Improving and Tracking Energy Performance in School Facilities

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Introduction

- Facilities are the 2nd Largest Expenditure in Budget
- Discuss How to Determine and Compare Facility Performance
- Discuss How and Why to Track Efficiencies
- Discuss No Cost, Low Cost and High Cost for improving energy efficiencies

Evaluating Facility Performance

- Benchmarking - Baseline
- Energy Usage Index (EUI)
- EPA Energy Star Rating

Energy Usage Intensity

- EUI - Energy Usage Intensity
  - Annual Building Energy Use/ Building Area (kBTU/FT^2)
  - Lower Values are Better
  - True “MPG” of Facility
  - Typical Range 25 – 180 for School Facilities
  - Smaller Facilities Typically have Larger EUI

EPA Energy Star Rating

- Compares energy performance of similar type and vintage buildings nationwide – 55k School Facilities
- Ratings of 0 – 100 (Higher is better)
  - A rating of 70 means the facility is performing better than 70% of the similar buildings but not as well as 30%
- A Rating of 75 or above qualifies for an Energy Star Award – Verification Required
- Also Calculates EUI

Programs to Track Utilities and Performance

- EPA Energy Star Portfolio Manager – Free
  - Provides Energy Star Rating and EUI
- School Dude Energy Manager – Not Free
  - Provides Energy Star Rating and EUI
- Energy Education – Not Free
- Microsoft Excel
  - You Design it
  - WVDE Can Provide a Template
- Many Others

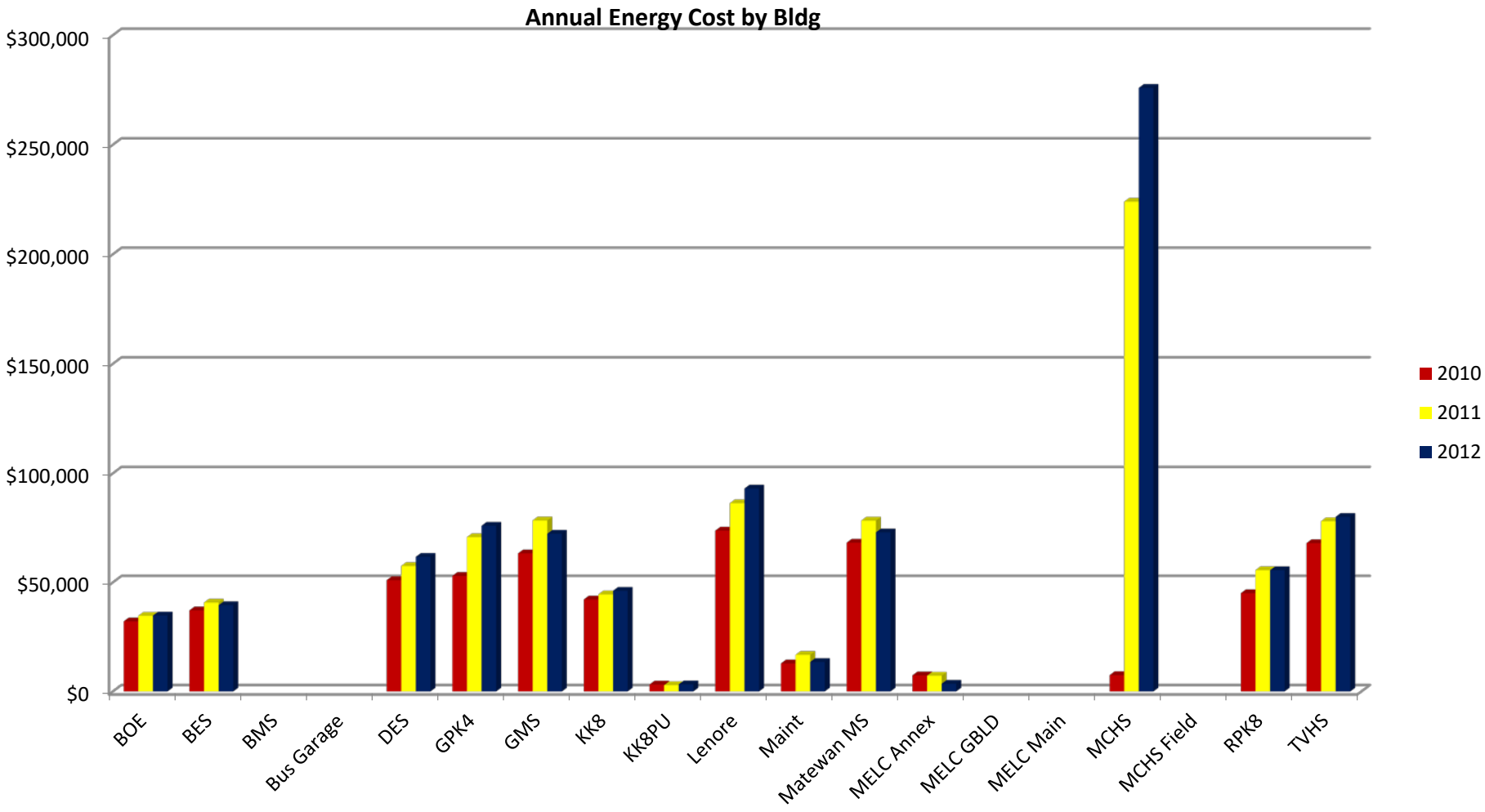
Why Track Energy Performance?

