan FLA	3.1 (amp)
Frequency	60 (Hz)	CondensingUnit FLA	1.7 (amp)
System MCA	17.0 (amp)	CondenserFan Power	250 (W)
System MOCP	25 (amp)		
Compressors RLA	8.7 (amp)		
Cooling FLA Total	13.5 (amp)		
Unit Oper Range-Nom Voltage	+/- 10%		

DIMENSIONS

Cabinet Width	47.0 (in.)	Horizontal Return Height	11.0 (in.)
Cabinet Length	83.3 (in.)	Horizontal Return Width	29.0 (in.)
Cabinet Height	36.4 (in.)		
Total Weight	658 (lb)		
Horizontal Supply Height	19.5 (in.)		
Horizontal Supply Width	20.0 (in.)		

SOUND

Outdoor Sound Rating	75 (db)

Lennox Industries Inc. - Product Submittal

System ID: LAKEVIEW ELEMENTARY SCH 3 TON	
Package Model: KCB036S4D	**Description:** PKGEE/3TON/BTO

SYSTEM FEATURES

Durable Outdoor Enamel Paint Finish	Limited compressor warranty of 5 years
Scroll Compressor	Limited warranty on all other components of 1 year
High Capacity Driers	See Limited Warranty Certificate included with unit for details
Separate Compressor and Controls Compartment	

INCLUDED SYSTEM OPTIONS - FACTORY INSTALLED

SINGLE ENTHALPY ECONOMIZER
BAROMETRIC RELIEF DAMPERS
CONSTANT AIR VOLUME DIRECT DRIVE
BACNET CONTROL MODULE
GFCI - FACTORY INSTALLED/NON-POWERED
2 IN MERV4 FILTER
DISCONNECT - WEATHERPROOF
BAROMETRIC RELIEF DAMPERS

INCLUDED SYSTEM OPTIONS - FIELD INSTALLED

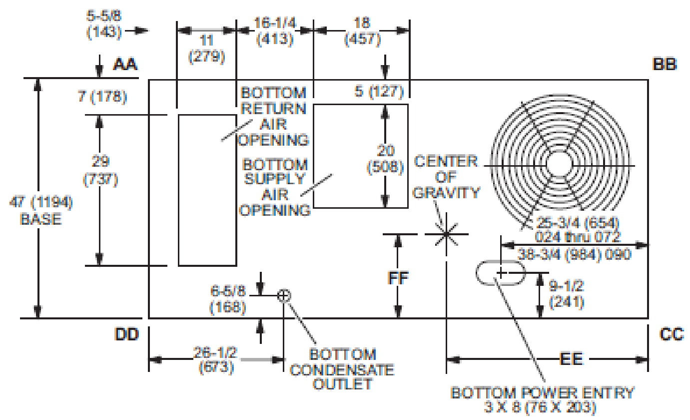
97W23	1	BACNET SENSOR WITH DISPLAY STE-8001
17W45	1	FDHECK00AN1 HORIZ. ECONO CONVERSION KT
77N39	1	EG T8100-D-LN CO2 DETECTOR/WHITE/WALL

DIMENSIONS - UNIT - INCHES (MM) KCB

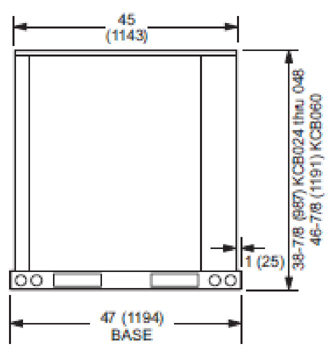
Model No.	CORNER WEIGHTS																CENTER OF GRAVITY							
	AA				BB				CC				DD				EE				FF			
	Base		Max.		Base		Max.		Base		Max.		Base		Max.		Base		Max.		Base		Max.	
	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	in.	mm	in.	mm	in.	mm	in.	mm
024	85	38	103	47	103	47	121	55	166	75	195	88	137	62	176	80	38-1/2	978	40	1016	18	457	18	457
030	89	40	106	48	108	49	124	56	174	79	200	91	143	65	181	82	38-1/2	978	40	1016	18	457	18	457
036	89	40	125	57	108	49	147	67	174	79	237	108	143	65	214	97	38-1/2	978	40	1016	18	457	18	457
048	91	42	125	57	111	50	147	67	179	81	237	107	147	67	214	97	38-1/2	978	40	1016	18	457	18	457
060	105	48	130	59	127	58	153	69	205	93	246	112	169	77	223	101	38-1/2	978	40	1016	18	457	18	457

Base Unit - The unit with NO INTERNAL OPTIONS.

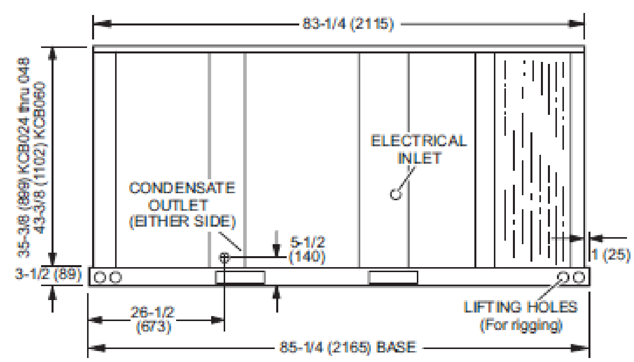
Max. Unit - The unit with ALL INTERNAL OPTIONS Installed. (Economizer, Standard Static Power Exhaust Fans, Controls, etc.). Does not include accessories external to unit or high static power exhaust.



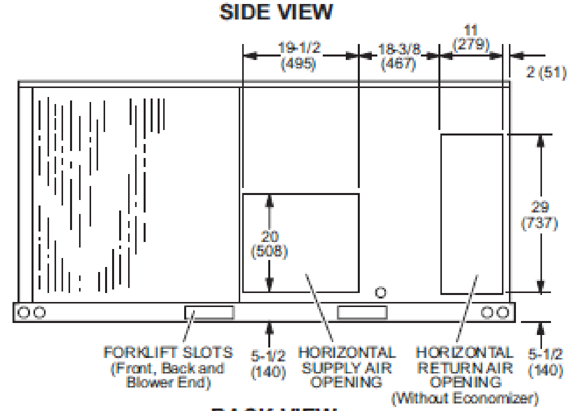
TOP VIEW (Base)



END VIEW

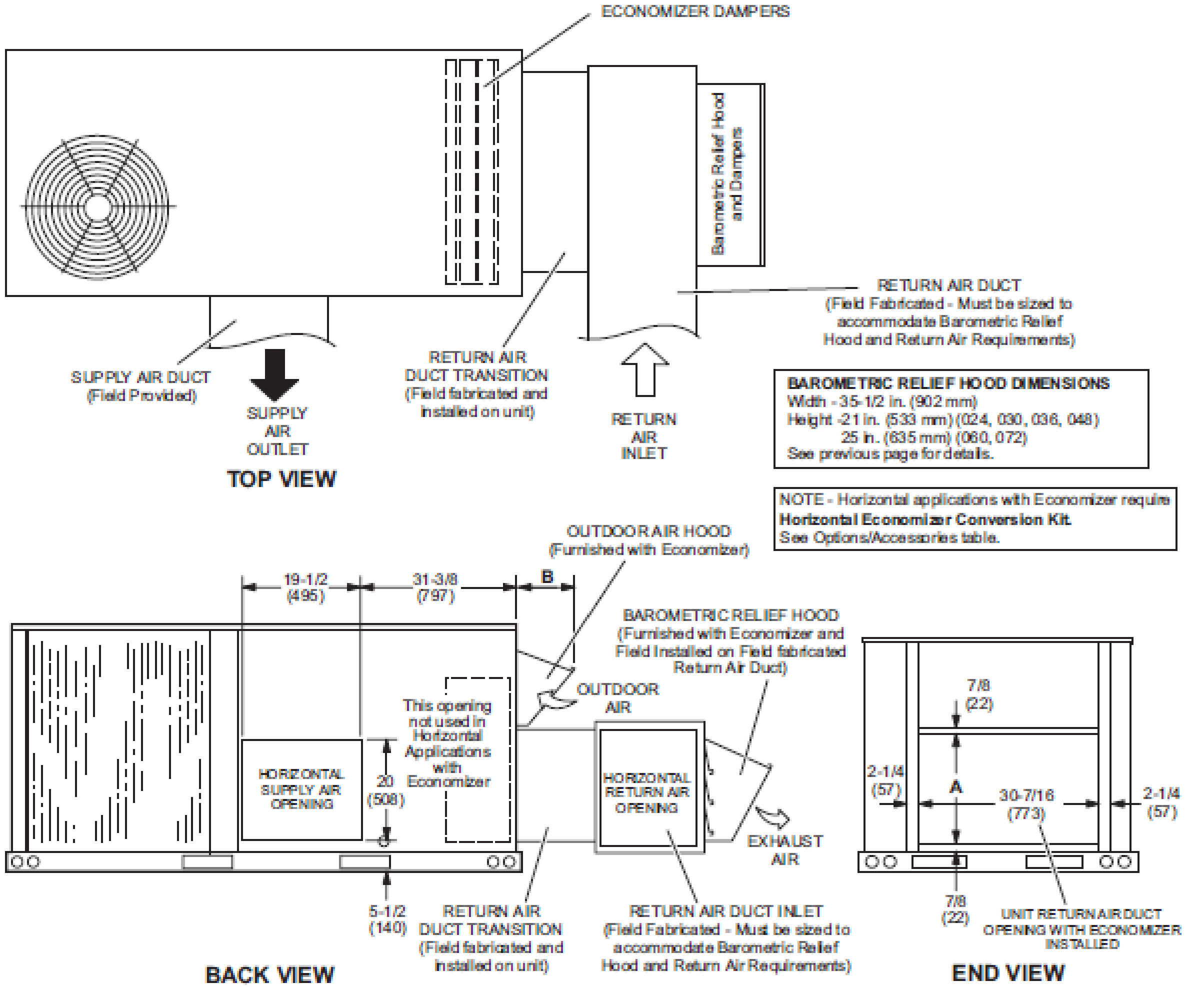


SIDE VIEW



BACK VIEW

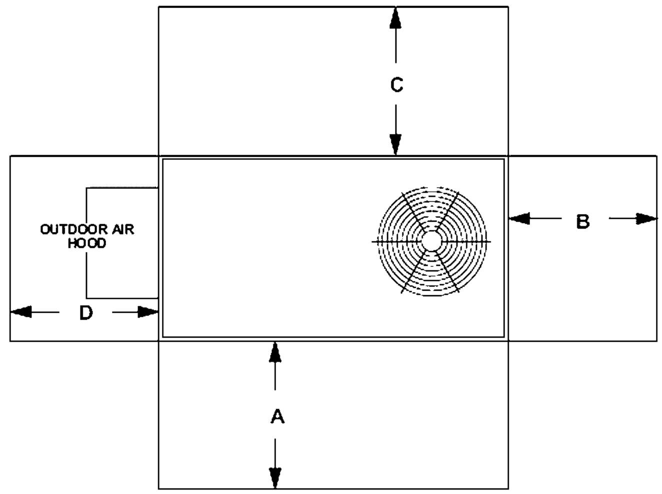
OUTDOOR AIR HOOD DETAIL WITH OPTIONAL ECONOMIZER AND BAROMETRIC RELIEF DAMPERS (Horizontal Applications)



NOTE - Return Air Duct and Transition must be supported.

Model No.	A		B	
	in.	mm	in.	mm
024, 030, 036, 048	18-3/4	476	11-3/4	298
060, 072	22-1/2	572	15-3/4	400

UNIT CLEARANCES - INCHES (MM)



[1] Unit Clearance	A		B		C		D		Top Clearance
	in.	mm	in.	mm	in.	mm	in.	mm	
Service Clearance	36	914	36	914	36	934	36	914	Unobstructed
Minimum Operation Clearance	36	914	36	914	36	914	36	914	

NOTE - Entire perimeter of unit base requires support when elevated above the mounting surface.
1 **Service Clearance** - Required for removal of serviceable parts.
Minimum Operation Clearance - Required clearance for proper unit operation.

Submittal Data Sheet

2.0-Ton Ceiling Suspended Cooling Only - FHQ24PVJURZR24PVJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

FEATURES

- Auto-swing capability with 100° airflow pattern
- Innovative stream fan technology
- 10 year limited parts and compressor warranty

BENEFITS

- Lateral servicing space allows installation in corners, narrow space, walls, and ceilings

INDOOR UNIT

OUTDOOR UNIT

NOTES

- Unit may not be installed in the Southwest Region (AZ, CA, NM, & NV). Refer www.daikincomfort.com/standards for additional information.

DAIKIN

Submittal Data Sheet

2.0-Ton Ceiling Suspended Cooling Only - FHQ24PVJURZR24PVJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

SYSTEM PERFORMANCE

Indoor Unit Model No.	FHQ24PVJU	Indoor Unit Name:	FHQ24PVJU
Outdoor Unit Model No.	RZR24PVJU	Outdoor Unit Name:	2.0-Ton SkyAir Cool Only
Rated Cooling Capacity (Btu/hr):	24,000	Rated Cooling Conditions:	Indoor (°F DB/WB): 80 / 67 Ambient (°F DB/WB): 95 / 75
Sensible Capacity (Btu/hr):	17,100	Rated Piping Length(ft):	25
Max/Min Cooling Capacity (Btu/hr):	24,000 /	Rated Height Difference (ft):	98.00
Cooling Input Power (kW):	2.190	Rated Heating Conditions:	Indoor (°F DB/WB): 70 / 70 Ambient (°F DB/WB): 47 / 43
SEER (Non-Ducted/Ducted):	18.10 /		
EER (Non-Ducted/Ducted):	12.60 /		
Heating Input Power (kW):	2.48		

SYSTEM DETAILS

Refrigerant Type:	R-410A	Cooling Operation Range (°F DB):	23 - 115
Holding Refrigerant Charge (lbs):	5.1	Heating Operation Range (°F WB):	0 - 77
Additional Charge (lb/ft):	0.04	Max. Pipe Length (Vertical) (ft):	98
Pre-charge Piping (Length) (ft):	0	Cooling Range w/Baffle (°F DB):	0 - 115
Max. Pipe Length (Total) (ft):	164	Heating Range w/Baffle (°F WB):	- 77
Max Height Separation (Ind to Ind ft):	98		

Submittal Data Sheet

2.0-Ton Ceiling Suspended Cooling Only - FHQ24PVJURZR24PVJU

Project: Denville Schools

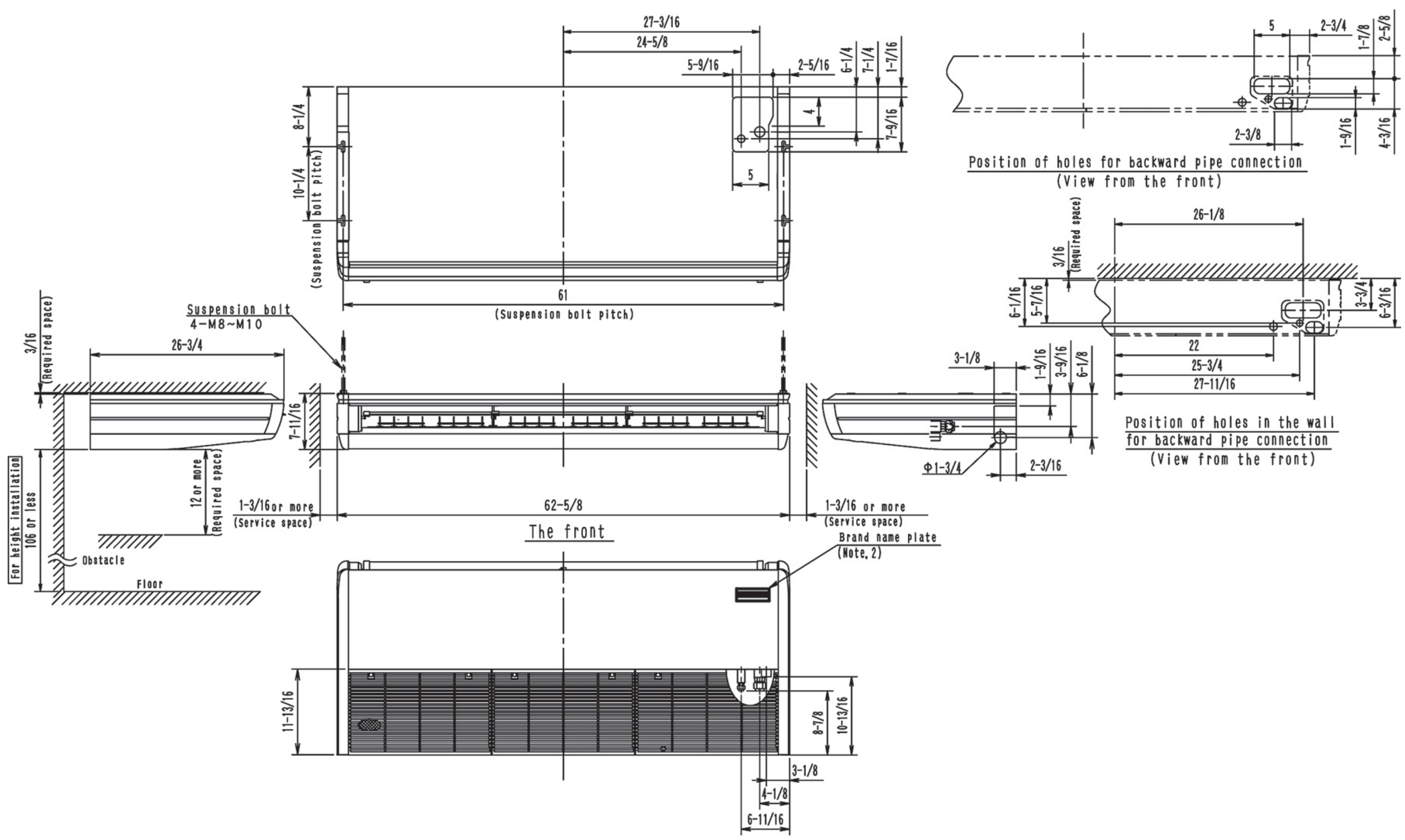
Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

INDOOR UNIT DETAILS			
Power Supply (V/Hz/Ph):	208-230 / 60 / 1	Airflow Rate (H/L) (CFM):	790/670
Power Supply Connections:	L1, L2, Ground	Moisture Removal (Gal/hr):	
Min. Circuit Amps MCA (A):	1.30	Gas Pipe Connection (inch):	5/8
Max Overcurrent Protection (MOP) (A):	15.00	Liquid Pipe Connection (inch):	3/8
Dimensions (HxWxD) (in):	7-11/16 x 62-5/8 x 26-3/4	Condensate Connection (inch):	1
Panel (HxWxD) (in):		Sound Pressure (H) (dBA):	45
Net Weight (lb):	90	Sound Power Level (dBA):	
Panel Weight (lb):		Ext. Static Pressure (Rated/Max) (inWg):	0.00 / 0.00

DIMENSIONAL DRAWING - INDOOR UNIT

FHQ18/24/30/36/42MVJU
Unit (in.)



Submittal Data Sheet

2.0-Ton Ceiling Suspended Cooling Only - FHQ24PVJURZR24PVJU

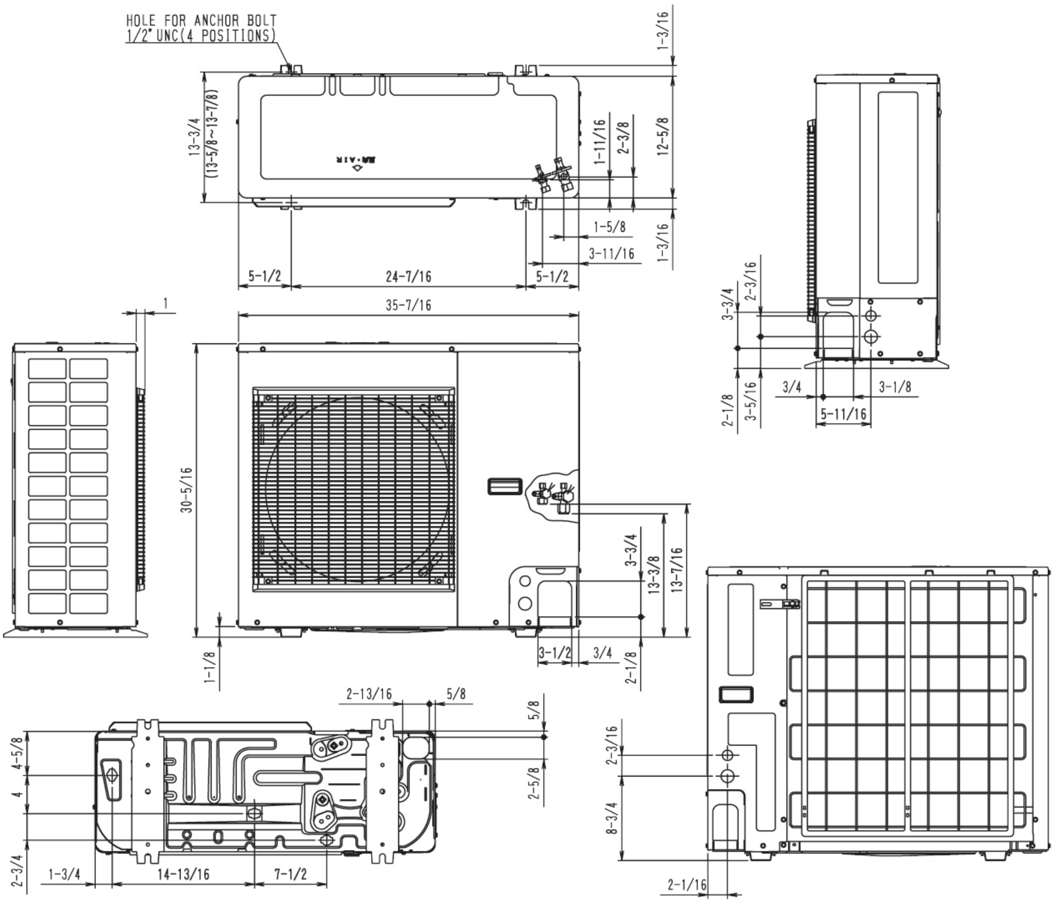
Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

OUTDOOR UNIT DETAILS			
Power Supply (V/Hz/Ph):	208-230 / 60 / 1	Compressor Type:	Inverter
Power Supply Connections:	L1, L2, Ground	Capacity Control Range (%):	30 - 100
Min. Circuit Amps MCA (A):	16.50	Airflow Rate (H) (CFM):	1,835
Max Overcurrent Protection (MOP) (A):	20.00	Gas Pipe Connection (inch):	5/8
Max Starting Current MSC(A):		Liquid Pipe Connection (inch):	3/8
Rated Load Amps RLA(A):	10.3	Sound Pressure (H) (dBA):	49
Dimensions (HxWxD) (in):	30-5/16 x 35-7/16 x 12-5/8	Sound Power Level (dBA):	
Net Weight (lb):	150		

DIMENSIONAL DRAWING - OUTDOOR UNIT



Submittal Data Sheet

3.0-Ton Ceiling Suspended Cooling Only - FHQ36MVJURZR36PVJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

FEATURES

- Auto-swing capability with 100° airflow pattern
- Innovative stream fan technology
- 10 year limited parts and compressor warranty

BENEFITS

- Lateral servicing space allows installation in corners, narrow space, walls, and ceilings

INDOOR UNIT

OUTDOOR UNIT

NOTES

- Unit may not be installed in the Southwest Region (AZ, CA, NM, & NV). Refer www.daikincomfort.com/standards for additional information.

Submittal Data Sheet

3.0-Ton Ceiling Suspended Cooling Only - FHQ36MVJURZR36PVJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

SYSTEM PERFORMANCE			
Indoor Unit Model No.	FHQ36MVJU	Indoor Unit Name:	FHQ36MVJU
Outdoor Unit Model No.	RZR36PVJU	Outdoor Unit Name:	3.0-Ton SkyAir Cool Only
Rated Cooling Capacity (Btu/hr):	36,000	Rated Cooling Conditions:	Indoor (°F DB/WB): 80 / 67 Ambient (°F DB/WB): 95 / 75
Sensible Capacity (Btu/hr):	25,100	Rated Piping Length(ft):	25
Max/Min Cooling Capacity (Btu/hr):	36,000 /	Rated Height Difference (ft):	164.00
Cooling Input Power (kW):	3.760	Rated Heating Conditions:	Indoor (°F DB/WB): 70 / 70 Ambient (°F DB/WB): 47 / 43
SEER (Non-Ducted/Ducted):	14.00 /		
EER (Non-Ducted/Ducted):	10.20 /		
Heating Input Power (kW):	4.26		

SYSTEM DETAILS			
Refrigerant Type:	R-410A	Cooling Operation Range (°F DB):	23 - 115
Holding Refrigerant Charge (lbs):	8.8	Heating Operation Range (°F WB):	0 - 77
Additional Charge (lb/ft):	0.04	Max. Pipe Length (Vertical) (ft):	164
Pre-charge Piping (Length) (ft):	0	Cooling Range w/Baffle (°F DB):	0 - 115
Max. Pipe Length (Total) (ft):	230	Heating Range w/Baffle (°F WB):	- 77
Max Height Separation (Ind to Ind ft):	164		

DAIKIN

Submittal Data Sheet

3.0-Ton Ceiling Suspended Cooling Only - FHQ36MVJURZR36PVJU

Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

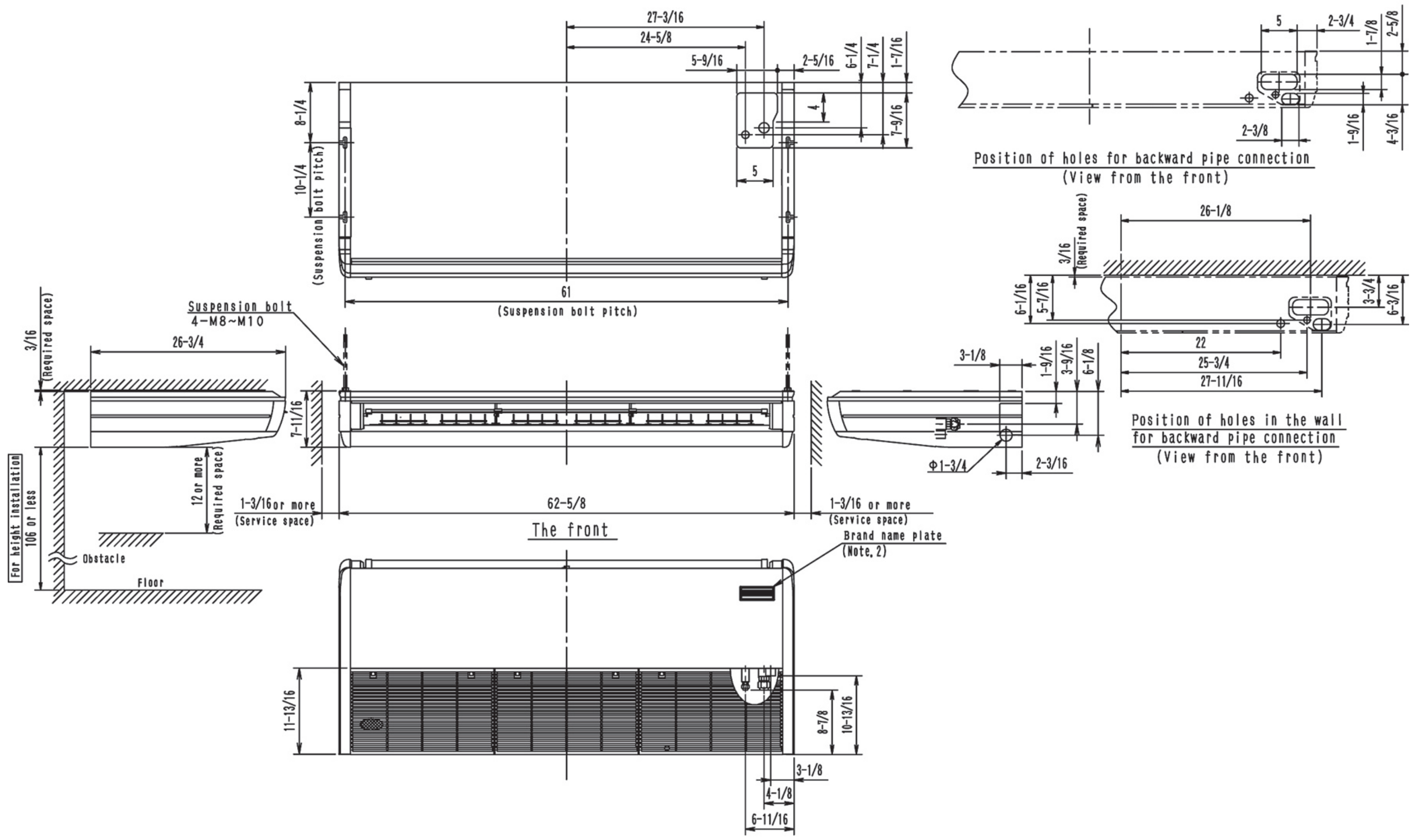
Submitted to: No Engineer Name Specified

INDOOR UNIT DETAILS			
Power Supply (V/Hz/Ph):	208-230 / 60 / 1	Airflow Rate (H/L) (CFM):	830/670
Power Supply Connections:	L1, L2, Ground	Moisture Removal (Gal/hr):	
Min. Circuit Amps MCA (A):	1.40	Gas Pipe Connection (inch):	5/8
Max Overcurrent Protection (MOP) (A):	15.00	Liquid Pipe Connection (inch):	3/8
Dimensions (HxWxD) (in):	7-11/16 x 62-5/8 x 26-3/4	Condensate Connection (inch):	1
Panel (HxWxD) (in):		Sound Pressure (H) (dBA):	46
Net Weight (lb):	90	Sound Power Level (dBA):	
Panel Weight (lb):		Ext. Static Pressure (Rated/Max) (inWg):	0.00 / 0.00

DIMENSIONAL DRAWING - INDOOR UNIT

FHQ18/24/30/36/42MVJU

Unit (in.)



![DAIKIN]

Submittal Data Sheet

3.0-Ton Ceiling Suspended Cooling Only - FHQ36MVJURZR36PVJU

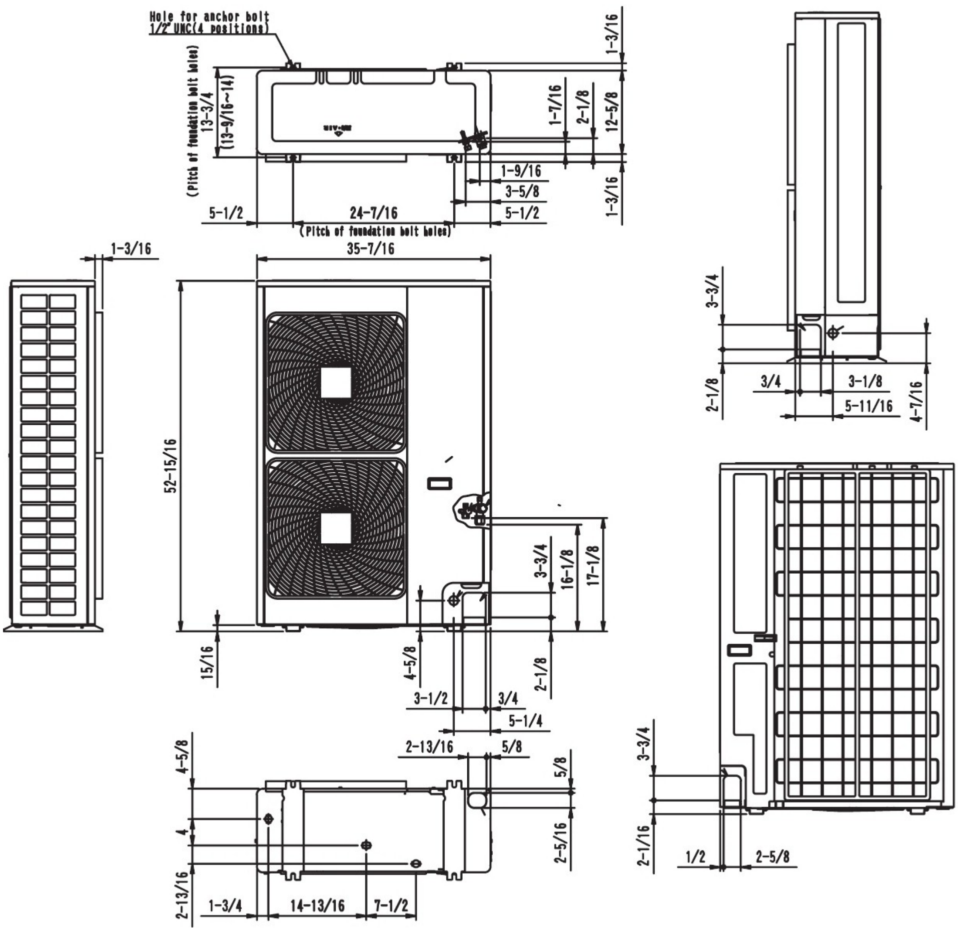
Project: Denville Schools

Submitted by: Jenn Olivo of D&B Engineering Of New Jersey on 11/20/2015

Submitted to: No Engineer Name Specified

OUTDOOR UNIT DETAILS			
Power Supply (V/Hz/Ph):	208-230 / 60 / 1	Compressor Type:	Inverter
Power Supply Connections:	L1, L2, Ground	Capacity Control Range (%):	25 - 100
Min. Circuit Amps MCA (A):	27.00	Airflow Rate (H) (CFM):	3,740
Max Overcurrent Protection (MOP) (A):	30.00	Gas Pipe Connection (inch):	5/8
Max Starting Current MSC(A):		Liquid Pipe Connection (inch):	3/8
Rated Load Amps RLA(A):	18.6	Sound Pressure (H) (dBA):	58
Dimensions (HxWxD) (in):	52-15/16 x 35-7/16 x 12-5/8	Sound Power Level (dBA):	
Net Weight (lb):	283		

DIMENSIONAL DRAWING - OUTDOOR UNIT



Submittal Data Sheet

BRC1E73 - Navigation Remote Controller

Project Name:	
Location:	Approval:
Engineer:	Date:
Submitted to:	Construction:
Submitted by:	Unit #:
Reference:	Drawing #:

Model Compatibility:

For use with the following VRV indoor unit models: FXAQ, FXDQ, FXEQ, FXFQ, FXHQ, FXLQ, FXMQ, FXMQ_MF, FXNQ, FXTQ, FXUQ, FXZQ

For use with the following Daikin SkyAir indoor unit models: FAQ, FBQ, FCQ, FHQ, FTQ

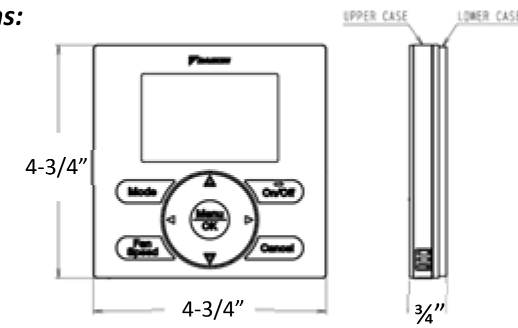
Product Image:

1 of 3 display options – Detailed display shown

Specifications:

Model	BRC1E73
Description	Navigation Remote Controller
Maximum Connections	16 indoor units
Communication Wire	18AWG-2, No polarity Stranded, Non-shielded
Total Wiring Length	1,640 ft. (500 m)
Communication Protocol	Daikin Proprietary P1P2 protocol
Power	16VDC supplied by Indoor unit (1.58VA maximum)
Comfort Setpoint Range	60 to 90 °F (16 to 32 °C)
Setback Setpoint Range	40 to 95 °F (5 to 35°C)
Operating Temp Range	14 to 122°F (-10 to 50°C)
Operating Humidity Range	75% or less (RH) (w/o condensation)
Dimensions (WxHxD)	4.72x4.72x0.75 inch (120x120x19 mm)
Weight (Mass)	0.42 lbs. (0.19 kg)

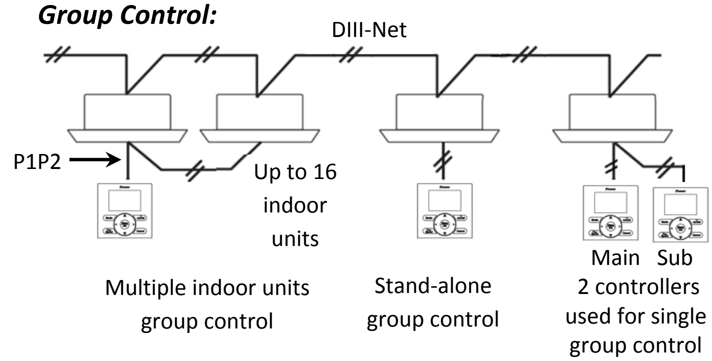
Dimensions:



Features/Benefits:

1. Up to 16 indoor units are controllable within one group
2. Within one group, up to 2 Navigation Remote Controllers can be used, one as a main and one as a sub
3. Backlit LCD displays in English, Spanish or French
4. Temperature sensor built-in with configurable offset
5. Display of Temperature and Setpoint in 1°F / °C increments
6. Three configurable display options: Detailed, Standard and Simple
7. Dual setpoints (independent cooling and heating setpoints) with configurable minimum setpoint differential or Single Setpoint (occupied period)
8. Setpoint range limit for cooling and heating modes
9. Independent cooling and heating setback setpoints (unoccupied period)
10. Auto changeover control with configurable Primary changeover at setpoint ±1° F with guard timer

Group Control:



11. Airflow – Individual air flow direction, dual airflow and auto draft prevention (prevents air blowing directly on occupants)*
12. Built-in 7, 5+2, 5+1+1 and 1 (Everyday) schedules with up to 5 actions per day with independent cooling and heating or setback setpoints
13. Automatic Setback by occupancy sensor*
14. Automatic Off by occupancy sensor*
15. Configuration for Self-cleaning filter panel**
16. Automatic adjustment for Daylight Savings Time (DST)
17. 48 hour clock/calendar battery backup (protects schedule timing in cases of short term power loss from indoor unit)
18. Real-time monitoring of system malfunctions with immediate display of unit in error and error code
19. The buttons on the remote controller are selectable by locking out the unwanted buttons
20. The operation modes can be restricted to provide only the desired mode(s) of operation
21. Display can be configured to show “Off” and room temperature only when indoor unit is turned off
22. To prevent unwanted changes, fan speed selection and display may be hidden
23. Auto off timer configurable in 10 minute increments (range 30-180 minutes)
24. Can be used to replace earlier versions of remote controllers

* Available for FXFQ_TVJU and FXUQ_PVJU indoor units
**Available for FXTQ_TVJU indoor units

Auto changeover:
Automatic changeover is available for Heat Pump system and Heat Recovery systems. The setpoint for cooling and heating are configurable with a minimum differential of 0 to 7°F or single setpoint. The changeover is automatically controlled to happen in either of the following two cases:
Case 1: Changeover at the primary changeover temperature after the guard timer expires.

1. In default, the primary changeover setpoint is 1°F above cooling setpoint or 1°F below heating setpoint, which is configurable between 1°F – 4°F.
2. In default, the guard timer is 60 minutes, which is selectable among 15, 30, 60 (default) or 90 minutes.
3. The initiation of guard timer is built in to help prevent frequent changeover which may cause energy loss.

Case 2: Changeover at the secondary changeover temperature.

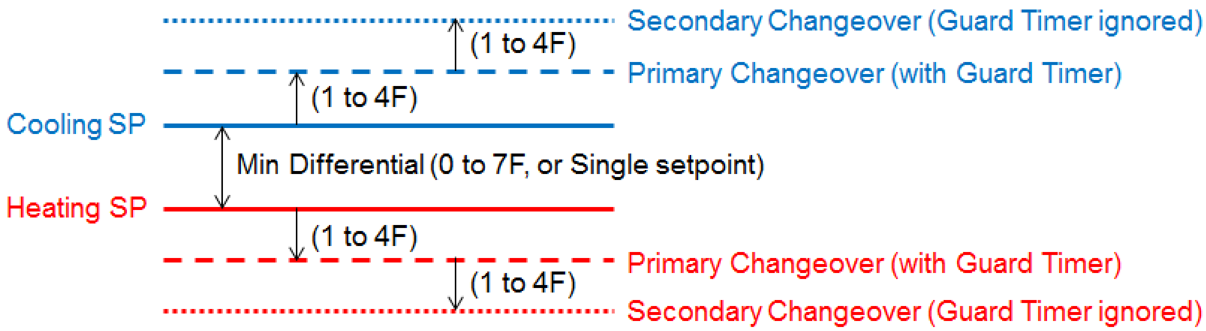
1. In default, the secondary changeover temperature is 1°F above the primary changeover temperature for cooling or 1°F below the primary changeover temperature for heating, which is configurable between 1°F – 4°F.
2. Case 2 will happen while the guard time is active in case 1.

Submittal Data Sheet

BRC1E73 - Navigation Remote Controller

Project Name:

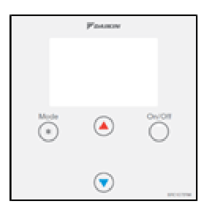
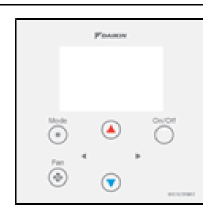
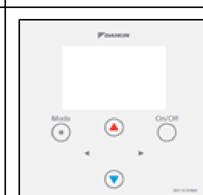
Location:	Approval:
Engineer:	Date:
Submitted to:	Construction:
Submitted by:	Unit #:
Reference:	Drawing #:



Face Decal Options:

Face decal options to hide unnecessary buttons

1. The face decal is designed to adhere to the BRC1E faceplate
2. Hidden buttons can be used/accessed by service personnel without removing the face decal due to its flexibility

Used with	Single Setpoint mode			Dual Setpoint mode		
	BRC1E72RM	BRC1E72RF	BRC1E72RMF	BRC1E72RM2	BRC1E72RF2	BRC1E72RMF2
Model						
On/Off	X	X	X	X	X	X
Mode	X		X	X		X
Fan		X	X		X	X
Up, Down	X	X	X	X	X	X
Left, Right				X	X	X
Menu/Ok						
Cancel						

Submittal Data Sheet
BRC1E73 - Navigation Remote Controller

Project Name:	
Location:	Approval:
Engineer:	Date:
Submitted to:	Construction:
Submitted by:	Unit #:
Reference:	Drawing #:

Documentation:

Documentation available on www.daikincity.com or www.daikinac.com

- Installation Manual
- Operation Manual
- Submittal
- Guide Specifications

Goodman®

Air Conditioning & Heating

DSZC16

Split System Heat Pump
Up to 16 SEER

Cooling Capacity: 24,000 - 57,000 BTU/h

Heating Capacity: 24,000 - 57,000 BTU/h

Contents

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Wiring Diagram.................................... 27

Dimensions 28

Accessories 28

Standard Features

- Two-Stage Copeland® UltraTech™ scroll compressor
- High-density foam compressor sound blanket
- ComfortNet™ Communications System compatible
- Expanded ComfortAlert™ diagnostics built in
- Set-up capable with two low-voltage wires to outdoor unit
- Diagnostic indicator lights and storage of six fault codes
- Color-coded terminal strip for non-communicating set-up
- SmartShift® technology to ensure quiet, reliable defrost
- Factory-installed bi-flow liquid line filter drier
- Factory-installed suction line accumulator
- Factory-installed compressor crankcase heater
- Factory-installed high-capacity muffler
- Factory-installed coil and ambient temperature sensors
- High- and low-pressure switches
- Fully charged for 15’ of tubing length
- Two-speed quiet condenser fan motor
- Sweat connection service valves with easy access to gauge ports
- AHRI Certified; ETL Listed

Cabinet Features

- Heavy-gauge galvanized-steel cabinet covered with a powder-paint finish with 500-hour salt-spray approval
- Wire fan discharge grille
- Steel louver coil guard
- Rust-resistant coated screws
- Compact footprint
- Top and side maintenance access
- Single-panel access to controls with space provided for field-installed accessories
- When properly anchored, meets 2010 Florida Building Code unit integrity requirements for hurricane-type winds (Anchor bracket kits available.)

* Complete warranty details available from your local dealer or at www.goodmamfg.com. To receive the Lifetime Compressor Limited Warranty (good for as long as you own your home), 10-Year Unit Replacement Limited Warranty and 10-Year Parts Limited Warranty, online registration must be completed within 60 days of installation. Online registration is not required in California or Québec.

D	S	Z	C	16	036	1	A	A
1	2	3	4	5,6	7,8,9	10	11	12

Brand
D Goodman® Brand
High Feature Set

Product Category
S Split System

Unit Type
X Condenser R-410A
Z Heat Pump R-410A

Communication Feature
C ComfortNet 4-wire communications ready

Efficiency
13 13 SEER
14 14 SEER
16 16 SEER
18 18 SEER

Engineering *
Minor Revision

Engineering *
Major Revision

Electrical
1 208/230 V, 1 Phase, 60 Hz
2 220/240 V, 1 Phase, 50 Hz
3 208/230 V, 3 Phase, 60 Hz
4 460 V, 3 Phase, 60 Hz

Nominal Capacity
024 2 Tons
036 3 Tons
048 4 Tons
060 5 Tons

* Neither used for order entry or inventory management.

	DSZC16 0241A	DSZC16 0361A	DSZC16 0481A	DSZC16 0601B
CAPACITIES AND RATINGS				
Nominal Cooling (BTU/h)	24,000	36,000	48,000	60,000
Nominal Heating (BTU/h)	24,000	36,000	48,000	60,000
Decibels	72	73	74	75
COMPRESSOR				
RLA	11.7	15.3	21.2	28.8
LRA	58.3	83.0	104.0	152.9
CONDENSER FAN MOTOR				
Horsepower	1/6	1/6	1/6	1/6
FLA	1.2	1.2	1.2	1.2
REFRIGERATION SYSTEM				
Refrigerant Line Size[1]				
Liquid Line Size ("O.D.)	⅜"	⅜"	⅜"	⅜"
Suction Line Size ("O.D.)	¾"	⅞"	1⅛"	1⅛"
Refrigerant Connection Size				
Liquid Valve Size ("O.D.)	⅜"	⅜"	⅜"	⅜"
Suction Valve Size ("O.D.)	¾"	⅞"	⅞"	⅞"
Valve Connection Type	Sweat	Sweat	Sweat	Sweat
Refrigerant Charge	153	203	263	273
Shipped with Orifice Size	NA	NA	NA	NA
ELECTRICAL DATA				
Volts -Hz	208/230-60	208/230-60	208/230-60	208/230-60
Minimum Circuit Ampacity [2]	15.8	20.3	27.7	37.2
Max. Overcurrent Protection [3]	25	35	45	60
Min / Max Volts	197/253	197/253	197/253	197/253
Power Supply Conduit Size	½" or ¾"	½" or ¾"	½" or ¾"	½" or ¾"
EQUIPMENT WEIGHT	190	233	305	309
SHIP WEIGHT (LBS)	208	255	327	331

[1] Tested and rated in accordance with AHRI Standard 210/240

[2] Wire size should be determined in accordance with National Electrical Codes; extensive wire runs will require larger wire sizes

[3] Must use time-delay fuses or HACR-type circuit breakers of the same size as noted.

NOTES

- Always check the rating plate for electrical data on the unit being installed.
- Installer will need to supply ⅞" to 1⅛" adapters for suction line connections.
- Unit is charged with refrigerant for 15' of ⅜" liquid line. System charge must be adjusted per Installation Instructions Final Charge Procedure.
- Installation of these units requires the specified TXV Kit to be installed on the indoor coil. THE SPECIFIED TXV IS DETERMINED BY THE OUTDOOR UNIT NOT THE INDOOR COIL.

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	**Airflow**		**59**	**63**	**67**	**71**	**59**	**63**	**67**	**71**	**59**	**63**	**67**	**71**	**59**	**63**	**67**	**71**	**59**	**63**	**67**	**71**	**59**	**63**	**67**	**71**
70	731	MBh	17.7	18.3	20.1	-	17.3	17.9	19.6	-	16.9	17.5	19.2	-	16.5	17.1	18.7	-	15.6	16.2	17.8	-	14.5	15.0	16.5	-
		S/T	0.79	0.66	0.46	-	0.82	0.68	0.47	-	0.84	0.70	0.48	-	0.86	0.72	0.50	-	0.90	0.75	0.52	-	0.90	0.76	0.52	-
		ΔT	18	15	12	-	18	15	12	-	18	15	12	-	18	15	12	-	18	15	12	-	16	14	11	-
		kW	1.06	1.09	1.12	-	1.15	1.17	1.21	-	1.22	1.25	1.29	-	1.29	1.32	1.36	-	1.34	1.37	1.42	-	1.39	1.42	1.47	-
		Amps	4.2	4.3	4.4	-	4.5	4.6	4.8	-	4.9	5.0	5.2	-	5.2	5.3	5.5	-	5.6	5.7	5.9	-	5.9	6.0	6.2	-
		Hi PR	209	225	237	-	235	252	266	-	267	287	303	-	304	327	345	-	342	368	388	-	378	406	429	-
		Lo PR	113	121	132	-	120	127	139	-	124	132	144	-	131	139	152	-	137	146	159	-	142	151	164	-
	637	MBh	17.2	17.8	19.5	-	16.8	17.4	19.1	-	16.4	17.0	18.6	-	16.0	16.6	18.2	-	15.2	15.7	17.2	-	14.1	14.6	16.0	-
		S/T	0.75	0.63	0.43	-	0.78	0.65	0.45	-	0.80	0.67	0.46	-	0.82	0.69	0.48	-	0.86	0.71	0.50	-	0.86	0.72	0.50	-
		ΔT	19	16	12	-	19	16	12	-	19	16	12	-	19	16	12	-	19	16	12	-	18	15	12	-
		kW	1.06	1.08	1.11	-	1.14	1.16	1.20	-	1.21	1.24	1.28	-	1.28	1.31	1.35	-	1.33	1.36	1.41	-	1.38	1.41	1.46	-
		Amps	4.1	4.2	4.4	-	4.5	4.6	4.7	-	4.8	5.0	5.1	-	5.2	5.3	5.5	-	5.5	5.6	5.8	-	5.8	6.0	6.2	-
		Hi PR	207	223	235	-	232	250	264	-	264	284	300	-	301	324	342	-	338	364	384	-	374	402	425	-
		Lo PR	112	119	130	-	118	126	138	-	123	131	143	-	129	138	150	-	136	144	157	-	140	149	163	-
	569	MBh	16.3	16.9	18.5	-	15.9	16.5	18.1	-	15.6	16.1	17.7	-	15.2	15.7	17.2	-	14.4	15.0	16.4	-	13.4	13.9	15.2	-
		S/T	0.72	0.60	0.42	-	0.75	0.62	0.43	-	0.77	0.64	0.44	-	0.79	0.66	0.46	-	0.82	0.68	0.47	-	0.83	0.69	0.48	-
		ΔT	19	16	12	-	19	17	13	-	19	17	13	-	19	17	13	-	19	17	13	-	18	15	12	-
		kW	1.04	1.06	1.10	-	1.12	1.14	1.18	-	1.19	1.22	1.26	-	1.26	1.28	1.33	-	1.31	1.34	1.38	-	1.36	1.39	1.43	-
		Amps	4.1	4.2	4.3	-	4.4	4.5	4.6	-	4.8	4.9	5.0	-	5.1	5.2	5.4	-	5.4	5.5	5.7	-	5.7	5.9	6.1	-
		Hi PR	203	218	230	-	228	245	259	-	259	278	294	-	295	317	335	-	332	357	377	-	366	394	416	-
		Lo PR	110	117	128	-	116	124	135	-	121	128	140	-	127	135	147	-	133	141	154	-	137	146	160	-
75	731	MBh	18.0	18.5	20.1	21.5	17.6	18.1	19.6	21.0	17.2	17.7	19.1	20.5	16.7	**17.2**	18.7	20.0	15.9	16.4	17.7	19.0	14.7	15.2	16.4	17.6
		S/T	0.90	0.80	0.61	0.39	0.93	0.83	0.63	0.40	0.95	0.85	0.64	0.41	0.98	**0.88**	0.67	0.43	1.00	0.91	0.69	0.44	1.00	0.92	0.70	0.45
		ΔT	20	19	15	11	21	19	15	11	21	19	15	11	21	**19**	16	11	20	19	15	11	19	18	14	10
		kW	1.07	1.10	1.13	1.17	1.16	1.18	1.22	1.26	1.23	1.26	1.30	1.35	1.30	**1.33**	1.37	1.42	1.36	1.39	1.43	1.48	1.40	1.44	1.48	1.54
		Amps	4.2	4.3	4.5	4.6	4.6	4.7	4.8	5.0	4.9	5.1	5.2	5.4	5.3	**5.4**	5.6	5.8	5.6	5.7	5.9	6.2	5.9	6.1	6.3	6.5
		Hi PR	211	227	240	250	237	255	269	281	269	290	306	319	307	**330**	349	364	345	372	392	409	381	410	433	452
		Lo PR	114	122	133	142	121	129	140	150	126	134	146	155	132	**140**	153	163	138	147	161	171	143	152	166	177
	637	MBh	17.5	18.0	19.5	20.9	17.1	17.6	19.0	20.4	16.7	17.2	18.6	19.9	16.3	**16.7**	18.1	19.4	15.4	15.9	17.2	18.5	14.3	14.7	15.9	17.1
		S/T	0.85	0.76	0.58	0.37	0.89	0.79	0.60	0.39	0.91	0.81	0.61	0.40	0.94	**0.84**	0.63	0.41	0.97	0.87	0.66	0.42	0.98	0.88	0.66	0.43
		ΔT	22	20	16	11	22	20	16	11	22	20	16	11	22	**20**	17	11	22	20	16	11	20	19	15	11
		kW	1.06	1.09	1.12	1.16	1.15	1.17	1.21	1.25	1.22	1.25	1.29	1.34	1.29	**1.32**	1.36	1.41	1.34	1.37	1.42	1.47	1.39	1.42	1.47	1.52
		Amps	4.2	4.3	4.4	4.6	4.5	4.6	4.8	4.9	4.9	5.0	5.2	5.4	5.2	**5.3**	5.5	5.7	5.6	5.7	5.9	6.1	5.9	6.0	6.2	6.5
		Hi PR	209	225	238	248	235	252	267	278	267	287	303	316	304	**327**	345	360	342	368	388	405	378	406	429	448
		Lo PR	113	121	132	140	120	127	139	148	124	132	144	154	131	**139**	152	162	137	146	159	169	142	151	165	175
	569	MBh	16.6	17.1	18.5	19.9	16.2	16.7	18.1	19.4	15.8	16.3	17.6	18.9	15.4	**15.9**	17.2	18.5	14.7	15.1	16.3	17.5	13.6	14.0	15.1	16.3
		S/T	0.82	0.73	0.55	0.36	0.85	0.76	0.57	0.37	0.87	0.78	0.59	0.38	0.90	**0.80**	0.61	0.39	0.93	0.83	0.63	0.41	0.94	0.84	0.64	0.41
		ΔT	22	20	17	11	22	20	17	12	22	20	17	12	22	**21**	17	12	22	20	17	12	21	19	16	11
		kW	1.05	1.07	1.10	1.14	1.13	1.15	1.19	1.23	1.20	1.23	1.27	1.31	1.27	**1.29**	1.34	1.38	1.32	1.35	1.40	1.44	1.37	1.40	1.45	1.50
		Amps	4.1	4.2	4.3	4.5	4.4	4.5	4.7	4.9	4.8	4.9	5.1	5.3	5.1	**5.3**	5.4	5.6	5.5	5.6	5.8	6.0	5.8	5.9	6.1	6.3
		Hi PR	205	220	233	243	230	247	261	272	261	281	297	310	298	**320**	338	353	335	360	381	397	370	398	421	439
		Lo PR	111	118	129	137	117	125	136	145	122	130	142	151	128	**136**	149	158	134	143	156	166	139	148	161	172

