



NORTHEAST ENERGY EFFICIENCY PARTNERSHIPS

# AIA Session 9: THE HAND-OFF AND STAYING IN SHAPE: OPERATIONS, MAINTENANCE, AND EDUCATION

1.22.15

Policy and Practice Perspectives

# PRESENTATION SUMMARY



1. About NEEP
2. Predicted v. Actual Performance
3. The Handoff
4. Further Engagement and NE-CHPS
  - a. Integrated Design
  - b. Operations and Metrics
5. Total Cost of Ownership: Policies on the horizon
6. Case Studies and Exemplars
7. Resources

# 1. ABOUT NEEP

# Accelerate the efficient use of energy in the Northeast and Mid-Atlantic Regions

Overcome barriers to efficiency through  
*Collaboration, Education & Advocacy*

Transform the way we think about  
and use energy in the world around us.

One of six Regional Energy Efficiency Organizations (REEOs) designated by U.S. Dept. of Energy to work collaboratively with them in linking regions to DOE guidance, products



## 2. PREDICTED V. ACTUAL PERFORMANCE

# PREDICTED V. ACTUAL PERFORMANCE



New Buildings Institute- (2008)

“Energy Performance of LEED New Construction Buildings”

- Required one full year of measured post-occupancy energy usage data
- Of 552 buildings, only 121 buildings (21 percent) respond with the necessary data
- Measured EUIs for over half the projects deviate by more than 25% from design projections, with 30% significantly better and 25% significantly worse.

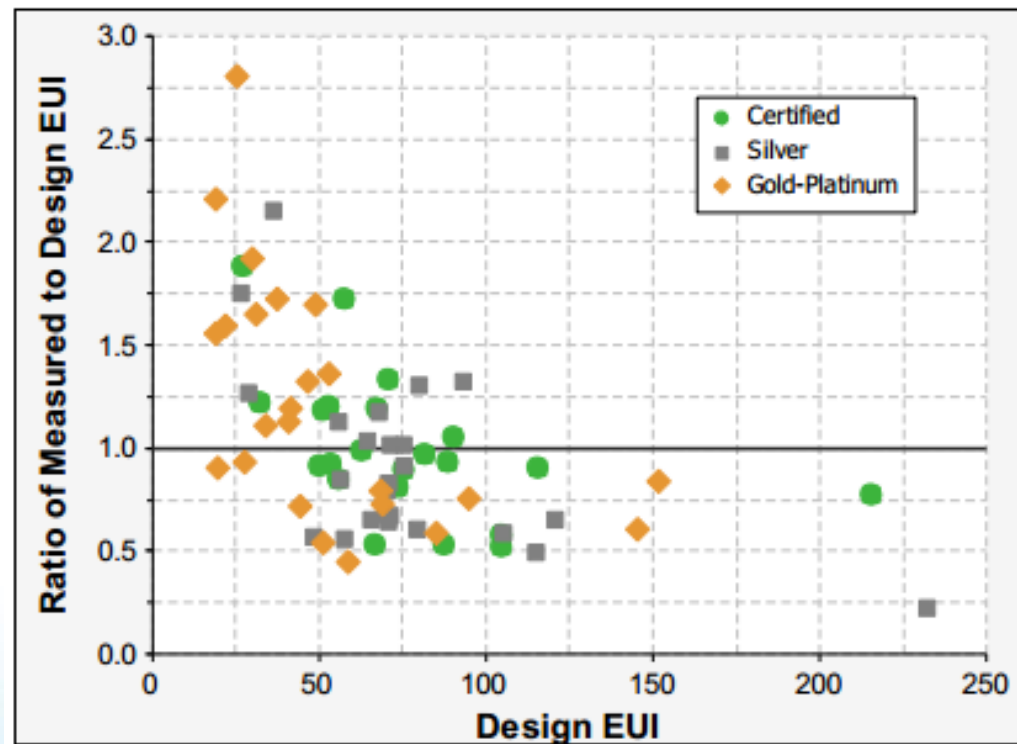


Figure 19: Measured/Design Ratios Relative to Design EUI

## Ideal world's Design/Construction Team

- Design Professionals
- The Owner
- Owner's Project Manager
- Commissioning Agent
- Facilities Director
- Occupants

But how often does this happen in practice?

What are some of the advantages?

Drawbacks?

More on this later...

# 3. THE HANDOFF



# “THE HANDOFF”: HORROR STORIES



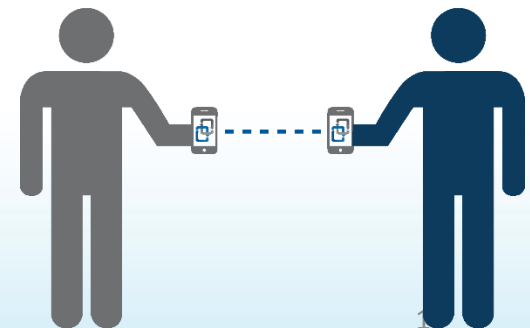
- Coordination between the trades
- Real world horror stories
  - Non Accessible filters
  - Walls and finish work before electrical finished
  - “Job Security”
- How can we move forward?



# “THE HANDOFF”: SUCCESS



- Planned replacements should be easily accessible
- Coordination between the trades
- Training and promotion
  - Building Operator Certification
    - Lakes Region Community College
    - February 20-May 29
    - \$1,480, reduced to \$740 if C&I customer of PSNH, Unitil, Liberty Utilities, or NHEC