- Allows Energy Performance Comparison of Facilities
- Proves or Disproves that Improvements have Increased Energy Performance as Expected
- Identifies Lower Performing Facilities for Equipment Upgrade Consideration
- Provides Disclosure and Accountability
- Indicates Operational Issues Faster

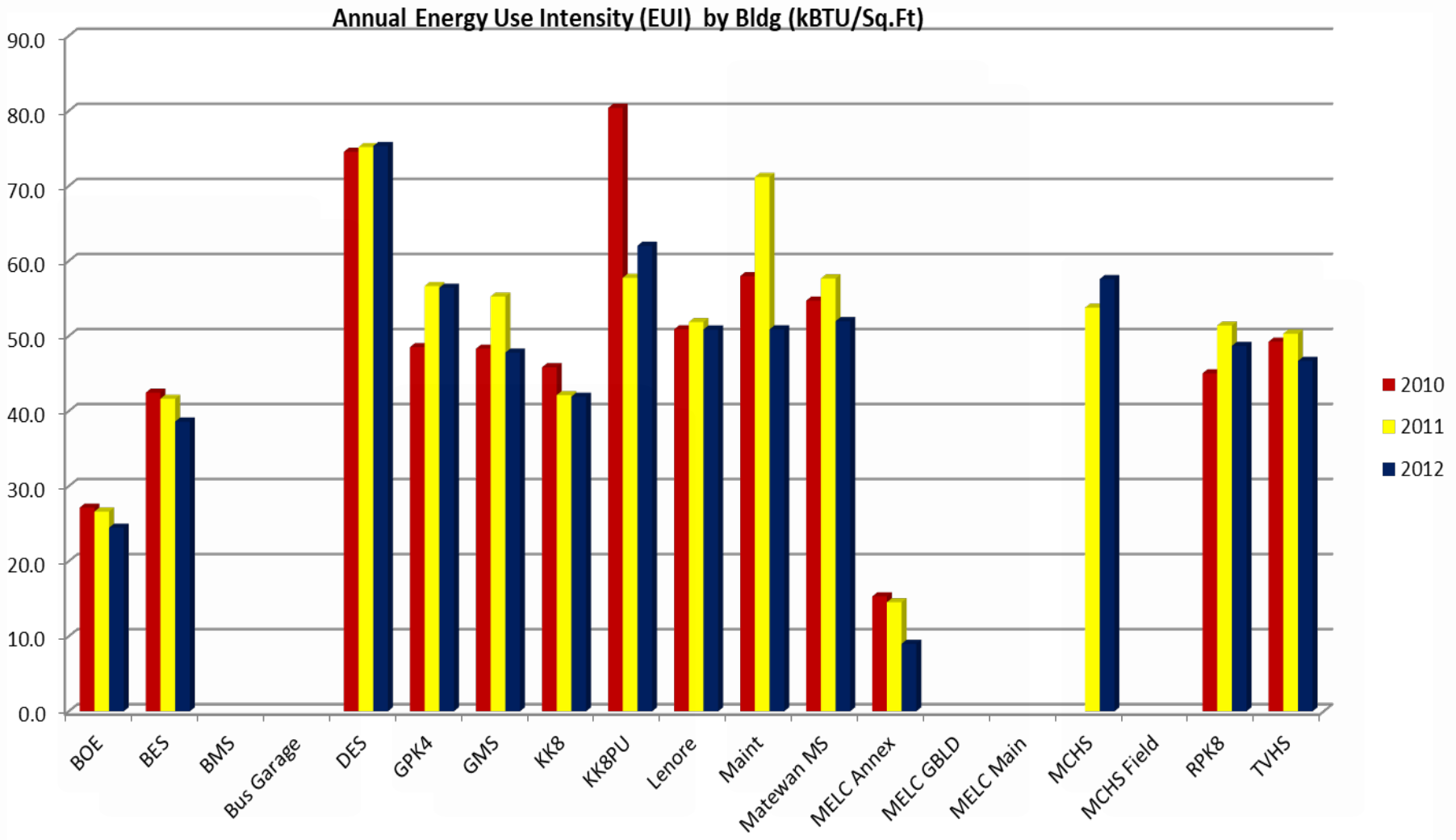
SBA Quality &Performance Standards Requirement

- Section III - BUILDING DESIGN CRITERIA
- 3. The design professionals shall study and analyze various building technologies to provide the most efficient, cost effective, energy efficient and maintainable building systems. **All new schools and schools with total HVAC replacements will maintain historic utility records of electricity, natural gas or other primary fuel usage and provide annual reports to the SBA and WVDE Office of School Facilities that provide the utility cost per square foot and KBTU cost per square foot for the project. SBA funded projects of this type shall be bench marked and this data shall be maintained in the EPA's Portfolio Manager. This information shall be reported annually with the CEFP annual update.**

