



Real-time Energy Management: Saving Energy Every 15 Minutes

May 8, 2014

Overview and Agenda

- Welcome and Overview
- Lawrence Berkeley National Laboratory (LBNL) – Business Case for Energy Information Systems (EIS)
- Massachusetts Department of Energy -- State Facilities
- Lend Lease – Military Housing
- The Tower Companies – Commercial Properties
- Q & A

Today's Presenters



Jessica Granderson

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Massachusetts Department of
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Costs and Energy-Saving Benefits of EIS

Jessica Granderson, PhD
Guanjing Lin, PhD
Lawrence Berkeley National Laboratory

2014 Better Buildings Summit, May 7-9, 2014

Supported by DOE Building Technologies Office, K. Taddonio, A. Jiron

Outline

- Motivation
- Study design
- Findings highlights
- Conclusions

EIS - Promising Technology, Barriers to Adoption

- Growing number of case studies document benefits, but use different metrics, narratives
 - payback, \$ savings in year 1, % EUI savings, total Btu savings
- Currently we can say that EIS
 - Enable savings up to 20% depending on depth of metering, user engagement,
 - Cost anywhere from \$5K/yr up, depending on extent of software features, # points, configuration needs
- Widespread EIS adoption hindered by 2 critical barriers:
 - 1) lack of information on technology cost, associated energy/cost savings
 - 2) limited understanding of how to use technology for maximum benefit

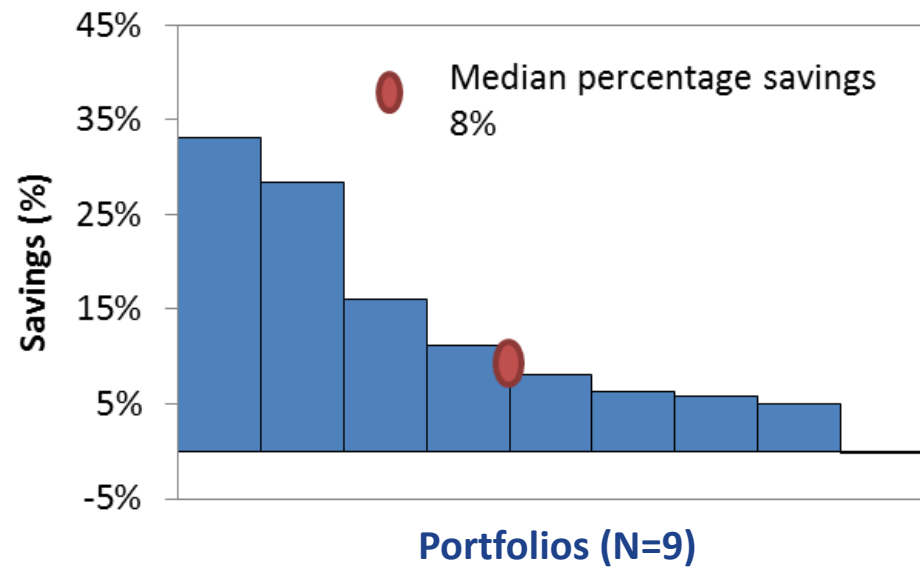
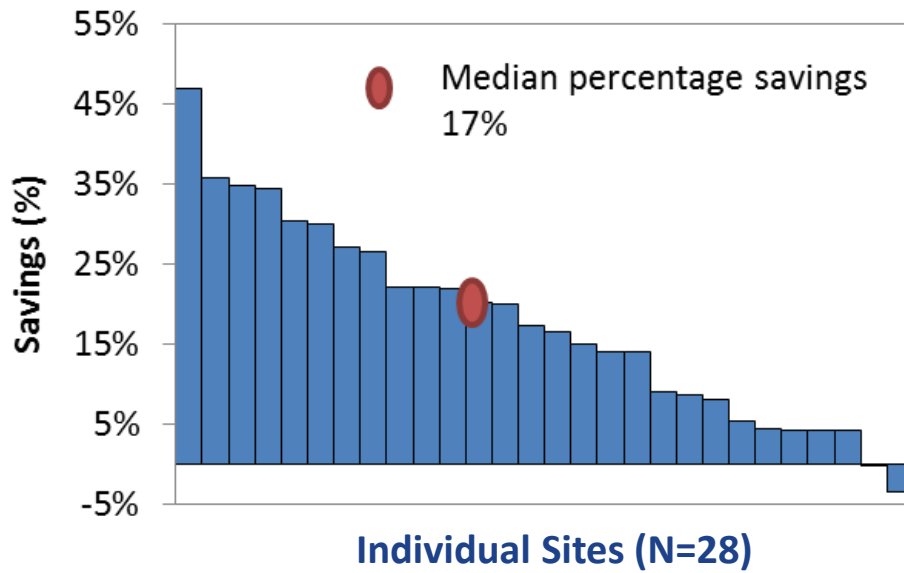
Study Design

- Conduct a series of targeted case investigations of 20-30 EIS implementations to determine
 - Technology costs, site/campus energy saving trends since adoption of the EIS
 - Technology uses to identify opportunities, realize savings
- Participant cohort represents diverse EIS solutions, commercial building sectors, geographies
 - mostly enterprises and hospital, office, and educational campuses
 - **17 different EIS, 26 participating organizations**



Findings Highlights: Achieved Savings, Role of EIS

- Median energy savings - 17% (building); 8% (portfolio)
- Median utility savings - \$56K (building); \$1.3M (portfolio)
- 21 of 23 cases said they couldn't achieve this performance w/o EIS



Findings Highlights: EIS Benefits

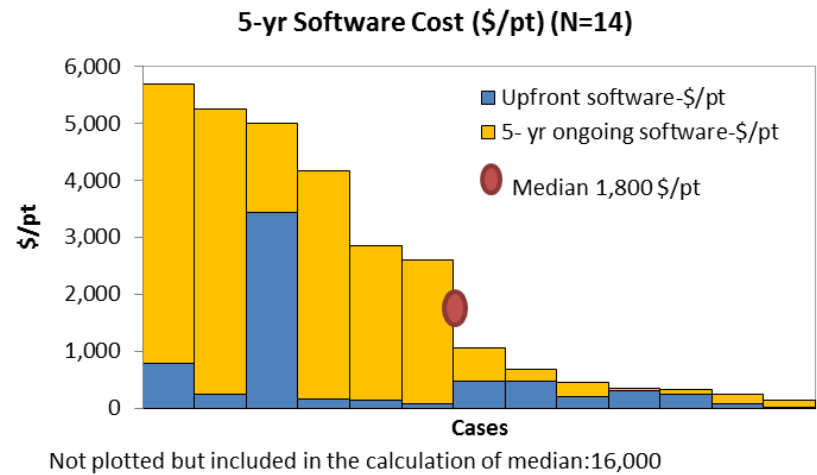
- Most frequently cited benefits of EIS included
 - Identify **operational efficiency opportunities**
 - Scheduling, faults and anomalies, changes in load profile
 - Ability to **track performance, compare** to self and others
 - Monitor peak load and **manage demand charges**
 - Utility **billing validation**
 - **Data** for other custom analyses
 - Information to **ground and set energy goals**

“To realize savings you have to provide tools to enable people to measure their success - you can’t put a price tag on that.”

“Operators ended up considering it like a game... Everybody in the building got excited, and realized how powerful the tool was, and that it would really be used to save”

Findings Highlights: EIS Technology Costs

- What drives the range?
 - No effect due to on-premise vs SaaS delivery models
 - Economies of scale in \$/pt as size of implementation increases (total #pts)
 - Diversity in vendor pricing models, market maturity and rapid evolution
- **Extrapolation: Median 5-yr cost of Ownership \$150K, 1800\$/pt, .06\$/sf**



Findings Highlights: Payback Examples

- “Does a car mechanic quantify the value of their tools?”
- 2 cases self-reported payback, and for 2 cases the R&D team was able to calculate a payback based on data collected
- < 2 years in 3 of 4 case instances, within the range reported in the literature
 - Case 1: 3.4 year payback for 2 buildings 4.3 for another
 - Case 2: 1.2 years for full campus deployment
 - Case 3: <1 month due to non-energy savings, streamlining of personnel bill payment
 - Case 4: <2 months

Conclusions: Value of EIS

- Median building and portfolio savings of 17% and 8% would not be possible without use of the EIS
 - Median building and portfolio utility savings of \$56K, and \$1.3M
 - Median savings from the buildings that had low extent of EE projects of 5%
- Key Benefits
 - Operational efficiency, utility validation and payment, data/info for other processes and analyses
- Median 5-yr cost of software ownership, \$150K, \$1800/pt, .06\$/sf, median number of points = 200
 - Large range in costs, some economies of scale with number of points
 - Commonly, ongoing costs assessed annually, per-building or -portfolio
- Payback of the EIS not typically tracked by participants, however
 - In 3 of 4 cases, payback was less than two years
 - Consistent with reported findings in the literature

Conclusions: Key Factors and Best Practices

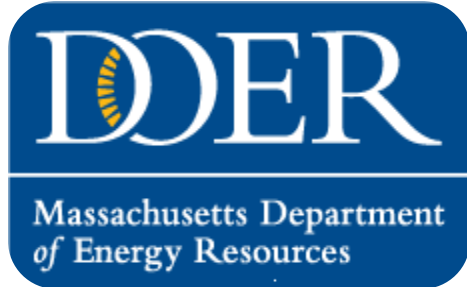
- Key factors associated with deeper savings
 - Extent of efficiency projects, initial EUI, depth of metering, and years of EIS installation
- Best practices
 - Installation of submetering, beyond whole-building level
 - Load profiling on a regular basis
 - Use of automated energy anomaly detection features
 - Monitoring peak load and managing demand charges
 - With regular usage over time, savings can accrue and deepen

THANK YOU

eere.energy.gov/betterbuildingsalliance/EMIS
eis.lbl.gov

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Using Real-Time Data to Reduce Energy Use and Costs at State Facilities

May 8th, 2014 – Better Buildings Summit

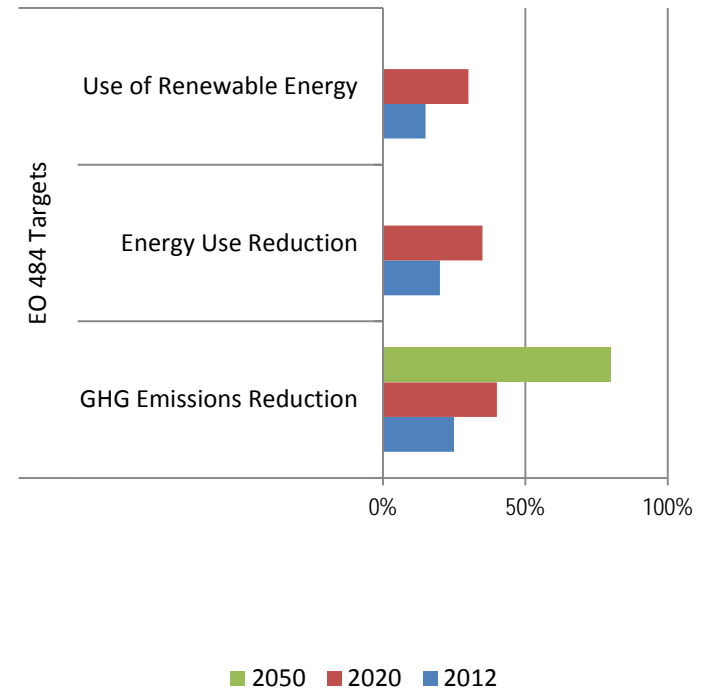
Maggie McCarey

Executive Order No. 484

Leading by Example—Clean Energy and Efficient Buildings

Issued April 2007 by Governor Deval Patrick

- Sets goals for state agencies:
 - GHG emission reduction
 - Energy reduction
 - Renewable energy
- Requires all new construction to meet Mass. LEED Plus
- Includes executive agencies, colleges and universities, courts, authorities



