

MSBO – Technology for Operational Management

Utility Tracking – Key Activities



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About Ameresco

Ameresco, Inc. (NYSE:AMRC) is a leading cleantech integrator and renewable energy asset developer, owner and operator.

Founded in 2000 | Public in 2010



Comprehensive Portfolio

Objective approach and in-house technical expertise delivers the most advanced technologies to meet the unique needs of each customer. Majority of projects are budget-neutral, funded by energy cost savings.

Customer Driven

Federal Government, Public Sector, Higher Ed, K12, Healthcare, Manufacturing & Commercial Services, Housing & Community Development, Transportation, and Utilities. Market reputation across North America & Europe for excellence in customer satisfaction.



\$11+ Billion in energy solution projects,
340+ MWe of Owned Assets in Operation



1,000+ Employees throughout United States, Canada, UK and Europe



60+ Offices providing local expertise in markets served



8,000+ Customers benefitting from energy efficiency measures and renewable energy generation



Up to 45% Energy cost savings with comprehensive, audit- based improvements



In 2021, our renewable energy assets and customer projects delivered a carbon offset equivalent to **~13.6M metric tons of CO₂**



Jarret Kelley



Andrew Hascher

Why Ameresco?



Innovative

Ameresco (NYSE:AMRC) is an innovative cleantech integrator with a comprehensive portfolio of energy efficiency and renewable energy solutions.



Experts

We deliver a broad and deep solution portfolio within a single energy partner. From design and development to financing and construction, our in-house technical expertise sets us apart.



Independent

Our objective approach enables us to implement the most advanced technologies to meet the unique needs of each customer.

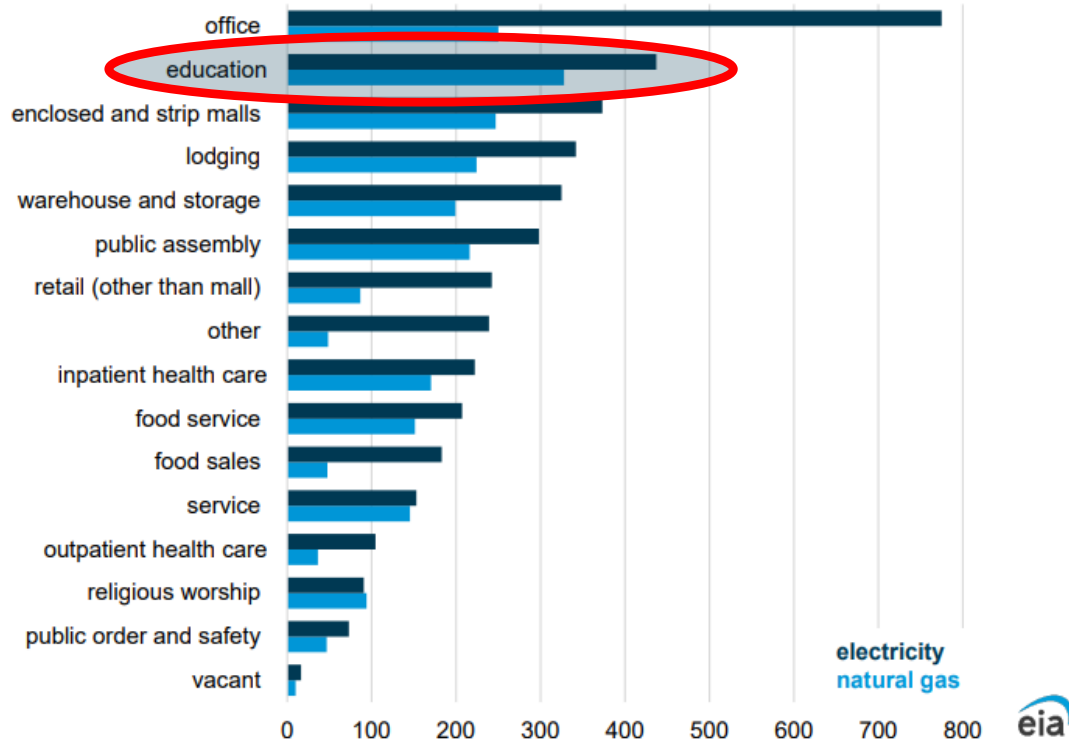


Presentation Objectives

- ❑ Discuss importance of employing utility & energy management best practices in your school district
- ❑ Provide proven framework for implementing a high-performance utility & energy management program
- ❑ Share energy management case studies, best practices and ideas for getting started today

Challenges Facing Administrators

Electricity and natural gas consumption by principal building activity, 2018
trillion British thermal units



Data source: U.S. Energy Information Administration, *Commercial Buildings Energy Consumption Survey*

**“Education wastes \$2.4B a year in energy
an amount equivalent to 40M text books”**

- ❑ K-12 spends nearly \$8B in energy per year with 30% inefficiency, 2nd largest expense to salaries (DOE).
- ❑ Education sector uses the most natural gas per SF and the 2nd most electricity (see left).
- ❑ Aging facilities combined with limited school budgets result in an estimated \$270 billion needed for deferred maintenance.
- ❑ Funding is tight and schools struggling to pay for repairs and renovations
- ❑ Everyone wants to be “Green” but not go in the “Red”
- ❑ Facility staff has poor visibility into energy consumption

Other Important Factors to Consider

External Factors

- Increasing Utility Costs (+)
- Compliance with Regulations (+)
- New & Emerging Technologies (-/+)

Administrative Factors

- Year Round Facility Access (+)
- Computer Based Programs (+)
- Facility Closures/New Schools (-/+)