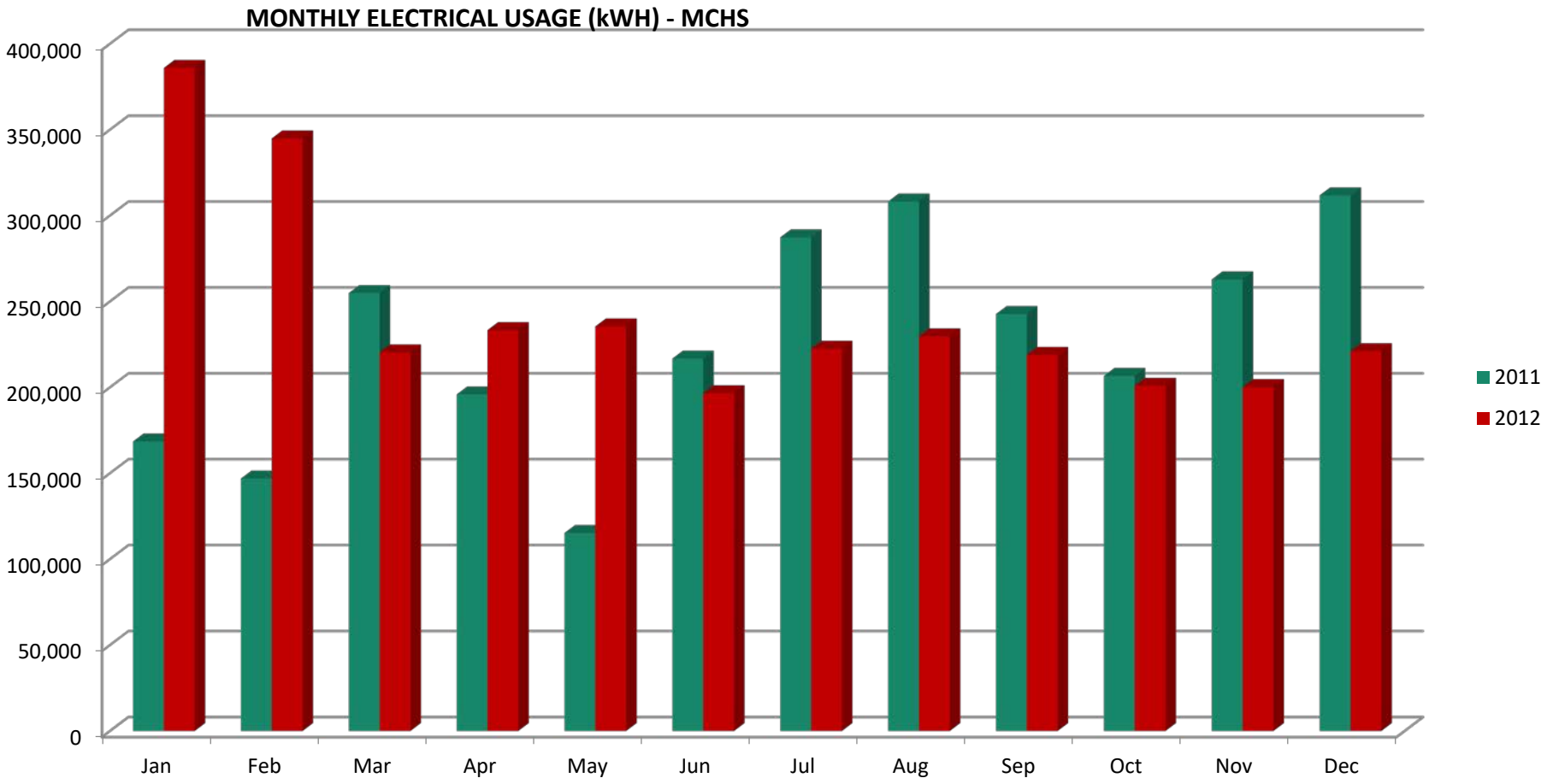
Compare Annual Energy Cost



Compare Annual EUI



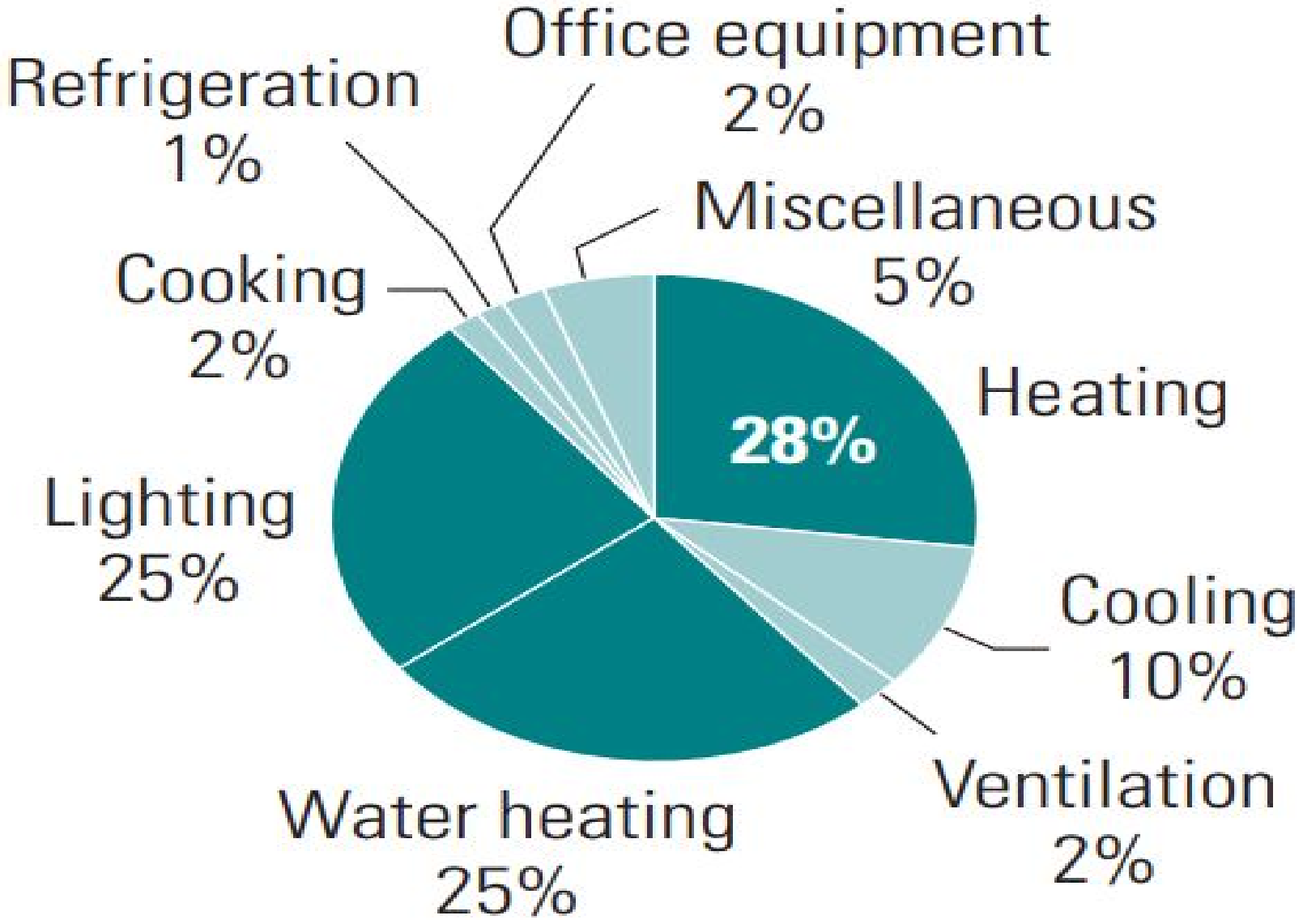
Compare Monthly Usage



How To Start

- Benchmark the Facility
  - At Least One Year of Utility Data
  - Get Total Floor Area
  - Pick a Program to Track the Data
  - Set Up Sites on Energy Star or School Dude
  - Import Utility Information
  - Sets Baseline for Future Comparisons

Climate zone 3



No Cost Improvements

- Behavioral Changes
  - Turn off Lights, Equipment
  - Remove Personal Refrigerators ($35 - $50 per Year)
  - Operation of thermostat
- Operational Changes