Data Needs and Challenges

- Track progress toward LBE goals
- Measure performance of facilities
- Measure impacts of ECMs
- Improve facility management
- Large amounts of data not readily available
- Lack of timely access to bill information
- Disconnect between costs and usage
- Mapping use data to facilities
- Lack of building level data

Enterprise Energy Management System (EEMS)

DOER \$9.7 million contract with EnerNOC

Installation of **1,300** real-time meters completed in August 2012

Electricity, NG, oil, steam, chilled & hot water, propane monitoring

25 million square feet,
470 state buildings



Primary Goals

- Help track energy use at the building level where such data was not previously available
- Provide real-time use information for all fuels to help facilities respond immediately and reduce use/costs
- Enable building comparisons within facilities and across facilities
- Support efforts to prioritize projects based on consumption data
- Compare usage to bills to find discrepancies

Features and Deliverables



Real-time
Data



Real Time Alerts



Savings
Identification



Benchmarking and
Reporting



Dashboards



Utility Bill
Management



Analyst Support

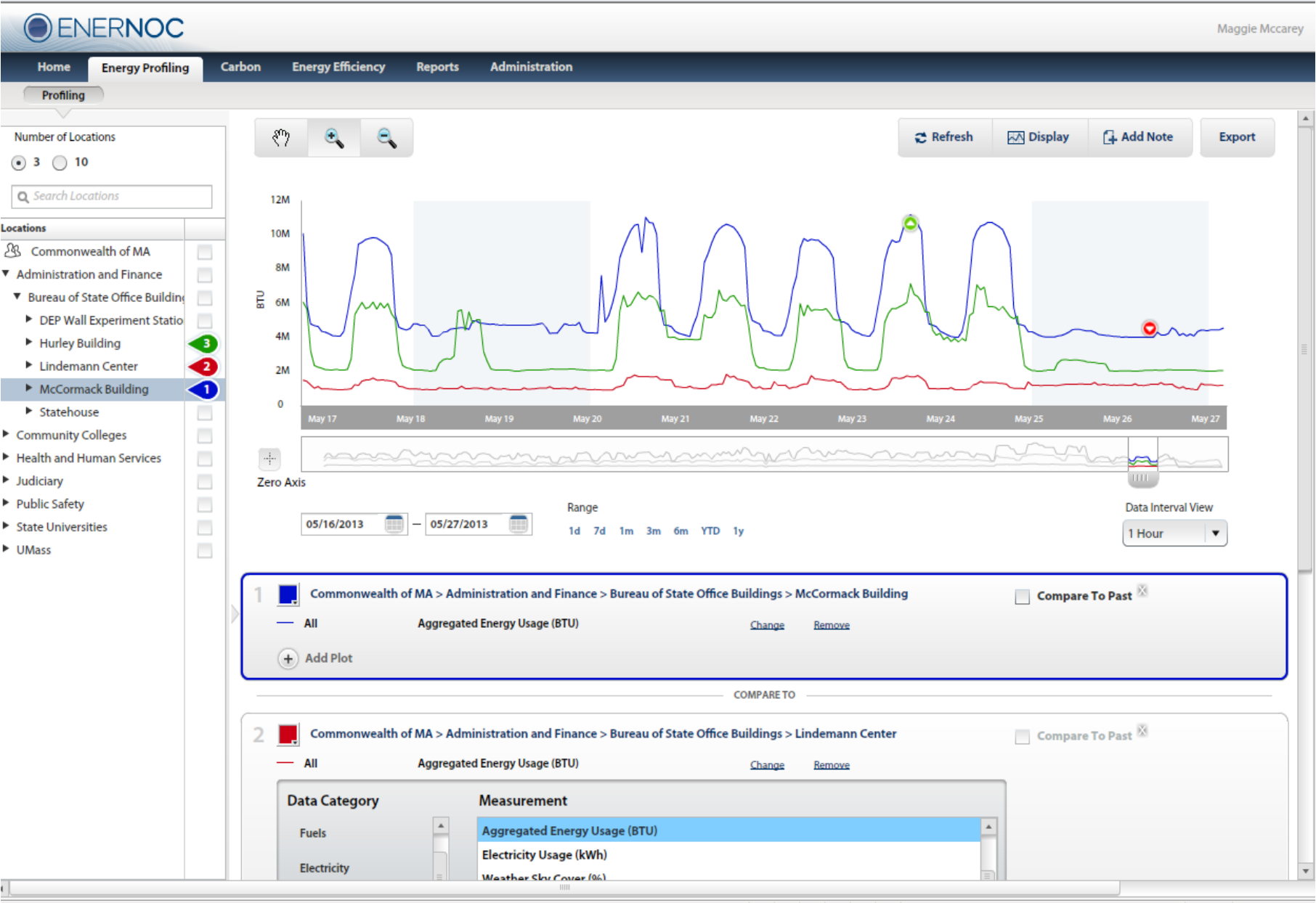


Massachusetts Department
of Energy Resources

Portfolio View: EUI Snapshot



Real-time Visibility into Energy Use Patterns



Energy Usage Compare to Past – UMass Lowell

Using EEMS, Paul Piraino confirmed that electric usage in 2012 (blue) was much higher than 2011 (black)



By making a simple change to the BMS, the electricity usage was brought back to normal levels

SAVINGS \$45,000

kW Savings

600 kW

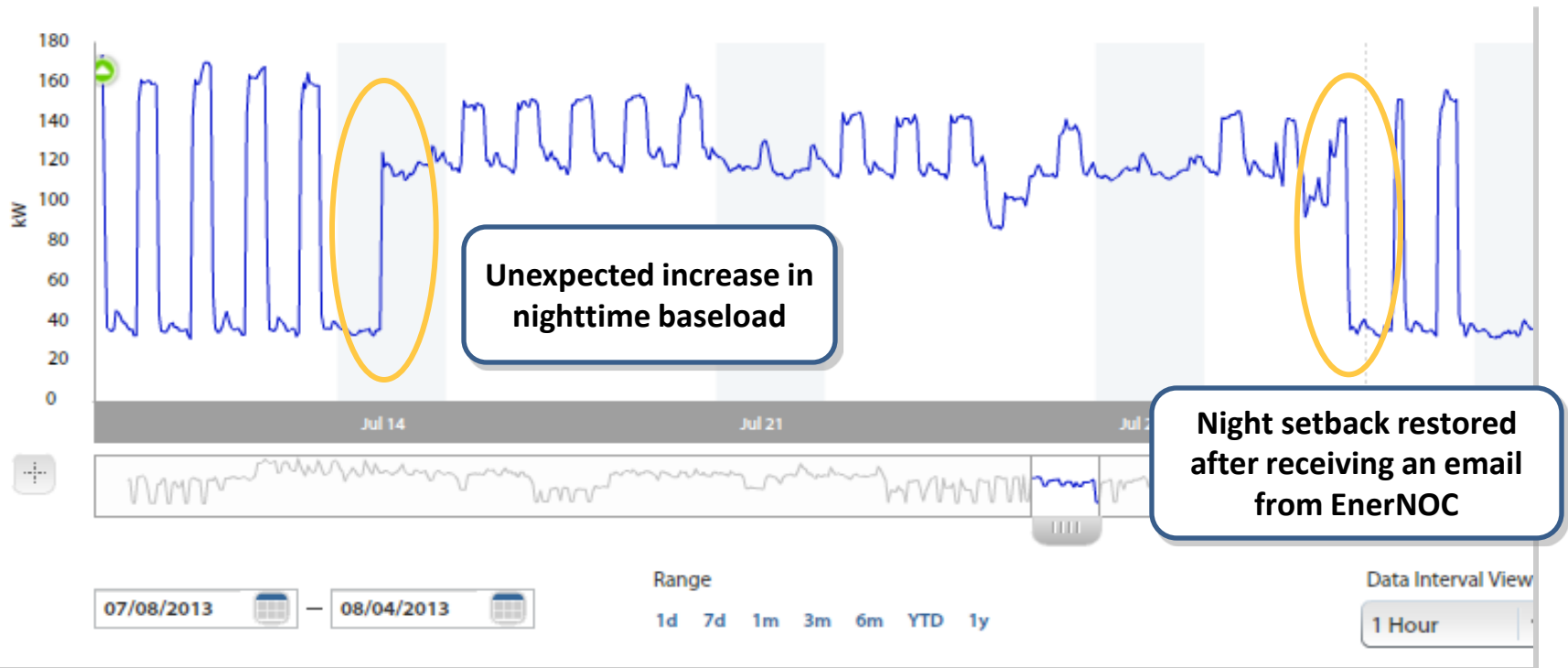
kWh Savings

273,000 kWh

Reduced Carbon Emissions

290 tons

Night Setback – Framingham State University



SAVINGS \$16,700

kW Savings

80 kW

kWh Savings

152,000 kWh

Reduced Carbon Emissions

164 tons

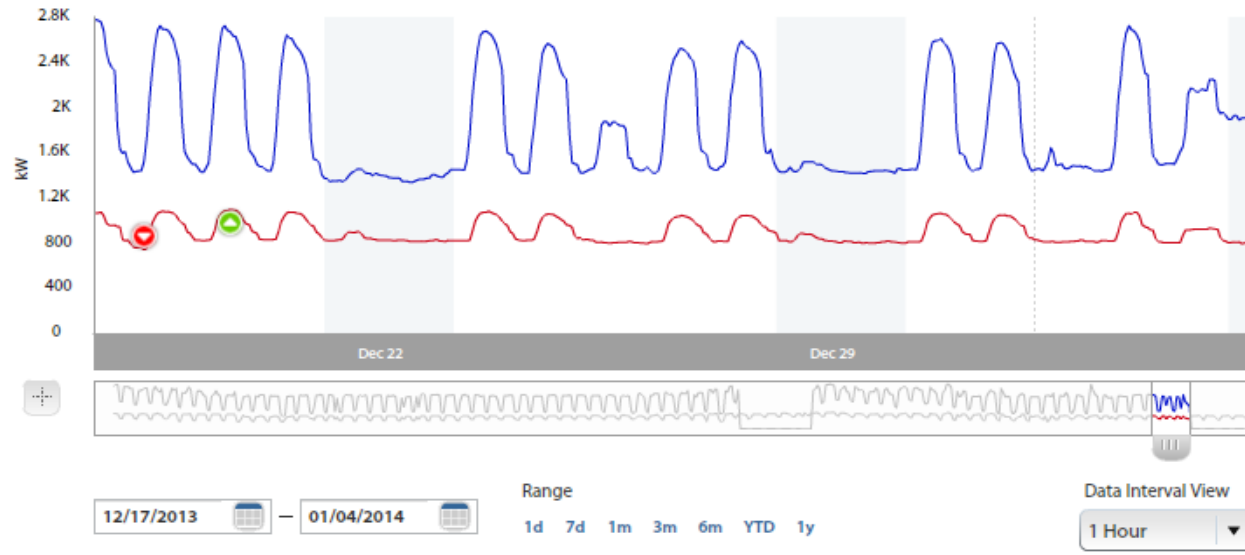
Night Baseload – State Office Buildings

McCormack shuts off just 40% of its electric load at night.