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects ACCA (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
80	731	MBh	18.3	18.7	20.0	21.4	17.9	18.3	19.5	20.9	17.5	17.8	19.1	20.4	17.0	17.4	18.6	19.9	16.2	16.5	17.7	18.9	15.0	15.3	16.4	17.5
		S/T	1.00	0.92	0.75	0.56	1.00	0.95	0.78	0.58	1.00	1.00	0.80	0.60	1.00	1.00	0.82	0.61	1.00	1.00	0.85	0.64	1.00	1.00	0.86	0.64
		ΔT	23	22	19	15	22	22	19	15	22	22	19	15	21	22	19	15	20	21	19	15	19	19	18	14
		kW	1.08	1.11	1.14	1.18	1.17	1.19	1.23	1.27	1.24	1.27	1.31	1.36	1.31	1.34	1.38	1.43	1.37	1.40	1.45	1.50	1.42	1.45	1.50	1.55
		Amps	4.3	4.4	4.5	4.7	4.6	4.7	4.9	5.0	5.0	5.1	5.3	5.5	5.3	5.4	5.6	5.8	5.7	5.8	6.0	6.2	6.0	6.1	6.3	6.6
		Hi PR	213	229	242	253	239	258	272	284	272	293	309	323	310	334	352	367	349	375	396	413	385	415	438	457
		Lo PR	116	123	134	143	122	130	142	151	127	135	147	157	133	142	155	165	140	149	162	173	145	154	168	179
	637	MBh	17.8	18.2	19.4	20.8	17.4	17.8	19.0	20.3	17.0	17.3	18.5	19.8	16.5	16.9	**18.1**	19.3	15.7	16.1	17.2	18.3	14.6	14.9	15.9	17.0
		S/T	0.94	0.88	0.72	0.53	0.97	0.91	0.74	0.55	1.00	0.93	0.76	0.57	1.00	0.96	**0.78**	0.59	1.00	1.00	0.81	0.61	1.00	1.00	0.82	0.61
		ΔT	24	23	20	16	24	23	20	16	24	23	20	16	24	24	**20**	16	23	23	20	16	21	21	19	15
		kW	1.07	1.10	1.13	1.17	1.16	1.18	1.22	1.26	1.23	1.26	1.30	1.35	1.30	1.33	**1.37**	1.42	1.36	1.39	1.43	1.48	1.40	1.44	1.48	1.54
		Amps	4.2	4.3	4.5	4.6	4.6	4.7	4.8	5.0	4.9	5.1	5.2	5.4	5.3	5.4	**5.6**	5.8	5.6	5.7	5.9	6.2	5.9	6.1	6.3	6.5
		Hi PR	211	227	240	250	237	255	269	281	269	290	306	319	307	330	**349**	364	345	372	392	409	381	411	433	452
		Lo PR	114	122	133	142	121	129	140	150	126	134	146	155	132	140	**153**	163	138	147	161	171	143	152	166	177
	569	MBh	16.9	17.3	18.4	19.7	16.5	16.9	18.0	19.3	16.1	16.5	17.6	18.8	15.7	16.1	17.2	18.3	14.9	15.3	16.3	17.4	13.8	14.1	15.1	16.1
		S/T	0.90	0.84	0.69	0.51	0.93	0.87	0.71	0.53	0.95	0.89	0.73	0.54	0.98	0.92	0.75	0.56	1.02	0.96	0.78	0.58	1.03	0.97	0.79	0.59
		ΔT	25	23	20	16	25	24	21	17	25	24	21	17	25	24	21	17	25	24	21	16	23	22	19	15
		kW	1.06	1.08	1.11	1.15	1.14	1.16	1.20	1.24	1.21	1.24	1.28	1.32	1.28	1.31	1.35	1.40	1.33	1.36	1.41	1.46	1.38	1.41	1.46	1.51
		Amps	4.1	4.2	4.4	4.5	4.5	4.6	4.7	4.9	4.8	5.0	5.1	5.3	5.2	5.3	5.5	5.7	5.5	5.6	5.8	6.0	5.8	6.0	6.2	6.4
		Hi PR	207	223	235	245	232	250	264	275	264	284	300	313	301	324	342	356	338	364	384	401	374	402	425	443
		Lo PR	112	119	130	139	118	126	138	147	123	131	143	152	129	138	150	160	136	144	157	168	140	149	163	173
85	731	MBh	18.6	19.0	19.9	21.2	18.2	18.6	19.4	20.7	17.8	18.1	19.0	20.2	17.3	17.7	18.5	19.7	16.5	16.8	17.6	18.8	15.3	15.6	16.3	17.4
		S/T	1.00	0.99	0.90	0.73	1.00	1.00	0.93	0.75	1.00	1.00	0.95	0.77	1.00	1.00	0.98	0.80	1.00	1.00	1.00	0.83	1.00	1.00	1.00	0.84
		ΔT	23	24	22	19	23	23	23	20	22	23	23	20	22	22	23	20	21	21	22	20	19	20	20	18
		kW	1.09	1.11	1.15	1.19	1.18	1.20	1.24	1.29	1.25	1.28	1.32	1.37	1.32	1.35	1.40	1.44	1.38	1.41	1.46	1.51	1.43	1.46	1.51	1.56
		Amps	4.3	4.4	4.5	4.7	4.6	4.7	4.9	5.1	5.0	5.1	5.3	5.5	5.4	5.5	5.7	5.9	5.7	5.8	6.0	6.3	6.0	6.2	6.4	6.6
		Hi PR	215	232	245	255	242	260	275	286	275	296	312	326	313	337	356	371	352	379	400	417	389	419	442	461
		Lo PR	117	124	136	144	123	131	143	153	128	136	149	159	135	143	156	167	141	150	164	175	146	155	170	181
	637	MBh	18.1	18.4	19.3	20.6	17.7	18.0	18.9	20.1	17.3	17.6	18.4	19.7	16.8	17.2	18.0	19.2	16.0	16.3	17.1	18.2	14.8	15.1	15.8	16.9
		S/T	0.98	0.95	0.86	0.69	1.00	0.98	0.89	0.72	1.00	1.00	0.91	0.74	1.00	1.00	0.94	0.76	1.00	1.00	0.97	0.79	1.00	1.00	0.98	0.80
		ΔT	26	25	24	21	26	26	24	21	25	25	24	21	24	25	24	21	23	24	24	21	21	22	22	19
		kW	1.08	1.11	1.14	1.18	1.17	1.19	1.23	1.27	1.24	1.27	1.31	1.36	1.31	1.34	1.38	1.43	1.37	1.40	1.45	1.50	1.42	1.45	1.50	1.55
		Amps	4.3	4.4	4.5	4.7	4.6	4.7	4.9	5.0	5.0	5.1	5.3	5.5	5.3	5.4	5.6	5.8	5.7	5.8	6.0	6.2	6.0	6.1	6.3	6.6
		Hi PR	213	229	242	253	239	258	272	284	272	293	309	323	310	334	352	367	349	375	396	413	385	415	438	457
		Lo PR	116	123	134	143	122	130	142	151	127	135	147	157	133	142	155	165	140	149	162	173	145	154	168	179
	569	MBh	17.2	17.5	18.4	19.6	16.8	17.1	17.9	19.1	16.4	16.7	17.5	18.7	16.0	16.3	17.1	18.2	15.2	15.5	16.2	17.3	14.1	14.3	15.0	16.0
		S/T	0.94	0.91	0.82	0.66	0.98	0.94	0.85	0.69	1.00	0.96	0.87	0.71	1.00	1.00	0.90	0.73	1.00	1.00	0.93	0.76	1.00	1.00	0.94	0.76
		ΔT	26.1	26	24	21	26	26	25	21	26	26	25	21	26	26	25	21	25	25	24	21	23	23	23	20
		kW	1.06	1.09	1.12	1.16	1.15	1.17	1.21	1.25	1.22	1.25	1.29	1.33	1.29	1.32	1.36	1.41	1.34	1.37	1.42	1.47	1.39	1.42	1.47	1.52
		Amps	4.2	4.3	4.4	4.6	4.5	4.6	4.8	4.9	4.9	5.0	5.2	5.4	5.2	5.3	5.5	5.7	5.6	5.7	5.9	6.1	5.9	6.0	6.2	6.5
		Hi PR	209	225	237	248	235	252	266	278	267	287	303	316	304	327	345	360	342	368	388	405	378	406	429	448
		Lo PR	113	121	132	140	120	127	139	148	124	132	144	154	131	139	152	162	137	146	159	169	142	151	164	175

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects AHRI (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
70	984	MBh	23.5	24.4	26.7	-	23.0	23.8	26.1	-	22.4	23.2	25.5	-	21.9	22.7	24.8	-	20.8	21.5	23.6	-	19.3	20.0	21.9	-
		S/T	0.80	0.66	0.46	-	0.82	0.69	0.48	-	0.85	0.71	0.49	-	0.87	0.73	0.51	-	0.91	0.76	0.52	-	0.91	0.76	0.53	-
		ΔT	17	15	11	-	18	15	12	-	18	15	12	-	18	15	12	-	18	15	12	-	16	14	11	-
		kW	1.56	1.60	1.65	-	1.68	1.72	1.78	-	1.79	1.83	1.90	-	1.89	1.93	2.00	-	1.97	2.02	2.09	-	2.04	2.09	2.16	-
		Amps	6.0	6.1	6.3	-	6.5	6.6	6.8	-	7.0	7.2	7.4	-	7.5	7.7	7.9	-	8.0	8.2	8.5	-	8.5	8.7	9.0	-
		Hi PR	223	240	253	-	250	269	284	-	284	306	323	-	324	349	368	-	365	392	414	-	403	433	458	-
		Lo PR	111	118	129	-	117	125	136	-	122	130	142	-	128	136	149	-	134	143	156	-	139	148	161	-
	875	MBh	22.8	23.7	25.9	-	22.3	23.1	25.3	-	21.8	22.6	24.7	-	21.2	22.0	24.1	-	20.2	20.9	22.9	-	18.7	19.4	21.2	-
		S/T	0.76	0.63	0.44	-	0.79	0.66	0.46	-	0.81	0.67	0.47	-	0.83	0.70	0.48	-	0.86	0.72	0.50	-	0.87	0.73	0.50	-
		ΔT	18	16	12	-	18	16	12	-	18	16	12	-	19	16	12	-	18	16	12	-	17	15	11	-
		kW	1.55	1.58	1.63	-	1.67	1.71	1.76	-	1.78	1.82	1.88	-	1.87	1.92	1.98	-	1.96	2.00	2.07	-	2.03	2.07	2.14	-
		Amps	5.9	6.1	6.3	-	6.4	6.6	6.8	-	7.0	7.1	7.4	-	7.4	7.6	7.9	-	7.9	8.1	8.4	-	8.4	8.6	8.9	-
		Hi PR	221	238	251	-	248	267	281	-	282	303	320	-	321	345	365	-	361	388	410	-	399	429	453	-
		Lo PR	110	117	128	-	116	124	135	-	121	128	140	-	127	135	147	-	133	141	154	-	137	146	160	-
	766	MBh	21.1	21.8	23.9	-	20.6	21.3	23.4	-	20.1	20.8	22.8	-	19.6	20.3	22.3	-	18.6	19.3	21.1	-	17.3	17.9	19.6	-
		S/T	0.73	0.61	0.42	-	0.76	0.63	0.44	-	0.78	0.65	0.45	-	0.80	0.67	0.46	-	0.83	0.70	0.48	-	0.84	0.70	0.49	-
		ΔT	19	16	12	-	19	16	12	-	19	16	12	-	19	16	12	-	19	16	12	-	17	15	11	-
		kW	1.51	1.54	1.59	-	1.63	1.67	1.72	-	1.73	1.77	1.83	-	1.83	1.87	1.93	-	1.91	1.95	2.01	-	1.97	2.02	2.09	-
		Amps	5.8	5.9	6.1	-	6.2	6.4	6.6	-	6.8	6.9	7.2	-	7.2	7.4	7.6	-	7.7	7.9	8.1	-	8.1	8.3	8.6	-
		Hi PR	214	230	243	-	240	259	273	-	273	294	310	-	311	335	354	-	350	377	398	-	387	416	440	-
		Lo PR	107	113	124	-	113	120	131	-	117	125	136	-	123	131	143	-	129	137	150	-	133	142	155	-
75	984	MBh	23.9	24.6	26.7	28.6	23.4	24.1	26.0	27.9	22.8	23.5	25.4	27.3	22.2	**22.9**	24.8	26.6	21.1	21.8	23.6	25.3	19.6	20.2	21.8	23.4
		S/T	0.90	0.81	0.61	0.39	0.94	0.84	0.63	0.41	0.96	0.86	0.65	0.42	0.99	**0.89**	0.67	0.43	1.00	0.92	0.70	0.45	1.00	0.93	0.70	0.45
		ΔT	20	19	15	11	20	19	15	11	20	19	15	11	21	**19**	16	11	20	19	15	11	18	17	14	10
		kW	1.57	1.61	1.66	1.72	1.70	1.74	1.79	1.85	1.81	1.85	1.91	1.98	1.91	**1.95**	2.02	2.08	1.99	2.03	2.10	2.18	2.06	2.11	2.18	2.26
		Amps	6.0	6.2	6.4	6.6	6.5	6.7	6.9	7.2	7.1	7.3	7.5	7.8	7.6	**7.8**	8.0	8.3	8.1	8.3	8.5	8.9	8.5	8.7	9.0	9.4
		Hi PR	225	242	256	267	253	272	287	300	287	309	327	341	327	**352**	372	388	368	396	418	436	407	438	462	482
		Lo PR	112	119	130	139	119	126	138	147	123	131	143	152	129	**138**	150	160	136	144	157	168	140	149	163	173
	875	MBh	23.2	23.9	25.9	27.8	22.7	23.4	25.3	27.1	22.1	22.8	24.7	26.5	21.6	**22.2**	24.1	25.8	20.5	21.1	22.9	24.5	19.0	19.6	21.2	22.7
		S/T	0.86	0.77	0.58	0.38	0.89	0.80	0.61	0.39	0.92	0.82	0.62	0.40	0.95	**0.85**	0.64	0.41	0.98	0.88	0.67	0.43	0.99	0.89	0.67	0.43
		ΔT	21	19	16	11	21	20	16	11	21	20	16	11	21	**20**	16	11	21	20	16	11	20	18	15	10
		kW	1.56	1.60	1.65	1.70	1.68	1.72	1.78	1.84	1.79	1.83	1.90	1.96	1.89	**1.93**	2.00	2.07	1.97	2.02	2.09	2.16	2.04	2.09	2.16	2.24
		Amps	6.0	6.1	6.3	6.6	6.5	6.6	6.8	7.1	7.0	7.2	7.4	7.7	7.5	**7.7**	7.9	8.2	8.0	8.2	8.5	8.8	8.5	8.7	9.0	9.3
		Hi PR	223	240	253	264	250	269	284	297	285	306	323	337	324	**349**	368	384	365	392	414	432	403	434	458	477
		Lo PR	111	118	129	137	117	125	136	145	122	130	142	151	128	**136**	149	158	134	143	156	166	139	148	161	172
	766	MBh	21.4	22.1	23.9	25.6	20.9	21.6	23.3	25.0	20.4	21.0	22.8	24.4	19.9	**20.5**	22.2	23.8	18.9	19.5	21.1	22.7	17.5	18.1	19.6	21.0
		S/T	0.83	0.74	0.56	0.36	0.86	0.77	0.58	0.38	0.88	0.79	0.60	0.39	0.91	**0.82**	0.62	0.40	0.95	0.85	0.64	0.41	0.96	0.85	0.65	0.42
		ΔT	21	20	16	11	22	20	16	11	22	20	16	11	22	**20**	16	11	22	20	16	11	20	19	15	10
		kW	1.52	1.56	1.61	1.66	1.64	1.68	1.73	1.79	1.75	1.79	1.85	1.91	1.84	**1.88**	1.95	2.01	1.92	1.97	2.03	2.10	1.99	2.04	2.10	2.18
		Amps	5.8	6.0	6.2	6.4	6.3	6.4	6.6	6.9	6.8	7.0	7.2	7.5	7.3	**7.5**	7.7	8.0	7.8	8.0	8.2	8.5	8.2	8.4	8.7	9.0
		Hi PR	216	233	246	256	243	261	276	288	276	297	314	327	314	**338**	357	373	354	381	402	419	391	421	444	463
		Lo PR	108	115	125	133	114	121	132	141	118	126	137	146	124	**132**	144	154	130	139	151	161	135	143	156	167

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects ACCA (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
80	984	MBh	24.3	24.9	26.6	28.4	23.8	24.3	26.0	27.7	23.2	23.7	25.3	27.1	22.6	23.1	24.7	26.4	21.5	22.0	23.5	25.1	19.9	20.4	21.8	23.3
		S/T	1.00	0.93	0.76	0.57	1.00	0.96	0.79	0.59	1.00	1.00	0.81	0.60	1.00	1.00	0.83	0.62	1.00	1.00	0.86	0.64	1.00	1.00	0.87	0.65
		ΔT	23	22	19	15	22	22	19	15	22	22	19	15	21	22	19	15	20	21	19	15	19	19	18	14
		kW	1.59	1.62	1.67	1.73	1.71	1.75	1.81	1.87	1.82	1.87	1.93	1.99	1.92	1.97	2.03	2.10	2.01	2.05	2.12	2.20	2.08	2.13	2.20	2.28
		Amps	6.1	6.2	6.4	6.7	6.6	6.7	7.0	7.2	7.1	7.3	7.6	7.9	7.6	7.8	8.1	8.4	8.1	8.3	8.6	8.9	8.6	8.8	9.1	9.5
		Hi PR	227	245	258	270	255	275	290	303	290	312	330	344	331	356	376	392	372	400	423	441	411	442	467	487
		Lo PR	113	121	132	140	120	127	139	148	124	132	145	154	131	139	152	162	137	146	159	169	142	151	165	175
	875	MBh	23.6	24.1	25.8	27.6	23.1	23.6	25.2	26.9	22.5	23.0	24.6	26.3	22.0	22.5	**24.0**	25.7	20.9	21.3	22.8	24.4	19.3	19.8	21.1	22.6
		S/T	0.95	0.89	0.72	0.54	0.98	0.92	0.75	0.56	1.00	0.94	0.77	0.57	1.00	0.97	**0.79**	0.59	1.00	1.00	0.82	0.61	1.00	1.00	0.83	0.62
		ΔT	24	23	20	16	24	23	20	16	24	23	20	16	23	23	**20**	16	22	22	20	16	20	21	18	15
		kW	1.57	1.61	1.66	1.72	1.70	1.74	1.79	1.85	1.81	1.85	1.91	1.98	1.91	1.95	**2.02**	2.08	1.99	2.03	2.10	2.18	2.06	2.11	2.18	2.26
		Amps	6.0	6.2	6.4	6.6	6.5	6.7	6.9	7.2	7.1	7.3	7.5	7.8	7.6	7.8	**8.0**	8.3	8.1	8.3	8.5	8.9	8.5	8.7	9.0	9.4
		Hi PR	225	242	256	267	253	272	287	300	287	309	327	341	327	352	**372**	388	368	396	419	436	407	438	462	482
		Lo PR	112	119	130	139	119	126	138	147	123	131	143	152	129	138	**150**	160	136	144	158	168	140	149	163	174
	766	MBh	21.8	22.3	23.8	25.5	21.3	21.8	23.3	24.9	20.8	21.3	22.7	24.3	20.3	20.7	22.2	23.7	19.3	19.7	21.0	22.5	17.9	18.2	19.5	20.8
		S/T	0.91	0.86	0.70	0.52	0.95	0.89	0.72	0.54	0.97	0.91	0.74	0.55	1.00	0.94	0.76	0.57	1.04	0.97	0.79	0.59	1.05	0.98	0.80	0.60
		ΔT	24	23	20	16	24	23	20	16	24	23	20	16	24	23	20	16	24	23	20	16	22	22	19	15
		kW	1.54	1.57	1.62	1.67	1.66	1.69	1.75	1.81	1.76	1.80	1.86	1.93	1.86	1.90	1.96	2.03	1.94	1.98	2.05	2.12	2.01	2.05	2.12	2.20
		Amps	5.9	6.0	6.2	6.4	6.3	6.5	6.7	7.0	6.9	7.1	7.3	7.6	7.4	7.5	7.8	8.1	7.8	8.0	8.3	8.6	8.3	8.5	8.8	9.1
		Hi PR	218	235	248	259	245	264	279	291	279	300	317	330	318	342	361	376	357	384	406	423	395	425	449	468
		Lo PR	109	116	126	135	115	122	134	142	120	127	139	148	126	134	146	155	132	140	153	163	136	145	158	168
85	984	MBh	24.8	25.2	26.4	28.2	24.2	24.7	25.8	27.6	23.6	24.1	25.2	26.9	23.0	23.5	24.6	26.2	21.9	22.3	23.4	24.9	20.3	20.7	21.6	23.1
		S/T	1.00	1.00	0.91	0.74	1.00	1.00	0.94	0.76	1.00	1.00	0.96	0.78	1.00	1.00	0.99	0.81	1.00	1.00	1.00	0.84	1.00	1.00	1.00	0.84
		ΔT	23	24	22	19	23	23	23	20	22	22	23	20	22	22	23	20	20	21	22	19	19	19	20	18
		kW	1.60	1.64	1.69	1.74	1.73	1.77	1.82	1.89	1.84	1.88	1.94	2.01	1.94	1.98	2.05	2.12	2.02	2.07	2.14	2.21	2.10	2.14	2.22	2.30
		Amps	6.1	6.3	6.5	6.7	6.6	6.8	7.0	7.3	7.2	7.4	7.6	7.9	7.7	7.9	8.2	8.5	8.2	8.4	8.7	9.0	8.7	8.9	9.2	9.6
		Hi PR	230	247	261	272	258	277	293	306	293	316	333	348	334	359	379	396	376	404	427	445	415	447	472	492
		Lo PR	114	122	133	142	121	129	140	150	126	134	146	155	132	140	153	163	138	147	161	171	143	152	166	177
	875	MBh	24.0	24.5	25.7	27.4	23.5	23.9	25.1	26.8	22.9	23.4	24.5	26.1	22.4	22.8	23.9	25.5	21.2	21.7	22.7	24.2	19.7	20.1	21.0	22.4
		S/T	0.99	0.96	0.86	0.70	1.00	0.99	0.90	0.73	1.00	1.00	0.92	0.74	1.00	1.00	0.95	0.77	1.00	1.00	0.98	0.80	1.00	1.00	0.99	0.80
		ΔT	25	25	23	20	25	25	24	20	24	25	24	20	24	24	24	21	22	23	23	20	21	21	22	19
		kW	1.59	1.62	1.67	1.73	1.71	1.75	1.81	1.87	1.82	1.87	1.93	1.99	1.92	1.97	2.03	2.10	2.01	2.05	2.12	2.20	2.08	2.13	2.20	2.28
		Amps	6.1	6.2	6.4	6.7	6.6	6.7	7.0	7.2	7.1	7.3	7.6	7.9	7.6	7.8	8.1	8.4	8.1	8.3	8.6	8.9	8.6	8.8	9.1	9.5
		Hi PR	227	245	258	270	255	275	290	303	290	312	330	344	331	356	376	392	372	400	423	441	411	442	467	487
		Lo PR	113	121	132	140	120	127	139	148	124	132	145	154	131	139	152	162	137	146	159	169	142	151	165	175
	766	MBh	22.2	22.6	23.7	25.3	21.7	22.1	23.1	24.7	21.2	21.6	22.6	24.1	20.6	21.0	22.0	23.5	19.6	20.0	20.9	22.3	18.2	18.5	19.4	20.7
		S/T	0.96	0.92	0.83	0.68	0.99	0.96	0.86	0.70	1.00	0.98	0.89	0.72	1.00	1.00	0.91	0.74	1.00	1.00	0.95	0.77	1.00	1.00	0.96	0.78
		ΔT	25	25	24	21	26	25	24	21	25	25	24	21	25	25	24	21	24	24	24	21	22	22	22	19
		kW	1.55	1.58	1.63	1.69	1.67	1.71	1.76	1.82	1.78	1.82	1.88	1.94	1.87	1.92	1.98	2.05	1.95	2.00	2.07	2.14	2.02	2.07	2.14	2.22
		Amps	5.9	6.1	6.3	6.5	6.4	6.6	6.8	7.0	7.0	7.1	7.4	7.6	7.4	7.6	7.9	8.2	7.9	8.1	8.4	8.7	8.4	8.6	8.9	9.2
		Hi PR	221	237	251	262	248	266	281	293	282	303	320	334	321	345	364	380	361	388	410	428	399	429	453	472
		Lo PR	110	117	128	136	116	124	135	144	121	128	140	149	127	135	147	157	133	141	154	164	137	146	160	170

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects AHRI (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
70	900	MBh	24.7	25.6	28.1	-	24.1	25.0	27.4	-	23.6	24.4	26.8	-	23.0	23.8	26.1	-	21.8	22.6	24.8	-	20.2	21.0	23.0	-
		S/T	0.75	0.62	0.43	-	0.77	0.65	0.45	-	0.79	0.66	0.46	-	0.82	0.68	0.47	-	0.85	0.71	0.49	-	0.86	0.72	0.50	-
		ΔT	19	16	12	-	19	17	13	-	19	17	13	-	19	17	13	-	19	16	12	-	18	15	12	-
		kW	1.44	1.48	1.52	-	1.56	1.59	1.64	-	1.66	1.69	1.75	-	1.74	1.78	1.84	-	1.82	1.86	1.92	-	1.88	1.93	1.99	-
		Amps	5.8	5.9	6.1	-	6.2	6.3	6.5	-	6.7	6.9	7.1	-	7.2	7.3	7.6	-	7.6	7.8	8.0	-	8.0	8.2	8.5	-
		Hi PR	207	223	236	-	233	250	265	-	265	285	301	-	302	324	343	-	339	365	385	-	375	403	426	-
		Lo PR	111	118	129	-	117	124	136	-	122	129	141	-	128	136	148	-	134	142	155	-	138	147	161	-
	800	MBh	24.0	24.9	27.3	-	23.4	24.3	26.6	-	22.9	23.7	26.0	-	22.3	23.1	25.4	-	21.2	22.0	24.1	-	19.6	20.4	22.3	-
		S/T	0.71	0.59	0.41	-	0.74	0.62	0.43	-	0.76	0.63	0.44	-	0.78	0.65	0.45	-	0.81	0.68	0.47	-	0.82	0.68	0.47	-
		ΔT	20	17	13	-	20	17	13	-	20	17	13	-	20	17	13	-	20	17	13	-	18	16	12	-
		kW	1.43	1.46	1.51	-	1.54	1.58	1.63	-	1.64	1.68	1.73	-	1.73	1.77	1.83	-	1.80	1.84	1.91	-	1.87	1.91	1.97	-
		Amps	5.7	5.8	6.0	-	6.2	6.3	6.5	-	6.7	6.8	7.0	-	7.1	7.3	7.5	-	7.5	7.7	8.0	-	8.0	8.1	8.4	-
		Hi PR	205	221	233	-	230	248	262	-	262	282	298	-	299	321	339	-	336	361	382	-	371	399	422	-
		Lo PR	110	117	127	-	116	123	135	-	120	128	140	-	126	135	147	-	133	141	154	-	137	146	159	-
	700	MBh	22.2	23.0	25.2	-	21.6	22.4	24.6	-	21.1	21.9	24.0	-	20.6	21.4	23.4	-	19.6	20.3	22.2	-	18.1	18.8	20.6	-
		S/T	0.69	0.57	0.40	-	0.71	0.59	0.41	-	0.73	0.61	0.42	-	0.75	0.63	0.44	-	0.78	0.65	0.45	-	0.79	0.66	0.46	-
		ΔT	20	17	13	-	20	18	13	-	20	18	13	-	20	18	13	-	20	17	13	-	19	16	12	-
		kW	1.40	1.43	1.47	-	1.51	1.54	1.59	-	1.60	1.64	1.69	-	1.69	1.72	1.78	-	1.76	1.80	1.86	-	1.82	1.86	1.92	-
		Amps	5.6	5.7	5.9	-	6.0	6.1	6.3	-	6.5	6.6	6.8	-	6.9	7.1	7.3	-	7.3	7.5	7.7	-	7.7	7.9	8.2	-
		Hi PR	199	214	226	-	224	241	254	-	254	274	289	-	290	312	329	-	326	351	370	-	360	387	409	-
		Lo PR	106	113	124	-	112	120	131	-	117	124	136	-	123	131	142	-	129	137	149	-	133	141	154	-
75	900	MBh	25.1	25.9	28.0	30.1	24.6	25.3	27.4	29.4	24.0	24.7	26.7	28.7	23.4	**24.1**	26.1	28.0	22.2	22.9	24.8	26.6	20.6	21.2	22.9	24.6
		S/T	0.85	0.76	0.57	0.37	0.88	0.79	0.60	0.38	0.90	0.81	0.61	0.39	0.93	**0.83**	0.63	0.41	0.97	0.86	0.65	0.42	0.97	0.87	0.66	0.42
		ΔT	22	20	16	11	22	20	17	11	22	20	17	12	22	**20**	17	12	22	20	17	11	20	19	15	11
		kW	1.46	1.49	1.53	1.59	1.57	1.60	1.66	1.71	1.67	1.71	1.76	1.82	1.76	**1.80**	1.86	1.92	1.83	1.88	1.94	2.00	1.90	1.94	2.01	2.08
		Amps	5.8	5.9	6.1	6.3	6.3	6.4	6.6	6.8	6.8	6.9	7.2	7.4	7.2	**7.4**	7.6	7.9	7.7	7.8	8.1	8.4	8.1	8.3	8.6	8.9
		Hi PR	210	226	238	248	235	253	267	279	267	288	304	317	305	**328**	346	361	343	369	389	406	379	407	430	449
		Lo PR	112	119	130	138	118	126	137	146	123	131	143	152	129	**137**	150	160	135	144	157	167	140	149	162	173
	800	MBh	24.4	25.1	27.2	29.2	23.8	24.5	26.6	28.5	23.3	24.0	25.9	27.8	22.7	**23.4**	25.3	27.2	21.6	22.2	24.0	25.8	20.0	20.6	22.3	23.9
		S/T	0.81	0.72	0.55	0.35	0.84	0.75	0.57	0.37	0.86	0.77	0.58	0.37	0.89	**0.79**	0.60	0.39	0.92	0.82	0.62	0.40	0.93	0.83	0.63	0.40
		ΔT	23	21	17	12	23	21	17	12	23	21	17	12	23	**21**	17	12	23	21	17	12	21	20	16	11
		kW	1.44	1.48	1.52	1.57	1.56	1.59	1.64	1.70	1.66	1.69	1.75	1.81	1.74	**1.78**	1.84	1.90	1.82	1.86	1.92	1.99	1.88	1.93	1.99	2.06
		Amps	5.8	5.9	6.1	6.3	6.2	6.3	6.5	6.8	6.7	6.9	7.1	7.3	7.2	**7.3**	7.6	7.8	7.6	7.8	8.0	8.3	8.0	8.2	8.5	8.8
		Hi PR	207	223	236	246	233	251	265	276	265	285	301	314	302	**325**	343	357	339	365	386	402	375	403	426	444
		Lo PR	111	118	129	137	117	125	136	145	122	129	141	150	128	**136**	148	158	134	142	156	166	139	147	161	171
	700	MBh	22.5	23.2	25.1	26.9	22.0	22.7	24.5	26.3	21.5	22.1	23.9	25.7	21.0	**21.6**	23.4	25.1	19.9	20.5	22.2	23.8	18.4	19.0	20.6	22.1
		S/T	0.78	0.70	0.53	0.34	0.81	0.72	0.55	0.35	0.83	0.74	0.56	0.36	0.86	**0.77**	0.58	0.37	0.89	0.79	0.60	0.39	0.90	0.80	0.61	0.39
		ΔT	23	21	17	12	23	22	18	12	23	22	18	12	24	**22**	18	12	23	21	18	12	22	20	16	11
		kW	1.41	1.44	1.49	1.53	1.52	1.55	1.60	1.65	1.62	1.65	1.70	1.76	1.70	**1.74**	1.80	1.86	1.77	1.81	1.87	1.94	1.83	1.88	1.94	2.01
		Amps	5.6	5.7	5.9	6.1	6.0	6.2	6.4	6.6	6.5	6.7	6.9	7.2	7.0	**7.1**	7.4	7.6	7.4	7.6	7.8	8.1	7.8	8.0	8.3	8.6
		Hi PR	201	217	229	239	226	243	257	268	257	276	292	304	293	**315**	332	347	329	354	374	390	364	391	413	431
		Lo PR	107	114	125	133	114	121	132	140	118	126	137	146	124	**132**	144	153	130	138	151	161	134	143	156	166

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects ACCA (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																						
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																						
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
80	900	MBh	25.6	26.1	27.9	29.9	25.0	25.5	27.3	29.2	24.4	24.9	26.6	28.5	23.8	24.3	26.0	27.8	22.6	23.1	24.7	26.4	20.9	21.4	22.9	24.4
		S/T	0.93	0.87	0.71	0.53	0.96	0.90	0.74	0.55	1.00	0.93	0.75	0.56	1.00	0.96	0.78	0.58	1.00	1.00	0.81	0.60	1.00	1.00	0.82	0.61
		ΔT	24	23	20	16	25	24	21	16	25	24	21	16	24	24	21	17	23	24	20	16	21	22	19	15
		kW	1.47	1.50	1.55	1.60	1.58	1.62	1.67	1.73	1.68	1.72	1.78	1.84	1.77	1.81	1.87	1.94	1.85	1.89	1.95	2.02	1.92	1.96	2.02	2.09
		Amps	5.9	6.0	6.2	6.4	6.3	6.5	6.7	6.9	6.8	7.0	7.2	7.5	7.3	7.5	7.7	8.0	7.7	7.9	8.2	8.5	8.2	8.4	8.6	9.0
		Hi PR	212	228	241	251	238	256	270	282	270	291	307	320	308	331	350	365	346	372	393	410	382	412	435	453
		Lo PR	113	120	131	140	119	127	139	148	124	132	144	154	130	139	151	161	137	145	159	169	141	150	164	175
	800	MBh	24.8	25.4	27.1	29.0	24.3	24.8	26.5	28.3	23.7	24.2	25.9	27.6	23.1	23.6	**25.2**	27.0	22.0	22.4	24.0	25.6	20.3	20.8	22.2	23.7
		S/T	0.89	0.83	0.68	0.51	0.92	0.86	0.70	0.52	0.94	0.88	0.72	0.54	0.97	0.91	**0.74**	0.56	1.00	0.95	0.77	0.58	1.00	0.96	0.78	0.58
		ΔT	25	24	21	17	26	25	21	17	26	25	21	17	26	25	**22**	17	25	24	21	17	23	23	20	16
		kW	1.46	1.49	1.54	1.59	1.57	1.60	1.66	1.71	1.67	1.71	1.76	1.82	1.76	1.80	**1.86**	1.92	1.83	1.88	1.94	2.00	1.90	1.94	2.01	2.08
		Amps	5.8	5.9	6.1	6.3	6.3	6.4	6.6	6.8	6.8	6.9	7.2	7.4	7.2	7.4	**7.6**	7.9	7.7	7.8	8.1	8.4	8.1	8.3	8.6	8.9
		Hi PR	210	226	238	248	235	253	267	279	267	288	304	317	305	328	**346**	361	343	369	389	406	379	407	430	449
		Lo PR	112	119	130	138	118	126	137	146	123	131	143	152	129	137	**150**	160	135	144	157	167	140	149	162	173
	700	MBh	22.9	23.4	25.0	26.8	22.4	22.9	24.5	26.1	21.9	22.3	23.9	25.5	21.3	21.8	23.3	24.9	20.3	20.7	22.1	23.7	18.8	19.2	20.5	21.9
		S/T	0.86	0.80	0.65	0.49	0.89	0.83	0.68	0.51	0.91	0.85	0.69	0.52	0.94	0.88	0.72	0.54	0.97	0.91	0.74	0.56	0.98	0.92	0.75	0.56
		ΔT	26	25	21	17	26	25	22	17	26	25	22	17	26	25	22	18	26	25	22	17	24	23	20	16
		kW	1.42	1.45	1.50	1.55	1.53	1.56	1.62	1.67	1.63	1.66	1.72	1.78	1.71	1.75	1.81	1.87	1.79	1.83	1.89	1.95	1.85	1.89	1.96	2.02
		Amps	5.7	5.8	6.0	6.2	6.1	6.2	6.4	6.7	6.6	6.8	7.0	7.2	7.0	7.2	7.4	7.7	7.5	7.6	7.9	8.2	7.9	8.1	8.3	8.6
		Hi PR	203	219	231	241	228	245	259	270	259	279	295	307	295	318	336	350	332	358	378	394	367	395	417	435
		Lo PR	109	115	126	134	115	122	133	142	119	127	138	147	125	133	145	155	131	140	152	162	136	144	158	168
85	900	MBh	26.0	26.5	27.8	29.7	25.4	25.9	27.2	29.0	24.8	25.3	26.5	28.3	24.2	24.7	25.9	27.6	23.0	23.5	24.6	26.2	21.3	21.7	22.8	24.3
		S/T	0.98	0.94	0.85	0.69	1.00	0.98	0.88	0.71	1.00	1.00	0.90	0.73	1.00	1.00	0.93	0.76	1.00	1.00	0.97	0.78	1.00	1.00	0.98	0.79
		ΔT	26	26	24	21	26	26	24	21	25	26	24	21	25	25	25	21	24	24	24	21	22	22	23	20
		kW	1.48	1.51	1.56	1.61	1.60	1.63	1.68	1.74	1.70	1.74	1.79	1.85	1.79	1.83	1.89	1.95	1.87	1.91	1.97	2.04	1.93	1.98	2.04	2.11
		Amps	5.9	6.1	6.2	6.5	6.4	6.5	6.7	7.0	6.9	7.1	7.3	7.5	7.3	7.5	7.8	8.0	7.8	8.0	8.2	8.5	8.2	8.4	8.7	9.0
		Hi PR	214	230	243	253	240	258	273	284	273	294	310	323	311	334	353	368	350	376	397	414	386	416	439	458
		Lo PR	114	121	133	141	121	128	140	149	125	133	146	155	132	140	153	163	138	147	160	171	143	152	166	177
	800	MBh	25.3	25.8	27.0	28.8	24.7	25.2	26.4	28.1	24.1	24.6	25.7	27.5	23.5	24.0	25.1	26.8	22.3	22.8	23.8	25.4	20.7	21.1	22.1	23.6
		S/T	0.93	0.90	0.81	0.66	0.96	0.93	0.84	0.68	0.99	0.95	0.86	0.70	1.00	0.98	0.89	0.72	1.00	1.00	0.92	0.75	1.00	1.00	0.93	0.75
		ΔT	27	27	25	22	27	27	25	22	27	27	25	22	27	27	26	22	26	26	25	22	24	24	24	20
		kW	1.47	1.50	1.55	1.60	1.58	1.62	1.67	1.73	1.68	1.72	1.78	1.84	1.77	1.81	1.87	1.94	1.85	1.89	1.95	2.02	1.92	1.96	2.02	2.09
		Amps	5.9	6.0	6.2	6.4	6.3	6.5	6.7	6.9	6.8	7.0	7.2	7.5	7.3	7.5	7.7	8.0	7.7	7.9	8.2	8.5	8.2	8.4	8.6	9.0
		Hi PR	212	228	241	251	238	256	270	282	270	291	307	320	308	331	350	365	346	372	393	410	382	412	435	453
		Lo PR	113	120	131	140	119	127	139	148	124	132	144	154	130	139	151	161	137	145	159	169	141	150	164	175
	700	MBh	23.3	23.8	24.9	26.6	22.8	23.2	24.3	26.0	22.2	22.7	23.8	25.3	21.7	22.1	23.2	24.7	20.6	21.0	22.0	23.5	19.1	19.5	20.4	21.8
		S/T	0.90	0.87	0.78	0.63	0.93	0.90	0.81	0.66	0.95	0.92	0.83	0.67	0.98	0.95	0.86	0.70	1.00	0.99	0.89	0.72	1.00	0.99	0.90	0.73
		ΔT	27.5	27	26	22	28	27	26	22	28	27	26	22	28	28	26	23	27	27	26	22	25	25	24	21
		kW	1.43	1.46	1.51	1.56	1.54	1.58	1.63	1.68	1.64	1.68	1.73	1.79	1.73	1.77	1.83	1.89	1.80	1.84	1.90	1.97	1.87	1.91	1.97	2.04
		Amps	5.7	5.8	6.0	6.2	6.2	6.3	6.5	6.7	6.7	6.8	7.0	7.3	7.1	7.3	7.5	7.8	7.5	7.7	8.0	8.2	8.0	8.1	8.4	8.7
		Hi PR	205	221	233	243	230	248	262	273	262	282	298	311	298	321	339	354	336	361	382	398	371	399	422	440
		Lo PR	110	117	127	136	116	123	135	143	120	128	140	149	126	135	147	156	133	141	154	164	137	146	159	170

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects AHRI (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
70	1294	MBh	33.9	35.1	38.5	-	33.1	34.3	37.6	-	32.3	33.5	36.7	-	31.5	32.7	35.8	-	30.0	31.1	34.0	-	27.8	28.8	31.5	-
		S/T	0.74	0.62	0.43	-	0.76	0.64	0.44	-	0.78	0.65	0.45	-	0.81	0.67	0.47	-	0.84	0.70	0.49	-	0.85	0.71	0.49	-
		ΔT	18	15	12	-	18	16	12	-	18	16	12	-	18	16	12	-	18	15	12	-	17	14	11	-
		kW	2.16	2.20	2.27	-	2.33	2.38	2.46	-	2.48	2.53	2.62	-	2.61	2.67	2.76	-	2.72	2.78	2.88	-	2.82	2.88	2.98	-
		Amps	8.3	8.5	8.8	-	9.0	9.2	9.5	-	9.7	10.0	10.3	-	10.4	10.7	11.0	-	11.1	11.3	11.7	-	11.7	12.0	12.4	-
		Hi PR	220	237	250	-	247	266	280	-	281	302	319	-	320	344	363	-	360	387	409	-	397	428	452	-
		Lo PR	108	114	125	-	114	121	132	-	118	126	137	-	124	132	144	-	130	138	151	-	135	143	156	-
	1150	MBh	32.9	34.1	37.4	-	32.2	33.3	36.5	-	31.4	32.5	35.6	-	30.6	31.7	34.8	-	29.1	30.2	33.0	-	26.9	27.9	30.6	-
		S/T	0.70	0.59	0.41	-	0.73	0.61	0.42	-	0.75	0.62	0.43	-	0.77	0.64	0.45	-	0.80	0.67	0.46	-	0.81	0.67	0.47	-
		ΔT	18	16	12	-	19	16	12	-	19	16	12	-	19	16	12	-	19	16	12	-	17	15	11	-
		kW	2.14	2.19	2.26	-	2.31	2.36	2.44	-	2.46	2.51	2.59	-	2.59	2.65	2.73	-	2.70	2.76	2.85	-	2.79	2.86	2.95	-
		Amps	8.2	8.4	8.7	-	8.9	9.1	9.4	-	9.7	9.9	10.2	-	10.3	10.6	10.9	-	11.0	11.2	11.6	-	11.6	11.9	12.3	-
		Hi PR	218	234	247	-	244	263	278	-	278	299	316	-	317	341	360	-	356	383	405	-	393	423	447	-
		Lo PR	107	113	124	-	113	120	131	-	117	124	136	-	123	131	143	-	129	137	150	-	133	142	155	-
	1006	MBh	30.4	31.5	34.5	-	29.7	30.8	33.7	-	29.0	30.0	32.9	-	28.3	29.3	32.1	-	26.9	27.8	30.5	-	24.9	25.8	28.2	-
		S/T	0.68	0.57	0.39	-	0.70	0.59	0.41	-	0.72	0.60	0.42	-	0.74	0.62	0.43	-	0.77	0.64	0.45	-	0.78	0.65	0.45	-
		ΔT	19	16	12	-	19	16	13	-	19	16	13	-	19	17	13	-	19	16	12	-	18	15	12	-
		kW	2.09	2.13	2.20	-	2.25	2.30	2.37	-	2.39	2.45	2.53	-	2.52	2.58	2.66	-	2.63	2.69	2.78	-	2.72	2.78	2.88	-
		Amps	8.0	8.2	8.5	-	8.7	8.9	9.1	-	9.4	9.6	9.9	-	10.0	10.3	10.6	-	10.7	10.9	11.3	-	11.3	11.6	12.0	-
		Hi PR	211	227	240	-	237	255	269	-	270	290	306	-	307	330	349	-	345	372	393	-	382	411	434	-
		Lo PR	103	110	120	-	109	116	127	-	113	121	132	-	119	127	138	-	125	133	145	-	129	137	150	-
75	1294	MBh	34.5	35.5	38.4	41.2	33.7	34.7	37.5	40.3	32.9	33.8	36.6	39.3	32.1	**33.0**	35.7	38.4	30.5	31.4	34.0	36.4	28.2	29.1	31.5	33.8
		S/T	0.84	0.75	0.57	0.36	0.87	0.78	0.59	0.38	0.89	0.80	0.60	0.39	0.92	**0.82**	0.62	0.40	0.95	0.85	0.65	0.42	0.96	0.86	0.65	0.42
		ΔT	21	19	15	11	21	19	16	11	21	19	16	11	21	**19**	16	11	21	19	16	11	19	18	15	10
		kW	2.17	2.22	2.29	2.37	2.35	2.40	2.48	2.56	2.50	2.55	2.64	2.73	2.63	**2.69**	2.78	2.88	2.74	2.81	2.90	3.00	2.84	2.91	3.01	3.11
		Amps	8.4	8.6	8.9	9.2	9.1	9.3	9.6	9.9	9.8	10.1	10.4	10.8	10.5	**10.8**	11.1	11.5	11.2	11.4	11.8	12.3	11.8	12.1	12.5	13.0
		Hi PR	222	239	253	263	249	268	283	296	284	305	322	336	323	**348**	367	383	363	391	413	431	401	432	456	476
		Lo PR	109	116	126	134	115	122	133	142	119	127	139	148	125	**133**	146	155	131	140	153	163	136	145	158	168
	1150	MBh	33.5	34.5	37.3	40.0	32.7	33.7	36.4	39.1	31.9	32.9	35.6	38.2	31.1	**32.1**	34.7	37.2	29.6	30.5	33.0	35.4	27.4	28.2	30.5	32.8
		S/T	0.80	0.71	0.54	0.35	0.83	0.74	0.56	0.36	0.85	0.76	0.57	0.37	0.88	**0.78**	0.59	0.38	0.91	0.81	0.62	0.40	0.92	0.82	0.62	0.40
		ΔT	21	20	16	11	22	20	16	11	22	20	16	11	22	**20**	16	11	22	20	16	11	20	18	15	10
		kW	2.16	2.20	2.28	2.35	2.33	2.38	2.46	2.54	2.48	2.53	2.62	2.70	2.61	**2.67**	2.76	2.85	2.72	2.78	2.88	2.98	2.82	2.88	2.98	3.08
		Amps	8.3	8.5	8.8	9.1	9.0	9.2	9.5	9.8	9.7	10.0	10.3	10.7	10.4	**10.7**	11.0	11.4	11.1	11.3	11.7	12.2	11.7	12.0	12.4	12.9
		Hi PR	220	237	250	261	247	266	281	293	281	302	319	333	320	**344**	363	379	360	387	409	426	397	428	452	471
		Lo PR	108	115	125	133	114	121	132	141	118	126	137	146	124	**132**	144	154	130	138	151	161	135	143	156	166
	1006	MBh	30.9	31.8	34.4	37.0	30.2	31.1	33.6	36.1	29.5	30.3	32.8	35.2	28.7	**29.6**	32.0	34.4	27.3	28.1	30.4	32.7	25.3	26.0	28.2	30.3
		S/T	0.77	0.69	0.52	0.34	0.80	0.71	0.54	0.35	0.82	0.73	0.55	0.36	0.84	**0.76**	0.57	0.37	0.88	0.78	0.59	0.38	0.88	0.79	0.60	0.39
		ΔT	22	20	16	11	22	20	17	11	22	20	17	11	22	**20**	17	12	22	20	16	11	20	19	15	11
		kW	2.10	2.15	2.22	2.29	2.27	2.32	2.39	2.47	2.41	2.47	2.55	2.64	2.54	**2.60**	2.69	2.78	2.65	2.71	2.80	2.90	2.75	2.81	2.90	3.00
		Amps	8.1	8.3	8.6	8.9	8.7	8.9	9.2	9.6	9.5	9.7	10.0	10.4	10.1	**10.4**	10.7	11.1	10.8	11.0	11.4	11.8	11.4	11.7	12.1	12.5
		Hi PR	213	230	243	253	239	258	272	284	272	293	309	323	310	**334**	352	368	349	376	397	414	386	415	438	457
		Lo PR	104	111	121	129	110	117	128	136	115	122	133	142	120	**128**	140	149	126	134	147	156	131	139	152	161

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects ACCA (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
		MBh	35.1	35.9	38.3	41.0	34.3	35.0	37.4	40.0	33.5	34.2	36.5	39.0	32.6	33.4	35.6	38.1	31.0	31.7	33.9	36.2	28.7	29.4	31.4	33.5
		S/T	0.92	0.86	0.70	0.52	0.95	0.89	0.73	0.54	1.00	0.92	0.74	0.56	1.00	0.94	0.77	0.57	1.00	1.00	0.80	0.60	1.00	1.00	0.80	0.60
		ΔT	23	22	19	15	23	22	19	15	24	22	19	15	23	22	19	16	22	23	19	15	20	21	18	14
	1294	kW	2.19	2.24	2.31	2.39	2.37	2.42	2.50	2.58	2.52	2.58	2.66	2.75	2.65	2.71	2.80	2.90	2.77	2.83	2.93	3.03	2.87	2.93	3.03	3.14
		Amps	8.5	8.7	8.9	9.3	9.1	9.4	9.7	10.0	9.9	10.2	10.5	10.9	10.6	10.9	11.2	11.6	11.3	11.5	11.9	12.4	11.9	12.2	12.6	13.1
		Hi PR	224	242	255	266	252	271	286	299	286	308	325	339	326	351	371	387	367	395	417	435	406	436	461	481
		Lo PR	110	117	128	136	116	123	135	144	121	128	140	149	127	135	147	157	133	141	154	164	137	146	159	170
		MBh	34.1	34.8	37.2	39.8	33.3	34.0	36.3	38.8	32.5	33.2	35.5	37.9	31.7	32.4	**34.6**	37.0	30.1	30.8	32.9	35.1	27.9	28.5	30.4	32.5
		S/T	0.88	0.82	0.67	0.50	0.91	0.85	0.69	0.52	0.93	0.87	0.71	0.53	0.96	0.90	**0.73**	0.55	1.00	0.94	0.76	0.57	1.00	0.94	0.77	0.57
		ΔT	24	23	20	16	24	23	20	16	24	23	20	16	24	23	**20**	16	24	23	20	16	22	21	19	15
80	1150	kW	2.18	2.22	2.29	2.37	2.35	2.40	2.48	2.56	2.50	2.55	2.64	2.73	2.63	2.69	**2.78**	2.88	2.74	2.81	2.90	3.00	2.84	2.91	3.01	3.11
		Amps	8.4	8.6	8.9	9.2	9.1	9.3	9.6	9.9	9.8	10.1	10.4	10.8	10.5	10.8	**11.1**	11.5	11.2	11.4	11.8	12.3	11.8	12.1	12.5	13.0
		Hi PR	222	239	253	263	249	268	283	296	284	305	322	336	323	348	**367**	383	363	391	413	431	401	432	456	476
		Lo PR	109	116	126	134	115	122	133	142	119	127	139	148	125	133	**146**	155	131	140	153	163	136	145	158	168
		MBh	31.4	32.1	34.3	36.7	30.7	31.4	33.5	35.8	30.0	30.6	32.7	35.0	29.3	29.9	31.9	34.1	27.8	28.4	30.3	32.4	25.7	26.3	28.1	30.0
		S/T	0.84	0.79	0.64	0.48	0.88	0.82	0.67	0.50	0.90	0.84	0.69	0.51	0.93	0.87	0.71	0.53	0.96	0.90	0.73	0.55	0.97	0.91	0.74	0.55
		ΔT	24	23	20	16	25	24	20	16	25	24	20	16	25	24	21	16	24	23	20	16	23	22	19	15
	1006	kW	2.12	2.17	2.24	2.31	2.29	2.34	2.41	2.50	2.44	2.49	2.57	2.66	2.56	2.62	2.71	2.80	2.67	2.74	2.83	2.92	2.77	2.83	2.93	3.03
		Amps	8.2	8.4	8.6	8.9	8.8	9.0	9.3	9.7	9.6	9.8	10.1	10.5	10.2	10.5	10.8	11.2	10.9	11.1	11.5	11.9	11.5	11.8	12.2	12.6
		Hi PR	216	232	245	255	242	260	275	287	275	296	313	326	313	337	356	371	352	379	401	418	389	419	443	462
		Lo PR	105	112	122	130	111	119	129	138	116	123	134	143	122	129	141	150	127	136	148	158	132	140	153	163
		MBh	35.7	36.4	38.1	40.7	34.9	35.6	37.2	39.7	34.0	34.7	36.3	38.8	33.2	33.9	35.5	37.8	31.6	32.2	33.7	35.9	29.2	29.8	31.2	33.3
		S/T	0.96	0.93	0.84	0.68	1.00	0.96	0.87	0.70	1.00	0.99	0.89	0.72	1.00	1.00	0.92	0.75	1.00	1.00	0.95	0.77	1.00	1.00	0.96	0.78
		ΔT	24	24	23	20	25	24	23	20	24	24	23	20	24	24	23	20	22	23	23	20	21	21	21	18
	1294	kW	2.21	2.26	2.33	2.41	2.39	2.44	2.52	2.60	2.54	2.60	2.68	2.77	2.68	2.74	2.83	2.93	2.79	2.86	2.95	3.05	2.89	2.96	3.06	3.17
		Amps	8.5	8.7	9.0	9.4	9.2	9.4	9.7	10.1	10.0	10.3	10.6	11.0	10.7	11.0	11.3	11.7	11.4	11.7	12.0	12.5	12.0	12.3	12.8	13.2
		Hi PR	227	244	258	269	254	274	289	301	289	311	329	343	329	355	374	391	371	399	421	439	410	441	465	485
		Lo PR	111	118	129	137	117	125	136	145	122	130	141	151	128	136	149	158	134	143	156	166	139	148	161	172
		MBh	34.7	35.3	37.0	39.5	33.9	34.5	36.1	38.6	33.1	33.7	35.3	37.6	32.2	32.9	34.4	36.7	30.6	31.2	32.7	34.9	28.4	28.9	30.3	32.3
		S/T	0.92	0.89	0.80	0.65	0.95	0.92	0.83	0.67	0.98	0.94	0.85	0.69	1.00	0.97	0.88	0.71	1.00	1.00	0.91	0.74	1.00	1.00	0.92	0.74
		ΔT	25	25	24	20	26	25	24	21	26	25	24	21	26	26	24	21	24	25	24	21	23	23	22	19
85	1150	kW	2.19	2.24	2.31	2.39	2.37	2.42	2.50	2.58	2.52	2.58	2.66	2.75	2.65	2.71	2.80	2.90	2.77	2.83	2.93	3.03	2.87	2.93	3.03	3.14
		Amps	8.5	8.7	8.9	9.3	9.1	9.4	9.7	10.0	9.9	10.2	10.5	10.9	10.6	10.9	11.2	11.6	11.3	11.5	11.9	12.4	11.9	12.2	12.6	13.1
		Hi PR	224	242	255	266	252	271	286	299	286	308	325	339	326	351	371	387	367	395	417	435	406	436	461	481
		Lo PR	110	117	128	136	116	123	135	144	121	128	140	149	127	135	147	157	133	141	154	164	137	146	159	170
		MBh	32.0	32.6	34.2	36.4	31.3	31.9	33.4	35.6	30.5	31.1	32.6	34.7	29.8	30.3	31.8	33.9	28.3	28.8	30.2	32.2	26.2	26.7	28.0	29.8
		S/T	0.89	0.85	0.77	0.63	0.92	0.89	0.80	0.65	0.94	0.91	0.82	0.66	0.97	0.94	0.85	0.69	1.00	0.97	0.88	0.71	1.00	0.98	0.89	0.72
		ΔT	26	25	24	21	26	26	24	21	26	26	24	21	26	26	25	21	26	26	24	21	24	24	23	20
	1006	kW	2.14	2.19	2.26	2.33	2.31	2.36	2.43	2.52	2.46	2.51	2.59	2.68	2.59	2.64	2.73	2.83	2.70	2.76	2.85	2.95	2.79	2.86	2.95	3.06
		Amps	8.2	8.4	8.7	9.0	8.9	9.1	9.4	9.7	9.7	9.9	10.2	10.6	10.3	10.6	10.9	11.3	11.0	11.2	11.6	12.0	11.6	11.9	12.3	12.8
		Hi PR	218	234	247	258	244	263	278	290	278	299	316	329	316	341	360	375	356	383	405	422	393	423	447	466
		Lo PR	107	113	124	132	113	120	131	139	117	124	136	145	123	131	143	152	129	137	150	159	133	142	155	165