## 4. IS FURTHER ENGAGEMENT THE ANSWER?

### THE NE-CHPS METHOD...

- A. Background
- B. Integrated Design
- C. Operations and Metrics

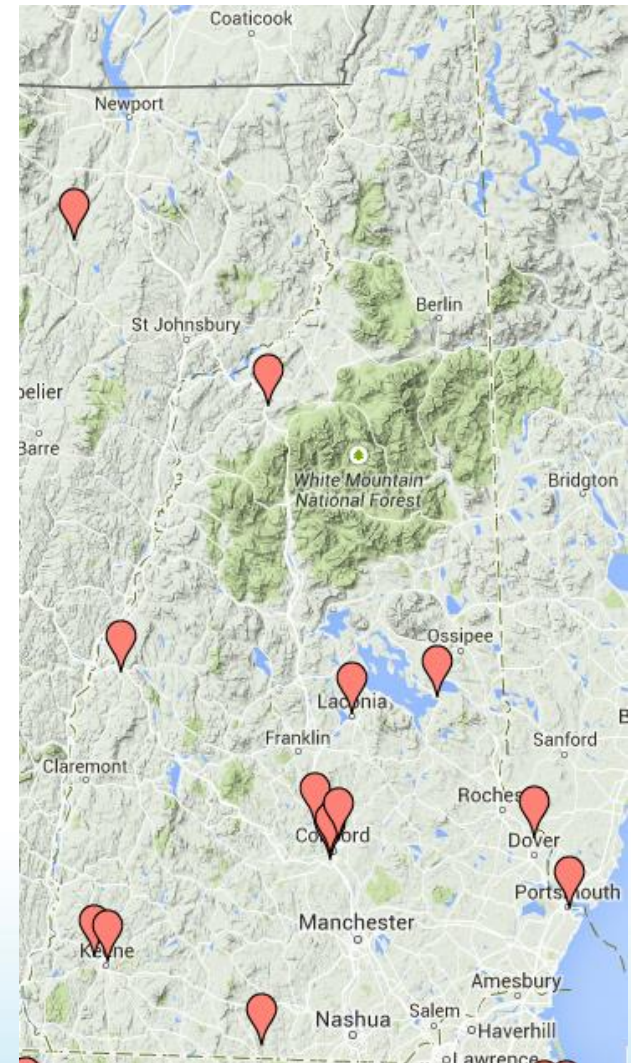
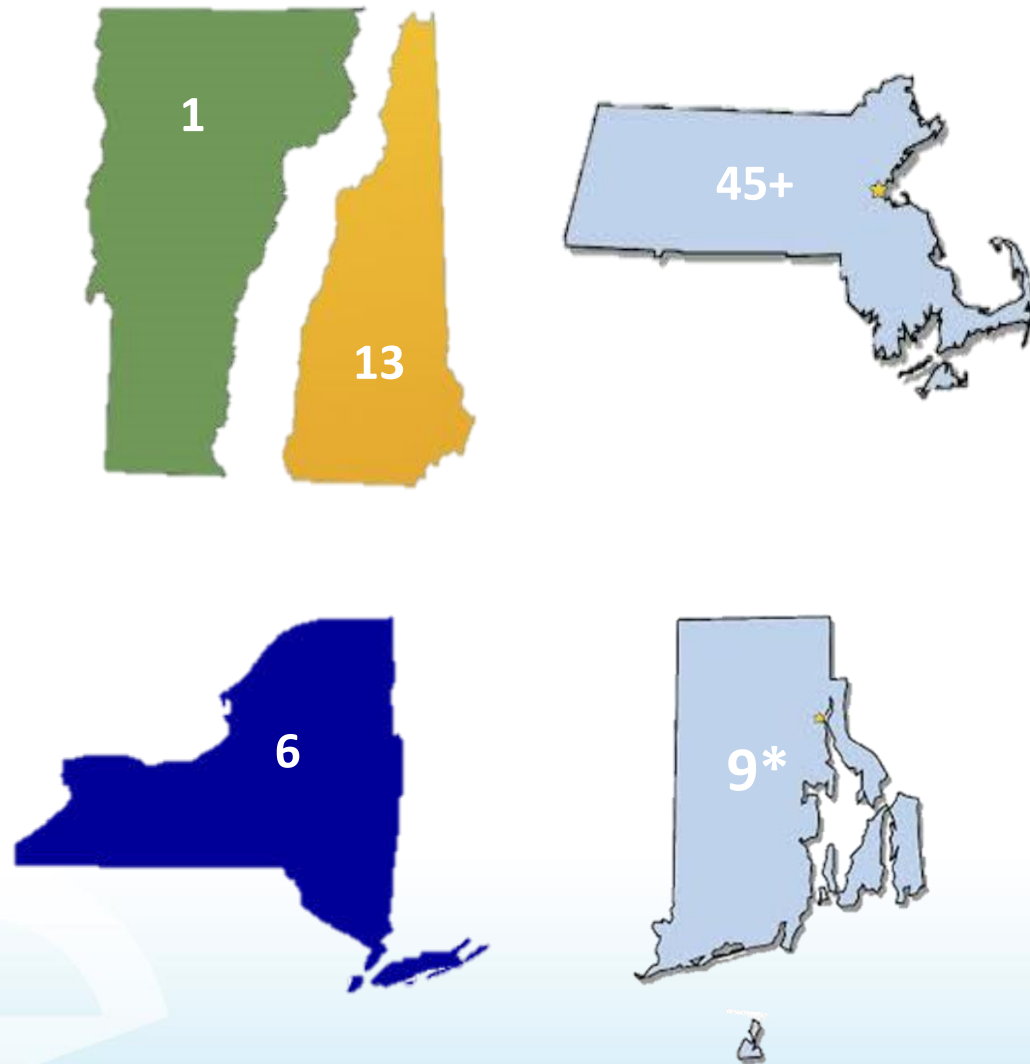
# BACKGROUND: WHAT IS NE-CHPS?



- NE-CHPS criteria is a **points based new construction/renovation roadmap** toward healthier, more efficient, and more productive schools
- For all schools from pre-K through community colleges.
- Stresses an integrated design process, indoor environmental quality, energy efficiency and building operation and maintenance practices that enable high performance without high costs



# BACKGROUND: CHPS IN THE REGION



# EXISTING NEW HAMPSHIRE NE-CHPS HIGH PERFORMANCE SCHOOLS



School Name	Location	Criteria Used	Status
Keene Middle School	Keene, NH	NE-CHPS Verified	Completed
Merrimack Valley High School	Penacook, NH	NE-CHPS Verified	Completed
Profile School	Bethlehem, NH	NE-CHPS Verified	Completed
Mason Elementary School	Mason, NH	NE-CHPS Verified	Completed
TNT Alternative School	Keene, NH	NE-CHPS Verified	Completed
Idelhurst Elementary School	Somersworth, NH	NE-CHPS Verified	Completed
Lebanon Middle School	Lebanon, NH	NE-CHPS Verified	Completed
Portsmouth Middle School	Portsmouth, NH	NE-CHPS Verified	Completed
Kingswood High School	Wolfeboro, NH	NE-CHPS Verified	Completed
Abbott-Downing Elementary School	Concord, NH	NE-CHPS Verified	Completed
Christa McAuliffe Elementary School	Concord, NH	NE-CHPS Verified	Completed
Mill Brook Primary School	Concord, NH	NE-CHPS Verified	Completed
Laconia Middle School	Laconia, NH	NE-CHPS Verified	Completed

# THE CRITERIA: PREREQUISITES



## Integration and Innovation

- Integrated Design
- Educational Display
- Crime Prevention through Environmental Design

## Operations and Metrics

- Facility, Staff, and Occupant Training
- Performance Benchmarking
- Indoor Environmental Management Plan
- Integrated Pest Management
- Anti-Idling Measures
- ENERGY STAR Equipment and Appliances

## Indoor Environmental Quality

- HVAC Designed to ASHRAE 62.1
- Outdoor Moisture Management
- Low Emitting Materials
- Daylighting: Glare Protection
- Views
- Acoustic Performance (35 dBA)

