Demand Response & Energy Efficiency

International Conference for Enhanced Building Operations

ENERNOC

You've Probably Heard All This Before…

"The average commercial building uses 26% more energy than needed."

- DOE / Energy Star

"Closing our 'national electric productivity gap [GDP generated/kWh consumed]' could curtail up to 30% of our power consumption."

- Rocky Mountain Institute

"Less than 5% of commercial buildings in the US are actually commissioned after construction."

- BCS Partners

There is still ample room to improve efficiency in this space.

So… What's Stopping Us?

- To be sure, part of the problem lies with ongoing inefficient practices and a lack of attention to our energy costs drivers…

- But that's not the whole story. We still have a gap to close because we potentially lack the resources, technology, or model to address the challenge.

An Innovative Solution to Get the Ball Rolling

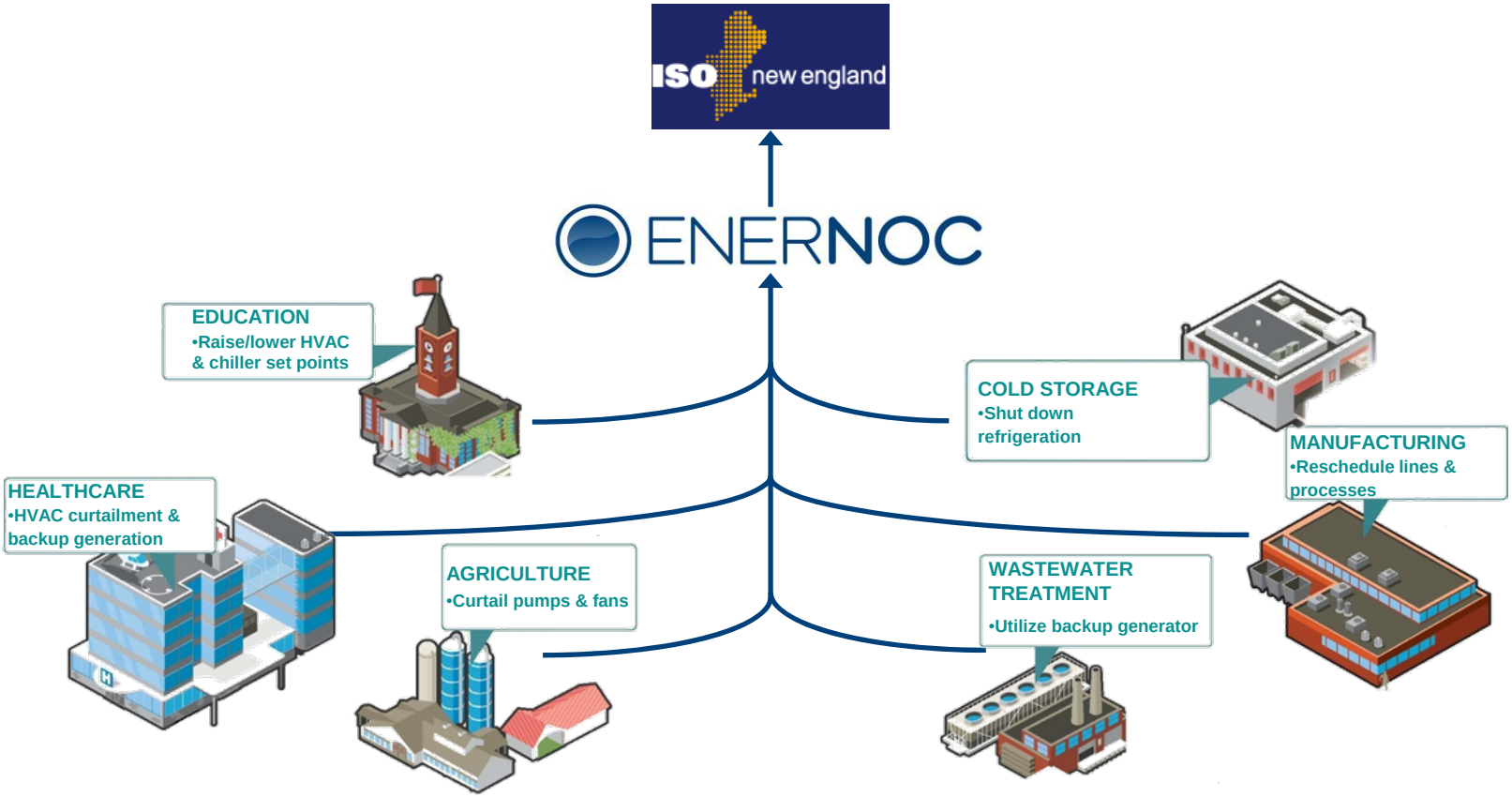
EnerNOC has a solution involving two complementary offerings.

- Demand Response (DR)
- Monitoring Based Commissioning (MBCx)

What is Demand Response?

"The temporary reduction of electricity demanded from the grid by an end-user in response to capacity shortages, system reliability events, or high wholesale prices."

How Can Businesses Contribute?



Each business earns **capacity payments** for being on call to respond when demand response events occur and typically earns **energy payments** when they actually respond to an event

How Does Technology Enable Participation?

The EnerNOC technology platform makes participation simple, accurate, and informative for you.

1. **EnerNOC Site Server**
2. **PowerTrak Energy Management Software**
3. **Network Operations Center**

DR: A Gateway to Energy Efficiency

Through technology and revenue synergies, demand response can be a gateway to energy efficiency products like MBCx.

Technology

- Technology used to enable and monitor DR sites (meters, real-time output) can also be leveraged for energy efficiency products.
- Display and analysis of real-time data through advanced software (PowerTrak) also supports further awareness about efficiency.