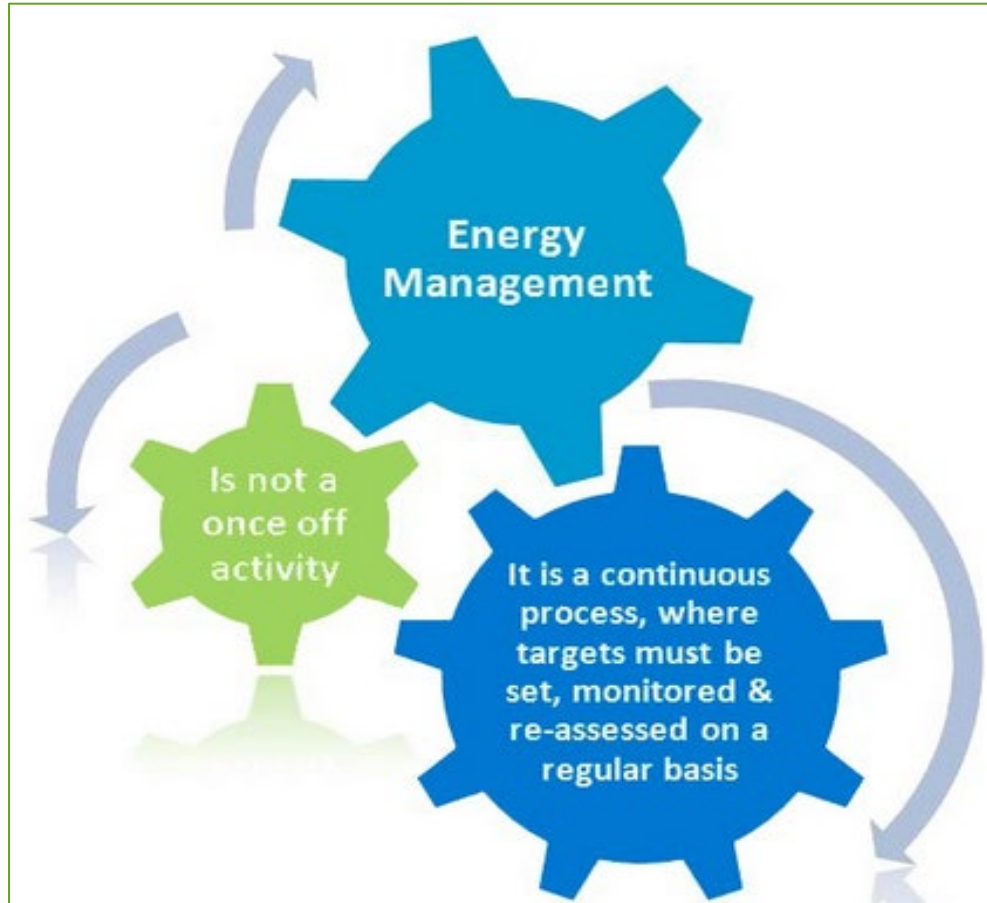
Design Factors

- LEED Building Designs (-)
- Renewable Energy Options (-)
- Value Engineering at EE Expense (+/-)

Budget Factors

- Deferred Maintenance Issues (+)
- Community Reluctance to Levy (+)
- Reduced General & Sinking Funds (+)

What is Energy Management



**The Three C's of Energy Management:
Cost, Consumption, Carbon**

- ☐ Process of monitoring, controlling, and managing the Three C's
- ☐ The Three C's – Cost (\$/sq ft), Consumption (BTU/Sq Ft), and Carbon (Tons Co₂)
- ☐ Human Element– People need be educated and engaged
- ☐ Equipment Element – Building infrastructure needs controlled, maintained, and monitored
- ☐ Process Improvement Element – Not a one time project or activity. It's a continuous process

Energy Management Benefits



Less Efficient Schools: 3x more energy, spend \$60-\$100 more per student and have less \$\$\$ for classroom education

- ☐ 5%-15% energy savings reduction by implementing low cost/no cost measures (per DOE)
- ☐ 15%-40% energy savings reductions by implementing an energy efficiency project / performance contract
- ☐ Energy management can help administrators create positive public image
- ☐ Active energy management help contributes to reducing fossil fuel usage and emissions
- ☐ Serves as an educational tool and models positive behaviors for students if applicable

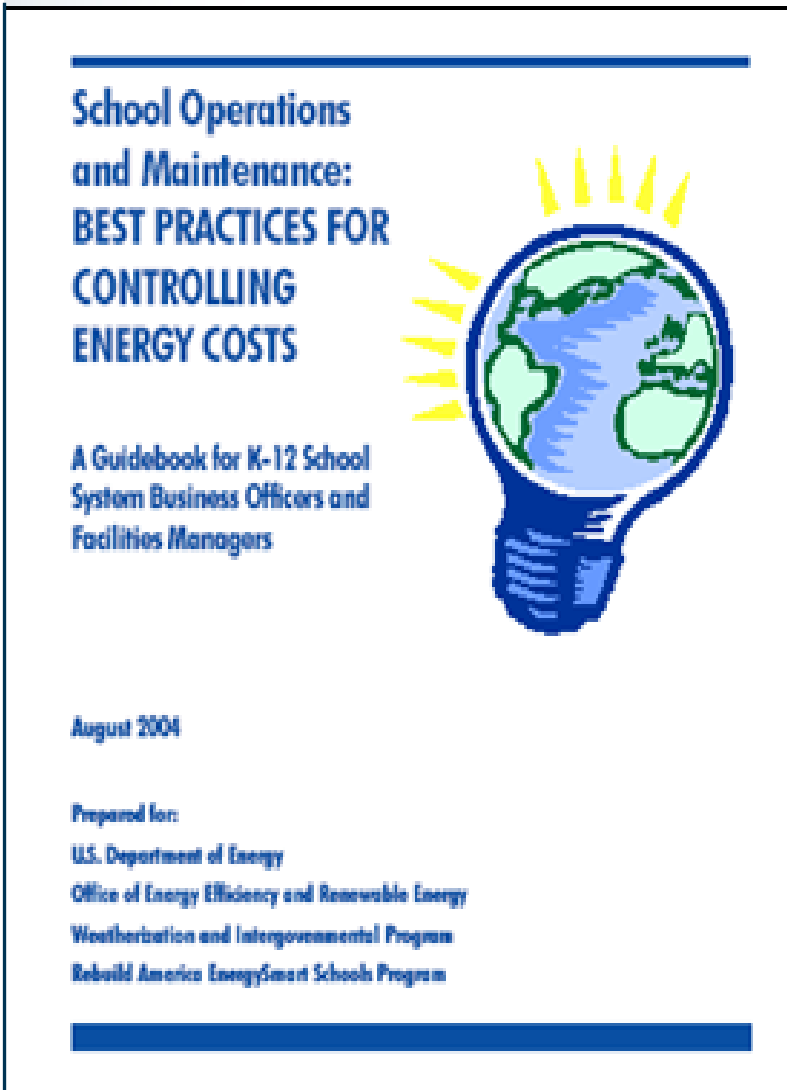
Energy Management Cornerstones



A good energy management framework needs to address people, process, technology and change

