plug smart™

The Importance of Employing Energy Management in Your School District

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About Plug Smart

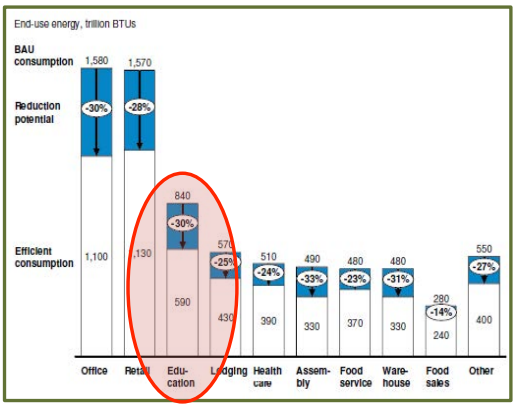
Selected K-12 Energy Projects

- Ohio based company with offices in Columbus, Cincinnati, Dayton, and Cleveland
- Energy services company that specializes in developing self funding energy projects
- We are project developer that does not self-perform installation
  - Vendor Neutral – not tied to any particular brand or technology
  - Subcontractor Choices – partner with subs know, like & trust
  - Best Value Solutions – open book & competitive bid process

Presentation Objectives

- ❑ The importance of employing energy management best practices in your school district
- ❑ A proven framework for employing and implementing an energy management system
- ❑ Energy management case studies, best practices and ideas for getting started today

Challenges Facing Administrators



"Education wastes $2B a year in energy an amount equivalent to 40M text books"

- ❑ Uncomfortable learning & administrative environments
- ❑ Schools struggling to fund repairs and renovations
- ❑ Poor visibly into buildings energy consumption and use
- ❑ Lack of a clear energy policy, or mandate to create change
- ❑ Pressure to keep pace with peers who have already taken action
- ❑ Everyone wants to be "Green" but not go in the "Red"

Source: EIA AEO 2008, McKinsey analysis

Other Important Factors to Consider

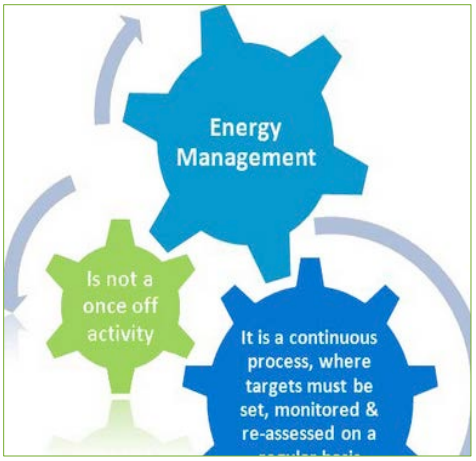
External Factors
- Increasing Generation Costs(+)
- Increasing Demand Charges(+)
- Government & Regulatory (-/+)
- New & Emerging Technologies (-/+)

Administrative Factors
- Smaller Class Sizes (-/+)
- Year Round Facility Access (+)
- Computer Based Programs (+)
- Facility Closures or Additions (-/+)

Design Factors
- LEED & Integrated Building Designs (-)
- Building Code Compliance (-)
- Renewable Energy Options (-)
- Improved ASHRAE Standards (+/-)

Budget Factors
- Reduced GI & PI Funds (+)
- Reduced Staff & Personnel (+)
- Community Reluctance to Levy (+)
- Deferred Maintenance Issues (+)

What is Energy Management



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

- ❑ The process of monitoring, controlling, and conserving energy to reduce costs and improving the environment
- ❑ Also known as the Three C's – Cost, Consumption, & Carbon
- ❑ Human Element– People need be aware, educated, engaged and empowered
- ❑ Equipment Element – Building infrastructure needs controlled, properly maintained, and systematically 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

- DOE estimates public facilities can reduce energy costs 5%-15% by implementing low cost/no cost measures
- Energy Conservation Programs (e.g. HB 264) consistently reduce energy costs from 15%-40%.
- 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 and tool and models positive behaviors for students if applicable

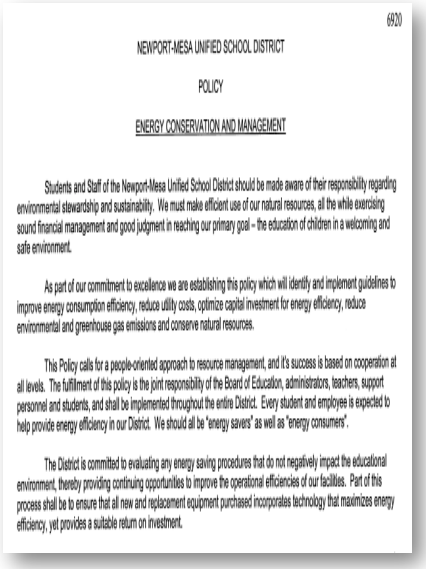
Energy Management Cornerstones

Executive Buy-In	**Energy Management System**
Facility Improvement	**Empowering People**

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



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NEWPORT-MESA UNIFIED SCHOOL DISTRICT

POLICY

ENERGY CONSERVATION AND MANAGEMENT

Students and Staff of the Newport-Mesa Unified School District should be made aware of their responsibility regarding environmental stewardship and sustainability. We must make efficient use of our natural resources, all the while exercising sound financial management and good judgment in reaching our primary goal – the education of children in a welcoming and safe environment.

