



**Better
Buildings®**
U.S. DEPARTMENT OF ENERGY

**Best Practices in Data Access,
Tracking, and Analysis:
Workshop for the Public Sector**

5/29/2015

Panelists/Energy Data Experts

Data Collection & Tracking

- **Emily Soontornsaratool** | State of Maryland
- **Anand Natarajan** | City of Cleveland
- **Willie Overmann** | City of Columbus
- **Jessica Granderson** | LBNL
- **Leslie Cook** | EPA

REEOs

- **Steve Kismohr** | MEEA
- **Ken Baker** | NEEA
- **Carolyn Sarno Goldthwaite & Charlie Taylor** | NEEP
- **Ann Livingston** | SWEEP
- **Chris Herbert** | SPEER

Data Cleansing & Analysis

- **Kathy Pecora** | Will County, IL
- **Zach Wilson** | New City Energy
- **Elise Anderson** | MA DOER
- **Andrea Hessenius** | MA DOER
- **Elena Alschuler** | DOE
- **Paul Mathew** | LBNL
- **Ben Cohen** | CBEI

Data Collection & Tracking

Emily Soontornsaratool
Maryland Department of General Services

State of Maryland Energy Data Tracking

Emily Soontornsaratool
Maryland Department of General Services



DGS

Office of Energy Performance & Conservation

- Energy Performance Contracting
- Energy Planning
- Electricity & Natural Gas Purchasing
- Renewable Energy Purchasing
- Measurement & Verification
- Demand Response
- Tracking State Government Energy Usage & Cost

LEGISLATION

2006 - SB267

- Leading By Example
- DGS must track and report on energy reduction across all State government facilities

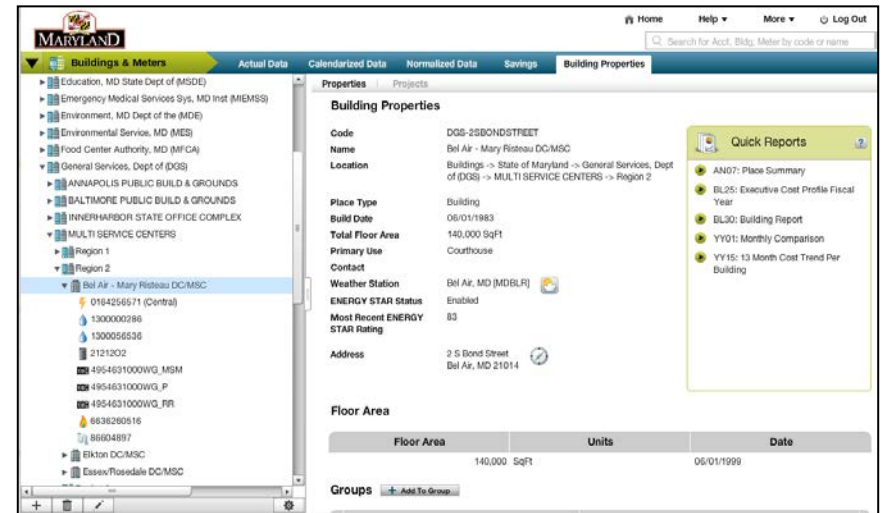
2008 - EmPOWER Maryland Energy Efficiency Act

- Mandates a 15% in per capita electricity consumption and peak demand by 2015
- Leading by Example



STATE ENERGY DATABASE

- 1st contract awarded 2008
- ~1M / year
- Contracted responsibilities:
- Create and maintain a comprehensive utility database Process ~12,000 invoices / mo
- Audit data
- Technical Support
- Training (70 hrs/year)



STATE ENERGY DATABASE

- Tracks **all commodities**: electricity, gas, oil, propane, water, sewer, steam, and chilled water
- **All energy using facilities** (buildings, traffic lights, stadiums, hospitals, fisheries, university campuses, etc.)
- **58 State Agencies** (including the University System of Maryland)
- Includes over **22,000 accounts** (16,000 active)
- Gather data from **120 accounts payable offices**
- Bills are from **124 vendors**
- Over **1 million invoices** in the database
- Comprehensive utility database services contract (~ 1.1M /yr)
- Runs on EnergyCAP software