Hurley shuts off 30%

EnerNOC analyst and DCAMM team agreed these buildings should be able to achieve at least a 50% reduction.

- ▼ Bureau of State Office Buildings
 - ▶ DEP Wall Experiment Station
 - ▼ Hurley Building
 - ▶ Hurley Building
 - ▶ Lindemann Center
 - ▼ McCormack Building
 - ▶ McCormack Building
 - ▶ Statehouse
- ▶ Community Colleges
- ▶ Health and Human Services
- ▼ Judiciary



EXPECTED SAVINGS \$100,000

kW Savings

kWh Savings

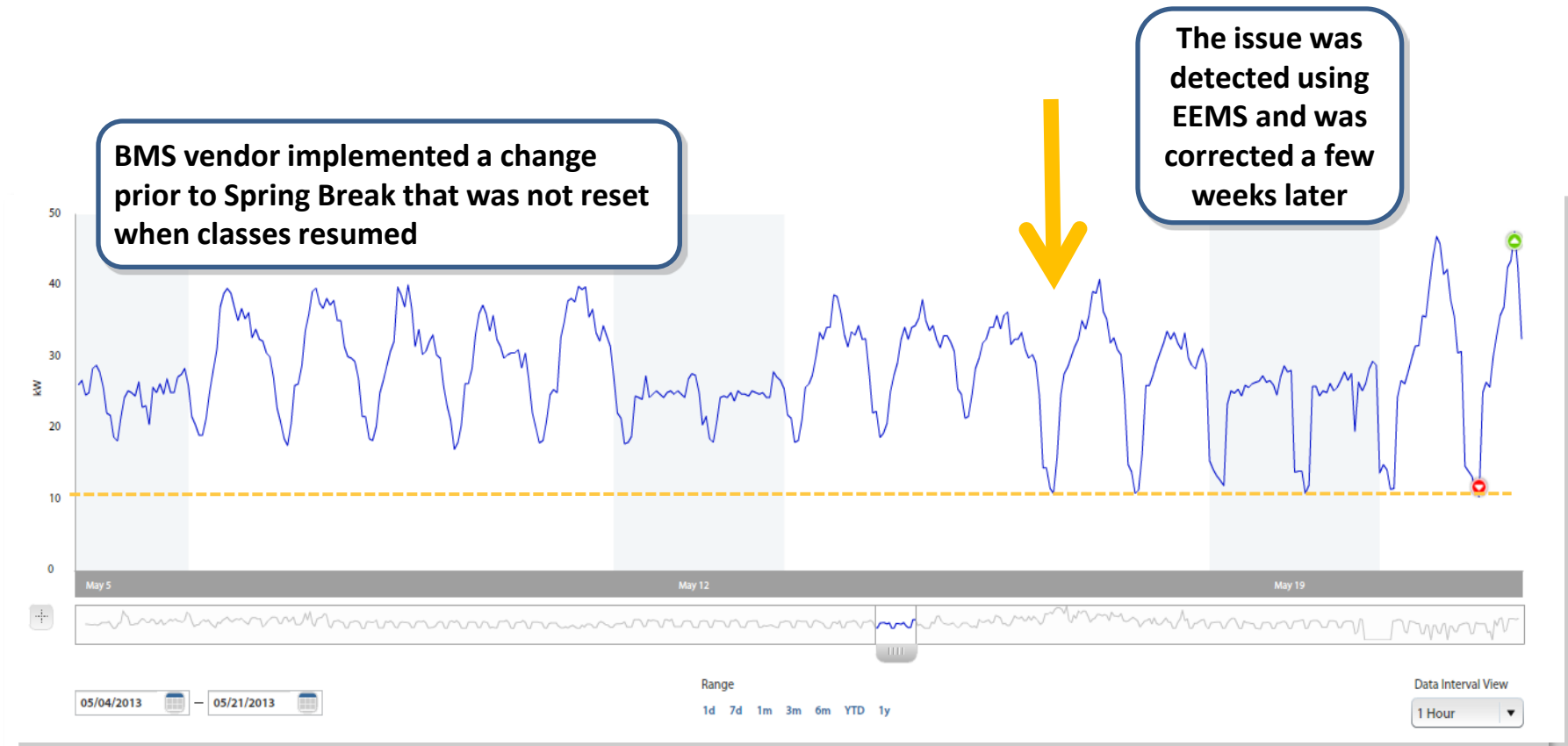
Reduced Carbon Emissions

600 kW

909,000 kWh

979 tons

Break Scheduling – Massasoit Community College



SAVINGS **\$3,600**

kW Savings

12 kW

kWh Savings

32,700 kWh

Reduced Carbon Emissions

35 tons

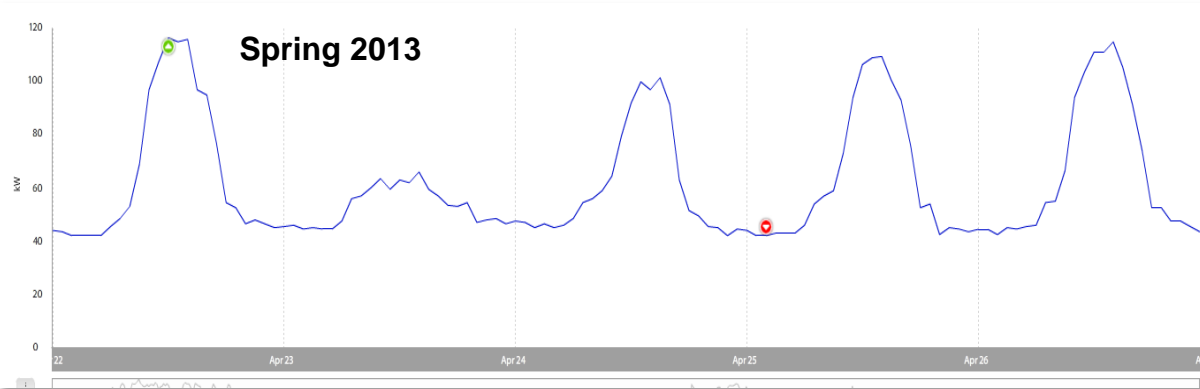
Morning Startup – Peaks – Chelsea Soldiers' Home

Spring 2012



In the spring of 2012, chillers were being turned on simultaneously leading to unnecessary peaks

Spring 2013



After speaking with an EnerNOC analyst, the building was able to implement a staged startup sequence and eliminate the peaks

SAVINGS **\$19,000**

kW Savings

60 kW

kWh Savings

173,000 kWh

Reduced Carbon Emissions

185 tons

Morning Startup – Delayed Start – Bristol CC



Three buildings were starting up earlier than they needed to. They are now starting up 1 to 2 hours later than before.