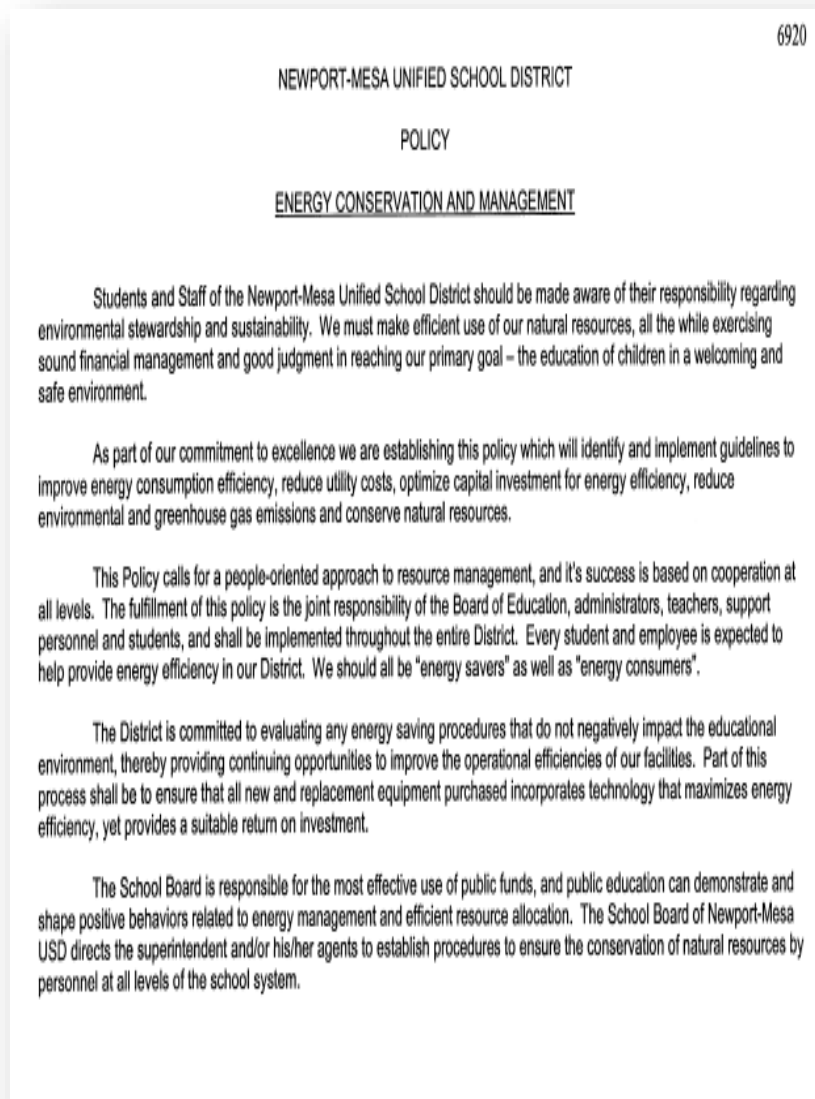
- ☐ Executive Buy-In
 - ▶ Creating a top-down approach to creating and implementing behavioral change
- ☐ Energy Management System
 - ▶ Having a tool to proactively collect, analyze and act on energy management data
- ☐ Facility Improvement
 - ▶ Using tools to continuously track, monitoring, and improve the performance of your energy systems
- ☐ Empowering People
 - ▶ Empowering people to embrace and evangelize the power of energy efficiency

Cornerstone #1: Executive Buy-In



- ☐ Culture is created and driven from the top down
- ☐ Needs to be put in writing in the form of a policy, program or charter
- ☐ Needs revisited several times per year
- ☐ At a minimum it needs to state:
 - ▶ Rising utility, operations and maintenance costs are a concern
 - ▶ A plan will be prepared and implemented
 - ▶ Specific energy management goals will be obtained
 - ▶ The Administration is authorizing the Energy Manager position
 - ▶ Incentive and reward ideas will be considered

Cornerstone #1: Executive Buy-In



- ❑ Energy management is an on-going program that should:
 - ▶ Be visible and shared with all stakeholder groups
 - ▶ Include as many facilities as staff can support
 - ▶ Address people, process, and equipment side of equation
 - ▶ Provide guidelines for best practices
 - ▶ Measure and verify that money is being saved over time

Cornerstone #1: Executive Buy-In

Responsibilities of Energy Manager

Create Energy Management Policies	Chair Energy Committee	Generate/ Update/ Implement Master Plan	Create Program For Individual Facilities
Produce and/or Supervise Annual Audits	Help Create Preventive Maintenance Program	Help Balance Efficiency and Safety [e.g., IAQ]	Help Create Efficient Construction
Institute and Oversee Commissioning	Prepare Both Annual and Project Budgets	Serve as Utility Negotiations Coordinator	Establish Energy Efficiency Rewards
Find Technical and Financial Resources [Grants/Rebates]	Create Evaluation and Reporting Procedures	Standardize Savings and Verification Procedures	Inform and Discuss – Communicate

Cornerstone #2: Energy Management System

Data Types

- KWH
- KW
- BTU
- Building
- Square footage
- Degree Days
- Operating Hours
- Meter Serial Number
- Meter Service Address
- Fuel Type

Data Sources

- Electric Utility Company
- Gas Utility Company
- Water Utility Company
- Interval Meters
- Energy Management System
- As-Built Electrical & Mechanical Drawings

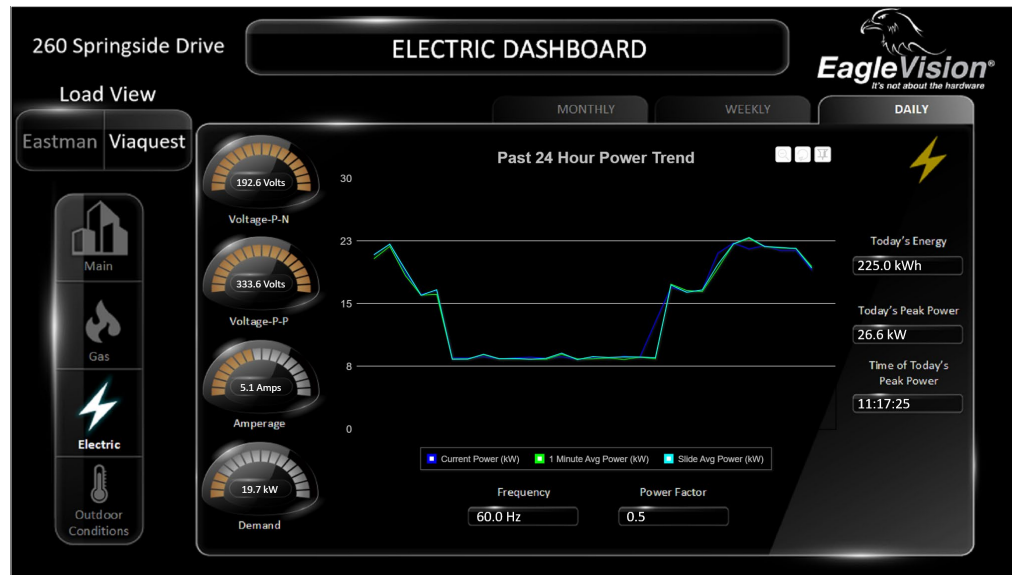
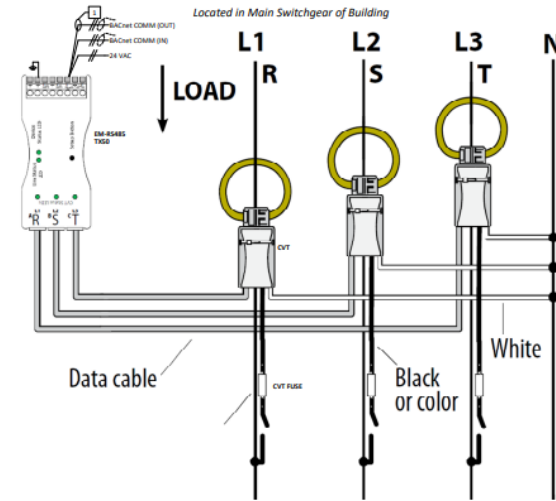
Data Use