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects AHRI (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
70	1209	MBh	33.7	35.0	38.3	-	33.0	34.2	37.4	-	32.2	33.3	36.5	-	31.4	32.5	35.6	-	29.8	30.9	33.9	-	27.6	28.6	31.4	-
		S/T	0.74	0.62	0.43	-	0.77	0.64	0.45	-	0.79	0.66	0.46	-	0.81	0.68	0.47	-	0.85	0.71	0.49	-	0.85	0.71	0.49	-
		ΔT	19	16	13	-	19	17	13	-	19	17	13	-	19	17	13	-	19	17	13	-	18	15	12	-
		kW	1.96	2.00	2.07	-	2.12	2.16	2.23	-	2.25	2.30	2.38	-	2.37	2.43	2.51	-	2.48	2.53	2.62	-	2.57	2.62	2.71	-
		Amps	7.6	7.8	8.0	-	8.2	8.4	8.7	-	8.9	9.1	9.4	-	9.5	9.7	10.1	-	10.1	10.4	10.7	-	10.7	11.0	11.3	-
		Hi PR	205	220	233	-	230	247	261	-	261	281	297	-	297	320	338	-	335	360	380	-	370	398	420	-
		Lo PR	109	116	126	-	115	122	134	-	120	127	139	-	126	134	146	-	132	140	153	-	136	145	158	-
	1075	MBh	32.8	34.0	37.2	-	32.0	33.2	36.3	-	31.2	32.4	35.5	-	30.5	31.6	34.6	-	28.9	30.0	32.9	-	26.8	27.8	30.4	-
		S/T	0.71	0.59	0.41	-	0.73	0.61	0.42	-	0.75	0.63	0.44	-	0.78	0.65	0.45	-	0.81	0.67	0.47	-	0.81	0.68	0.47	-
		ΔT	20	17	13	-	20	17	13	-	20	17	13	-	20	18	13	-	20	17	13	-	19	16	12	-
		kW	1.95	1.99	2.05	-	2.10	2.15	2.22	-	2.23	2.28	2.36	-	2.35	2.41	2.49	-	2.46	2.51	2.60	-	2.54	2.60	2.69	-
		Amps	7.5	7.7	8.0	-	8.1	8.3	8.6	-	8.8	9.0	9.3	-	9.4	9.7	10.0	-	10.0	10.3	10.6	-	10.6	10.9	11.2	-
		Hi PR	203	218	230	-	227	245	258	-	259	278	294	-	294	317	335	-	331	356	376	-	366	394	416	-
		Lo PR	108	115	125	-	114	121	132	-	118	126	137	-	124	132	144	-	130	139	151	-	135	143	156	-
	941	MBh	30.2	31.3	34.3	-	29.5	30.6	33.5	-	28.8	29.9	32.7	-	28.1	29.1	31.9	-	26.7	27.7	30.3	-	24.7	25.7	28.1	-
		S/T	0.68	0.57	0.40	-	0.71	0.59	0.41	-	0.73	0.61	0.42	-	0.75	0.63	0.43	-	0.78	0.65	0.45	-	0.78	0.65	0.45	-
		ΔT	20	17	13	-	20	18	13	-	20	18	13	-	21	18	14	-	20	18	13	-	19	16	12	-
		kW	1.90	1.94	2.00	-	2.05	2.09	2.16	-	2.18	2.23	2.30	-	2.29	2.35	2.42	-	2.39	2.45	2.53	-	2.48	2.53	2.62	-
		Amps	7.3	7.5	7.8	-	7.9	8.1	8.4	-	8.6	8.8	9.1	-	9.2	9.4	9.7	-	9.8	10.0	10.3	-	10.3	10.6	10.9	-
		Hi PR	197	211	223	-	221	237	251	-	251	270	285	-	286	307	325	-	321	346	365	-	355	382	403	-
		Lo PR	105	111	121	-	110	117	128	-	115	122	133	-	121	128	140	-	126	134	147	-	131	139	152	-
75	1209	MBh	34.3	35.3	38.2	41.0	33.5	34.5	37.3	40.1	32.7	33.7	36.5	39.1	31.9	**32.9**	35.6	38.2	30.3	31.2	33.8	36.3	28.1	28.9	31.3	33.6
		S/T	0.84	0.75	0.57	0.37	0.87	0.78	0.59	0.38	0.90	0.80	0.61	0.39	0.93	**0.83**	0.63	0.40	0.96	0.86	0.65	0.42	0.97	0.87	0.66	0.42
		ΔT	22	20	17	11	22	21	17	12	22	21	17	12	22	**21**	17	12	22	20	17	12	21	19	16	11
		kW	1.98	2.02	2.09	2.16	2.13	2.18	2.25	2.33	2.27	2.32	2.40	2.48	2.39	**2.45**	2.53	2.62	2.50	2.56	2.64	2.73	2.59	2.65	2.74	2.83
		Amps	7.7	7.9	8.1	8.4	8.3	8.5	8.8	9.1	9.0	9.2	9.5	9.9	9.6	**9.8**	10.2	10.5	10.2	10.5	10.8	11.2	10.8	11.1	11.4	11.9
		Hi PR	207	222	235	245	232	250	264	275	264	284	300	313	300	**323**	341	356	338	364	384	401	373	402	424	443
		Lo PR	110	117	128	136	116	124	135	144	121	128	140	149	127	**135**	147	157	133	141	154	164	137	146	160	170
	1075	MBh	33.3	34.3	37.1	39.8	32.5	33.5	36.3	38.9	31.8	32.7	35.4	38.0	31.0	**31.9**	34.5	37.1	29.4	30.3	32.8	35.2	27.3	28.1	30.4	32.6
		S/T	0.80	0.72	0.54	0.35	0.83	0.75	0.56	0.36	0.86	0.77	0.58	0.37	0.88	**0.79**	0.60	0.38	0.92	0.82	0.62	0.40	0.92	0.83	0.63	0.40
		ΔT	23	21	17	12	23	21	18	12	23	21	18	12	23	**22**	18	12	23	21	17	12	22	20	16	11
		kW	1.96	2.00	2.07	2.14	2.12	2.16	2.23	2.31	2.25	2.30	2.38	2.46	2.37	**2.43**	2.51	2.60	2.48	2.53	2.62	2.71	2.57	2.63	2.71	2.81
		Amps	7.6	7.8	8.0	8.3	8.2	8.4	8.7	9.0	8.9	9.1	9.4	9.8	9.5	**9.7**	10.1	10.4	10.1	10.4	10.7	11.1	10.7	11.0	11.3	11.8
		Hi PR	205	220	233	243	230	247	261	272	261	281	297	310	297	**320**	338	353	335	360	380	397	370	398	420	438
		Lo PR	109	116	126	135	115	122	134	142	120	127	139	148	126	**134**	146	155	132	140	153	163	136	145	158	168
	941	MBh	30.7	31.7	34.3	36.8	30.0	30.9	33.5	35.9	29.3	30.2	32.7	35.1	28.6	**29.4**	31.9	34.2	27.2	28.0	30.3	32.5	25.2	25.9	28.0	30.1
		S/T	0.78	0.69	0.53	0.34	0.80	0.72	0.54	0.35	0.82	0.74	0.56	0.36	0.85	**0.76**	0.58	0.37	0.88	0.79	0.60	0.38	0.89	0.80	0.60	0.39
		ΔT	23	21	18	12	24	22	18	12	24	22	18	12	24	**22**	18	12	23	22	18	12	22	20	17	11
		kW	1.91	1.95	2.02	2.08	2.06	2.11	2.18	2.25	2.20	2.25	2.32	2.40	2.31	**2.37**	2.45	2.53	2.41	2.47	2.55	2.64	2.50	2.56	2.64	2.74
		Amps	7.4	7.6	7.8	8.1	8.0	8.2	8.4	8.8	8.7	8.9	9.2	9.5	9.3	**9.5**	9.8	10.2	9.8	10.1	10.4	10.8	10.4	10.7	11.0	11.4
		Hi PR	199	214	226	235	223	240	253	264	253	273	288	300	289	**311**	328	342	325	349	369	385	359	386	408	425
		Lo PR	106	112	123	131	112	119	130	138	116	123	135	143	122	**130**	141	151	128	136	148	158	132	140	153	163

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects ACCA (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
80	1209	MBh	34.9	35.7	38.1	40.8	34.1	34.9	37.2	39.8	33.3	34.0	36.3	38.9	32.5	33.2	35.5	37.9	30.9	31.5	33.7	36.0	28.6	29.2	31.2	33.4
		S/T	0.93	0.87	0.71	0.53	0.96	0.90	0.73	0.55	1.00	0.92	0.75	0.56	1.00	0.95	0.78	0.58	1.00	1.00	0.80	0.60	1.00	1.00	0.81	0.61
		ΔT	25	24	20	16	25	24	21	17	25	24	21	17	25	24	21	17	23	24	21	16	22	22	19	15
		kW	1.99	2.04	2.10	2.17	2.15	2.20	2.27	2.35	2.29	2.34	2.42	2.50	2.42	2.47	2.55	2.64	2.52	2.58	2.67	2.76	2.61	2.67	2.76	2.86
		Amps	7.7	7.9	8.2	8.5	8.4	8.6	8.8	9.2	9.1	9.3	9.6	10.0	9.7	9.9	10.3	10.6	10.3	10.6	10.9	11.3	10.9	11.2	11.6	12.0
		Hi PR	209	225	237	247	234	252	266	278	266	287	303	316	303	327	345	360	341	367	388	405	377	406	429	447
		Lo PR	111	118	129	137	117	125	136	145	122	130	142	151	128	136	149	158	134	143	156	166	139	148	161	172
	1075	MBh	33.9	34.6	37.0	39.6	33.1	33.8	36.2	38.6	32.3	33.0	35.3	37.7	31.5	32.2	**34.4**	36.8	30.0	30.6	32.7	35.0	27.8	28.4	30.3	32.4
		S/T	0.88	0.83	0.67	0.50	0.91	0.86	0.70	0.52	0.94	0.88	0.72	0.54	0.97	0.91	**0.74**	0.55	1.00	0.94	0.77	0.57	1.00	0.95	0.77	0.58
		ΔT	26	25	21	17	26	25	22	17	26	25	22	17	26	25	**22**	17	26	25	21	17	24	23	20	16
		kW	1.98	2.02	2.09	2.16	2.13	2.18	2.25	2.33	2.27	2.32	2.40	2.48	2.40	2.45	**2.53**	2.62	2.50	2.56	2.64	2.73	2.59	2.65	2.74	2.83
		Amps	7.7	7.9	8.1	8.4	8.3	8.5	8.8	9.1	9.0	9.2	9.5	9.9	9.6	9.8	**10.2**	10.5	10.2	10.5	10.8	11.2	10.8	11.1	11.4	11.9
		Hi PR	207	222	235	245	232	250	264	275	264	284	300	313	300	323	**341**	356	338	364	384	401	373	402	424	443
		Lo PR	110	117	128	136	116	124	135	144	121	128	140	149	127	135	**147**	157	133	141	154	164	137	146	160	170
	941	MBh	31.3	32.0	34.2	36.5	30.6	31.2	33.4	35.7	29.8	30.5	32.6	34.8	29.1	29.7	31.8	34.0	27.7	28.3	30.2	32.3	25.6	26.2	28.0	29.9
		S/T	0.85	0.80	0.65	0.49	0.88	0.83	0.67	0.50	0.90	0.85	0.69	0.52	0.93	0.88	0.71	0.53	0.97	0.91	0.74	0.55	0.98	0.92	0.75	0.56
		ΔT	26	25	22	17	26	25	22	18	26	25	22	18	27	25	22	18	26	25	22	17	24	23	20	16
		kW	1.93	1.97	2.03	2.10	2.08	2.13	2.20	2.27	2.22	2.26	2.34	2.42	2.33	2.39	2.47	2.55	2.43	2.49	2.57	2.66	2.52	2.58	2.67	2.76
		Amps	7.5	7.6	7.9	8.2	8.1	8.3	8.5	8.8	8.8	9.0	9.3	9.6	9.3	9.6	9.9	10.3	9.9	10.2	10.5	10.9	10.5	10.8	11.1	11.6
		Hi PR	201	216	228	238	225	242	256	267	256	275	291	303	291	314	331	345	328	353	373	389	362	390	412	429
		Lo PR	107	113	124	132	113	120	131	139	117	125	136	145	123	131	143	152	129	137	150	159	133	142	155	165
85	1209	MBh	35.5	36.2	37.9	40.5	34.7	35.4	37.0	39.5	33.9	34.5	36.2	38.6	33.1	33.7	35.3	37.6	31.4	32.0	33.5	35.8	29.1	29.6	31.1	33.1
		S/T	0.97	0.94	0.85	0.69	1.00	0.97	0.88	0.71	1.00	1.00	0.90	0.73	1.00	1.00	0.93	0.75	1.00	1.00	0.96	0.78	1.00	1.00	0.97	0.79
		ΔT	26	26	24	21	26	26	25	21	26	26	25	21	25	26	25	22	24	24	25	21	22	23	23	20
		kW	2.01	2.05	2.12	2.19	2.17	2.22	2.29	2.37	2.31	2.36	2.44	2.53	2.44	2.49	2.58	2.66	2.54	2.60	2.69	2.78	2.63	2.69	2.79	2.88
		Amps	7.8	8.0	8.3	8.6	8.4	8.6	8.9	9.2	9.2	9.4	9.7	10.0	9.8	10.0	10.3	10.7	10.4	10.7	11.0	11.4	11.0	11.3	11.7	12.1
		Hi PR	211	227	240	250	237	255	269	280	269	290	306	319	307	330	348	363	345	371	392	409	381	410	433	452
		Lo PR	112	119	130	139	119	126	138	147	123	131	143	152	129	138	150	160	136	144	157	168	140	149	163	173
	1075	MBh	34.5	35.2	36.8	39.3	33.7	34.3	36.0	38.4	32.9	33.5	35.1	37.5	32.1	32.7	34.3	36.5	30.5	31.1	32.5	34.7	28.2	28.8	30.1	32.2
		S/T	0.93	0.89	0.81	0.65	0.96	0.93	0.84	0.68	0.98	0.95	0.86	0.69	1.00	0.98	0.88	0.72	1.00	1.00	0.92	0.74	1.00	1.00	0.93	0.75
		ΔT	27	27	25	22	28	27	26	22	28	27	26	22	27	27	26	22	26	27	26	22	24	25	24	21
		kW	1.99	2.04	2.10	2.17	2.15	2.20	2.27	2.35	2.29	2.34	2.42	2.50	2.42	2.47	2.55	2.64	2.52	2.58	2.67	2.76	2.61	2.67	2.76	2.86
		Amps	7.7	7.9	8.2	8.5	8.4	8.6	8.8	9.2	9.1	9.3	9.6	10.0	9.7	9.9	10.3	10.6	10.3	10.6	10.9	11.3	10.9	11.2	11.6	12.0
		Hi PR	209	225	237	247	234	252	266	278	266	287	303	316	303	327	345	360	341	367	388	405	377	406	429	447
		Lo PR	111	118	129	137	117	125	136	145	122	130	142	151	128	136	149	158	134	143	156	166	139	148	161	172
	941	MBh	31.8	32.5	34.0	36.3	31.1	31.7	33.2	35.4	30.4	30.9	32.4	34.6	29.6	30.2	31.6	33.7	28.1	28.7	30.0	32.0	26.1	26.6	27.8	29.7
		S/T	0.89	0.86	0.78	0.63	0.92	0.89	0.81	0.65	0.95	0.92	0.83	0.67	0.98	0.94	0.85	0.69	1.00	0.98	0.88	0.72	1.00	0.99	0.89	0.72
		ΔT	27.8	27	26	22	28	28	26	23	28	28	26	23	28	28	26	23	28	27	26	22	25	26	24	21
		kW	1.94	1.99	2.05	2.12	2.10	2.14	2.22	2.29	2.23	2.28	2.36	2.44	2.35	2.41	2.49	2.57	2.46	2.51	2.60	2.69	2.54	2.60	2.69	2.78
		Amps	7.5	7.7	8.0	8.3	8.1	8.3	8.6	8.9	8.8	9.0	9.3	9.7	9.4	9.7	10.0	10.3	10.0	10.3	10.6	11.0	10.6	10.9	11.2	11.7
		Hi PR	203	218	230	240	227	245	258	269	258	278	294	306	294	317	335	349	331	356	376	393	366	394	416	434
		Lo PR	108	115	125	133	114	121	132	141	118	126	137	146	124	132	144	154	130	139	151	161	135	143	156	167

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects AHRI (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																					
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
70	1744	MBh	46.5	48.2	52.9	-	45.5	47.1	51.6	-	44.4	46.0	50.4	-	43.3	44.9	49.2	-	41.1	42.6	46.7	-	38.1	39.5	43.3	-
		S/T	0.76	0.63	0.44	-	0.79	0.66	0.45	-	0.81	0.67	0.47	-	0.83	0.70	0.48	-	0.86	0.72	0.50	-	0.87	0.73	0.50	-
		ΔT	19	16	12	-	19	16	12	-	19	16	12	-	19	16	12	-	19	16	12	-	18	15	11	-
		kW	2.82	2.88	2.98	-	3.04	3.11	3.21	-	3.24	3.31	3.42	-	3.41	3.48	3.60	-	3.55	3.63	3.75	-	3.68	3.76	3.89	-
		Amps	5.8	6.0	6.4	-	6.6	6.9	7.3	-	7.6	7.9	8.3	-	8.5	8.8	9.3	-	9.3	9.7	10.2	-	10.2	10.5	11.1	-
		Hi PR	212	228	241	-	238	256	270	-	270	291	307	-	308	331	350	-	346	373	393	-	382	412	435	-
		Lo PR	107	114	124	-	113	120	131	-	117	125	136	-	123	131	143	-	129	137	150	-	133	142	155	-
	1550	MBh	45.2	46.8	51.3	-	44.1	45.7	50.1	-	43.1	44.7	48.9	-	42.0	43.6	47.7	-	39.9	41.4	45.4	-	37.0	38.3	42.0	-
		S/T	0.72	0.60	0.42	-	0.75	0.63	0.43	-	0.77	0.64	0.44	-	0.79	0.66	0.46	-	0.82	0.69	0.48	-	0.83	0.69	0.48	-
		ΔT	19	17	13	-	20	17	13	-	20	17	13	-	20	17	13	-	20	17	13	-	18	16	12	-
		kW	2.80	2.86	2.95	-	3.02	3.08	3.18	-	3.21	3.28	3.39	-	3.38	3.45	3.57	-	3.52	3.60	3.72	-	3.65	3.73	3.86	-
		Amps	5.7	5.9	6.3	-	6.5	6.8	7.2	-	7.5	7.8	8.2	-	8.4	8.7	9.1	-	9.2	9.5	10.0	-	10.0	10.4	10.9	-
		Hi PR	210	226	238	-	235	253	267	-	267	288	304	-	305	328	346	-	343	369	389	-	379	408	430	-
		Lo PR	106	112	123	-	112	119	130	-	116	123	135	-	122	130	142	-	128	136	148	-	132	141	153	-
	1356	MBh	41.7	43.2	47.4	-	40.7	42.2	46.3	-	39.8	41.2	45.2	-	38.8	40.2	44.1	-	36.9	38.2	41.9	-	34.1	35.4	38.8	-
		S/T	0.70	0.58	0.40	-	0.72	0.60	0.42	-	0.74	0.62	0.43	-	0.77	0.64	0.44	-	0.79	0.66	0.46	-	0.80	0.67	0.46	-
		ΔT	20	17	13	-	20	17	13	-	20	17	13	-	20	17	13	-	20	17	13	-	19	16	12	-
		kW	2.73	2.79	2.88	-	2.94	3.01	3.10	-	3.13	3.20	3.30	-	3.29	3.37	3.48	-	3.43	3.51	3.63	-	3.55	3.63	3.76	-
		Amps	5.4	5.6	6.0	-	6.2	6.5	6.9	-	7.2	7.5	7.9	-	8.0	8.3	8.7	-	8.8	9.1	9.6	-	9.6	10.0	10.5	-
		Hi PR	203	219	231	-	228	245	259	-	259	279	295	-	296	318	336	-	332	358	378	-	367	395	417	-
		Lo PR	102	109	119	-	108	115	126	-	113	120	131	-	118	126	137	-	124	132	144	-	128	136	149	-
75	1744	MBh	47.3	48.7	52.8	56.6	46.2	47.6	51.5	55.3	45.1	46.5	50.3	54.0	44.0	**45.3**	49.1	52.7	41.8	43.1	46.6	50.0	38.7	39.9	43.2	46.3
		S/T	0.86	0.77	0.58	0.38	0.89	0.80	0.61	0.39	0.92	0.82	0.62	0.40	0.95	**0.85**	0.64	0.41	0.98	0.88	0.66	0.43	0.99	0.89	0.67	0.43
		ΔT	22	20	16	11	22	20	16	11	22	20	16	11	22	**20**	17	11	22	20	16	11	20	19	15	11
		kW	2.85	2.91	3.00	3.10	3.07	3.14	3.24	3.34	3.26	3.34	3.45	3.56	3.44	**3.51**	3.63	3.75	3.58	3.66	3.79	3.92	3.71	3.79	3.92	4.06
		Amps	5.9	6.1	6.5	6.9	6.7	7.0	7.4	7.9	7.7	8.0	8.5	9.0	8.6	**8.9**	9.4	9.9	9.5	9.8	10.3	10.9	10.3	10.7	11.2	11.8
		Hi PR	214	230	243	253	240	258	273	284	273	294	310	323	311	**334**	353	368	350	376	397	414	386	416	439	458
		Lo PR	108	115	125	133	114	121	132	141	118	126	137	146	124	**132**	144	154	130	139	151	161	135	143	157	167
	1550	MBh	46.0	47.3	51.2	55.0	44.9	46.2	50.0	53.7	43.8	45.1	48.8	52.4	42.8	**44.0**	47.6	51.1	40.6	41.8	45.3	48.6	37.6	38.7	41.9	45.0
		S/T	0.82	0.74	0.56	0.36	0.85	0.76	0.58	0.37	0.87	0.78	0.59	0.38	0.90	**0.81**	0.61	0.39	0.94	0.84	0.63	0.41	0.94	0.84	0.64	0.41
		ΔT	22	21	17	12	23	21	17	12	23	21	17	12	23	**21**	17	12	23	21	17	12	21	19	16	11
		kW	2.82	2.88	2.98	3.07	3.04	3.11	3.21	3.32	3.24	3.31	3.42	3.53	3.41	**3.48**	3.60	3.72	3.55	3.63	3.75	3.88	3.68	3.76	3.89	4.02
		Amps	5.8	6.0	6.4	6.8	6.6	6.9	7.3	7.7	7.6	7.9	8.3	8.8	8.5	**8.8**	9.3	9.8	9.3	9.7	10.2	10.7	10.2	10.5	11.1	11.7
		Hi PR	212	228	241	251	238	256	270	282	270	291	307	320	308	**331**	350	365	346	373	393	410	383	412	435	453
		Lo PR	107	114	124	132	113	120	131	139	117	125	136	145	123	**131**	143	152	129	137	150	160	133	142	155	165
	1356	MBh	42.4	43.7	47.3	50.7	41.4	42.7	46.2	49.6	40.4	41.6	45.1	48.4	39.5	**40.6**	44.0	47.2	37.5	38.6	41.8	44.8	34.7	35.8	38.7	41.5
		S/T	0.79	0.71	0.54	0.35	0.82	0.74	0.56	0.36	0.84	0.75	0.57	0.37	0.87	**0.78**	0.59	0.38	0.90	0.81	0.61	0.39	0.91	0.81	0.62	0.40
		ΔT	23	21	17	12	23	21	17	12	23	21	17	12	23	**21**	18	12	23	21	17	12	21	20	16	11
		kW	2.76	2.81	2.90	3.00	2.97	3.03	3.13	3.23	3.16	3.23	3.33	3.44	3.32	**3.40**	3.51	3.63	3.46	3.54	3.66	3.78	3.59	3.67	3.79	3.92
		Amps	5.5	5.7	6.1	6.5	6.3	6.6	7.0	7.4	7.3	7.6	8.0	8.5	8.1	**8.4**	8.9	9.4	8.9	9.3	9.8	10.3	9.8	10.1	10.6	11.2
		Hi PR	205	221	233	243	230	248	262	273	262	282	298	311	299	**321**	339	354	336	361	382	398	371	399	422	440
		Lo PR	104	110	120	128	109	116	127	135	114	121	132	141	119	**127**	139	148	125	133	145	155	129	138	150	160

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects ACCA (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
80	1744	MBh	48.2	49.2	52.6	56.2	47.1	48.1	51.4	54.9	45.9	46.9	50.1	53.6	44.8	45.8	48.9	52.3	42.6	43.5	46.5	49.7	39.4	40.3	43.1	46.0
		S/T	0.95	0.89	0.72	0.54	1.00	0.92	0.75	0.56	1.00	0.94	0.77	0.57	1.00	1.00	0.79	0.59	1.00	1.00	0.82	0.61	1.00	1.00	0.83	0.62
		ΔT	24	23	20	16	25	23	20	16	24	23	20	16	24	24	20	16	22	23	20	16	21	21	19	15
		kW	2.87	2.93	3.03	3.12	3.09	3.16	3.26	3.37	3.29	3.36	3.48	3.59	3.47	3.54	3.66	3.79	3.61	3.70	3.82	3.95	3.74	3.83	3.96	4.09
		Amps	6.0	6.2	6.6	7.0	6.8	7.1	7.5	8.0	7.9	8.2	8.6	9.1	8.7	9.1	9.5	10.1	9.6	10.0	10.4	11.0	10.5	10.8	11.4	12.0
		Hi PR	216	232	245	256	242	261	275	287	276	297	313	327	314	338	357	372	353	380	401	419	390	420	443	463
		Lo PR	109	116	126	135	115	122	134	142	120	127	139	148	126	134	146	155	132	140	153	163	136	145	158	168
	1550	MBh	46.8	47.8	51.1	54.6	45.7	46.7	49.9	53.3	44.6	45.6	48.7	52.0	43.5	44.5	**47.5**	50.8	41.3	42.2	45.1	48.2	38.3	39.1	41.8	44.7
		S/T	0.90	0.85	0.69	0.51	0.94	0.88	0.71	0.53	0.96	0.90	0.73	0.55	0.99	0.93	**0.76**	0.56	1.00	0.96	0.78	0.59	1.00	0.97	0.79	0.59
		ΔT	25	24	21	17	25	24	21	17	25	24	21	17	26	24	**21**	17	25	24	21	17	23	23	20	16
		kW	2.85	2.91	3.00	3.10	3.07	3.14	3.24	3.34	3.26	3.34	3.45	3.56	3.44	3.51	**3.63**	3.75	3.58	3.66	3.79	3.92	3.71	3.79	3.92	4.06
		Amps	5.9	6.1	6.5	6.9	6.7	7.0	7.4	7.9	7.7	8.0	8.5	9.0	8.6	8.9	**9.4**	9.9	9.5	9.8	10.3	10.9	10.3	10.7	11.2	11.8
		Hi PR	214	230	243	253	240	258	273	284	273	294	310	323	311	335	**353**	368	350	376	397	414	386	416	439	458
		Lo PR	108	115	125	133	114	121	132	141	118	126	137	146	124	132	**144**	154	130	139	151	161	135	143	157	167
	1356	MBh	43.2	44.1	47.1	50.4	42.2	43.1	46.0	49.2	41.2	42.1	44.9	48.0	40.2	41.0	43.8	46.9	38.2	39.0	41.7	44.5	35.3	36.1	38.6	41.2
		S/T	0.87	0.82	0.66	0.50	0.90	0.85	0.69	0.51	0.92	0.87	0.71	0.53	0.95	0.89	0.73	0.54	0.99	0.93	0.76	0.57	1.00	0.94	0.76	0.57
		ΔT	25	24	21	17	26	25	21	17	26	25	21	17	26	25	22	17	26	25	21	17	24	23	20	16
		kW	2.78	2.84	2.93	3.02	2.99	3.06	3.16	3.26	3.18	3.25	3.36	3.47	3.35	3.43	3.54	3.66	3.49	3.57	3.69	3.82	3.62	3.70	3.82	3.95
		Amps	5.6	5.8	6.2	6.6	6.4	6.7	7.1	7.5	7.4	7.7	8.1	8.6	8.2	8.6	9.0	9.5	9.1	9.4	9.9	10.4	9.9	10.3	10.8	11.4
		Hi PR	207	223	236	246	233	251	265	276	265	285	301	314	302	324	343	357	339	365	385	402	375	403	426	444
		Lo PR	105	111	121	129	110	118	128	137	115	122	133	142	121	128	140	149	126	134	147	156	131	139	152	162
85	1744	MBh	49.0	50.0	52.3	55.8	47.9	48.8	51.1	54.5	46.7	47.6	49.9	53.2	45.6	46.5	48.7	51.9	43.3	44.2	46.2	49.3	40.1	40.9	42.8	45.7
		S/T	0.99	0.96	0.86	0.70	1.00	0.99	0.90	0.73	1.00	1.00	0.92	0.74	1.00	1.00	0.95	0.77	1.00	1.00	0.98	0.80	1.00	1.00	0.99	0.80
		ΔT	26	25	24	21	25	26	24	21	25	25	24	21	24	25	24	21	23	23	24	21	21	22	22	19
		kW	2.89	2.96	3.05	3.15	3.12	3.19	3.29	3.40	3.32	3.39	3.50	3.62	3.49	3.57	3.69	3.82	3.64	3.73	3.85	3.98	3.77	3.86	3.99	4.13
		Amps	6.1	6.3	6.7	7.1	7.0	7.2	7.6	8.1	8.0	8.3	8.7	9.2	8.9	9.2	9.7	10.2	9.7	10.1	10.6	11.2	10.6	11.0	11.5	12.1
		Hi PR	218	235	248	259	245	263	278	290	278	300	316	330	317	341	360	376	357	384	405	423	394	424	448	467
		Lo PR	110	117	128	136	116	124	135	144	121	128	140	149	127	135	147	157	133	141	154	164	137	146	160	170
	1550	MBh	47.6	48.5	50.8	54.2	46.5	47.4	49.6	52.9	45.4	46.3	48.4	51.7	44.3	45.1	47.3	50.4	42.1	42.9	44.9	47.9	39.0	39.7	41.6	44.4
		S/T	0.95	0.91	0.82	0.67	0.98	0.95	0.85	0.69	1.00	0.97	0.88	0.71	1.00	1.00	0.90	0.73	1.00	1.00	0.94	0.76	1.00	1.00	0.95	0.77
		ΔT	27	26	25	21	27	27	25	22	27	27	25	22	26	27	25	22	25	25	25	22	23	24	23	20
		kW	2.87	2.93	3.03	3.12	3.09	3.16	3.26	3.37	3.29	3.36	3.48	3.59	3.47	3.54	3.66	3.79	3.61	3.70	3.82	3.95	3.74	3.83	3.96	4.09
		Amps	6.0	6.2	6.6	7.0	6.8	7.1	7.5	8.0	7.9	8.2	8.6	9.1	8.7	9.1	9.5	10.1	9.6	10.0	10.4	11.0	10.5	10.8	11.4	12.0
		Hi PR	216	232	245	256	242	261	275	287	276	297	313	327	314	338	357	372	353	380	401	419	390	420	443	463
		Lo PR	109	116	126	135	115	122	134	142	120	127	139	148	126	134	146	155	132	140	153	163	136	145	158	168
	1356	MBh	43.9	44.8	46.9	50.0	42.9	43.7	45.8	48.9	41.9	42.7	44.7	47.7	40.9	41.7	43.6	46.5	38.8	39.6	41.4	44.2	36.0	36.7	38.4	41.0
		S/T	0.91	0.88	0.79	0.64	0.95	0.91	0.82	0.67	0.97	0.94	0.84	0.68	1.00	0.97	0.87	0.71	1.00	1.00	0.90	0.73	1.00	1.00	0.91	0.74
		ΔT	27	27	25	22	27	27	26	22	28	27	26	22	28	27	26	22	26	27	25	22	24	25	24	21
		kW	2.80	2.86	2.95	3.05	3.02	3.08	3.18	3.29	3.21	3.28	3.39	3.50	3.38	3.45	3.57	3.69	3.52	3.60	3.72	3.85	3.65	3.73	3.85	3.99
		Amps	5.7	5.9	6.3	6.7	6.5	6.8	7.2	7.6	7.5	7.8	8.2	8.7	8.4	8.7	9.1	9.7	9.2	9.5	10.0	10.6	10.0	10.4	10.9	11.5
		Hi PR	210	225	238	248	235	253	267	279	267	288	304	317	305	328	346	361	343	369	389	406	379	407	430	449
		Lo PR	106	112	123	131	112	119	130	138	116	123	135	143	122	130	141	151	128	136	148	158	132	140	153	163

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects AHRI (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
70	1350	MBh	39.4	40.8	44.7	-	38.5	39.9	43.7	-	37.6	38.9	42.7	-	36.7	38.0	41.6	-	34.8	36.1	39.5	-	32.3	33.4	36.6	-
		S/T	0.72	0.60	0.42	-	0.75	0.63	0.43	-	0.77	0.64	0.44	-	0.79	0.66	0.46	-	0.82	0.69	0.48	-	0.83	0.69	0.48	-
		ΔT	19	17	13	-	20	17	13	-	20	17	13	-	20	17	13	-	20	17	13	-	18	16	12	-
		kW	2.38	2.43	2.51	-	2.57	2.62	2.71	-	2.73	2.79	2.88	-	2.87	2.94	3.03	-	3.00	3.06	3.17	-	3.10	3.17	3.28	-
		Amps	8.9	9.1	9.4	-	9.6	9.8	10.1	-	10.3	10.6	10.9	-	11.0	11.2	11.6	-	11.7	11.9	12.3	-	12.3	12.6	13.0	-
		Hi PR	205	221	233	-	230	247	261	-	262	281	297	-	298	321	338	-	335	361	381	-	370	398	421	-
		Lo PR	107	113	124	-	113	120	131	-	117	124	136	-	123	131	143	-	129	137	150	-	133	142	155	-
	1150	MBh	38.3	39.7	43.4	-	37.4	38.7	42.4	-	36.5	37.8	41.4	-	35.6	36.9	40.4	-	33.8	35.0	38.4	-	31.3	32.5	35.6	-
		S/T	0.69	0.58	0.40	-	0.71	0.60	0.41	-	0.73	0.61	0.42	-	0.76	0.63	0.44	-	0.79	0.66	0.45	-	0.79	0.66	0.46	-
		ΔT	21	18	14	-	21	18	14	-	21	19	14	-	22	19	14	-	21	18	14	-	20	17	13	-
		kW	2.36	2.41	2.49	-	2.54	2.60	2.68	-	2.71	2.77	2.86	-	2.85	2.91	3.01	-	2.97	3.04	3.14	-	3.08	3.14	3.25	-
		Amps	8.8	9.0	9.3	-	9.5	9.7	10.0	-	10.2	10.5	10.8	-	10.9	11.1	11.5	-	11.6	11.8	12.2	-	12.2	12.5	12.9	-
		Hi PR	203	218	231	-	228	245	259	-	259	279	294	-	295	317	335	-	332	357	377	-	367	394	417	-
		Lo PR	105	112	122	-	111	119	129	-	116	123	134	-	122	129	141	-	127	136	148	-	132	140	153	-
	1050	MBh	37.7	39.1	42.8	-	36.8	38.1	41.8	-	35.9	37.2	40.8	-	35.1	36.3	39.8	-	33.3	34.5	37.8	-	30.8	32.0	35.0	-
		S/T	0.67	0.56	0.38	-	0.69	0.58	0.40	-	0.71	0.59	0.41	-	0.73	0.61	0.42	-	0.76	0.63	0.44	-	0.76	0.64	0.44	-
		ΔT	22	19	14	-	22	19	15	-	22	19	15	-	22	19	15	-	22	19	15	-	21	18	14	-
		kW	2.33	2.38	2.45	-	2.51	2.56	2.65	-	2.67	2.73	2.82	-	2.81	2.87	2.97	-	2.93	2.99	3.09	-	3.03	3.10	3.20	-
		Amps	8.7	8.9	9.2	-	9.3	9.6	9.8	-	10.1	10.3	10.6	-	10.7	11.0	11.3	-	11.4	11.6	12.0	-	12.0	12.3	12.7	-
		Hi PR	199	215	227	-	224	241	254	-	255	274	289	-	290	312	329	-	326	351	371	-	360	388	409	-
		Lo PR	104	110	120	-	110	117	127	-	114	121	132	-	120	127	139	-	125	133	146	-	130	138	151	-
75	1350	MBh	40.1	41.3	44.7	47.9	39.1	40.3	43.6	46.8	38.2	39.3	42.6	45.7	37.3	**38.4**	41.5	44.6	35.4	36.5	39.5	42.4	32.8	33.8	36.6	39.2
		S/T	0.82	0.74	0.56	0.36	0.85	0.76	0.58	0.37	0.87	0.78	0.59	0.38	0.90	**0.81**	0.61	0.39	0.94	0.84	0.63	0.41	0.94	0.84	0.64	0.41
		ΔT	22	21	17	12	23	21	17	12	23	21	17	12	23	**21**	17	12	23	21	17	12	21	19	16	11
		kW	2.40	2.45	2.53	2.61	2.59	2.64	2.73	2.82	2.75	2.81	2.91	3.00	2.90	**2.96**	3.06	3.16	3.02	3.09	3.19	3.30	3.13	3.20	3.31	3.42
		Amps	9.0	9.2	9.4	9.8	9.6	9.9	10.2	10.5	10.4	10.7	11.0	11.4	11.1	**11.3**	11.7	12.1	11.8	12.0	12.4	12.9	12.4	12.7	13.1	13.6
		Hi PR	207	223	235	245	232	250	264	275	264	284	300	313	301	**324**	342	357	339	364	385	401	374	402	425	443
		Lo PR	108	114	125	133	114	121	132	141	118	126	137	146	124	**132**	144	154	130	138	151	161	135	143	156	166
	1150	MBh	38.9	40.1	43.4	46.5	38.0	39.1	42.3	45.4	37.1	38.2	41.3	44.4	36.2	**37.3**	40.3	43.3	34.4	35.4	38.3	41.1	31.8	32.8	35.5	38.1
		S/T	0.78	0.70	0.53	0.34	0.81	0.73	0.55	0.35	0.83	0.75	0.56	0.36	0.86	**0.77**	0.58	0.37	0.89	0.80	0.60	0.39	0.90	0.81	0.61	0.39
		ΔT	24	22	18	13	25	23	19	13	25	23	19	13	25	**23**	19	13	25	23	19	13	23	21	17	12
		kW	2.38	2.43	2.51	2.59	2.57	2.62	2.71	2.80	2.73	2.79	2.88	2.98	2.87	**2.94**	3.04	3.14	3.00	3.06	3.17	3.27	3.10	3.17	3.28	3.39
		Amps	8.9	9.1	9.4	9.7	9.6	9.8	10.1	10.4	10.3	10.6	10.9	11.3	11.0	**11.2**	11.6	12.0	11.7	11.9	12.3	12.7	12.3	12.6	13.0	13.5
		Hi PR	205	221	233	243	230	248	261	273	262	281	297	310	298	**321**	339	353	335	361	381	397	370	399	421	439
		Lo PR	107	113	124	132	113	120	131	139	117	124	136	145	123	**131**	143	152	129	137	150	159	133	142	155	165
	1050	MBh	38.3	39.5	42.7	45.8	37.4	38.5	41.7	44.8	36.5	37.6	40.7	43.7	35.6	**36.7**	39.7	42.6	33.9	34.9	37.7	40.5	31.4	32.3	35.0	37.5
		S/T	0.76	0.68	0.51	0.33	0.78	0.70	0.53	0.34	0.80	0.72	0.54	0.35	0.83	**0.74**	0.56	0.36	0.86	0.77	0.58	0.37	0.87	0.78	0.59	0.38
		ΔT	25	23	19	13	26	24	19	13	26	24	19	13	26	**24**	20	13	26	24	19	13	24	22	18	12
		kW	2.35	2.40	2.47	2.55	2.53	2.59	2.67	2.76	2.69	2.75	2.84	2.94	2.83	**2.90**	2.99	3.09	2.95	3.02	3.12	3.23	3.06	3.13	3.23	3.34
		Amps	8.8	9.0	9.2	9.5	9.4	9.6	9.9	10.3	10.2	10.4	10.7	11.1	10.8	**11.1**	11.4	11.8	11.5	11.7	12.1	12.6	12.1	12.4	12.8	13.3
		Hi PR	201	217	229	239	226	243	257	268	257	277	292	305	293	**315**	333	347	329	355	374	390	364	392	414	431
		Lo PR	105	111	122	130	111	118	129	137	115	122	134	142	121	**129**	140	149	127	135	147	157	131	139	152	162

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects ACCA (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
80	1350	MBh	40.8	41.7	44.5	47.6	39.8	40.7	43.5	46.5	38.9	39.7	42.5	45.4	37.9	38.8	41.4	44.3	36.0	36.8	39.3	42.1	33.4	34.1	36.4	39.0
		S/T	0.90	0.85	0.69	0.51	0.93	0.88	0.71	0.53	0.96	0.90	0.73	0.55	1.00	0.93	0.75	0.56	1.00	0.96	0.78	0.59	1.00	0.97	0.79	0.59
		ΔT	25	24	21	17	25	24	21	17	25	24	21	17	26	24	21	17	25	24	21	17	23	23	20	16
		kW	2.42	2.47	2.55	2.63	2.61	2.67	2.75	2.84	2.77	2.84	2.93	3.03	2.92	2.99	3.09	3.19	3.05	3.12	3.22	3.33	3.15	3.23	3.34	3.45
		Amps	9.0	9.2	9.5	9.9	9.7	9.9	10.2	10.6	10.5	10.7	11.1	11.5	11.2	11.4	11.8	12.2	11.9	12.1	12.5	13.0	12.5	12.8	13.2	13.7
		Hi PR	209	225	238	248	235	253	267	278	267	287	303	316	304	327	345	360	342	368	389	405	378	407	429	448
		Lo PR	109	116	126	134	115	122	133	142	119	127	139	148	125	133	146	155	131	140	153	163	136	145	158	168
	1150	MBh	39.6	40.5	43.2	46.2	38.7	39.5	42.2	45.1	37.8	38.6	41.2	44.1	36.8	37.6	**40.2**	43.0	35.0	35.8	38.2	40.8	32.4	33.1	35.4	37.8
		S/T	0.86	0.81	0.66	0.49	0.89	0.84	0.68	0.51	0.91	0.86	0.70	0.52	0.94	0.88	**0.72**	0.54	0.98	0.92	0.75	0.56	0.99	0.93	0.75	0.56
		ΔT	27	26	23	18	28	26	23	18	28	26	23	18	28	27	**23**	18	27	26	23	18	26	25	21	17
		kW	2.40	2.45	2.53	2.61	2.59	2.64	2.73	2.82	2.75	2.81	2.91	3.00	2.90	2.96	**3.06**	3.16	3.02	3.09	3.19	3.30	3.13	3.20	3.31	3.42
		Amps	9.0	9.2	9.4	9.8	9.6	9.9	10.2	10.5	10.4	10.7	11.0	11.4	11.1	11.3	**11.7**	12.1	11.8	12.0	12.4	12.9	12.4	12.7	13.1	13.6
		Hi PR	207	223	235	245	232	250	264	275	264	284	300	313	301	324	**342**	357	339	364	385	401	374	403	425	443
		Lo PR	108	114	125	133	114	121	132	141	118	126	137	146	124	132	**144**	154	130	138	151	161	135	143	156	166
	1050	MBh	39.0	39.9	42.6	45.5	38.1	38.9	41.6	44.5	37.2	38.0	40.6	43.4	36.3	37.1	39.6	42.3	34.5	35.2	37.6	40.2	31.9	32.6	34.9	37.3
		S/T	0.83	0.78	0.63	0.47	0.86	0.81	0.66	0.49	0.88	0.83	0.67	0.50	0.91	0.85	0.69	0.52	0.94	0.89	0.72	0.54	0.95	0.89	0.73	0.54
		ΔT	28	27	24	19	29	27	24	19	29	28	24	19	29	28	24	19	28	27	24	19	27	26	22	18
		kW	2.37	2.42	2.49	2.58	2.55	2.61	2.69	2.78	2.71	2.77	2.86	2.96	2.86	2.92	3.02	3.12	2.98	3.05	3.15	3.25	3.08	3.15	3.26	3.37
		Amps	8.8	9.0	9.3	9.6	9.5	9.7	10.0	10.4	10.3	10.5	10.8	11.2	10.9	11.2	11.5	11.9	11.6	11.9	12.2	12.7	12.2	12.5	12.9	13.4
		Hi PR	204	219	231	241	228	246	260	271	260	280	295	308	296	318	336	351	333	358	378	394	368	396	418	436
		Lo PR	106	113	123	131	112	119	130	138	116	124	135	144	122	130	142	151	128	136	149	158	132	141	154	164
85	1350	MBh	41.5	42.3	44.3	47.3	40.5	41.3	43.3	46.2	39.6	40.3	42.2	45.1	38.6	39.3	41.2	44.0	36.7	37.4	39.1	41.8	34.0	34.6	36.3	38.7
		S/T	0.95	0.91	0.82	0.67	0.98	0.95	0.85	0.69	1.00	0.97	0.87	0.71	1.00	1.00	0.90	0.73	1.00	1.00	0.94	0.76	1.00	1.00	0.94	0.77
		ΔT	27	26	25	21	27	27	25	22	27	27	25	22	26	27	25	22	25	25	25	22	23	24	23	20
		kW	2.44	2.49	2.57	2.66	2.63	2.69	2.77	2.87	2.80	2.86	2.95	3.05	2.95	3.01	3.11	3.22	3.07	3.14	3.25	3.36	3.18	3.25	3.36	3.48
		Amps	9.1	9.3	9.6	9.9	9.8	10.0	10.3	10.7	10.6	10.8	11.2	11.6	11.3	11.5	11.9	12.3	12.0	12.2	12.6	13.1	12.6	12.9	13.4	13.8
		Hi PR	211	227	240	250	237	255	269	281	270	290	306	319	307	330	349	364	345	372	392	409	382	411	434	452
		Lo PR	110	117	127	136	116	123	135	143	121	128	140	149	127	135	147	157	133	141	154	164	137	146	159	170
	1150	MBh	40.3	41.1	43.0	45.9	39.3	40.1	42.0	44.8	38.4	39.2	41.0	43.8	37.5	38.2	40.0	42.7	35.6	36.3	38.0	40.5	33.0	33.6	35.2	37.6
		S/T	0.90	0.87	0.79	0.64	0.93	0.90	0.81	0.66	0.96	0.92	0.83	0.68	0.99	0.95	0.86	0.70	1.00	0.99	0.89	0.73	1.00	1.00	0.90	0.73
		ΔT	29	29	27	23	29	29	27	24	29	29	27	24	30	29	28	24	28	29	27	24	26	27	25	22
		kW	2.42	2.47	2.55	2.63	2.61	2.67	2.75	2.84	2.77	2.84	2.93	3.03	2.92	2.99	3.09	3.19	3.05	3.12	3.22	3.33	3.15	3.23	3.34	3.45
		Amps	9.0	9.2	9.5	9.9	9.7	9.9	10.2	10.6	10.5	10.7	11.1	11.5	11.2	11.4	11.8	12.2	11.9	12.1	12.5	13.0	12.5	12.8	13.2	13.7
		Hi PR	209	225	238	248	235	253	267	278	267	287	303	316	304	327	345	360	342	368	389	405	378	407	429	448
		Lo PR	109	116	126	134	115	122	133	142	119	127	139	148	125	133	146	155	131	140	153	163	136	145	158	168
	1050	MBh	39.7	40.5	42.4	45.2	38.8	39.5	41.4	44.1	37.8	38.6	40.4	43.1	36.9	37.6	39.4	42.0	35.1	35.7	37.4	39.9	32.5	33.1	34.7	37.0
		S/T	0.87	0.84	0.76	0.61	0.90	0.87	0.78	0.64	0.92	0.89	0.80	0.65	0.95	0.92	0.83	0.67	0.99	0.96	0.86	0.70	1.00	0.96	0.87	0.71
		ΔT	30	30	28	24	31	30	28	25	31	30	28	25	31	30	29	25	30	30	28	24	28	28	26	23
		kW	2.39	2.44	2.52	2.60	2.57	2.63	2.71	2.80	2.74	2.80	2.89	2.98	2.88	2.94	3.04	3.15	3.00	3.07	3.17	3.28	3.11	3.18	3.29	3.40
		Amps	8.9	9.1	9.4	9.7	9.6	9.8	10.1	10.5	10.4	10.6	10.9	11.3	11.0	11.3	11.6	12.0	11.7	12.0	12.3	12.8	12.3	12.6	13.0	13.5
		Hi PR	206	221	234	244	231	248	262	273	262	282	298	311	299	322	340	354	336	362	382	398	371	400	422	440
		Lo PR	107	114	124	132	113	120	131	140	117	125	136	145	123	131	143	152	129	137	150	160	134	142	155	165

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects AHRI (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			OUTDOOR AMBIENT TEMPERATURE																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			ENTERING INDOOR WET BULB TEMPERATURE																							
IDB	AIRFLOW		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
70	2000	MBh	55.9	57.9	63.4	-	54.6	56.5	62.0	-	53.3	55.2	60.5	-	52.0	53.9	59.0	-	49.4	51.2	56.1	-	45.7	47.4	51.9	-
		S/T	0.74	0.62	0.43	-	0.77	0.64	0.44	-	0.79	0.66	0.46	-	0.81	0.68	0.47	-	0.84	0.70	0.49	-	0.85	0.71	0.49	-
		ΔT	19	16	13	-	19	17	13	-	19	17	13	-	19	17	13	-	19	17	13	-	18	15	12	-
		kW	3.55	3.62	3.74	-	3.82	3.90	4.02	-	4.05	4.14	4.27	-	4.26	4.36	4.50	-	4.44	4.54	4.68	-	4.59	4.69	4.85	-
		Amps	13.9	14.2	14.7	-	15.0	15.4	15.9	-	16.3	16.7	17.2	-	17.4	17.8	18.4	-	18.5	19.0	19.6	-	19.6	20.1	20.8	-
		Hi PR	218	234	248	-	244	263	278	-	278	299	316	-	317	341	360	-	356	383	405	-	394	424	447	-
		Lo PR	104	111	121	-	110	117	128	-	114	122	133	-	120	128	139	-	126	134	146	-	130	138	151	-
	1750	MBh	54.2	56.2	61.6	-	53.0	54.9	60.1	-	51.7	53.6	58.7	-	50.4	52.3	57.3	-	47.9	49.7	54.4	-	44.4	46.0	50.4	-
		S/T	0.71	0.59	0.41	-	0.73	0.61	0.42	-	0.75	0.63	0.43	-	0.78	0.65	0.45	-	0.80	0.67	0.47	-	0.81	0.68	0.47	-
		ΔT	20	17	13	-	20	18	13	-	20	18	13	-	21	18	14	-	20	18	13	-	19	16	12	-
		kW	3.52	3.60	3.71	-	3.79	3.87	3.99	-	4.02	4.11	4.24	-	4.23	4.32	4.46	-	4.40	4.50	4.65	-	4.55	4.65	4.81	-
		Amps	13.8	14.1	14.6	-	14.9	15.2	15.7	-	16.1	16.5	17.1	-	17.3	17.7	18.3	-	18.4	18.8	19.4	-	19.4	19.9	20.6	-
		Hi PR	216	232	245	-	242	261	275	-	275	296	313	-	314	337	356	-	353	380	401	-	390	419	443	-
		Lo PR	103	110	120	-	109	116	126	-	113	120	131	-	119	126	138	-	125	132	145	-	129	137	150	-
	1600	MBh	53.4	55.4	60.7	-	52.2	54.1	59.2	-	50.9	52.8	57.8	-	49.7	51.5	56.4	-	47.2	48.9	53.6	-	43.7	45.3	49.7	-
		S/T	0.68	0.57	0.39	-	0.71	0.59	0.41	-	0.72	0.61	0.42	-	0.75	0.62	0.43	-	0.78	0.65	0.45	-	0.78	0.65	0.45	-
		ΔT	21	18	14	-	21	18	14	-	21	18	14	-	21	18	14	-	21	18	14	-	20	17	13	-
		kW	3.48	3.55	3.66	-	3.74	3.82	3.94	-	3.97	4.05	4.18	-	4.17	4.26	4.40	-	4.34	4.44	4.58	-	4.49	4.59	4.74	-
		Amps	13.6	13.9	14.3	-	14.6	15.0	15.5	-	15.9	16.3	16.8	-	17.0	17.4	18.0	-	18.1	18.5	19.1	-	19.1	19.6	20.3	-
		Hi PR	212	228	241	-	238	256	270	-	271	291	308	-	308	332	350	-	347	373	394	-	383	412	435	-
		Lo PR	101	108	118	-	107	114	124	-	111	118	129	-	117	124	136	-	122	130	142	-	127	135	147	-
75	2000	MBh	56.8	58.5	63.3	67.9	55.5	57.1	61.8	66.4	54.2	55.8	60.4	64.8	52.8	**54.4**	58.9	63.2	50.2	51.7	55.9	60.0	46.5	47.9	51.8	55.6
		S/T	0.84	0.75	0.57	0.37	0.87	0.78	0.59	0.38	0.90	0.80	0.61	0.39	0.92	**0.83**	0.63	0.40	0.96	0.86	0.65	0.42	0.97	0.87	0.65	0.42
		ΔT	22	20	17	11	22	21	17	12	22	21	17	12	22	**21**	17	12	22	20	17	12	21	19	16	11
		kW	3.58	3.65	3.77	3.89	3.85	3.93	4.05	4.19	4.09	4.18	4.31	4.45	4.30	**4.39**	4.53	4.68	4.48	4.58	4.72	4.88	4.63	4.73	4.89	5.05
		Amps	14.0	14.4	14.8	15.4	15.1	15.5	16.0	16.6	16.4	16.8	17.4	18.1	17.6	**18.0**	18.6	19.3	18.7	19.2	19.8	20.5	19.8	20.3	21.0	21.8
		Hi PR	220	237	250	261	247	266	281	293	281	302	319	333	320	**344**	364	379	360	387	409	427	398	428	452	471
		Lo PR	105	112	122	130	111	118	129	137	115	123	134	143	121	**129**	141	150	127	135	148	157	131	140	153	163
	1750	MBh	55.1	56.8	61.5	66.0	53.9	55.5	60.0	64.4	52.6	54.1	58.6	62.9	51.3	**52.8**	57.2	61.4	48.7	50.2	54.3	58.3	45.1	46.5	50.3	54.0
		S/T	0.80	0.72	0.54	0.35	0.83	0.74	0.56	0.36	0.85	0.76	0.58	0.37	0.88	**0.79**	0.60	0.38	0.91	0.82	0.62	0.40	0.92	0.83	0.62	0.40
		ΔT	23	21	18	12	24	22	18	12	24	22	18	12	24	**22**	18	12	23	22	18	12	22	20	17	11
		kW	3.55	3.62	3.74	3.85	3.82	3.90	4.02	4.15	4.05	4.14	4.27	4.41	4.26	**4.36**	4.50	4.64	4.44	4.54	4.69	4.84	4.59	4.69	4.85	5.01
		Amps	13.9	14.2	14.7	15.2	15.0	15.4	15.9	16.5	16.3	16.7	17.2	17.9	17.4	**17.8**	18.4	19.1	18.5	19.0	19.6	20.4	19.6	20.1	20.8	21.6
		Hi PR	218	235	248	258	245	263	278	290	278	299	316	330	317	**341**	360	375	356	383	405	422	394	424	447	467
		Lo PR	104	111	121	129	110	117	128	136	114	122	133	141	120	**128**	139	148	126	134	146	156	130	138	151	161
	1600	MBh	54.3	55.9	60.5	65.0	53.1	54.6	59.1	63.5	51.8	53.3	57.7	62.0	50.5	**52.0**	56.3	60.4	48.0	49.4	53.5	57.4	44.5	45.8	49.6	53.2
		S/T	0.78	0.69	0.52	0.34	0.80	0.72	0.54	0.35	0.82	0.74	0.56	0.36	0.85	**0.76**	0.58	0.37	0.88	0.79	0.60	0.38	0.89	0.80	0.60	0.39
		ΔT	24	22	18	13	24	23	18	13	25	23	18	13	25	**23**	19	13	24	22	18	13	23	21	17	12
		kW	3.50	3.58	3.69	3.80	3.77	3.85	3.97	4.09	4.00	4.08	4.22	4.35	4.20	**4.30**	4.43	4.58	4.38	4.47	4.62	4.77	4.53	4.63	4.78	4.94
		Amps	13.7	14.0	14.5	15.0	14.8	15.1	15.6	16.2	16.0	16.4	17.0	17.6	17.1	**17.6**	18.1	18.8	18.2	18.7	19.3	20.0	19.3	19.8	20.5	21.2
		Hi PR	214	231	243	254	240	259	273	285	273	294	311	324	311	**335**	354	369	350	377	398	415	387	417	440	459
		Lo PR	102	109	119	127	108	115	126	134	112	119	130	139	118	**126**	137	146	124	132	144	153	128	136	149	158