## Energy

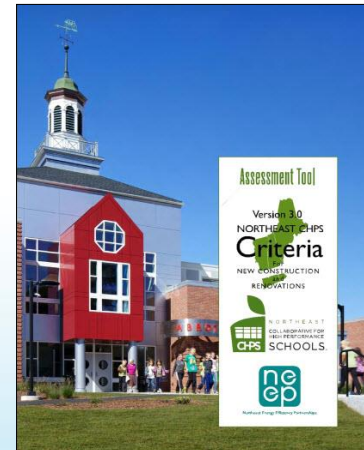
- Energy Performance (IECC 2012+10%/ NBI)
- Commissioning
- Environmentally Preferable Refrigerants
- Local Energy Efficiency Incentive & Assistance

## Sites

- Site Selection
- Site and Building Best Practices

## Materials and Waste Management

- Storage and Collection of Recyclables
- Minimum Construction Site Waste Management





# THE CRITERIA: METRICS AND EXAMPLES



Seven Basic Metrics	Related Example
1. Integrated Design Process	Architects consult with commissioning agents, teachers, and students
2. Indoor Environmental Quality	Walk-off mats keep pollutants outside
3. Energy Usage	Photosensor activated lighting
4. Water Usage	Low-flow toilets & waterless urinals
5. Site Selection/Development	Facility located near public transportation
6. Materials & Waste Management	Locally produced materials
7. Operations & Metrics	Occupant behavior seminars



## 4. THE NE-CHPS METHOD:

### A. INTEGRATED DESIGN

# INTEGRATED DESIGN PROCESS



- BC- Before construction
- Perform two integrated design team workshops
  - One prior to the end of the schematic design phase
  - One prior to the construction documentation phase

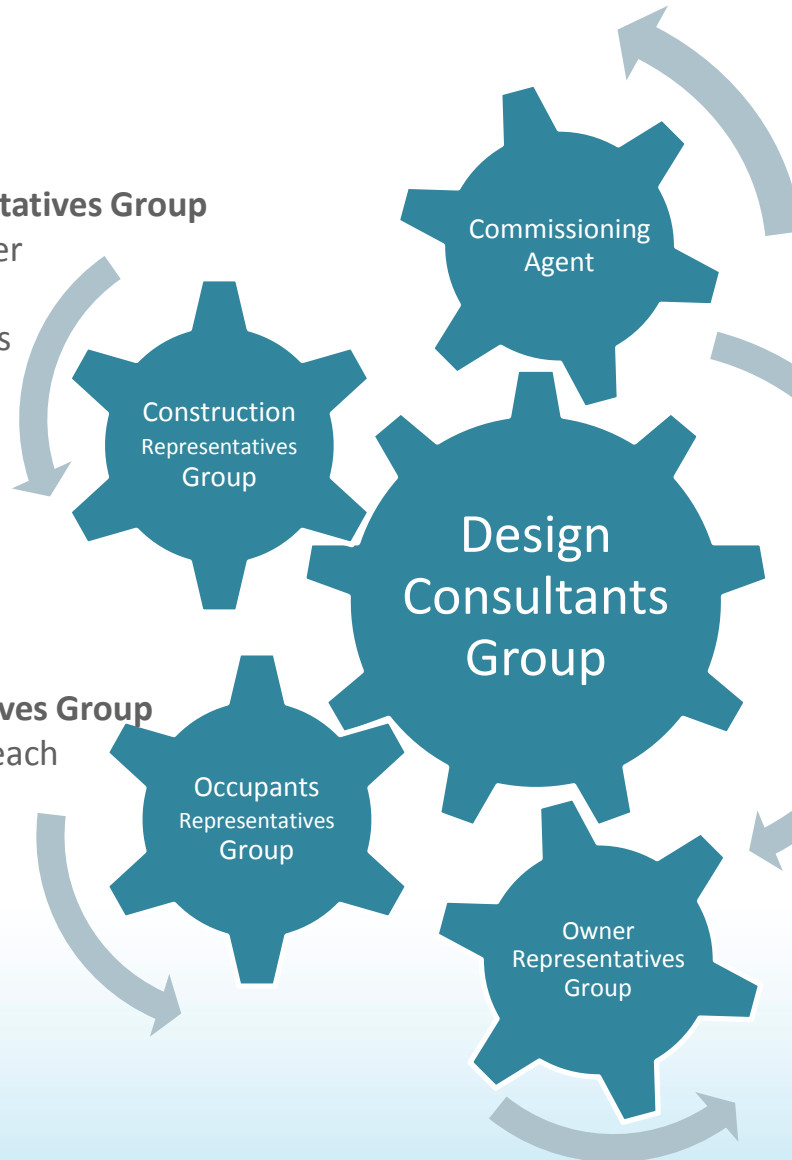
**But *who* participates?**

# NE-CHPS: INTEGRATED DESIGN PROCESS



## Construction Representatives Group

- Construction Manager
- General Contractor
- Major Subcontractors



## Design Consultants Group

- Architect
- Interior Designers
- Engineers (mechanical, plumbing, and civil)
- Food Service
- Acoustic and Energy Consultants
- Lighting Designer
- Landscape Architect

## Owner Representatives Group:

- OPM
- Facilities Maintenance Representative
- District or School Capital Project Staff
- Utility Representative

# 4. THE NE-CHPS METHOD:

## B. OPERATIONS AND METRICS

# NE-CHPS: OPERATIONS AND METRICS



- A. Facility staff and Occupant Training
- B. Post Occupancy Transition Plan
- C. Systems Maintenance Plan
- D. Computerized Maintenance Management Systems
- E. Occupant Engagement
- F. Performance Benchmarking
  - i. Portfolio Manager
  - ii. Data Access and Green Button

# OPERATIONS AND METRICS



## Facility Staff and Occupant Training (Required)

- Facility staff required to receive training and documentation on all building systems including all high performance characteristics, as well as the commissioning scope of work
  - Provided by construction contractor and reviewed by commissioning agent
- Key occupants are provided with training within 30 days of occupancy on any user operable of lighting, heating, and cooling systems.
  - Training re-occurs on an annual basis
  - Brief users' guide provided for all other occupants
- Commissioning agent responsible for reviewing all training documentation
- Building operator responsible for follow-up trainings

# OPERATIONS AND METRICS



## Post Occupancy Transition Plan (Credit)

### 1. Reach Out

- Brief post-occupancy survey to obtain feedback

### 2. Engage

- Post occupancy transition meeting of key stakeholders three months after substantial completion