SAVINGS **\$2,500**

kW Savings

N/A

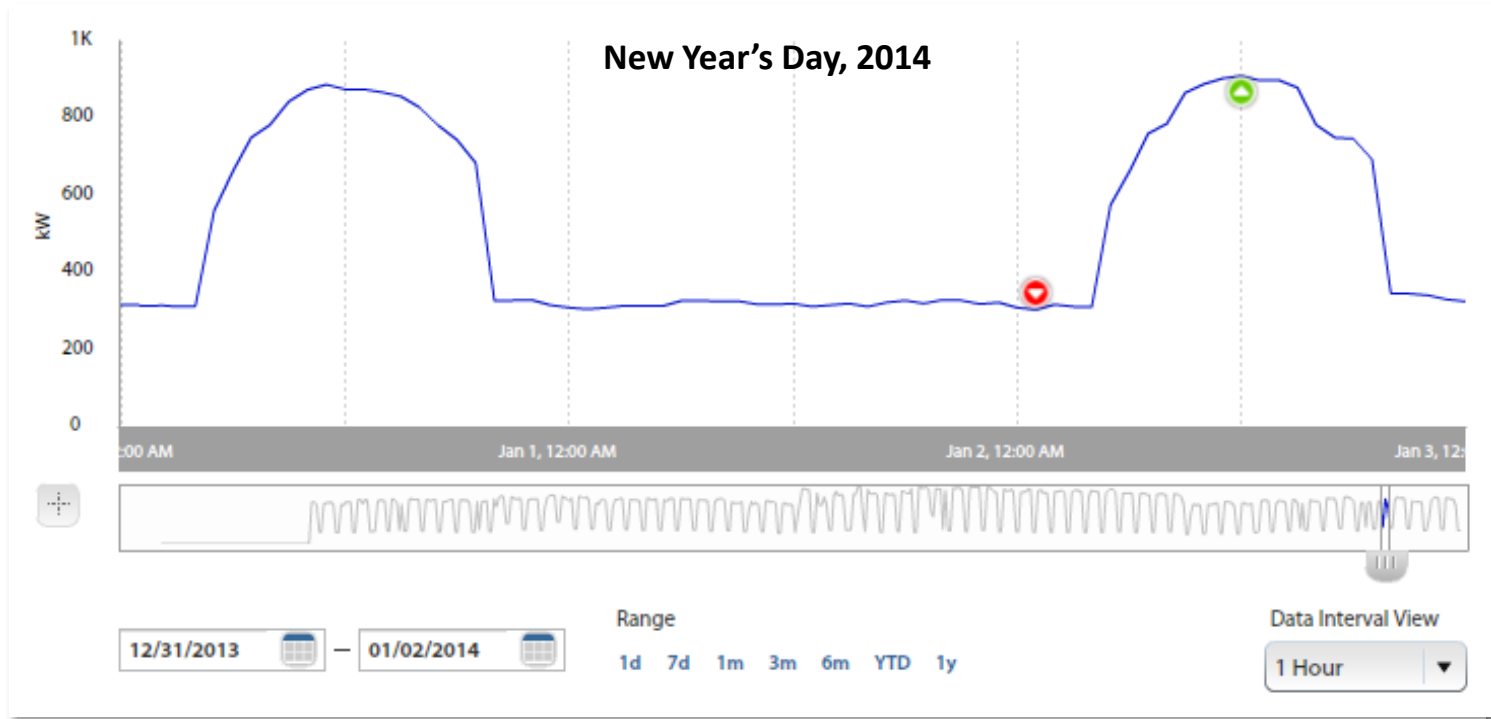
kWh Savings

22,700 kWh

Reduced Carbon Emissions

24 tons

Holiday Shutdowns – Trial Courts



SAVINGS **\$10,000**

kW Savings

500 kW

kWh Savings

8,000 kWh

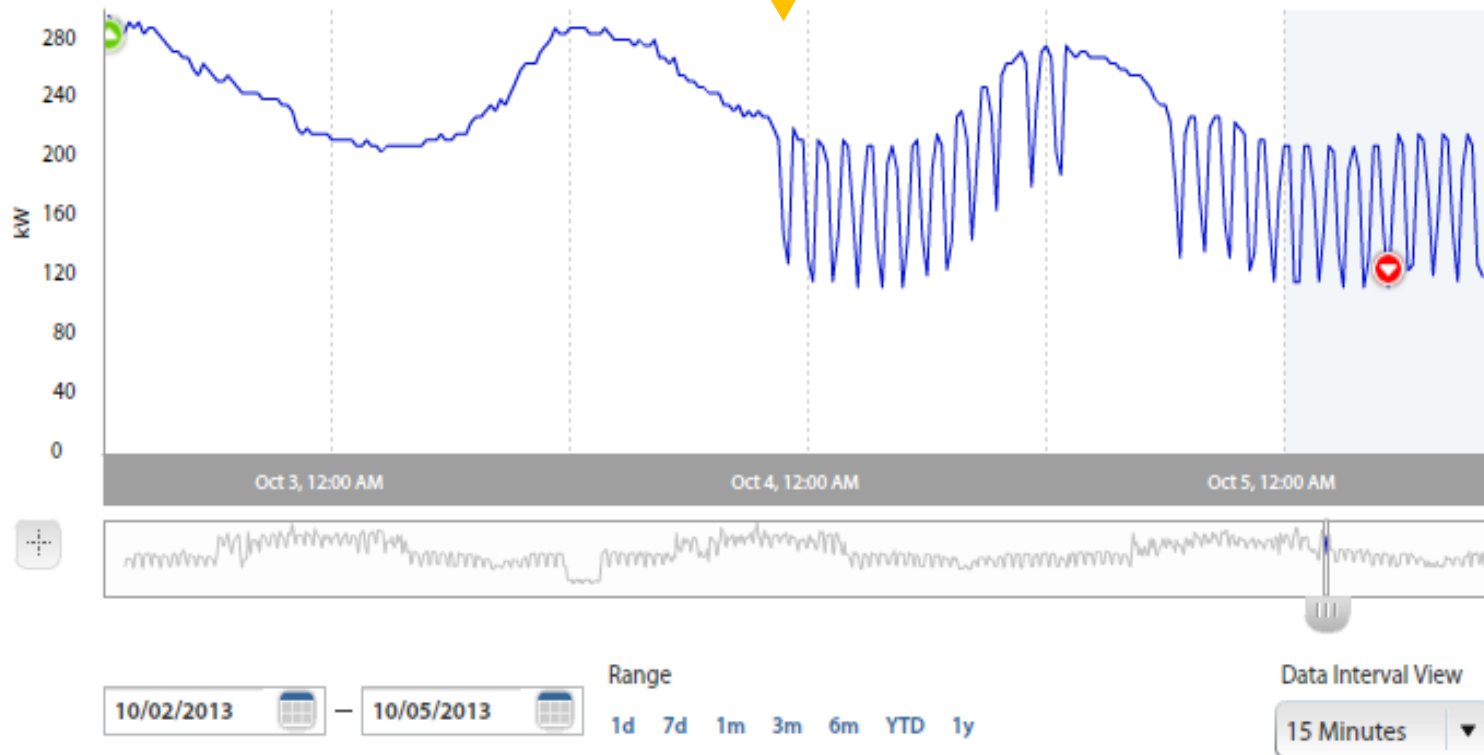
Reduced Carbon Emissions

8 tons

Maintenance Cost Avoidance – UMass Lowell

Using granular EEMS data, this site was able to identify a large piece of equipment that was cycling on and off.

Proactively identifying and eliminating this issue will significantly increase the lifespan of the equipment and reduce maintenance costs

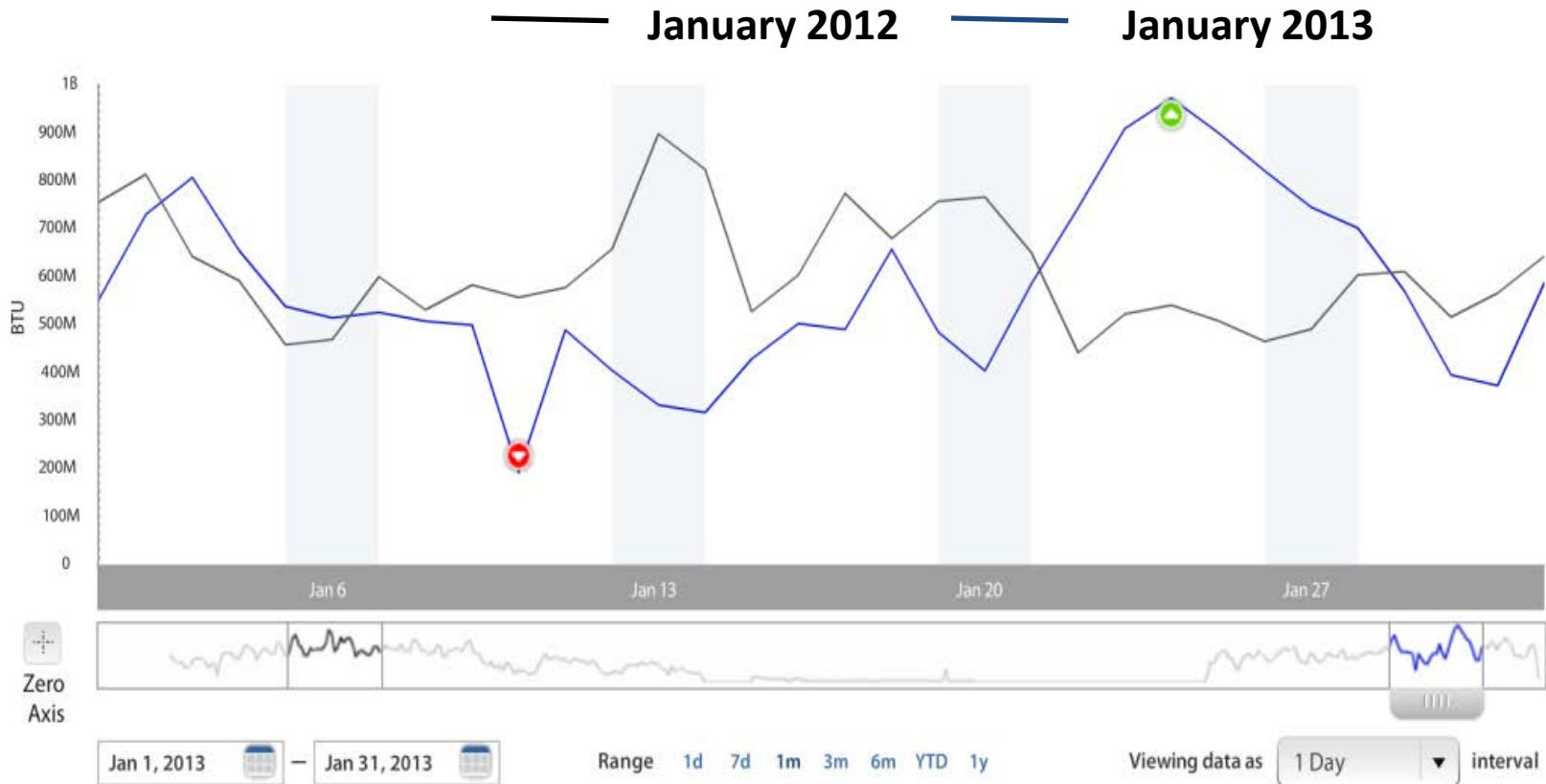


Zero Net Energy Building Performance Tracking – North Shore Community College



EEMS provides North Shore Community College with the necessary data to track the building's performance and determine how closely the building is performing to net zero.

Measurement & Verification – UMass Lowell



EEMS is a great way to track the results of efficiency projects. The college's Energy Manager is using the EnerNOC application for M&V, to determine the level of savings achieved and to help inform his decisions going forward.

Other EEMS Uses and Benefits

- **BASELINE ANALYSIS**
 - Use EEMS data to project heat demand for potential CHP system (MassArt) and sizing of new boilers (Fitchburg State University, Dept of Correction)
 - Use historical data to benchmark buildings for large-scale efficiency projects (DCAMM)
- **BUILDING USAGE DATA FOR DEPARTMENT CHARGEBACK**
 - Use EEMS data each month to correctly distribute campus utility bill charges to appropriate departments (Westfield State University)
- **SCHEDULED REPORTS AND ALERTS**
 - Use scheduled reports to keep tabs on building performance and prioritize day-to-day work (Mass Hospital School)
- **EDUCATION AND OUTREACH**
 - Incorporate EEMS in sustainability courses (Bunker Hill CC)
 - Use EEMS data to implement dorm energy reduction competitions
 - Use EEMS data to feed public-facing Lucid dashboard to promote public awareness and behavioral change (Bunker Hill CC, MassART)
- **EXTRAPOLATE EEMS FINDINGS TO NON-METERED BUILDINGS**
 - Holiday shutdowns (Trial Courts)

Total Identified Savings by Measure Type

Measure Type	# of Identified Measures	Annual Savings
Peak Demand and Usage Spikes	298	\$641,000
Energy Intensity/Unexpected Usage	86	\$592,000
Heating Optimization	204	\$339,000
Night Setback	133	\$269,000
Day to Day Comparison	380	\$180,000
Extended Breaks	150	\$120,000
Night Baseload	34	\$114,000
Weekend Setback	55	\$72,000
Delayed Start	41	\$52,000
Holidays	215	\$43,000
Total	1,596	\$2,422,000

EEMS Challenges

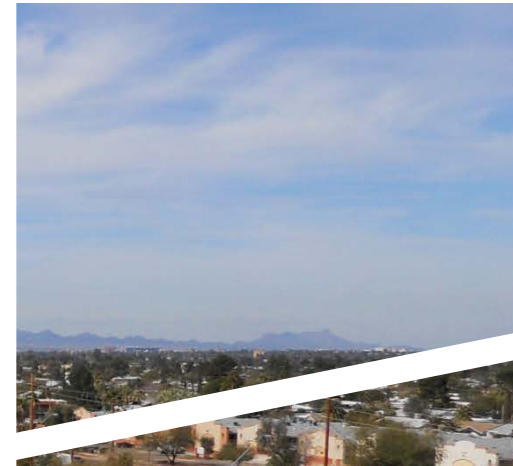
- Building selection process
- Procurement, installation process, schedule
- Data quality
- Old buildings and infrastructure
- Steam metering
- On-site resources and staffing
- Implementation of identified measures
- 24 hour sites and different usage patterns
- Planning for future projects, changes at sites
- Costs

Chad Harrell
Director of Energy Solutions
Lend Lease

Lend Lease Public Partnerships DoD

Real-time Energy Management: Energy Savings
Every 15 Minutes

A Lend Lease vision for
Smarter Homes & Communities



Chad Harrell
Director Energy Solutions, PP DoD
April 2014



Leader

As a global leader, we understand the importance of building communities that stand the test of time, enrich people's lives and foster economic growth.