  - Use Reasonable Schedules
  - Utilize Holidays /Special Event Schedules
  - Use Night Set Back on BAS and Thermostats
  - Set Correct Date and Time
  - Eliminate Overrides – Lock Out Controls
  - Ensure Outdoor Lights are Off During Daylight Hours

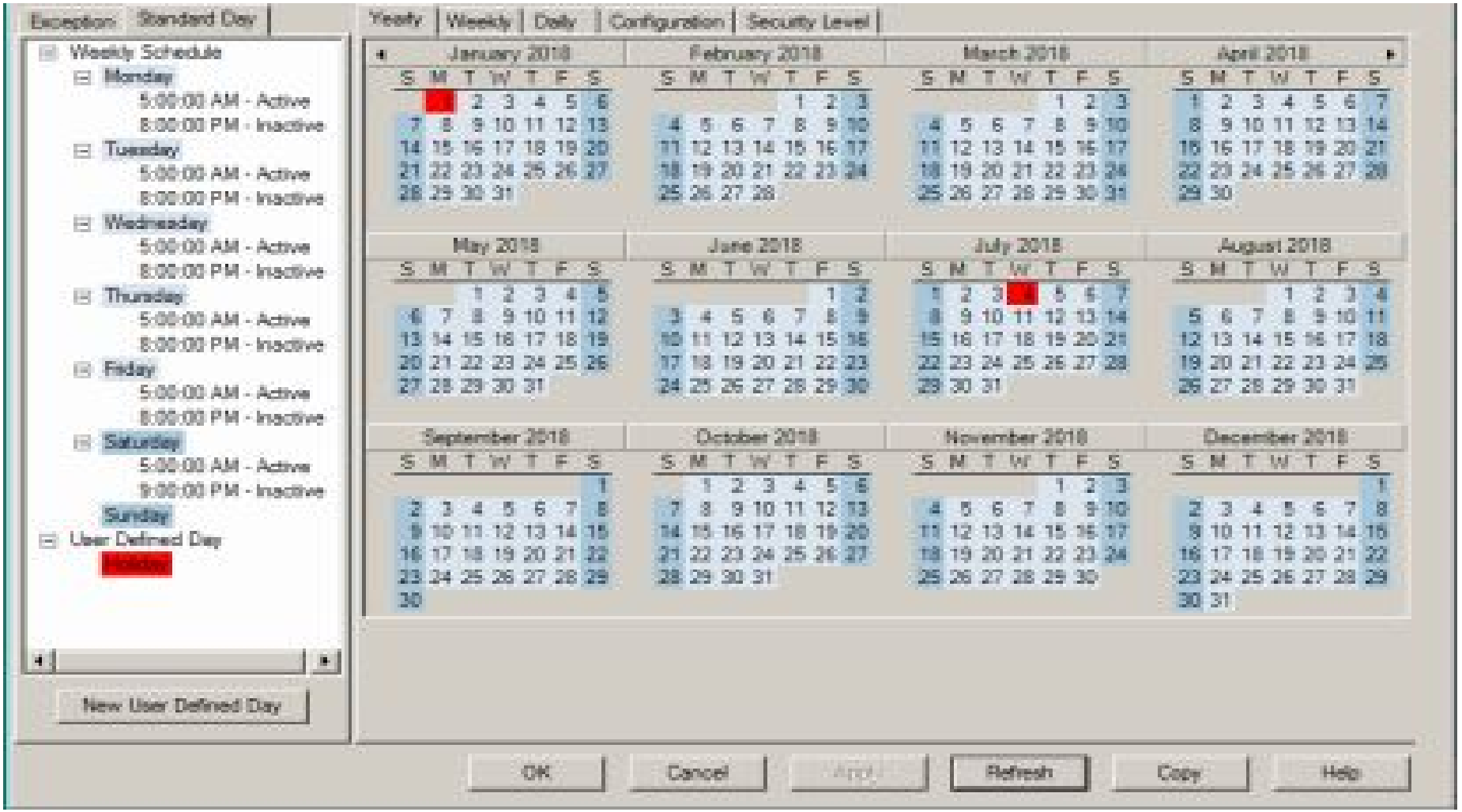
Summer Time Usage – No Cost

- Close Outside Air dampers
- Turn up T-stats to maintain 78°F
- Unplug Vending Machines
- Empty Classroom Refrigerators and Unplug
- Turn off Domestic Water Heaters & Recirc. Pumps
- Turn off Computers and Copiers
- Turn off Exhaust Fans
- Review outside lighting schedules