### 3. Enhance

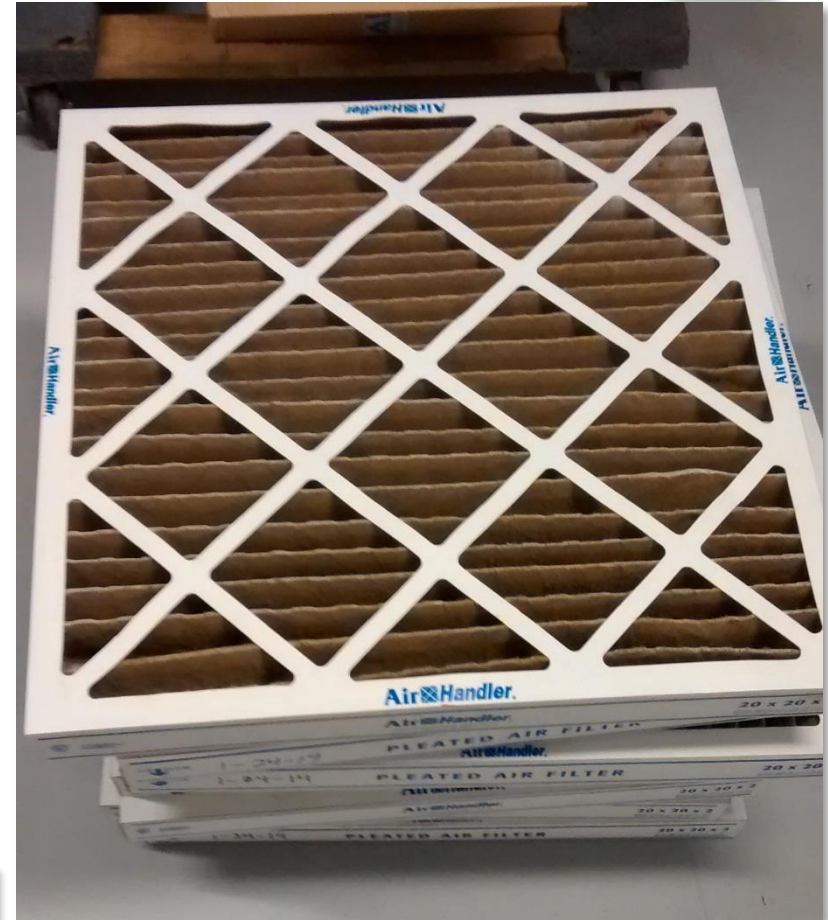
- Design and commissioning team use feedback to enhance building performance post-occupancy

# OPERATIONS AND METRICS



## Systems Maintenance Plan

- Putting out fires
- Plan ahead, set aside time, money
- Document maintenance





# OPERATIONS AND METRICS



## Systems Maintenance Plan- Saves money!

### DECREASES

- Equipment replacement costs over time
- Renovation costs because fewer large-scale repair jobs are needed
- Overhead costs (such as utility bills) because of increased system efficiency



# OPERATIONS AND METRICS



## Systems Maintenance Plan- What's included?

### **Electrical Systems:**

- Lighting fixtures and controls (daylight, occupancy, timing switches, etc.)
- On-site renewable solar electric or wind systems
- Telecommunication systems
- Electrical distribution systems
- Life and safety systems

### **HVAC Systems:**

- HVAC systems (such as hot water systems, chilled water systems, central air systems, ventilation systems)
- Domestic hot water systems
- Energy Management system
- Renewable energy heating systems (if applicable)

### **Plumbing Systems:**

- Flow control devices
- Pumping systems
- Special hazardous waste treatment systems (e.g. for lab wastes)
- Domestic hot water systems
- Graywater systems (if applicable)

### **Building Envelope and Roofing Systems (particularly acid management)**

### **Significant Plug Loads**

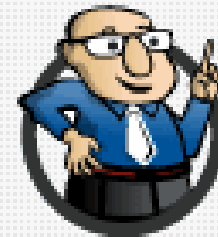
**Other High Performance systems as applicable.**

# OPERATIONS AND METRICS



## Computerized Maintenance Management System

- Not required, but encouraged
- Automatic scheduling and tracking of maintenance procedures
  - Distribution of work orders
  - Compilation of repair/replacement records
- May be integrated with other software programs, such as the energy management system
  - Can offer critical alarm notifications from BAS intelligent building devices



**FACILITY  
DUDE®**

# OPERATIONS AND METRICS



## Occupant Engagement

- LEED Dynamic Plaque
- Measures Energy, Water, Waste, Air, and Transportation in real time
- But... no requirement for real-time data; only as frequent as project team chooses
- Data uploaded via building automation system, Energy Star Portfolio Manager, manual input, etc...



Photo credit: [www.leedon.io](http://www.leedon.io)

# OPERATIONS AND METRICS



## Occupant Engagement

- Green Teams
- Shutting lights off
- Open / closing windows

### *See it in Action:*

#### **Energy Behavior Program in the Workplace: An Energy and Cost Savings Initiative from New Hampshire State Government**

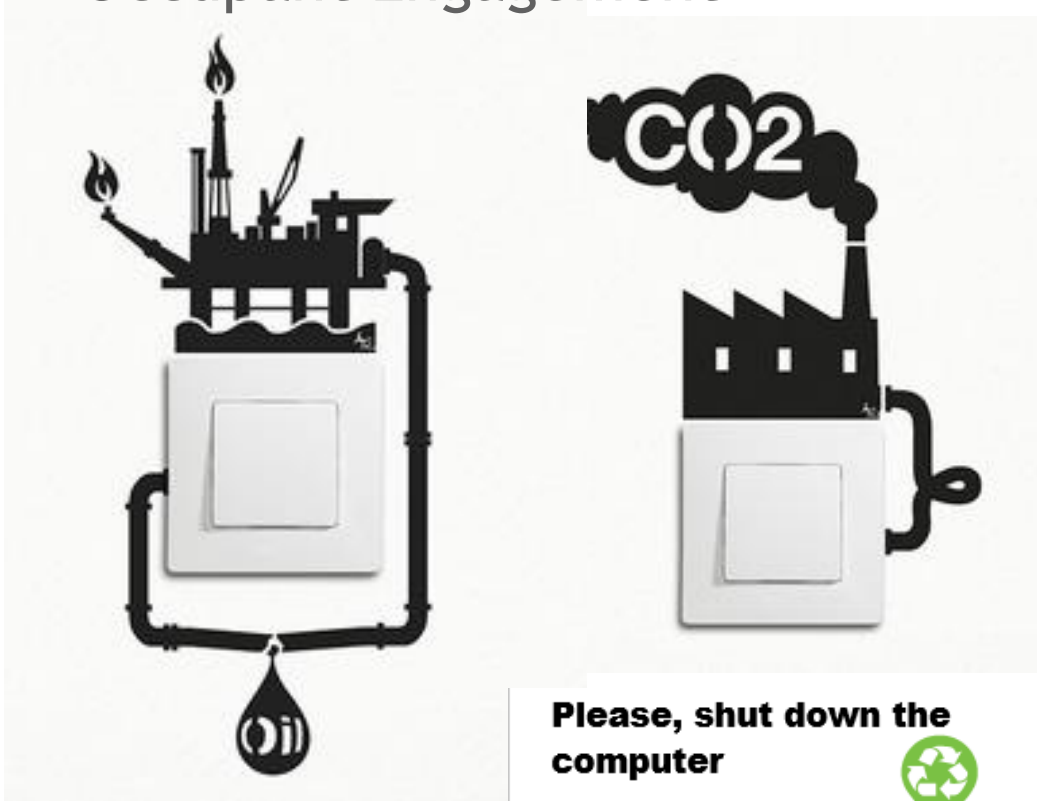
According to ACEEE 2012 report, "[\*Greening Work Styles: An Analysis of Energy Behavior Programs in the Workplaces\*](#)," government and institutional buildings are the best candidates to take the lead in promoting and set an example for energy behavior programs. An analysis of the reviewed case studies reports energy savings between 4% and 75% from standalone behavior program to comprehensive project with behavior component. Notable shared strategy among successful behavior programs is the use of [\*community-based social marketing\*](#) techniques and effective communication tools to engage building occupants.