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects ACCA (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

			Outdoor Ambient Temperature																							
			65ºF				75ºF				85ºF				95ºF				105ºF				115ºF			
			Entering Indoor Wet Bulb Temperature																							
IDB	Airflow		59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71	59	63	67	71
80	2000	MBh	57.8	59.1	63.1	67.5	56.5	57.7	61.6	65.9	55.1	56.3	60.2	64.3	53.8	55.0	58.7	62.8	51.1	52.2	55.8	59.6	47.3	48.4	51.7	55.2
		S/T	0.92	0.87	0.71	0.53	0.96	0.90	0.73	0.55	1.00	0.92	0.75	0.56	1.00	0.95	0.77	0.58	1.00	1.00	0.80	0.60	1.00	1.00	0.81	0.61
		ΔT	25	24	20	16	25	24	21	17	25	24	21	17	25	24	21	17	23	24	21	16	22	22	19	15
		kW	3.61	3.68	3.80	3.92	3.88	3.96	4.09	4.22	4.12	4.21	4.34	4.49	4.33	4.43	4.57	4.72	4.51	4.61	4.76	4.92	4.67	4.77	4.93	5.10
		Amps	14.1	14.5	15.0	15.5	15.3	15.6	16.2	16.8	16.6	17.0	17.6	18.2	17.7	18.2	18.8	19.5	18.9	19.3	20.0	20.7	20.0	20.5	21.2	22.0
		Hi PR	222	239	253	264	249	268	284	296	284	305	322	336	323	348	367	383	364	391	413	431	402	432	456	476
		Lo PR	106	113	123	131	112	119	130	139	117	124	135	144	122	130	142	151	128	137	149	159	133	141	154	164
	1750	MBh	56.1	57.4	61.3	65.5	54.8	56.0	59.9	64.0	53.5	54.7	58.4	62.5	52.2	53.4	**57.0**	60.9	49.6	50.7	54.2	57.9	45.9	46.9	50.2	53.6
		S/T	0.88	0.83	0.67	0.50	0.91	0.86	0.70	0.52	0.94	0.88	0.71	0.53	0.97	0.91	**0.74**	0.55	1.00	0.94	0.77	0.57	1.00	0.95	0.77	0.58
		ΔT	26	25	22	17	26	25	22	18	26	25	22	18	27	25	**22**	18	26	25	22	17	24	23	20	16
		kW	3.58	3.65	3.77	3.89	3.85	3.93	4.05	4.19	4.09	4.18	4.31	4.45	4.30	4.39	**4.53**	4.68	4.48	4.58	4.72	4.88	4.63	4.73	4.89	5.05
		Amps	14.0	14.4	14.8	15.4	15.1	15.5	16.0	16.6	16.4	16.8	17.4	18.1	17.6	18.0	**18.6**	19.3	18.7	19.2	19.8	20.5	19.8	20.3	21.0	21.8
		Hi PR	220	237	250	261	247	266	281	293	281	302	319	333	320	344	**364**	379	360	387	409	427	398	428	452	471
		Lo PR	105	112	122	130	111	118	129	137	115	123	134	143	121	129	**141**	150	127	135	148	157	131	140	153	163
	1600	MBh	55.3	56.5	60.4	64.5	54.0	55.2	59.0	63.0	52.7	53.9	57.5	61.5	51.4	52.6	56.1	60.0	48.9	49.9	53.3	57.0	45.3	46.2	49.4	52.8
		S/T	0.85	0.80	0.65	0.48	0.88	0.83	0.67	0.50	0.90	0.85	0.69	0.52	0.93	0.87	0.71	0.53	0.97	0.91	0.74	0.55	0.98	0.92	0.74	0.56
		ΔT	27	26	23	18	27	26	23	18	27	26	23	18	28	26	23	18	27	26	23	18	25	24	21	17
		kW	3.53	3.60	3.72	3.83	3.80	3.88	4.00	4.13	4.03	4.12	4.25	4.39	4.24	4.33	4.47	4.62	4.41	4.51	4.66	4.81	4.57	4.67	4.82	4.98
		Amps	13.8	14.1	14.6	15.1	14.9	15.3	15.8	16.4	16.2	16.6	17.1	17.8	17.3	17.7	18.3	19.0	18.4	18.9	19.5	20.2	19.5	20.0	20.6	21.4
		Hi PR	216	233	246	256	243	261	276	288	276	297	314	327	315	338	357	373	354	381	402	419	391	421	444	463
		Lo PR	103	110	120	128	109	116	127	135	113	121	132	140	119	127	138	147	125	133	145	154	129	137	150	160
85	2000	MBh	58.8	60.0	62.8	67.0	57.5	58.6	61.3	65.4	56.1	57.2	59.9	63.9	54.7	55.8	58.4	62.3	52.0	53.0	55.5	59.2	48.2	49.1	51.4	54.8
		S/T	0.97	0.93	0.84	0.68	1.00	0.97	0.87	0.71	1.00	0.99	0.90	0.73	1.00	1.00	0.93	0.75	1.00	1.00	0.96	0.78	1.00	1.00	0.97	0.79
		ΔT	26	26	24	21	26	26	25	21	26	26	25	21	25	26	25	22	24	24	25	21	22	23	23	20
		kW	3.64	3.71	3.83	3.95	3.91	3.99	4.12	4.25	4.15	4.24	4.38	4.52	4.37	4.46	4.61	4.76	4.55	4.65	4.80	4.96	4.71	4.81	4.97	5.14
		Amps	14.3	14.6	15.1	15.6	15.4	15.8	16.3	16.9	16.7	17.2	17.7	18.4	17.9	18.3	18.9	19.7	19.0	19.5	20.2	20.9	20.2	20.7	21.4	22.2
		Hi PR	225	242	255	266	252	271	286	299	287	308	326	340	326	351	371	387	367	395	417	435	406	437	461	481
		Lo PR	107	114	125	133	113	121	132	140	118	125	137	146	124	132	144	153	130	138	151	160	134	143	156	166
	1750	MBh	57.1	58.2	61.0	65.0	55.8	56.9	59.6	63.5	54.5	55.5	58.1	62.0	53.1	54.2	56.7	60.5	50.5	51.4	53.9	57.5	46.7	47.7	49.9	53.2
		S/T	0.92	0.89	0.80	0.65	0.96	0.92	0.83	0.68	0.98	0.95	0.86	0.69	1.00	0.98	0.88	0.72	1.00	1.00	0.92	0.74	1.00	1.00	0.92	0.75
		ΔT	28	27	26	22	28	28	26	23	28	28	26	23	28	28	26	23	27	27	26	22	25	25	24	21
		kW	3.61	3.68	3.80	3.92	3.88	3.96	4.09	4.22	4.12	4.21	4.34	4.49	4.33	4.43	4.57	4.72	4.51	4.61	4.76	4.92	4.67	4.77	4.93	5.10
		Amps	14.1	14.5	15.0	15.5	15.3	15.6	16.2	16.8	16.6	17.0	17.6	18.2	17.7	18.2	18.8	19.5	18.9	19.3	20.0	20.7	20.0	20.5	21.2	22.0
		Hi PR	222	239	253	264	249	268	284	296	284	305	322	336	323	348	367	383	364	391	413	431	402	432	456	476
		Lo PR	106	113	123	131	112	119	130	139	117	124	135	144	122	130	142	151	128	137	149	159	133	141	154	164
	1600	MBh	56.3	57.3	60.1	64.1	54.9	56.0	58.7	62.6	53.6	54.7	57.3	61.1	52.3	53.3	55.9	59.6	49.7	50.7	53.1	56.6	46.0	46.9	49.2	52.4
		S/T	0.89	0.86	0.78	0.63	0.92	0.89	0.80	0.65	0.95	0.91	0.82	0.67	0.98	0.94	0.85	0.69	1.00	0.98	0.88	0.72	1.00	0.99	0.89	0.72
		ΔT	29	28	27	23	29	29	27	23	29	29	27	23	29	29	27	24	29	29	27	23	26	27	25	22
		kW	3.56	3.63	3.75	3.86	3.83	3.91	4.03	4.16	4.06	4.15	4.28	4.42	4.27	4.37	4.51	4.66	4.45	4.55	4.70	4.85	4.60	4.71	4.86	5.02
		Amps	13.9	14.3	14.7	15.3	15.0	15.4	15.9	16.5	16.3	16.7	17.3	17.9	17.5	17.9	18.5	19.2	18.6	19.0	19.7	20.4	19.7	20.2	20.8	21.6
		Hi PR	219	235	248	259	245	264	279	291	279	300	317	331	318	342	361	377	357	385	406	424	395	425	449	468
		Lo PR	104	111	121	129	110	117	128	136	115	122	133	142	120	128	140	149	126	134	147	156	130	139	152	161

IDB: Entering Indoor Dry Bulb Temperature
High and low pressures are measured at the liquid and suction service valves.

Shaded area reflects AHRI (TVA) conditions

kW = Total system power
Amps = outdoor unit amps (compressor + fan)

DSZC160241A* / CA*F3636*6A* + TXV / MBE1600-1 — Low Stage**

	Outdoor Ambient Temperature																	
	65	60	55	50	47	45	40	35	30	25	20	17	15	10	5	0	-5	-10
MBh	20.8	19.7	18.5	17.3	**16.6**	16.0	14.9	13.7	13.1	12.1	11.1	10.5	10.1	9.1	8.1	7.0	6.0	4.9
ΔT	30.2	28.6	26.9	25.2	24.1	23.3	21.7	20.0	19.0	17.6	16.2	15.3	14.7	13.2	11.7	10.2	8.7	7.1
kW	1.42	1.40	1.37	1.34	**1.3**	1.31	1.28	1.25	1.37	1.33	1.30	1.28	1.27	1.23	1.20	1.17	1.14	1.10
Amps	6.8	6.3	5.9	5.6	5.4	5.3	5.0	4.7	4.5	4.3	4.1	4.0	4.0	3.8	3.5	3.3	3.1	2.8
COP	4.27	4.13	3.97	3.79	3.67	3.59	3.41	3.21	2.81	2.66	2.51	2.40	2.34	2.15	1.96	1.76	1.54	1.30
EER	14.6	14.1	13.6	13.0	12.5	12.3	11.6	11.0	9.6	9.1	8.6	8.2	8.0	7.4	6.7	6.0	5.3	4.5

DSZC160241A* / CA*F3636*6A* + TXV / MBE1600-1 — High Stage**

	Outdoor Ambient Temperature																	
	65	60	55	50	47	45	40	35	30	25	20	17	15	10	5	0	-5	-10
MBh	30.2	28.6	26.9	25.1	**24.0**	23.3	21.6	19.9	18.7	17.3	15.9	15.0	14.4	13.0	11.5	10.0	8.6	7.0
ΔT	31.9	30.2	28.4	26.6	25.4	24.6	22.9	21.1	19.8	18.3	16.8	15.9	15.3	13.7	12.2	10.6	9.0	7.4
kW	1.86	1.83	1.79	1.75	**1.7**	1.71	1.68	1.64	1.72	1.68	1.64	1.61	1.60	1.56	1.52	1.48	1.44	1.40
Amps	8.7	8.0	7.5	7.1	6.8	6.7	6.3	6.0	5.7	5.5	5.2	5.1	5.0	4.8	4.5	4.2	3.9	3.5
COP	4.74	4.58	4.40	4.20	4.06	3.97	3.77	3.55	3.18	3.01	2.84	2.72	2.65	2.44	2.22	1.99	1.74	1.47
EER	16.2	15.6	15.0	14.3	13.9	13.6	12.9	12.1	10.9	10.3	9.7	9.3	9.0	8.3	7.6	6.8	6.0	5.0

DSZC160361A* / CA*F3642*6A* + TXV / MBE1600-1 — Low Stage**

	Outdoor Ambient Temperature																	
	65	60	55	50	47	45	40	35	30	25	20	17	15	10	5	0	-5	-10
MBh	30.3	28.7	27.0	25.3	**24.1**	23.4	21.7	20.0	18.1	16.7	15.4	14.5	14.0	12.6	11.1	9.7	8.3	6.8
ΔT	35.1	33.2	31.3	29.2	27.9	27.1	25.1	23.2	21.0	19.4	17.8	16.8	16.2	14.5	12.9	11.2	9.6	7.9
kW	2.03	1.98	1.94	1.90	**1.9**	1.86	1.82	1.78	1.93	1.89	1.84	1.81	1.79	1.75	1.70	1.65	1.61	1.56
Amps	9.8	9.1	8.5	8.0	7.8	7.6	7.2	6.8	6.6	6.3	6.0	5.8	5.8	5.5	5.1	4.8	4.5	4.1
COP	4.38	4.23	4.07	3.89	3.76	3.68	3.49	3.29	2.74	2.60	2.45	2.35	2.29	2.11	1.92	1.72	1.51	1.27
EER	15.0	14.5	13.9	13.3	12.8	12.6	11.9	11.3	9.4	8.9	8.4	8.0	7.8	7.2	6.6	5.9	5.2	4.4

DSZC160361A* / CA*F3642*6A* + TXV / MBE1600-1 — High Stage**

	Outdoor Ambient Temperature																	
	65	60	55	50	47	45	40	35	30	25	20	17	15	10	5	0	-5	-10
MBh	43.2	40.9	38.5	36.0	**34.4**	33.3	31.0	28.6	26.2	24.2	22.2	21.0	20.2	18.1	16.1	14.0	12.0	9.8
ΔT	34.8	33.0	31.0	29.0	27.7	26.8	24.9	23.0	21.1	19.4	17.9	16.9	16.3	14.6	13.0	11.3	9.6	7.9
kW	2.80	2.74	2.69	2.63	**2.6**	2.57	2.52	2.46	2.39	2.33	2.28	2.24	2.22	2.16	2.11	2.05	2.00	1.94
Amps	13.1	12.1	11.4	10.7	10.3	10.1	9.5	9.1	8.7	8.3	7.9	7.7	7.6	7.2	6.7	6.4	5.9	5.3
COP	4.52	4.37	4.20	4.01	3.88	3.79	3.60	3.40	3.21	3.03	2.86	2.74	2.66	2.45	2.23	2.00	1.75	1.48
EER	15.4	14.9	14.3	13.7	13.2	13.0	12.3	11.6	11.0	10.4	9.8	9.4	9.1	8.4	7.6	6.8	6.0	5.0

Calculations are based on nominal CFM and 70 °F indoor dry bulb.
Note: Shaded area is AHRI Rating Conditions at 47°F outdoor ambient temperature

Amps = Outdoor unit amps (comp.+fan)
kW = Total system power

DSZC160481A* / CA*F4860*6A* +T XV / MBE2000**-1 — Low Stage

	Outdoor Ambient Temperature																	
	65	60	55	50	47	45	40	35	30	25	20	17	15	10	5	0	-5	-10
MBh	43.2	40.9	38.5	36.0	**34.4**	33.3	30.9	28.5	25.7	23.7	21.8	20.6	19.9	17.8	15.8	13.8	11.8	9.6
ΔT	37.2	35.2	33.1	31.0	29.6	28.7	26.6	24.6	22.1	20.4	18.8	17.8	17.1	15.4	13.6	11.9	10.1	8.3
kW	2.97	2.91	2.85	2.79	**2.8**	2.72	2.66	2.60	2.71	2.65	2.58	2.54	2.52	2.45	2.38	2.32	2.25	2.18
Amps	14.1	13.1	12.2	11.5	11.1	10.9	10.3	9.7	9.3	8.9	8.5	8.3	8.1	7.7	7.2	6.8	6.3	5.6
COP	4.25	4.11	3.95	3.78	3.66	3.58	3.40	3.21	2.77	2.62	2.48	2.38	2.31	2.13	1.94	1.74	1.53	1.29
EER	14.5	14.0	13.5	12.9	12.5	12.2	11.6	11.0	9.5	9.0	8.5	8.1	7.9	7.3	6.6	5.9	5.2	4.4

DSZC160481A* / CA*F4860*6A* + TXV / MBE2000**-1 — High Stage

	Outdoor Ambient Temperature																	
	65	60	55	50	47	45	40	35	30	25	20	17	15	10	5	0	-5	-10
MBh	59.1	55.9	52.6	49.2	**47.0**	45.5	42.3	39.0	41.1	38.0	34.9	33.0	31.8	28.5	25.3	22.0	18.8	15.4
ΔT	35.3	33.4	31.4	29.4	28.1	27.2	25.3	23.3	24.6	22.7	20.9	19.7	19.0	17.0	15.1	13.2	11.2	9.2
kW	3.81	3.73	3.65	3.58	**3.5**	3.50	3.42	3.35	3.33	3.25	3.17	3.13	3.10	3.02	2.94	2.86	2.78	2.71
Amps	18.8	17.1	15.6	14.4	13.7	13.3	12.2	11.3	10.6	9.9	9.2	8.8	8.6	7.9	7.0	6.3	5.4	4.3
COP	4.54	4.39	4.22	4.03	3.89	3.81	3.61	3.41	3.61	3.42	3.22	3.09	3.00	2.77	2.52	2.25	1.98	1.67
EER	15.5	15.0	14.4	13.8	13.3	13.0	12.4	11.7	12.3	11.7	11.0	10.6	10.3	9.5	8.6	7.7	6.8	5.7

DSZC16060B / CAPF4961D6 / MBVC2000A — Low Stage

	Outdoor Ambient Temperature																	
	65	60	55	50	47	45	40	35	30	25	20	17	15	10	5	0	-5	-10
MBh	49.9	47.3	44.5	41.6	**39.7**	38.5	35.8	33.0	30.8	28.4	26.2	24.7	23.8	21.3	18.9	16.5	14.1	11.5
ΔT	40.2	38.1	35.8	33.5	32.0	31.0	28.8	26.5	24.8	22.9	21.1	19.9	19.2	17.2	15.2	13.3	11.3	9.3
kW	3.51	3.44	3.36	3.29	**3.3**	3.22	3.15	3.08	3.47	3.38	3.30	3.25	3.22	3.13	3.05	2.96	2.88	2.79
Amps	18.3	16.9	15.9	14.9	14.4	14.1	13.3	12.7	12.1	11.6	11.1	10.8	10.7	10.1	9.5	8.9	8.3	7.5
COP	4.17	4.03	3.87	3.70	3.58	3.50	3.32	3.14	2.60	2.46	2.32	2.22	2.16	2.00	1.82	1.63	1.43	1.21
EER	14.2	13.8	13.2	12.6	12.2	12.0	11.4	10.7	8.9	8.4	7.9	7.6	7.4	6.8	6.2	5.6	4.9	4.1

DSZC16060B / CAPF4961D6 / MBVC2000A — High Stage

	Outdoor Ambient Temperature																	
	65	60	55	50	47	45	40	35	30	25	20	17	15	10	5	0	-5	-10
MBh	71.0	67.2	63.3	59.2	**56.5**	54.7	50.9	46.9	44.6	41.2	37.9	35.8	34.5	30.9	27.4	23.9	20.4	16.7
ΔT	37.6	35.6	33.5	31.3	29.9	29.0	26.9	24.8	23.6	21.8	20.1	18.9	18.2	16.4	14.5	12.7	10.8	8.8
kW	4.67	4.58	4.49	4.40	**4.3**	4.30	4.22	4.12	4.62	4.51	4.41	4.34	4.30	4.19	4.08	3.98	3.87	3.76
Amps	22.9	21.2	19.9	18.7	18.0	17.7	16.6	15.8	15.1	14.4	13.7	13.4	13.2	12.6	11.7	11.0	10.2	9.2
COP	4.45	4.30	4.13	3.94	3.81	3.72	3.53	3.33	2.82	2.67	2.52	2.41	2.35	2.16	1.97	1.76	1.54	1.30
EER	15.2	14.7	14.1	13.5	13.0	12.7	12.1	11.4	9.6	9.1	8.6	8.2	8.0	7.4	6.7	6.0	5.3	4.4

Calculations are based on nominal CFM and 70 °F indoor dry bulb.
Note: Shaded area is AHRI Rating Conditions at 47°F outdoor ambient temperature

Amps = Outdoor unit amps (comp.+fan)
kW = Total system power

Outdoor Unit	Indoor Units		Cooling Ratings ^				TVA Ratings [3]		Heating Ratings ^			CFM	AHRI #
	Coils/Air Handlers	Furnaces	Total	Sens.	SEER [1]	EER [2]	Total	Sens.	Hi [4]	HSPF [5]	Low [6]		
DSZC16 0241A*	AVPTC30C14A*		23,400	18,200	15.0	11.8	21,600	18,400	22,400	8.5	14,400	875	5933795
	CA*F3636*6D*+MBVC1200**-1A*+TXV		24,000	18,700	16.0	12.5	22,200	18,900	23,000	9.2	15,000	825	4392818
	CA*F3636*6D*+MBVC1600**-1A*+TXV		24,000	18,700	16.0	12.5	22,200	18,900	23,000	9.5	15,000	875	4392819
	CA*F3636*6D*+TXV	G*VC80805C*B*	24,000	18,700	16.0	12.0	22,200	18,900	23,000	9.0	15,000	810	5038666
	CA*F3636*6D*+TXV	G*VC80604B*B*	24,000	18,700	16.0	12.0	22,200	18,900	23,000	9.0	15,000	820	5038676
	CA*F3636*6D*+TXV	G*VC81005C*B*	24,000	18,700	16.0	12.0	22,200	18,900	23,000	9.0	15,000	810	5038677
	CA*F3636*6D*+TXV	ADVC80805C*B*	24,000	18,700	16.0	12.0	22,200	18,900	23,000	9.0	15,000	810	5038733
	CA*F3636*6D*+TXV	A*VC80603B*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	880	5038747
	CA*F3636*6D*+TXV	A*VC80805C*B*	24,000	18,700	16.0	12.0	22,200	18,900	23,000	9.0	15,000	810	5038769
	CA*F3636*6D*+TXV	ADVC81005C*B*	24,000	18,700	16.0	12.0	22,200	18,900	23,000	9.0	15,000	810	5038770
	CA*F3636*6D*+TXV	A*VC80604B*B*	24,000	18,700	16.0	12.0	22,200	18,900	23,000	9.0	15,000	820	5038775
	CA*F3636*6D*+TXV	A*VC81005C*B*	24,000	18,700	16.0	12.0	22,200	18,900	23,000	9.0	15,000	810	5038776
	CA*F3636*6D*+TXV	G*VC960403BNA*	23,000	17,900	15.5	12.0	21,200	18,100	24,000	9.0	15,000	800	7360630
	CA*F3636*6D*+TXV	G*VC960603BNA*	23,000	17,900	15.5	12.0	21,200	18,100	24,000	9.0	15,000	800	7360633
	CA*F3636*6D*+TXV	G*VC960803BNA*	23,000	17,900	15.5	12.0	21,200	18,100	24,000	9.0	15,000	800	7360636
	CA*F3636*6D*+TXV	G*VM970603BNA*	23,000	17,900	15.5	12.0	21,200	18,100	24,000	9.0	15,000	800	7360659
	CA*F3636*6D*+TXV	G*VM970803BNA*	23,000	17,900	15.5	12.0	21,200	18,100	24,000	9.0	15,000	800	7360662
	CA*F3636*6D*+TXV	A*VC960403BNA*	23,000	17,900	15.5	12.0	21,200	18,100	24,000	9.0	15,000	800	7360682
	CA*F3636*6D*+TXV	A*VC960603BNA*	23,000	17,900	15.5	12.0	21,200	18,100	24,000	9.0	15,000	800	7360685
	CA*F3636*6D*+TXV	A*VC960803BNA*	23,000	17,900	15.5	12.0	21,200	18,100	24,000	9.0	15,000	800	7360688
	CA*F3636*6D*+TXV	A*VM970603BNA*	23,000	17,900	15.5	12.0	21,200	18,100	24,000	9.0	15,000	800	7360711
	CA*F3636*6D*+TXV	A*VM970803BNA*	23,000	17,900	15.5	12.0	21,200	18,100	24,000	9.0	15,000	800	7360714
	CA*F3636*6D*+TXV	G*EC960302BNA*	23,000	17,900	15.5	12.0	21,200	18,100	23,600	9.0	15,000	800	7368121
	CA*F3636*6D*+TXV	G*EC960402BNA*	23,000	17,900	15.5	12.0	21,200	18,100	24,000	9.0	15,000	850	7368126
	CA*F3636*6D*+TXV	G*EC960603BNA*	23,000	17,900	15.5	12.0	21,200	18,100	23,600	9.0	15,000	800	7368131
	CA*F3636*6D*+TXV	G*EC960803BNA*	23,000	17,900	15.5	12.0	21,200	18,100	23,600	9.0	15,000	800	7368136
	CA*F3636*6D*+TXV	A*EC960302BNA*	23,000	17,900	15.5	12.0	21,200	18,100	23,600	9.0	15,000	800	7368156
	CA*F3636*6D*+TXV	A*EC960402BNA*	23,000	17,900	15.5	12.0	21,200	18,100	24,000	9.0	15,000	850	7368161
	CA*F3636*6D*+TXV	A*EC960603BNA*	23,000	17,900	15.5	12.0	21,200	18,100	23,600	9.0	15,000	800	7368166
	CA*F3636*6D*+TXV	A*EC960803BNA*	23,000	17,900	15.5	12.0	21,200	18,100	23,600	9.0	15,000	800	7368171
	CA*F3642*6D*+MBVC1600**-1A*+TXV		24,000	18,700	16.0	12.5	22,200	18,900	24,000	9.2	15,000	860	3880698
	CA*F3642*6D*+TXV	G*VC80805C*B*	23,800	18,500	16.0	12.0	22,000	18,700	24,000	9.0	15,000	810	5038622
	CA*F3642*6D*+TXV	G*VC81005C*B*	23,800	18,500	16.0	12.0	22,000	18,700	24,000	9.0	15,000	810	5038624
	CA*F3642*6D*+TXV	G*VC80604B*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	820	5038631
	CA*F3642*6D*+TXV	A*VC80805C*B*	23,800	18,500	16.0	12.0	22,000	18,700	24,000	9.0	15,000	810	5038734
	CA*F3642*6D*+TXV	A*VC81005C*B*	23,800	18,500	16.0	12.0	22,000	18,700	24,000	9.0	15,000	810	5038737
	CA*F3642*6D*+TXV	A*VC80604B*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	820	5038748
	CA*F3642*6D*+TXV	A*VC80603B*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	880	5038777
	CA*F3642*6D*+TXV	ADVC81005C*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	810	5038778
	CA*F3642*6D*+TXV	ADVC80805C*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	810	5038788
	CA*F3642*6D*+TXV	G*VC960403BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360631
	CA*F3642*6D*+TXV	G*VC960603BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360634
	CA*F3642*6D*+TXV	G*VC960803BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360637
	CA*F3642*6D*+TXV	G*VM970603BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360660
	CA*F3642*6D*+TXV	G*VM970803BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360663
	CA*F3642*6D*+TXV	A*VC960403BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360683
	CA*F3642*6D*+TXV	A*VC960603BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360686
	CA*F3642*6D*+TXV	A*VC960803BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360689
	CA*F3642*6D*+TXV	A*VM970603BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360712
	CA*F3642*6D*+TXV	A*VM970803BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360715
	CA*F3642*6D*+TXV	G*EC960302BNA*	23,600	18,400	15.5	12.0	21,800	18,600	23,600	9.0	15,000	800	7368122
	CA*F3642*6D*+TXV	G*EC960402BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	850	7368127
	CA*F3642*6D*+TXV	G*EC960603BNA*	23,600	18,400	15.5	12.0	21,800	18,600	23,600	9.0	15,000	800	7368132
	CA*F3642*6D*+TXV	G*EC960803BNA*	23,600	18,400	15.5	12.0	21,800	18,600	23,600	9.0	15,000	800	7368137
	CA*F3642*6D*+TXV	A*EC960302BNA*	23,600	18,400	15.5	12.0	21,800	18,600	23,600	9.0	15,000	800	7368157
	CA*F3642*6D*+TXV	A*EC960402BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	850	7368162
	CA*F3642*6D*+TXV	A*EC960603BNA*	23,600	18,400	15.5	12.0	21,800	18,600	23,600	9.0	15,000	800	7368167
	CA*F3642*6D*+TXV	A*EC960803BNA*	23,600	18,400	15.5	12.0	21,800	18,600	23,600	9.0	15,000	800	7368172
	CA*F3743*6D*+TXV	G*EC960302BNA*	23,800	18,500	15.5	12.5	22,000	18,700	23,800	9.0	15,000	800	7368123
	CA*F3743*6D*+TXV	G*EC960402BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	850	7368128

See Notes on Page 26.

Outdoor Unit	Indoor Units: Coils/Air Handlers	Indoor Units: Furnaces	Cooling Ratings ^: Total	Cooling Ratings ^: Sens.	Cooling Ratings ^: SEER [1]	Cooling Ratings ^: EER [2]	TVA Ratings [3]: Total	TVA Ratings [3]: Sens.	Heating Ratings ^: Hi [4]	Heating Ratings ^: HSPF [5]	Heating Ratings ^: Low [6]	CFM	AHRI #
DSZC16 0241A* (cont.)	CA*F3743*6D*+TXV	G*EC960603BNA*	23,800	18,500	15.5	12.5	22,000	18,700	23,800	9.0	15,000	800	7368133
	CA*F3743*6D*+TXV	G*EC960803BNA*	23,800	18,500	15.5	12.5	22,000	18,700	23,800	9.0	15,000	800	7368138
	CA*F3743*6D*+TXV	A*EC960302BNA*	23,800	18,500	15.5	12.5	22,000	18,700	23,800	9.0	15,000	800	7368158
	CA*F3743*6D*+TXV	A*EC960402BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	850	7368163
	CA*F3743*6D*+TXV	A*EC960603BNA*	23,800	18,500	15.5	12.5	22,000	18,700	23,800	9.0	15,000	800	7368168
	CA*F3743*6D*+TXV	A*EC960803BNA*	23,800	18,500	15.5	12.5	22,000	18,700	23,800	9.0	15,000	800	7368173
	CHPF3636B6C*+MBVC1200**-1A*+TXV		24,000	18,700	16.0	12.5	22,200	18,900	23,000	9.2	15,000	850	3654487
	CHPF3636B6C*+TXV	G*VC80604B*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	820	5038709
	CHPF3636B6C*+TXV	A*VC80604B*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	820	5038798
	CHPF3636B6C*+TXV	G*EC960302BNA*	23,000	17,900	15.0	11.5	21,200	18,100	23,000	9.0	13,000	800	7368124
	CHPF3636B6C*+TXV	G*EC960402BNA*	23,000	17,900	15.0	11.5	21,200	18,100	23,000	9.0	13,000	850	7368129
	CHPF3636B6C*+TXV	G*EC960603BNA*	23,000	17,900	15.0	11.5	21,200	18,100	23,000	9.0	13,000	800	7368134
	CHPF3636B6C*+TXV	G*EC960803BNA*	23,000	17,900	15.0	11.5	21,200	18,100	23,000	9.0	13,000	800	7368139
	CHPF3636B6C*+TXV	A*EC960302BNA*	23,000	17,900	15.0	11.5	21,200	18,100	23,000	9.0	13,000	800	7368159
	CHPF3636B6C*+TXV	A*EC960402BNA*	23,000	17,900	15.0	11.5	21,200	18,100	23,000	9.0	13,000	850	7368164
	CHPF3636B6C*+TXV	A*EC960603BNA*	23,000	17,900	15.0	11.5	21,200	18,100	23,000	9.0	13,000	800	7368169
	CHPF3636B6C*+TXV	A*EC960803BNA*	23,000	17,900	15.0	11.5	21,200	18,100	23,000	9.0	13,000	800	7368174
	CHPF3642C6C*+MBVC1600**-1A*+TXV		24,000	18,700	16.0	12.5	22,200	18,900	24,000	9.2	15,000	860	3654501
	CHPF3642C6C*+TXV	G*VC80805C*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	810	5038603
	CHPF3642C6C*+TXV	G*VC80604B*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	820	5038623
	CHPF3642C6C*+TXV	G*VC81005C*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	810	5038695
	CHPF3642C6C*+TXV	A*VC80805C*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	810	5038724
	CHPF3642C6C*+TXV	A*VC80604B*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	820	5038735
	CHPF3642C6C*+TXV	A*VC81005C*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	810	5038790
	CHPF3642C6C*+TXV	G*VC960403BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360632
	CHPF3642C6C*+TXV	G*VC960603BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360635
	CHPF3642C6C*+TXV	G*VC960803BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360638
	CHPF3642C6C*+TXV	G*VM970603BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360661
	CHPF3642C6C*+TXV	G*VM970803BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360664
	CHPF3642C6C*+TXV	A*VC960403BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360684
	CHPF3642C6C*+TXV	A*VC960603BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360687
	CHPF3642C6C*+TXV	A*VC960803BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360690
	CHPF3642C6C*+TXV	A*VM970603BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360713
	CHPF3642C6C*+TXV	A*VM970803BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	800	7360716
	CHPF3642C6C*+TXV	G*EC960302BNA*	23,800	18,500	15.5	12.5	22,000	18,700	23,800	9.0	15,000	800	7368125
	CHPF3642C6C*+TXV	G*EC960402BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	850	7368130
	CHPF3642C6C*+TXV	G*EC960603BNA*	23,800	18,500	15.5	12.5	22,000	18,700	23,800	9.0	15,000	800	7368135
	CHPF3642C6C*+TXV	G*EC960803BNA*	23,800	18,500	15.5	12.5	22,000	18,700	23,800	9.0	15,000	800	7368140
	CHPF3642C6C*+TXV	A*EC960302BNA*	23,800	18,500	15.5	12.5	22,000	18,700	23,800	9.0	15,000	800	7368160
	CHPF3642C6C*+TXV	A*EC960402BNA*	24,000	18,700	15.5	12.0	22,200	18,900	24,000	9.0	15,000	850	7368165
	CHPF3642C6C*+TXV	A*EC960603BNA*	23,800	18,500	15.5	12.5	22,000	18,700	23,800	9.0	15,000	800	7368170
	CHPF3642C6C*+TXV	A*EC960803BNA*	23,800	18,500	15.5	12.5	22,000	18,700	23,800	9.0	15,000	800	7368175
	CHPF3743C6B*+TXV	G*VC80805C*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	810	5038625
	CHPF3743C6B*+TXV	G*VC81005C*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	810	5038680
	CHPF3743C6B*+TXV	A*VC80805C*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	810	5038739
	CHPF3743C6B*+TXV	A*VC81005C*B*	24,000	18,700	16.0	12.0	22,200	18,900	24,000	9.0	15,000	810	5038780
	CHPF3743D6B*+MBVC1600**-1A*+TXV		24,000	18,700	16.0	12.5	22,200	18,900	23,000	9.2	15,000	850	3654519
DSZC16 0361A*	AVPTC42D14A*		34,600	26,200	16.0	12.5	32,200	25,000	34,400	9.2	21,000	1,200	5933258
	AVPTC48D14A*		36,000	27,200	16.0	12.5	33,400	26,000	34,400	9.2	21,000	1,200	5933259
	CA*F3642*6D*+MBVC1600**-1A*+TXV		34,600	26,200	16.0	12.5	32,200	25,000	34,400	9.2	21,000	1,200	6498031
	CA*F3743*6D*+MBVC1600**-1A*+TXV		34,600	26,200	16.0	12.5	32,200	25,000	34,400	9.7	21,000	1,200	4415183
	CA*F3743*6D*+MBVC2000**-1A*+TXV		34,600	26,200	16.0	12.5	32,200	25,000	34,400	9.2	21,000	1,200	4415184
	CA*F3743*6D*+TXV	G*VC80805C*B*	34,200	25,800	15.0	12.0	31,800	24,800	34,000	9.2	20,400	1,080	5038627
	CA*F3743*6D*+TXV	G*VC80604B*B*	34,200	25,800	15.5	11.5	31,800	24,800	34,000	9.2	21,000	1,260	5038632
	CA*F3743*6D*+TXV	A*VC80603B*B*	34,200	25,800	15.5	11.5	31,800	24,800	34,000	9.2	21,000	1,170	5038741
	CA*F3743*6D*+TXV	A*VC80805C*B*	34,200	25,800	15.0	12.0	31,800	24,800	34,000	9.2	20,400	1,080	5038742
	CA*F3743*6D*+TXV	ADVC80805C*B*	34,200	25,800	15.0	12.0	31,800	24,800	34,000	9.2	20,400	1,090	5038743
	CA*F3743*6D*+TXV	A*VC80604B*B*	34,200	25,800	15.5	11.5	31,800	24,800	34,000	9.2	21,000	1,260	5038751
	CA*F3743*6D*+TXV	A*VC81005C*B*	34,600	26,200	15.0	12.0	32,200	25,000	34,000	9.2	20,400	1,080	6498032
	CA*F3743*6D*+TXV	ADVC81005C*B*	34,600	26,200	15.0	12.0	32,200	25,000	34,000	9.2	20,400	1,110	6498043

See Notes on Page 26.

Outdoor Unit	Indoor Units		Cooling Ratings ^				TVA Ratings ³		Heating Ratings ^			CFM	AHRI #
	Coils/Air Handlers	Furnaces	Total	Sens.	SEER ¹	EER ²	Total	Sens.	Hi ⁴	HSPF ⁵	Low ⁶		
DSZC16 0361A* (cont.)	CA*F3743*6D*+TXV	G*VC81005C*B*	34,600	26,200	15.0	12.0	32,200	25,000	34,000	9.2	20,400	1,080	6498044
	CA*F3743*6D*+TXV	G*VC960403BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360639
	CA*F3743*6D*+TXV	G*VC960603BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360642
	CA*F3743*6D*+TXV	G*VC960803BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360645
	CA*F3743*6D*+TXV	G*VC960804CNA*	34,600	26,200	15.5	12.5	32,200	25,000	34,000	9.0	21,000	1,200	7360648
	CA*F3743*6D*+TXV	G*VM970603BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360665
	CA*F3743*6D*+TXV	G*VM970803BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360668
	CA*F3743*6D*+TXV	G*VM970804CNA*	34,600	26,200	15.5	12.5	32,200	25,000	34,000	9.0	21,000	1,200	7360671
	CA*F3743*6D*+TXV	A*VC960403BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360691
	CA*F3743*6D*+TXV	A*VC960603BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360694
	CA*F3743*6D*+TXV	A*VC960803BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360697
	CA*F3743*6D*+TXV	A*VC960804CNA*	34,600	26,200	15.5	12.5	32,200	25,000	34,000	9.0	21,000	1,200	7360700
	CA*F3743*6D*+TXV	A*VM970603BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360717
	CA*F3743*6D*+TXV	A*VM970803BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360720
	CA*F3743*6D*+TXV	A*VM970804CNA*	34,600	26,200	15.5	12.5	32,200	25,000	34,000	9.0	21,000	1,200	7360723
	CA*F3743*6D*+TXV	G*VC961005CNA*	34,600	26,200	15.5	12.5	32,200	25,000	34,000	9.0	21,000	1,200	7362544
	CA*F3743*6D*+TXV	G*VM971005CNA*	34,600	26,200	15.5	12.5	32,200	25,000	34,000	9.0	21,000	1,200	7362554
	CA*F3743*6D*+TXV	A*VC961005CNA*	34,600	26,200	15.5	12.5	32,200	25,000	34,000	9.0	21,000	1,200	7362566
	CA*F3743*6D*+TXV	A*VM971005CNA*	34,600	26,200	15.5	12.5	32,200	25,000	34,000	9.0	21,000	1,200	7362577
	CA*F3743*6D*+TXV	G*EC960603BNA*	34,600	26,200	15.0	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7368141
	CA*F3743*6D*+TXV	G*EC960803BNA*	34,600	26,200	15.0	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7368144
	CA*F3743*6D*+TXV	G*EC961004CNA*	34,600	26,200	15.5	12.5	32,200	25,000	34,000	9.0	21,000	1,250	7368147
	CA*F3743*6D*+TXV	A*EC960603BNA*	34,600	26,200	15.0	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7368176
	CA*F3743*6D*+TXV	A*EC960803BNA*	34,600	26,200	15.0	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7368179
	CA*F3743*6D*+TXV	A*EC961004CNA*	34,600	26,200	15.5	12.5	32,200	25,000	34,000	9.0	21,000	1,250	7368182
	CA*F4860*6D*+MBVC1600**-1A*+TXV		35,000	26,600	16.0	12.5	32,400	25,400	34,400	9.2	21,000	1,200	3880756
	CA*F4860*6D*+MBVC2000**-1A*+TXV		35,000	26,600	16.0	12.5	32,400	25,400	34,400	9.2	21,000	1,200	3880762
	CA*F4860*6D*+TXV	G*VC80805C*B*	35,000	26,600	15.5	12.0	32,400	25,400	34,000	9.2	20,400	1,080	5038667
	CA*F4860*6D*+TXV	G*VC80604B*B*	35,000	26,600	15.5	11.5	32,400	25,400	34,000	9.2	21,000	1,260	5038681
	CA*F4860*6D*+TXV	ADVC80805C*B*	35,000	26,600	15.5	12.0	32,400	25,400	34,000	9.2	20,400	1,090	5038744
	CA*F4860*6D*+TXV	A*VC80603B*B*	34,600	26,200	15.5	12.0	32,200	25,000	34,000	9.2	21,000	1,170	5038752
	CA*F4860*6D*+TXV	A*VC80805C*B*	35,000	26,600	15.5	12.0	32,400	25,400	34,000	9.2	20,400	1,080	5038771
	CA*F4860*6D*+TXV	A*VC80604B*B*	35,000	26,600	15.5	11.5	32,400	25,400	34,000	9.2	21,000	1,260	5038781
	CA*F4860*6D*+TXV	A*VC81005C*B*	35,000	26,600	15.0	12.0	32,400	25,400	34,000	9.2	20,400	1,080	6498045
	CA*F4860*6D*+TXV	ADVC81005C*B*	35,000	26,600	15.0	12.0	32,400	25,400	34,000	9.2	20,400	1,110	6498054
	CA*F4860*6D*+TXV	G*VC81005C*B*	35,000	26,600	15.0	12.0	32,400	25,400	34,000	9.2	20,400	1,080	6498055
	CA*F4860*6D*+TXV	G*VC960403BNA*	35,000	26,600	15.5	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7360640
	CA*F4860*6D*+TXV	G*VC960603BNA*	35,000	26,600	15.5	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7360643
	CA*F4860*6D*+TXV	G*VC960803BNA*	35,000	26,600	15.5	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7360646
	CA*F4860*6D*+TXV	G*VC960804CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7360649
	CA*F4860*6D*+TXV	G*VM970603BNA*	35,000	26,600	15.5	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7360666
	CA*F4860*6D*+TXV	G*VM970803BNA*	35,000	26,600	15.5	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7360669
	CA*F4860*6D*+TXV	G*VM970804CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7360672
	CA*F4860*6D*+TXV	A*VC960403BNA*	35,000	26,600	15.5	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7360692
	CA*F4860*6D*+TXV	A*VC960603BNA*	35,000	26,600	15.5	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7360695
	CA*F4860*6D*+TXV	A*VC960803BNA*	35,000	26,600	15.5	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7360698
	CA*F4860*6D*+TXV	A*VC960804CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7360701
	CA*F4860*6D*+TXV	A*VM970603BNA*	35,000	26,600	15.5	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7360718
	CA*F4860*6D*+TXV	A*VM970803BNA*	35,000	26,600	15.5	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7360721
	CA*F4860*6D*+TXV	A*VM970804CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7360724
	CA*F4860*6D*+TXV	G*VC961005CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7362545
	CA*F4860*6D*+TXV	G*VM971005CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7362556
	CA*F4860*6D*+TXV	A*VC961005CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7362568
	CA*F4860*6D*+TXV	A*VM971005CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7362578
	CA*F4860*6D*+TXV	G*EC960603BNA*	35,000	26,600	15.0	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7368142
	CA*F4860*6D*+TXV	G*EC960803BNA*	35,000	26,600	15.0	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7368145
	CA*F4860*6D*+TXV	G*EC961004CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,250	7368148
	CA*F4860*6D*+TXV	A*EC960603BNA*	35,000	26,600	15.0	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7368177
	CA*F4860*6D*+TXV	A*EC960803BNA*	35,000	26,600	15.0	11.5	32,400	25,400	34,000	9.0	21,000	1,150	7368180
	CA*F4860*6D*+TXV	A*EC961004CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,250	7368183

See Notes on Page 26.

Outdoor Unit	Indoor Units		Cooling Ratings ^				TVA Ratings [3]		Heating Ratings ^			CFM	AHRI #
	Coils/Air Handlers	Furnaces	Total	Sens.	SEER [1]	EER [2]	Total	Sens.	Hi [4]	HSPF [5]	Low [6]		
DSZC16 0361A* (cont.)	CHPF3636B6C*+TXV	A*VC80604B*B*	34,000	25,800	14.5	12.0	31,600	24,600	34,000	8.5	20,000	1,220	6498056
	CHPF3642C6C*+MBVC1600**-1A*+TXV		34,600	26,200	16.0	12.5	32,200	25,000	34,400	9.2	21,000	1,200	3654592
	CHPF3642D6C*+MBVC2000**-1A*+TXV		34,600	26,200	16.0	12.5	32,200	25,000	34,400	9.2	21,000	1,200	3654594
	CHPF3743C6B*+MBVC1600**-1A*+TXV		34,600	26,200	16.0	12.5	32,200	25,000	34,400	9.2	21,000	1,200	3654600
	CHPF3743C6B*+TXV	G*VC80805C*B*	35,000	26,600	15.0	12.0	32,400	25,400	34,000	9.2	20,400	1,080	5038634
	CHPF3743C6B*+TXV	G*VC80604B*B*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.2	21,000	1,260	5038696
	CHPF3743C6B*+TXV	A*VC80805C*B*	35,000	26,600	15.0	12.0	32,400	25,400	34,000	9.2	20,400	1,080	5038753
	CHPF3743C6B*+TXV	A*VC80604B*B*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.2	21,000	1,260	5038791
	CHPF3743C6B*+TXV	A*VC81005C*B*	34,600	26,200	15.0	12.0	32,200	25,000	34,000	9.2	20,400	1,080	6498057
	CHPF3743C6B*+TXV	G*VC81005C*B*	34,600	26,200	15.0	12.0	32,200	25,000	34,000	9.2	20,400	1,080	6498066
	CHPF3743C6B*+TXV	G*VC960403BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360641
	CHPF3743C6B*+TXV	G*VC960603BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360644
	CHPF3743C6B*+TXV	G*VC960803BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360647
	CHPF3743C6B*+TXV	G*VM970603BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360667
	CHPF3743C6B*+TXV	G*VM970803BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360670
	CHPF3743C6B*+TXV	A*VC960403BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360693
	CHPF3743C6B*+TXV	A*VC960603BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360696
	CHPF3743C6B*+TXV	A*VC960803BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360699
	CHPF3743C6B*+TXV	A*VM970603BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360719
	CHPF3743C6B*+TXV	A*VM970803BNA*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7360722
	CHPF3743C6B*+TXV	G*EC960603BNA*	34,600	26,200	15.0	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7368143
	CHPF3743C6B*+TXV	G*EC960803BNA*	34,600	26,200	15.0	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7368146
	CHPF3743C6B*+TXV	A*EC960603BNA*	34,600	26,200	15.0	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7368178
	CHPF3743C6B*+TXV	A*EC960803BNA*	34,600	26,200	15.0	11.5	32,200	25,000	34,000	9.0	21,000	1,150	7368181
	CHPF3743D6B*+MBVC2000**-1A*+TXV		34,600	26,200	16.0	12.5	32,200	25,000	34,400	9.2	21,000	1,200	3654615
	CHPF3743D6B*+TXV	G*VC80604B*B*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.2	21,000	1,260	5038604
	CHPF3743D6B*+TXV	G*VC80805C*B*	34,200	25,800	15.5	12.0	31,800	24,800	34,000	9.2	20,400	1,080	5038682
	CHPF3743D6B*+TXV	A*VC80604B*B*	34,600	26,200	15.5	11.5	32,200	25,000	34,000	9.2	21,000	1,260	5038726
	CHPF3743D6B*+TXV	A*VC80805C*B*	34,200	25,800	15.5	12.0	31,800	24,800	34,000	9.2	20,400	1,080	5038783
	CHPF3743D6B*+TXV	A*VC81005C*B*	34,600	26,200	15.0	12.0	32,200	25,000	34,000	9.2	20,400	1,080	6498067
	CHPF3743D6B*+TXV	G*VC81005C*B*	34,600	26,200	15.0	12.0	32,200	25,000	34,000	9.2	20,400	1,080	6498076
	CHPF3743D6B*+TXV	G*EC961004CNA*	34,600	26,200	15.5	12.5	32,200	25,000	34,000	9.0	21,000	1,250	7368149
	CHPF3743D6B*+TXV	A*EC961004CNA*	34,600	26,200	15.5	12.5	32,200	25,000	34,000	9.0	21,000	1,250	7368184
	CHPF4860D6D*+TXV	G*VC960804CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7360650
	CHPF4860D6D*+TXV	G*VM970804CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7360673
	CHPF4860D6D*+TXV	A*VC960804CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7360702
	CHPF4860D6D*+TXV	A*VM970804CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7360725
	CHPF4860D6D*+TXV	G*VC961005CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7362547
	CHPF4860D6D*+TXV	G*VM971005CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7362557
	CHPF4860D6D*+TXV	A*VC961005CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7362569
	CHPF4860D6D*+TXV	A*VM971005CNA*	35,000	26,600	15.5	12.5	32,400	25,400	34,000	9.0	21,000	1,200	7362580
DSZC16 0481A*	AVPTC48D14A*		46,000	34,000	15.5	12.0	42,500	34,600	46,000	9.2	34,000	1,550	5933260
	CA*F4961*6D*+MBVC1600**-1A*+TXV		47,000	34,800	15.5	12.5	43,500	35,200	47,000	9.2	34,000	1,550	4431870
	CA*F4961*6D*+MBVC2000**-1A*+TXV		47,500	35,200	16.0	13.0	44,000	35,600	47,000	9.7	34,000	1,550	4431871
	CA*F4961*6D*+TXV	G*VC81005C*B*	47,500	35,200	15.5	12.0	44,000	35,600	46,000	9.2	30,000	1,610	5589999
	CA*F4961*6D*+TXV	A*VC80805C*B*	47,000	34,800	15.5	12.0	43,500	35,200	46,000	9.2	30,000	1,510	6498085
	CA*F4961*6D*+TXV	A*VC81005C*B*	47,500	35,200	15.5	12.0	44,000	35,600	46,000	9.2	30,000	1,610	6498086
	CA*F4961*6D*+TXV	ADVC80805C*B*	47,000	34,800	15.5	12.0	43,500	35,200	46,000	9.2	30,000	1,500	6498095
	CA*F4961*6D*+TXV	ADVC81005C*B*	47,500	35,200	15.5	12.0	44,000	35,600	46,000	9.2	30,000	1,620	6498096
	CA*F4961*6D*+TXV	G*VC80805C*B*	47,000	34,800	15.5	12.0	43,500	35,200	46,000	9.2	30,000	1,510	6498097
	CA*F4961*6D*+TXV	G*VC960804CNA*	47,000	34,800	15.5	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360651
	CA*F4961*6D*+TXV	G*VC961005CNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,550	7360653
	CA*F4961*6D*+TXV	G*VC961205DNA*	47,000	34,800	16.0	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360655
	CA*F4961*6D*+TXV	G*VM970804CNA*	47,000	34,800	15.5	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360674
	CA*F4961*6D*+TXV	G*VM971005CNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,550	7360676
	CA*F4961*6D*+TXV	G*VM971205DNA*	47,000	34,800	16.0	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360678
	CA*F4961*6D*+TXV	A*VC960804CNA*	47,000	34,800	15.5	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360703
	CA*F4961*6D*+TXV	A*VC961005CNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,550	7360705
	CA*F4961*6D*+TXV	A*VC961205DNA*	47,000	34,800	16.0	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360707
	CA*F4961*6D*+TXV	A*VM970804CNA*	47,000	34,800	15.5	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360726

See Notes on Page 26.