Revenue

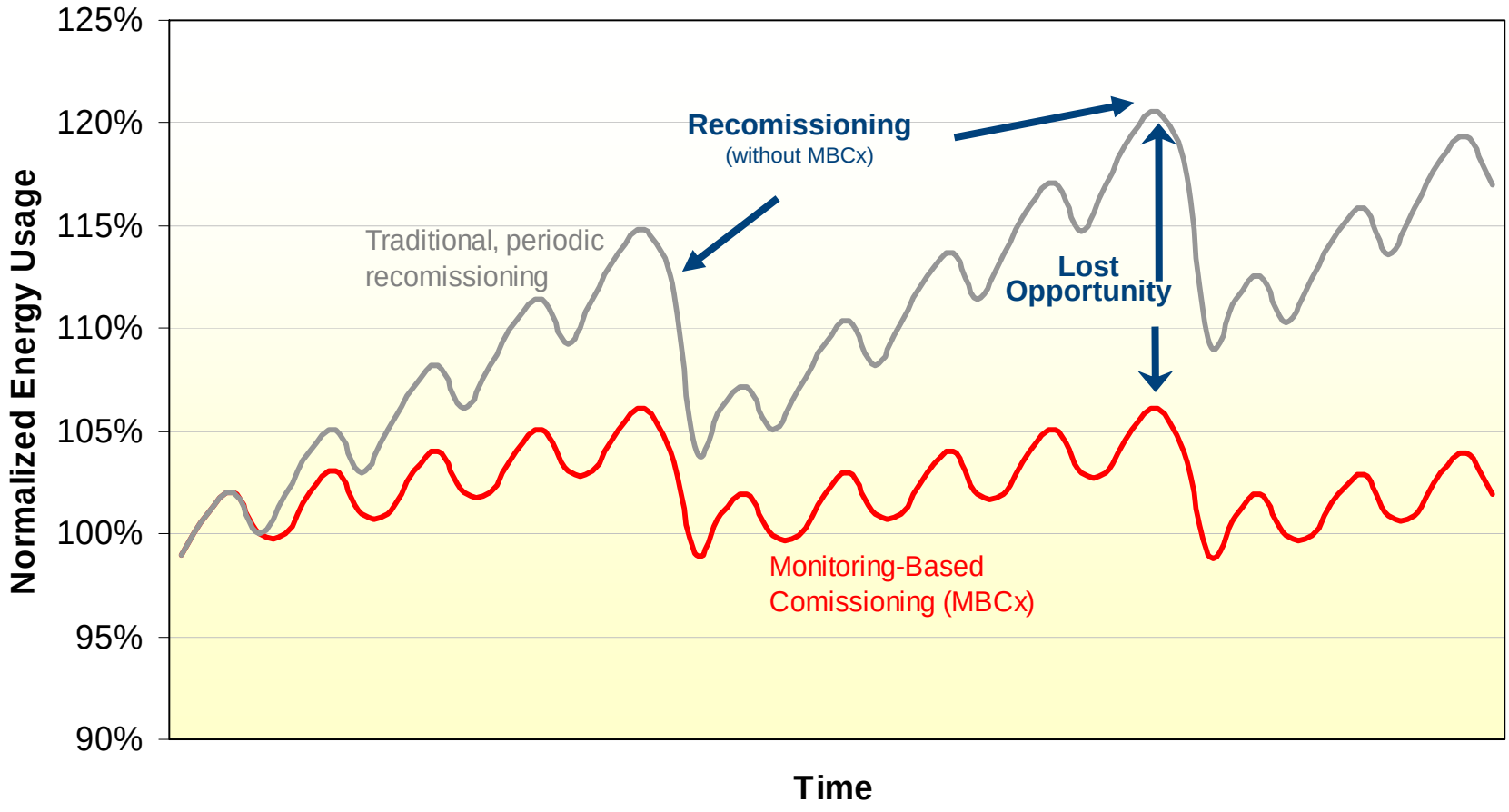
- DR program participation provides an excellent source of additional energy-related revenue.
- DR revenue can be re-invested towards the implementation of additional energy efficiency measures, like MBCx.

What is MBCx?

- MBCx combines **advanced metering technology** with sophisticated analysis software to provide actionable insights.
- MBCx seamlessly **integrates data from disparate energy management** systems and provides a clear window into overall energy use.
- **Advanced filtering technology** processes energy-related data to identify potential opportunities for efficiency.
- MBCx energy analysts review data to provide a set of **clear and actionable recommendations** helping reduce energy consumption, prioritize maintenance issues and enhance occupant comfort.

MBCx vs. Retro-Commissioning

Impact of Monitoring-Based Commissioning on Building Consumption



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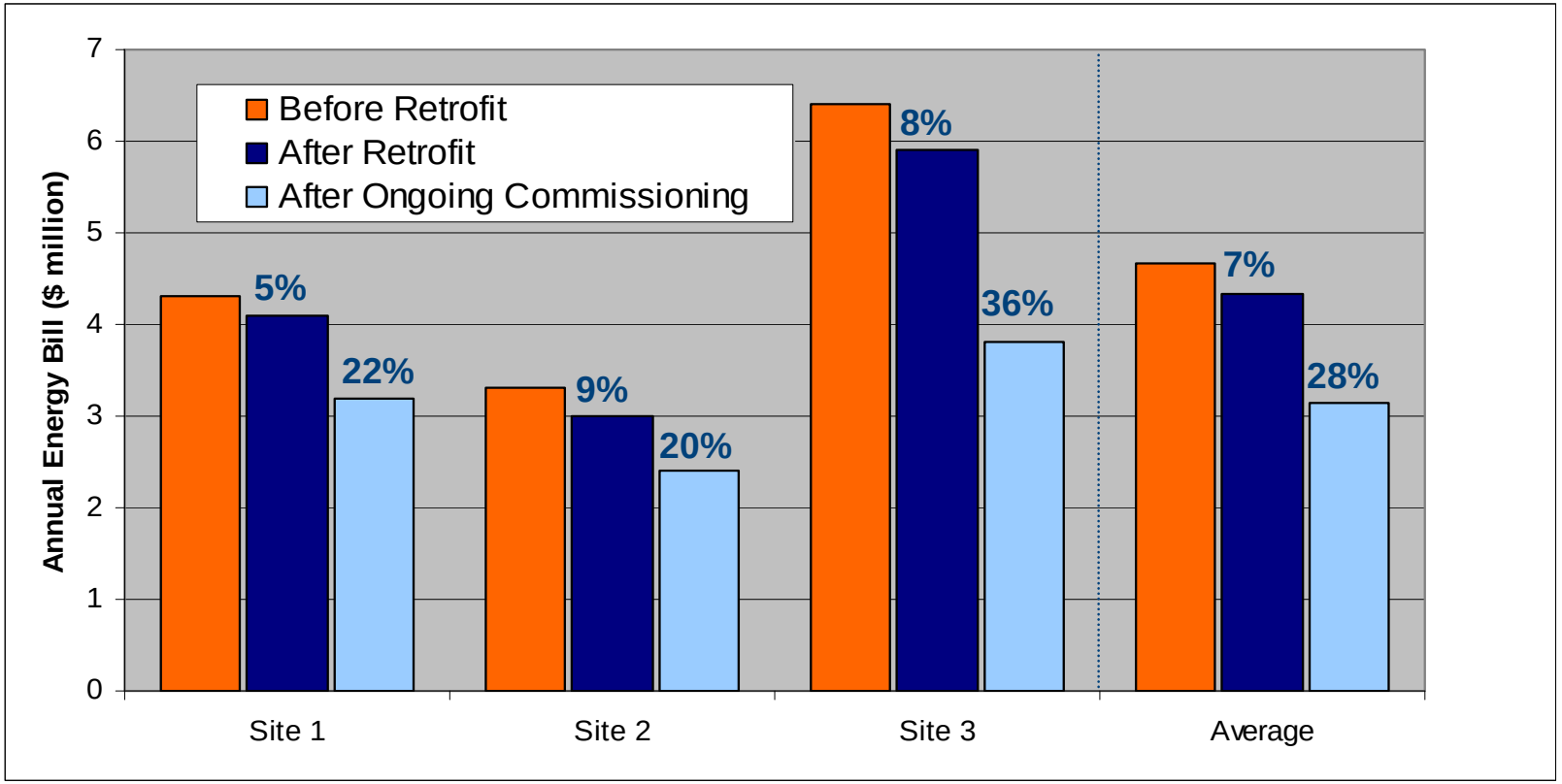
MBCx and Persistence