As part of the interagency effort to encourage energy-savings behavior among state employees both at work and at home, New Hampshire recently launched an initiative that uses personal pledge forms asking employees to commit to various energy-saving actions, such as shutting off lights or unplugging appliances when not in use. The initiative accompanied with the use of prompt signs as action cue throughout state agency further increases the visibility of the program. The ACEEE 2012 study notes that personal pledge forms made in public often lead to a higher rate of actual action.

# OPERATIONS AND METRICS



## Occupant Engagement



**Please, switch me off**

[www.neep.org](http://www.neep.org)



**Please, shut down the computer**

[www.neep.org](http://www.neep.org)



**Please, turn off the copier at the end of the day**

[www.neep.org](http://www.neep.org)



**Please, don't leave the faucet running**

[www.neep.org](http://www.neep.org)



**Please, turn off the lights**

[www.neep.org](http://www.neep.org)



# OPERATIONS AND METRICS



## Performance Benchmarking (Required)

- Annual tracking of energy performance (building owner/facility manager's responsibility)

Industry standard=



BUT...

“I don’t have time to track down and input 12 months worth of utility bills from four different utilities...”

# OPERATIONS AND METRICS



## Portfolio Manager Manual Data Entry

▶ Natural Gas <a href="#">Edit</a>						<a href="#">✕ Delete Meter</a>
▼ Electric Grid Meter <a href="#">Edit</a>						<a href="#">✕ Delete Meter</a>
	Start Date	End Date	Usage kWh (thousand Watt-hours)	Cost (\$)	Estimation	Green Power
<input type="checkbox"/>	11/21/2014	12/22/2014	89	22.26	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	10/23/2014	11/21/2014	81	20.85	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	9/23/2014	10/23/2014	81	20.85	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	8/22/2014	9/23/2014	94	23.18	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	7/24/2014	8/22/2014	98	23.89	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	6/24/2014	7/24/2014	105	25.14	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	5/23/2014	6/24/2014	86	21.81	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	4/23/2014	5/23/2014	81	20.9	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	3/25/2014	4/23/2014	77	20.19	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	2/24/2014	3/25/2014	80	20.73	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	2/1/2014	2/24/2014	61	15.83	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	12/23/2014	1/24/2015	89	22.26	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	1/24/2015	2/25/2014	89	22.26	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Manual Input Errors, Time consuming...



# OPERATIONS AND METRICS



## Data Access

- US Department of Energy' Green Button Initiative
  - Download energy utility data in standardized format
  - Format matches EPA ENERGY STAR Portfolio Manager upload template
- Green Button “Connect My Data”
- US DOE's Apps for Energy challenge ([en.openEI.org](http://en.openEI.org))
  - 166 web apps, 36 mobile apps, 82 desktop apps
- Also, Portfolio Manager Web Service Data Exchange
  - Only with select few utilities



# OPERATIONS AND METRICS



## Green Button and Portfolio Manager

PM Template [Compatibility Mode] - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW ADD-INS ACROBAT Brian Buc...

Clipboard Font Styles

A2

1	Start Date	End Date	Usage	Cost	Estimated Value	F	G
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
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17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							

Consumption Info

READY



Portfolio Manager's  
Upload Template

output - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW ADD-INS ACROBAT Brian Buc...

Clipboard Font Alignment Number Styles

A1

Energy Usage Information- National Grid

1	Energy Usage Information- National Grid						
2	End Date	Days In Bill	Meter Read	Read Type	Usage (CCF)	Usage (Therms)	Usage (Cost)
3	12/11/2014	31	6062	ACTUAL	4	4	\$14.51
4	11/10/2014	32	6058	ACTUAL	4	4	\$13.90
5	10/9/2014	29	6054	ACTUAL	4	4	\$12.72
6	9/10/2014	28	6050	ACTUAL	3	3	\$11.39
7	8/13/2014	29	6047	ACTUAL	4	4	\$13.11
8	7/15/2014	32	6043	ACTUAL	4	4	\$13.91
9	6/13/2014	30	6039	ACTUAL	3	3	\$12.02
10	5/14/2014	33	6036	ACTUAL	5	5	\$16.54
11	4/11/2014	28	6031	ACTUAL	3	3	\$12.57
12	3/14/2014	30	6028	ACTUAL	4	4	\$14.46
13	2/12/2014	6	6024	ACTUAL	1	1	\$3.14

output

READY

Green\_Button - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW ADD-INS ACROBAT Brian Buc...

Clipboard Font Alignment Number Styles

A1

Energy Usage Information- NSTAR

1	Energy Usage Information- NSTAR						
2	For location:	7 LAKEVIEW TERRACE	WOBURN	MA 01801			
3	Data for period starting/ending	2/1/2014	12/22/2014				
4	Current billing period as of:	12/22/2014					
5							
6	Time period (start)	Time period (end)	Usage (KWH)	Cost of Usage			
7	11/21/2014	12/22/2014	89	\$22.26			
8	10/23/2014	11/21/2014	81	\$20.85			
9	9/23/2014	10/23/2014	81	\$20.85			
10	8/22/2014	9/23/2014	94	\$23.18			
11	7/24/2014	8/22/2014	98	\$23.89			
12	6/24/2014	7/24/2014	105	\$25.14			
13	5/23/2014	6/24/2014	86	\$21.81			
14	4/23/2014	5/23/2014	81	\$20.90			
15	3/25/2014	4/23/2014	77	\$20.19			
16	2/24/2014	3/25/2014	80	\$20.73			
17	2/1/2014	2/24/2014	61	\$15.83			

Green\_Button Export:

21 The data you have downloaded from the Green Button allows you to view your electricity usage i

22 This information can help you make money-saving and environmentally-friendly decisions.

23 As you make changes use Energy Charts to monitor how your energy use changes over time.

Green\_Button

READY

Data from  
Green Button



# WHO OFFERS GREEN BUTTON?



(Northeast and Mid-Atlantic Region)