Outdoor Unit	Indoor Units		Cooling Ratings ^				TVA Ratings [3]		Heating Ratings ^			CFM	AHRI #
	Coils/Air Handlers	Furnaces	Total	Sens.	SEER [1]	EER [2]	Total	Sens.	Hi [4]	HSPF [5]	Low [6]		
DSZC16 0481A* (cont.)	CA*F4961*6D*+TXV	A*VM971005CNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,550	7360728
	CA*F4961*6D*+TXV	A*VM971205DNA*	47,000	34,800	16.0	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360730
	CA*F4961*6D*+TXV	G*EC961004CNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,550	7368150
	CA*F4961*6D*+TXV	G*EC961205DNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,520	7368152
	CA*F4961*6D*+TXV	A*EC961004CNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,550	7368185
	CA*F4961*6D*+TXV	A*EC961205DNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,520	7368187
	CHPF4860D6D*+MBVC2000**-1A*+TXV		47,500	35,200	16.0	12.5	44,000	35,600	47,000	9.2	34,000	1,550	3654680
	CHPF4860D6D*+TXV	A*VC80805C*B*	47,500	35,200	15.5	12.0	44,000	35,600	46,000	9.2	30,000	1,510	5265336
	CHPF4860D6D*+TXV	A*VC81005C*B*	47,500	35,200	15.5	12.0	44,000	35,600	46,000	9.2	30,000	1,610	5265337
	CHPF4860D6D*+TXV	G*VC80805C*B*	47,500	35,200	15.5	12.0	44,000	35,600	46,000	9.2	30,000	1,510	6498106
	CHPF4860D6D*+TXV	G*VC81005C*B*	47,500	35,200	15.5	12.0	44,000	35,600	46,000	9.2	30,000	1,610	6498107
	CHPF4860D6D*+TXV	G*VC960804CNA*	47,000	34,800	15.5	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360652
	CHPF4860D6D*+TXV	G*VC961005CNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,550	7360654
	CHPF4860D6D*+TXV	G*VC961205DNA*	47,000	34,800	16.0	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360656
	CHPF4860D6D*+TXV	G*VM970804CNA*	47,000	34,800	15.5	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360675
	CHPF4860D6D*+TXV	G*VM971005CNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,550	7360677
	CHPF4860D6D*+TXV	G*VM971205DNA*	47,000	34,800	16.0	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360679
	CHPF4860D6D*+TXV	A*VC960804CNA*	47,000	34,800	15.5	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360704
	CHPF4860D6D*+TXV	A*VC961005CNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,550	7360706
	CHPF4860D6D*+TXV	A*VC961205DNA*	47,000	34,800	16.0	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360708
	CHPF4860D6D*+TXV	A*VM970804CNA*	47,000	34,800	15.5	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360727
	CHPF4860D6D*+TXV	A*VM971005CNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,550	7360729
	CHPF4860D6D*+TXV	A*VM971205DNA*	47,000	34,800	16.0	12.5	43,500	35,200	47,000	9.0	32,000	1,600	7360731
	CHPF4860D6D*+TXV	G*EC961004CNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,550	7368151
	CHPF4860D6D*+TXV	G*EC961205DNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,520	7368153
	CHPF4860D6D*+TXV	A*EC961004CNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,550	7368186
	CHPF4860D6D*+TXV	A*EC961205DNA*	47,000	34,800	15.0	12.0	43,500	35,200	47,000	9.0	32,000	1,520	7368188
DSZC16 0601B*	AVPTC60D14A*		57,000	41,000	16.0	12.0	53,000	41,500	57,000	9.0	36,200	1,700	5933261
	CA*F4961*6D*+MBVC2000**-1A*+TXV		57,000	41,000	16.0	12.5	53,000	41,500	56,500	9.1	35,800	1,600	4514554
	CA*F4961*6D*+TXV	G*VC80805C*B*	55,000	39,500	15.5	12.0	51,000	40,000	56,000	9.1	35,400	1,580	5038635
	CA*F4961*6D*+TXV	G*VC81005C*B*	55,500	40,000	15.5	12.0	51,500	40,500	56,000	9.1	35,600	1,800	5038710
	CA*F4961*6D*+TXV	A*VC80805C*B*	55,000	39,500	15.5	12.0	51,000	40,000	56,000	9.1	35,400	1,580	5038754
	CA*F4961*6D*+TXV	ADVC80805C*B*	54,500	39,000	15.0	12.0	50,500	40,000	56,000	9.1	35,400	1,580	5038772
	CA*F4961*6D*+TXV	ADVC81005C*B*	55,500	40,000	15.5	12.0	51,500	40,500	56,000	9.1	35,600	1,820	5038792
	CA*F4961*6D*+TXV	A*VC81005C*B*	55,500	40,000	15.5	12.0	51,500	40,500	56,000	9.1	35,600	1,800	5038800
	CA*F4961*6D*+TXV	G*VC961205DNA*	55,500	40,000	15.5	12.0	51,500	40,500	56,000	9.0	35,000	1,600	7360657
	CA*F4961*6D*+TXV	G*VM971205DNA*	55,500	40,000	15.5	12.0	51,500	40,500	56,000	9.0	35,000	1,600	7360680
	CA*F4961*6D*+TXV	A*VC961205DNA*	55,500	40,000	15.5	12.0	51,500	40,500	56,000	9.0	35,000	1,600	7360709
	CA*F4961*6D*+TXV	A*VM971205DNA*	55,500	40,000	15.5	12.0	51,500	40,500	56,000	9.0	35,000	1,600	7360732
	CA*F4961*6D*+TXV	G*EC961205DNA*	55,500	40,000	15.5	12.0	51,500	40,500	56,000	9.0	35,000	1,520	7368154
	CA*F4961*6D*+TXV	A*EC961205DNA*	55,500	40,000	15.5	12.0	51,500	40,500	56,000	9.0	35,000	1,520	7368189
	CHPF4860D6D*+MBVC2000**-1A*+TXV		56,000	40,500	16.0	12.7	52,000	41,000	55,500	9.2	35,200	1,600	4236528
	CHPF4860D6D*+TXV	G*VC80805C*B*	55,000	39,500	15.5	12.0	51,000	40,000	55,500	9.1	35,200	1,590	5038605
	CHPF4860D6D*+TXV	G*VC81005C*B*	55,500	40,000	15.5	12.0	51,500	40,500	56,000	9.1	35,400	1,800	5038697
	CHPF4860D6D*+TXV	A*VC80805C*B*	55,000	39,500	15.5	12.0	51,000	40,000	55,500	9.1	35,200	1,590	5038727
	CHPF4860D6D*+TXV	A*VC81005C*B*	55,500	40,000	15.5	12.0	51,500	40,500	56,000	9.1	35,400	1,800	5038793
	CHPF4860D6D*+TXV	G*VC961205DNA*	55,000	39,500	15.5	12.0	51,000	40,000	56,000	9.0	35,000	1,600	7360658
	CHPF4860D6D*+TXV	G*VM971205DNA*	55,000	39,500	15.5	12.0	51,000	40,000	56,000	9.0	35,000	1,600	7360681
	CHPF4860D6D*+TXV	A*VC961205DNA*	55,000	39,500	15.5	12.0	51,000	40,000	56,000	9.0	35,000	1,600	7360710
	CHPF4860D6D*+TXV	A*VM971205DNA*	55,000	39,500	15.5	12.0	51,000	40,000	56,000	9.0	35,000	1,600	7360733
	CHPF4860D6D*+TXV	G*EC961205DNA*	55,000	39,500	15.0	12.0	51,000	40,000	56,000	9.0	35,000	1,520	7368155
	CHPF4860D6D*+TXV	A*EC961205DNA*	55,000	39,500	15.0	12.0	51,000	40,000	56,000	9.0	35,000	1,520	7368190

^ Rated in accordance with ANSI/AHRI Standard 210/240

[1] Seasonal Energy Efficiency Ratio

[2] Energy Efficiency Ratio @ 80°F/ 67°F/ 95°F

[3] TVA Rating: BTU/h @ 75°F/ 63°F - 95°F

[4] Rated heating capacity at 47°F outdoor per AHRI 210/240

[5] HSPF = Heating Seasonal Performance Factor

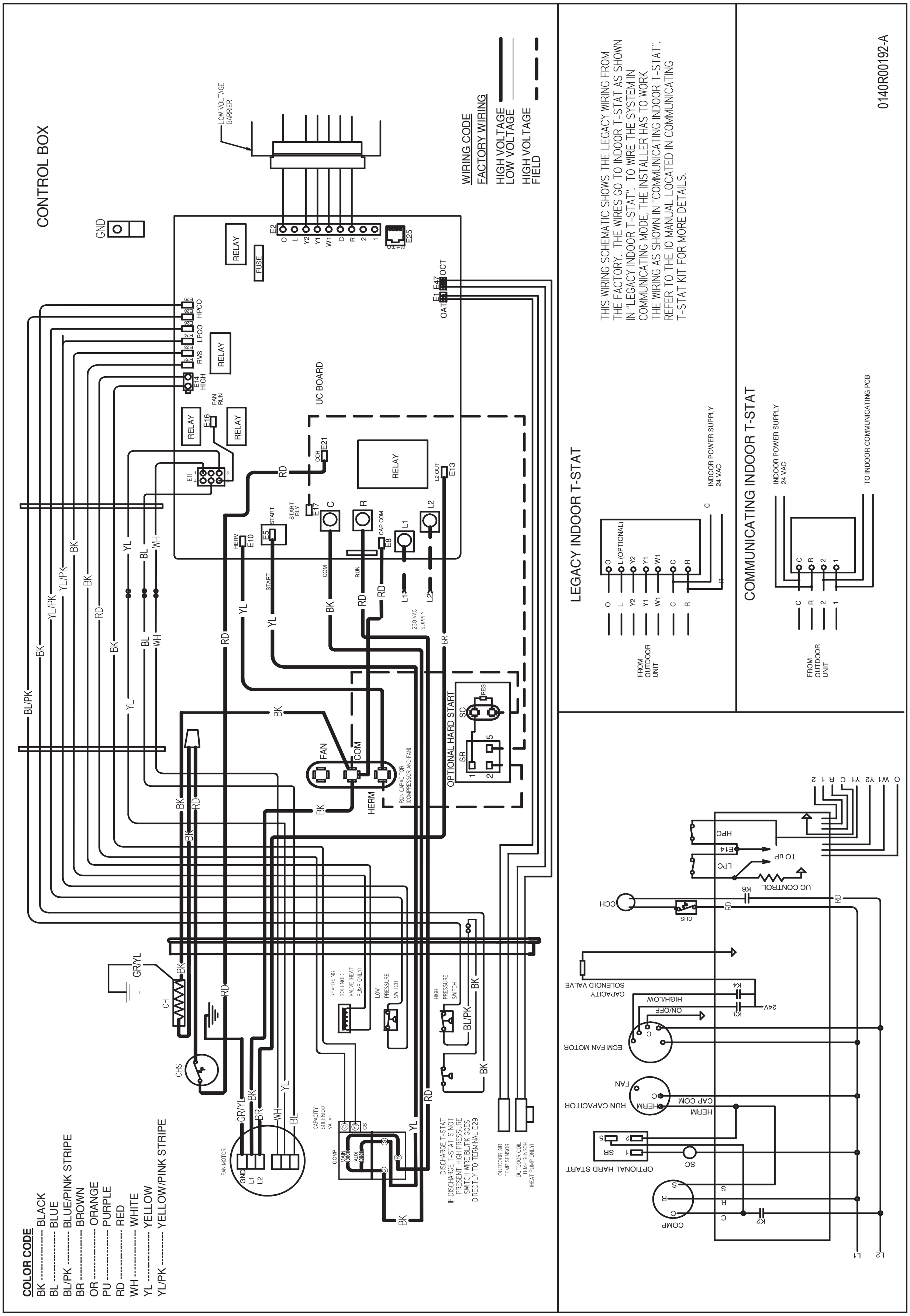
[6] Heating capacity at 17°F outdoor

[7] CFM at High stage

[8] CFM at Intermediate and low stage

Notes

- Always check the S&R plate for electrical data on the unit being installed.
- When matching outdoor unit to indoor unit, use the piston supplied with the outdoor unit or that specified on the piston kit chart supplied with the indoor unit.
- EEP - Order from Service Dept. Part No. B13707-38 or new Solid State Board B13707-35S. Part No. B13707-38 is not interchangeable with B13707-35S. The Goodman brand gas furnace contains the EEP cooling time delay.

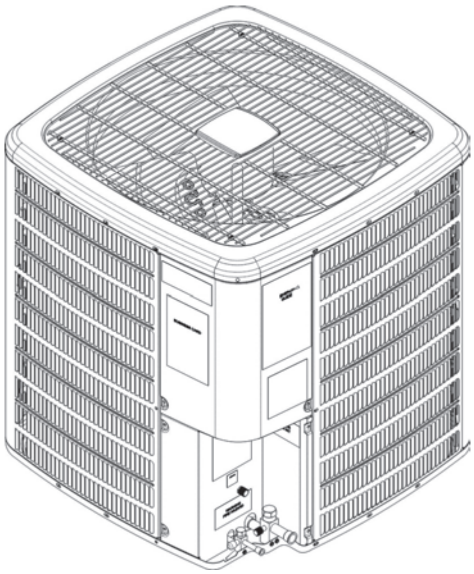


⚠ **WARNING**

High Voltage: Disconnect all power before servicing or installing this unit. Multiple power sources may be present. Failure to do so may cause property damage, personal injury, or death.

Wiring is subject to change. Always refer to the wiring diagram or the unit for the most up-to-date wiring.

DIMENSIONS



MODEL	DIMENSIONS		
	W"	D"	H"
DSZC160241A	29	29	38¼
DSZC160361A	35½	35½	38¼
DSZC160481A	35½	35½	38¼
DSZC160601A	35½	35½	38¼
DSZC160601B	35½	35½	38¼

ACCESSORIES

MODEL	DESCRIPTION	DSZC16 024**	DSZC16 036**	DSZC16 048**	DSZC16 060**
ABK-20	Anchor Bracket Kit◊				
B1141643[1]	24V Transformer	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X	
CSR-U-2	Hard-start Kit				
CSR-U-3	Hard-start Kit				X
FSK01A[2]	Freeze Protection Kit	X	X	X	X
OT18-60A[3]	Outdoor Thermostat/Lockout Thermostat	X	X	X	X
TX2N4	TXV Kit				
TX2N4A	TXV Kit	X			
TX3N4	TXV Kit		X		
TX5N4	TXV Kit			X	X

◊ Contains 20 brackets; four brackets needed to anchor unit to pad
[1] Available in 24V legacy mode only. This feature is integrated in the communicating mode.
[2] Installed on indoor coil
[3] Available in 24V legacy mode only. This feature is integrated in the communicating mode. Required for heat pump applications where ambient temperature falls below 0 0F with 50% or higher relative humidity.
Note: Maximum number of installed accessories at the same time is limited by the size of the unit's control box.

Goodman®
Air Conditioning & Heating

MBVC

Multi-Position, Variable-Speed ECM-Based, Modular Blower ComfortNet™ Compatible

Contents

Air Handler Nomenclature.................... 2
Heater Kit Nomenclature...................... 2
Product Specifications........................... 3
Airflow Data... 3
Heat Kit Data.. 4
Dimensions.. 5
Wiring Diagram...................................... 6

Product Features

- Variable-speed ECM blower motor
- ComfortNet™ Communicating System compatible
- Advanced configuration of the airflow and tonnage in communicating mode
- Provides constant CFM over a wide range of static pressure conditions independent of duct system
- CFM indicator
- Fault recall of six most recent faults
- Provides adjustable low CFM for efficient fan-only operation
- Improved humidity and comfort control
- Built-in compatibility with multi-stage heat pump and cooling applications
- 3 kW – 21 kW electric heat kits
- Blower section usable as electric heater
- Horizontal or vertical configuration capabilities
- 21" depth for easier attic access
- Foil-faced insulation covers the internal casing to reduce cabinet condensation
- Galvanized, leather grain-embossed finish
- Cabinet air leakage less than 2% at 1.0 inch H_20 when tested in accordance with ASHRE standard 193
- Cabinet air leakage less than 1.4% at 0.5 inch H_20 when tested in accordance with ASHRE standard 193
- AHRI certified; ETL listed

* Complete warranty details available from your local dealer or at www.goodmanmfg.com. To receive the 10-Year Parts Limited Warranty, online registration must be completed within 60 days of installation. Online registration is not required in California or Québec.

MB	VC	12	00	A	A	1
1,2	3,4	5,6	7,8	9	10	11

Design Series
MB Modular Blower

Motor Speed
V Variable Speed
C ComfortNet™ Compatible

Airflow Delivered
08 800 CFM
12 1200 CFM
16 1600 CFM
20 2000 CFM

Electrical
1 208-230/60/1

Revisions
A First Series

Circuit Breaker
A No Circuit Breaker
B Circuit Breaker

Factory-installed Electric Heat
00 No Heat

HKR	*	-05	*	A
1	2	3	4,5	11

Unit Type
HKR Air Handlers & Packaged Units
HKA Air Handlers
HKP Packaged Units

Phase
None Single-Phase
3 Three-Phase

Heating Capacity @ 240 Volts
5 4.75 kW
8 7.00 kW
10 9.50 kW
15 14.25 to 15.00 kW
20 19.00 to 19.60 kW

Revisions
Engineering Revisions

Circuit Breaker
None Single- or 3-Phase Kit; No Circuit Breaker
C Single-Phase Kit w/ Circuit Breaker

Model	**MBVC1200AA-1**	**MBVC1600AA-1**	**MBVC2000AA-1**
Blower			
Diameter	10"	10"	11"
Width	8"	8"	10"
Electrical Data			
Voltage	208 / 230	208 / 230	208 / 230
Min Circuit Ampacity	4.3	6.3	5.8
Max. Overcurrent Device (Amps)	15	15	15
Blower Motor			
Horsepower (HP)	½	¾	¾
Ship Weight (Lbs.)	67	80	86

- Minimum Circuit Ampacity (MCA) and Maximum Overcurrent Protection (MOP) for blower without supplemental heat installed. Refer to unit nameplate for these specifications with approved accessory heaters installed.

Model	Speed Tap	Speed	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
MBVC1200A*	A	Low	420	415	400	400	395	390	390	390	380
	B	Low	550	545	540	540	535	530	530	525	520
	C	Low	680	675	670	665	660	655	655	650	640
	D	Low	810	805	800	800	800	795	790	785	785
	A	High	615	605	600	600	595	590	590	585	580
	B	High	805	805	800	800	800	795	790	785	780
	C	High	1010	1005	1000	1000	995	995	990	985	975
	D	High	1210	1205	1200	1200	1200	1195	1195	1190	1180
MBVC1600A*	A	Low	690	680	670	665	660	655	625	595	575
	B	Low	850	830	800	795	790	785	775	750	725
	C	Low	980	970	940	935	930	910	890	865	860
	D	Low	1110	1085	1070	1055	1045	1025	1000	990	975
	A	High	1045	1015	1000	990	975	950	935	920	900
	B	High	1245	1215	1200	1180	1175	1165	1150	1130	1115
	C	High	1415	1410	1400	1365	1360	1350	1340	1330	1320
	D	High	1605	1600	1600	1540	1530	1520	1510	1500	1490
MBVC2000A*	A	Low	835	815	800	800	795	795	790	775	750
	B	Low	1075	1070	1070	1065	1050	1045	1045	1040	1035
	C	Low	1210	1205	1200	1200	1195	1190	1190	1185	1175
	D	Low	1345	1340	1340	1320	1320	1315	1315	1305	1305
	A	High	1210	1205	1200	1195	1150	1150	1145	1135	1115
	B	High	1610	1605	1600	1540	1535	1535	1530	1520	1510
	C	High	1830	1805	1800	1785	1760	1760	1755	1750	1715
	D	High	2020	2010	2000	1995	1995	1970	1970	1965	1955

Cooling and Heat Pump Airflow

S1	S2	Speed Tap	MBVC1200 Airflow (SCFM)	MBVC1600 Airflow (SCFM)	MBVC2000 Airflow (SCFM)
off	off	A	600	1000	1200
on	off	B	800	1200	1600
off	on	C	1000	1400	1800
on	on	D	1200	1600	2000

Heat Kit Airflow

Cooling / HP / Aux Trim			Cooling Profile		
S3	S4	Trim Value	S5	S6	
off	off	0	off	off	A
on	off	10%	on	off	B
off	on	-10%	off	on	C
on	on	0	on	on	D

Notes
- The chart is for information only. For satisfactory operation, external static pressure must not exceed value shown on rating plate.
- Use the CFM adjustment factors of .98 for horizontal left, .95 for horizontal right & .96 for downflow orientations.

MODELS	CIRCUIT 1			CIRCUIT 2			SINGLE-POINT KIT	
	HEATER AMPS	MCA¹	MOP²	HEATER AMPS	MCA¹	MOP²	MCA¹	MOP²
MBVC1200AA-1A*	0 / 0	4.3 / 4.3	15 / 15	---	---	---	---	---
HKR-03*	10.8 / 12.5	17.8 / 19.9	20 / 20	---	---	---	---	---
HKR-05* / 05C*	17.2 / 19.8	25.7 / 29.0	30 / 30	---	---	---	---	---
HKR-06*	21.7 / 25.0	31.3 / 35.5	35 / 40	---	---	---	---	---
HKR-08* / -08C*	25.3 / 29.2	35.8 / 40.7	40 / 45	---	---	---	---	---
HKR-10* / -10C*	34.3 / 39.6	47.1 / 53.7	50 / 60	---	---	---	---	---
HKA-15C*	34.3 / 39.6	47.1 / 53.7	50 / 60	17.2 / 19.8	21.4 / 24.7	25 / 25	69/79	70 / 80
MBVC1600AA-1A*	0 / 0	6.3 / 6.3	15 / 15	---	---	---	---	---
HKR-03*	10.8 / 12.5	19.8 / 21.9	20 / 25	---	---	---	---	---
HKR-05* / 05C*	17.2 / 19.8	27.7 / 31.0	30 / 35	---	---	---	---	---
HKR-06*	21.7 / 25.0	33.3 / 37.5	35 / 40	---	---	---	---	---
HKR-08* / -08C*	25.3 / 29.2	37.8 / 42.7	40 / 45	---	---	---	---	---
HKR-10* / -10C*	34.3 / 39.6	49.1 / 55.7	50 / 60	---	---	---	---	---
HKA-15C*	34.3 / 39.6	49.1 / 55.7	50 / 60	17.2 / 19.8	21.4 / 24.7	25 / 25	71/81	80 / 90
MBVC2000AA-1A*	0 / 0	5.8 / 5.8	15 / 15	---	---	---	---	---
HKR-03*	10.8 / 12.5	19.3 / 21.4	20 / 25	---	---	---	---	---
HKR-05* / 05C*	17.2 / 19.8	27.2 / 30.5	30 / 35	---	---	---	---	---
HKR-06*	21.7 / 25.0	32.8 / 37.0	35 / 40	---	---	---	---	---
HKR-08* / -08C*	25.3 / 29.2	37.3 / 42.2	40 / 45	---	---	---	---	---
HKR-10* / -10C*	34.3 / 39.6	48.6 / 55.2	50 / 60	---	---	---	---	---
HKA-15C*	34.3 / 39.6	48.6 / 55.2	50 / 60	17.2 / 19.8	21.4 / 24.7	25 / 25	70/80	70 / 80
HKA-20C*	34.3 / 39.6	48.6 / 55.2	50 / 60	34.3 / 39.6	42.9 / 49.5	45 / 50	92/105	100 / 110

All ampacities noted above include air handler motor amps

Circuit 1: Single-phase for Air Handlers / Circuit 2: Three-phase for HKR3 Heater Kits

¹ Minimum Circuit Ampacity (Heater Amps + Motor Amps) X 1.25

² Maximum Overcurrent Protection = 2.25 X Motor Amps + Heater Amps

* Revision level that may or may not be designated

C = Circuit Breaker Option

--- indicates Not Required

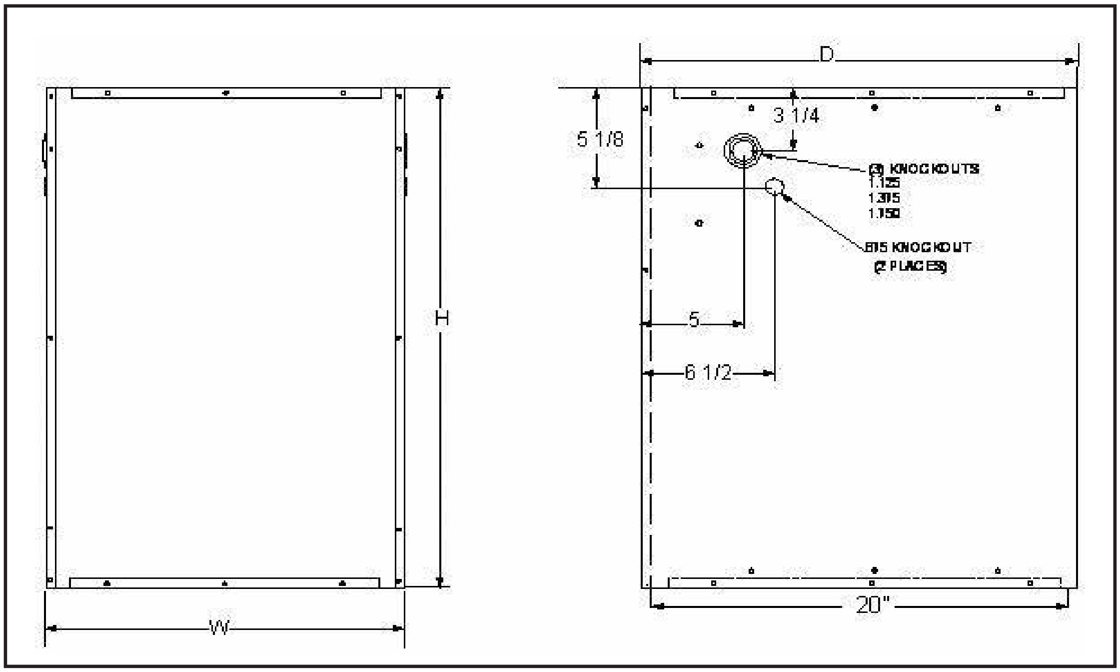
- Only applicable when HKA kits are included in table
  HKA meets the new UL1995 requirements for 15 and 20KW heaters
- MBVC and MBR models

Heating kW Correction Factor

SUPPLY VOLTAGE	240	230	220	210	208
CORRECTION FACTOR	1.00	0.92	0.84	0.77	0.75

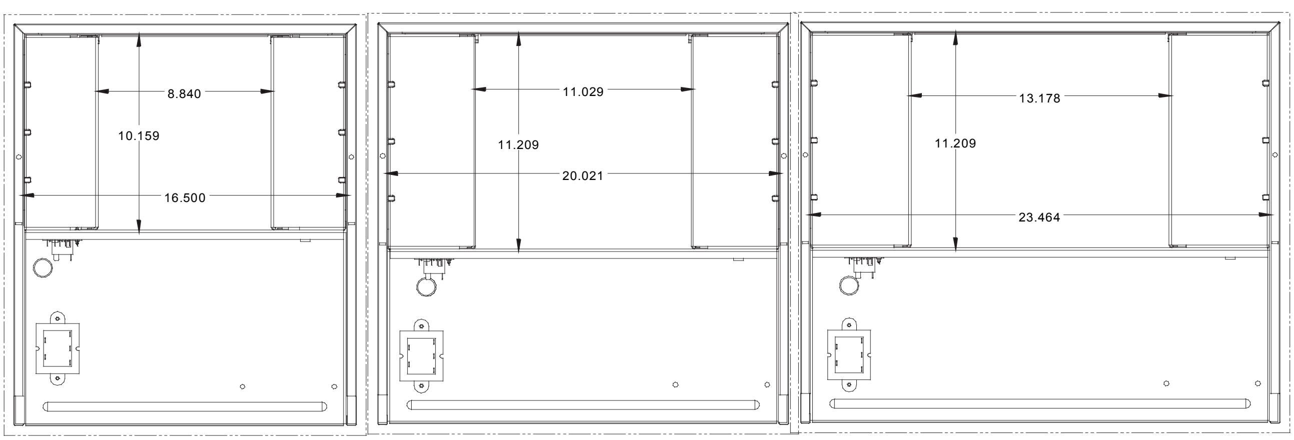
Multiply the 240-volt heating capacity by correction factors.

Side and Front Views

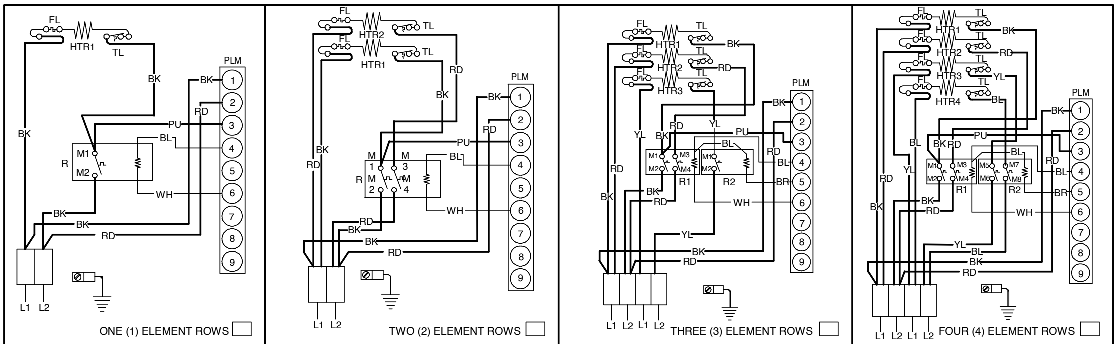


Model	Dimensions		
	Width	Depth	Height
MBVC1200AA-1	17½"	21"	26"
MBVC1600AA-1	21"	21"	30"
MBVC2000AA-1	24½"	21"	30"

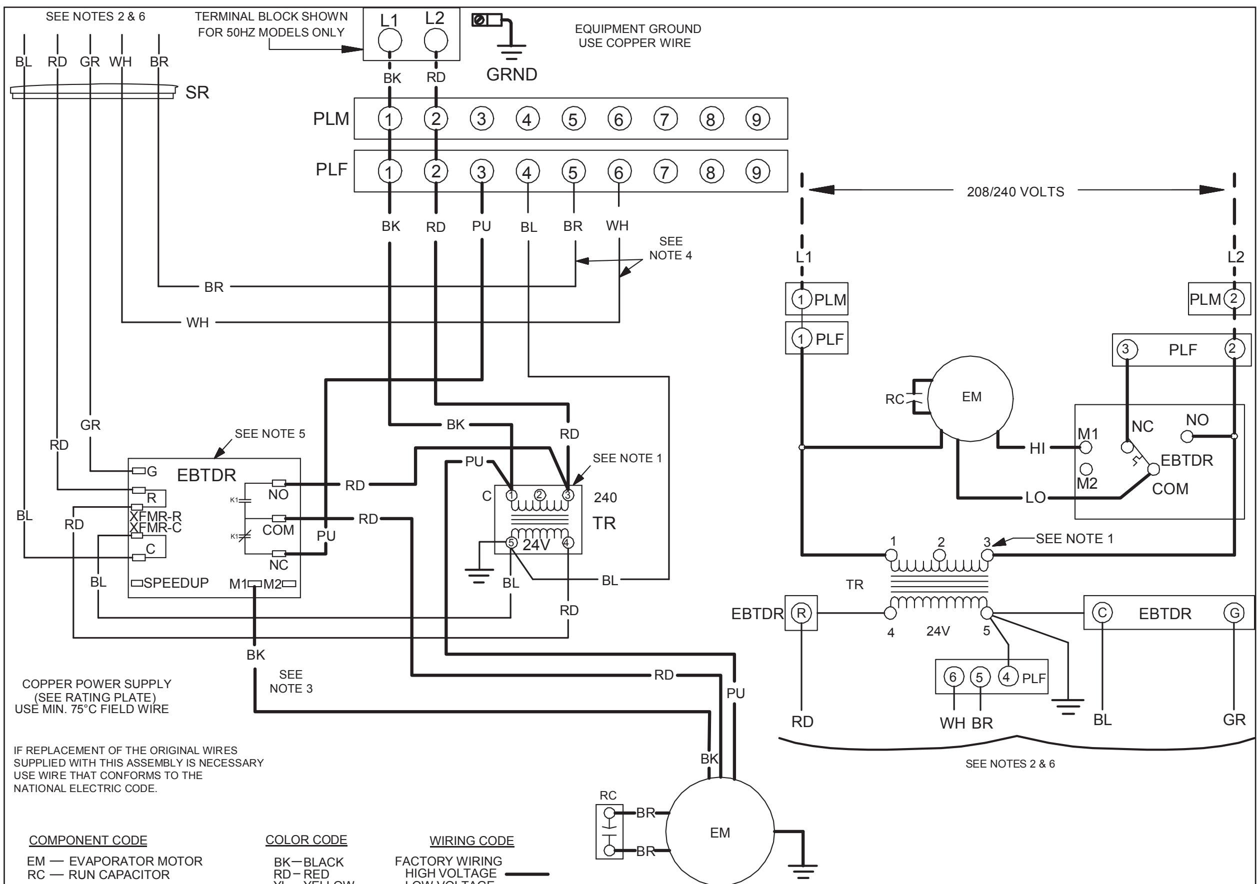
Top View



17½" **21"** **24½"**



NOTE: WHEN INSTALLING HEATER KIT, ENSURE SPEED TAP DOES NOT EXCEED MINIMUM BLOWER SPEED (MBS) SPECIFIED FOR THE AIRHANDLER/HEATER KIT COMBINATION ON THIS UNIT'S INSTALLATION INSTRUCTIONS. AFTER INSTALLING OPTIONAL HEAT KIT, MARK AN "X" IN THE ☐ PROVIDED ABOVE. MARK ACCORDING TO NUMBER OF HEATER ELEMENT ROWS INSTALLED. NO MARK INDICATES NO HEAT KIT INSTALLED. 0140M00011



COMPONENT CODE

EM — EVAPORATOR MOTOR
RC — RUN CAPACITOR
SR — STRAIN RELIEF
R — RELAY
EBTDR — ELECTRONIC BLOWER TIME DELAY RELAY
TR — TRANSFORMER
PLF — FEMALE PLUG CONNECTOR
PLM — MALE PLUG CONNECTOR
FL — FUSE LINK
TL — THERMAL LIMIT
GRND — GROUND

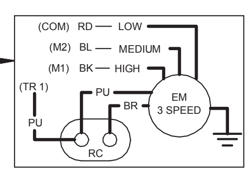
COLOR CODE

BK — BLACK
RD — RED
YL — YELLOW
BL — BLUE
GR — GREEN
PU — PURPLE
BR — BROWN
WH — WHITE

WIRING CODE

FACTORY WIRING
HIGH VOLTAGE ———
LOW VOLTAGE ———
FIELD WIRING
HIGH VOLTAGE — —
LOW VOLTAGE — —

THREE SPEED MOTOR WIRING (SELECT MODELS ONLY) SEE NOTE 3



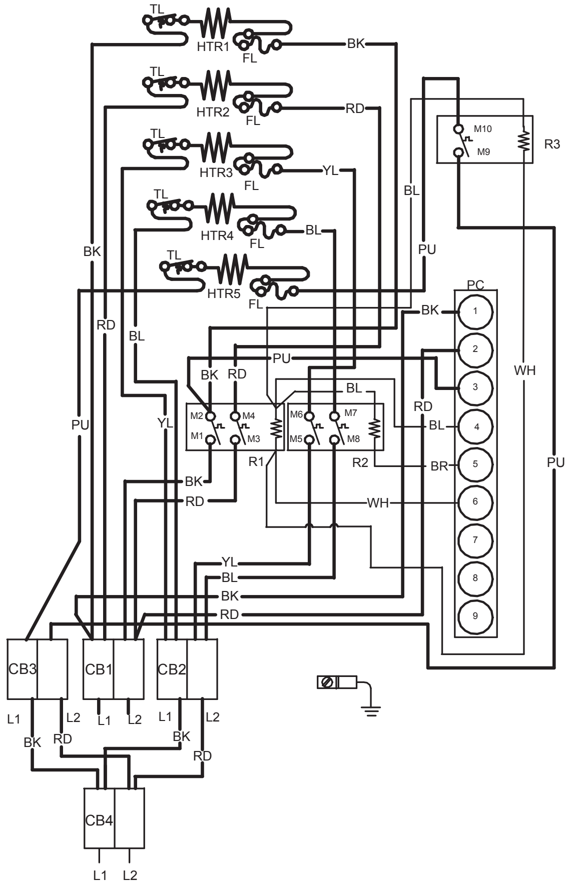
NOTES:

1. RED WIRES TO BE ON TRANSFORMER TERMINAL "3" FOR 240 VOLTS AND ON TERMINAL "2" FOR 208 VOLTS
2. SEE COMPOSITE WIRING DIAGRAMS IN INSTALLATION INSTRUCTIONS FOR PROPER LOW VOLTAGE WIRING CONNECTIONS
3. CONFIRM SPEED TAP SELECTED IS APPROPRIATE FOR APPLICATION. IF SPEED TAP NEEDS TO BE CHANGED, CONNECT APPROPRIATE MOTOR WIRE (RED FOR LOW, BLUE FOR MEDIUM, AND BLACK FOR HIGH SPEED) ON "COM" CONNECTION OF THE EBTDR INACTIVE MOTOR WIRES MUST BE CONNECTED TO "M1 OR M2" ON EBTDR.
4. BROWN AND WHITE WIRES ARE USED WITH HEAT KITS ONLY.
5. EBTDR HAS A 7 SECOND ON DELAY WHEN "G" IS ENERGIZED AND A 65 SECOND OFF DELAY WHEN "G" IS DE-ENERGIZED.
6. LOW VOLTAGE FIELD WIRING TO BE N.E.C CLASS 2 WIRES.

0140A00245-A

Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.

⚠ **WARNING**	***High Voltage:*** Disconnect all power before servicing or installing this unit. Multiple power sources may be present. Failure to do so may cause property damage, personal injury, or death.



COMPONENT CODE

PC = 9 PIN CONNECTOR
HTR = HEATER ELEMENT
TL = THERMAL LMT
RS = RELAY/SEQUENCER
TB = TERMINAL BLOCK
CB = CIRCUIT BREAKER
CC = CONTACTOR
FL = FUSE LINK
EM = EVAPORATOR MOTOR
EBTDR = ELEC. BLOWER TIME DELAY
RC = RUN CAPACITOR
TR = TRANSFORMER
SR = STRAIN RELIEF

COLOR CODE

BK = BLACK
BL = BLUE
BR = BROWN
GR = GREEN
OR = ORANGE
PK = PINK
PU = PURPLE
RD = RED
WH = WHITE
YL = YELLOW

WIRING CODE:

HIGH VOLTAGE
LOW VOLTAGE

NOTE: WHEN INSTALLING HEATER KIT, ENSURE SPEED TAP MUST EXCEED OR EQUAL THE MINIMUM BLOWER SPEED (MBS) SPECIFIED FOR THE AIRHANDLER / HEATER KIT COMBINATION ON THIS UNIT'S SERIAL PLATE. AFTER INSTALLING OPTIONAL HEAT KIT, MARK AN "X" IN THE ☐ PROVIDED BELOW.
NO MARK INDICATES NO HEAT KIT INSTALLED.

FIVE (5) ELEMENT ROWS ☐

NOTE:-
THIS LABEL MUST BE ATTACHED ON THE AIRHANDLER IN A PROMINENT LOCATION

0140M00274-A

Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.

⚠ **WARNING**	***High Voltage:*** Disconnect all power before servicing or installing this unit. Multiple power sources may be present. Failure to do so may cause property damage, personal injury, or death.

Tunstall Steam Trap Capsules®
Typical Specification

Quality Engineering

Typical Specification

Thermostatic steam trap repair units shall be Tunstall Steam Trap Capsule® (1-800-423-5578) or approved equal. Capsules to be rated for Vac to 125 psig working pressure. Due to the extended life of high pressure bellows units on low pressure applications, only high pressure bellows units will be acceptable.

Capsule to be made entirely of corrosion resistant stainless steel with TIG welded construction. The actuator shall be a ten plate stainless steel bellows, with heat treated hardened ball bearing close off mechanism. Bellows shall be entirely enclosed in a protective stainless steel capsule to prevent damage from water hammer and debris build-up.

The replacement capsule shall include integral welded stainless steel seat able to fit directly into the condensate portion of the steam trap body. Diaphragm, Nozzle, Orifice, Venturi, Quick Fix, Wafer, Nugget or low pressure units are not acceptable.

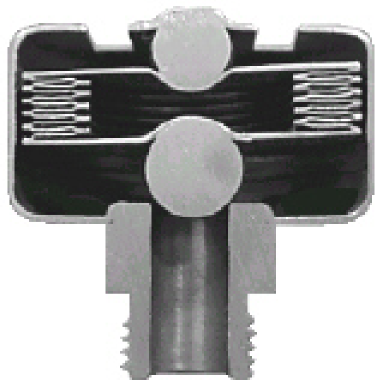
The replacement Tunstall unit must be of universal design, able to retrofit the existing thermostatic steam traps.

New covers may be necessary and shall be provided as required.

Typical Examples

TF (Class 1) Post & Spring Style

TC (Class 2) Post & Spring Style



TC (Class 2) Thread Style Cut Away
Available in Class 1 & Class 2

Top View

TC Tool

Toll Free:1-800-423-5578
Give Us A Call To Cross Reference Any Manufacturers Unit.
Tunstall Corporation - 118 Exchange Street - Chicopee, MA 01013
Phone:(413)594-8695 - Fax:(413)598-8109

Tunstall Capsule
Thermostatic Traps
Thermal-Disc Traps
F&T Traps
F&T Repair Kits
Inverted Bucket Traps
Pressure Action Pump
Inlet Orifice
Heat Exchangers
Mixing Valves
Miscellaneous
Literature Downloads
Questions / Comments
Steam Trap Team
Reps & Distributors
Tunstall Corporation
Links

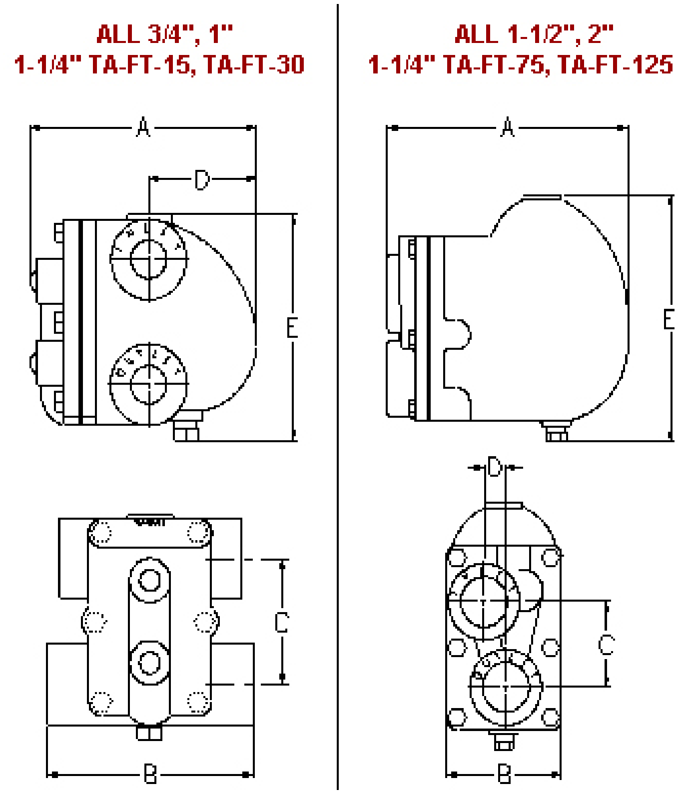
Tunstall®

Series TA-FT Engineering Specifications

CAPACITIES

lbs. Condensate per hour

			DIFFERENTIAL PRESSURE (PSI)														
Model	**Size NPT**	**PSIG Orifice**	**¼**	**½**	**1**	**2**	**5**	**10**	**15**	**20**	**25**	**30**	**40**	**50**	**75**	**100**	**125**
TA-FT3-15	¾"	.218	279	369	489	650	785	1000	1075								
TA-FT4-15	1"	.218	279	369	489	650	785	1000	1075								
TA-FT5-15	1¼"	.312	600	770	980	1240	1640	2000	2340								
TA-FT6-15	1½"	.500	1100	1700	2400	3300	5000	6600	7600								
TA-FT8-15	2"	.625	2300	2800	3600	4650	6900	9000	10900								
TA-FT3-30	¾"	.218	279	369	489	650	785	1000	1075	1210	1300	1370					
TA-FT4-30	1"	.218	279	369	489	650	785	1000	1075	1210	1300	1370					
TA-FT5-30	1¼"	.228	375	500	690	910	1200	1500	1680	1800	1900	2000					
TA-FT6-30	1½"	.390	1000	1300	1700	2300	3400	4600	5500	6000	6600	7000					
TA-FT8-30	2"	.500	1300	1800	2500	3400	5200	6800	7800	8600	9300	10000					
TA-FT3-75	¾"	.166	160	213	280	365	520	700	795	875	930	970	1120	1230	1450		
TA-FT4-75	1"	.166	160	213	280	365	520	700	795	875	930	970	1120	1230	1450		
TA-FT5-75	1¼"	.312	550	725	960	1300	1900	2650	3050	3400	3700	4000	4400	4750	5400		
TA-FT6-75	1½"	.312	550	725	960	1300	1900	2650	3050	3400	3700	4000	4400	4750	5400		
TA-FT8-75	2"	.421	850	1100	1500	2000	3100	4150	4750	5200	5500	5800	6400	6800	7700		
TA-FT3-125	¾"	.125	100	135	175	230	330	415	500	585	620	685	750	830	970	1110	1190
TA-FT4-125	1"	.125	100	135	175	230	330	415	500	585	620	685	750	830	970	1110	1190
TA-FT5-125	1¼"	.246	400	520	680	890	1300	1700	2050	2300	2500	2700	3000	3200	3800	4200	4500
TA-FT6-125	1½"	.246	400	520	680	890	1300	1700	2050	2300	2500	2700	3000	3200	3800	4200	4500
TA-FT8-125	2"	.332	550	675	880	1225	1950	2600	3000	3250	3500	3800	4200	4600	5500	6100	6600



		DIMENSIONS (Inches)					
Model	**Size**	**A**	**B**	**C**	**D**	**E**	**Weight (lbs.)**
TA-FT3-15	¾"	6.25	5.50	3.31	3.00	5.75	9
TA-FT4-15	1"	6.25	5.50	3.31	3.00	5.75	9
TA-FT5-15	1¼"	6.25	5.75	3.00	3.81	5.75	9½
TA-FT6-15	1½"	8.50	4.25	3.00	0.70	8.40	18
TA-FT8-15	2"	9.81	4.94	4.94	0.12	9.12	26
TA-FT3-30	¾"	6.25	5.50	3.31	3.00	5.75	9
TA-FT4-30	1"	6.25	5.50	3.31	3.00	5.75	9
TA-FT5-30	1¼"	6.25	5.75	3.00	3.81	5.75	9½
TA-FT6-30	1½"	8.50	4.25	3.00	0.70	8.40	18
TA-FT8-30	2"	9.81	4.94	4.94	0.12	9.12	26
TA-FT3-75	¾"	6.25	5.50	3.31	3.00	5.75	9
TA-FT4-75	1"	6.25	5.50	3.31	3.00	5.75	9
TA-FT5-75	1¼"	8.50	4.25	3.00	0.70	8.40	18
TA-FT6-75	1½"	8.50	4.25	3.00	0.70	8.40	18
TA-FT8-75	2"	9.81	4.94	4.94	0.12	9.12	26
TA-FT3-125	¾"	6.25	5.50	3.31	3.00	5.75	9
TA-FT4-125	1"	6.25	5.50	3.31	3.00	5.75	9

TA-FT5-125	1¼"	8.50	4.25	3.00	0.70	8.40	18
TA-FT6-125	1½"	8.50	4.25	3.00	0.70	8.40	18
TA-FT8-125	2"	9.81	4.94	4.94	0.12	9.12	26

Toll Free:1-800-423-5578
Give Us A Call To Cross Reference Any Manufacturers Unit.
Tunstall Corporation - 118 Exchange Street - Chicopee, MA 01013
Phone:(413)594-8695 - Fax:(413)598-8109

Thermostatic Radiator Steam Traps

Series TA

Established 1958

Operation

Tunstall Associates, Inc. produces a complete line of thermostatic radiator steam traps with ratings up to 125 psi. Each unit is tested and inspected before leaving the factory guaranteeing years of trouble free service. All units are "normally open" to expel air and water and will "close" at saturated steam temperature thereby preventing steam from entering into condensate return lines. Each Tunstall Steam Trap features the Tunstall Capsule® which has become the best steam trap replacement bellows available today.

Features

- Chrome-plated heavy duty forged brass
- TIG welded stainless steel Tunstall Capsule® with balanced pressure stainless steel bellows
- Calibrated, inspected and tested
- Ratings from 25" Hg vacuum to 125 psi
- Available in 1/2" & 3/4" straight or angle, 1/2" x 3/4" angle, 1/2" vertical and 1" angle patterns

Tunstall Capsule®

Benefits

- Simple installation
- Corrosion resistant stainless steel internals
- Extended life on low pressure applications

Applications

- Cast Iron Radiators
- Finned Tube Radiation
- Convectors
- Air Coils
- Sterilizers
- Drips

Typical Specification

Furnish and install Tunstall Thermostatic Steam Traps as shown or as specified on plans and in accordance with manufacturer's instructions, sizes 1/2", 3/4" or 1". The trap body and cover shall be forged brass and provided with an entirely stainless steel Tunstall Capsule®. Rating shall be ______ lbs/hr at ______ PSIG pressure differential. Each unit shall be guaranteed for 2 years from date of installation.

The Tunstall Capsule® professionally upgrades all thermostatic steam traps. Refer to catalog #795 or www.tunstall-inc.com for more detailed information.

Tunstall Associates, Inc.
118 Exchange Street · Chicopee, MA 01013

Phone (413) 594-8695 · Fax (413) 598-8109
www.tunstall-inc.com

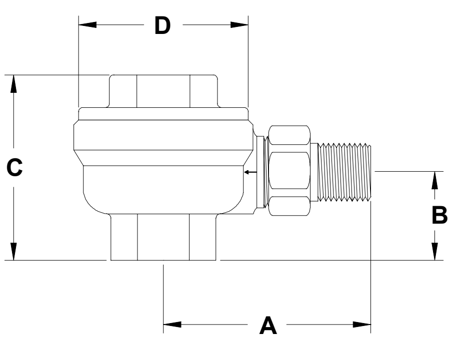
TUNSTALL THERMOSTATIC STEAM TRAPS SERIES "TA"

Engineering Specifications

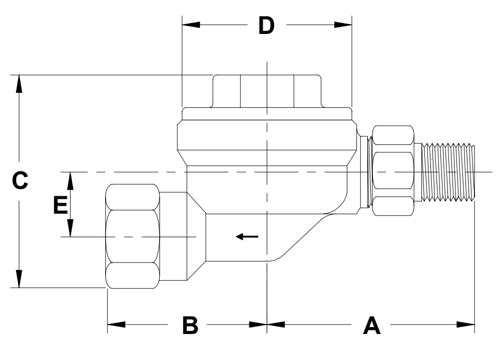
CAPACITIES*

			DIFFERENTIAL PRESSURE (PSI)									
			Square Feet EDR**							lbs Condensate per hour***		
Model	**Size NPT**	**PSIG Orifice**	**1/2**	**1**	**1-1/2**	**2**	**5**	**10**	**25**	**50**	**75**	**125**
TA-1/2-A	1/2"	5/16	120	165	200	230	3320	500	825	1400	1700	1950
TA-3/4-A	3/4"	5/16	230	330	400	465	730	1050	1700	2375	2680	3300
TA-1-A	1"	1/4	430	590	700	760	1200	1750	4100	4050	4700	5500
TA-1/2x3/4-A	1/2"x3/4"	5/16	230	330	400	465	730	1050	1700	2375	2680	3300
TA-1/2-S	1/2"	5/16	120	165	200	230	320	500	825	1400	1700	1950
TA-3/4-S	3/4"	5/16	230	330	400	465	730	1050	1700	2375	2680	3300
TA-1/2-V	1/2"	5/16	120	165	200	230	320	500	825	1400	1700	1950

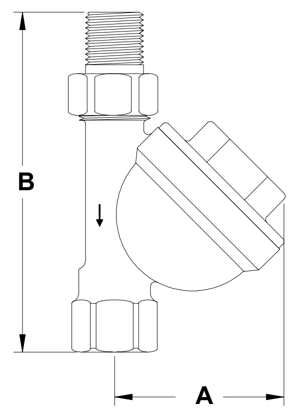
*Ratings are in accordance with standards established by The Steam Heating Equipment Manufacturers Association (SHEMA). No safety factor required.
**To convert Square Feet EDR to pounds of condensate per hour: Divide the square foot ratings by 4.
One Square Foot EDR is equivalent to net emission of 240 BTU per hour with 215°F steam in the radiator surrounded by 70°F air temperature.
***Basic ratings for trap pressures greater than 25psi are given in lbs of condensate per hour.
One pound of condensate is equivalent to approximately 1000 BTU; 1000 BTU is equivalent to approximately 4 square feet EDR.



Angle Pattern (A)



Straight Pattern (S)



Vertical Pattern (V)

Model No.	Pipe Size	A	B	C	D	E	Weight
TA-1/2-A	1/2" Angle	3.00	1.25	2.57	2.56	--	1.75 lbs
TA-3/4-A	3/4" Angle	3.38	1.37	2.87	2.56	--	1.84 lbs
TA-1-A	1" Angle	4.13	2.00	4.12	2.08	--	2.50 lbs
TA-1/2-S	1/2" Straight	3.00	2.15	3.00	2.50	1.00	1.94 lbs
TA-3/4-S	3/4" Straight	3.38	2.15	3.00	2.50	1.00	2.05 lbs
TA-1/2X3/4-A	1/2" X 3/4" Angle	3.38	1.25	2.57	2.56	--	1.75 lbs
TA-1/2-V	1/2" Vertical	2.50	4.85	--	--	--	1.65 lbs

Tunstall Associates, Inc.
118 Exchange Street · Chicopee, MA 01013

Tunstall

Phone (413) 594-8695 · Fax (413) 598-8109
www.tunstall-inc.com

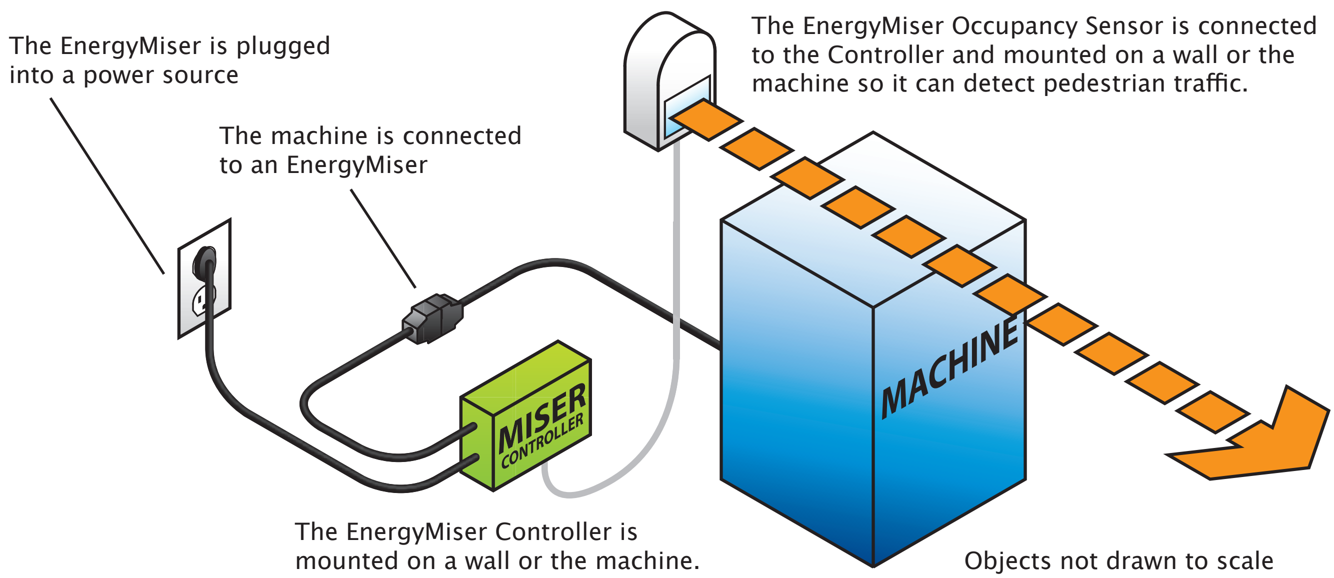
EnergyMisers

EnergyMiser® Products are easy to install devices designed to lower the energy consumption of vending machines, commercial coolers, and other "always on" machines and appliances. No other technology can compete with its price and ease of installation for the immediate energy savings that can be achieved.

- Win and retain accounts by offering energy-efficient technology
- Save clients up to $150 per machine, per year
- Typical return on investment in 12 months
- Easy retrofit field installation
- Reduction in machine energy use an average of 35-45%
- Reduced machine maintenance and longer machine lifespans
- Environmental benefits such as reducing pollution and natural resource use

How EnergyMisers Work

External EnergyMisers use a controller and a machine mounted sensor to monitor room occupancy and temperature. If 15 minutes pass without any pedestrian traffic, the EnergyMiser will power down the machine. The machine is powered back up when people return and at regular intervals to to keep the product cold. External controllers are best suited for low traffic areas.



Internal EnergyMisers use sales based intelligence to power down the cooling system while leaving lighting and controller electronics on. While the cooling system is powered down, the internal EnergyMiser monitors the room's temperature and automatically re-powers the cooling system at regular intervals to keep the product cold. Internal controllers are best suited for high traffic areas.

Who Uses EnergyMisers

Several large retailers such as Wal-Mart and Kroger have installed EnergyMiser Products at their locations. Educational facilities along with the US Government have purchased EnergyMisers through GSA. Also, many utilities offer rebates on the purchase of EnergyMiser products and several have provided customers with EnergyMiser Products at no cost through Turnkey Programs.

USA Technologies 100 Deerfield Lane, Suite 140, Malvern, PA 19355 • 800.633.0340 • www.usatech.com

EnergyMiser Products

VendingMiser® - for cold drink vending machines
VM150 - Indoor Wall Mount Controller with Occupancy Sensor
VM151 - Indoor Wall Mount Controller with 10' Repeater Cable
VM160 - Outdoor Wall Mount Controller with Occupancy Sensor and Weather-proof Enclosure
VM161 - Outdoor Wall Mount Controller with 10' Repeater Cable and Weather-proof Enclosure
VM170 - Indoor Controller with EZ Mount Z-Bracket and Occupancy Sensor
VM171 - Indoor Controller with EZ Mount L-Bracket and 10' Repeater Cable
VM180 - Outdoor Controller with EZ Mount Z-Bracket, Occupancy Sensor, and Weatherproof Enclosure
VM181 - Outdoor Controller with EZ Mount L-Bracket, 10' Repeater Cable and Weatherproof Enclosure
VM2iQ - Internal VendingMiser

CoolerMiser™ - for commercial glass-front coolers
CM150 - Indoor Wall Mount Controller with Occupancy Sensor
CM151 - Indoor Wall Mount Controller with 10' Repeater Cable
CM170 - Indoor Controller with EZ Mount Z-Bracket and Occupancy Sensor
CM171 - Indoor Controller with EZ Mount L-Bracket and 10' Repeater Cable
CM2iQ - Internal CoolerMiser

SnackMiser® - for snack vending machines
SM150 - Indoor Wall Mount Controller with Occupancy Sensor
SM151 - Indoor Wall Mount Controller with 10' Repeater Cable
SM170 - Indoor Controller with EZ Mount Z-Bracket and Occupancy Sensor
SM171 - Indoor Controller with EZ Mount L-Bracket and 10' Repeater Cable

PlugMiser™ - for most major electrical equipment
PM150 - Indoor Wall Mount Controller with Occupancy Sensor
PM151 - Indoor Wall Mount Controller with 10' Repeater Cable
PM190 - Indoor Controller with Leg Mount and Occupancy Sensor

VendingMiser VM150

CoolerMiser CM150

SnackMiser SM150

PlugMiser PM150

Visit www.energymisers.com for more information.