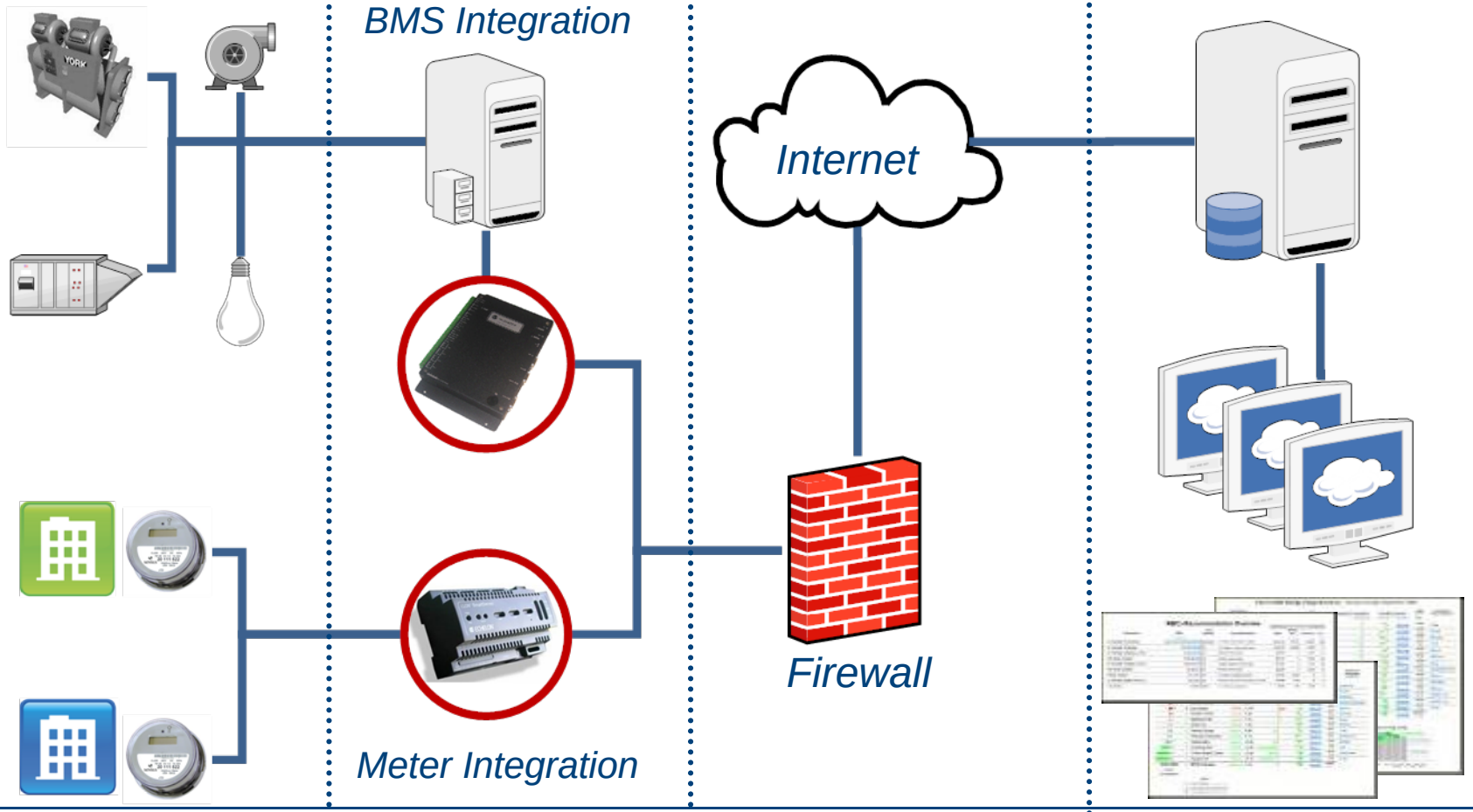
By ensuring persistence, MBCx can enhance traditional energy efficiency retrofits to deliver more than 4x the savings of retrofits alone.



Sources: US Department of Energy, based on data from the University of Texas.