## Currently uses

- Pepco Holdings
- National Grid
- Baltimore Gas and Electric
- Bangor Hydro Electric Company
- Consolidated Edison
- Connecticut Light and Power
- NSTAR
- Public Service of New Hampshire
- United Illuminating
- Western Massachusetts Electric Company

## Future Commitments

- Central Maine Power
- Efficiency Vermont
- PPL Electric Utilities
- PECO
- West Penn Power



## 5. TOTAL COST OF OWNERSHIP: POLICIES ON THE HORIZON

# TOTAL COST OF OWNERSHIP



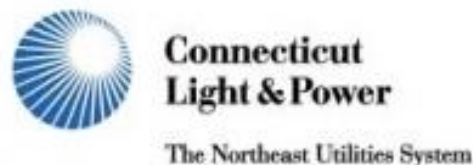
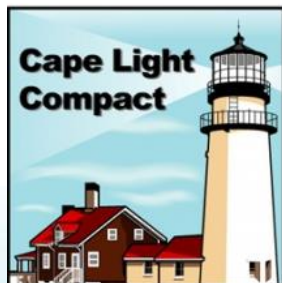
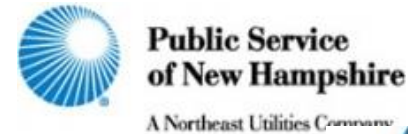
Policy land...

- A. Efficiency Program Incentives
- B. Outdoor lighting and LEDs
- C. Lighting controls
- D. Plug Loads and Advanced Power Strips
- E. Photovoltaic Ready
- F. Electric Vehicle Ready
- G. Energy Storage and Grid Defection

# EFFICIENCY PROGRAM INCENTIVES



Check Before Purchase!!





# OUTDOOR LIGHTING AND LEDs



## Cost Savings

- ❑ Energy Cost-Savings (uses 50% less energy)
- ❑ Maintenance Cost-Savings (~\$50/lamp/year)



## Collateral Benefits

- ❑ Extended Lifecycle
- ❑ Reduced Carbon Emissions
- ❑ Reduced Light Pollution at Night
- ❑ Lighting Quality
- ❑ Durability Impedes Vandalism
- ❑ Great Perceived Security

### *See in Action:*

#### **New Hampshire Communities Taking Advantage of PSNH Municipal Smart Start Program to Upgrade Streetlights**

The [Smart Start Program](#) offered by Public Service of New Hampshire (PSNH), an electric utility, assists municipalities installing energy-saving measures with no up-front costs. Payments can be made over time through an added cost, which is calculated to be less than the monthly savings to a municipal facility's monthly electric bill. Municipalities benefit from both the payment plan and savings obtained from lower energy costs.

Thanks to the PSNH's Smart Start program, several New Hampshire communities have been able to make important energy saving [upgrades to their streetlights](#) by replacing inefficient fixtures with more energy-efficiency ones. For example, towns of Bristol, Chesterfield, Jaffrey, and Marlow converted a total of 479 inefficient streetlights, with an estimated conversion cost per town ranging from \$10,904 to \$91,038. Savings are estimated to range between 15 to 30 percent of an annual municipal street lighting bill.

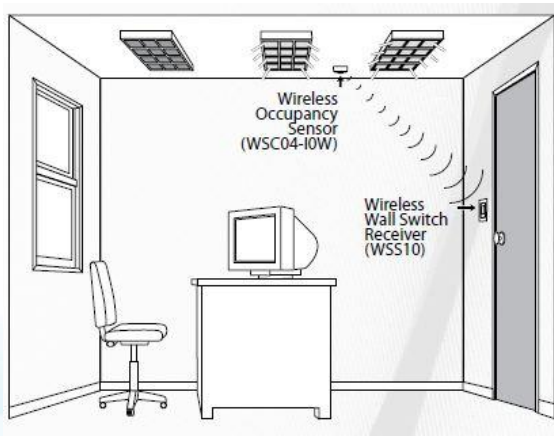
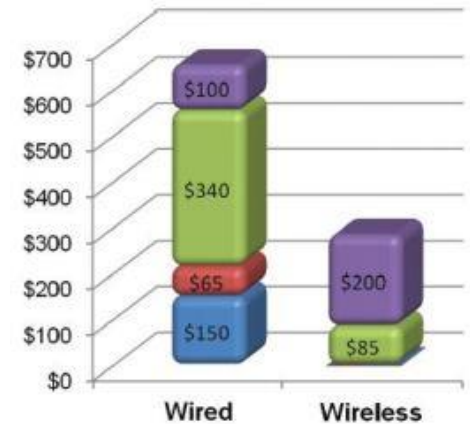
# BUILDING LIGHTING CONTROLS



## Types (to name a few):

- Photosensor-based (reactive to daylighting)
- Scheduled (on a timer)
- Motion sensitive (Ceiling or wall mount- ceiling preferred)
- Wireless controls are cost-competitive in many applications

## WIRED VS. WIRELESS COSTS



■ Parts ■ Re-Paint  
■ Labor ■ Drywall Patching



# BUILDING LIGHTING CONTROLS

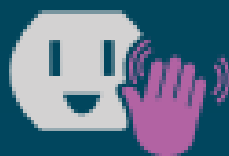


- Lighting controls can serve as a gateway to the internet of things
- Networked, IP addressable
- Sensor node in a broader intelligent network
- Occupancy sensors integrate into building automation system, interacting with:
  - Lighting and controls for natural light optimization
  - Electrochromic windows
  - Plug load controllers
  - Security protocols
  - HVAC
  - Etc.
- NEEP's CALC project attempting to bring order to protocol chaos

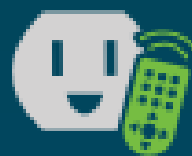
# ADVANCED POWER STRIPS



**Timer Power Strip**



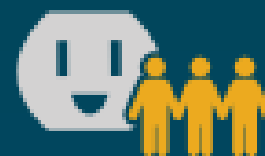
**Activity Monitor Power Strip**



**Remote Switch Power Strip**



**Master-Controlled Power Strip**



**Masterless Power Strip**

**COST**



**FEATURES**

Power strip automatically turns off outlets based on a pre-set schedule.

Power strip looks for signs of activity in the room, and turns off outlets if none is detected.

Power strip can be turned off by the user via a remote switch.

When a primary device (such as a computer or TV) is turned off by the user, the power strip automatically turns off the controlled outlets where the peripheral devices (such as the printer or game console) are plugged in.

When all of the controlled devices are turned off, the power strip turns off power to those outlets completely, eliminating all of the vampire loads.

**POSSIBLE DRAWBACKS**

You have to set up the timer and stick to your schedule for maximum energy savings.