USA Technologies 100 Deerfield Lane, Suite 140, Malvern, PA 19355 • 800.633.0340 • www.usatech.com

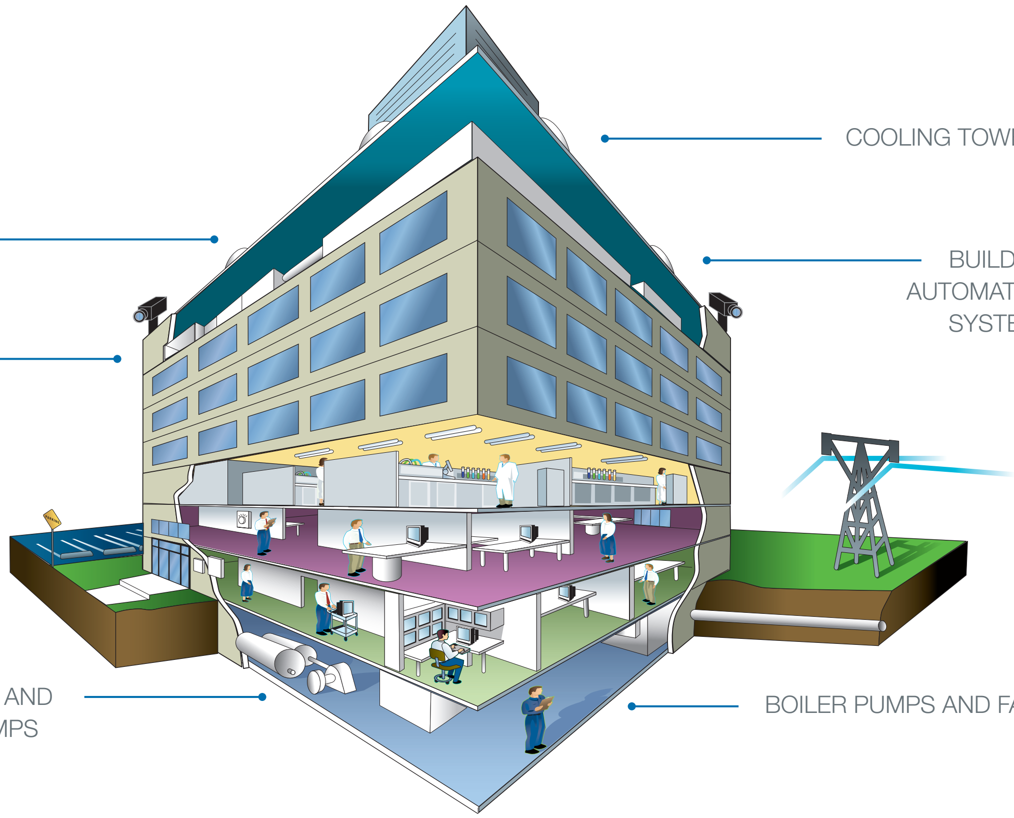
SmartVFD HVAC and BYPASS

Honeywell

The Smart Choice for Energy Savings.

Saving Energy the Smart Way

Buildings consume more than 70 percent of the electricity produced in North America — and roughly half of that is used to circulate air and water. Honeywell SmartVFD HVAC, BYPASS and COMPACT variable frequency drives maximize energy savings by modulating the speed of fans and pumps. VFDs achieve these savings by operating within a building's control system or independently through its internal PID capabilities. Additionally, Honeywell's VFDs are loaded with labor-saving features such as startup wizards, PC programming, and an intuitive graphical interface that allows for faster, more accurate commissioning and reliable maintenance over the life of the drive.



BACKED BY HONEYWELL

Already among the leading names in HVAC variable frequency drives, Honeywell is pleased to deliver the SmartVFD HVAC line — the third generation of Honeywell VFDs. Designed specifically for commercial applications and backed by more than a century of Honeywell's control expertise, you can count on Honeywell's SmartVFD HVAC and BYPASS to deliver long-term service and energy savings for your customer. You simply can't find a commercial building control name with a more proven record than Honeywell.

The Smart Choice for Efficient Investment

It's a common myth that any VFD can easily be applied in a commercial application, but many VFDs are not the right tool for the job. The Honeywell SmartVFD HVAC and BYPASS are designed specifically for commercial buildings to deliver the energy savings that building owners and facility managers need with 98 percent energy efficiency, minimal labor and a fast ROI.

SMARTVFD HVAC – SMART INSTALLATION, SMART COMMISSIONING AND SMART COMMUNICATION

The Honeywell SmartVFD HVAC meets UL and cUL standards which makes installation and commissioning easy for you and energy savings easy for your customers:

Easy Communication

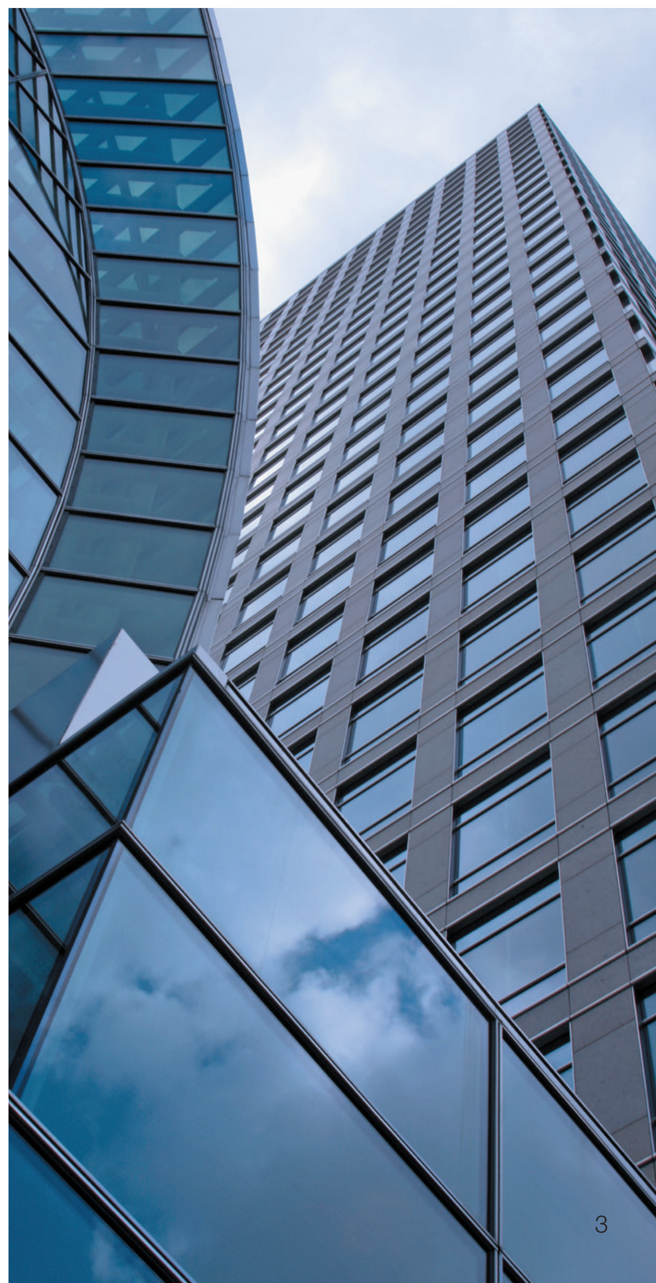
- Start-up Wizards — Set the clock and tell the VFD whether you have a pump or a fan, enter nominal motor information, and you are up and running. PID and multi-pumps wizards are also built in.
- PC Software Wizards — Commissioning, programming and troubleshooting are all a snap with the PC Software Wizards.
- Graphic Interface — The easy-to-use keypad and interface deliver menu-driven programming and monitoring for fast, uniform commissioning. It's also easy for the building owner or manager to learn and use, helping to reduce service calls. Every parameter has a built-in help feature to provide assistance while programming.
- Built-In Communications — With BACnet®, N2 and Modbus built in, your customers will enjoy a lower total installed cost and reliable communications with the building management system.
- Built-In PLC — PC based tools eliminate the need for an expensive external controller.

Built-in Protection

- DC Choke for harmonic protection.
- Standard RFI Filter — Ensures that EMC/RFI requirements are met.
- Bypass Options — Meet specifications and system critical applications with a comprehensive bypass offering.

Smart Software

- Real-Time Clock — Battery included.
- Fire Mode to improve fire safety in the building.
- Motor Switch Ride-Through — Easy, fault-free maintenance.
- Hand-Off-Auto (HOA) control built into the keypad.
- Plenum rated for install flexibility.
- 100 KA Short Circuit Current Rating (SCCR) rated.



Smart Benefits with Easy Commissioning

Honeywell SmartVFD HVAC doesn't just work in the laboratory — it works in the field. From the variety of network protocols that make integration easy, to the guided Startup and PID wizards, the design and technology of SmartVFDs make them true HVAC drives. Intuitive menus assist with commissioning, programming, troubleshooting and overall operation.

COMMUNICATION STANDARD

Integrating Honeywell SmartVFD HVAC into a building management system is a breeze. There's no need for extra cards because it offers a wide range of communications protocols right out of the box, including:

- RS485 – BACnet®, Modbus and N2
- Ethernet – BACnet/IP and Modbus/TCP
- Available options – LonWorks® and DeviceNet

HIGH-RESOLUTION GRAPHIC DISPLAY

It's not just easy on the eyes, it's also easy to use. The menu driven display shows the minimum, maximum and actual values for all parameters and allows easy uploading and downloading of parameters, and has multiple help functions and the manual built-in. In addition, there is a Local/Remote button on the keypad for built in HOA control.

DETERMINE ROOT CAUSE OF FAULTS

With the SmartVFD HVAC, troubleshooting involves very little trouble. The built in, diagnostic screen provides a description for every fault, and the actual values and references are stored at the time of the fault for easy review and problem resolution.

MONITOR SYSTEM PERFORMANCE

The data needed to analyze usage and make adjustments for maximum energy savings is right at your fingertips. Actual electricity consumption in kWh can be monitored using the VFD PC Wizard, and can be conveniently displayed in bar graphs. At any time, the user can see the actual power consumption currently in use — a great tool for managing energy savings.

Honeywell

Smart Configurations

For system critical applications, you must be able to select a bypass that meets the requirements of the specification. The SmartVFD BYPASS is easy to specify, select, install and commission. The SmartVFD BYPASS is UL certified and is the perfect complement to the advanced capabilities of the SmartVFD family — a combination that is both simple and smart.

SMARTVFD BYPASS CONFIGURATIONS

Our five configurations make it easy for you to select the right bypass to complete your drive package. All bundles are available in NEMA 1, NEMA 12 and ventilated NEMA 3R HOA (HAND OFF AUTO).

SmartVFD Disconnect Only

- Adds a fused disconnect to the VFD.

SmartVFD 2-Contactor Bypass

Provides an economical means of bypassing the VFD.

- Freeze/Fire/Smoke Interlock

SmartVFD 3-Contactor Bypass

Commission, service or replace the VFD without affecting the operation of the motor.

- Fused Disconnect
- Freeze/Fire/Smoke Interlock
- VFD is isolated from power with motor running in BYPASS mode
- TEST position powers the VFD without sending power to the motor

SmartVFD 3-Contactor Bypass with Auto-Bypass

The package adds the control capabilities below to the standard three contactor bypass.

- Any VFD fault will automatically send the bypass to BYPASS mode
- A contact closure sends the bypass to BYPASS mode
- Dry contacts indicate when the bypass is in BYPASS mode, alerting the building management system

SLEEKER. SMALLER. SMARTER.

As the latest evolution of the Honeywell VFD line, the SmartVFD BYPASS is sleeker, smaller, lighter and less expensive.

Smart Selection

HVFDSD 3 C 0100 G 1 0 0

Product Family
HVFDSD = Honeywell SmartVFD HVAC
HVFDSB = Honeywell SmartVFD BYPASS

Input Phase
3 = Three Phase (3~in, 3~out)

Nominal Voltage
A = 208/230 Vac Drive Alone, 208 Vac Bypass
B = 230 Vac Bypass
C = 480 Vac
D = 575 Vac

Nominal Horsepower
0007 = .75 Horse Power
0010 = 1 Horse Power
0100 = 10 Horse Power

Interface
G = Graphic KeyPad

Enclosure Type
1 = NEMA 1
2 = NEMA 12
3 = NEMA 3R

Contactors
0 = Drive Only
1 = Disconnect Only
2 = Two Contactor Bypass
3 = Three Contactor Bypass

Options
0 = Drive Only or No Special Options
1 = Auto-Bypass

PICK THE RIGHT VFD FOR THE APPLICATION

- Drives are typically sized to match the horsepower rating of the motor, which will be accurate 95 percent of the time. But for the greatest accuracy, drives should be sized based upon the Full Load Amps or current draw of the motor. The VFD must have a slightly larger current rating maximum.
- The environment the drive will operate in is critical for selection. Honeywell offers NEMA 1, NEMA 12 (for dusty, dirtier environments) and NEMA 3R enclosures (for falling water or rain situations).
- Because of the complexity of VFDs, a clean, conditioned space with temperatures between 14° F and 104° F provides an environment for ideal operation. Heaters are an option in order to keep your VFD at its recommended temperature.
- Honeywell SmartVFD HVAC has a model range from 1.5-250 HP for 460 Vac, 0.75-125 HP for 208/230 Vac.
- Honeywell SmartVFD offers a standard 3-year warranty from the date of purchase.

Find all SmartVFD selection information on the following pages

SmartVFD HVAC Drive Alone

	HP	AMPS	Frame	NEMA 1 Drive Alone	NEMA 12 Drive Alone	NEMA 3R Drive Alone
460 Vac	1.5	3.4	4	HVFDSD3C0015G100	HVFDSD3C0015G200	HVFDSD3C0015G300
	2	4.8	4	HVFDSD3C0020G100	HVFDSD3C0020G200	HVFDSD3C0020G300
	3	5.6	4	HVFDSD3C0030G100	HVFDSD3C0030G200	HVFDSD3C0030G300
	4	8	4	HVFDSD3C0040G100	HVFDSD3C0040G200	HVFDSD3C0040G300
	5	9.6	4	HVFDSD3C0050G100	HVFDSD3C0050G200	HVFDSD3C0050G300
	7.5	12	4	HVFDSD3C0075G100	HVFDSD3C0075G200	HVFDSD3C0075G300
	10	16	5	HVFDSD3C0100G100	HVFDSD3C0100G200	HVFDSD3C0100G300
	15	23	5	HVFDSD3C0150G100	HVFDSD3C0150G200	HVFDSD3C0150G300
	20	31	5	HVFDSD3C0200G100	HVFDSD3C0200G200	HVFDSD3C0200G300
	25	38	6	HVFDSD3C0250G100	HVFDSD3C0250G200	HVFDSD3C0250G300
	30	46	6	HVFDSD3C0300G100	HVFDSD3C0300G200	HVFDSD3C0300G300
	40	61	6	HVFDSD3C0400G100	HVFDSD3C0400G200	HVFDSD3C0400G300
	50	72	7	HVFDSD3C0500G100	HVFDSD3C0500G200	HVFDSD3C0500G300
	60	87	7	HVFDSD3C0600G100	HVFDSD3C0600G200	HVFDSD3C0600G300
	75	105	7	HVFDSD3C0750G100	HVFDSD3C0750G200	HVFDSD3C0750G300
	100	140	8	HVFDSD3C1000G100	HVFDSD3C1000G200	HVFDSD3C1000G300
	125	170	8	HVFDSD3C1250G100	HVFDSD3C1250G200	HVFDSD3C1250G300
	150	205	8	HVFDSD3C1500G100	HVFDSD3C1500G200	HVFDSD3C1500G300
	200	261	9	HVFDSD3C2000G100	HVFDSD3C2000G200	-
	250	310	9	HVFDSD3C2500G100	HVFDSD3C2500G200	-
	HP	AMPS	Frame	NEMA 1 Drive Alone	NEMA 12 Drive Alone	NEMA 3R Drive Alone
208/ 230 Vac	.75	3.7	4	HVFDSD3A0007G100	HVFDSD3A0007G200	HVFDSD3A0007G300
	1	4.8	4	HVFDSD3A0010G100	HVFDSD3A0010G200	HVFDSD3A0010G300
	1.5	6.6	4	HVFDSD3A0015G100	HVFDSD3A0015G200	HVFDSD3A0015G300
	2	8	4	HVFDSD3A0020G100	HVFDSD3A0020G200	HVFDSD3A0020G300
	3	11	4	HVFDSD3A0030G100	HVFDSD3A0030G200	HVFDSD3A0030G300
	5	18	5	HVFDSD3A0050G100	HVFDSD3A0050G200	HVFDSD3A0050G300
	7.5	24	5	HVFDSD3A0075G100	HVFDSD3A0075G200	HVFDSD3A0075G300
	10	31	5	HVFDSD3A0100G100	HVFDSD3A0100G200	HVFDSD3A0100G300
	15	48	6	HVFDSD3A0150G100	HVFDSD3A0150G200	HVFDSD3A0150G300
	20	62	6	HVFDSD3A0200G100	HVFDSD3A0200G200	HVFDSD3A0200G300
	25	75	7	HVFDSD3A0250G100	HVFDSD3A0250G200	HVFDSD3A0250G300
	30	88	7	HVFDSD3A0300G100	HVFDSD3A0300G200	HVFDSD3A0300G300
	40	105	7	HVFDSD3A0400G100	HVFDSD3A0400G200	HVFDSD3A0400G300
	50	140	8	HVFDSD3A0500G100	HVFDSD3A0500G200	HVFDSD3A0500G300
	60	170	8	HVFDSD3A0600G100	HVFDSD3A0600G200	HVFDSD3A0600G300
	75	205	8	HVFDSD3A0750G100	HVFDSD3A0750G200	HVFDSD3A0750G300
	100	261	9	HVFDSD3A1000G100	HVFDSD3A1000G200	-
	125	310	9	HVFDSD3A1250G100	HVFDSD3A1250G200	-

SmartVFD HVAC NEMA 1 Disconnect and SmartVFD BYPASS

	HP	AMPS	Frame	NEMA 1 Fused Disconnect	NEMA 1 2-Contactor Bypass	NEMA 1 3-Contactor Bypass	NEMA 1 3-Cont. Bypass + Auto-Bypass
	1.5	3.4	4	HVFDSB3C0015G110	HVFDSB3C0015G120	HVFDSB3C0015G130	HVFDSB3C0015G131
	2	4.8	4	HVFDSB3C0020G110	HVFDSB3C0020G120	HVFDSB3C0020G130	HVFDSB3C0020G131
	3	5.6	4	HVFDSB3C0030G110	HVFDSB3C0030G120	HVFDSB3C0030G130	HVFDSB3C0030G131
	4	8	4	HVFDSB3C0040G110	HVFDSB3C0040G120	HVFDSB3C0040G130	HVFDSB3C0040G131
	5	9.6	4	HVFDSB3C0050G110	HVFDSB3C0050G120	HVFDSB3C0050G130	HVFDSB3C0050G131
	7.5	12	4	HVFDSB3C0075G110	HVFDSB3C0075G120	HVFDSB3C0075G130	HVFDSB3C0075G131
	10	16	5	HVFDSB3C0100G110	HVFDSB3C0100G120	HVFDSB3C0100G130	HVFDSB3C0100G131
	15	23	5	HVFDSB3C0150G110	HVFDSB3C0150G120	HVFDSB3C0150G130	HVFDSB3C0150G131
460 Vac	20	31	5	HVFDSB3C0200G110	HVFDSB3C0200G120	HVFDSB3C0200G130	HVFDSB3C0200G131
	25	38	6	HVFDSB3C0250G110	HVFDSB3C0250G120	HVFDSB3C0250G130	HVFDSB3C0250G131
	30	46	6	HVFDSB3C0300G110	HVFDSB3C0300G120	HVFDSB3C0300G130	HVFDSB3C0300G131
	40	61	6	HVFDSB3C0400G110	HVFDSB3C0400G120	HVFDSB3C0400G130	HVFDSB3C0400G131
	50	72	7	HVFDSB3C0500G110	HVFDSB3C0500G120	HVFDSB3C0500G130	HVFDSB3C0500G131
	60	87	7	HVFDSB3C0600G110	HVFDSB3C0600G120	HVFDSB3C0600G130	HVFDSB3C0600G131
	75	105	7	HVFDSB3C0750G110	HVFDSB3C0750G120	HVFDSB3C0750G130	HVFDSB3C0750G131
	100	140	8	HVFDSB3C1000G110	HVFDSB3C1000G120	HVFDSB3C1000G130	HVFDSB3C1000G131
	125	170	8	HVFDSB3C1250G110	HVFDSB3C1250G120	HVFDSB3C1250G130	HVFDSB3C1250G131
	150	205	8	HVFDSB3C1500G110	HVFDSB3C1500G120	HVFDSB3C1500G130	HVFDSB3C1500G131
	HP	AMPS	Frame	NEMA 1 Fused Disconnect	NEMA 1 2-Contactor Bypass	NEMA 1 3-Contactor Bypass	NEMA 1 3-Cont. Bypass + Auto-Bypass
	.75	3.7	4	HVFDSB3A0007G110	HVFDSB3A0007G120	HVFDSB3A0007G130	HVFDSB3A0007G131
	1	4.8	4	HVFDSB3A0010G110	HVFDSB3A0010G120	HVFDSB3A0010G130	HVFDSB3A0010G131
	1.5	6.6	4	HVFDSB3A0015G110	HVFDSB3A0015G120	HVFDSB3A0015G130	HVFDSB3A0015G131
	2	8	4	HVFDSB3A0020G110	HVFDSB3A0020G120	HVFDSB3A0020G130	HVFDSB3A0020G131
	3	11	4	HVFDSB3A0030G110	HVFDSB3A0030G120	HVFDSB3A0030G130	HVFDSB3A0030G131
	5	18	5	HVFDSB3A0050G110	HVFDSB3A0050G120	HVFDSB3A0050G130	HVFDSB3A0050G131
	7.5	24	5	HVFDSB3A0075G110	HVFDSB3A0075G120	HVFDSB3A0075G130	HVFDSB3A0075G131
208 Vac	10	31	5	HVFDSB3A0100G110	HVFDSB3A0100G120	HVFDSB3A0100G130	HVFDSB3A0100G131
	15	48	6	HVFDSB3A0150G110	HVFDSB3A0150G120	HVFDSB3A0150G130	HVFDSB3A0150G131
	20	62	6	HVFDSB3A0200G110	HVFDSB3A0200G120	HVFDSB3A0200G130	HVFDSB3A0200G131
	25	75	7	HVFDSB3A0250G110	HVFDSB3A0250G120	HVFDSB3A0250G130	HVFDSB3A0250G131
	30	88	7	HVFDSB3A0300G110	HVFDSB3A0300G120	HVFDSB3A0300G130	HVFDSB3A0300G131
	40	105	7	HVFDSB3A0400G110	HVFDSB3A0400G120	HVFDSB3A0400G130	HVFDSB3A0400G131
	50	140	8	HVFDSB3A0500G110	HVFDSB3A0500G120	HVFDSB3A0500G130	HVFDSB3A0500G131
	60	170	8	HVFDSB3A0600G110	HVFDSB3A0600G120	HVFDSB3A0600G130	HVFDSB3A0600G131
	75	205	8	HVFDSB3A0750G110	HVFDSB3A0750G120	HVFDSB3A0750G130	HVFDSB3A0750G131
	HP	AMPS	Frame	NEMA 1 Fused Disconnect	NEMA 1 2-Contactor Bypass	NEMA 1 3-Contactor Bypass	NEMA 1 3-Cont. Bypass + Auto-Bypass
	.75	3.7	4	HVFDSB3B0007G110	HVFDSB3B0007G120	HVFDSB3B0007G130	HVFDSB3B0007G131
	1	4.8	4	HVFDSB3B0010G110	HVFDSB3B0010G120	HVFDSB3B0010G130	HVFDSB3B0010G131
	1.5	6.6	4	HVFDSB3B0015G110	HVFDSB3B0015G120	HVFDSB3B0015G130	HVFDSB3B0015G131
	2	8	4	HVFDSB3B0020G110	HVFDSB3B0020G120	HVFDSB3B0020G130	HVFDSB3B0020G131
	3	11	4	HVFDSB3B0030G110	HVFDSB3B0030G120	HVFDSB3B0030G130	HVFDSB3B0030G131
	5	18	5	HVFDSB3B0050G110	HVFDSB3B0050G120	HVFDSB3B0050G130	HVFDSB3B0050G131
	7.5	24	5	HVFDSB3B0075G110	HVFDSB3B0075G120	HVFDSB3B0075G130	HVFDSB3B0075G131
230 Vac	10	31	5	HVFDSB3B0100G110	HVFDSB3B0100G120	HVFDSB3B0100G130	HVFDSB3B0100G131
	15	48	6	HVFDSB3B0150G110	HVFDSB3B0150G120	HVFDSB3B0150G130	HVFDSB3B0150G131
	20	62	6	HVFDSB3B0200G110	HVFDSB3B0200G120	HVFDSB3B0200G130	HVFDSB3B0200G131
	25	75	7	HVFDSB3B0250G110	HVFDSB3B0250G120	HVFDSB3B0250G130	HVFDSB3B0250G131
	30	88	7	HVFDSB3B0300G110	HVFDSB3B0300G120	HVFDSB3B0300G130	HVFDSB3B0300G131
	40	105	7	HVFDSB3B0400G110	HVFDSB3B0400G120	HVFDSB3B0400G130	HVFDSB3B0400G131
	50	140	8	HVFDSB3B0500G110	HVFDSB3B0500G120	HVFDSB3B0500G130	HVFDSB3B0500G131
	60	170	8	HVFDSB3B0600G110	HVFDSB3B0600G120	HVFDSB3B0600G130	HVFDSB3B0600G131
	75	205	8	HVFDSB3B0750G110	HVFDSB3B0750G120	HVFDSB3B0750G130	HVFDSB3B0750G131

Smart Selection

SmartVFD HVAC NEMA 12 Disconnect and SmartVFD BYPASS

	HP	AMPS	Frame	NEMA 12 Fused Disconnect	NEMA 12 2-Contactor Bypass	NEMA 12 3-Contactor Bypass	NEMA 12 3-Cont. Bypass + Auto-Bypass
460 Vac	1.5	3.4	4	HVFDSB3C0015G210	HVFDSB3C0015G220	HVFDSB3C0015G230	HVFDSB3C0015G231
	2	4.8	4	HVFDSB3C0020G210	HVFDSB3C0020G220	HVFDSB3C0020G230	HVFDSB3C0020G231
	3	5.6	4	HVFDSB3C0030G210	HVFDSB3C0030G220	HVFDSB3C0030G230	HVFDSB3C0030G231
	4	8	4	HVFDSB3C0040G210	HVFDSB3C0040G220	HVFDSB3C0040G230	HVFDSB3C0040G231
	5	9.6	4	HVFDSB3C0050G210	HVFDSB3C0050G220	HVFDSB3C0050G230	HVFDSB3C0050G231
	7.5	12	4	HVFDSB3C0075G210	HVFDSB3C0075G220	HVFDSB3C0075G230	HVFDSB3C0075G231
	10	16	5	HVFDSB3C0100G210	HVFDSB3C0100G220	HVFDSB3C0100G230	HVFDSB3C0100G231
	15	23	5	HVFDSB3C0150G210	HVFDSB3C0150G220	HVFDSB3C0150G230	HVFDSB3C0150G231
	20	31	5	HVFDSB3C0200G210	HVFDSB3C0200G220	HVFDSB3C0200G230	HVFDSB3C0200G231
	25	38	6	HVFDSB3C0250G210	HVFDSB3C0250G220	HVFDSB3C0250G230	HVFDSB3C0250G231
	30	46	6	HVFDSB3C0300G210	HVFDSB3C0300G220	HVFDSB3C0300G230	HVFDSB3C0300G231
	40	61	6	HVFDSB3C0400G210	HVFDSB3C0400G220	HVFDSB3C0400G230	HVFDSB3C0400G231
	50	72	7	HVFDSB3C0500G210	HVFDSB3C0500G220	HVFDSB3C0500G230	HVFDSB3C0500G231
	60	87	7	HVFDSB3C0600G210	HVFDSB3C0600G220	HVFDSB3C0600G230	HVFDSB3C0600G231
	75	105	7	HVFDSB3C0750G210	HVFDSB3C0750G220	HVFDSB3C0750G230	HVFDSB3C0750G231
	100	140	8	HVFDSB3C1000G210	HVFDSB3C1000G220	HVFDSB3C1000G230	HVFDSB3C1000G231
	125	170	8	HVFDSB3C1250G210	HVFDSB3C1250G220	HVFDSB3C1250G230	HVFDSB3C1250G231
	150	205	8	HVFDSB3C1500G210	HVFDSB3C1500G220	HVFDSB3C1500G230	HVFDSB3C1500G231
	HP	AMPS	Frame	NEMA 12 Fused Disconnect	NEMA 12 2-Contactor Bypass	NEMA 12 3-Contactor Bypass	NEMA 12 3-Cont. Bypass + Auto-Bypass
208 Vac	.75	3.7	4	HVFDSB3A0007G210	HVFDSB3A0007G220	HVFDSB3A0007G230	HVFDSB3A0007G231
	1	4.8	4	HVFDSB3A0010G210	HVFDSB3A0010G220	HVFDSB3A0010G230	HVFDSB3A0010G231
	1.5	6.6	4	HVFDSB3A0015G210	HVFDSB3A0015G220	HVFDSB3A0015G230	HVFDSB3A0015G231
	2	8	4	HVFDSB3A0020G210	HVFDSB3A0020G220	HVFDSB3A0020G230	HVFDSB3A0020G231
	3	11	4	HVFDSB3A0030G210	HVFDSB3A0030G220	HVFDSB3A0030G230	HVFDSB3A0030G231
	5	18	5	HVFDSB3A0050G210	HVFDSB3A0050G220	HVFDSB3A0050G230	HVFDSB3A0050G231
	7.5	24	5	HVFDSB3A0075G210	HVFDSB3A0075G220	HVFDSB3A0075G230	HVFDSB3A0075G231
	10	31	5	HVFDSB3A0100G210	HVFDSB3A0100G220	HVFDSB3A0100G230	HVFDSB3A0100G231
	15	48	6	HVFDSB3A0150G210	HVFDSB3A0150G220	HVFDSB3A0150G230	HVFDSB3A0150G231
	20	62	6	HVFDSB3A0200G210	HVFDSB3A0200G220	HVFDSB3A0200G230	HVFDSB3A0200G231
	25	75	7	HVFDSB3A0250G210	HVFDSB3A0250G220	HVFDSB3A0250G230	HVFDSB3A0250G231
	30	88	7	HVFDSB3A0300G210	HVFDSB3A0300G220	HVFDSB3A0300G230	HVFDSB3A0300G231
	40	105	7	HVFDSB3A0400G210	HVFDSB3A0400G220	HVFDSB3A0400G230	HVFDSB3A0400G231
	50	140	8	HVFDSB3A0500G210	HVFDSB3A0500G220	HVFDSB3A0500G230	HVFDSB3A0500G231
	60	170	8	HVFDSB3A0600G210	HVFDSB3A0600G220	HVFDSB3A0600G230	HVFDSB3A0600G231
	75	205	8	HVFDSB3A0750G210	HVFDSB3A0750G220	HVFDSB3A0750G230	HVFDSB3A0750G231
	HP	AMPS	Frame	NEMA 12 Fused Disconnect	NEMA 12 2-Contactor Bypass	NEMA 12 3-Contactor Bypass	NEMA 12 3-Cont. Bypass + Auto-Bypass
230 Vac	.75	3.7	4	HVFDSB3B0007G210	HVFDSB3B0007G220	HVFDSB3B0007G230	HVFDSB3B0007G231
	1	4.8	4	HVFDSB3B0010G210	HVFDSB3B0010G220	HVFDSB3B0010G230	HVFDSB3B0010G231
	1.5	6.6	4	HVFDSB3B0015G210	HVFDSB3B0015G220	HVFDSB3B0015G230	HVFDSB3B0015G231
	2	8	4	HVFDSB3B0020G210	HVFDSB3B0020G220	HVFDSB3B0020G230	HVFDSB3B0020G231
	3	11	4	HVFDSB3B0030G210	HVFDSB3B0030G220	HVFDSB3B0030G230	HVFDSB3B0030G231
	5	18	5	HVFDSB3B0050G210	HVFDSB3B0050G220	HVFDSB3B0050G230	HVFDSB3B0050G231
	7.5	24	5	HVFDSB3B0075G210	HVFDSB3B0075G220	HVFDSB3B0075G230	HVFDSB3B0075G231
	10	31	5	HVFDSB3B0100G210	HVFDSB3B0100G220	HVFDSB3B0100G230	HVFDSB3B0100G231
	15	48	6	HVFDSB3B0150G210	HVFDSB3B0150G220	HVFDSB3B0150G230	HVFDSB3B0150G231
	20	62	6	HVFDSB3B0200G210	HVFDSB3B0200G220	HVFDSB3B0200G230	HVFDSB3B0200G231
	25	75	7	HVFDSB3B0250G210	HVFDSB3B0250G220	HVFDSB3B0250G230	HVFDSB3B0250G231
	30	88	7	HVFDSB3B0300G210	HVFDSB3B0300G220	HVFDSB3B0300G230	HVFDSB3B0300G231
	40	105	7	HVFDSB3B0400G210	HVFDSB3B0400G220	HVFDSB3B0400G230	HVFDSB3B0400G231
	50	140	8	HVFDSB3B0500G210	HVFDSB3B0500G220	HVFDSB3B0500G230	HVFDSB3B0500G231
	60	170	8	HVFDSB3B0600G210	HVFDSB3B0600G220	HVFDSB3B0600G230	HVFDSB3B0600G231
	75	205	8	HVFDSB3B0750G210	HVFDSB3B0750G220	HVFDSB3B0750G230	HVFDSB3B0750G231

SmartVFD HVAC NEMA 3R Disconnect and SmartVFD BYPASS

	HP	AMPS	Frame	NEMA 3R Fused Disconnect	NEMA 3R 2-Contactor Bypass	NEMA 3R 3-Contactor Bypass	NEMA 3R 3-Cont. Bypass + Auto-Bypass
460 Vac	1.5	3.4	4	HVFDSB3C0015G310	HVFDSB3C0015G320	HVFDSB3C0015G330	HVFDSB3C0015G331
	2	4.8	4	HVFDSB3C0020G310	HVFDSB3C0020G320	HVFDSB3C0020G330	HVFDSB3C0020G331
	3	5.6	4	HVFDSB3C0030G310	HVFDSB3C0030G320	HVFDSB3C0030G330	HVFDSB3C0030G331
	4	8	4	HVFDSB3C0040G310	HVFDSB3C0040G320	HVFDSB3C0040G330	HVFDSB3C0040G331
	5	9.6	4	HVFDSB3C0050G310	HVFDSB3C0050G320	HVFDSB3C0050G330	HVFDSB3C0050G331
	7.5	12	4	HVFDSB3C0075G310	HVFDSB3C0075G320	HVFDSB3C0075G330	HVFDSB3C0075G331
	10	16	5	HVFDSB3C0100G310	HVFDSB3C0100G320	HVFDSB3C0100G330	HVFDSB3C0100G331
	15	23	5	HVFDSB3C0150G310	HVFDSB3C0150G320	HVFDSB3C0150G330	HVFDSB3C0150G331
	20	31	5	HVFDSB3C0200G310	HVFDSB3C0200G320	HVFDSB3C0200G330	HVFDSB3C0200G331
	25	38	6	HVFDSB3C0250G310	HVFDSB3C0250G320	HVFDSB3C0250G330	HVFDSB3C0250G331
	30	46	6	HVFDSB3C0300G310	HVFDSB3C0300G320	HVFDSB3C0300G330	HVFDSB3C0300G331
	40	61	6	HVFDSB3C0400G310	HVFDSB3C0400G320	HVFDSB3C0400G330	HVFDSB3C0400G331
	50	72	7	HVFDSB3C0500G310	HVFDSB3C0500G320	HVFDSB3C0500G330	HVFDSB3C0500G331
	60	87	7	HVFDSB3C0600G310	HVFDSB3C0600G320	HVFDSB3C0600G330	HVFDSB3C0600G331
	75	105	7	HVFDSB3C0750G310	HVFDSB3C0750G320	HVFDSB3C0750G330	HVFDSB3C0750G331
	100	140	8	HVFDSB3C1000G310	HVFDSB3C1000G320	HVFDSB3C1000G330	HVFDSB3C1000G331
	125	170	8	HVFDSB3C1250G310	HVFDSB3C1250G320	HVFDSB3C1250G330	HVFDSB3C1250G331
	150	205	8	HVFDSB3C1500G310	HVFDSB3C1500G320	HVFDSB3C1500G330	HVFDSB3C1500G331
	HP	AMPS	Frame	NEMA 3R Fused Disconnect	NEMA 3R 2-Contactor Bypass	NEMA 3R 3-Contactor Bypass	NEMA 3R 3-Cont. Bypass + Auto-Bypass
208 Vac	.75	3.7	4	HVFDSB3A0007G310	HVFDSB3A0007G320	HVFDSB3A0007G330	HVFDSB3A0007G331
	1	4.8	4	HVFDSB3A0010G310	HVFDSB3A0010G320	HVFDSB3A0010G330	HVFDSB3A0010G331
	1.5	6.6	4	HVFDSB3A0015G310	HVFDSB3A0015G320	HVFDSB3A0015G330	HVFDSB3A0015G331
	2	8	4	HVFDSB3A0020G310	HVFDSB3A0020G320	HVFDSB3A0020G330	HVFDSB3A0020G331
	3	11	4	HVFDSB3A0030G310	HVFDSB3A0030G320	HVFDSB3A0030G330	HVFDSB3A0030G331
	5	18	5	HVFDSB3A0050G310	HVFDSB3A0050G320	HVFDSB3A0050G330	HVFDSB3A0050G331
	7.5	24	5	HVFDSB3A0075G310	HVFDSB3A0075G320	HVFDSB3A0075G330	HVFDSB3A0075G331
	10	31	5	HVFDSB3A0100G310	HVFDSB3A0100G320	HVFDSB3A0100G330	HVFDSB3A0100G331
	15	48	6	HVFDSB3A0150G310	HVFDSB3A0150G320	HVFDSB3A0150G330	HVFDSB3A0150G331
	20	62	6	HVFDSB3A0200G310	HVFDSB3A0200G320	HVFDSB3A0200G330	HVFDSB3A0200G331
	25	75	7	HVFDSB3A0250G310	HVFDSB3A0250G320	HVFDSB3A0250G330	HVFDSB3A0250G331
	30	88	7	HVFDSB3A0300G310	HVFDSB3A0300G320	HVFDSB3A0300G330	HVFDSB3A0300G331
	40	105	7	HVFDSB3A0400G310	HVFDSB3A0400G320	HVFDSB3A0400G330	HVFDSB3A0400G331
	50	140	8	HVFDSB3A0500G310	HVFDSB3A0500G320	HVFDSB3A0500G330	HVFDSB3A0500G331
	60	170	8	HVFDSB3A0600G310	HVFDSB3A0600G320	HVFDSB3A0600G330	HVFDSB3A0600G331
	75	205	8	HVFDSB3A0750G310	HVFDSB3A0750G320	HVFDSB3A0750G330	HVFDSB3A0750G331
	HP	AMPS	Frame	NEMA 3R Fused Disconnect	NEMA 3R 2-Contactor Bypass	NEMA 3R 3-Contactor Bypass	NEMA 3R 3-Cont. Bypass + Auto-Bypass
230 Vac	.75	3.7	4	HVFDSB3B0007G310	HVFDSB3B0007G320	HVFDSB3B0007G330	HVFDSB3B0007G331
	1	4.8	4	HVFDSB3B0010G310	HVFDSB3B0010G320	HVFDSB3B0010G330	HVFDSB3B0010G331
	1.5	6.6	4	HVFDSB3B0015G310	HVFDSB3B0015G320	HVFDSB3B0015G330	HVFDSB3B0015G331
	2	8	4	HVFDSB3B0020G310	HVFDSB3B0020G320	HVFDSB3B0020G330	HVFDSB3B0020G331
	3	11	4	HVFDSB3B0030G310	HVFDSB3B0030G320	HVFDSB3B0030G330	HVFDSB3B0030G331
	5	18	5	HVFDSB3B0050G310	HVFDSB3B0050G320	HVFDSB3B0050G330	HVFDSB3B0050G331
	7.5	24	5	HVFDSB3B0075G310	HVFDSB3B0075G320	HVFDSB3B0075G330	HVFDSB3B0075G331
	10	31	5	HVFDSB3B0100G310	HVFDSB3B0100G320	HVFDSB3B0100G330	HVFDSB3B0100G331
	15	48	6	HVFDSB3B0150G310	HVFDSB3B0150G320	HVFDSB3B0150G330	HVFDSB3B0150G331
	20	62	6	HVFDSB3B0200G310	HVFDSB3B0200G320	HVFDSB3B0200G330	HVFDSB3B0200G331
	25	75	7	HVFDSB3B0250G310	HVFDSB3B0250G320	HVFDSB3B0250G330	HVFDSB3B0250G331
	30	88	7	HVFDSB3B0300G310	HVFDSB3B0300G320	HVFDSB3B0300G330	HVFDSB3B0300G331
	40	105	7	HVFDSB3B0400G310	HVFDSB3B0400G320	HVFDSB3B0400G330	HVFDSB3B0400G331
	50	140	8	HVFDSB3B0500G310	HVFDSB3B0500G320	HVFDSB3B0500G330	HVFDSB3B0500G331
	60	170	8	HVFDSB3B0600G310	HVFDSB3B0600G320	HVFDSB3B0600G330	HVFDSB3B0600G331
	75	205	8	HVFDSB3B0750G310	HVFDSB3B0750G320	HVFDSB3B0750G330	HVFDSB3B0750G331

Smart Selection

VFD Pricing/Job Estimating Tools

*For additional tools you can use for the selection and pricing of VFDs, click on the "Commercial Components Estimating Tools" link at **customer.honeywell.com.***

NEMA 1

Frame Size	HP And Voltage		Configuration	Dimensions (in)			Weight (lb)
	208/230 VAC	460 VAC		W	H	D	
4	0.75-3 HP	1.5-7.5 HP	Drive alone	5	12.9	7.5	13.2
			Disconnect	8.9	31.9	10.3	33
			2-Contactor	8.9	31.9	9.6	38
			3-Contactor	8.9	38.9	10.3	44
			3-Contactor with Auto-Bypass	8.9	38.9	10.3	46
5	5 HP 7.5 HP 10 HP	10 HP 15 HP 20 HP	Drive alone	5.7	16.5	8.4	22
			Disconnect	8.9	34.7	10.3	43
			2-Contactor	8.9	34.7	9.6	48/50/50
			3-Contactor	8.9	41.7	10.3/10.3/10.8	55.5/57/59.5
			3-Contactor with Auto-Bypass	8.9	41.7	10.3/10.3/10.8	56/57.5/60
6	15 HP 20 HP	25 HP 30 HP 40 HP	Drive alone	7.7	21.9	9	44.1
			Disconnect	12.4	45.1	11.3	50
			2-Contactor	12.4	45.1	10.1	55/59
			3-Contactor	12.4	55.2	11.3	94.5/98.5/105.5
			3-Contactor with Auto-Bypass	12.4	55.2	11.3	96.5/100.5/107.5
7	25 HP 30 HP 40 HP	50 HP 60 HP 75 HP	Drive alone	9.3	25.4	10.2	82.7
			Disconnect	20.8	51.5	13.2	100
			2-Contactor	20.8	51.5	12.2	169/179/189
			3-Contactor	20.8	59	13.2	175/184/195
			3-Contactor with Auto-Bypass	20.8	59	13.2	177/186/197
8	50 HP 60 HP 75 HP	100 HP 125 HP 150 HP	Drive alone	11.4	38	13.5	154.3
			Disconnect	25	60	16.2	200
			2-Contactor	25	60	15.2	250/265/280
			3-Contactor	25	70	16.2	285/295/331
			3-Contactor with Auto-Bypass	25	70	16.2	287/297/333
9	100-125 HP	200-250 HP	Drive alone	18.9	45.3	14.4	238.1

NEMA 12

Frame Size	HP And Voltage		Configuration	208/230 Vac Dimensions (in) & Weight (lb)				460 Vac Dimensions (in) & Weight (lb)			
	208/230 VAC	460 VAC		W	H	D	lb	W	H	D	lb
4	0.75-3 HP	1.5HP-7.5 HP	Drive alone	5	12.9	7.5	13.2	5	12.9	7.5	13.2
			Disconnect	12	37.5	11	40	12	37.5	11	40
			2-Contactor	16	37.5	11	55	16	37.5	11	53
			3-Contactor	16	37.5	11	55	16	37.5	11	53
			3-Contactor with Auto-Bypass	16	37.5	11	55	16	37.5	11	53
5	5-10 HP	10 HP 15 HP 20 HP	Drive alone	5.7	16.5	8.4	22	5.7	16.5	8.4	22
			Disconnect	12	41	11	72	12	41	11	72
			2-Contactor	16	41/41/45	11	70/70/84	16	41/41/45	11	64/64/76
			3-Contactor	16	41/41/45	11	70/70/84	16	41/41/45	11	64/64/76
			3-Contactor with Auto-Bypass	16	41/41/45	11	70/70/84	16	41/41/45	11	64/64/76
6	15-20 HP	25 HP 30 HP 40 HP	Drive alone	7.7	21.9	9	44.1	7.7	21.9	9	44.1
			Disconnect	12	46.5	13	120	12/12/16	46.5	13	120/120/136
			2-Contactor	16/20	50.5/54.5	13	125/140	16/16/20	50.5/50.5/54.5	13	120/120/136
			3-Contactor	16/20	50.5/54.5	13	125/140	16/16/20	50.5/50.5/54.5	13	120/120/136
			3-Contactor with Auto-Bypass	16/20	50.5/54.5	13	125/140	16/16/20	50.5/50.5/54.5	13	120/120/136
7	25-40 HP	50 HP 60 HP 75 HP	Drive alone	9.3	25.4	10.2	82.7	9.3	25.4	10.2	82.7
			Disconnect	16	50.5	13.5	145/160/175	16	50.5	13.5	145/160/175
			2-Contactor	20/24/30	58.5/65.5/70.5	13.5	160/175/200	20/24/30	58.5/65.5/70.5	13.5	150/165/193
			3-Contactor	20/24/30	58.5/65.5/70.5	13.5	160/175/200	20/24/30	58.5/65.5/70.5	13.5	150/165/193
			3-Contactor with Auto-Bypass	20/24/30	58.5/65.5/70.5	13.5	160/175/200	20/24/30	58.5/65.5/70.5	13.5	150/165/193
8	50-75 HP	100 HP 125 HP 150 HP	Drive alone	11.4	38	13.5	154.3	11.42	38.03	13.5	154.3
			Disconnect	Contact Customer Care				Contact Customer Care			
			2-Contactor								
			3-Contactor								
			3-Contactor with Auto-Bypass								
9	100-125 HP	180-220 HP	Drive alone	18.9	45.3	14.4	238.1	14.37	45.27	18.9	238.1

NEMA 3R

Frame Size	HP And Voltage		Configuration	Dimensions (in)			Weight (lb)
	208/230 VAC	460 VAC		W	H	D	
4	0.75-3 HP	1.5-7.5 HP	Drive alone	20.5	20	10.5	39
			Disconnect	20.5	20	12	43
			2-Contactor	24.5	24	10.5	49
			3-Contactor	24.5	24	12	54
			3-Contactor with Auto-Bypass	24.5	24	12	54
5	5-10 HP	10-20 HP	Drive alone	20.5	24	10.5	58
			Disconnect	20.5	24	12	61
			2-Contactor	24.5	24	10.5	72
			3-Contactor	28.5	30	12	78
			3-Contactor with Auto-Bypass	28.5	30	12	78
6	15-20 HP	25-40 HP	Drive alone	28.5	36	10.5	80
			Disconnect	28.5	36	12	88
			2-Contactor	28.5	36	10.5	118
			3-Contactor	34.5	36	12	124
			3-Contactor with Auto-Bypass	34.5	36	12	124
7	25-40 HP	50-75 HP	Drive alone	28.5	48	12.5	130
			Disconnect	28.5	48	14	149
			2-Contactor	28.5	48	12.5	185
			3-Contactor	40.5	48	14	193
			3-Contactor with Auto-Bypass	40.5	48	14	193
8	50-75 HP	100-150 HP	Drive alone	40.5	60	12.5	299
			Disconnect	40.5	60	14	340
			2-Contactor	40.5	60	12.5	430
			3-Contactor	40.5	60	14	440
			3-Contactor with Auto-Bypass	40.5	60	14	440

Honeywell SmartVFD HVAC and SmartVFD BYPASS are smaller, sleeker and require a smaller footprint than other manufacturers. They are specifically designed for your HVAC application.

Smart Accessories

SmartVFD Accessories

Accessory	Description	Drive Used with
32006630-001/U	LON Communication Card (NXOPTC4)	SMART
HVFDSDOPT1AI2AO/U	1 x AI, 2 x AO (isolated, D- and E- slot compatible)	SMART
HVFDSDOPT1RO5DI/U	1 x RO, 5 x DI (42-240 VAC, D- and E- slot compatible)	SMART
HVFDSDREP2RO1T/U	2 x RO + Thermistor (B- slot compatible)	SMART
HVFDSDOPT2RO1T/U	2 x RO + Thermistor (D- and E- slot compatible)	SMART
HVFDSDOPT3RO/U	3 x RO (D- and E- slot compatible)	SMART
HVFDSDBATTERY/U	Battery Package, 5 pcs, for Real Time Clock	SMART
HVFDSDREP3RO/U	3 x RO (B- slot compatible)	SMART
HVFDSDOPT6DI/U	6 x DI / DO Programmable (D- and E- slot compatible)	SMART
HVFDSDTRAINER/U	SmartVFD HVAC Training Demonstration Kit	SMART
HVFDSDGRAPHICKP/U	SmartVFD HVAC Replacement Graphical Keypad	SMART
HVFDSDMOUNTKIT/U	SmartVFD HVAC Panel Mount Kit for NEMA 12 Install 3 Meter Cable	SMART
HVFDSDNEMA12FR4/U	SmartVFD HVAC NEMA 12 Kit Frame 4	SMART
HVFDSDNEMA12FR5/U	SmartVFD HVAC NEMA 12 Kit Frame 5	SMART
HVFDSDNEMA12FR6/U	SmartVFD HVAC NEMA 12 Kit Frame 6	SMART
HVFDSDFLANGEFR4/U	SmartVFD HVAC Flange Mounting Kit for Frame 4	SMART
HVFDSDFLANGEFR5/U	SmartVFD HVAC Flange Mounting Kit for Frame 5	SMART
HVFDSDFLANGEFR6/U	SmartVFD HVAC Flange Mounting Kit for Frame 6	SMART
HVFDSDFLANGEFR7/U	SmartVFD HVAC Flange Mounting Kit for Frame 7	SMART
HVFDSDFANFR4/U	SmartVFD HVAC Frame 4 Replacement Fan	SMART
HVFDSDFANFR5/U	SmartVFD HVAC Frame 5 Replacement Fan	SMART
HVFDSDFANFR6/U	SmartVFD HVAC Frame 6 Replacement Fan	SMART
HVFDSDFANFR7/U	SmartVFD HVAC Frame 7 Replacement Fan	SMART
HVFDSDINSTALLFR4/U	SmartVFD HVAC Replacement Installation Accessories Frame 4	SMART
HVFDSDINSTALLFR5/U	SmartVFD HVAC Replacement Installation Accessories Frame 5	SMART
HVFDSDINSTALLFR6/U	SmartVFD HVAC Replacement Installation Accessories Frame 6	SMART
HVFDCABLE/U	SmartVFD Compact Commissioning Cable and USB Adaptor	COMPACT & SMART

See the Big Picture

With an optional Micro Communication Adapter (MCA), you can turn your computer into a window to easily setup, operate, monitor and diagnose your SmartVFD drives. Just download the free PC Tool software from customer.honeywell.com, then use the adapter to connect to the drive.

PROGRAMMING AND COMMISSIONING

You'll have it all at your fingertips:

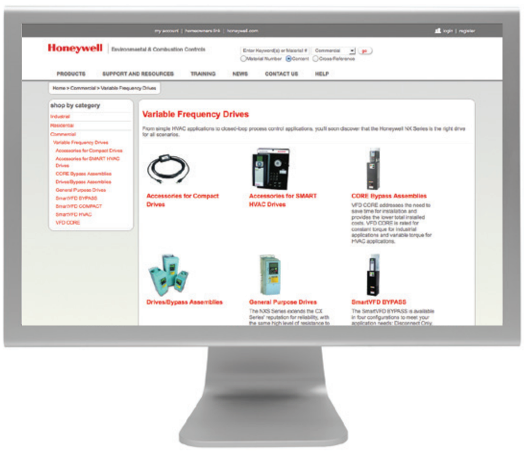
- Upload and download parameters to the SmartVFD drive for viewing and editing with maximum, minimum and default values for each parameter
- Directly control the drive to run it through its paces
- Save parameters for offline editing
- Directly control the drive speed in real time

MONITORING AND DIAGNOSTICS

See it all onscreen:

- Monitor parameters in real time
- Save screen shots and export values to a spreadsheet
- Pause a real-time monitoring window to capture accurate data
- For diagnostic assistance, view detailed active faults, the fault history (up to 40 stored faults), and I/O states

Smart Contacts and Websites



Honeywell Take-Off Service

1. Submit your information in one of the following ways:
   a) E-mail to takeoff.service@honeywell.com (preferred)
   b) Fax toll-free to 1-877-880-3386

2. Include your desired turn-around time

3. Take-Off Service staff will send you a confirmation that your e-mail or fax was received. We always attempt to have your request finished as soon as possible. Please note, however, that the quality of the submitted information largely determines the turn-around time. We will work closely with you to ensure that we have enough information to move forward as quickly as possible.

4. Following take-off completion, a final product schedule spreadsheet will be returned to you that includes:
- Complete product schedule
- Base Price
- Directions on how to order Honeywell products
- Links to product submittals
- Quote identification number

Main VFD Website
customer.honeywell.com/VFD

VFD Technical Hotline
763-954-6464 or
888-516-9347 option 4
techmail@honeywell.com

VFD for Consulting Engineer Site
specifyhoneywell.com/product.resources

Literature Ordering for VFD
literature.honeywell.com

Honeywell Promotional Materials
honeywell.promocollection.com

Buildings University Online and Face-to-Face Training
customer.honeywell.com/buildingsuniversity

New Product and Programs Website
beyondinnovation.honeywell.com

Learn More
For more information on Honeywell Variable Frequency Drives, contact your local Honeywell distributor, your Honeywell sales representative, call 1-800-466-3993 or visit **customer.honeywell.com/VFD**.

Automation and Control Solutions
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1985 Douglas Drive North
Golden Valley, MN 55422-3992

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Honeywell Limited
35 Dynamic Drive
Toronto, Ontario M1V 4Z9

In Latin America:
Honeywell
9315 N.W. 112th Avenue
Miami, FL 33178
www.honeywell.com

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Honeywell

67-7505 PM
February 2013

Z5655-BWL

TAG ____________

HET Elongated Floor Mounted EcoVantage® Flush Valve Toilet System

Z5655 Series Elongated

Recommended Trim:

☐ **Z5955SS-EL** Elongated, standard white, open front toilet seat less cover with stainless steel check hinge.

☐ **Z5972-COMB** Closet bolt/wax ring kit

Note: To ensure system performance:
Minimum Running Water Pressure = 25 psi.

Z5655 HET Series

- Zurn High Efficiency Toilets and paired performance flush valve systems are designed to exceed industry standards while using as little as 1.1 gallons of water per flush.
- Universal high efficiency toilet can be specified with 1.28 gpf [4.8 lpf], 1.6 gpf [6.0 lpf] or dual flush valves.
- Vitreous china
- Elongated front rim
- 2-1/8" fully glazed trapway
- High efficiency siphon jet flush action
- Shipping Weight: 55 lbs.

Engineering Specification

☐ **Z5655-BWL**
EcoVantage High Efficiency Toilet System
Vitreous China, 1.1 gpf [4.16 lpf] or greater high efficiency, floor mounted, bottom outlet toilet with siphon jet flushing action and elongated front rim with 1-1/2" top spud. This bowl is designed to perform to industry standards with as little as 1.1 gallons per flush.
*Replaces Zurn Z5650

☐ **Z5656-BWL**
EcoVantage High Efficiency Toilet System
Vitreous China, 1.1 gpf [4.16 lpf] or greater high efficiency, floor mounted, bottom outlet toilet with siphon jet flushing action and elongated front rim with integral bedpan lugs, and 1-1/2" top spud. This bowl is designed to perform to industry standards with as little as 1.1 gallons per flush.
*Replaces Zurn Z5651

These dimensions and specifications are subject to change without notice.

Fixture dimensions meet ANSI/ASME standard A112.19.2 and CAN/CSA B45 requirements.

Architectural/Engineering Approval

See Zurn One Systems for suggested packages.