"Our future lies in building relationships with all stakeholders to deliver the best outcomes imaginable. Our leadership in sustainable practices ensures this will be achieved."

Steve McCann

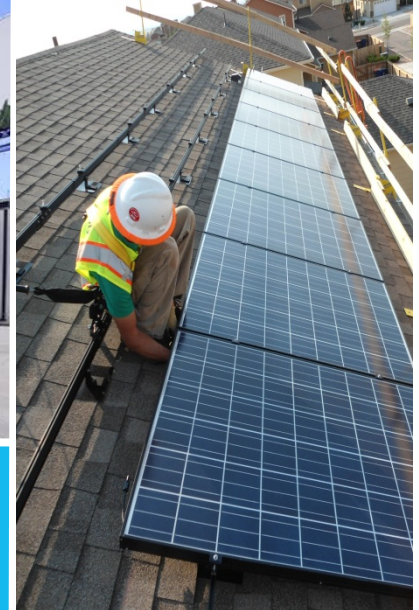
Group Chief Executive Officer and
Managing Director
Lend Lease

Lend Lease:

- Is one of the leading fully integrated property solutions providers in the world
- Has more than 50 years of operation
- 16,500 employees
- Develops, constructs and/or manages large, complex projects
- Specializes across multiple asset classes
- A\$15 billion funds under management (30 June 2013)
- Is committed to creating and building innovative and sustainable solutions
- Operates Incident & Injury Free

Green Building Experience

Home Depot
Smart Home
at Duke
University,
LEED-NC
Platinum ▶



▶
BP Helios House,
LEED-NC Certified



Shriever Air Force
Base Solar ▶

Army Hawaii
▼



▶
IKEA
Corporate
Headquarters,
LEED-NC
Certified



▶
440 South Church,
LEED-NC Gold



Reputational Excellence for Our Future

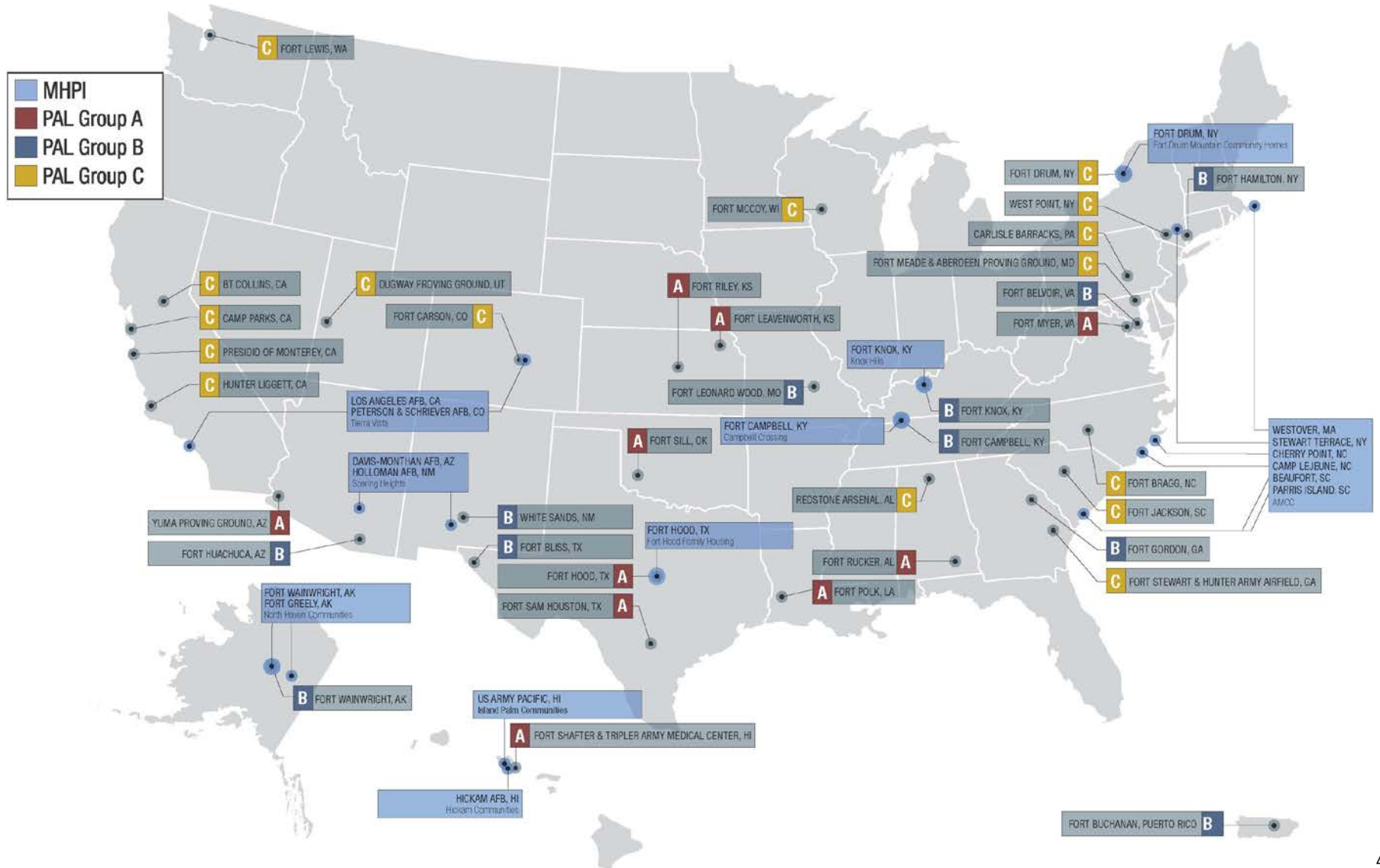


- | | | |
|--|--|---------------------------------------|
| 1. Trump International Hotel & Tower | 6. Camp Lejuene, Atlantic Marine Corps Communities | 12. Time Warner Center |
| 2. National September 11 Memorial & Museum at the World Trade Center | 7. New York-Presbyterian Hospital, Various | 13. Citi Field, NY Mets Stadium |
| 3. US Court of Appeals Restoration | 8. Bank of America Corporate Center | 14. Genzyme Building 78 |
| 4. Statue of Liberty Restoration | 9. SC Johnson Argentina New Industrial Plant | 15. 1996 Summer Olympic Games |
| 5. American Museum of Natural History, Various | 10. Grand Central Terminal Revitalization | 16. Fort Campbell Zero Energy Housing |
| | 11. Duke University School of Nursing | 17. Los Angeles City Hall Restoration |

More than 40,000 homes,
192 apartments
and nearly 12,000
privatized hotel rooms
nationwide.

Lend Lease PP DoD Portfolio:

Military Housing & Privatized Army Lodging



US Department of Defense

Single Largest Energy Consumer in the US



800
TRILLION BTU

FY11 Consumption:
800 trillion BTU

(80% operational
and 20% buildings)

Energy Bill for Buildings:
\$3.6 Billion



2.7
TRILLION BTU

Lend Lease MHPI represents
1.7% of DoD buildings total
energy consumption.

2.7 trillion BTU is **15.6%** of
the total consumption of the
bases we operate on.



25%
COMMITMENT

Army, Air Force and Navy
have publicly committed to
25% renewable energy
procurement by 2025 (3-4GW of
on-site renewable generation).

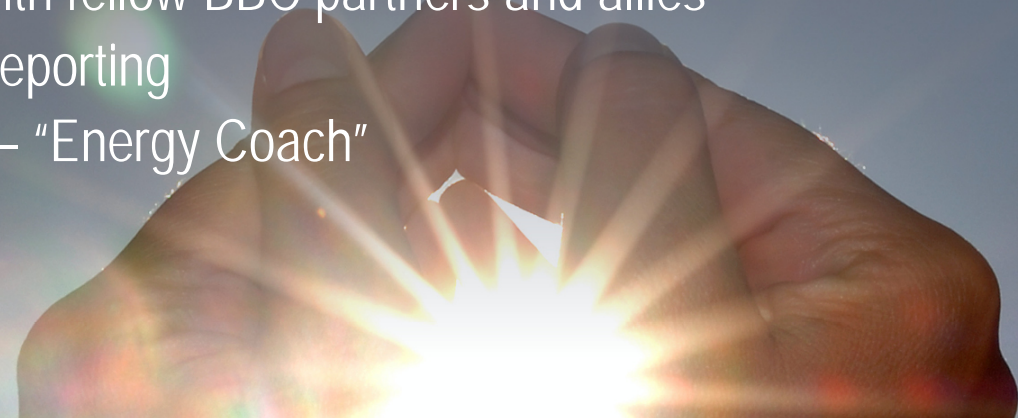
Lend Lease Partnerships Better Buildings Challenge



Energy Solutions Through Collaboration

Accepted President Obama and DoE's challenge as founding partner Dec 2011

- Committed 42k homes, 61m SF to 20% Source EUI improvement by 2020
- Take action with fellow BBC partners and allies
- Transparent reporting
- DoE support – “Energy Coach”



Leadership in Energy & Sustainability



Energy Efficiency & Renewable Energy



Environmental & Energy GMRs



Energy Policy & Action Plans



Solar PV & Thermal Experience



Green Retrofits



Resident Awareness & Education



Client Relationships



Partner Commitment



BBC Partnership

BETTER BUILDINGS CHALLENGE
DOD COMMITMENT BASELINE

Renewable Funding
Abundant
Green Campus Partners



Lend Lease accepted President Obama's Better Buildings Challenge and committed to achieving a 20% reduction in energy consumption for our entire MHPI/PAL portfolio by 2020.

12/31/2008
BASELINE

52,202,504
SQ. FT.