Schedules

- Holidays
- Snow Days
- Half Days
- Weekends
- Partially Occupied Facilities
- Vacation Breaks
- 180 Student Days – 185 Atypical Days

Scheduling Issues – No Cost



Schedules – No Cost

Review the Weekly HVAC schedules

- Who has decided these schedules, are they qualified to make this decision?
- Can the hours be reduced?
- Can the hours of certain days be reduced?
- Are weekend, holiday and snow day schedules used?
- Are there individual schedules for specialized areas?

Scheduling of Areas

Areas that benefit by having individual scheduling and control

- Gymnasium
- Auditorium
- Kitchen
- Cafeteria
- Band Room
- Library
- Classrooms by Floor or by Wing
- Classrooms Grouped by OA Supply Equipment
- Classrooms Independently Controlled

No Cost Performance Improvements

- Verify Outdoor Air Supply
- Turn Off Outside Air During Unoccupied Periods
- Performance Contracting
  - No Out of Pocket Cost
  - Uses Savings from Utilities to Pay for Project
- Reconcile Meters
- Review Tariff Rates
- Vending Machines
- Kitchen Freezers/Coolers – Empty During Summer Break

Performance Contracting

- Upgrades Paid by Savings from Utilities
- Upgrades Lights
- Upgrades Controls
- Replaces Inefficient/Older HVAC Units
- Installs Water Saving Devices
- Can Partner with SBA for Low Payback Items – Windows, Boilers, Roofs etc.,.

	EUI Pre	EUI Post	%Change
Ashton Elementary	50.46	23.55	53%
Beale Elementary	72.00	56.93	21%
Leon Elementary	50.19	23.17	54%
New Haven Elementary	49.82	29.18	41%
Point Pleasant Intermediate	73.60	50.13	32%
Point Pleasant Elementary	48.30	26.63	45%
Roosevelt Elementary	105.29	59.27	44%
Hannan Jr./Sr. High School	75.77	53.68	29%
Point Pleasant Jr./Sr. High School	54.89	41.69	24%
Wahama Jr./Sr. High School	85.26	54.43	36%

*EUI is presented as total kBtu/sqft

Low Cost

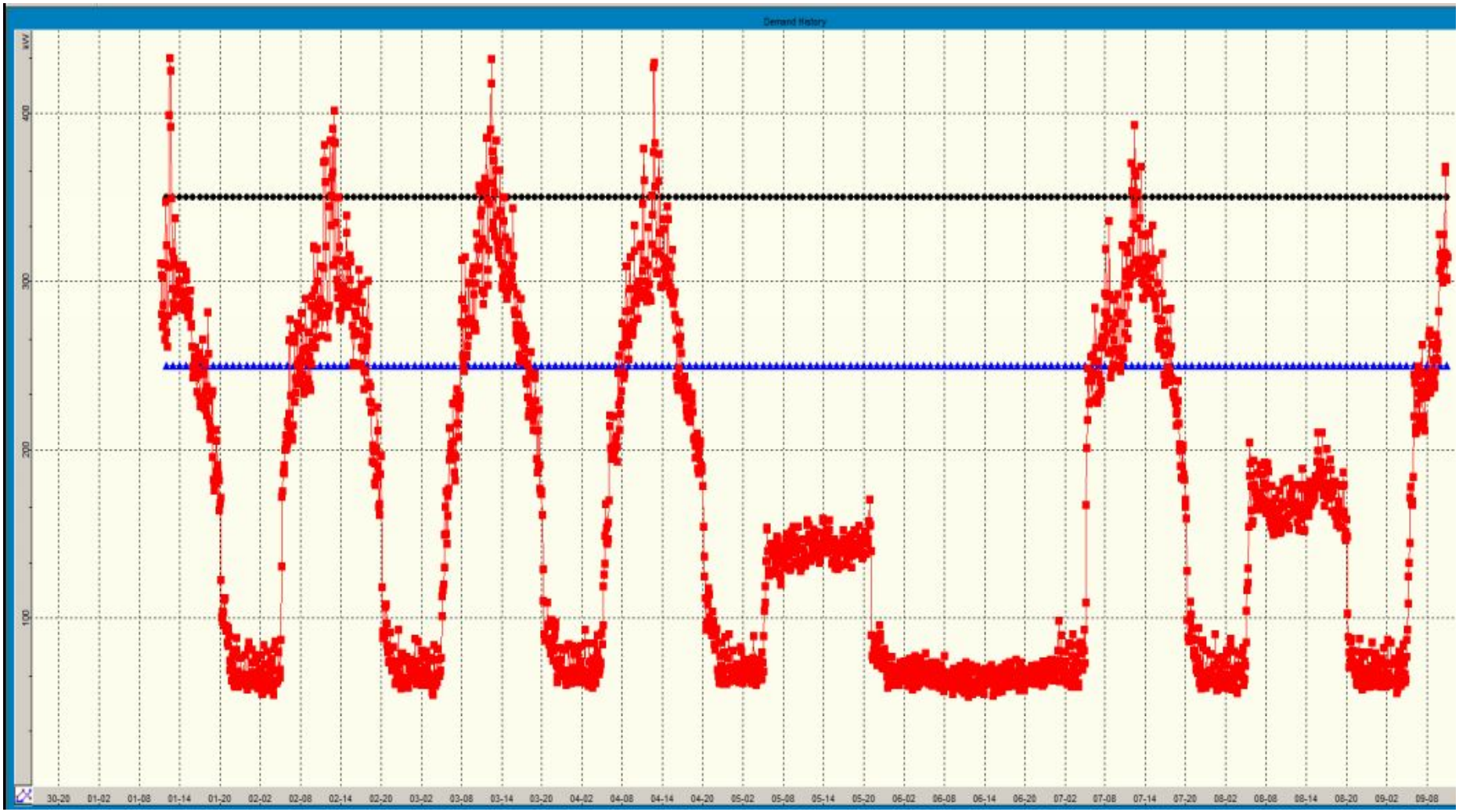
- Preventive Maintenance
- Water Treatment - Prevents Scale, Rust and Microbio Fouling
- Lighting Upgrades - 1 to 2 Year ROI
- Turn off Domestic Water Heaters Afterhours
- Reduce Domestic Hot Water Storage
- Retro Commissioning
  - $.05 - $.40 per Ft^2
  - .7 to 1.5 Year ROI
  - 16% Average Energy Savings