ZURN INDUSTRIES, LLC. ♦ COMMERCIAL BRASS OPERATION ♦ 5900 ELWIN BUCHANAN DRIVE ♦ SANFORD NC 27330
Phone: 1-800-997-3876 ♦ Fax: 919-775-3541 ♦ World Wide Web: www.zurn.com
In Canada: ZURN INDUSTRIES LIMITED ♦ 3544 Nashua Drive ♦ Mississauga, Ontario L4V1L2 ♦ Phone: 905-405-8272 Fax: 905-405-1292

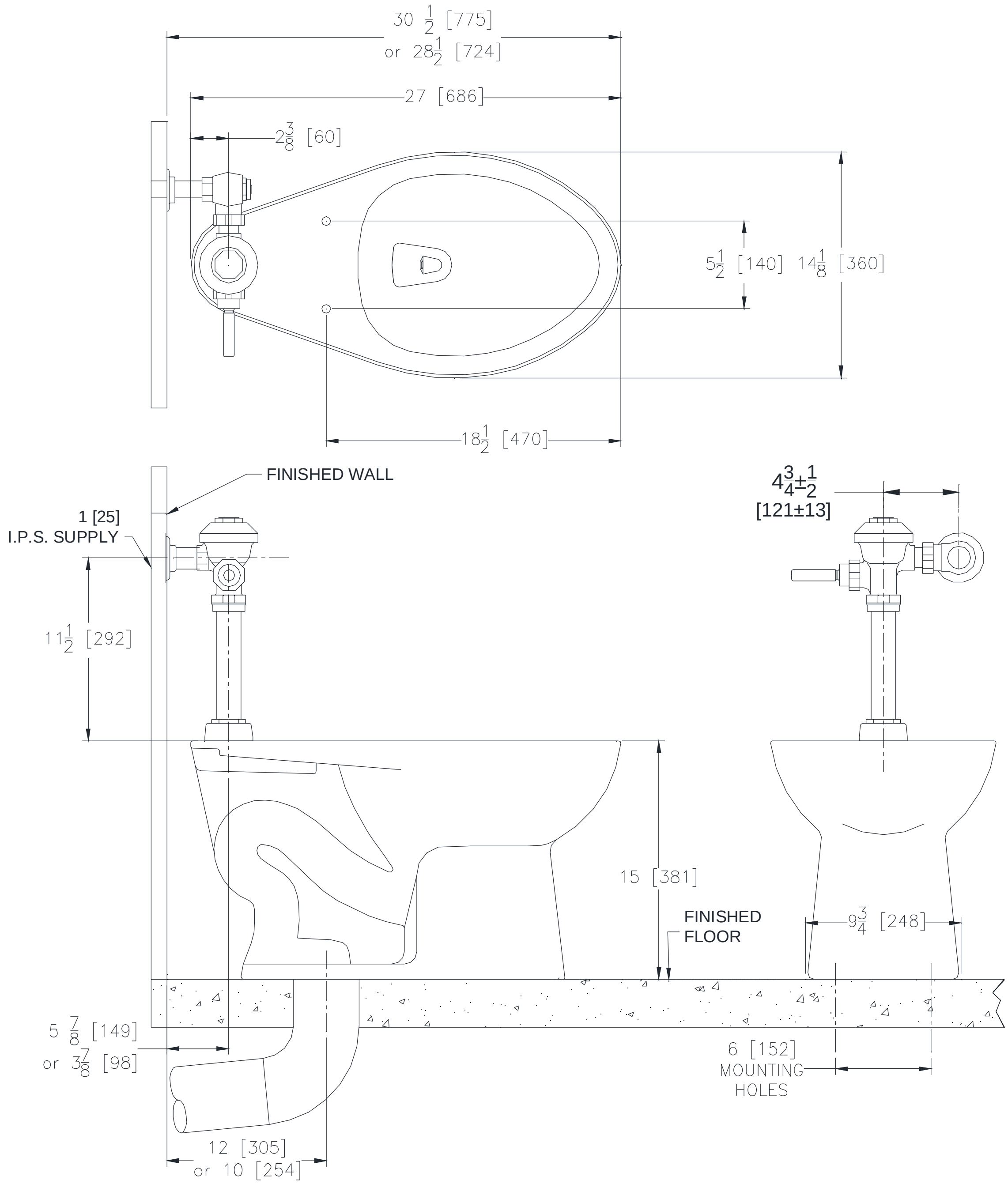
Z5655-BWL

TAG ______________

HET Elongated Floor Mounted EcoVantage® Flush Valve Toilet System

Rough-in dimensions for Z5655 Series

- Z5655 with top spud, shown with Z6000AV-HET manual valve



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EcoVantage® is a registered trademark of Zurn Industries

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Z5675-BWL

TAG ____________

HET Children's Floor Mounted EcoVantage® Flush Valve Toilet

Z5675 Series

Z5675 HET Series

- Zurn High Efficiency Toilets and paired performance flush valve systems are designed to exceed industry standards, while using as little as 1.1 gallons of water per flush.
- Universal high efficiency toilet can be specified with 1.28 gpf [4.8 lpf], 1.6 gpf [6.0 lpf] or dual flush valves.
- Vitreous china
- Elongated front rim
- 2" fully glazed trapway
- High efficiency siphon jet flush action
- Zurn product system component compatibility and quality assurance
- Shipping Weight: 42 lbs

Recommended Trim:

☐ **Z5959SS-JUV** White, open front juvenile toilet seat less cover with stainless steel check hinge.

☐ **Z5972-COMB** Closet bolt/wax ring kit

Note: To ensure system performance:
Minimum Running Water Pressure = 25 psi.

These dimensions and specifications are subject to change without notice.

Fixture dimensions meet ANSI/ASME standard A112.19.2 and CAN/CSA B45 requirements.

Architectural/Engineering Approval

Engineering Specification:
Recommended Trim:

☐ **Z5675-BWL**

Vitreous china, 1.1 gpf [4.16 lpf] or greater high efficiency, floor mounted, children's toilet with siphon jet flushing action, 10" high elongated front rim, with 1-1/2" top spud. This bowl is designed to perform to industry standards with as little as 1.1 gallons per flush, engineered to provide optimal performance.

See Zurn One Systems for suggested packages.

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Please contact Zurn for most up to date information.

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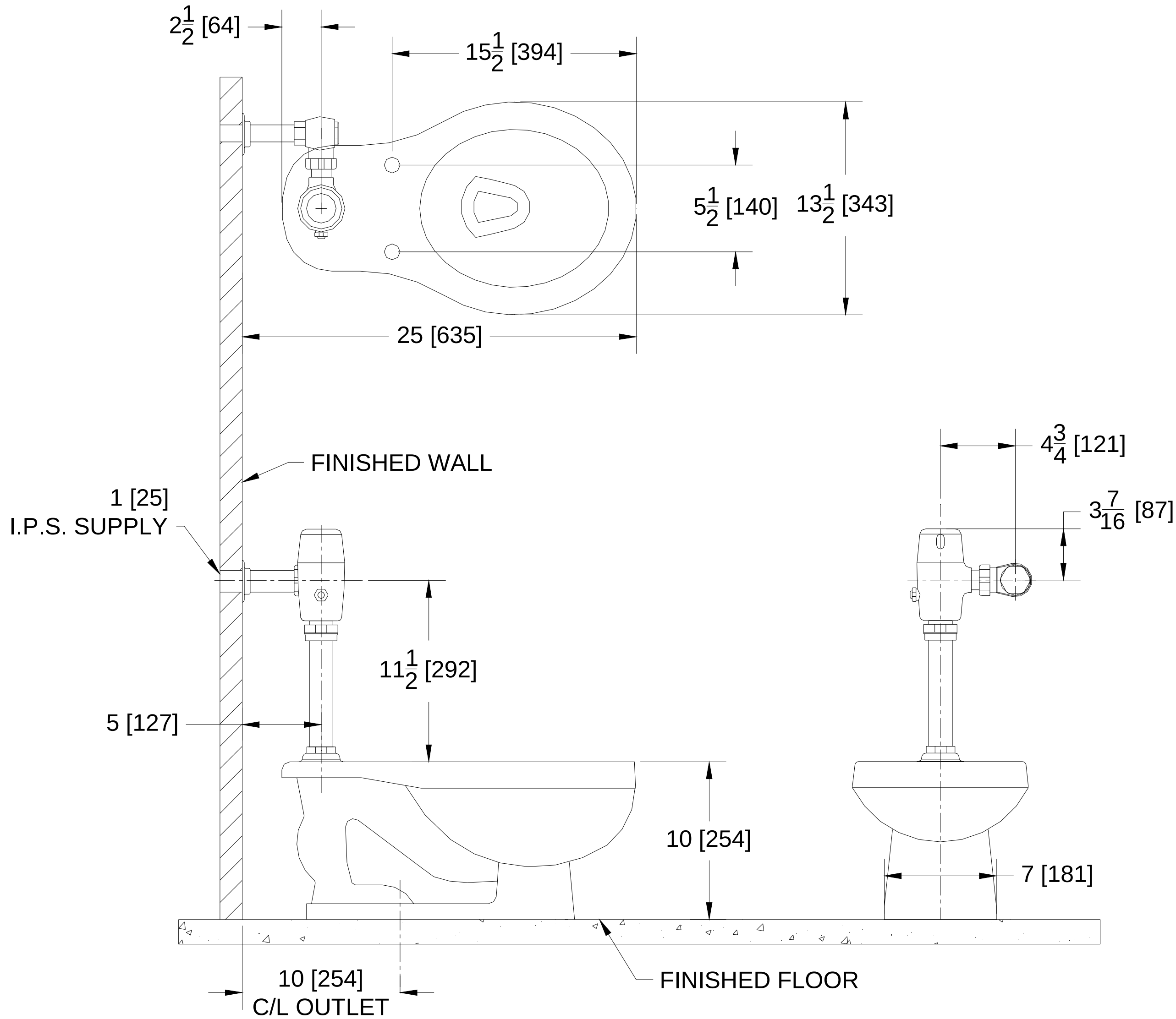
ZURN

Z5675-BWL

TAG ____________________

HET Children's Floor Mounted EcoVantage® Flush Valve Toilet

Rough-in dimensions for Z5675 Series



These dimensions and specifications are subject to change without notice.

Fixture dimensions meet ANSI/ASME standard A112.19.2 and CAN/CSA B45 requirements.

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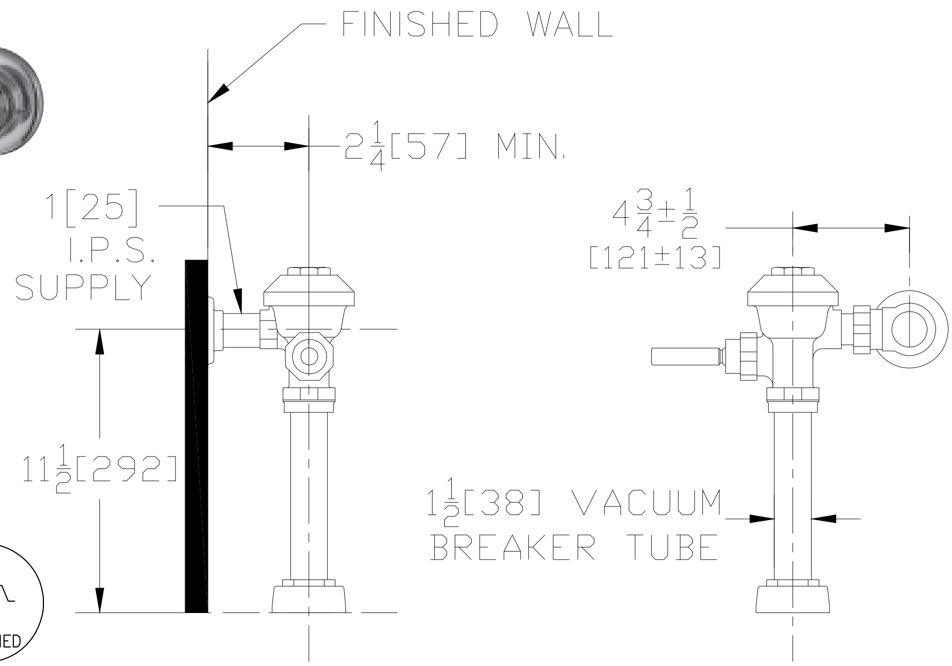
AquaVantage® AV Model

TAG ________________

Exposed Z6000AV-HET Model

For Water Closets



ADA DESIGNED

Suffix Options (Check/Specify Appropriate Options)

_____	**-BG**	BioCare Handle
_____	**-H**	Handle on Front of Flush Valve
_____	**-L**	1" [25] Metal Push Button
_____	**-L3**	3" [76] Metal Push Button
_____	**-YJ**	Split Ring Pipe Support
_____	**-YK**	Solid Ring Pipe Support
_____	**-YO**	Bumper on Angle Stop
_____		Other

This space is for Architectural/engineering Approval

ENGINEERING SPECIFICATION: ZURN Z6000AV-HET AquaVantage® 'AV' Exposed Closet Flush Valve - Exposed, quiet diaphragm-type, chrome plated flushometer valve with a polished exterior. Complete with Zurn's 1.28 gpf AquaVantage® TPE, chloramine resistant, dual seal diaphragm with a clog resistant, filtered by-pass. The valve is ADA compliant with a non-hold open and no leak handle feature, high back pressure vacuum breaker, one piece hex coupling nut, adjustable tail-piece, spud coupling and flange for top spud connection. Control stop has internal siphon-guard protection, vandal resistant stop cap, sweat solder kit, and a cast wall flange with set screw. Internal seals are made of chloramine resistant materials.

The information contained in this document is subject to change without notice.
Please contact Zurn for most up to date information.

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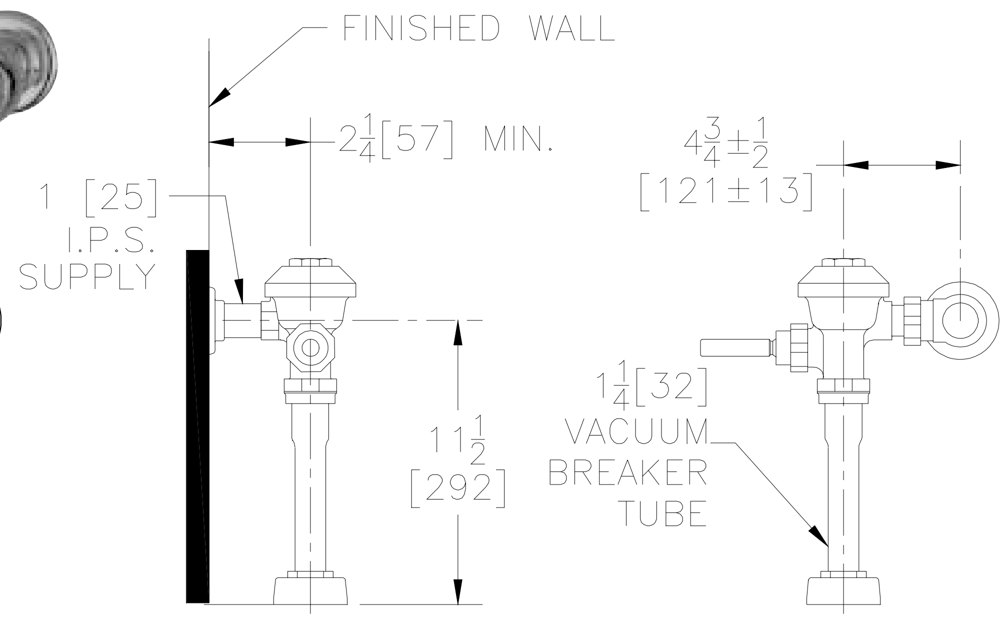
AquaVantage® AV Model

TAG ________________

Exposed Z6001AV Model

For 1-1/4" Urinals



Flow Options

☐	**-WS1**	1.0 Gal. Low Consumption
☐	**-WS**	1.5 Gal. Water Saver
☐	**Standard Flush**	3.0 Gallons Per Flush

Suffix Options (Check/Specify Appropriate Options)

_____	**-BG**	BioCare Handle
_____	**-H**	Handle on Front of Flush Valve
_____	**-L**	1" [25] Metal Push Button
_____	**-L3**	3" [76] Metal Push Button
_____	**-YJ**	Split Ring Pipe Support
_____	**-YK**	Solid Ring Pipe Support
_____		Other

ENGINEERING SPECIFICATION: ZURN Z6001AV AquaVantage® 'AV' Exposed Urinal Flush Valve- Exposed, quiet diaphragm-type, chrome plated flushometer valve with a polished exterior. Complete with Zurn's AquaVantage® TPE, chloramine resistant, dual seal diaphragm with a clog resistant, triple filtered by-pass. The valve is ADA compliant with a non-hold open and no leak handle feature, high back pressure vacuum breaker, one piece hex coupling nut, adjustable tailpiece, spud coupling and flange for top spud connection. Control stop has internal siphon-guard protection, vandal resistant stop cap, sweat solder kit, and a cast wall flange with set screw. Internal seals are made of chloramine resistant materials.

This space is for Architectural/engineering Approval

ZURN INDUSTRIES, INC. ♦ COMMERCIAL BRASS OPERATION ♦ 5900 ELWIN BUCHANAN DRIVE ♦ SANFORD NC 27330
Phone: 1-800-997-3876 ♦ Fax: 919-775-3541 ♦ World Wide Web: www.zurn.com
In Canada: ZURN INDUSTRIES LIMITED ♦ 3544 Nashua Drive ♦ Mississauga, Ontario L4V1L2 ♦ Phone: 905-405-8272 Fax: 905-405-1292

Rev. D
Dwg. No. 65362
Date: 4/28/03
Product No. Z6001AV

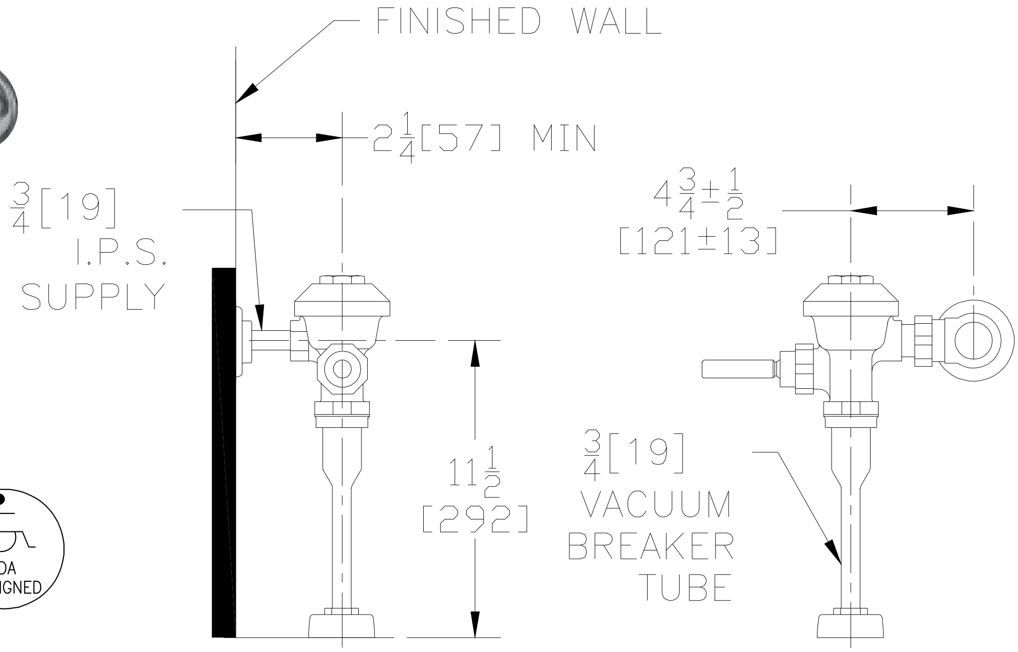
ZURN®

AquaVantage® AV Model

TAG ________________

Exposed Z6003AV Model

For 3/4" Urinals



ADA DESIGNED

Flow Options

☐-EWS	0.5 Gallons Per Flush
☐-WS1	1.0 Gal. Low Consumption

Suffix Options (Check/Specify Appropriate Options)

☐-BG	BioCare Handle
☐-D1	1" Supply
☐-H	Handle on Front of Flush Valve
☐-L	1" [25] Metal Push Button
☐-L3	3" [76] Metal Push Button
☐-YJ	Split Ring Pipe Support
☐-YK	Solid Ring Pipe Support
☐-	Other

The information contained in this document is subject to change without notice. Please contact Zurn for most up to date information.

ENGINEERING SPECIFICATION: ZURN Z6003AV AquaVantage® 'AV' Exposed Urinal Flush Valve- Exposed, quiet diaphragm-type, chrome plated flushometer valve with a polished exterior. Complete with Zurn's AquaVantage® TPE, chloramine resistant, dual seal diaphragm with a clog resistant, triple filtered by-pass. The valve is ADA compliant with a non-hold open and no leak handle feature, high back pressure vacuum breaker, one piece hex coupling nut, adjustable tailpiece, spud coupling and flange for top spud connection. Control stop has internal siphon-guard protection, vandal resistant stop cap, sweat solder kit, and a cast wall flange with set screw. Internal seals are made of chloramine resistant materials.

This space is for Architectural/engineering Approval

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Rev. G
Dwg. No. 65353
Date: 6/19/13
Product No. Z6003AV

APPENDIX 5 SAFETY MANAGEMENT PLAN

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HSE Safety Management Plan

Prepared by:	Tim Laverick
Signature:	
Date:	12/17/15
HSE Manager:	Steve Serian
Signature:	
Date:	
Customer:	Denville Township Schools
Signature:	
Date:	

NOTE: A SIGNED AND ACCEPTED COPY IS TO BE KEPT ON SITE AND ON CONTRACT FILE.

INTRODUCTION

The Health, Safety & Environmental (HSE) Site Management Plan is an integral part of all work and site specific procedures for all Honeywell operations. Honeywell is committed to developing safety systems which ensure the highest standard of health and safety for all employees. We aim to continually improve the systems of work and strive for best practice in the area of health, safety and environment. Honeywell aims to control risk through the implementation of an effective HSE Site Management Plan and Program.

The objective of this document is to establish a plan for implementing the company safe operations management program. The plan is intended to minimize losses, meet regulatory compliance requirements and to implement site health, safety and environmental regulations established by the Customer.

Honeywell demonstrates its commitment to health and safety by making all levels of management accountable for all health and safety issues. We attribute the success of effective safety systems to the ability to communicate the agreed standards of performance between employees and management. Honeywell's commitment to health, safety and the environment can be viewed at **Attachment 1: Honeywell HSE Commitment Statements**.

1. Plan Deployment

The HSE Plan is one component of Honeywell's Safe Operations Management (SOM) program. The HSE Plan, and its relevant components and references specific to this project, should be reviewed with the Customer, Honeywell representatives and subcontractors/contractors to ensure effective deployment of the SOM program. This includes:

(1) On-site meeting between Customer and Honeywell representative(s) and subcontractors.
(2) Customer and Honeywell representative(s) and subcontractors are briefed and understand the Safety Management Plan:
  a) Site information,
  b) Hazard and risk assessments,
  c) HSE training,
  d) Activity schedules,
  e) Measures of HSE performance.
(3) Plan is to be reviewed on a quarterly basis to ensure Management of Change.
(4) Plan shall be maintained to ensure that relevant information is available to employees, contractors, customers, clients and the public concerning the effects of the Company's activities and materials on the safety and health of people and impact on the environment.
(5) Communication and management systems shall be developed, implemented and maintained throughout each site to facilitate continuous improvement in performance.

(6) Active consultation and communication with employees and contractors in the improvement of health, safety and environmental work.

Honeywell Management Systems are the property of Honeywell and must be maintained in accordance with Honeywell Information Security guidelines. Clients wishing to view any components of the Honeywell Operating System (external to Safe Operations Management) can request to do so by contacting the Honeywell Project Manager, who will assess the request and where deemed appropriate, arrange for viewing of the relevant Honeywell information.

2. Revision Sheet

When changes are made to this document, the revision sheet must be revised and all controlled copies of the document updated and distributed per the Distribution List.

Revision	Date	Description
Initial Draft	12/17/15	Initial document

3. Distribution List

One hard copy will be maintained for the assigned contract on site. Electronic copy can be distributed, upon request.

Copy	Name	Organization & Title	Email Address
1	Robert Letso	Honeywell Project Manager	Robert.Letso@Honeywell.com
2	Steve Serian	Honeywell HSE Leader	Steven.Serian@Honeywell.com
3	Jim Freeman	Honeywell PM Leader	James.Freeman@Honeywell.com
4	Jerry Rolph	Customer Project Manager	jrolph@denville.org
5		Customer HSE Leader	

4. Contents

Introduction
Section 1 Site Information
Section 2 Site Hazards and Safety Management Plan
Section 3 Site Requirements
Section 4 Site HSE Activity Schedule
Section 5 Site HSE Performance
Section 6 Contract Form and Attachments

SECTION 1 – SITE INFORMATION & HSE ADMINISTRATION

5. Contract – Scope of Work Description

Project name:	Denville Township Schools
Customer name and address:	400 Morris Ave Suite 279, Denville, NJ 07834
Scope of work (summary):	Lighting, Mechanical, Controls, Building Envelope
Start Date:	
Completion Date:	

6. Key Project Contacts (List all Honeywell Employees & Contractors)

Honeywell Project Manager	Robert Letso	908-256-0735, robert.letso@honeywell.com
Honeywell Project Administrator	Tim Laverick	908-635-3853, timothy.laverick@honeywell.com
Honeywell Branch Project Manager		
Honeywell Regional HSE Leader	Steve Serian	603-930-0222, steven.serian@honeywell.com
Customer Project Manager	Jerry Rolph	973-296-5699, jrolph@denville.org
Customer HSE Leader		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		

7. Customer HSE Reporting

Honeywell will report HSE performance to the Customer, if required, as defined in the scope of work and/or contract. Reporting topics may include:

- Customer requested HSE metrics at customer request,
- Incidents/injuries, Safety Observation System events,
- Summary of HSE Project Manager site reviews/audits, Contractor audit results

8. Cardinal Rules – Unacceptable Behaviors & Attitudes

The Cardinal Rules shall be displayed at all Honeywell locations, including field offices and also at designated Honeywell offices within the Customer site. All employees are to adhere to the Cardinal Rules which can be viewed at **Attachment 2: Honeywell Cardinal Rules**.

9. Responsibilities, Authority & Resources

Management & Resources

The Honeywell Project Manager is responsible for the implementation of the Honeywell Health, Safety and Environment Plan requirements and shall maintain and monitor programs aimed at continuous improvement of HSE performance. Appropriate health, safety and environmental support and resources shall be available to assist project and service managers to discharge their responsibilities.

Honeywell Project Manager Responsibilities

Each PM is accountable for implementation of Honeywell's HSE Policy. Specific responsibilities are:

- Supports and promotes jobsite safety through leadership and example.
- Becomes involved in task safety analysis in order to identify any hazards and manage the associated risks prior to work being done.
- Ensures the completion of job hazard analysis prior to the beginning of any work including review and approval.
- Insist upon employee's and subcontractor's compliance with established safety rules, correcting any unsafe acts or conditions, and implementing corrective or disciplinary actions as necessary for the effective functioning of the safety program.
- Ensure all team members are trained in safe work procedures.
- Ensure regular hazard inspections are carried out within areas under their control.
- Verify that employees and subcontractors implement the designated site safe work procedures/systems.
- Ensure approved Honeywell employee protective equipment is issued and proper instruction given as to its use, maintenance and storage.
- Be involved in formal as well as informal safety audits and monitor contractor and site safety performance on a regular basis.
- Ensure that all accidents and injuries are reported and investigated.
- Identify cause of non-compliance and investigate/document actions to correct safe work method deficiencies or rectify inappropriate workplace behaviors, including consultation, counselling, training and/or disciplinary action.
- Preparation and regular review of work procedures.

All Honeywell Employee Responsibilities

Employees have a duty to cooperate in the achievement of a safe and accident free workplace, through:

- Cooperating in fulfilment of the obligations placed on Honeywell International.
- Identify all tasked and prepare risk assessments.
- Working with care for their own safety and that of others who may be affected by their actions
- Reporting unsafe conditions and behaviours.
- Wear and maintain any issued personal protective equipment (PPE) when necessary.
- Assisting in the investigation of any accidents with the objective to prevent recurrence.
- Maintain a safe working environment for all Honeywell/Contractor employees that may be utilized for this project.
- Report all safety issues or events directly to the Honeywell Project Manager.

Subcontractors shall be responsible for complying with all Subcontractor Responsibilities

Subcontractors shall be responsible for complying with all statutory obligations and shall exercise all possible care for the health and safety of their personnel and other persons at the workplace who may be affected by their activities. Subcontractors shall at all times comply with Honeywell's HSE policy and procedures. As a condition of employment all employees are expected to work in a safe and responsible manner. The employee is ultimately responsible for his or her own safety. All contractors shall provide the employee with all the necessary training and PPE, but the employee must make the proper choices when performing an assigned task. Any issues not covered by this Safety Plan should be communicated to the relevant Honeywell representative. The Contractor's personnel will have responsibilities, which include but may not be limited to the following:

- Establishing safety responsibilities for their site personnel including their subcontractors.
- Insisting and ensuring correct and safe practices are used at all times.
- Providing adequate resources, personnel, equipment, time and funds to ensure the objectives of the safety plan are met.
- Completing the required work authorization forms and safety permits for each activity.

- Following safety rules and verbal instructions. Ask superintendent questions when any uncertainty exists.
- Ensuring their site personnel are suitably trained to effectively carry out their HSE responsibilities.
- Using tools in a safe and appropriate manner in accordance with their design; inspecting them for damage prior to each use.
- Ensuring safety auditing and performance reporting requirements specified by Honeywell are met.
- Reporting any unsafe acts or conditions, correcting them whenever possible.
- Reporting all injuries, incidents and near misses immediately, no matter how minor.

Project Employee/Contractor List

The Honeywell Project Manager will maintain the **Attachment 3 Site Project Contractor/Employee List**. All Contractors and Honeywell Employees working on site, listed or not, have a duty to cooperate in the achievement of a safe and accident free workplace.

10. Site Facilities

Honeywell Designated Areas

All designated Honeywell areas, if any, at the customer site must be maintained by Honeywell staff to ensure these facilities are kept in a clean and hygienic condition for the duration of the contract. At a minimum, these areas are to be inspected weekly to identify any workplace hazards or risks and to ensure minimum standards are maintained. If there is a Honeywell office you are required to post the Honeywell Commitment Statement and Cardinal Safety Rules. Depending on local or federal requirements ensure regulatory postings are current.

Security

Honeywell employees must meet all customer security requirements. This may include visitor badges, access training, appropriate regulatory and/or customer documentation, background checks, registry upon arrival and departure, etc. Badges are to be worn above the waist and in a visible position at all times while on site.

11. Honeywell Staff Training

Training needs shall be identified and training delivered to ensure that the project and service managers have the appropriate health, safety and environmental management skills. Honeywell employees shall be instructed in safe systems of work to ensure they work with proper regard for the safety, health, and protection of themselves, others and the environment. The Honeywell Project Manager is responsible for identifying the specific training requirements of their team members and ensuring the required training is undertaken. This training may be either Honeywell internal training, or training specific to the project location provided by the customer, provided the minimum content requirements are met. The minimum required training for the project scope of work is listed in Section 3 of this safety management plan.

12. Contractor Work Authorization & Permits

Contractor Sign-in & Work Authorization

Contractors must complete the Contractor Safety Declaration and Work Authorization Form with required risk assessments and permits prior to commencing work. Low risk work can be undertaken by contractors without direct authorization given that the relevant Honeywell Project Manager is aware of the:

1) Scope of work.
2) Time the work is to be undertaken.
3) Workers performing the work.

Attachment 4: Contractor Safety Declaration & Work Authorization Form
Attachment 5: Safety Permit Applications

13. Accident / Incident Events

Reporting of Accident / Incident Events

Honeywell Employees & Contractors must adhere to the following reporting requirements,

(1) Globally contact the Honeywell Project Manager
(2) Honeywell employees only - Call the HSE Hotline at 1-866-466-1765
(3) Honeywell Project Manager will contact the customer safety manager if required.
(4) The Honeywell HSE Manager must be contacted should any of these events occur.
    a. All injuries and incident events
    b. Release of dangerous goods or hazardous substances to the environment
(5) Certain incidents must also be reported to the relevant local workplace safety or environmental

protection authorities in accordance with local legislation.

Incident Investigation of Accident / Incident Events

Honeywell Representative must follow the following criteria after an accident or incident occurs.

(1) Conduct an incident investigation in accordance with Honeywell injury and incident investigation requirements in consultation with the regional HSE manager and affected employee(s).
(2) Ensure implementation and close out of short and/or long-term corrective actions to prevent re-occurrence.
(3) Present to Honeywell Project Management Leader and HSE Manager all planned corrective actions.

Attachment 6: Incident Investigation Report

14. Safety Observation System Events

Safety Observations must be submitted to the Honeywell Project Manager by any Honeywell employee using the **Attachment 7 Safety Observation Form**. Safety Observation is an unplanned event or condition that could have reasonably resulted in personal injury or illness, equipment or property damage, an environmental excursion, or when a safety control measure is challenged or ignored.

15. Site Evacuation Procedures

The Honeywell site specific **Emergency Response Plan, Attachment 17** shall be prepared, if a customer equivalent response plan is not available. The Honeywell Project Manager shall review and incorporate the emergency response plan into the Safety Management Plan. Either the Honeywell or Customer site specific emergency response plan shall be followed and this plan shall be communicated to all Honeywell employees, contractors, and visitors prior to working at the project site. For any Honeywell-occupied spaces such as a job trailer, leased office space or warehouse used during the course of a project, Honeywell shall complete a Honeywell site specific Emergency Risk Assessment by checking the appropriate boxes, then complete a site specific Emergency Response Plan as explained in the Emergency Response Procedure.

SECTION 2 – SITE RISK ASSESSMENT TOOLS

16. Hazard Reporting

It is the responsibility of all employees to immediately report any unsafe act or condition to the Honeywell Project Manager. Honeywell actively encourages all employees and contractors to report hazards. The strength of our Health, Safety Management Plan relies on the ability of Honeywell employees and contractors to report hazards.
At each site, all hazards that are identified by employees or contractors shall be communicated immediately to the Honeywell Project Manager. In the event that the hazard is considered significant, it must be reported immediately to the appropriate Customer representative.

17. Site Assessment Tools

Identify Site Hazards

Hazards associated with contracted scope of work shall be identified and documented in the **Attachment 8 hazard assessment site inventory**. The Hazard Assessment Site Inventory should include all identified hazards for the scope of work on this contract. The Hazard Assessment is used to prepare task and generic risk assessments or contractor authorizations.

Risk Assessment & Contractor Work Authorization Forms

Each hazard must be assessed according to the risk calculator listed on the **Attachment 9 Risk Assessment Form** to ensure the hazards are categorized as low, medium or high risks. Risk exposure to hazards in the work environment is determined by consequence and severity resulting in a low, medium or high risk level. **[**Click **HERE** for sample Risk Assessments / Safe Work Procedures.**]**

Risk assessments and contractor work authorization forms include a list of control measures which need to be developed and made readily available for the duration of the work. Hazards shall be controlled to ensure that consequent risks are eliminated or reduced as far as is reasonably practicable. Control measures shall be reviewed and monitored for their effectiveness. Continuous consultation should occur with all employees and contractors on site to ensure that hazards are identified and controls implemented.

Control measures will be selected in accordance with both established Field Risk Assessment Forms and the “Hierarchy of Control Measures” aimed at eliminating the hazard or hazardous activity. The most desirable control measure must be selected using the control hierarchy, in this order, elimination, substitution, engineering control, administrative control and personal protective equipment.

Tasks assessed as a high risk will require notifying the Honeywell Project Manager prior to commencement of work. The Honeywell Project Manager will evaluate the task for personal safety issues. All relevant activity check sheets and permits shall be completed in advance, and applicable guidelines, procedures, and/or work instructions will be reviewed and followed prior to and during the performance of the tasks.

Both contract and site specific data should be reviewed for inclusion in the orientation process to ensure key hazards/risks and any expectations in relation to the hazard elimination/risk management are communicated to the relevant employees and contractors.

The Honeywell Project Manager shall ensure that risk assessment and contractor authorization forms are implemented where required and ensure a quality standard of service is provided. Honeywell has developed a list of safety procedures for site work that facilitate compliance to legislative requirements. After the contractor completes the work authorization form the contractor may use previously completed Honeywell and/or the customer field risk assessment forms, provided that the contractor understands the procedure and takes ownership of the field risk assessment forms. All field risk assessment forms need to be reviewed by each employee prior to commencement of work.

Field Risk Assessment Forms identified are assessed for any potential risks of personal injury or injury to others, and property damage or environmental damage. Risk Assessments are separated into generic and task specific functions. The following are only examples and do not include all tasks that may apply at the customer or Honeywell location,

- Generic Field Risk Assessment Forms include common steps that are prepared once and can be used at multiple locations,
  - Climbing a ladder, working from a scaffold, scissor lifts, aerial lifts, man lift, etc.
  - Safe driving to/from customer locations
  - Personnel safety at customer locations, including walking on site
  - Roof Work
  - Mobilization of personnel, equipment or heavy components
  - Working on operating equipment
- Task Specific Field Risk Assessment Forms are prepared for a unique task at the customer site,
  - Equipment specific Lock Out / Tag Out, of electrical, mechanical, hydraulic, pneumatic, gravity, gas tie-ins, refrigerant servicing, etc.
  - Working from heights involving fall protection
  - Demolition of Electrical Cabling, equipment, etc.
  - Working in areas (e.g., installation, demolition) with live power or active control / fiber-optic cable, including junction boxes, where there is a substantial possibility of interrupting a live circuit.

18. Site Specific Field Risk Assessment Form Inventory

The Project Manager is responsible for keeping an inventory of the completed risk assessments and contractor work authorizations for the scope of work of this contract using the table provided in the hazard assessment site survey Attachment 8. This includes specific Field Risk Assessment Forms identified as a result of the completed Risk Assessments and Contractor Work Authorization Forms. All contract personnel are required to be familiar with the procedures and when they are to be used. These procedures must be followed at all times when the identified major risk activity is performed. Full records are to be kept for every major risk activity performed.

SECTION 3 – Site Requirements, HSE Training, Licenses and Competency

19. Customer Site Orientation

General Requirements

All Honeywell employees and contractors working on the customers sites will complete the customer site orientation, if required by the customer. Honeywell contractor orientations shall be managed by the Honeywell Project Manager to ensure that all orientations, including site safety management plan requirements are received and accepted by contractors and Honeywell staff, documented as being completed, and maintained in this plan for all contract personnel as required by Honeywell.

Orientation Schedule

The following orientations must be completed:

Orientation	Orientation Frequency	Key Contact(s)
Contractor Orientation	Prior to commencement of work. Complete **Site Orientation Form Attachment 10** with contractors & their employees Prior to commencement of work. Complete **Attachment 12 Field Safety Checklist** which document potential hazards. Review Contractor Work Authorization Forms with required safety permits.	Tim Laverick
Honeywell Employee Orientation	1. Prior to commencement of work and annually. Complete required monthly training modules per **Attachment 11 Training Register**. 2. Document employee having completed Risk Assessment Forms with required safety permits.	Tim Laverick

20. HSE Training, Licenses & Certificate of Competency

Honeywell Staff, Contractors and Sub-contractors

Both Honeywell Staff and contractors are required to complete the Attachment 11 Training Register as proof of completion of the required training. Honeywell employees are required to complete **Attachment 15 Vehicle, Tool, & PPE Inspection Checklist**. Additional training requirements may be required by local regulations. If applicable, this must be verified as completed before commencing work at the site. Training must be completed prior to performing site specific task or activities. All contractors and Honeywell employees are required to be currently licensed in accordance with state and local requirements to perform the work and activities associated with the contract scope of work.

SECTION 4 – Site HSE Activity Schedule

21. Honeywell Project Manager HSE Activity Schedule

1) Conduct Safety Inspections:
   a) Attachment 12 Field Safety Checklist – Project Manager to complete prior to starting work onsite and annually.
   b) **Attachment 13 Behavioural Observation Checklist** – Project Manager to complete periodically to assess Honeywell field employees during scheduled construction.
   c) **Attachment 14 Contractor Safety Checklist** – Project Manager to complete periodically to assess Contractor safety compliance.
2) Attend Customer safety meetings and audits, as scheduled.
3) Report Safety Observations to the HSE Manager and Customer.
4) Document and approve all Risk Assessments, Contractor Work Authorizations and required safety permits.

SECTION 5 – Site HSE Performance

22. HSE Metrics

The following HSE metrics will be documented and maintained during project construction,

- Attendance at weekly contractor safety meetings.
- Number of safety audits performed and completed.
- Number (and %) of safety audit items in conformance with requirements.
- Number and types of injuries, illnesses, and safety observation events noted during the project.

SECTION 6 – Contract Forms and Tools

23. Contract Forms and Tools

Contracts Forms, Tools and Procedures

The following list includes all pertinent safety forms for the use of initiating and maintaining safe work practices as described in this Safety Management Plan. These forms are also included in the following pages of this section.

Attachment No.	Document Name	Time to Complete:	Frequency	Responsible to Complete
–	Safety Management Plan (SMP)	Start of contract	Once for each phase/contract	Honeywell PM
1	HSE Commitment Statements	Start of contract	Once with SMP	Honeywell PM (Post on-site)
2	HSE Cardinal Rules	Start of contract	Once with SMP	Honeywell PM (Post on-site)
3	Site Employee/Contractor list	Booking Date – Before Installation	Update as needed throughout project duration	Honeywell PM
4	Contractor Work Authorization Form	Booking Date – Before Installation	Update as needed throughout project duration	All Subcontractors
5	Safety Permit Applications	Before performing task that requires it.	As required throughout installation	Contractor / Honeywell Field Employees
6	Incident Investigation Report Form	Within 24 hours of incident.	As required throughout project duration	Honeywell PM
7	Safety Observation Form	Throughout Project Duration	Monthly	All Honeywell Employees
8	Hazard Assessment Site Inventory	Booking Date – Before Installation	Update as needed throughout project duration	Honeywell PM
9	Risk Assessment Form	Booking Date – Before Installation	Update as needed throughout project duration	Honeywell Field Employees
10	Site Orientation Form	Booking Date – Before Installation	Once with SMP	Honeywell PM
11	Training Register	Booking Date – Before Installation	Once with SMP	Honeywell PM
12	Field Safety Checklist	Booking Date – Before Installation	Done once for each trade, Update as needed throughout project duration	Honeywell PM
13	Behavioral Observation Checklist	Throughout installation	Monthly while Honeywell field employees are working	Honeywell PM
14	Contractor Safety Checklist	Throughout installation	Monthly while subcontractors are working	Honeywell PM
15	Vehicle, Tool, & PPE Inspection Checklist	Throughout project duration	Quarterly	Honeywell PM/Employees
16	Site Specific Emergency Plan	Booking Date – Before Install	Once with SMP	Honeywell PM

Sustainable Opportunity Policy
Honeywell's Commitment to Health, Safety and the Environment

By integrating health, safety and environmental considerations into all aspects of our business, we protect our employees, our communities and the environment, achieve sustainable growth and accelerated productivity, drive compliance with all applicable regulations and develop technologies that expand the sustainable capacity of our world. Our health, safety and environmental management systems reflect our values and help us meet our business objectives.

- We protect the safety and health of our employees, and minimize the environmental footprint of our operations through efforts to prevent illness, injury and pollution.
- We actively promote and develop opportunities for expanding sustainable capacity by increasing fuel efficiency, improving security and safety, and reducing emissions of harmful pollutants.
- We are committed to compliance with all of our health, safety, environmental and legal requirements everywhere we operate.
- Our commitment to health, safety and the environment is an integral aspect of our design of products, processes and services, and of the lifecycle management of our products.
- Our management systems apply a global standard that provides protection of both human health and the environment during normal and emergency situations.
- We identify, control and endeavor to reduce emissions, waste and inefficient use of resources and energy.
- We are open with stakeholders and work within our communities to advance laws, regulation and practices that safeguard the public.
- We abide by the company's own strict standards in cases where local laws are less stringent.
- Our senior leadership and individual employees are accountable for their role in meeting our commitments.
- We measure and periodically review our progress and strive for continuous improvement.

These are our commitments to health, safety, and the environment, and to creating Sustainable Opportunity everywhere we operate.

Dave Cote

Dave Cote
Chairman and CEO

John Rajchert
President HBS
July 6, 2014

SMP Attachment 2: Honeywell Cardinal Rules

No Employee/Contractor may:

1. Engage in horseplay or conduct that endangers or injures employees, risks damage or actually does damage to company and/or customer property or the environment.
2. Bring into any company and/or customer site: firearms, explosives, or weapons of any type.
3. Bypass or operate equipment without guards, safety devices, or control equipment without following company and/or customer established procedures and protocols.
4. Disassemble, enter or perform servicing, changeover or maintenance on equipment without properly de-energizing and safeguarding all power sources according to the applicable lock-out/tag-out policy.
5. Violate a life safety permit procedure (confined space, hot work, line breaking and fall protection).
6. Knowingly place her/himself or another person in physical danger, conceal a safety hazard or unlawful chemical release to the environment, or fail to promptly obtain attention for a personal injury or chemical spill.
7. Possess or be under the influence of illegal drugs (not prescribed by a Physician of for their own use) or alcohol while on a customer site, company-owned and/or company-operated facility.

The actions listed above have been found to have such great potential for serious injury or damage that any employee that engages in such actions may be subject to discipline, up to and including termination from the company or removal from the project site, regardless of previous performance. This policy is intended to protect the employee and his/her co-workers.

All employees are expected to understand and adhere to these Cardinal Rules and to request assistance in questionable situations. Further, all employees are encouraged to question the safety and environmental performance of all operations and become involved in improving them.

Project Manager Signature: ______________________________

SMP Attachment 3: Site Employee Contractor List

Badge #	Employer	Name	Phone Number	Supervisor

SMP Attachment 4: Contractor Safety Declaration & Work Authorization Form

Contractor Safety Declaration

As a duly authorized and designated representative and agent of ________________________________ , hereafter called "Contractor/Subcontractor", I hereby certify and agree for myself and for and on behalf of Contractor /Subcontractor:

I have visited the project site ____ and visually inspected the general and local conditions which could affect the Contractor /Subcontractor Work. Any failure of the Contractor /Subcontractor to reasonably ascertain from a visual inspection of the site, the general and local conditions which could affect the Contractor /Subcontractor Work, will not relieve the Contractor/Subcontractor from its responsibility to properly complete the Contractor /Subcontractor Work without additional expense to Honeywell. In addition, I have read and agree to comply with all the Terms and Conditions as specified in the written contract.

1. I have already instructed or will immediately instruct all such agents and employees with respect to such conditions and/or hazards and the proper safety precautions to be observed in regard there to;

2. I certify that all necessary, adequate and operative protective clothing and equipment have been or will be immediately issued to all such agents and employees, together with full instructions and training for their use at Contractor's cost;

3. I certify that all Honeywell Safety and Work Specific procedures as specified in the Honeywell Contractors Safety Guide, including those addressing employee personal protective equipment (PPE), Life Critical Tasks and tool and equipment requirements will be put into effect; and that all such agents and employees will be properly supervised to insure compliance in the use of PPE, procedures and equipment and in the strict observance of safety rules and regulations;

4. I certify that all such agents and employees have completed the identified and required training and that proof of such training has been submitted to Honeywell representative. If such identified training has not been completed I agree to complete such training as identified and required to a standard equivalent or exceeding Honeywell standards.

5. I certify that I will participate in the Honeywell program to observe and monitor all such agents and employees for compliance to specified Safety Procedures and work practices as defined or required by any and all governmental regulations and laws.

6. At a minimum, I certify that Contractor /Subcontractor employees have been trained and/or briefed for the following applicable programs (identified with x), in accordance with local laws/regulations,

☐ General safety rules and regulations
☐ Specific safety requirements
☐ Confined space entry
☐ Eye and face protection
☐ Hearing protection
☐ Burning, welding and cutting
☐ Utility line hazards/precautions
☐ Chemical line hazards/precautions
☐ Workplace chemical hazards
☐ other (specify)

☐ General protective clothing and equipment requirements
☐ Lockout and tagout
☐ Line breaking
☐ Excavation
☐ Respiratory protection
x_ Honeywell Contractor HSE Guide
____
____
____

Date: _____________

____
Signature of Contractor's/Subcontractor's Representative

Date: _____________

____
Signature of Honeywell Representative

Honeywell Use Only: **HID #:**

PRELIMINARY SAFETY DETAILS		*Honeywell Use Only: Work Authorisation Form Expiry : (Max 12 months) HSE Signed:*			
Site		Contractor		Phone	
Name (PM responsible for the work)		Job / PO / SR Number			
Names of other workers		Honeywell Project Manager			
Scope of Work		Project Duration			
Location of Work					

1. Will you be using sub-contractors?	Yes □	No □	*You must inform the Honeywell Works Supervisor of all sub-contractors you intend to use.*	
2. Are all workers inducted to site & aware of first aid & emergency procedures?		Yes □	No □→	*If **No**, Do Not Proceed. Contact The Honeywell Project Manager*
3. Are workers familiar with the work area and specific hazards in the work area(s)?		Yes □	No □→	
4. Are tools, plant and equipment in good order (plant maintained, electrical equip. tagged, etc)?	No Plant/Tools□	Yes □	No □→	
5. Are workers aware of the safety requirements for the job & licensed where required?		Yes □	No □→	

If the Scope of Works changes Honeywell must be contacted prior to undertaking the new works

HAZARD ID, RISK ASSESSMENT & CONTROLS ------------------------------

Identify the Hazards ✓ **applicable**	**Assess the Risk** ✓ **applicable**	When assessing risks use these risk levels:	Minor Potential for minor injury / first aid treatment Moderate Potential for lost time injury / medical treatment Major Potential for death or serious injury
		Detail Risk Control Measures to Be Used	**Responsible Person**
□ Exposure to live electrical circuit	**Major*** □	List controls to eliminate or minimize risks.	List who is responsible for ensuring the controls are in place and are
□ Fall > 1.8m	**Moderate*** □	Refer to relevant procedure or JSA.	
□ Line Breaking	**Minor** □		
□ Confined Space Entry	** Detail Risk Controls & Responsibilities. Direct Authorisation required from the Honeywell Work Supervisor prior to commencing works.*		
□ Asbestos			
□ Traffic / Mobile Plant			
□ Chemicals / Fumes / Dusts			
□ Noise / Vibration			
□ Public exposure to hazards			
□ Spill to Environment			
OTHER			

MANDATORY SAFETY PERMITS & SYSTEM ISOLATIONS Safety Permits must be obtained and approved before commencing the following works. If not listed below use "other" section. (✓ applicable):					**Other (not listed)**	List any Risk Control Safety permits not listed below here.	
□ Hot Works	□ Live Electrical	□ Confined Space Access	□ Line Breaking	□ Roof/Ceiling Access	□ Equipment Isolation	□ Fire / EVAC Impairment	□ Penetration in fire rating material
6. Will the work cause interruption/isolation of site utilities (water, gas, electricity)?					No □	Yes □→	*If **Yes**, contact the Honeywell Works Supervisor*
7. Will you need to isolate systems or services (medical gas, UPS, security, comms, etc)?					No □	Yes □→	
If Yes to Q7 or Q8, what is the extent and impact of the isolation(s) / interruption?							

CONTRACTOR DECLARATION

I confirm that all necessary Health, Safety and Environment protection measures and precautions as detailed in this form will be taken to ensure the health and safety of workers and others who may be affected by the work. I also confirm the workers undertaking this work are competent, and where required, licensed to carry out the tasks.

Contractor Signature		**Date**	

SMP Attachment 5: Safety Permit Applications (Contractor & Honeywell Employee)

The permits listed below are required when called for by a risk assessment or contractor work authorization and must be documented and kept with the SMP. Permits not included or shown below may still be applicable, as determined by the Honeywell PM. Contractors may also use their own permits if approved and accepted by Honeywell PM.

Line Breaking, roof/ceiling access, Equipment Isolation, Fire/EVAC Impairment, Penetration in Fire Rated Material, Others

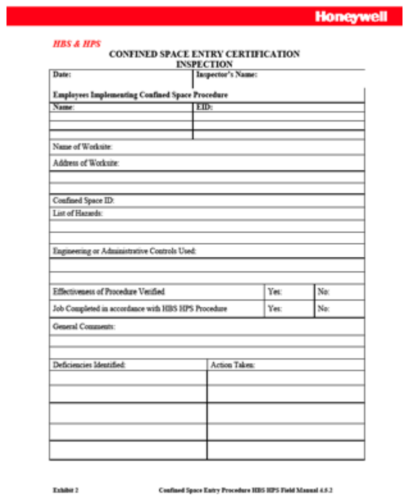
(Click on images below for PDF file attachment)

Hot Work Permit


HONEYWELL HOT WORK PERMIT

WARNING! HOT WORK IN PROGRESS WATCH FOR FIRE!

Confined Space Permit & Cert.


Honeywell

CONFINED SPACE ENTRY CERTIFICATION INSPECTION

Date: Inspector's Name:

Employees Implementing Confined Space Procedure

Name of Worksite:

Address of Worksite:

Confined Space ID:

List of Hazards:

Engineering or Administrative Controls Used:

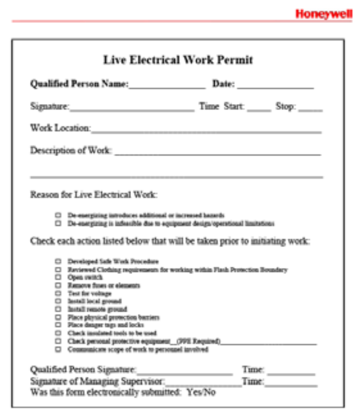
Effectiveness of Procedure Verified Yes: No:

Job Completed in accordance with HBS HPS Procedure Yes: No:

General Comments:

Deficiencies Identified: Action Taken:

Live Electrical Permit


Honeywell

Live Electrical Work Permit

Qualified Person Name: Date:

Signature: Time Start: Stop:

Work Location:

Description of Work:

Reason for Live Electrical Work:

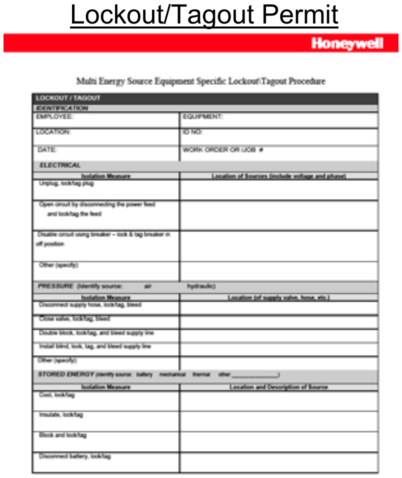
Check each action listed below that will be taken prior to initiating work:

Qualified Person Signature: Time:

Signature of Managing Supervisor: Time:

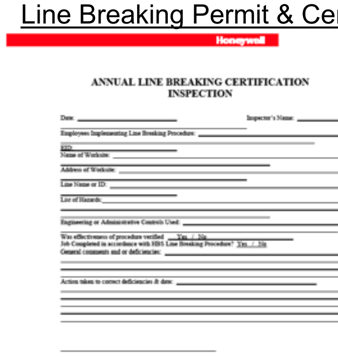
Was this form electronically submitted: Yes/No

Lockout/Tagout Permit


Honeywell

Multi Energy Source Equipment Specific Lockout/Tagout Procedure

Line Breaking Permit & Cert.


Honeywell

ANNUAL LINE BREAKING CERTIFICATION INSPECTION

SMP Attachment 6: Incident Investigation Report – Filed per Occurrence

Part 1: BASIC INFORMATION (Complete and return to HBS HSE Hotline within 24 hours)			
Name of person reporting (if not the Supervisor)	Date of report		
Name and address of location	Region/Business Site Code (LID)	Supervisor's name Supervisor's telephone number	
Claimant / Accident Information			
Full Name of injured party Employee ID #	Address of injured party Home phone: Work phone:	Is the injured party ☐ Male ☐ Female	
	Employee's typical work schedule:		
Date of Hire Job title Employment status	Days worked ☐ Mon ☐ Tue ☐ Wed ☐ Thu ☐ Fri ☐ Sat ☐ Sun	Time begins/ends to work	Contractor? ☐ Yes ☐ No If YES, please complete: Name and address of Temporary Agency/ Contractor: Contact: Phone number:
Date of accident Time of Accident ☐AM☐ PM	Employer notified on what date	Name of place where incident occurred Address where incident occurred	Was there lost time? ☐ Yes ☐ No If yes, Last day worked
Briefly describe the incident			
Were authorities contacted? (police, fire, ambulance) ☐ Yes ☐ No If YES, who	Was a report number given? ☐ Yes ☐ No If YES, list number		
Were any safeguards provided? ☐ Yes ☐ No Were they in use at the time of the incident? ☐ Yes ☐ No			
NATURE OF INCIDENT:			
TYPE OF INCIDENT:			
PART OF BODY:			
Medical Care Information			
Name and address of treating physician	Name and address of treating hospital/clinic		
Phone number of treating physician	Phone number of treating hospital/clinic		
Date employee first visited the doctor	What treatment was given (please check)		
Describe diagnosis / medical treatment the doctor provided (List prescribed medications if any)			
Physical restrictions noted by the medical provider during the initial visit?			
Witness Information			
Name and address of a witness to the incident	Phone number where witness can be reached		
Comments from witness Nº 1			
Name and address of a witness to the incident	Phone number where witness can be reached		
Comments from witness Nº 2			
Anything related to the incident you would like to add			

Part 2: INCIDENT INVESTIGATION (Complete & return to the HBS Regional HSE Leader within 5 days)	
Root Cause Analysis	
Why did the incident happen? (Direct Cause)	
Why did this occur? (Contributing Cause)	
Why did that occur? (Contributing Cause)	
ADDITIONAL COMMENTS:	
PRIMARY ROOT CAUSE:	
SECONDARY/CONTRIBUTING ROOT CAUSE(S)	
Please explain or if additional information is meaningful, please describe:	

List corrective and preventative actions:

Corrective Action	Responsible Person	Target Date	Completion Date

SMP Attachment 7: Safety Observation Form

SAFE OBSERVATION SYSTEM (SOS) REPORT FORM
A SOS is an unplanned event or condition that could have reasonably resulted in personal injury or illness, equipment or property damage, or an environmental excursion. Some examples include: Unsafe Conditions, Unsafe behavior, Events where injury could have occurred but did not, Events where property damage resulted or could have resulted, Events where a control measure was challenged or ignored.