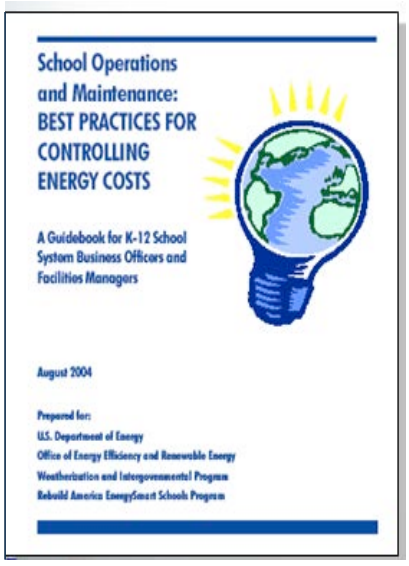
As part of our commitment to excellence we are establishing this policy which will identify and implement guidelines to improve energy consumption efficiency, reduce utility costs, optimize capital investment for energy efficiency, reduce environmental and greenhouse gas emissions and conserve natural resources.

This Policy calls for a people-oriented approach to resource management, and it's success is based on cooperation at all levels. The fulfillment of this policy is the joint responsibility of the Board of Education, administrators, teachers, support personnel and students, and shall be implemented throughout the entire District. Every student and employee is expected to help provide energy efficiency in our District. We should all be "energy savers" as well as "energy consumers".

The District is committed to evaluating any energy saving procedures that do not negatively impact the educational environment, thereby providing continuing opportunities to improve the operational efficiencies of our facilities. Part of this process shall be to ensure that all new and replacement equipment purchased incorporates technology that maximizes energy efficiency, yet provides a suitable return on investment.

- ❑ Culture is created and driven from the top down
- ❑ Needs to be put in writing in the form of a policy, program or charter
- ❑ At a minimum it needs to state:
  - ► Rising utility, operations and maintenance costs are a concern.
  - ► A trained employee/partner is needed to manage energy-related issues.
  - ► The Administration is authorizing the Energy Manager role and/or position.
  - ► Specific energy management goals will be obtained and should include training and education
  - ► A plan will be prepared and implemented.
  - ► Incentive and reward ideas will be considered

Cornerstone #1: Executive Buy-In



School Operations and Maintenance: BEST PRACTICES FOR CONTROLLING ENERGY COSTS

A Guidebook for K-12 School System Business Officers and Facilities Managers

August 2004

Prepared for:
U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Weatherization and Intergovernmental Program
Rebuild America EnergySmart Schools Program

- ❑ Energy management is an on-going program that should:
  - ► Share results and be visible to all stakeholder groups
  - ► Measure and verify that money is being saved over time
  - ► Acquire facility-specific information and detail
  - ► Address behavior and facility issues
  - ► Be tweaked and evolved over time
  - ► Use partners and external support resources as needed
  - ► Train for specific outcomes
  - ► Integrate into classroom curriculum
  - ► Provide guidelines for best practices

Cornerstone #1: Executive Buy-In

Responsibilities of Energy Manager

Create Energy Plan and Policy	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

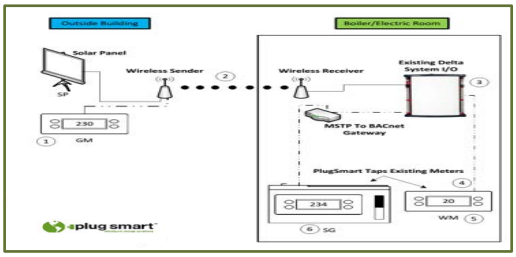
Data Sources
- Electric Utility Company
- Gas Utility Company
- Water Utility Company
- Interval Meters
- Energy Management System
- As-Built Electrical & Mechanical Drawings

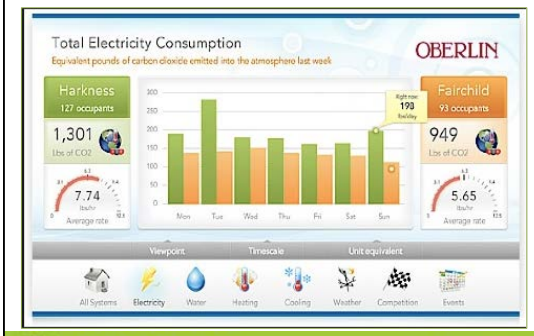
Data Use
- Utility Cost & Consumption
- Measurement & Verification
- Utility Baseline
- Billing Error Dispute Resolution
- Energy Audit & Assessment
- Ongoing Commissioning
- Facility Performance Tracking