129.1 EUI
TOTAL SOURCE ENERGY USE
(KBTU/SQ. FT.)

PP DoD MHPI CY2013 – Current State

BBC Progress: Source Energy Reduction



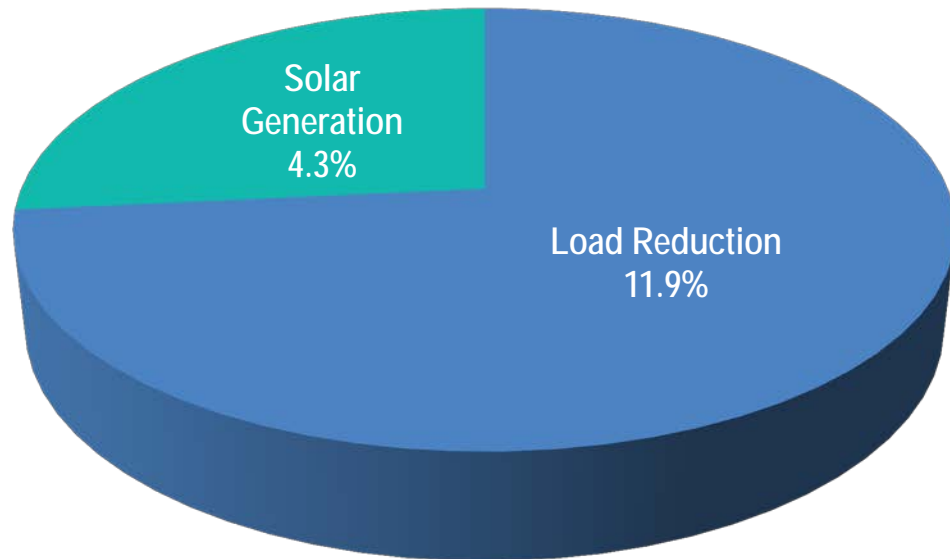
Better Buildings Challenge - Data Review Report

Partner Name: Lend Lease
Sq. Ft. Commitment 61,000,000
Number of Properties: 17
Number of Homes: 41,000

As of Dec 31, 2013

Portfolio Source % Improvement: <i>A positive percent change indicates an improvement in portfolio energy use between the baseline and current period.</i>	16.2%
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Portfolio Summary	Baseline			Current			Sq. Ft.	EUI
	Period	Sq Ft	EUI	Period	Sq Ft	EUI	% Change	% Improvement
Lend Lease	12/31/2008	52,202,504	123	12/31/2013	59,783,871	103	15%	16%



Building Energy Management System (BEMS)

Smart Homes & Communities Concept Paper

Opportunity:

- Foundation to our BBC Energy Security Strategy: Load, Generation and Storage
- Platform for energy Measurement & Verification – accurately measure & isolate energy savings by ECM for performance guarantee procurement (Enable enterprise, neighborhood and unit level)
- Affect OPEX: Drive consumption reduction (10-15%), enhance asset management efficiency, continuous commissioning, system optimization and inform CRR plans
- Resident awareness and education platform to support sustained energy conservation

Concept:

- Deploy controls, smart meters, demand management technologies to reduce consumption and leverage managed services capability – remote system monitoring and data analytics
- ‘Proof-of-Concept’ Pilot Projects at: Ft Hood, IPC, Campbell total 682 homes

Results (still in “crawl” phase but pilots are performing):

- Hood 12%
- IPC 9.5%
- Campbell 8%
- Total 9.8% savings

Risks:

- Funding to deploy pilot projects - ESPC
- Failure to deliver value/proof of concept
- Scalability



Single Home Projected Energy Savings

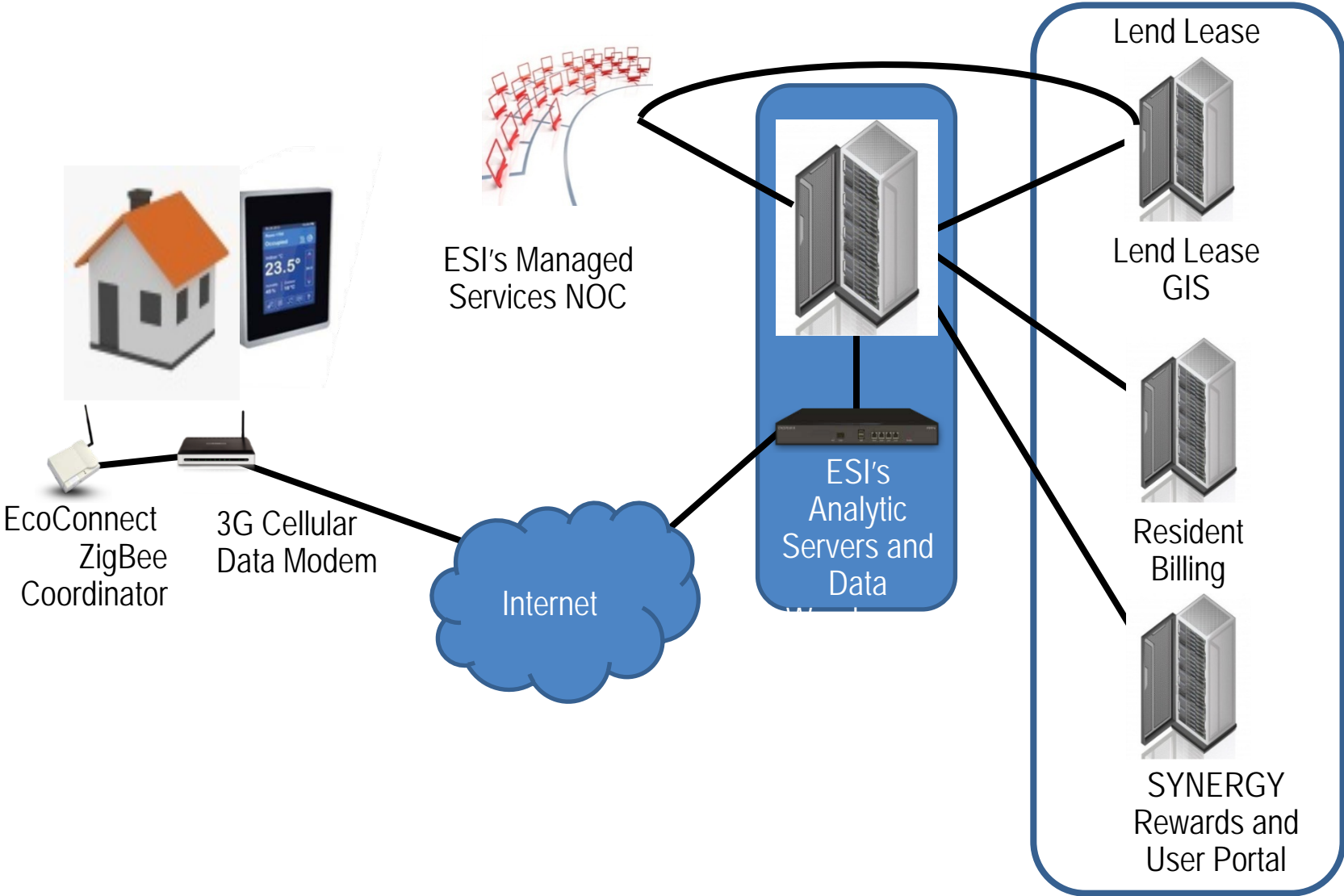
Average kWh per house per year	12,000 kWh
Projected Energy Savings	15%
Average kWh saved per home	1,800 kWh
Average cost per kWh	\$0.15
Average cost saved per home	\$270.00

Portfolio Projected Energy Savings

Average kWh per portfolio per year	492,000 MWh
Projected Energy Savings	15%
Average kWh saved per home	73,800 MWh
Average cost per MWh	\$150.00
Total cost saved	\$11.07 Million

Managed Services represents additional operational efficiencies and cost avoidance savings

Architecture - Enterprise



Welcome Fort Campbell User
Edit Profile | Log Out

Current User: 0001
Select User:

Search


- Home
- Comfort 2
- Energy Usage
- Control Charts
- Audit 5
 - Heating & Cooling
 - Thermal Characteristics
 - Water Heater
 - Refrigerator
 - Energy Intensity
- Contact

Audit

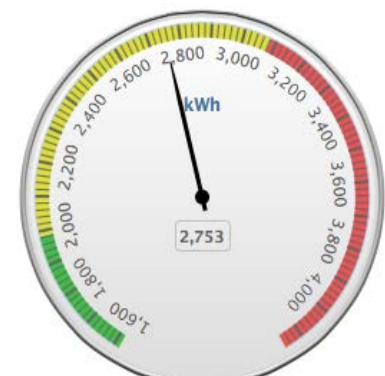
Energy Intensity

March 2014

Energy Usage



1.37 kWh/Ft²



2,753 kWh

More Efficient Homes Average Homes Less Efficient Homes

- Heating & Cooling
- Thermal Characteristics
- Water Heater
- Refrigerator
- Energy Intensity

57

Comfort Settings

Thermostat

1st Floor/Family

Cool

69° LEAVE

73°

Accept

Schedule

Vacation

Welcome Fort Campbell User
Edit Profile | Log Out

Current User: 0001
Select User:

Search

Home

Comfort 2

Thermostat

Water Heater

Energy Usage

Control Charts

Audit 5

Contact

Edit Profile

Address:



0001 1680 Morgan Avenue N
West Lakeland, MN 55082

To edit your address please contact a Customer Service representative at 1-931-431-3966.

Principal Contact:



Steve3 Cook3

Preferred Contact Method:

Email Phone

Phone:



111-111-1111

Email:



sdcook@intelligent-es.com

Heating & Cooling:



What is more important to you?

Energy Conservation Balanced Comfort

Water Heater:



How should we manage your water heater?

Scheduled Automatic

Please ensure that a schedule is configured for each water heater listed in the Comfort Settings.

Change Password

Save changes

156 Safi Rd - SYNERGY Score

YOUR Score

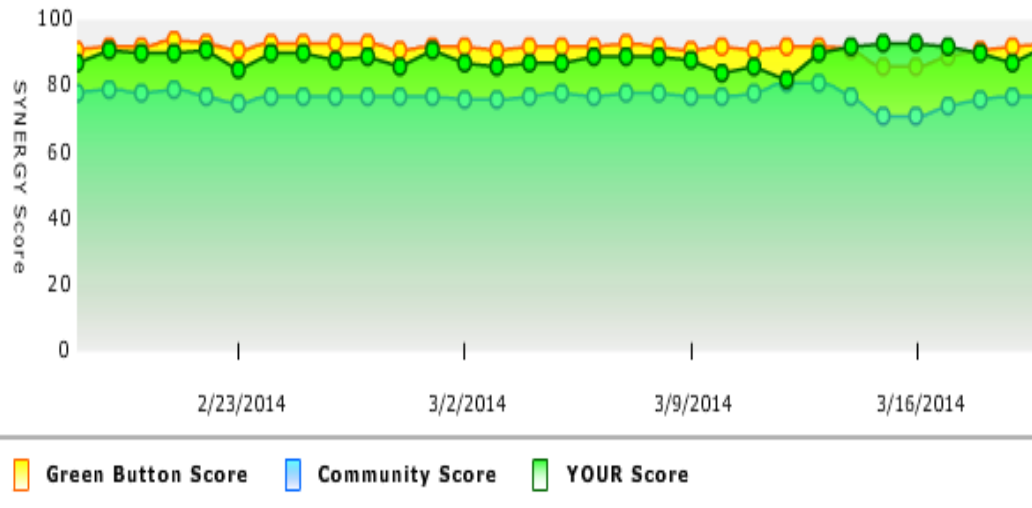
92 / 100

Community Score

77 / 100

Green Button Score

93 / 100



Most Current Status:

Room Temp **72**

Setpoint **72**

Green Button **ON**

What can I do to improve?