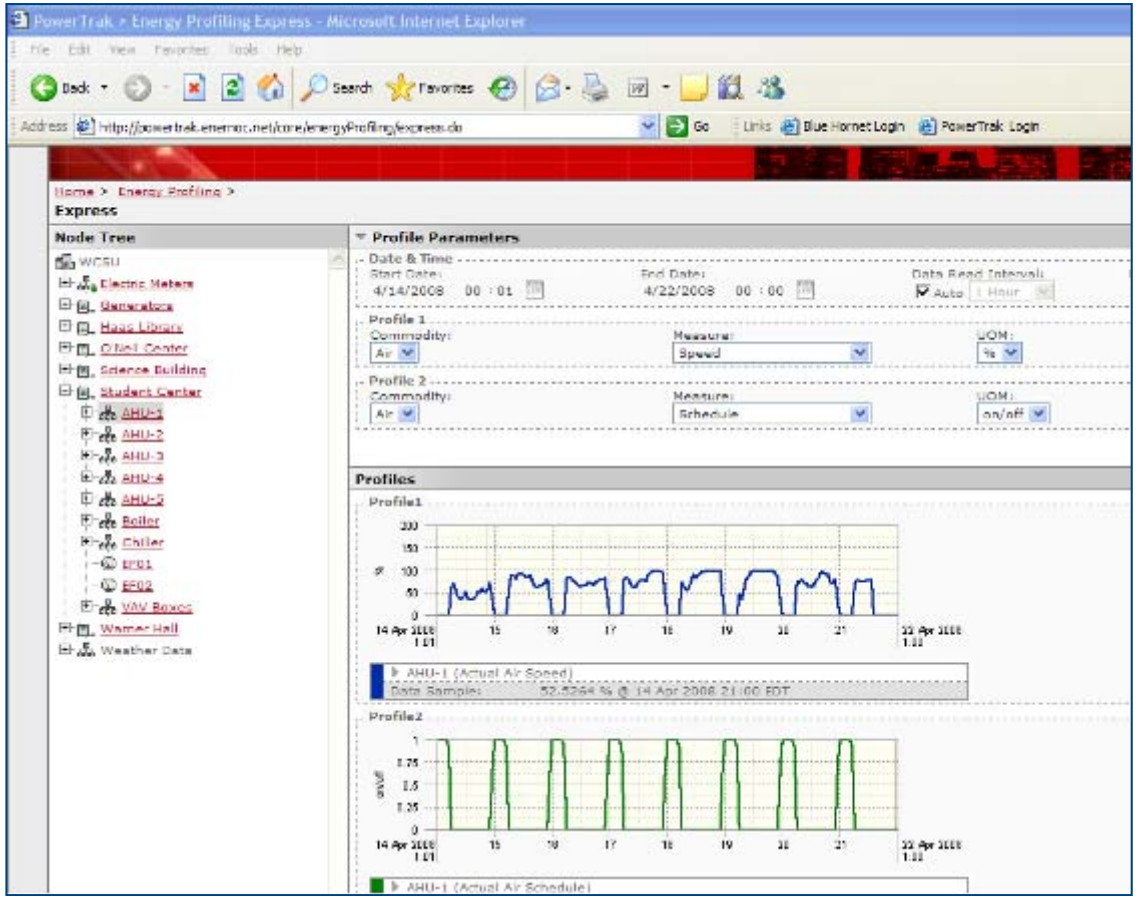
MBCx Connectivity

PowerTrak®



How Is MBCx Implemented?

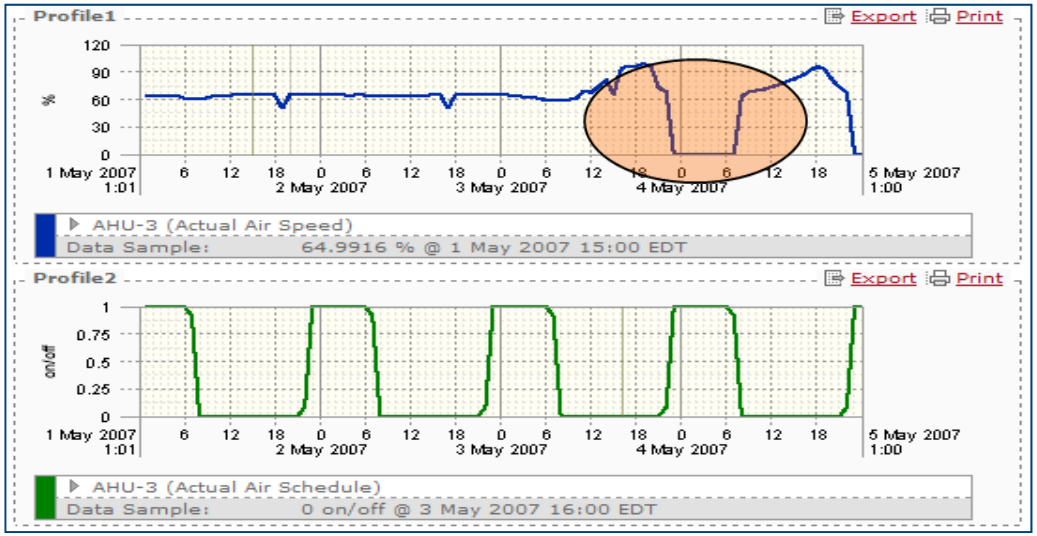
PowerTrak™ is EnerNOC's web-accessible platform that our energy analysts interface with to run data filters and identify energy savings opportunities.



- Integrate meter, BMS and external data points
- Collect and view data in real-time
- Advanced, proprietary data filtering flags energy savings opportunities
- Web-based & secure application, accessible anywhere to any number of users

Examples – Air Handling Schedules

Facility managers often don't have the time to identify maintenance issues like equipment operating during off-hours. Increased costs are an undetected result.



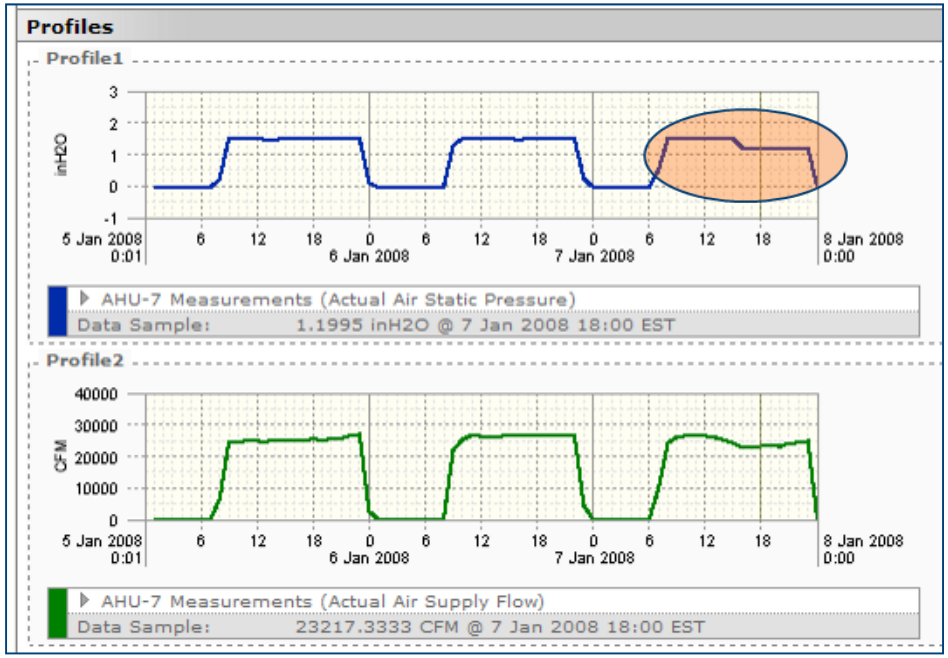
In this example, the change in schedule represents an annual savings of $21,000 and 102-Metric Tons of CO_2 avoidance.