1	SOS Title:					
2	Reporting Employee Name:		Employee EID:			
3	Name of Person responsible for closure:		Employee EID:			
4	Supervisor name:		Supervisor EID:			
5	Name of Contract	Contract Number	6	Address:		
7	Describe the SOS (what happened) / (Do *not use individual names if you have seen an unsafe practice)*:					
8	Honeywell HBS	9	Country: America	10	Region:	11 State:
12	Date SOS Observed:	DD/MM/YYYY				
13	Or select only one recommended time period for closing corrective action:	☐ One week ☐ Two weeks ☐ One month ☐ Three months ☐ Six months ☐ Twelve months				
14	Describe the corrective action:					
15	Date SOS to be closed (meet AOP goal):	DD/MM/YYYY				
16	Consequence of occurrence (select only one):	☐ Catastrophic (fatality) ☐ Major (hospitalisation) ☐ Serious (medical treatment/recordable) ☐ Minor (first aid) ☐ Negligible	17	Likelihood of Recurrence (select only one):	☐ Almost certain (>2 times/year) ☐ Highly likely (once per year ☐ Likely (once every three years) ☐ Unlikely (once every five years) ☐ Remote (once every ten years)	
18	Type of Hazard: (select only one):	☐ Contact in / between / under ☐ Contact with electricity ☐ Contact with sharp object ☐ Exposure to chemical (gas, dust, fume) ☐ Exposure to extreme temp. (hot/cold) ☐ Exposure to noise ☐ Exposure to low oxygen		☐ Fall from elevation ☐ Lifting / Repetitive Motion / Ergonomic exposure ☐ Liquid Splash / Contact struck against ☐ Slip / Trip / Fall (same level) ☐ Struck by ☐ Vehicle ☐ Another kind of hazard		
19	Type of SOS (select only one):	☐ Unsafe Behavior	☐ Unsafe Condition	☐ Incident with property damage	☐ Incident without property damage	
20	Location of Safety Observation (select only one):	☐ Manufacturing plant / Mill ☐ Honeywell Office ☐ Customer Office ☐ Hospital ☐ School ☐ Mechanical Room		☐ Laboratory ☐ Residence ☐ Warehouse ☐ Roof ☐ Computer Room / Control Room ☐ Vehicle ☐ Other		
21	Honeywell Risk Calculator (select only one):	☐ Major	☐ Moderate	☐ Minor		
22	Status:	☐ Open	☐ Closed			
23	Manager / Lead Signature:			Date:	DD/MM/YYYY	
	REMEMBER SAFETY IS EVERYONE'S RESPONSIBILITY					

SMP Attachment 8: Hazard Assessment Site Inventory

The following table lists each of the completed contractor work authorization forms and risk assessments for the scope of work of this contract.

HID#	Description of Hazard, Location, Safety Permits Required	Original Date	Check which is applicable below		Review Date
			Contractor Authorization Form	Risk Assessment Form	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
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25					

SMP Attachment 9: Field Risk Assessment Form

FIELD RISK ASSESSMENT FORM CRITERIA / CALCULATOR

Hierarchy of Controls

ELIMINATE THE HAZARD	→ SUBSTITUTE THE HAZARD	→ ENGINEERING CONTROLS	→ ADMINISTRA-TIVE CONTROLS	→ PERSONAL PROTECTIVE EQUIPMENT
Cut panel wood off site	Replace ladder with scissor lift	Physical barrier / exhaust ventilation	Written procedures / Work instructions / etc.	Hearing Protection, Hard Hats, Gloves, etc

HONEYWELL RISK ASSESSMENT CALCULATOR

SEVERITY / CONSEQUENCE

PROBABILITY / LIKELIHOOD	1. Negligible	2. Minor	3. Serious	4. Major	5. Catastrophic
5. Almost Certain	Medium	High	High	High	High
4. Highly Likely	Medium	Medium	Medium	High	High
3. Likely	Low	Low	Medium	Medium	High
2. Unlikely	Low	Low	Low	Medium	High
1. Remote	Low	Low	Low	Medium	Medium

Severity / Consequence Criteria	Probability / Likelihood Criteria
Catastrophic ❑ Injury: Fatality of employees, contractors or the public. (Tier 1) ❑ Environment/Assets: Irreversible contamination of environment; Significant damage to building/equipment integrity. ❑ Public Relations: Significant public interest, national and/or international media involvement or significant impact on business reputation. ❑ Law and Permits: Federal regulatory intervention and/or regulatory fines greater then $5M to the company/unit; Government withdrawal of permits to operate the entire Honeywell unit or project.	**Almost Certain** 5. Occurred or likely to occur many times.
Major ❑ Injury: Extensive injury or Hospitalization of employees, contractors or the public. (Tier 2) ❑ Environment/Assets: Reversible contamination of environment; Moderate damage to building/equipment integrity. ❑ Public Relations: Moderate public interest, regional media involvement or moderate impact on business reputation. ❑ Law and Permits: Regional/District/State regulatory intervention and or regulatory fines greater then $1M to the company/unit; Government suspension of permits to operate a project.	**Highly Likely** 4. Occurred or likely to occur several times.
Serious ❑ Injury: Medical treatment of employees, contractors or the public. (Tier 2) ❑ Environment/Assets: Reversible small contamination of environment; Minor damage to building/equipment integrity. ❑ Public Relations: Some public interest, local media involvement or some impact on business reputation. ❑ Law and Permits: Local regulatory intervention and/or fines less then $1M to the company/unit; Customer suspension of some permits to a daily operation or written warning to Honeywell or project management.	**Likely** 3. Occurred or likely to occur once.
Minor ❑ Injury: First-aid treatment or Safety Observation of an employee, contractor or a member of the public. (Tier 3) ❑ Environment/Assets: No contamination of environment, no breach of law and no damage to building/equipment integrity. ❑ Public Relations: Little public interest, local media involvement or little impact on business reputation. ❑ Law and Permits: No suspension of permits to operate, continue daily operations, verbal warning to Honeywell or project management.	**Unlikely** 2. Might occur or likely to occur.
Negligible ❑ Injury: No injury. ❑ Environment/Assets: No impact. ❑ Public Relations: No public interest, local media involvement or no impact on business reputation. ❑ Law and Permits: No impact.	**Remote** 1. Rarely occurs.

RISK ASSESSMENT GUIDELINES

In most instances, moderate and major risks to health and safety can be adequately managed using site specific safe systems of work. For example, if a safety harness is specified as the control measure for working at height the risk assessment form should specify the pre-use inspections, selection of proper anchorage points, training of wearers, rescue of a suspended worker, etc.

For work with plant and substances consideration must be given to any safety recommendations of the manufacturer (e.g. the MSDS).

The actual workers performing the task should participate in all steps of the risk assessment process. It is crucial that the workers involved in the activity have input in the development and review of the safety measures.

Remember.

1. The risk assessment provides a written record of the process to be used to carry out a task safely. To demonstrate mutual understanding, it should be signed off by the parties who have responsibility for the tasks.
2. Management processes must be in place to ensure workers are competent and have the skills to complete the job and that there is a required level of supervision to ensure the tasks are completed as documented.
3. The risk assessment should be completed by all employees involved in the activity, not just the principal contractor or supervisor.

Describe the Site and the Scope of Work (Job Task)

The risk assessment should contain a brief description of the scope of work, location, supervisor, contractors, date & revision date where relevant.
Details of the specific area where the work is to be performed should also be included with the site details (e.g., building 1, phase 1 etc)

Document the Hazards that Make up the Scope of Work (Job Task)

In consultation with the persons performing the work, write down the hazards required to perform the scope of work/job task in the order to be carried out.
Details of the equipment and tools to be used should also be included. (e.g., fixing cabling to metal frame in roof space using an explosive powered ramset gun).

Identify Harm from Exposure to the Hazard

For each hazard, identify the harm/injury that may be caused from exposure to the hazard (s) to those engaged in the task or to others in the vicinity. For example, the main hazards from drilling concrete include exposure to hazardous silica dust, flying debris, high torque of tools and noise. The respective consequences would typically include respiratory damage, hearing damage, eye damage, sprains or cuts.
Pay particular attention to the use of plant and power tools to ensure that all safety hazards are identified.
For mobile plant check the general plant risk assessment record/Work instructions, as this will provide specific information on potential hazards associated with the plant.

Document all the Existing Risk Control Measures Associated with the Hazard to Eliminate / Reduce Risk

List all the control measures required to eliminate or minimise the risk of injury from the identified hazard (Refer to relevant Honeywell HSE Procedures). Control measures include training, instructions, information and supervision. For each hazard assess the foreseeable level of risk using the Honeywell risk assessment calculator.

Also include cross reference in the control measure column to any other risk assessments undertaken as part of the task, by referring to relevant hazard assessed (i.e. manual handling of ladders).

Risk Control Measures

Risk control measures should be selected in consultation with the relevant workers, making reference to the Honeywell HSE procedures where applicable. It may be necessary to seek advice from persons with safety training, working experience & the relevant Safety Advisor to identify the most appropriate control measure.
When selecting control measures consider:

- All persons that may be affected by the hazard, not just those involved in performing the task.
- The actual work practices on site.
- How often and for how long people are exposed to the hazard.
- The experience of workers doing the task.
- Safe work methods available and their effectiveness.
- The degree of safety training & instruction required (e.g. Safety inductions, safe work procedures, PPE use, use of MSDS's or the amount of supervision required).

Document Risk Level

Using the Risk Calculator, perform a risk assessment: evaluate the potential severity and probability (1, 2, 3, 4 or 5) of an incident for each hazard associated with the task.

Use the Risk Matrix to establish the risk ranking for each Task and Hazard; based on the Severity and Probability of an event, determine Low, Medium or High risk
Low Risk (green): Adhere to current hazard controls
Medium Risk (yellow): Control plan requires cell supervisor approval. Task should only proceed once the controls are in place
High Risk (red): Control plan must be reviewed and approved by the supervisor and site HSE. Work should not proceed until all the controls are in place and verified.
High risk tasks must also be added to site Risk Assessment tool. Activities should take place to lower risk classification.

List in priority order any additional control measures required to eliminate or reduce the hazard to the lowest exposure level possible relevant to the Hierarchy of Control.

Hierarchy of Risk Control Measures

Select control measures from the highest level practicable in levels 1 to 5 below, e.g., first try to eliminate the hazard, as this gives the best result. The measures at the lower levels are less effective and require training of workers plus frequent review of the hazards and systems of work. In some situations a combination of control measures may need to be used.
1 - Eliminate the hazard
Discontinue the activity or stop using the plant, tool or substance where practicable.
2 - Substitute the hazard
Use something safer or change the system of work
3 - Engineering controls
Use guards, fencing, safety screens, etc to separate workers from the hazard, use dust extractors on tools or exhaust ventilation to reduce dust
4 - Administrative controls.
e.g. specific worker instructions or procedures.
5 - Personal protective equipment (PPE).
Only when level 1 - 4 control measures have been considered and applied to the highest extent practicable, any remaining risk may be reduced by using PPE such as safety harness, eye protection, hearing protection, etc.

Any specific training, permits and information needed to carry out the task safely should also be noted (e.g. work at height training).

Identify Who Is Responsible

Document the names of the person's responsible for implementing the control plan (additional controls/information) to lower the risk level.

Monitor and Review the Risk Assessment

Make sure the work is supervised to ensure that the work is carried out as documented in the risk assessment.
Review the risk assessment if conditions, location, etc of the work change or after an appropriate length of time. Consider also:

- Whether the control measures are suitable for the task.
- The degree of support it has amongst the employees concerned.
- The effectiveness of control measures.

Designated Major Risk Tasks

Major risk work includes, but is not limited to:

- Unprotected work at heights >1.8 meters / 6 feet, particularly on roofs.
- Working on ladders above 1.8 meters / 6 feet.
- Entering confined spaces.
- Live electrical works.
- Working with mobile plant and machinery.
- Working near power lines.
- Working with elevating work platforms and cranes.
- Trenching and excavation.
- Work on or near gas mains or electricity supplies.
- Working with/near asbestos or lead or their removal.
- Demolition.
- Using certain hazardous substances including carcinogens.

Assessing and Reviewing Subcontractor Risk Assessments

The team leader/project manager or their delegated representative should ensure that the adequacy of subcontractor risk assessments and any associated safety documents and instructions are assessed prior to commencing work. In assessing subcontractor risk assessments consider the following:

- Compliance with Honeywell's policies and procedures.
- Has the recommended process been followed to develop the risk assessment?
- Are foreseeable significant hazards and risks to health and safety identified in relation to the nature of the works, including plant, tools and equipment used?
- Are risk control measures adequate and in line with the hierarchy of controls?
- Are all legislative requirements satisfied?
- Has the subcontractors inducted their workers into their own risk assessment?
- Is there adequate provision for supervision to ensure control?

[CLICK HERE FOR LINK TO PRE-POPULATED RISK ASSESSMENTS/SAFE WORK PROCEDURES]

FIELD RISK ASSESSMENT FORM

ASSESSMENT NO:

SITE LOCATION:	SCOPE OF WORK (JOB TASK):	PERMIT TO WORK REQUIRED? Yes ☐ No ☐

PERSON POTENTIALLY EXPOSED:

☐	ALL STAFF	☐	CONTRACTORS
☐	STAFF MEMBER PERFORMING JOB ONLY	☐	VISITORS
☐	MEMBERS OF THE PUBLIC	☐	OTHER (SPECIFY)

DURATION OF EXPOSURE:

☐	UNDER 5 MINUTES	☐	6-15 MINUTES
☐	16-30 MINUTES	☐	31-45 MINUTES
☐	46 MINS -1 HOUR	☐	1 HOUR OR MORE

FREQUENCY OF JOB:

☐	CONTINUOUS/ ONGOING
☐	NO OF TIMES PER WEEK
☐	NO OF TIMES PER MONTH

HONEYWELL RISK ASSESSMENT CALCULATOR

Severity / Consequence

Probability/ Likelihood	1. Negligible	2. Minor	3. Serious	4. Major
5. Almost Certain	Medium	High	High	High
4. Highly Likely	Medium	Medium	Medium	High
3. Likely	Low	Low	Medium	Medium
2. Unlikely	Low	Low	Low	Medium
1. Remote	Low	Low	Low	Medium

JOB HAZARD EXPOSURE OR DETAILED HAZARD AND HARM *List each of the hazards associated with the scope of work in the sequence they are encountered including possible harm and effects.*	RISK LOW / MEDIUM /HIGH *Using the Honeywell Hazard & Risk Matrix list the risk level against each hazard*	RISK CONTROL MEASURES / SPECIAL PERMIT REQUIREMENTS *List the control measures required to eliminate or minimise the risk of injury from the identified hazard (Refer to relevant Honeywell HSE Procedures)*	RISK LOW / MEDIUM /HIGH *Using the Honeywell Hazard & Risk Matrix list the risk level against each hazard*	ASSIGN RESPONSIBILITY *Write the name of the person responsible (supervisor or above): implement the control measures identified.*

I have read and understood the content of this RISK ASSESSMENT and agree to follow the requirements as outlined or alternatively contact the responsible Honeywell supervisor to revise the agreement

This risk assessment is written and approved at an administrative level. This approval does not imply that the risk assessment is a comprehensive and accurate document. Any subsequent use of the risk assessment makes it implicit upon the user to verify the accurate sequence of events, potential hazards, risks and controls.	RISK ASSESSMENT AUTHOR (PRINT NAME)	AUTHOR'S SIGNATURE	ASSESSMENT DATE
	MANAGERS NAME (PRINT NAME)	MANAGER'S SIGNATURE	ASSESSMENT REVIEW DATE

EMPLOYEE SIGNATURES

EMPLOYEE NAME (PRINT NAME)	EMPLOYEE SIGNATURE	DATE	EMPLOYEE NAME (PRINT NAME)	EMPLOYEE SIGNATURE	DATE

SMP Attachment 10: Orientation Form (Completed at Project Construction Kick-off)

Employee/Contractor:…………………………………… Contract: ……………………………………… Date……………………………...

Honeywell Representative:……………………………………………………………………………

Please tick ✓	Yes	No	Comments
• Honeywell/Customer HSE Policy	☐	☐	
• Discuss (or provide copies) of relevant Honeywell and/or Customer HSE procedures	☐	☐	
• Discuss/provide copy of Contractor HSE guidelines	☐	☐	
• First Aid arrangements	☐	☐	
• Location of hazardous materials listed in Hazardous Materials Register	☐	☐	
• Emergency Procedures	☐	☐	
• Evacuation Procedures	☐	☐	
• HSE Risk Assessment Worksheet	☐	☐	
• Reviewed Health and Safety Plan	☐	☐	
• Site Entry/Access requirements	☐	☐	
• Specific Training for special Area/Tasks (list below)	☐	☐	
• Works Authorization Form requirements	☐	☐	
	☐	☐	
	☐	☐	

I have completed the Orientation & Training as required for this Contract and agree to follow the guidelines and procedures as outlined in these courses.

Name	Signature	Name	Signature

SMP Attachment 10: (Completed by ALL Contractor/HW Employees prior to construction start)

I have read and understand the Risk Assessments, completed Site Orientation & Safety training as required for this Contract at (enter project name) and agree to follow all guidelines to work safely			
Print Name	Signature	Company	Date

SMP Attachment 10: (Completed by ALL Contractor/HW Employees prior to construction start)

I have read and understand the Risk Assessments, completed Site Orientation & Safety training as required for this Contract at (enter project name) and agree to follow all guidelines to work safely

Print Name	Signature	Company	Date

SMP Attachment 11: Training Register

The following table lists the Site Specific training requirements that must be completed prior to working on the project site. These training procedures were identified as a result of the completed hazard and risk assessments observed at the contract site. All employees and contractors must be familiar with the required training for this project and agree to follow these procedures for the entire duration of the project.

Training Register				
#	Training Requirement	Contract Required (yes or no)	Who is to Complete	Comments
1	Customer orientation	Yes	Honeywell Employees	
2	Honeywell Safety Awareness / Orientation	Yes	Honeywell Employees	
3	Asbestos Awareness	Yes	Honeywell Employees	
4	Bloodborne Pathogen Awareness			
5	Canine Awareness			
6	Cold Weather Safety			
7	Compressed Gas Awareness			
8	Confined Space Awareness	Yes	Honeywell Employees	
9	Confined Space Entry – advanced training required	Yes	Honeywell Employees	
10	Cranes & Slings	Yes	Honeywell Employees	
11	Driver Safety	Yes	Honeywell Employees	
12	Electrical Arc Flash Awareness	Yes	Honeywell Employees	
13	Electrical Safety General Awareness	Yes	Honeywell Employees	
14	Emergency Preparedness Plan (Customer)			
15	Environmental Hazard	Yes	Honeywell Employees	
16	Eye & Face Protection	Yes	Honeywell Employees	
17	Fall Protection	Yes	Honeywell Employees	
18	Fire Extinguisher Usage	Yes	Honeywell Employees	
19	Hand & Power Tool	Yes	Honeywell Employees	
20	Hazard Communication	Yes	Honeywell Employees	
21	Hearing Protection	Yes	Honeywell Employees	
22	Hot Work Permit	Yes	Honeywell Employees	
23	Ladder Safety	Yes	Honeywell Employees	
24	Laser Safety			
25	Lead Safety	Yes	Honeywell Employees	
26	Line Breaking	Yes	Honeywell Employees	
27	Lock Out/Tag Out	Yes	Honeywell Employees	
28	Machine Safeguarding			
29	Management of Change	Yes	Honeywell Employees	
30	Manual Material Handling / Back Safety	Yes	Honeywell Employees	
31	Office Ergonomics	Yes	Honeywell Employees	
32	Personal Protective Equipment	Yes	Honeywell Employees	
33	Powered Industrial Trucks	Yes	Honeywell Employees	
34	Process Safety Management			
35	Refrigerant Management	Yes	Honeywell Employees	
36	Respiratory Protection	Yes	Honeywell Employees	
37	Safety Observation System (SOS)	Yes	Honeywell Employees	
38	Safe Operations Management (SOM)Training	Yes	Honeywell Employees	
Below list other customer specific training requirements, if applicable.				
1				
2				

SMP Attachment 12: Field Safety Checklist

Form completed by ________________ Date __________

Honeywell requires a Field HSE Check List be maintained onsite for all current or new projects. It is to be performed prior to starting work during the initial site visit. Hazards identified are to be communicated to all personnel working at the site and referenced during future visits.

Original Date: ________________ Revision Date: ________________
Contractor(s): ________________
Customer Name: ________________ Customer Contact: ________________ Address: ________________
Telephone No: ________________ Customer HSE Rep: ________________ Phone: ________________

1. Scope of work summary:

2. Personal protective equipment required on site?

	NO		YES (Honeywell)		YES (Contractor)	
Fall Protection?	☐		☐		☐	
Hard Hat?	☐		☐		☐	
Safety Glasses?	☐		☐		☐	
Hearing Protection?	☐		☐		☐	
Safety Shoes?	☐		☐		☐	
Protective Clothing? (specify)	☐		☐		☐	
Respiratory protection? Explain:	☐		☐		☐	

3. Safety hazards encountered at customer's facility (Check and explain plans for addressing the hazard).

Check for Yes	Safety Hazard	Name of Contractor / Personnel Performing Work	Plans to Address: Risk Assessment or Contractor Work Authorization
☐	Construction environment		
☐	High or low temperature materials or equipment		
☐	Welding		
☐	Laser equipment		
☐	Confined space or isolated work area		
☐	Overhead operations		
☐	Work at heights requiring a ladder, lift platform or basket; who provides the equipment and has appropriate training been completed?		
☐	Are there areas where the following conditions are present: Oxygen deficient atmosphere, toxic gases, vapors, fumes, mists, dusts, lead, mercury?		
☐	Known or suspected carcinogens including asbestos		
☐	Potential exposure to biohazards		
☐	Explosive or highly combustible materials		
☐	Excessive noise levels (signage identifies area)		
☐	High voltage (480 volts or greater) in the work area		
☐	Radiation sources		
☐	Ergonomics: excessive bending/stooping, cramped space		
☐	Slippery surfaces		
☐	Open pits, vats, trenches		
☐	Material handling requiring hoists, cranes, rigging, forklifts?		
☐	Raw or partially treated sewage		
☐	High pressure equipment		
☐	Unguarded machinery		
☐	Hot work permits required		
☐	Lockout/tagout permits required		
☐	Emergency evacuation		
☐	Special parking or security requirements		
☐	Customer hazard communication requirements		
☐	Process safety management requirements		
☐	Applicable MSDS's available; if no, who obtains them		
☐	Other hazards		

4. Specific safety considerations necessary to abide with customer's safety procedures. ________________________________

5. Have all employees been briefed on the customer's site emergency response and evacuation plans & how will employees be accounted for in the event of an emergency? ________________________________

6. Does the customer have a drug/alcohol policy for contractors and does it include drug testing? ________________________________

7. Have the employees assigned to this project received appropriate safety training to prepare them for safety issues identified? __________

Complete, Sign and review on first visit or after work order changes. Revise annually. Review, sign & date:

Honeywell Manager	Employee\Contractor	Customer Representative (Optional)

SMP Attachment 13: Behavioral Observation Checklist (HW Employee Monitoring)

Utilize the Behavior Observation Checklist to identify both safe and at risk conditions in the work environment. After observation provide feedback to the employee for both safe and at risk observations. All at risk observations must have comments to identify corrective action or explanation. Only respond to questions that apply to the task

1. Observer

Report Observer Name

Observer EID

2. Observed

Observed Name

Observed EID

3.Task performed by Employee:______________________________________

(4)	**Select SBU: HBS or HPS**	**(5)**	**Select Pole (Americas or EMEA or AP):**	**(6)**	**Region within Pole:**	**(7)**	**State/District /Branch within Region:**

(8) Location of Behavior Observation (select only one):	☐ Manufacturing plant / Mill ☐ Honeywell Office ☐ Customer Office ☐ Hospital ☐ School ☐ Mechanical Room	☐ Laboratory ☐ Residence ☐ Warehouse ☐ Roof ☐ Computer Room / Control Room ☐ Vehicle ☐ Other
(9) Date BOC Observed:	DD/MM/YYYY	

SAFE PATH OF TRAVEL			
Uses designated walkways to access work area	SAFE	AT RISK	N/A
Has clear view of path to travel	SAFE	AT RISK	N/A
PERSONAL PROTECTIVE EQUIPMENT (PPE)			
Head Protection	SAFE	AT RISK	N/A
Eye/Face Protection	SAFE	AT RISK	N/A
Hand Protection	SAFE	AT RISK	N/A
Foot Protection	SAFE	AT RISK	N/A
Respiratory Protection	SAFE	AT RISK	N/A
Electrical Protection	SAFE	AT RISK	N/A
Personal gas detector	SAFE	AT RISK	N/A
SAFE MOTOR VEHICLE OPERATION			
Does not use any mobile device while driving	SAFE	AT RISK	N/A
Secures equipment for safe transport	SAFE	AT RISK	N/A
Vehicle properly maintained	SAFE	AT RISK	N/A
Parking brake engaged when parked	SAFE	AT RISK	N/A
BODY POSITIONING DURING TASK			
Uses knees to lift not back	SAFE	AT RISK	N/A
Use knee pads when kneeling	SAFE	AT RISK	N/A
Watches hand placement / Keeps eyes on task	SAFE	AT RISK	N/A
Avoids pinch points or “line of fire” hazards	SAFE	AT RISK	N/A
Note: Line of fire: Struck by/against, caught in /between/under			
LADDERS			
Properly stores ladder on vehicle	SAFE	AT RISK	N/A
Ladders inspected prior to use	SAFE	AT RISK	N/A
Right ladder (step/extension) for the job	SAFE	AT RISK	N/A
Three points of contact at all times	SAFE	AT RISK	N/A
Does not use ladders in wet conditions	SAFE	AT RISK	N/A
Uses tool belt/back pack to carry tools	SAFE	AT RISK	N/A
PRE-JOB PLANNING			

Identifies all hazards in the work environment	SAFE	AT RISK	N/A
Conducts risk assessment using the risk calculator for	SAFE	AT RISK	N/A
Low / Medium or High Risks	SAFE	AT RISK	N/A
Obtains Work Permit where required	SAFE	AT RISK	N/A
Implements controls prior to starting work	SAFE	AT RISK	N/A
Communicates job activities with customer or team	SAFE	AT RISK	N/A
TOOLS			
Tools properly maintained	SAFE	AT RISK	N/A
Lock out, tag out properly applied	SAFE	AT RISK	N/A
Verifies zero energy after lock out	SAFE	AT RISK	N/A
Proper use of tools/ Uses right tool for the job	SAFE	AT RISK	N/A
Inspects tools before use	SAFE	AT RISK	N/A
INCLEMENT WEATHER			
Drinking plenty of fluids	SAFE	AT RISK	N/A
Taking rest breaks	SAFE	AT RISK	N/A
Uses ice cleats for icy conditions	SAFE	AT RISK	N/A
WORK ENVIRONMENT			
Keeps work area clean / free of trip hazards	SAFE	AT RISK	N/A
Checks work area for bees, wasps, snakes, etc	SAFE	AT RISK	N/A
HAZARD/INCIDENT REPORTING			
Reports Safety Observations	SAFE	AT RISK	N/A
Knows how to report injuries	SAFE	AT RISK	N/A
OTHER CRITICAL BEHAVIORS OBSERVED			
____________________	SAFE	AT RISK	N/A
____________________	SAFE	AT RISK	N/A

Describe At Risk Behavior:

Describe Safe Behavior:

Corrective action entered into SOS: Yes: **No:** **SOS Number:**

Manager / Lead Signature **Date** DD/MM/YYYY

SMP Attachment 14: Contractor Performance Safety Checklist (Contractor Audits)

Contractor Performance Safety Checklist				
Site location:		**Location of work**		
Auditor:		**Date and time**	**Date**	**Time**
Details of work being undertaken				
Contract Number or Name				
Name of contractor				

	Observed health and safety standards			**Comments**
(i)	Have all contractor and sub contractor staff attended a site safety orientation course and received required HSE training?	Yes	No	
(ii)	Have all contractor and sub contractor staff aware of the sites emergency procedures?	Yes	No	
(iii)	Have all contractor and sub contractor staff been aware of what to do in the event of an accident and/or safety observation? (speak to contractor staff)	Yes	No	
(iv)	Has the contractor made adequate first aid provision?	Yes	No	
(v)	Have safety observations been submitted to Honeywell on a periodic basis?	Yes	No	
(vi)	Are the contractor and sub contractor risk assessments, safe work procedures, method statements, HSE procedures, and permits to work being followed?	Yes	No	
(vii)	Has required PPE, e.g. hard hats, safety boots, etc. been provided according to the risk assessment and is it being worn?	Yes	No	
(viii)	Has the contractor implemented life critical control measures for fall protection, electrical safety, arc flash, and permit confined spaces?	Yes	No	
(ix)	Where applicable are the contractor works securely fenced off or otherwise protected from the public, staff, etc?	Yes	No	
(x)	Is the contractor maintaining a safe work area and implementing good housekeeping standards, including safe egress to roads, aisles, stairs, etc.?	Yes	No	
(xi)	Is the contractor holding regular tool box talks with employees?	Yes	No	
(xii)	Other observations			

Auditor: *I hereby declare that I have completed health and safety monitoring on the contractor named above*

Name (capitals)		Signature			
Job Title		Time		Date	
Contractors representatives name		Signature		Date	
Site managers name		Signature		Date	

SMP Attachment 15: Vehicle, Tool, & PPE Inspection Checklist (Honeywell Employees)

EMPLOYEE NAME:	VEHICLE #:
SUPERVISOR NAME:	VEHICLE MILEAGE:
LOCATION ID# VEHICLE ASSIGNED:	INSPECTION DATE (MM/DD/YY):

	Insp	Test	Items	OK	DEV	N/A	Deviations: Enter a brief description of deviation, action taken, and date corrected
VEHICLE SAFETY ITEMS	x		**Housekeeping -** vehicle, tools, and equipment are neat and orderly, items in driver compartment are adequately secured				
	x		**Ladder racks** - in good condition, hardware intact, operates easily, ladders secure				
	x		**Exterior/Body damage** - exterior clean and in good condition (note all damage including scratches, dents, etc.)				
	x	x	**Lights** visible and operational - headlights (low & high beam), tail lights, brake lights, emergency flashers, other lights				
	x	x	**Windshield washer system/wipers/fluid** - operating properly, good condition, appropriate fluid level				
	x	x	**Seatbelt** - available and in good condition				
	x		**Glass & mirrors** - clean, no cracks or pits in areas that obstruct driver's view, mirrors securely mounted, properly positioned				
	x	x	**Tire Condition and Pressure** - appropriate tire wear and pressure (including spare)				
	x	x	**Fluid levels -** verify that oil is full, no fluid leaks				
	x	x	**Tire Condition and Pressure** - adequate tread depth and appropriate tire wear, proper pressure (including spare)				
	x	x	**Brakes** - operating properly (per driver's verbal report), verify that emergency brake operates properly				
	x	x	**Doors & locks** - door catches and handles work properly, locks work properly and can be secured				
	x		**Fire extinguisher** - mounted within vehicle, gauge needle in "green" zone or otherwise indicates "full"				
	x		**First aid kit** - vehicle kit available and adequately stocked				
	x		**Chocks and cones -** available, as needed				
	x		**Vehicle registration, insurance card, driver's license, Honeywell driver's guide, fuel card** -present, current, available for appropriate vehicle				
LADDERS & FALL	x		**Ladders** - Rungs, rails, hardware, rope in good condition. Appropriate ladder size and type available (non-conductive ladder available when electricity could be encountered)				
	x		**Fall protection equipment** - harness, lanyard, anchoring equipment inspected and in good condition. Complete system from same manufacturer. Harness and lanyard stored properly (without twisting, bending, away from chemicals and direct sunlight). Replaced according to manufacturer guidance.				
PPE	x		**Eye protection** - readily available, clean, in good condition				
	x	x	**Hard hat** – in good condition, no cracks or dents. Cradle system intact and in good condition. Clean surface.				
	x		**Hand and foot protection** - available and in good condition				
	x		**Hearing protection** – appropriately selected, clean, in good condition, stored properly				

	x	x	**Respiratory protection** - appropriately selected, in good condition, stored properly				
TOOLS & EQUIPMENT	x		**Power tools** - in good condition; cords, plugs, prongs present and good condition; grounded or double insulated; no broken pads; guards in place; removed from service/replaced promptly if poor condition detected				
	x		**Pneumatic tools** - hose/whip secured to tool by positive means (to prevent tool from being accidentally disconnected); safety clips or retainers used on impact/percussion tools				
	x		**Hand tools** - Good condition, no mushroomed heads, no broken or cracked parts; removed from service/replaced promptly if poor condition				
	x		**Fuel-powered tools/equipment** - good condition; stored so as to prevent spilling of fuel during transport; when in use in enclosed spaces, measures are taken to prevent build-up of gases and fumes; stopped for refueling, service, and maintenance				
ELECTRICAL	x		**Extension cords** - cord and plugs in good condition (no cracks, cuts, or tape), prongs intact, cord is grounded or double-insulated (and/or GFI available)				
	x		**Lockout/Tagout** - appropriate devices available (locks, tags, hasps, etc.), appropriate variety available for job conditions				
	x	x	**Amp Meter** - clean, no damage, proper storage, good working order, test battery				
COMPRESSED	x		**Torches, hoses, regulators** - fittings in good condition, no leaks, auto shut-off tested, hoses & connections designed for pressure and service to which subjected; equipped with backflow prevention or flash arrestor				
	x		**Gas cylinders** - turned off, stored upright with caps in place, secured (to prevent tipping), properly labeled, used with appropriate PPE, regulators and torches removed and/or disconnected from cylinders when not used				
	x		**Personal Protective Equipment for Hot Work** (i.e. face shield, body protection, etc.) - protective equipment available and in good condition				
MISCELLANEOUS	x		**Outdoor/inclement weather supplies & equipment** - appropriate supplies available for hazards encountered (i.e. drinking water/fluids, snow/ice management equipment {sand, shovels, etc.], insect spray [di-electric spray required if working near electricity], sunscreen, etc.)				
	x		**Chemicals** - only "approved" chemicals used, all containers properly labeled, containers stored properly (secured). Material Safety Data Sheets (MSDS) on file at HON office. If refrigerant is distributed, logs are available and up-to-date.				
	x		**Hand lines and ropes** - no cuts, abrasions, decay, burns, signs of wear				
	x		**Portable blowers** - in good condition, proper ratings on blower, proper set-up and use (test)				
	x	x	**Air monitoring equipment (for confined space entry)** - appropriate for job conditions and hazards potentially encountered, in good condition and functioning properly, test/calibrate equipment according to requirements, appropriate calibration gases and test kit available				
	x	x	**Electrical insulating gloves (for electrical hot work) -** if used and available, ensure appropriate class/type for use, verify current inspection/test date stamp rubber protective layer (w/in past 9 mos.), stored in bag with fingers upright, stored away from direct sunlight in dedicated bag				
	x		**Electrical mats/barriers** - Mats and barriers in good condition, no tears, rips or holes. Appropriate for hazards encountered.				
	x		**Gasoline** - stored in approved flammable liquid container with self-closing lid, flame/flash arrestor. Stored to prevent tipping. Maximum capacity stored less than 5 gallons.				
	x		**Heaters** – equipped with proper shut-off (tip over protection), use only approved heaters in good condition.				
	x		**Permits** - verify adequate supply of required permits (Hot Work, Live Electrical, Permit-Required Confined Space Entry, etc.)				

SMP Attachment 17: Emergency Response Plan

HBS & HPS Facilities Emergency Response Plan

Honeywell Business Unit:	
Street Address:	
City, State, Zip:	
Date of ERP Review:	

Emergency Response Preparedness (ERP) Checklist: ***(Click on PDF)***

SMP Attachment 17: Emergency Response Plan

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1. EMERGENCY PREPAREDNESS PLAN SCOPE:

Honeywell International Inc. (Honeywell) will provide a safe and healthy work environment. Consistent with policy, the following emergency action plan is developed for this site and will guide the actions taken by employees, management, and emergency coordinators. Emergency events addressed by this plan include building evacuation, fires, severe weather, medical emergencies, Bomb Threats or other facility-related emergencies that could endanger employees and/or visitors to this Honeywell location.

2. HSE HOTLINE REPORTING GUIDANCE:

Report all Injuries and Illnesses and Emergency Events addressed within this reporting procedure to the **Honeywell Hotline at (866-466-1765).** Early Post Injury Reporting with Immediate First Aid measures can reduce Injury Severity & Eliminate the need for Future Medical Care (Recordable Injuries).

3. DRILLS/TEST OF EMERGENCY PREPAREDNESS PLAN:

Familiarity with responsibilities and procedures must be thorough so that response to the plan is automatic. Each location is responsible for accomplishing at least one emergency situation drill every twelve (12) months. After accomplishing the emergency situations drill it must be documented on the Emergency Preparedness Drill Critique.

4. FACILITY IDENTIFICATION, DESCRIPTION, GENERAL INFORMATION:

Office Name/LID	
Address	
Description of Bldg, Usage	
Location Description, Cross Streets, Directions	
Facility Utilities, Nearby Buildings	

5. EMERGENCY COORDINATOR INFORMATION

THE EMERGENCY COORDINATOR HAS PRIMARY RESPONSIBILITY FOR ASSURING THE IMPLEMENTATION OF THIS EMERGENCY PREPAREDNESS PLAN AND REQUIREMENTS STATED HEREIN. WHEN EMERGENCIES OCCUR, THE EMERGENCY COORDINATOR MAINTAINS PRIMARY RESPONSIBILITY FOR APPROPRIATE NOTIFICATIONS TO EMPLOYEES, HONEYWELL MANAGEMENT, MUNICIPAL EMERGENCY SERVICES (I.E. FIRE AND/OR POLICE DEPARTMENTS), AND OTHER AGENCIES OR SERVICES THAT MAY ASSIST IN MANAGEMENT OF THE EMERGENCY.

The alternate Emergency Coordinator serves in place of the Emergency Coordinator when the primary coordinator is unavailable. (It is recommended that these positions be filled with employees who are typically in the building for the majority of the workday.)

A. THE PRIMARY EMERGENCY COORDINATOR FOR THIS FACILITY IS:

Name	
Title	
Office Phone	
Pager or Cell	
Alternate Phone	

B. THE ALTERNATE EMERGENCY COORDINATOR FOR THIS FACILITY IS:

Name	
Title	
Office Phone	
Pager or Cell	
Alternate Phone	

6. HONEYWELL CRISIS COMMUNICATION:

Major crisis situations often generate interest from the news media and require effective internal communications to address employee concerns. As soon as possible following a major crisis event, contact the Communications Leader to discuss the situation so appropriate internal and external communications plans and tools can be developed. Examples of such times where crisis reporting should be accomplished include the following:

a. Catastrophic facility damage caused by fires, storms, explosions, or earthquakes, tsunamis, accidents that may result in severe injury and threats or acts of violence or terrorism

b. Other unexpected events that have the potential to cause harm to Honeywell's employees, reputation, competitive positioning, or financial viability.

I. INTERNAL RESOURCE NUMBERS: It is always appropriate to contact the local site leader if they are not on-site at the time of the incident. Additionally, based on the nature of the event/injury it may also be necessary to contact other Honeywell personnel listed below:

	Name	Office Phone	Cell Phone
Local Site Leader(s)			
HSE Leader	Steve Serian	603-930-0222	603-930-0222
Facilities Manager			
HR Leader			
ACS Security Director	Jeff Soholt	763-954-6123	952-303-1648

- **Additional Links**
  - Corporate Communication Policy
  - Corporate Communication Contacts

II. EXTERNAL RESOURCES / EMERGENCY PHONE NUMBERS:

	Name	Phone
Police Department		911
Fire & Ambulence		911
Building Landlord/Manager		
Other		

7. EMERGENCY EVACUATION SYSTEM:

A fire alarm will be used to alert employees within the building of fire or severe weather emergency or other need to evacuate the building or to seek shelter in place. In buildings that are not equipped with audible emergency alarms, employees will be alerted to other emergencies through direct verbal communication from the Emergency Coordinator(s) and/or designated alternate.

The Emergency Coordinator or designated alternate will make physical contact with employees who have sight or hearing disabilities to ensure that they are aware of the emergency.

a. BUILDING EVACUATION:

Evacuation of employees to a rally point outside of the building or to a refuge area within the building will be enacted whenever there is a threat to their safety or health because of an emergency condition. The refuge area shall be a safe area within the building away from windows where employees can gather, for example, in severe weather. The Emergency Coordinator is authorized to enact the evacuation of a particular room, floor, or the building.

- ✓ The designated rally point is:

  Specify:

  If the designated rally point is involved in the emergency, the alternate rally point will be:

  Specify:
- ✓ The designated (indoor) refuge area is:

  Specify:
- ✓ The Emergency Coordinator and Team will be responsible for accounting for all employees, visitors and contractors. If personnel are unaccounted for after conducting the headcount at the rally point, the Emergency Coordinator will be the designated person responsible for communicating with emergency services.
- ✓ Re-entry to the building will be coordinated through emergency services and the Emergency Coordinator. In the event of an incident preventing re-entry, the Emergency Coordinator will work with senior management, Facilities, and Health, Safety, Environmental (HSE) departments to assure the safety of the building and personnel.
- ✓ Injured personnel will receive medical care through the municipality's emergency response system.
- ✓ In the event an unplanned evacuation results from an actual site emergency, the Emergency Coordinator shall ensure appropriate notifications are made to site leadership.
- ✓ A diagram or description of the evacuation routes, exit doors, rally points and refuge areas are posted:

  Specify:

  The designated exit doors for this facility are (list exit doors).
- ✓ Know the locations of your building evacuation route, outdoor rally point, and indoor refuge area before an emergency occurs by reviewing the posted/attached instructions and/or evacuation map.

8. MEDICAL EMERGENCY:

Remember to report all injuries no matter how minor to your manager and HSE leader immediately and the **Honeywell Hotline at (866-466-1765).** *Never enter into a medical emergency area unless you are sure there are no hazards present. Scan the area visually, overhead as well, to ensure that there are no physical dangers present. We do not want to delay the initial medical emergency response nor do we want to provide additional responses to would-be rescuers. Never move or attempt to render any assistance that could impact greater injury to the already injured victim.*

The following steps to be taken in the event of an on-site medical emergency:

a. *Immediately contact First Aid personnel and dial 9-911 for assistance, such as loss of consciousness, uncontrolled bleeding, potential heart attack or stroke and give exact location and nature of the emergency.*

b. *Remember, when First Aid arrives, they are in charge. Persons in the immediate area should be limited to only those identified by the First Aid Attendant. The First Aid Person will provide direction and course of action.*

c. *If further medical assistance is required, the First Aid Attendant or designate will contact dial 911 and request an ambulance be dispatched*

9. FIRE EMERGENCY (Evacuate and call 9-911):

To protect yourself, it is important to understand the basic characteristics of fire. Fire spreads quickly so there is no time to gather valuables or make a phone call. In just two minutes, a fire can become life-threatening. In five minutes, a residence can be engulfed in flames. Heat and smoke from fire can be more dangerous than the flames. Inhaling the super-hot air can sear your lungs. Fire produces poisonous gases that make you disoriented and drowsy. Asphyxiation is the leading cause of fire deaths, exceeding burns by a three-to-one ratio.

a. Protective Measures for Fires:

- ✓ Insure smoke alarms are installed, tested and cleaned in accordance with applicable instructions.
- ✓ Ensure Fire Suppression Systems are maintained and tested in accordance with applicable instructions.
- ✓ Ensure Fire extinguishers are in place and serviceable.
- ✓ Accomplish Annual Emergency Fire Drills to prepare employees.

b. Escaping the Fire:

- ✓ Review escape routes with personnel and practice escaping from each room.
- ✓ Ensure security doors and other antitheft mechanisms that could block outside window entry are easily opened from the inside.
- ✓ Remain low to the floor (where the air is safer in a fire) when escaping from a fire.
- ✓ Clean out storage areas. Never allow trash, old newspapers, boxes or magazines to accumulate.

c. Flammable Items:

- ✓ Never use gasoline, benzene, naphtha, or similar flammable liquids indoors.
- ✓ Store flammable liquids in approved containers in well-ventilated storage areas.

d. Fire sources and smoking:

- ✓ Never smoke near flammable liquids
- ✓ Smoke only in designated smoking areas as described below:

Specify:

Provide deep sturdy ashtrays or outdoor approved cigarette/cigar disposal cans.

e. Heating Sources

- ✓ Be careful when using portable heating sources.
- ✓ Ensure space heaters are at least three feet (1 meter) away from combustible materials.
- ✓ Ensure Portable heating devices have a tilt shutoff as well as a timer shutoff.
- ✓ Always unplug Portable Heating Devices when not in use.

f. Electrical Wiring:

- ✓ Ensure electrical wiring is not exposed.
- ✓ Never Daisy Chain extension cords.
- ✓ Inspect extension cords for frayed or exposed wires or loose plugs.
- ✓ Make sure outlets have cover plates and no exposed wiring.
- ✓ Make sure wiring does not run under rugs, over nails, or across high-traffic areas.
- ✓ Do not overload extension cords or outlets. If you need to plug in two or three appliances, get a UL-approved unit with built-in circuit breakers to prevent sparks and short circuits.

g. During a Fire If your clothes catch on fire:

- ✓ Stop, drop, and roll until the fire is extinguished.

10. TERROIST / BOMB / BIOLOGICAL / CHEMICAL / RADIOLOGICALTHREAT EMERGENCY:

a. Remain calm, listen carefully and record the following details:

- ✓ *Time the call was received,*
- ✓ *Details of the threat (Where is the bomb or When it is expected to explode),*
- ✓ *Details of the caller (voice tone – angry, joking, sarcastic, quiet, business-like),*
- ✓ *Background noise (car noise, street noise, television, radio),*
- ✓ *Time the call ended*

c. Notify Local Police Department, Honeywell Management and Security immediately.

Bomb, Chemical and/or Biological Threat Guideline

Detailed DESCRIPTION OF CALLER'S VOICE

Male ______ Female______
Young _____ Middle Aged _____ Older______

_________ Calm _________ Nasal
_________ Angry _________ Stutter
_________ Excited _________ Lisp
_________ Slow _________ Raspy
_________ Rapid _________ Deep
_________ Soft _________ Cleared Throat
_________ Loud _________ Deep Breathing
_________ Laughter _________ Cracked Voice
_________ Crying __________Accent
_________ Normal __________Familiar
_________ Slurred __________Disguised

BACKGROUND SOUNDS

_________ Street _________ Factory
_________ Animal _________ Clear
_________ Voices __________PA System
_________ House __________Traffic
_________ Other

THREAT LANGUAGE

_________*Well spoken* __________ *Incoherent*
_________Foul/ Irrational ________ Read Message?

Ask the below EXACT WORDS upon BOMB THREAT

1. *Where is the device right now?*
2. *What does it look like?*
3. *What kind of a device is it?*
4. *Why are you doing this?*
5. *What is your name?*
6. Are you part of an organization?
7. *Why are you warning us?*
8. What will cause it to activate?

*Person receiving call*____________________________________ *Time Caller hung up*____________
*Phone number at which call was received*____________________ *Date*___________________

11. HAZARDOUS CHEMICALS:

If applicable, identify and list below all hazardous chemical quantities stored on site. Otherwise state "Not Applicable" to this location.

- ✓ **Inside and/or outside locations:**
- ✓ **Quantities of hazardous materials:**
- ✓ **Physical and/or chemical hazards, i.e., asphyxiation hazards**
- ✓ **Hazardous material properties, i.e. flammability, toxicity. Reference location of Safety Data Sheets**

12. INTERNAL HAZARD / CONTROL MEASURES:

Include in this section any process operations that may fail during an emergency event.

Possible Failures	Emergency Control Measure Description

The following are examples of process operations that are addressed in the procedure, but do not need to be part of this section if not applicable to your location: *(Truck/railcar deliveries, transfer of materials, utilities, pollution control devices, control rooms, pipelines, control valves, ventilation systems, boilers, pressure vessels, security access controls, fire protection systems, identify existing engineering control measures to avoid release of hazardous materials).* However, if applicable, prepare emergency control measures for each potential failed process that may apply to your location.

13. EMERGENCY DRILL REQUIREMENTS

a. *Annual Emergency Evacuation Drills*

- ✓ *Drills must be accomplished annually and include different types of Emergency Scenarios as outlined in this Emergency Preparedness Plan*
- ✓ *Upon completion of the Emergency Evacuation Drill use the Critique Form to Document Drill.*
- ✓ *In accordance with Corporate Policy,* once the Emergency Evacuation Drill is complete, forward the Critique Form to regional HSE Manager for entry into the Corporate Event Tracking System.

b. *Annual AED Emergency Drill*

- ✓ *If a location has more than 200 employees an AED is required.* Before making the determination to purchase an AED, contact your Regional Safety Manager.
- ✓ Locations with AEDs must conduct AED drills at least annually on all shifts where AED trained personnel are present. These drills must be documented and must measure the actual response time.
- ✓ When AED drill response times are greater than or equal to 5 minutes, the organization must create a corrective action plan to reduce the response time to less than 5 minutes. *This action plan must be documented in the Corporate Event Tracking System by the HSE Manager*. Corrective actions must include a mechanism for ensuring the response time of 5 minutes or less is met.

14. NATURAL DISASTERS:

a. TORNADO EMERGENCY:

I. Tornado Terms:

- ✓ **Tornado Watch:** Means Tornadoes are possible. Remain alert for approaching storms. Watch the sky and stay tuned to NOAA Weather Radio, commercial radio, or television for information.
- ✓ **Tornado Warning:** A tornado has been sighted or indicated by weather radar. Take shelter immediately.

II. Protective Measures before and during a Tornado:

- ✓ Listen to NOAA Weather Radio or to commercial radio or television newscasts for the latest information & remain alert.
- ✓ Look for approaching danger signs such as a dark greenish sky or dark low-lying cloud with rotation or evidence of large hail.
- ✓ Listen for a loud roar, similar to a freight train.
- ✓ If you see approaching storms or any of the danger signs, be prepared to take shelter immediately or if you're under a tornado WARNING, seek shelter immediately!
- ✓ If inside an enclosed structure such as a small building, school, nursing home, hospital, factory, shopping center or high-rise building, go to a pre-designated shelter area such as a safe room, basement, storm cellar, or the lowest building level. If there is no basement, go to the center of an interior room on the lowest level (closet, interior hallway) away from corners, windows, doors, and outside walls. Put as many walls as possible between you and the outside. Get under a sturdy table and use your arms to protect your head and neck. Do not open windows.
- ✓ If outside with no shelter lie flat in a nearby ditch or depression and cover your head with your hands.
- ✓ Watch out for flying debris. Flying debris from tornadoes causes most fatalities and injuries.

b. HURRICANE/CYCLONE EMERGENCY:

I. Hurricanes Terms:

- ✓ **Hurricane/Cyclone and Tropical Storm Watch**: Hurricane/tropical storm conditions are possible in the specified area, usually within 36 hours. Tune in to NOAA Weather Radio, commercial radio, or television for information.
- ✓ **Hurricane/Cyclone and Tropical Storm Warning**: Hurricane/tropical storm conditions are expected in the specified area, usually within 24 hours.

II. Hurricane/Cyclone Protective Measures before and during a Hurricane:

- ✓ Make plans to secure property by closing all windows, doors and roof vents if possible.
- ✓ Determine a safe room / location for shelter.
- ✓ Listen to the radio or TV for information.
- ✓ Turn off utilities if instructed to do so.
- ✓ Evacuate building if directed by local authorities and be sure to follow their instructions.

c. EARTHQUAKE EMERGENCY:

I. Protective Measures before and during an Earthquake:

- ✓ *Keep your cool, avoid panic and confusion and ride out the motion.*
- ✓ *Take cover under a sturdy desk, table, or bench or against an inside wall, and hold on. If there isn't a table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building.*
- ✓ *Stay away from glass, windows, outside doors and walls, and anything that could fall, such as lighting fixtures or furniture.*
- ✓ *Use a doorway for shelter only if it is in close proximity to you and if you know it is a strongly supported, load bearing doorway.*
- ✓ *Remain inside until shaking stops and it is safe to go outside. Most injuries during earthquakes occur when people are hit by falling objects when entering into or exiting from buildings.*
- ✓ *Be aware that the electricity may go out or the sprinkler systems or fire alarms may turn on.*
- ✓ *Do not use elevators during an Earthquake.*

II. Post Earthquake Protective Measures: *Being prepared for aftershocks are extremely important. Even though secondary shockwaves are usually less violent, they can be strong enough to cause additional damage to already weekend structures.*

- ✓ *Check for injuries amongst those around you. Notify First Aid of injured persons as soon as safe to do so. Do not move the seriously injured unless they are in immediate danger. Try and keep the injured warm.*
- ✓ *Contact local emergency resource centers such as the hospital or fire department as required for injuries or fire concerns or call 9-911.*
- ✓ *Stay away from damaged areas unless your assistance has been specifically requested by police, fire, or relief organizations*
- ✓ *Listen for sounds or smell of leaking gas and exit building if the smell of gas apparent.*
- ✓ *Be aware of possible tsunamis if you live in coastal areas. These are also known as seismic sea waves (mistakenly called "tidal waves"). When local authorities issue a tsunami warning, assume that a series of dangerous waves is on the way. Stay away from the beach.*
- ✓ *Always open cabinets cautiously as objects may have shifted causing falling hazards.*
- ✓ *Never leave the worksite area unless you have advised your Site Manager. You may be jeopardizing your safety (bridge or road damage, et cetera) as well as create traffic congestion for emergency vehicles.*
- ✓ *If evacuation is ordered, leave by the nearest emergency exit and report directly to your designated assembly/rally point.*

d. VOLCANO EMERGENCY:

I. Protective Measures before and during a Volcanic Eruption:

- ✓ Monitor local radio stations and News Broadcasts

- ✓ Ensure the building / office ventilation system is turned off. This will keep ash particulates from entering building.
- ✓ Cover sensitive equipment with plastic sheets to keep ash particulates from entering parts.
- ✓ Evacuate immediately from the volcano area to avoid flying debris, hot gases, lateral blast and lava flow.
- ✓ Wear long-sleeved shirts and long pants.
- ✓ Use goggles and war eyeglasses instead of contact lenses.
- ✓ Use a dust mask or hold a damp cloth over your face to help with breathing.
- ✓ Stay away from areas downwind from the volcano to avoid volcanic ash.
- ✓ Stay indoors until the ash has settled unless there is a danger of the roof collapsing.
- ✓ Close doors, windows and turn off all ventilation systems.

e. TSUNAMI EMERGENCY:

I. Understanding Tsunamis Terms:

- ✓ Advisory: An earthquake has occurred in the Pacific basin, which might generate a tsunami.
- ✓ Watch: A tsunami was or may have been generated, but is at least two hours travel time to the area in Watch status.
- ✓ Warning: A tsunami was, or may have been generated, which could cause damage; therefore, people in the warned area are strongly advised to evacuate.

II. Tsunami Protective measures before and during a tsunami event:

- ✓ Turn on your radio to learn if there is a tsunami warning if an earthquake occurs and you are in a coastal area.
- ✓ Move inland to higher ground immediately and stay there.
- ✓ **Visual Indication of Imminent Tsunami** - Strong Earthquake lasting 20 seconds or more where it is difficult to stand or walk or the water level at the beach begins receding / being pulled back into the ocean.

15. Insert PDF of Building Evacuation Map and Location of Fire Extinguishers on Following Page

Insert PDF map on here or on next page