Motion sensors don't always work perfectly.

To save any energy, you have to remember to turn off the power strip each time.

It can be tricky to select which appliance should be your "master" device.

Turning off one high-powered appliance could turn off the entire power strip.

**WHAT TO LOOK FOR**

Digital or dial timer.

Motion sensor or an infrared "eye" that detects remote control use around the TV or stereo.

A tethered switch or a remote switch.

One outlet is labeled as the "master."

No "master" outlet. Description may include "automatic switching" or "power detection."

# PHOTOVOLTAIC READY



Business Model Innovation will soon bring solar to all at no up front cost...

- Third party turn-key project developers around the country:  
Solar City, SunRun, Sungevity, Vidaris, **Real Goods Solar**

What *is* Photovoltaic ready?

- Traditional wisdom says a roof area facing due South at pitch roughly equivalent to average angle of the sun in the sky

But... Dynamic Pricing/Time of Use rates are coming...

- Peak Energy usage occur later in the day, suggesting a westward tilt of PV systems



# PLUG IN HYBRID ELECTRIC VEHICLE READY



## Chevy Volt

- \$39,995 MSRP
- 38 mile electric range



Photo Credit: Wikimedia

## Toyota Prius

- \$32,795 MSRP
- 10 mile electric range



Photo Credit: Wikimedia

## Ford CMAX Energi

- \$33,745 MSRP
- 20 mile electric range

Photo Credit: Wikimedia

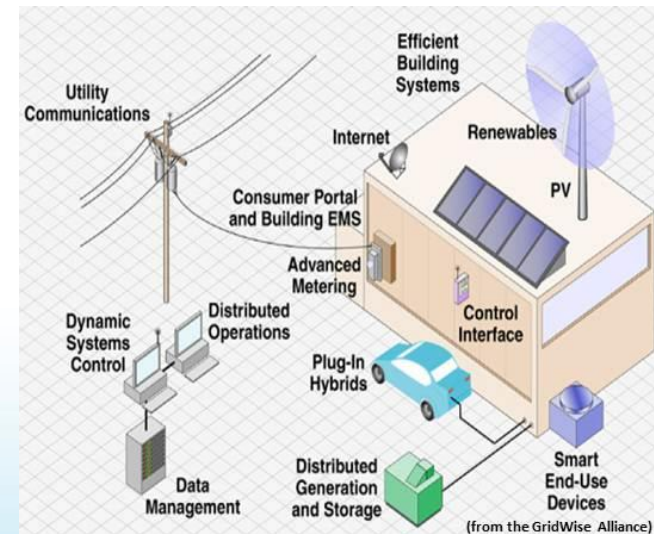


Photo Credit: GreenTechMedia

# ELECTRIC VEHICLE READY



## Tesla Model S

- 265 miles range
- Costs \$69,900
- **BUT model 3 coming in 2017 for \$35,000**

Photo Credit: Slate



## Chevy Bolt (projected 2017)

- 200 miles range
- \$30,000 (after tax credit)

Photo Credit: Wikimedia



## Nissan Leaf

- 75 miles range
- \$200/month lease
- Costs \$21,510 (after tax credit)

## BMW i3

Photo Credit: Car and Driver

- 80 miles range
- \$41,350





# ENERGY STORAGE AND GRID DEFLECTION



Photo Credit: RMI



## 6. CASE STUDIES

# THREE NEW HAMPSHIRE CASE STUDIES



## 1. Profile School

- Bethlehem, NH (2008)

## 2. Merrimack Valley High School

- Penacook, NH (2008)

## 3. Keene Middle School

- Keene, NH (2011)

## 4. Paul W. Crowley East Bay Met Center

- Newport, RI (2013)



# PROFILE SCHOOL

Bethlehem, NH - *NE-CHPS Verified* (Renovation)



Profile School  
Bethlehem, NH (2008)

## High Performance Features:

- 90% of the classrooms do not need air conditioning
- Indoor spaces receive 100% outdoor air ventilation
- three-part entry mat system stop pollutants at the door
- 60% local construction materials
- Community shared-space policy uses the school as a teaching tool

**“The air quality is *unbelievably* different.”**

—Principal Michael Kelley

# MERRIMACK VALLEY HIGH SCHOOL

Penacook, NH - *NE-CHPS Verified* (Renovation)



Merrimack Valley High School  
Penacook, NH (2008)

## High Performance Features:

- Air exchange/ventilation system
- Wood chip-fired boiler
- Hydronic heating distribution system
- Building envelope sealing
- Electrical improvement (lighting, pumps, motors, controls, remote sensing etc.)

*61% energy cost savings*

(prior condition as baseline)

# KEENE MIDDLE SCHOOL

Keene, NH - *NE-CHPS Verified* (New Construction)



Keene Middle School  
Keene, NH (2011)

## High Performance features:

- Wood chip heating plant
- 30,000 gallon rainwater harvesting system
- Reflective roof surface
- Extensive daylighting
- Heat recovery ventilation
- Energy management system
- Energy efficient lighting

*34.5% energy costs savings*

(projected from baseline)

# EAST BAY MET ( ZNE DESIGNED)

Newport, RI



## General Information

**Location:** 115 Girard Ave., Newport, RI 02840  
**Scope:** 16,800 square feet, new construction  
5,000 sqft of sheltered exterior program space  
**Cost:** \$8.8 million (including land purchase)  
**Completion:** January 2014  
**Enrollment:** 180 high school students  
**Project Team**  
Architect: Robinson Green Beretta Co.  
Engineering: Odeh Engineers/ Stantec, Inc.  
Construction: Gilbane, Inc.



“The greatest aspect of this school is the incredible indoor air quality“

-Taylor Rocc

Teacher, East Bay Met School

### **Net Zero Facility:**

- Maximize natural day lighting through building orientation.
- 150kW Photovoltaic system
- Air tight building enclosure
- Super insulated shell
- “Cool roof”
- Innovative ventilation system
- Geo-thermal heat pump
- LED Lighting/ Day Lighting Control
- Water efficient fixtures
- Rainwater Harvesting

### **School as a Teaching Tool:**

- Recycling Program
- Energy Tracking w/ EPA Portfolio Manager
- Drinking water sampling program
- School/Community Garden
- Green Team
- Indoor Environmental Management Plan
- Integrated Pest Management Plan



# EAST BAY MET ( ZNE DESIGNED)

Newport, RI



## Commissioned systems:

- Heating Hot Water Systems
- Energy Recovery Unit
- Geo-Exchange System & Ground Source Heat Pumps
- Solar Thermal Domestic Hot Water System
- Rainwater Harvesting System
- Energy Metering & Dashboard