Savings Category: No Cost

Action Recommended: Enable auto-control. This unit was habitually overridden, but from continuous monitoring, each incidence was caught with minimal loss in energy savings. As a result of this measure new protocols were established for requesting off-hours usage to further limit this issue from re-occurring.

Examples – Static Pressure Reset

Supply air static pressure is often used to control fans and ensure adequate air flow. When pressure is too high actual air flow and fan power usage is higher than needed.



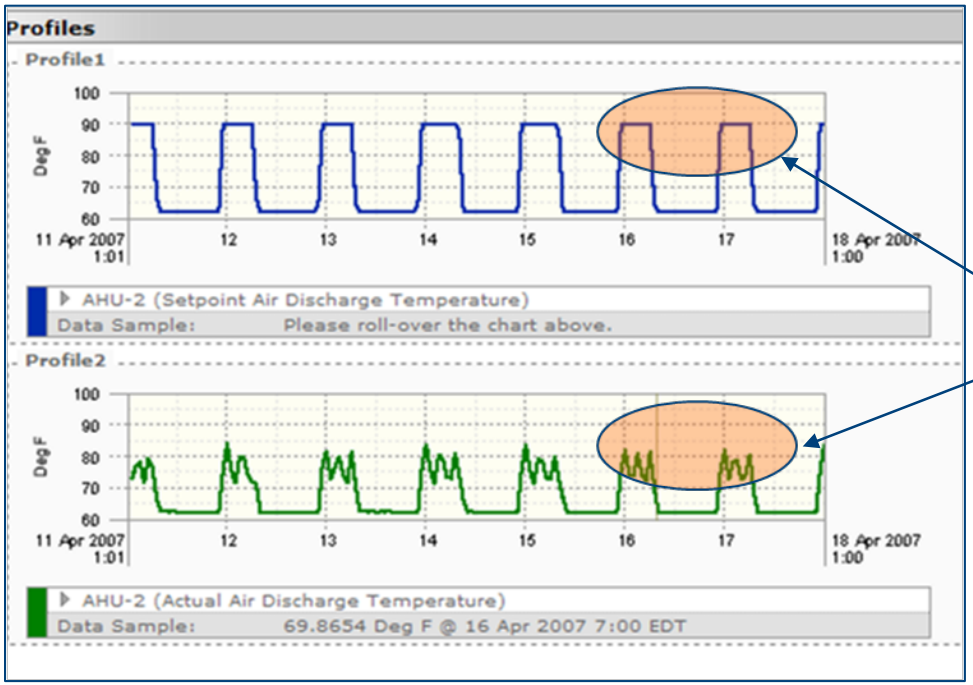
In this example, the slightly reduced static pressure set-point had an annual savings of $4,800 and 22-mTons of CO_2 avoidance.

Savings Category: No Cost.

Action Recommended: Based on continuous monitoring associated with small changes in static pressure, it was determined that a 20% reduction in set-point would work without impacting comfort. Actual savings was less than 'Fan-Laws' at 29% of previous usage.

Examples – Sub-Optimal Freeze

A design flaw in AHUs allows for leakage even when units are off. We employ a strategy that prevents freezing, but is implemented regardless of outside temp.



In this example, the change in control strategy represents an annual savings (occurring over swing season months) of $9,200 and 40-mTons of CO_2 avoidance.

Savings Category: No Cost

Action Recommended: Reprogram the control sequence so that this freeze protection strategy only occurs when freezing is possible. Even though the unit is off, the AHU heats up to +90ºF whenever heating is available to the facility.

Examples – Sub-Optimal Economizer

Often Mixed Air Temp (MAT) doesn't vary with Outside Air Temp, resulting in a higher then optimal MAT. Faulty damper action can cause the use of excessive Return Air Temp (RAT) resulting in higher energy usage.

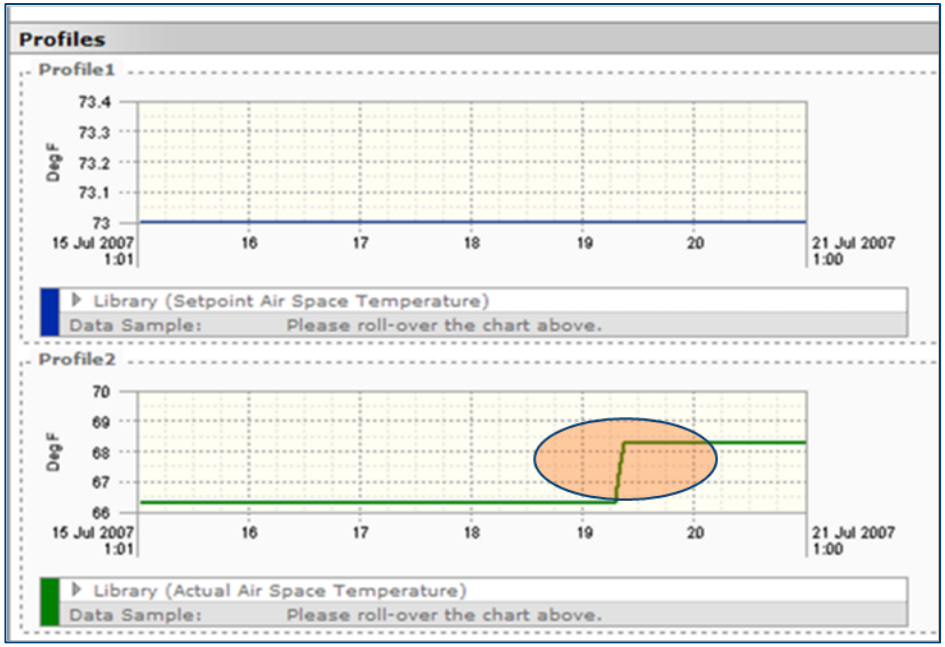
In this example, the change in control strategy represents an annual savings (occurring over swing season months) of $2,300 and 11- mTons of CO_2 avoidance.

Savings Category: Low Cost

Action Recommended: Repairing the damper linkage control resulted in proper Economizer operation reducing energy usage.

Examples – VAV Box Overcool

Often with many Variable Air Volume (VAV) boxes, actual space temperature can be significantly below the VAV Box set-point resulting in excessive cooling.



In this example, the properly operating VAV-Box had an annual savings of $260 and 1-short Ton of CO_2 avoidance, but was typical for 14 VAV-Boxes.