Scale Buildup – Reduces Efficiency by 50%

High Cost > $5000

- Controls Upgrades
- Electrical Demand Control
- Window Upgrades, Reduce Area
- Upgrade Motors - 2 Yr ROI
- Demand Control Ventilation - (CO_2 Sensors)
  - < 1 Yr ROI
  - Reduces Mean Outside Air Flow by 40%
- Reflective Roofing 15-20% Cooling load

Typical Electrical Demand Profile

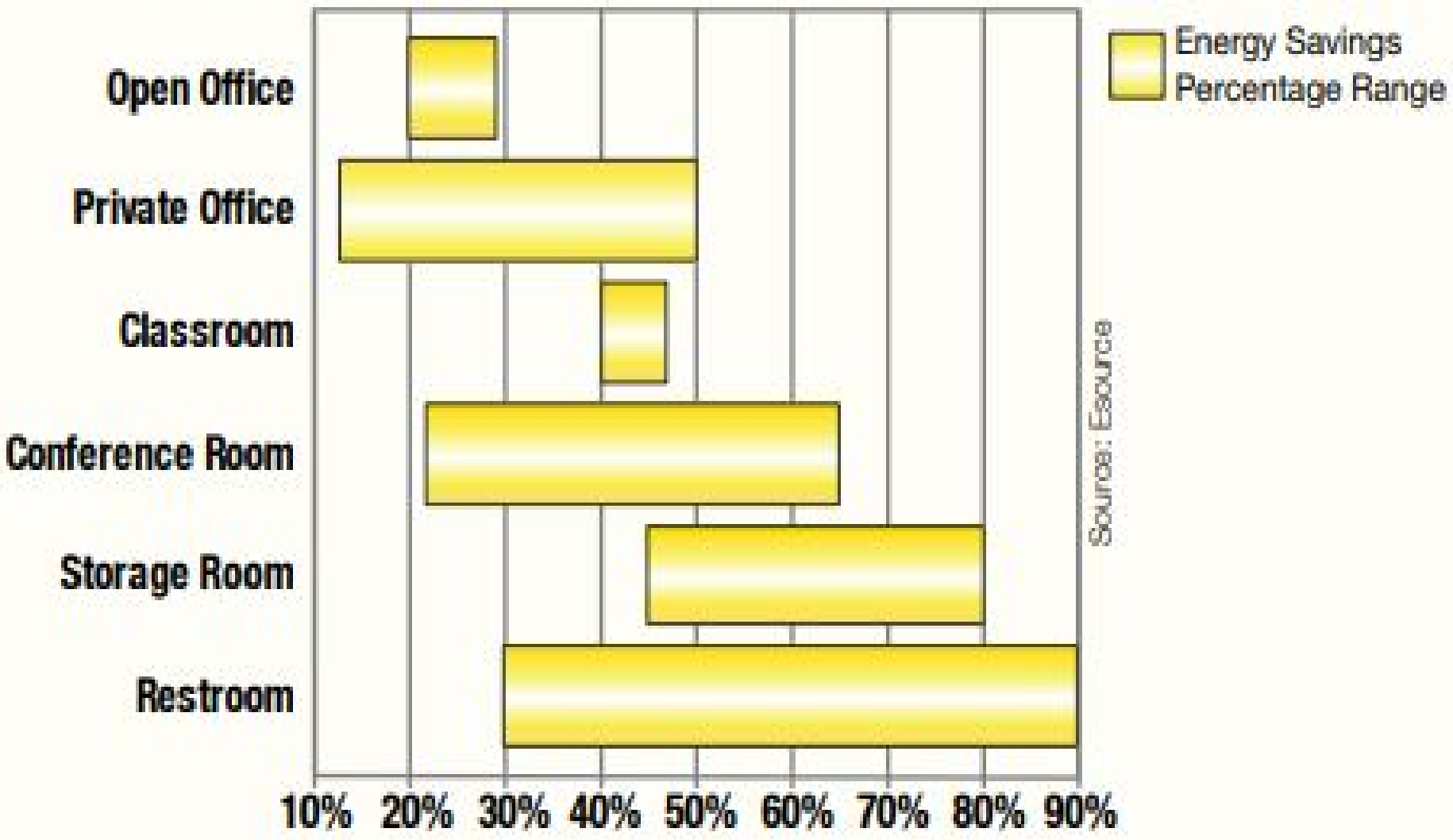


Lighting Efficiency

Lamp Type	Comp.	Life(Yrs)	Annual Cost
• T12	0%	5	$27.92
• T12 vs T8	25%	5-15	$22.18
• T12 vs T5	50%	5-15	$14.66
• T12 vs LED	70%	12-20	$11.28
• MH vs LED	75%		