- Utility Cost & Consumption
- Measurement & Verification
- Utility Baseline
- Billing Error Dispute Resolution
- Energy Audit & Assessment
- Ongoing Commissioning
- Facility Performance Tracking

- ❑ Foundation of sound energy management program is data
- ❑ Quality of information and data is key
 - ▶ Accurate – correct and complete
 - ▶ Timely – available as needed
 - ▶ Comparable – data definitions and units of measures
 - ▶ Utility – investment grade
- ❑ Pay close attention to data types, sources and use b/c at some point they will all come into play

“You can’t manage what you don’t measure”

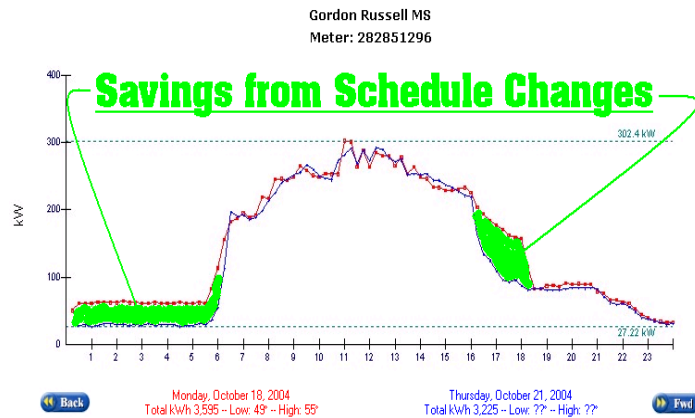
Cornerstone #2: Energy Management System



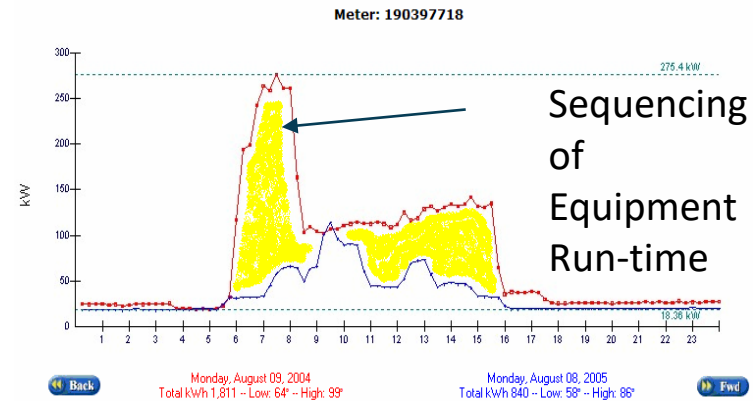
- ❑ Low cost data capture options are available that can leverage existing DDC building automation system
- ❑ Data capture systems can include:
 - ▶ Gas Meter, Electric Meter, Water Meter
 - ▶ Solar Panel/Wireless transmitters for remote meter
 - ▶ Gateways to integrate data with energy management system
- ❑ Energy Management Dashboard that presents trending, alerts, and benchmarking results in real time (15 min intervals)