Savings Category: Low Cost

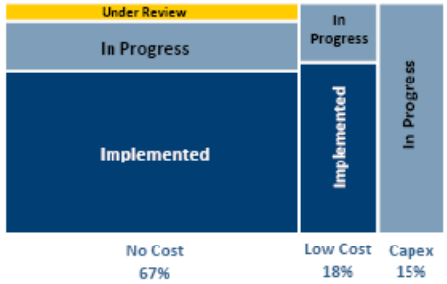
Action Recommended: This and several other VAV-Boxes, ~20%, were found to be in this condition and in a building that was still under warranty! The contractor was brought back in to fix all identified VAV-Boxes.

EnerNOC Deliverables – Monthly Scorecard

ABC Corporation Building 314 Monthly Scorecard for January 2009

MBCx Energy Efficiency Measure Overview

	annual savings	
No Cost	$31,631	67%
Low Cost	$8,404	18%
Capex	$7,219	15%
All Identified EEMs	$47,254	



Savings from MBCx Energy Efficiency Measures

$47,254 $

per year	
$2,430	Under Review
$16,213	In progress
$28,610	Implemented
-	Non- Actionable

756,170 kWh

per year	
14,481	Under Review
161,358	In progress
580,331	Implemented
-	Non- Actionable

9,425 therms

per year	
1,622	Under Review
7,803	In progress
-	Implemented
-	Non- Actionable

678 tons of CO_2

per year	
21	Under Review
175	In progress
482	Implemented
-	Non- Actionable

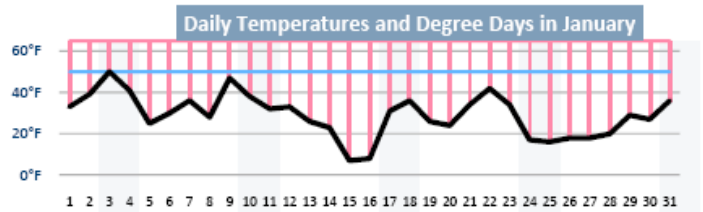
EnerNOC Deliverables – YTD Scorecard

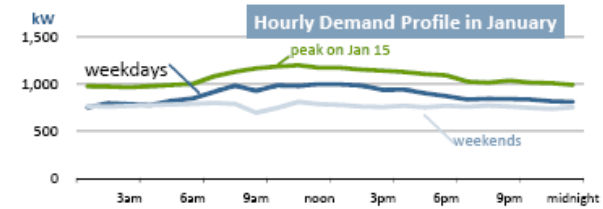
ABC Corporation Building 314 Detailed Electricity Usage

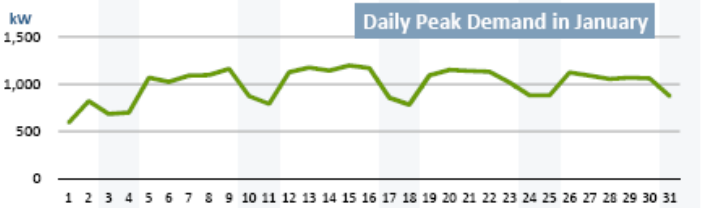
	January 1st-20th 2008	year to date
Usage	641,700 kWh	641,700 kWh
Baseline	615,400 kWh	615,400 kWh
Δ	26,300 kWh	26,300 kWh
	4.3% over baseline	4.3% over baseline
w/r/t IFMA Benchmark	-8.5% under IFMA avg	-8.5% under IFMA avg

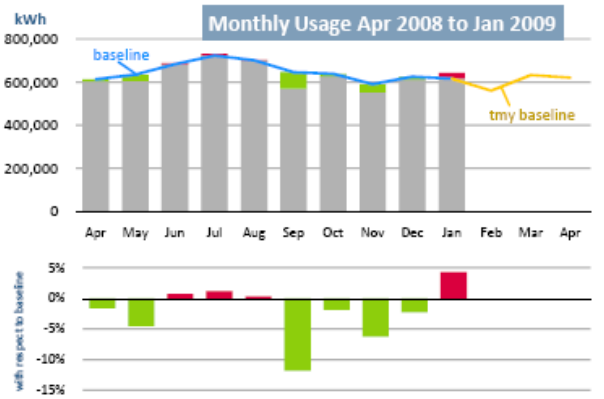
The electrical baseline was derived from hourly meter readings from April through November of 2008. This building's electricity usage baseline is dependent on cooling and occupancy.

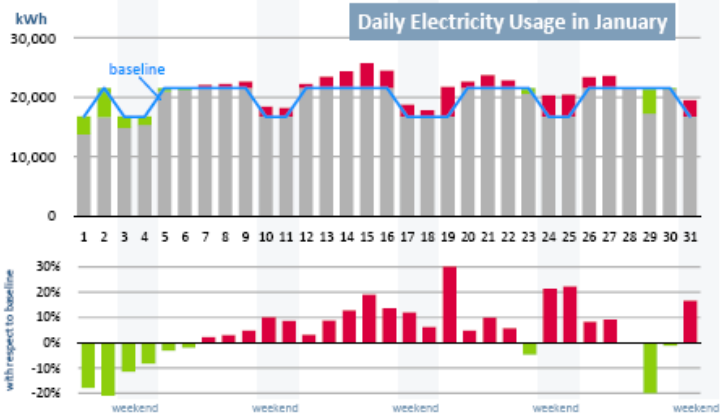
Heating Degree Days: 1,111 Cooling Degree Days: 0











EnerNOC Deliverables – MBCx Scorecard

Opportunities are summarized in a monthly report that lets your team focus on the highest value opportunities that fit into your capital budgeting process.

Energy Efficiency Measures - In Progress

	Recommendation	Equipment	Net Present Value (10 years @ 12% discount rate)	Estimated Cost	Payback (years)	Cost Category	Annual Savings: Value ($/yr)	Electricity (kWh/yr)	Natural Gas (therms/yr)	CO_2 (tons/yr)
EEM 10	Re-enable AHU Night and Weekend Setbacks	AHU - 6	$29,193	$0	0.0	No cost	$4,390	772	4,112	22
EEM 11	Waterside Economizer: Utilize Plate and Frame Heat Exchanger	Chiller 3	$23,501	$7,500	1.6	Capex	$4,662	94,557	-	79
EEM 15	Optimize Chiller #3 Chilled Water Temperature Delta	Chiller 3	$9,528	$100	0.1	Low cost	$1,448	29,366	-	24
EEM 16	Install Destratification Fan in Loading Dock and Remove Heater	HS-00378	$8,367	$2,000	1.3	Capex	$1,559	-	1,473	8
EEM 8	Re-enable AHU Night and Weekend Setbacks	AHU - 1	$8,203	$0	0.0	No cost	$1,234	292	1,152	6
EEM 9	Re-enable AHU Night and Weekend Setbacks	AHU - 2	$7,595	$0	0.0	No cost	$1,142	283	1,066	6
EEM 17	De-lamp T8 Lamp Fixtures in Hallways and Offices	Hallway and Office Overhead Lamps	$5,639	$1,000	1.0	Capex	$998	20,250	-	17
EEM 18	Lower Compressed Air Pressure	AHU - 1	$4,583	$100	0.1	Low cost	$704	14,285	-	12
EEM 19	Replace T12 with T8 Fixtures in East and West Mechanical Rooms	East and West mechanical rooms	$509	$0	0.0	No cost	$77	1,553	-	1
	All In Progress Measures		**$97,119**	**$10,700**			**$16,213**	**161,358**	**7,803**	**175**

Case Study – WCSU

WCSU has always been a progressive manager of energy. The Director of Facilities was initially skeptical that significant savings could be achieved through MBCx.