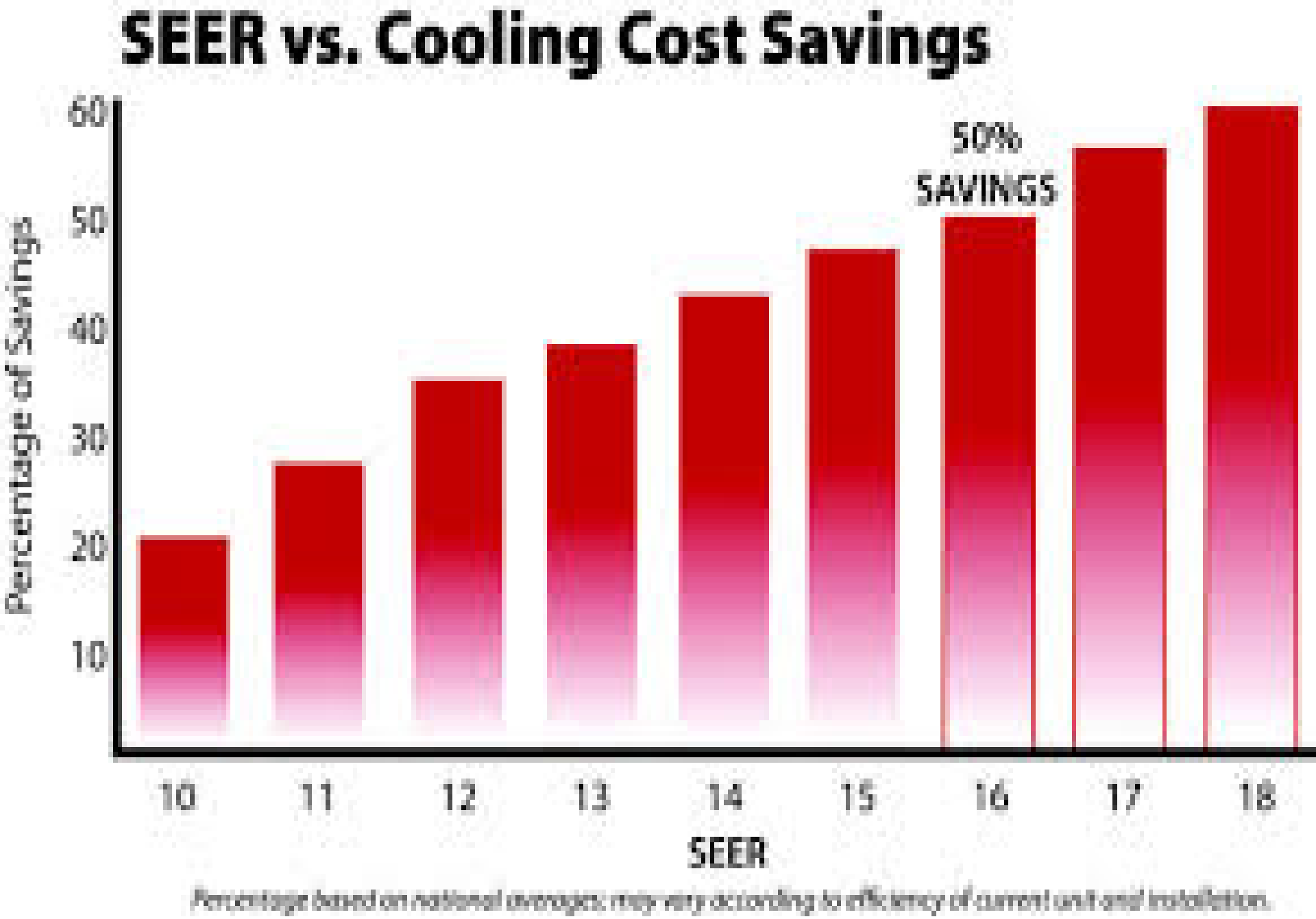
12 Hrs/Day at $.094/kWh

Potential Energy Savings Using Occupancy Sensors



Seasonal Energy Efficiency Rating

SEER Rating History	
Before 1980	6 or less
1980 to 1985	7 or less
1986 to 1991	8 or less
1992 to 2005	10 to 12
2006 to 2014	13 or more
2015 to present	14 or more


SEER vs. Cooling Cost Savings
Percentage of Savings
60
50
40
30
20
10
50%
SAVINGS
10
11
12
13
14
15
16
17
18
SEER
Percentage based on national averages; may vary according to efficiency of current unit and installation.

Other Energy Saving Efforts

- Water/Air Balance System Components
- Recover Energy Costs for Non School Activities
- Calibration of Outside Air Temperature and Humidity Sensors
- Solar Films on Windows
  - Reflects 78% of Solar Heat
  - 2-5 Yrs ROI
  - $5 - $7 per Sq. Ft^2
- Install Variable Speed Drives on Cooling Towers

Fuel Conversions

Fuel	Unit =	BTU or	kBTU
• Natural Gas	1 MCF	1,037,000	1,037
• Electricity	1 kWH	3412.14	3.412
• Propane	1 Gallon	91,333	91.333
• #2 Fuel Oil	1 Gallon	138,500	138.5
• Coal	1 Ton	27,790,252	27,790

Questions or Comments

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Energy Data for Miscellaneous School Sites