- ❑ 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





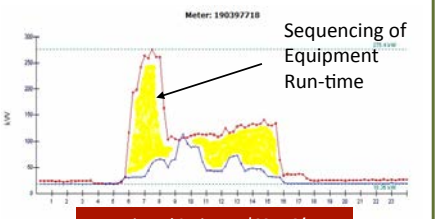
- Low cost data capture options are available that can leverage existing DDC building automation system
- Data capture systems can include:
  - Gas Meter, Electric Meter, Water Meter
  - Solar Panel/Wireless transmitters for remote meter
  - Gateways to integrate data with energy management system
-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

Cornerstone #2: Energy Management System

Schedule Savings

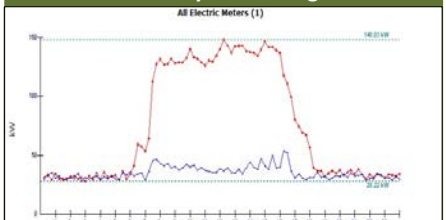
Projected Savings = $6,500/yr

Equipment Duty Cycling



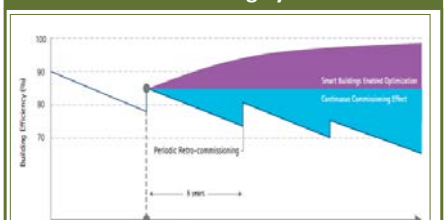
Projected Savings = $28,756/yr

Holiday Scheduling



Projected Savings = $4,500/yr

Smart Building System



Projected Savings = $1.1M/yr

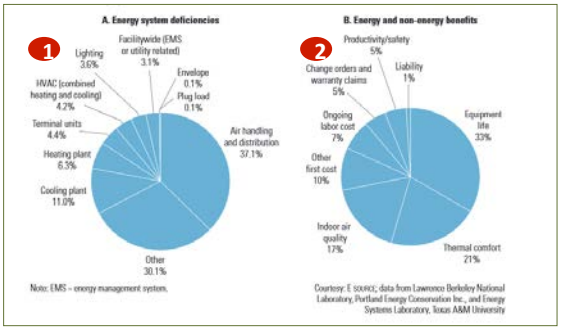
Cornerstone #3: Facility Infrastructure

Client Type	Total Project Size	Energy Conservation Measure Installation	ECM Investment	Annual Savings	15 Year Cum Cash Flow	Simple Payback
Educational – K-12	$1.4M	**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



3 **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	Project Size	Energy Conservation Measure Installation	ECM Investment	Annual Savings	15 Year Cum Cash Flow	Simple Payback
Educational – Higher Ed	$7.9M	**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 in Northern Ohio 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

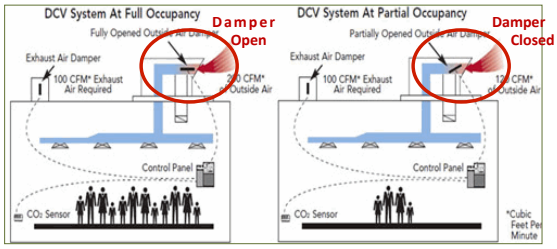
Cornerstone #3: Facility Infrastructure

Client Type	Project Size	Energy Conservation Measure Installation	ECM Investment	Annual Savings	15 Year Cum Cash Flow	Simple Payback
Educational – K-12	$2.3M	**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	Project Size	Energy Conservation Measure Installation	ECM Investment	Annual Savings	15 Year Cum Cash Flow	Simple Payback
Edu – K-12	$3.3M	9 Schools, **3 Boiler Plants (Condensing) w/ OAR**	$7,498	$4,619	$61,483	1.6 yrs
Edu – K-12	$3.3M	9 Schools, **3 Boiler Plants (Non-Cond) w/OAR**	$7,498	$1,732	$18,178	4.3 yrs

ECM Description

- 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

ECM Support Information

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%"

EPA Report, Clean Energy Strategies for EE in K-12 Schools

Case Study: London City Schools

HB 264 Package	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**

London City Schools
Student Success Is Our Mission

London City Schools

- Completed Summer 2013
- 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: Archbold Area Schools

HB 264 Package	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	**$672,880**	**$56,586**	**430,527**	**1,580**	**381**	**75**	**$15,745**	**11.3 yrs**

Archbold Area Schools
600 Lafayette St., Archbold, OH 43502
419.446.2728

Archbold Area Schools

- Completed Summer 2014
- Lighting Retrofits
- Motors & VFD's
- Retro-Commissioning
- Advanced Controls
- Duct Repair
- Roof Top Units

Energy Management Cost of Inaction

Over a 15 year period, Archbold Schools would pay an extra $711k ($65K=O&M) to their utilities if no action is taken on these projects.

Questions