Cornerstone #2: Energy Management System

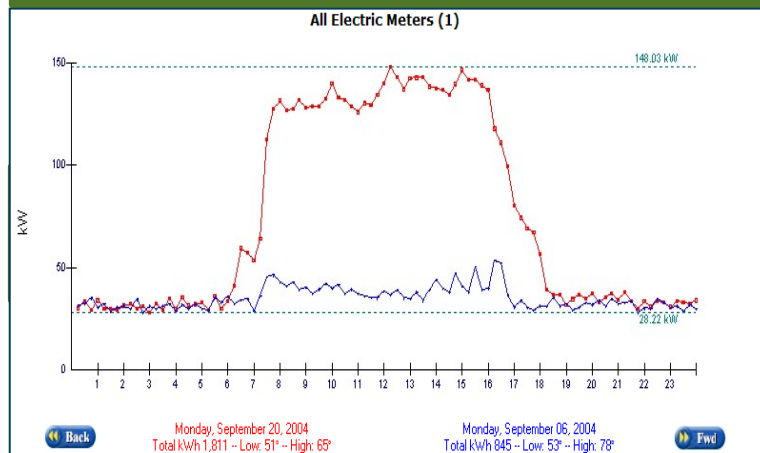
Schedule Savings



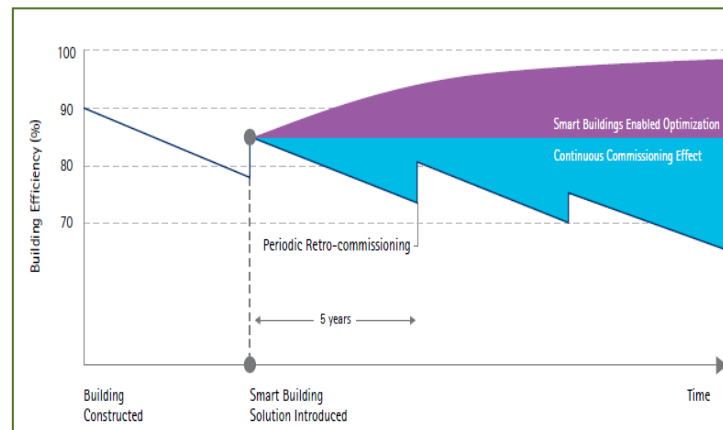
Equipment Duty Cycling



Holiday Scheduling



Smart Building System



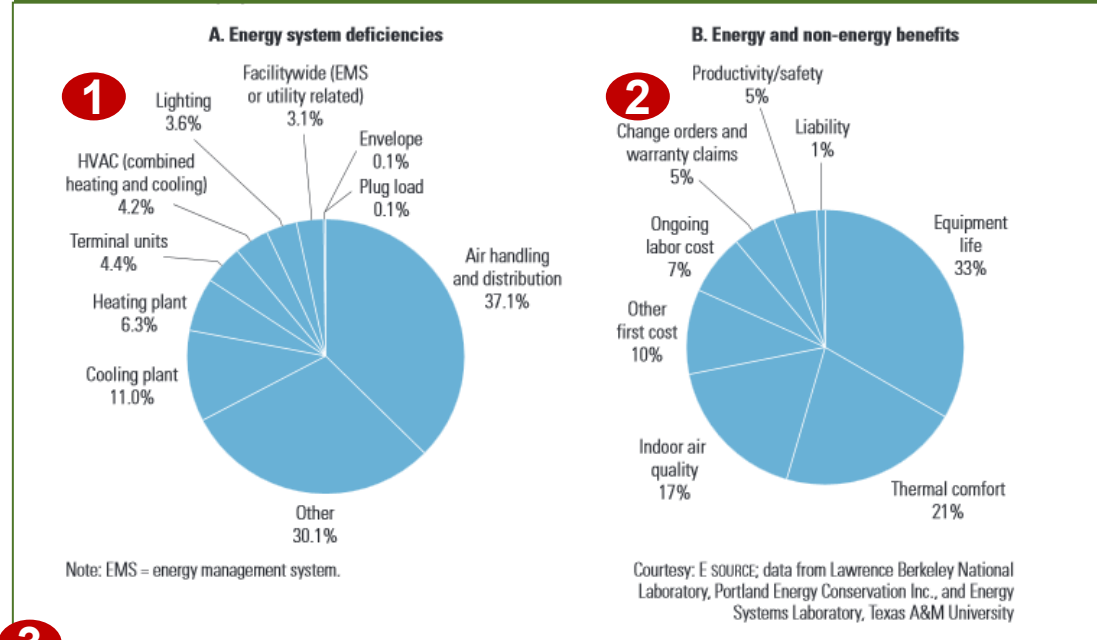
Cornerstone #3: Facility Infrastructure

Client Type	Energy Conservation Measure Installation	ECM Investment	Annual Savings	15 Year Cum Cash Flow	Simple Payback
Educational – K-12	Retro-Commissioning of Existing Building Automation System	\$72,788	\$63,455	\$1,045,308	1.1 yrs

ECM Description

- Think of RCx same way you would approach tune up for car
- Older buildings age & deteriorate
 - Control Sensors
 - Control Sequences
 - Set points/Schedules
 - New Equipment
 - Enrollment and/or Space Changes
- Newer buildings can have value engineering or commissioning problems
- To maintain peak performance important to RCx every 3-5 years

ECM Support Information



Sample Size: 224 Buildings; Median RCX cost: \$0.27 per sq ft; Energy Savings: 15%; Simple Payback Period: 0.7 years

Cornerstone #3: Facility Infrastructure

Client Type	Energy Conservation Measure Installation	ECM Investment	Annual Savings	15 Year Cum Cash Flow	Simple Payback
Educational – Higher Ed	Booster Heaters Fuel Switch	\$12K	\$3.7K	\$40K	3.2 yrs

ECM Description

- Strongly correlated with demand charges see on your electric bill
- Think of utility bill as car trip. Miles represents consumption (kWh). Max speed is demand (kW)
- Several coal fired power plants are shutting down causing price pressure in 2015+
- Several strategies can be implemented to save peak kW and reduce these charges
 - Fuel Switching
 - Demand Shifting
 - Demand Limiting
 - Duty Cycling

ECM Support Information

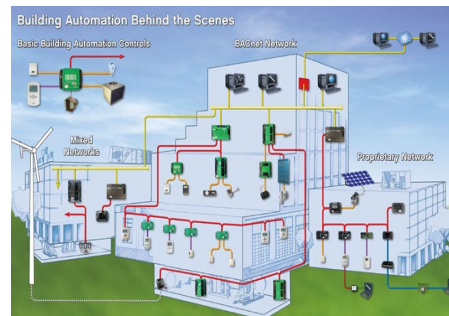
FUEL SWITCHING



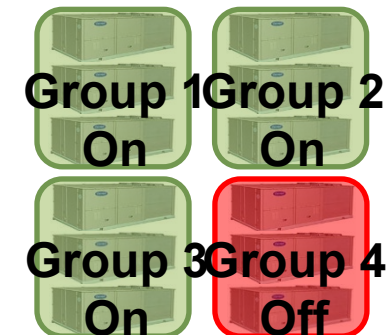
DEMAND SHIFTING



DEMAND LIMITING



DUTY CYCLING



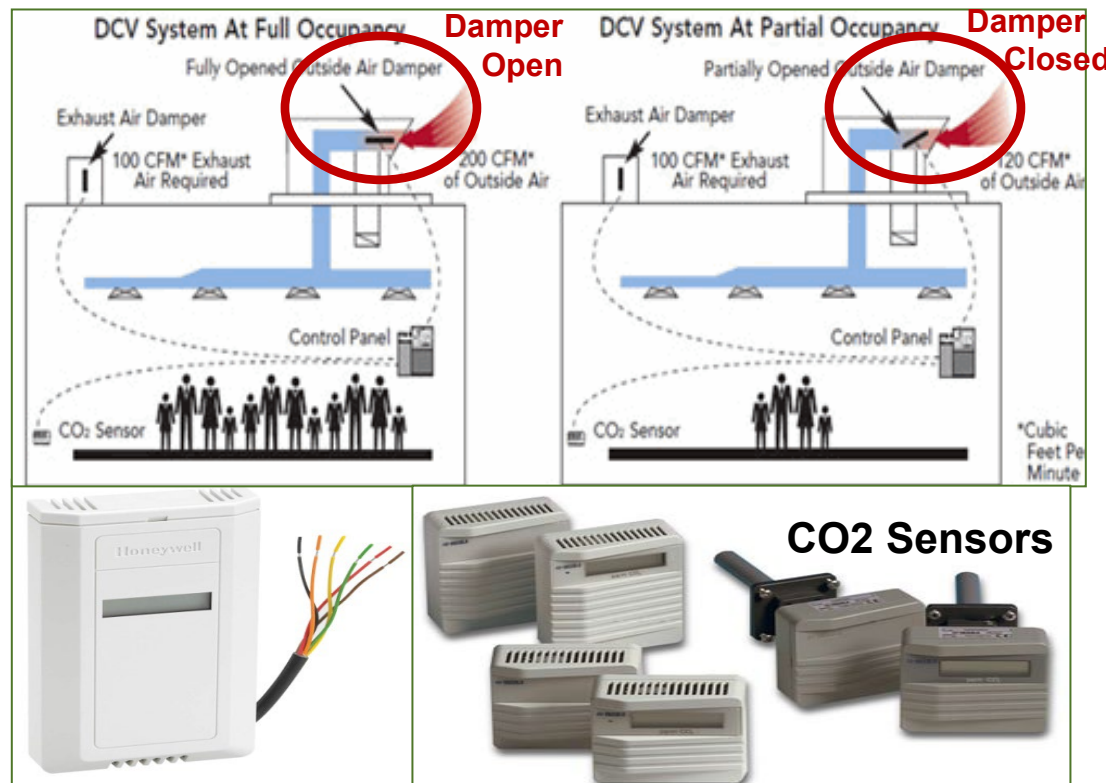
Cornerstone #3: Facility Infrastructure

Client Type	Energy Conservation Measure Installation	ECM Investment	Annual Savings	15 Year Cum Cash Flow	Simple Payback
Education – K-12	Demand Controlled Ventilation on All Major AHU's	\$25,429	\$8,957	\$107,890	2.8 yrs