- Two campuses, with 25 buildings:
  - 5 buildings monitored on the BMS (Johnson Controls Metasys)
  - 13 buildings included in sub-metering
  - 7 buildings remain to be enabled
- Buildings include 283,000 square feet
  - Academic (classroom) Buildings
  - Library
  - Student Center
  - Admin Building

- Successful EnerNOC demand response customer since 2004
- ~$2.1 million annual energy spend

Case Study – WCSU

WCSU faced common energy management challenges all of which were busting the budget.

- **Energy Costs:** CT energy prices spiked by 40% in 2006, busting the budget
- **Lack of Visibility:** No site-specific reporting of energy use/profile to perform building-to-building or year-to-year comparisons.
- **Lack of Integration**: Disparate systems monitoring building energy usage, no integrated platform.
- **Lack of Support:** University understaffed, so a “detailed evaluation” of the BMS not a priority. Shrinking budget, capital expenditures hard to justify.

Ideal Opportunity for Monitoring-Based Commissioning

Case Study – WCSU

WCSU sought an approach that would eliminate capital investment, and make the process as simple as possible for the customer.

- Expand NOC Monitoring to include all existing sub-meters
- Integrate NOC with existing BMS system – “plug and play”
- Collect Meter and BMS Data in near real-time through PowerTrak
- Perform continuous remote monitoring
- Provide recommendation to WCSU facility staff on regular basis
- Trade DR revenue to fund integration expense and offset monthly MBCx fees

Case Study – WCSU

EnerNOC has significantly exceeded WCSU expectations on total energy savings and we continue to increase value nearly two years after implementation.

- In first 12 months EnerNOC identified over **$320,000** in annualized energy savings for this customer – over 15% of annual energy spend
- In first 12 months WCSU implemented measures with an actual M&V'd savings of nearly **$110,000** with an annual run rate of **$170,000** – 8% of annual spend. Currently at 12%.
- WCSU was recognized for this effort in an award for best energy management project from the New England chapter of the Association of Energy Engineers.
- There was no capital outlay on the part of WCSU – services were paid through deductions from Demand Response payments.

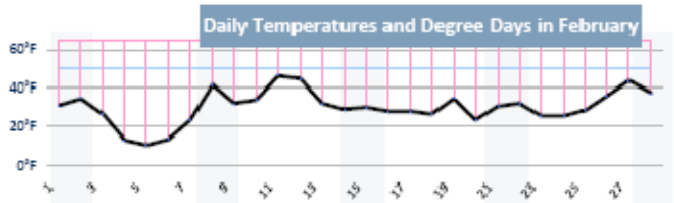
Case Study – WCSU

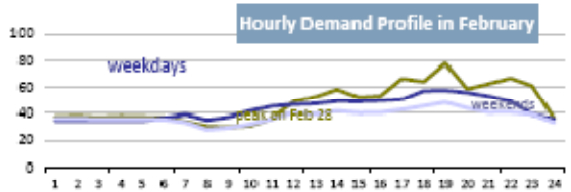
Building View

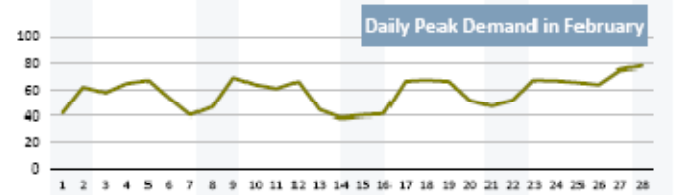
WCSU Berkshire Hall Detailed Electricity Usage

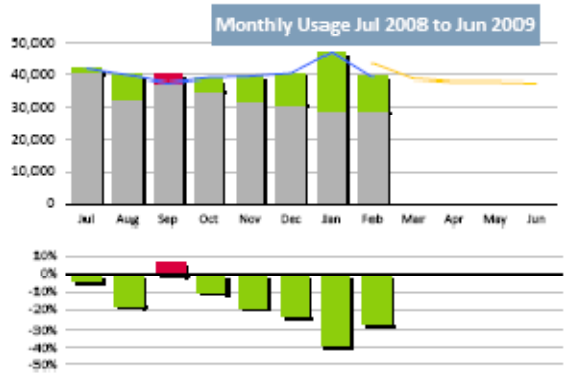
	February 2009	July 08 to Date
Usage	28,850 kWh	269,509 kWh
Baseline	39,310 kWh	324,541 kWh
Δ	-10,460 kWh	-55,030 kWh
	-26.6% under baseline	-17.0% under baseline

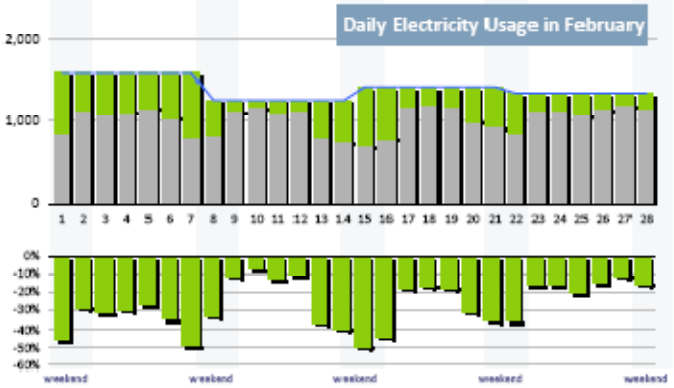
Heating Degree Days: 978 Cooling Degree Days: 0