# EAST BAY MET ( ZNE DESIGNED)

Newport, RI



- First year energy use monitoring indicates that the East Bay MET Center has used approximately 15% more energy than predicted. Primary causes of higher energy use than predicted are:
  - Operator error
  - Ground source heat pump integration issues
  - Solar thermal system operational issues
  - Occupant behavior

# EAST BAY MET ( ZNE DESIGNED)

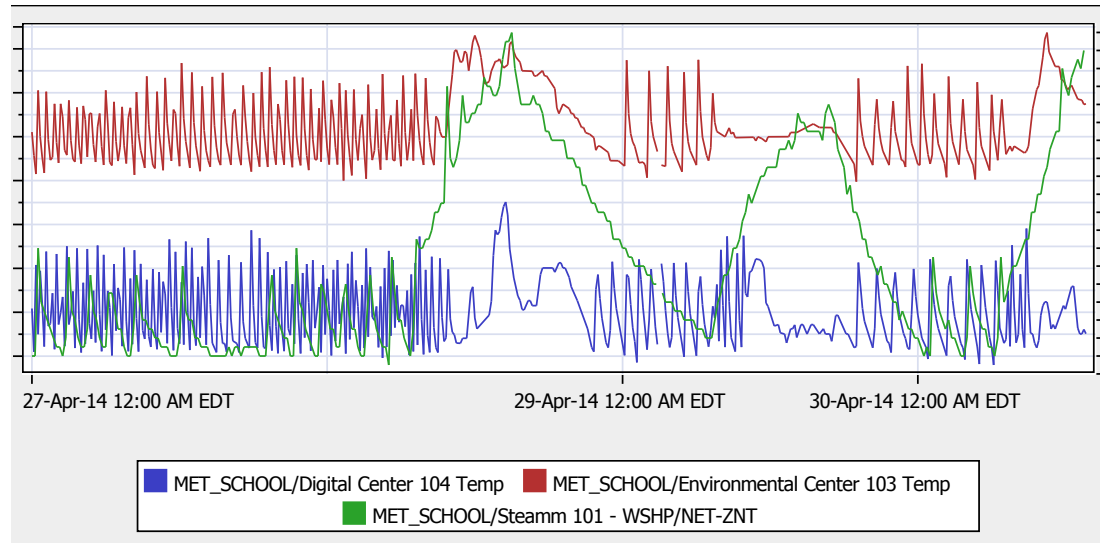
Newport, RI



- Vacation and holidays were not programmed into the Building Automation System (BAS) resulting in the building running in occupied mode for multiple days that were not predicted.
- The heating hot water plant was not turned off during summer months as predicted.

# EAST BAY MET ( ZNE DESIGNED)

Newport, RI



- Ground source heat pumps operate per Original Equipment Manufacturer (OEM) controls and serve the same spaces as field controlled fin tube radiation.
- Trend data indicates that ground source heat pumps are not operating to maintain the unoccupied temperature setpoint.



# EAST BAY MET ( ZNE DESIGNED)

Newport, RI



## Solar Thermal

- Operational issues were identified with the 3-way valve during functional performance testing.
- During first year monitoring it was determined that the 3-way valve was not modulating to circulate solar thermal energy to the pre-heat tank due to a faulty panel temperature sensor.
- Proper operation of the solar thermal system is predicted to save 5,860 kWh or approximately 20,000 kBtu per year.

Slide Credit: Chris Armstrong, Stephen Turner Inc.

# EAST BAY MET (ZNE DESIGNED)

Newport, RI



- Spaces designed as workrooms are being used as private offices.
- Space temperature setpoints set above (or below) assumptions used in energy modeling
- Stuff!! Items that were not intended to be in the building are in the building. (e.g., portable refrigerators, fans, task lights, holiday lights)

## 7. RESOURCES

# US DOE/EPA RESOURCES



- Better Buildings Challenge

- States, municipalities, corporations commit to reducing energy usage by 20% over five years
- Summit May 27-29, 2015



2 ENERGY STAR Guidelines for Energy Management

### Overview

Continuous improvement of energy performance requires establishing effective energy management practices and processes to guide the energy program. Any organization, regardless of size, function, or mission can develop an effective energy program if they are willing to make the commitment.

The US EPA's *ENERGY STAR Guidelines for Energy Management* provides a proven strategy for creating an energy management program focused on continuous improvement of energy performance. The process builds on the commitment organizations make when they become an ENERGY STAR partner.

Based on the successful practices of ENERGY STAR partners, these guidelines for energy management can assist your organization in improving its energy and financial performance while distinguishing your organization as an environmental leader. Thousands of organizations have used the Guidelines to tailor their approach towards managing energy that delivers results and demonstrates leadership.

This document is intended to provide additional information and guidance to the ENERGY STAR Guidelines for Energy Management outlined on the ENERGY STAR web site. References to additional energy management resources and tools discussed in the text and in the Appendix can all be found on the ENERGY STAR web site.

The Guidelines for Energy Management follow seven main steps that are outlined below and illustrated in the graphic.

**The steps:**

- STEP 1: Make Commitment
- STEP 2: Assess Performance
- STEP 3: Set Goals
- STEP 4: Create Action Plan
- STEP 5: Implement Action Plan
- STEP 6: Evaluate Progress
- STEP 7: Recognize Achievements

Compare your program to the Guidelines

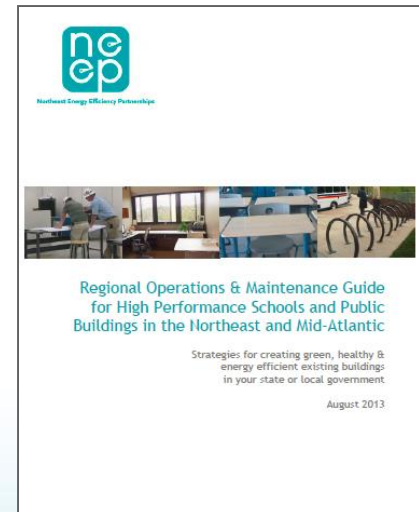
ENERGY STAR offers several assessment tools designed to help you compare your current energy program and practices to those identified in the Guidelines for Energy Management. Use the Energy Program Assessment Matrix to evaluate your organization's energy program. Use the Facility Energy Assessment Matrix to energy management practices at your facilities. Both tools are provided in Appendix 1 or can be downloaded at [www.energystar.gov/guidelines](http://www.energystar.gov/guidelines)

- ENERGYSTAR  
Guidelines for Energy Management

# NEXT STEPS: NEEP RESOURCES

For further info:

- Visit the NEEP's NE-CHPS [website](#)
- Access the [latest version](#) of NE-CHPS
- Check out the Public Buildings [Operation & Maintenance Guide](#)
- Contact:  
Brian Buckley at [bbuckley@neep.org](mailto:bbuckley@neep.org)  
Carolyn Sarno at [Csarno@Neep.org](mailto:Csarno@Neep.org)



QUESTIONS/COMMENTS?