Your Green Button Mode is currently being used. Continue using this mode to reduce energy usage.

BEMS Portal – Detailed KPIs

◀ 3/16/2014-3/22/2014 ▶

- All Homes
- Fort Hood
- Comanche III
- 52431 Iroquois Ct**

SPARK RULE	SYNERGY	OCC %	GB %	ENERGY	AVG TEMP
52431 Iroquois Ct	86	59.3 %	100.0 %	0.061	0.0 °F



Home

52431 Iroquois Ct

CLOSE [X]

Avg SYNERGY Score	86	Avg Daily Energy	91.3 kWh
Green Button	100 %	Energy (Norm)	0.06 kWh/occ/sqft
Avg Room Temp	72 °F	Avg Temp Setpoint	71 °F
Min Discharge Temp	27 °F	Max Discharge Temp	155 °F
Occupancy %	59 %	Fan Active %	22 %
Heating %	16 %	Cooling %	6 %
Avg Outdoor Temp	54 °F	Avg Outdoor Humidity	60 %

Automated Analytics



Group	Rules	dur	Timelines
Fort Hood 156 Safi Rd 1 sparks	Excessive Plug Load	2hr	
Fort Hood 48408 Craig Dr 2 sparks	Cooling Out-of-Season Excessive Plug Load	0.25hr 1.25hr	
Fort Hood 51112 Waco Ct 1 sparks	Excessive Plug Load	1.5hr	
Fort Hood 52431 Inquois Ct 2 sparks	Excessive Plug Load Ineffective Furnace Heating	2hr 0.25hr	
Fort Hood 53336 Drum Song Trail 3 sparks	Cooling Out-of-Season Excessive Plug Load Ineffective A/C Cooling	0.25hr 1.5hr 0.5hr	
Fort Hood 5680 Carter St Unit 1 2 sparks	Cooling Out-of-Season Excessive Plug Load	0.25hr 1hr	
Fort Hood 5723 Friedman St 1 sparks	Ineffective Furnace Heating	0.5hr	

- Deployment
- DSL vs Cellular vs Wireless
- Communication (Facility, Residence, Install team)
- Product evolution(12 mo./6 mo. /Today)
- Future proof
- Scalable
- Adoption and training

Applying Lessons Learned; key
to Phase 2 success





The journey to sustained energy and operational efficiency begins with first measuring energy usage before managing it

David Borchardt
Chief Sustainability Officer
The Tower Companies

“Real-Time” Energy Management



THE TOWER COMPANIES
Transcend.

NRDC launched a case study with a question:

Are claims of
10% to 20%
energy savings
realistic in
commercial
buildings?



THE TOWER COMPANIES
Transcend.

What were the savings?

Key Findings in \$

	Square Feet	2012 Occupancy	2011 kWh	2012 kWh	kWh Savings	\$ Savings	Percent of kWh Savings
1707 L Street	109,926	302	1,965,135	1,516,274	448,861	\$58,352	23%
1828 L Street	332,928	928	5,590,937	5,227,183	363,754	\$47,288	7%
1909 K Street	239,128	462	5,197,305	4,327,589	869,716	\$113,063	17%
Total for three buildings combined			12,753,377	11,071,046	1,682,331	\$218,703	13.2% Average



The Tower Companies Overview

- Family Owned Real Estate Development Company, Long-term investors
- Developed over 5 million Sq. Ft. including office buildings, a multi-family apartment campus, shopping centers, and a mixed use lifestyle center, Washington DC and surrounding areas
- Over 9 Million Sq. Ft. in Re-development, Mixed-Use Lifestyle Centers



The Tower Companies Is a Leader in Sustainability

- 4.2 Million sq. ft. of LEED certified projects, four that are Platinum
- 90% of Portfolio is US Green Building Council LEED® Certified
- 60% of Office Building Portfolio is ENERGY STAR® Certified
- 100% GHG Emissions Offset with RECs and Carbon Credits
- Four commercial office and eight residential buildings
 - LEED EB (Existing Building) certified
- ENERGY STAR Leader



2000 Tower Oaks—LEED Platinum



The Tower Companies' Portfolio



THE TOWER COMPANIES
Transcend.

The Tower Companies' Sustainability Mission

- 15 years ago when the owners realized buildings contribute 40% of GHGs. “Green” entered the corporate vocabulary
- Building “green” was the first goal
- Tower is a “green” building leader



*The Tower
Building
LEED Gold*

1050 K Street—LEED Platinum



Moving Beyond Benchmarking and into Real-Time

- Benchmarking using ENERGY STAR is just the start
 - We needed real time data
- Utility Bills are too late and lack detail
 - Not enough useful information
- How do you operate your building better?
- Detailed and real-time metrics are needed to improve building operations



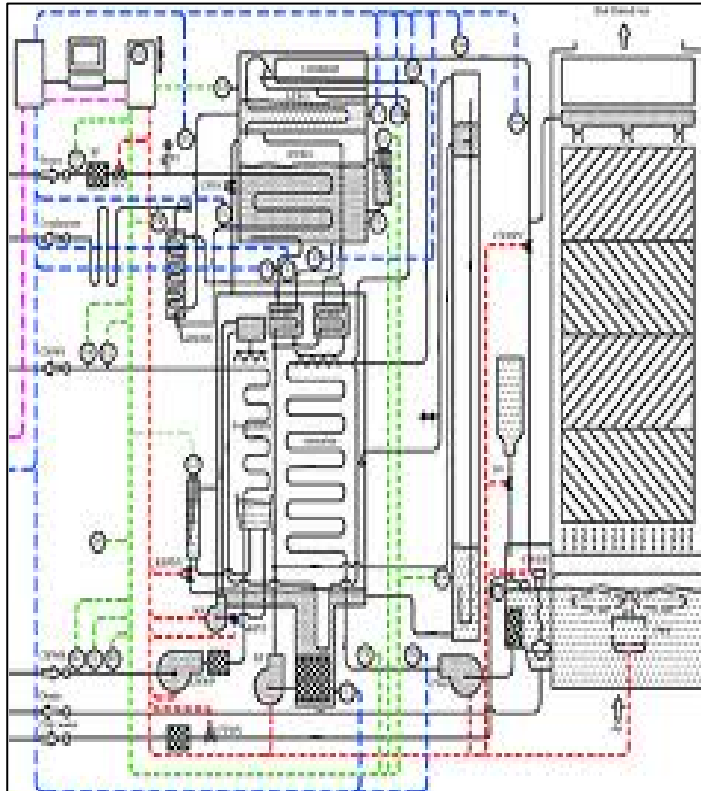
What We Did and Why

- Researched our options
- Learned what others did
- Tower's company requirements
 - Analytics
 - Monitoring 24/7
 - Optimize building operations

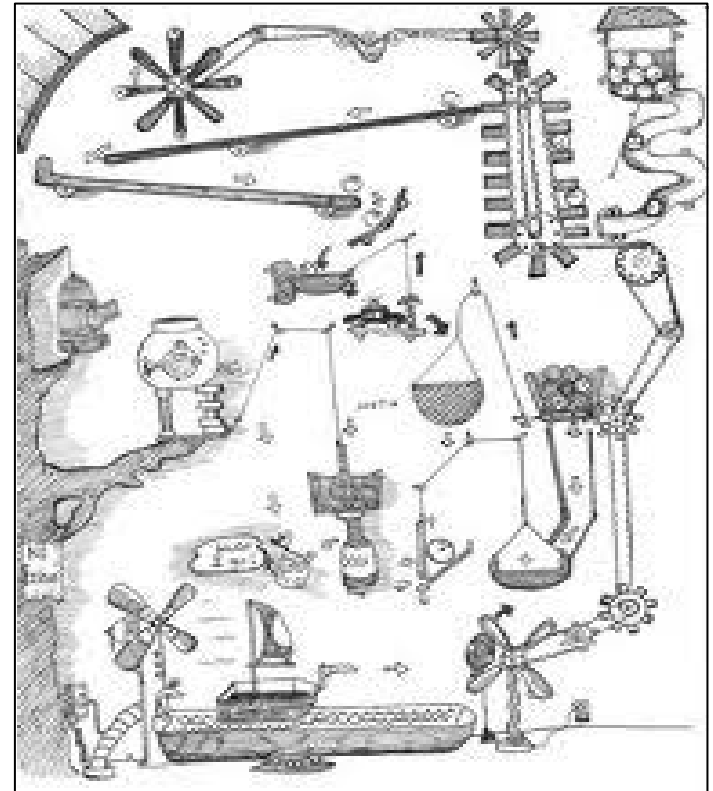


The Tower Companies' Portfolio

How it was designed

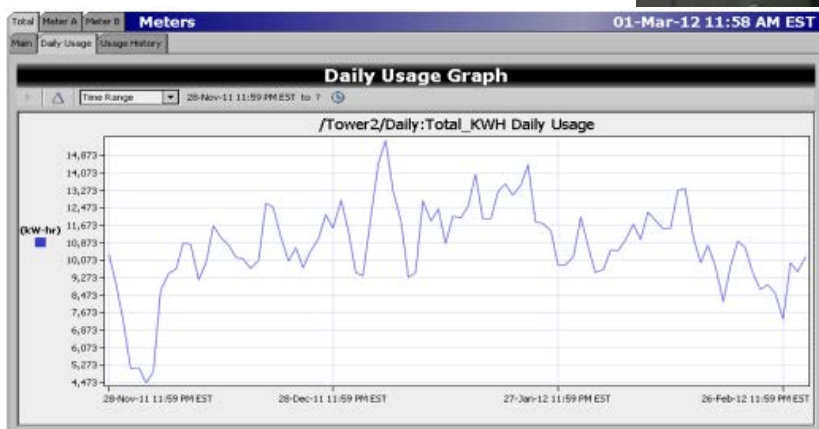


How it operates now



Hardware and Monitoring

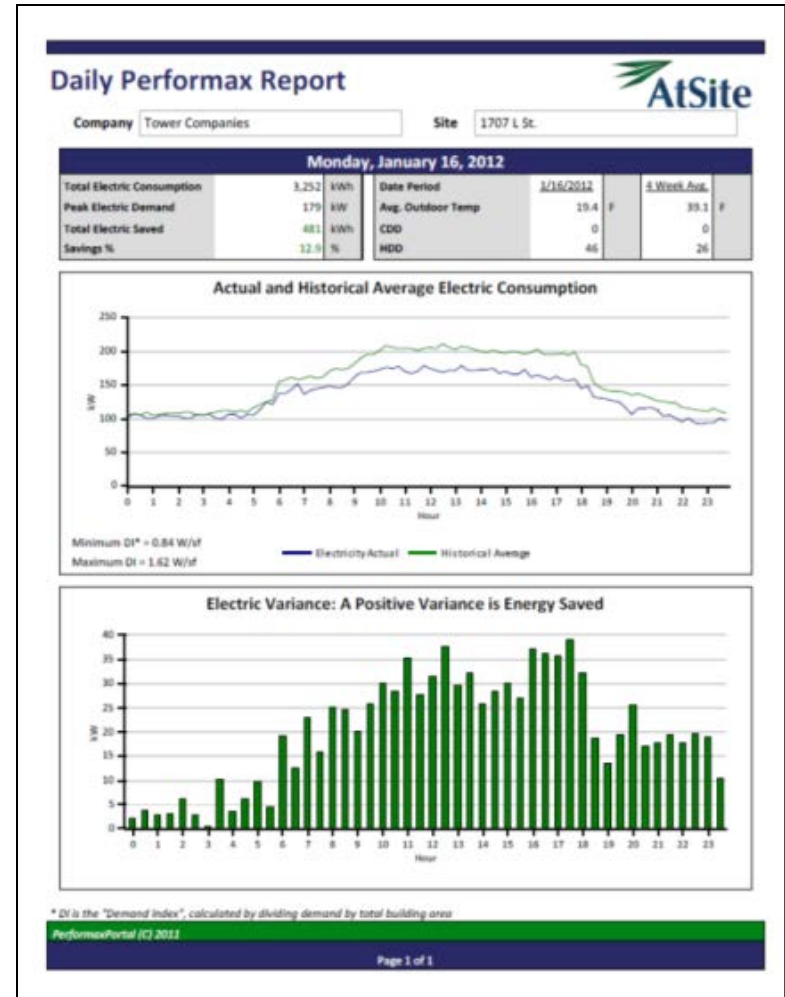
Hardware and 24/7 monitoring of our building central meters