ECM Description

- Building codes require ventilation to maintain IAQ
- Indoor air can 100 times more polluted than outdoor air
- HVAC systems designed to supply OA based on maximum occupancy
- DCV is control strategy that involves:
 - CO₂ sensors or “People Meters”
 - DDC Controls for intelligence
 - Modulating dampers
- Cafeterias, gymnasiums, multi-purpose rooms, theatres, & auditoriums are good applications

ECM Support Information



Cornerstone #3: Facility Infrastructure

Client Type	Energy Conservation Measure Installation	ECM Investment	Annual Savings	15 Year Cum Cash Flow	Simple Payback
Edu – K-12	9 Schools, <u>3 Boiler Plants (Condensing) w/ OAR</u>	\$7,498	\$4,619	\$61,483	1.6 yrs
Edu – K-12	9 Schools, <u>3 Boiler Plants (Non-Cond) w/OAR</u>	\$7,498	\$1,732	\$18,178	4.3 yrs

- Boiler systems sized for the highest load on the coldest day of the year (design day)
- Hot water boiler system oversized majority heating season
- Outside Air Reset is control strategy for that leverages:
 - Higher the outdoor air temperature
 - Lower the building heat loss
 - Cooler the boiler loop water can be
- Sends out cooler water on warm day; warmer water on cold day
- Amount savings depends on boiler type – condensing vs. non-condensing



Hot Water Condensing Boiler - 97% Efficient

- Condensing Boiler: Boiler Loop Temp Range (inlet) – **160°F to 100°F**
- Rule of thumb: For every 4°F boiler water is reduced, there is 1% energy savings.
- Example: 160°F vs. 100°F will provide minimum **15%**.



Hot Water Non-Condensing Boiler - 88% Efficient

- Non-Condensing Boiler: Boiler Loop Temp Range (inlet) – **160°F to 140°F**
- Rule of thumb: For every 4°F boiler water is reduced, there is 1% energy savings.
- Example: 160°F vs. 140 °F will provide minimum **5%**.

Cornerstone #4: Empowering People

Sharing the Good News



- Newsletters
- Website
- Public Events
- Social Media
- Email Campaigns
- Bulletin Boards
- Press releases

Energy Program Incentives



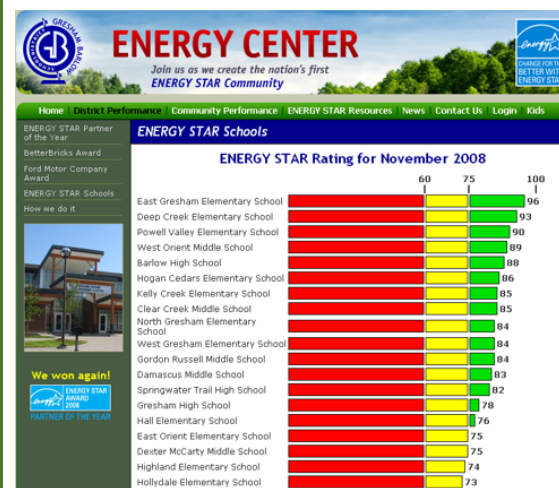
- Incentives can make a difference
- Spirit wear
- Coupons
- Pizza Parties
- Plagues & Trophies
- Parking privileges

Continuous Communication



- Regular communication
- Visible – If program not seen, it's not important
- Relevant – Support comes from those who know the "why":
- Responsive – They work with you when you work with them

Healthy Competitions



- Building by building
- Room by room
- Grade by grade
- Conference and athletic
- School and home

Cornerstone #4: Empowering People

No Cost

- **Adjust Thermostats (1 degree = 1% cost reduction –USGBC)**
- Reduce Hot Water Temperature
- Reduce Lighting
- Seal Off Unused Areas
- Turn off Equipment When Not Needed
- **Reduce Plug Load – Copiers, PC, Vending Machine (1-3% cost reduction - USGBC)**
- Keep Ventilation Units Unobstructed
- Inspect Outdoor Air Dampers
- Shut off Kitchen/Shop Exhaust Fans
- Cover Heated Pool
- **Close Doors/Windows Closed & Inspect Dampers (1-6% cost reduction - USGBC)**

Low Cost

- Demand controlled ventilation with CO2 Sensors
- Demand Limiting (e.g. RTU's)
- Optimized Boiler System Start and Stop
- Enthalpy Based Economizing
- Critical Zone Reset
- Retro-Commissioning
- Premium Efficiency Motors
- Variable Frequency Drives
- Kitchen Exhaust Hood Controls
- Booster Heating Fuel Switching
- Duct Leak Repair & Insulation
- Mechanical System Insulation
- Smart plug load controllers
- Energy Star appliance upgrades
- Energy Management Dashboards

Capital Intensive

- Retrofit Gymnasium Metal Halide with LED
- Retrofit 32/28/25 watt lamps and exterior lights with LED
- Install Occupancy Sensors and Lighting Controls
- Rooftop Unit (RTU) and Air Handling (AHU) Upgrades
- Chiller Replacement Projects
- Roof, Window and Other Building Envelope Systems
- Replace Pneumatic Controls with DDC Energy Mgmt System
- Replace Non-Condensing with Condensing Boilers
- Domestic Hot Water Fuel Switch
- Science Building Fume Hoods
- Geothermal, Solar Wind, CHP, WER, and Cogeneration

“Simple behavioral and operational measures alone can reduce costs by 25%”

Case Study: School District #1

	ECM Investment	Total Annual Savings	Electricity Saved (kWh)	Natural Gas Saved (MMBTU)	Carbon Offset Saved (Tons CO ₂)	Cars Per Year Saved	15 Year Cum Cash Flow	Simple Payback
Total	\$1,010,563	\$99,056	747,125	5,665	661	159	\$765,253	9.6 yrs

Implemented Projects

- Lighting Retrofits
- Ice Storage Optimization
- Controls Integration
- Chiller Replacement
- Water Deduct Meter
- Remote Monitoring
- **Retro-Commissioning**

RCx Winning Measures	Annual Savings
Scheduling/Setpoint Optimization	\$10k
Simultaneous Heating/Cooling	\$8k
Over Ventilating on Gym AHUs	\$3k
VFD Control Sequences	\$3k
Overrides on DA Static Setpoint, Exhaust Fans, OA Dampers	\$3k
DHW Economy Mode	\$2k
Building Envelope	\$1k
Total Estimated Savings:	\$30k
Overall Project Payback of 1 Year	