	Construction Date	County	Site Name	Type	EUI Rating	Energy Star	Notes
1		Grant	Grant Co Bus Garage	Aux	22.9		
2		Mingo	Mingo Maintenance Shop	Aux	71.2		
3		Berkeley	Bus Garage	Aux	75.6		
4		Barbour	Bus Garage	Aux	191.8		
5		Grant	Grant CO BOE	BOE	20.2		
6		Barbour	Barbour BOE	BOE	25.8		
7		Berkeley	Board of Education	BOE	54.6		
8		Lewis	Lewis CO BOE	BOE	114.9	37	
9		Berkeley	Opequon Elementary	Elementary	24.6	100	Geothermal
10		Berkeley	Tuscarora Elementary	Elementary	25.9	86	Geothermal
11		Berkeley	Valley View Elementary	Elementary	26.4	100	Geothermal
12	1953	Webster	Webster Springs Elem	Elementary	28.3	97	Geothermal
13		Barbour	Kasson Elem	Elementary	34.1		
14		Berkeley	Berkeley Heights Elementary	Elementary	35.5		Geothermal
15		Barbour	Junior Elem	Elementary	35.8		
16		Berkeley	Rosemont Elementary	Elementary	38.0		Geothermal
17		Barbour	Philippi Elem	Elementary	40.9		
18		Berkeley	Gerrardstown Elementary	Elementary	41.0		Geothermal
19		Berkeley	Inwood Primary School	Elementary	41.1	100	
20		Berkeley	Bedington Elementary	Elementary	41.2	100	
21		Mingo	Burch Elementary	Elementary	41.6		
22		Berkeley	Bunker Hill Elementary	Elementary	42.1	99	
23		Berkeley	Back Creek Valley ES	Elementary	43.5	94	
24		Berkeley	Marlowe Elementary School	Elementary	43.7	100	
25		Lewis	Roanoke Elementary	Elementary	44.7	97	
26		Berkeley	Spring Mills Primary	Elementary	47.6		Geothermal
27		Grant	Petersburg Elem	Elementary	49.8		
28		Barbour	Belington Elem	Elementary	50.7		
29		Berkeley	Hedgesville Elementary School	Elementary	51.0		
30		Grant	Maysville Elem	Elementary	53.2		
31		Berkeley	Winchester Avenue Elementary	Elementary	54.2	90	
32		Mingo	Gilbert PK 4	Elementary	56.7		

Energy Data for Miscellaneous School Sites

	Construction Date	County	Site Name	Type	EUI Rating	Energy Star	Notes
33		Berkeley	Burke St. Elementary	Elementary	58.3	91	
34		Lewis	Leading Creek Elementary	Elementary	60.9	33	
35	1976	Webster	Glade Elementary	Elementary	61.6	17	
36		Lewis	Peterson Central Elementary	Elementary	63.7	52	
37		Mingo	Dingess Elementary	Elementary	75.2		
38	2007	Webster	Hacker Valley Elementary	Elementary	78.1	18	
39		Lewis	Jane Lew Elementary	Elementary	87.2	32	
40	1974	Webster	Webster Co High/MS	High	43.1	45	Geothermal
41		Berkeley	Martinsburg High	High	46.2		
42		Berkeley	Spring Mills High	High	47.6		
43		Mingo	Tug Valley HS	High	50.4		
44		Grant	Petersburg High	High	51.7		
45		Mingo	Mingo Central HS	High	53.8		
46		Lewis	Lewis CO High	High	61.3	37	
47		Berkeley	Musselman High School	High	68.6		
48		Berkeley	Hedgesville High	High	70.2		
49		Grant	Union Educational Complex	High	76.2		
50		Barbour	Philip Barbour HS*	High	109.2		Shared Gas Meter
51		Berkeley	Mill Creek Intermediate	Intermediate	23.4	100	Geothermal
52		Berkeley	Orchard View Intermediate	Intermediate	41.2		
53		Berkeley	Tomahawk Intermediate	Intermediate	45.9		
54		Berkeley	Potomack Intermediate	Intermediate	46.5	80	
55		Berkeley	Mountain Ridge Intermediate	Intermediate	48.9		
56		Berkeley	Eagle Intermediate	Intermediate	57.1	79	
57		Barbour	Belington MS	Middle	26.8		
58		Barbour	Philippi MS	Middle	28.5		
59		Berkeley	Hedgesville Middle School	Middle	39.4	99	
60		Mingo	Kermit K-8	Middle	42.1		
61		Berkeley	Spring Mills Middle	Middle	47.1		
62		Berkeley	South Middle School	Middle	49.0	93	
63		Mingo	Riverside PK-8	Middle	51.4		
64		Mingo	Lenore K-8	Middle	51.9		

Energy Data for Miscellaneous School Sites

	Construction Date	County	Site Name	Type	EUI Rating	Energy Star	Notes
65	1952	Randolph	Elkins MS	Middle	52.6	88	
66		Mingo	Gilbert Middle	Middle	55.3		
67		Mingo	Matewan MS	Middle	57.7		
68		Berkeley	Musselman Middle School	Middle	61.0		
69		Berkeley	Mountain Ridge Middle	Middle	67.0		
70		Lewis	Robert L. Bland MS	Middle	79.9	27	
71		Berkeley	North Middle	Middle	101.6		
72		Mingo	Kermit K-8 Portable Unit	Portable	57.8		
73		Barbour	Barbour CTC Annex*	Vocational	11.5		Shared Gas Meter
74		Barbour	Barbour CTC*	Vocational	21.2		Shared Gas Meter
75		Berkeley	Pikeside Learning Center	Vocational	40.6	99	
76		Berkeley	Ramer Center	Vocational	65.6	83	
77							
78							
79							
			* - Common Gas Meter for 3 Sites	Average	52.7		