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Analytics, Reporting and Support

- Daily Reports
- Monthly Meetings with Building Operations Staff
- Quarterly reports reviewed with Management



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Real Savings in Real-Time

- Average cost including start-up cost per building \$37,000 in first year
- Average energy savings per building 9% or \$46,000 (normalized)
- 1707 L St saved 29% or \$78,000
 - ENERGY STAR Score went from 69 to 90
- One year payback for 64% of portfolio on a per building basis



Portfolio-wide Real-Time Energy Monitoring Results

- Over 2 years
 - Residential building energy use reduced 6%
 - Commercial Office energy use reduced 17%
- Identified easy to address items
 - Systems running after hours
 - Replaced inefficient lighting
 - Improved operations by optimizing equipment set points (temperature, fan, and pump speeds)
- Gave staff ownership of success
- Resident/Tenant comfort was not compromised
 - Some even noted improvements
- Reduced water use

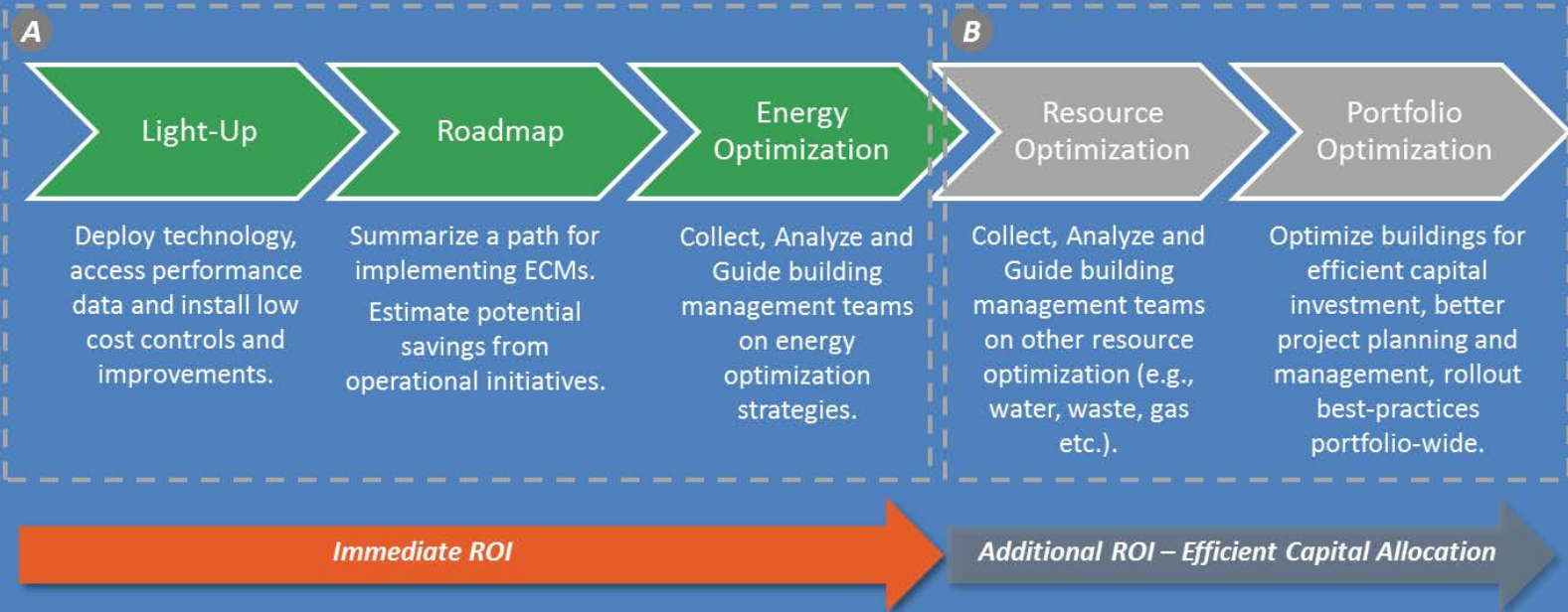


Building Performance Management Process

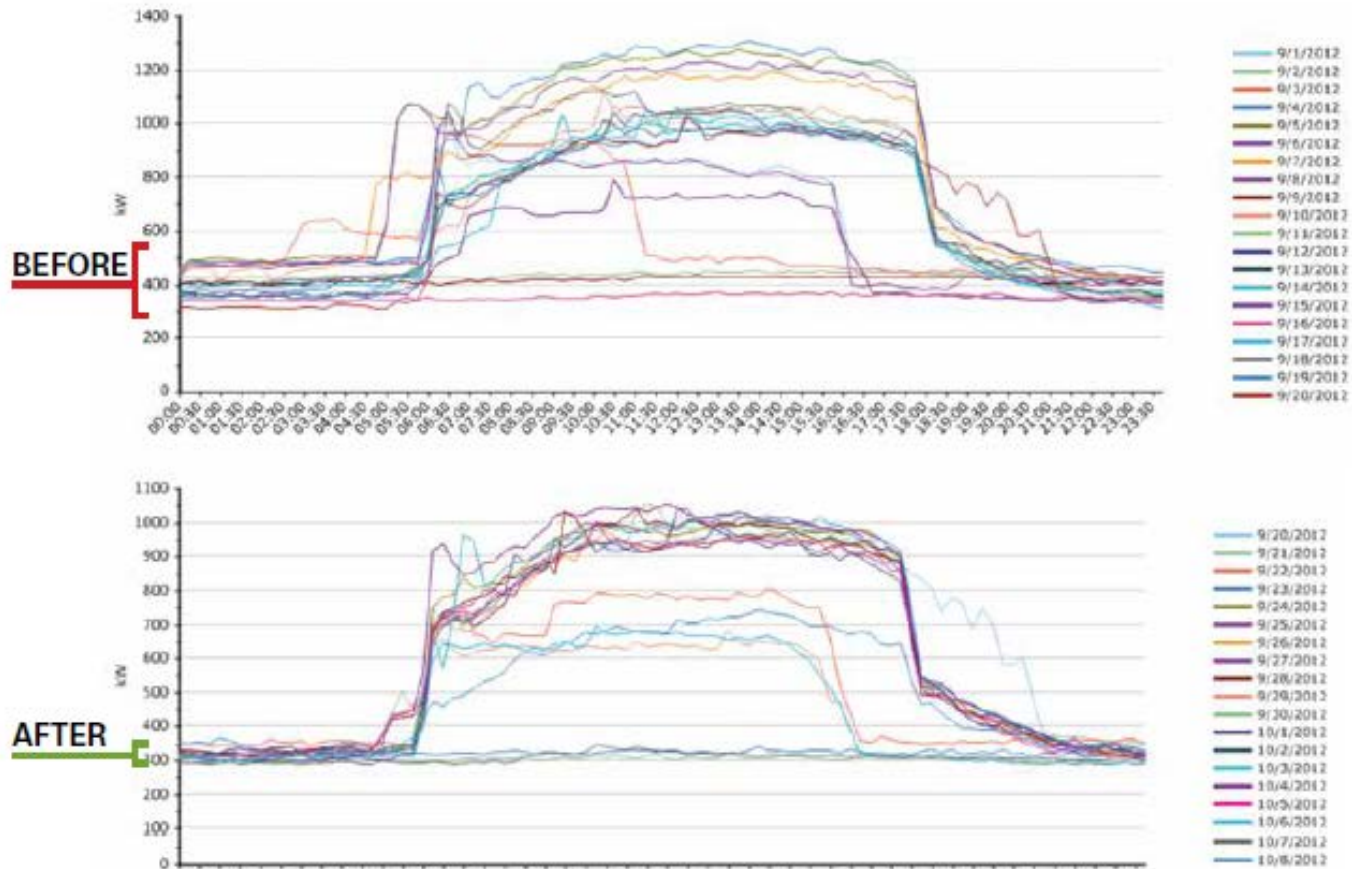
Goal: An integrated highly efficient portfolio

Strategy: Maximize the value of building portfolios by optimizing performance of existing building infrastructure and improving the overall health and quality of the built environment.

Building Performance Management (BPM) Strategy



Anomaly Detection: Faulty “Optimal Start”



What Tower Has Learned

- Nearly immediate improvements in some areas from real time monitoring
- Monitoring is continuous
- Staff education and engagement is critical
- Keep up to date on rebates, incentive, and tax incentives (dsireusa.org)
- Ongoing engagement with all parties for continuous improvement
- Worry about the little things



The Future

- We have begun providing sustainability education and support for building occupants
- Behavior Change is the next frontier
- Outreach and messaging must be tailored to the multiple audiences
- Keep looking for the next best thing
 - Smart thermostats
 - Smart buildings
- Education of the staff is continuous
- Educating the industry by working with BOMI International



REAL-TIME ENERGY MANAGEMENT

A CASE STUDY OF THREE LARGE COMMERCIAL BUILDINGS IN WASHINGTON, D.C.

AUTHORS

Philip Henderson
Meg Waltner
Natural Resources Defense Council



<http://www.nrdc.org/business/casestudies/files/tower-companies-case-study.pdf>

Better Building Challenge

- Partner since May 2013
- Inaugural Partner for Multi-Family Housing
- Committed 3.15 Million SF
- 2010 Energy Use Baseline, 20% by 2020
- 8% Reduction in first 2 years

- Partner Profile: <http://www4.eere.energy.gov/challenge/energy-performance/tower-companies>
- Challenge Website: <https://www4.eere.energy.gov/challenge/>

Thank you

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Q & A