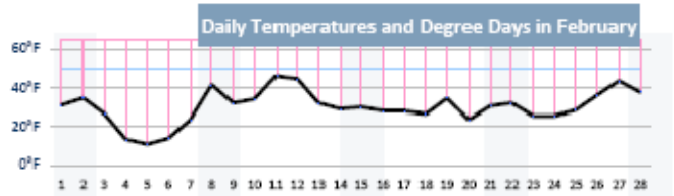
Case Study – WCSU

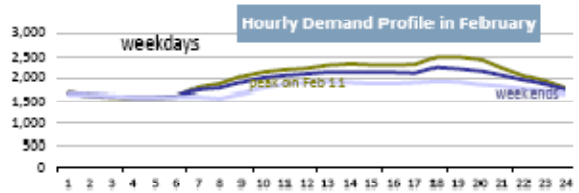
Campus View

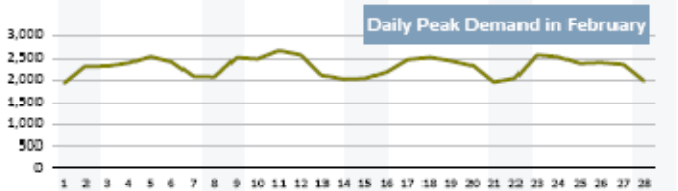
WCSU Campus Detailed Electricity Usage

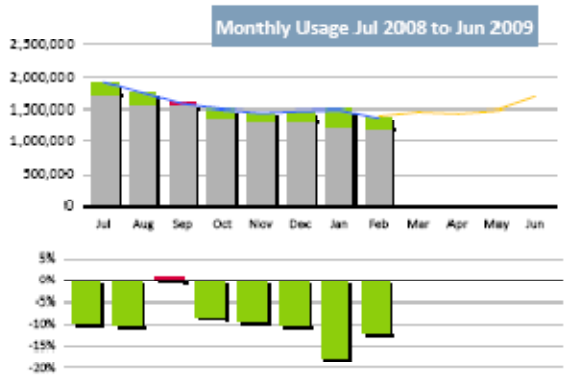
	February 2009	July 08 to Date
Usage	1,239,000 kWh	2,457,521 kWh
Baseline	1,381,000 kWh	2,888,041 kWh
Δ	-142,000 kWh	-430,500 kWh
	-10.3% under baseline	-14.9% under baseline

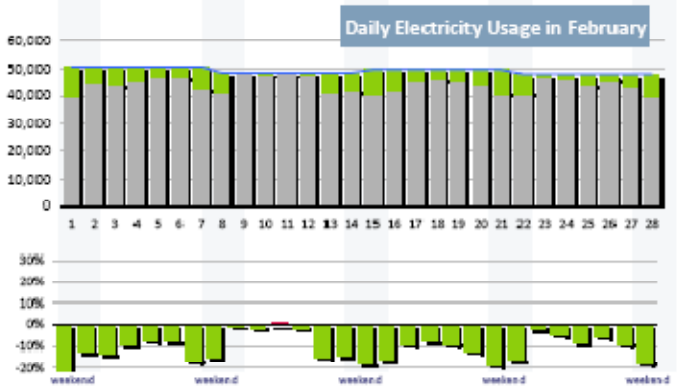
Heating Degree Days: 978 Cooling Degree Days: 0





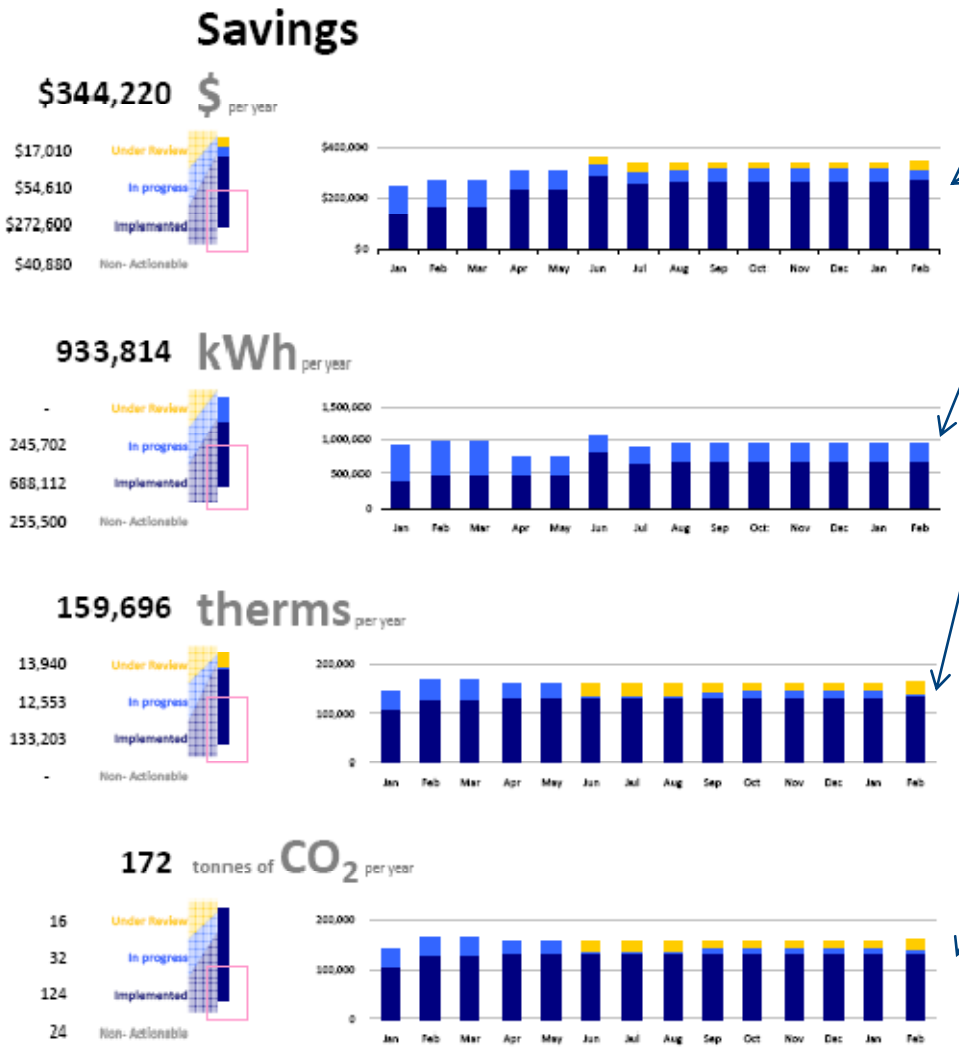






Case Study – WCSU

Savings Summary



Actual savings ramp over time.

Savings are converted into CO_2 equivalents using the eGrid database (US-EPA)