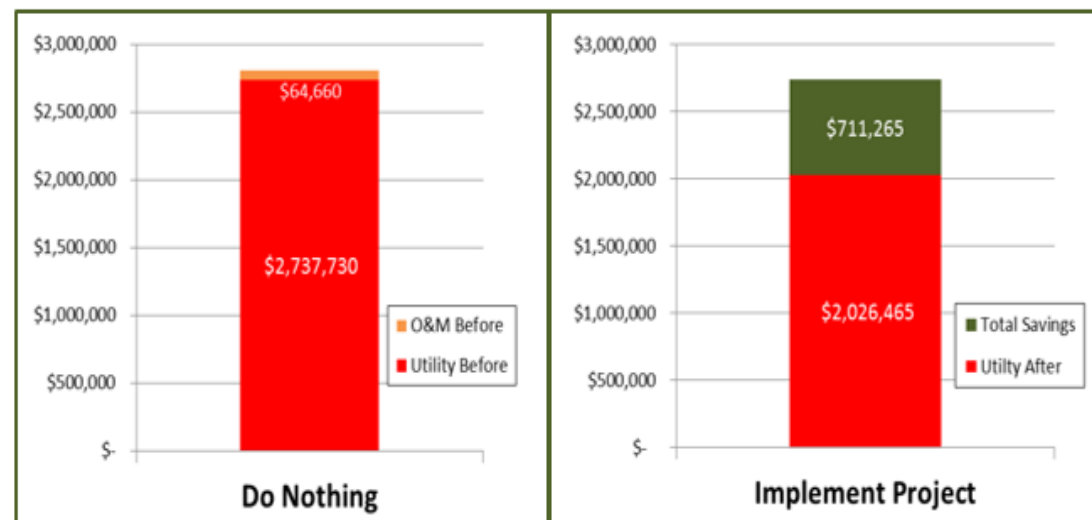
Case Study: School District #2

	ECM Investment	Total Annual Savings	Electricity Saved (kWh)	Natural Gas Saved (MMBTU)	Carbon Offset Saved (Tons CO ₂)	Cars Per Year Saved	15 Year Cum Cash Flow	Simple Payback
Total	\$873,296	\$70,260	430,527	1,580	381	75	\$15,745	11.8 yrs

Implemented Projects

- Lighting Retrofits
- Motors & VFD's
- Retro-Commissioning
- Advanced Controls
- Duct Repair
- Roof Top Units

Energy Management Cost of Inaction



Over a 15 yr period, this school would pay an extra \$711K to their utilities if no action is taken on these projects.



Tools for Tracking

Good – Better - Best

BSAVE Calculator – Good



In just 5 minutes, estimate your energy, cost & carbon savings potential with our B.Save Calculator... Try it today!

By answering a few simple questions about your building, location, and energy consumption, we can estimate your energy and carbon savings. We'll run your data through our analysis against benchmarks to calculate metrics related to your specific building performance. Let's get started...

[BSAVE Website](#)



Energy Star Portfolio Manager - Better



ENERGY STAR®
PortfolioManager®

Management Tool



Assess whole building energy and water consumption, plus waste



Track changes in energy, water, greenhouse gas emissions, and cost over time



Track green power purchase



Create custom reports



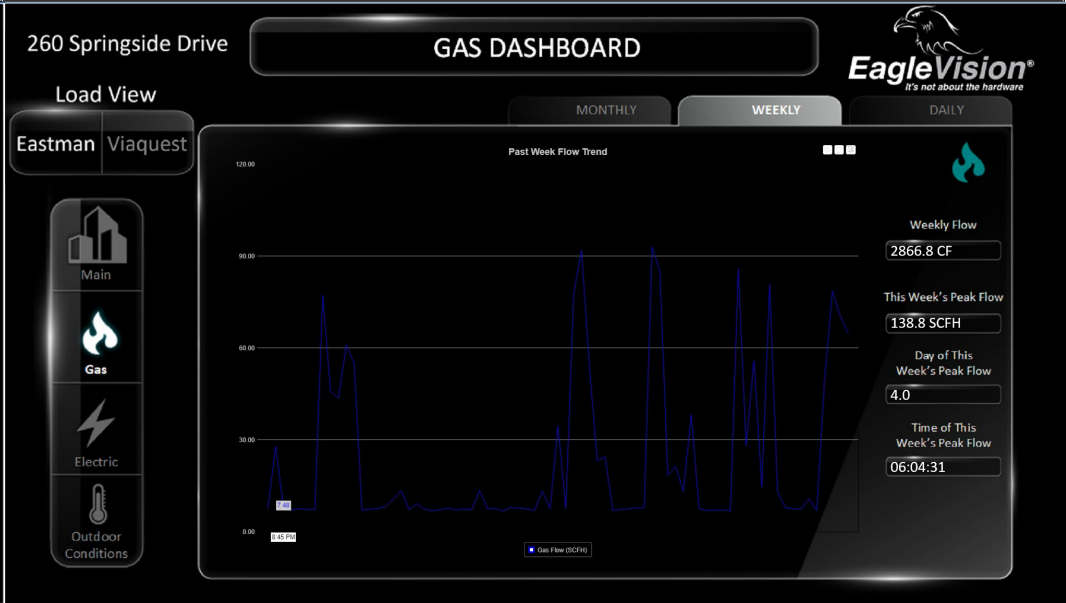
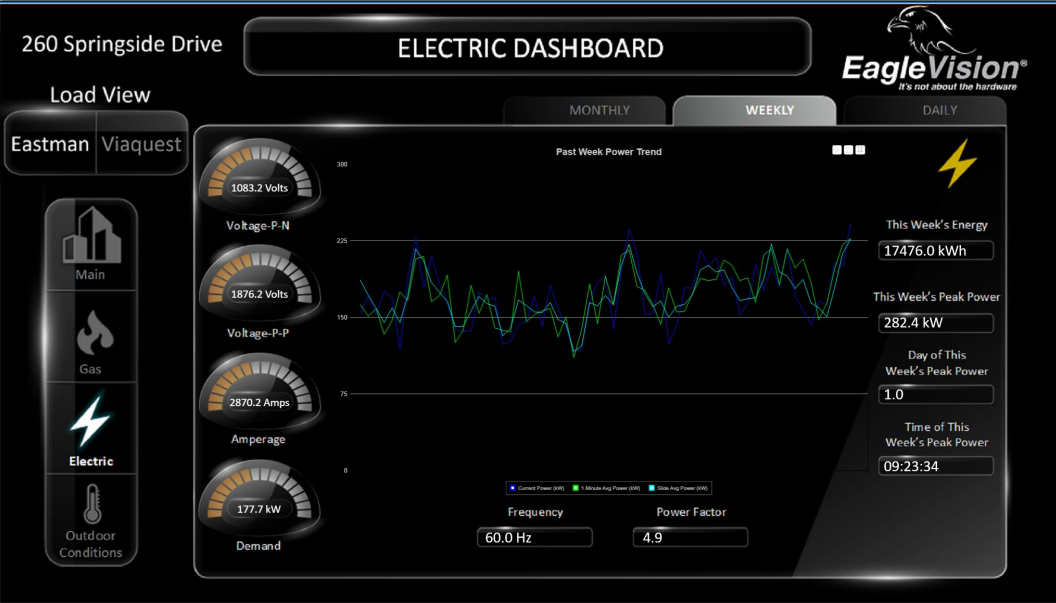
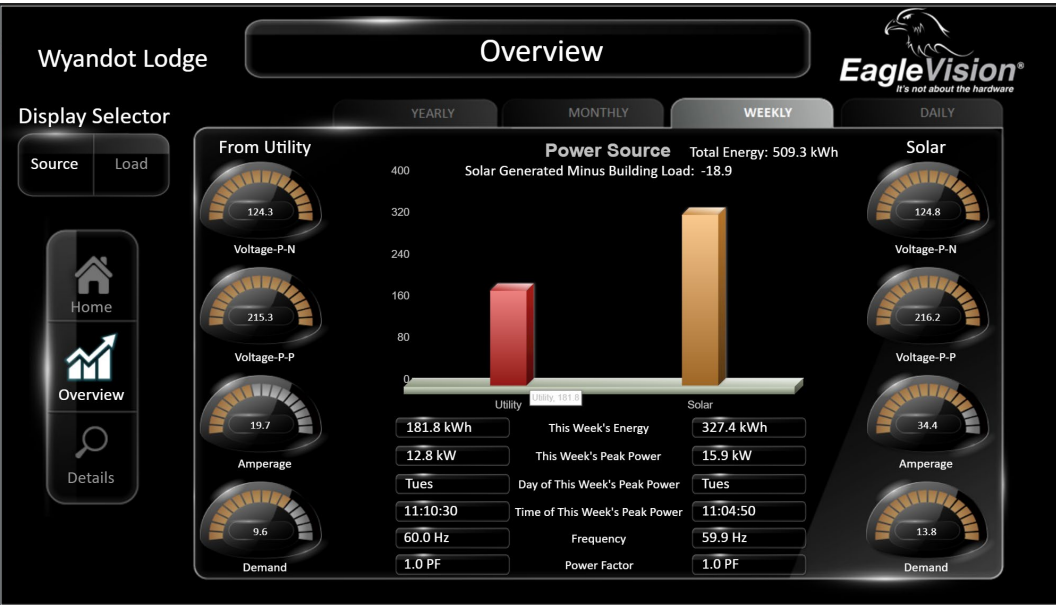
Share/report data with others



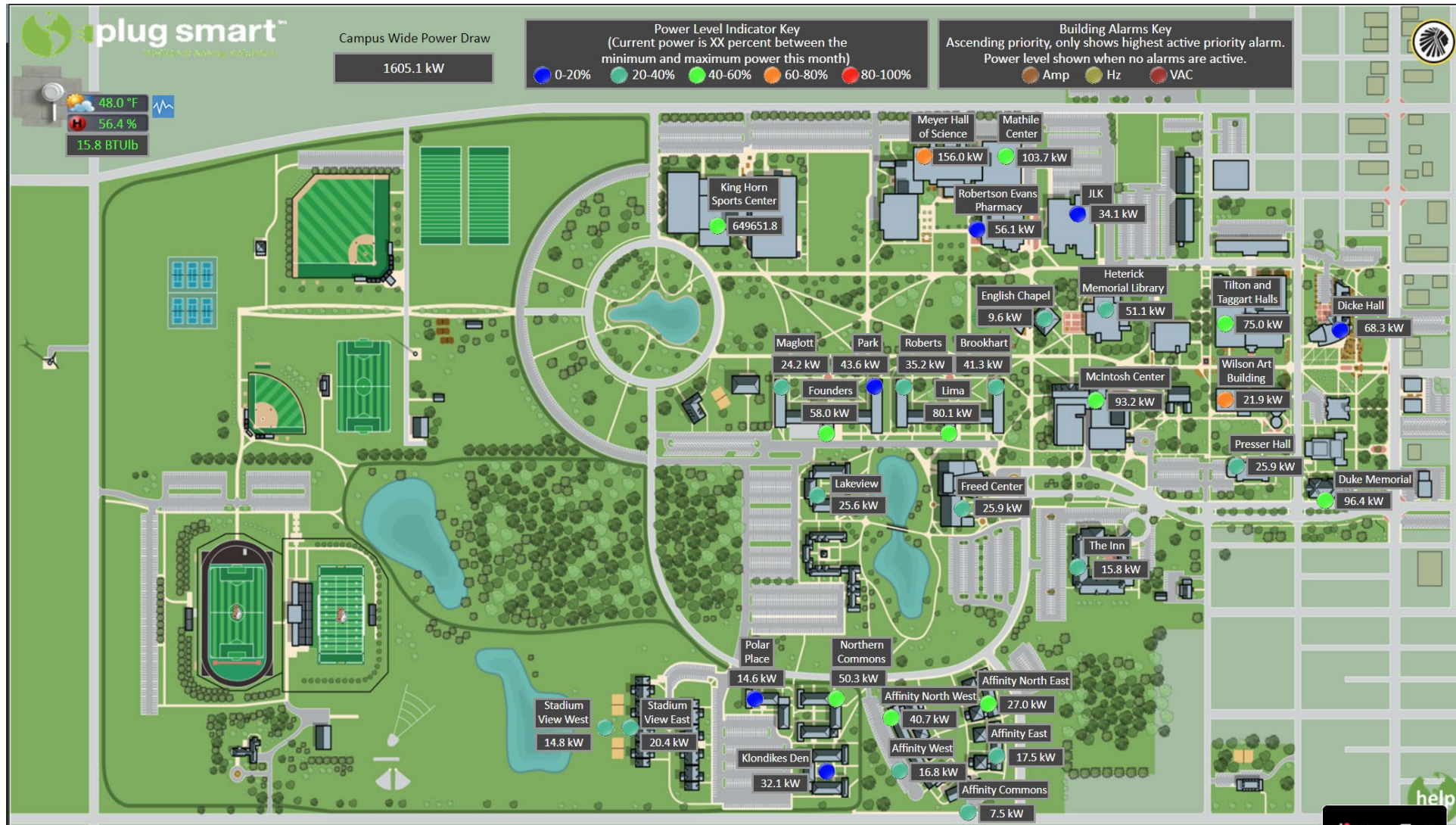
Apply for ENERGY STAR certification

[Energy Star Website](https://www.energystar.gov/PortfolioManager)

BMS Realtime Tracking - Best



Campus Wide View



Q&A

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Thank you!