STATE ENERGY DATABASE



Search for Acct, Bldg, Meter by code or name

- Buildings & Meters
 - Education, MD State Dept of (MSDE)
 - Emergency Medical Services Sys, MD Inst (MI)
 - Environment, MD Dept of the (MDE)
 - Environmental Service, MD (MES)
 - Food Center Authority, MD (MFCA)
 - General Services, Dept of (DGS)
 - ANNAPOLIS PUBLIC BUILD & GROUNDS
 - BALTIMORE PUBLIC BUILD & GROUNDS
 - INNERHARBOR STATE OFFICE COMPLEX
 - MULTI SERVICE CENTERS
 - Region 1
 - Region 2
 - Bel Air - Mary Risteau DC/MSC
 - 0164256571 (Central)
 - 1300000286
 - 1300056536
 - 21212O2
 - 4954631000WG_MSM
 - 4954631000WG_P
 - 4954631000WG_RR
 - 6636260516
 - 86604897
 - Elkton DC/MSC
 - Essex/Rosedale DC/MSC

[Actual Data](#)
[Calendarized Data](#)
[Normalized Data](#)
[Savings](#)
[Meter Properties](#)

[Summary](#)
[Trends](#)
[Monthly](#)
[Bills](#)
[Greenhouse Gas](#)
[Demand](#)

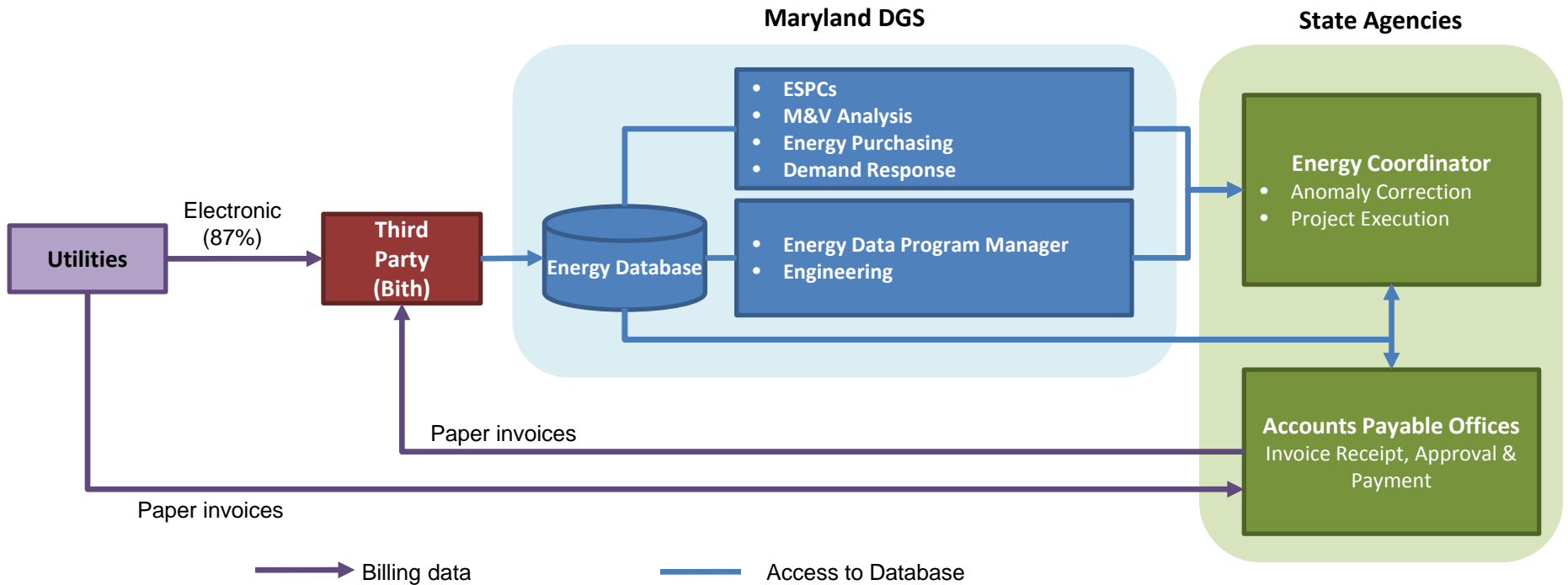
Filter Settings: Meter = V000032325 [0164256571 (Central)]

Total Cost All Bills: \$1,556,294.13
Displaying 1 To 100 of 205

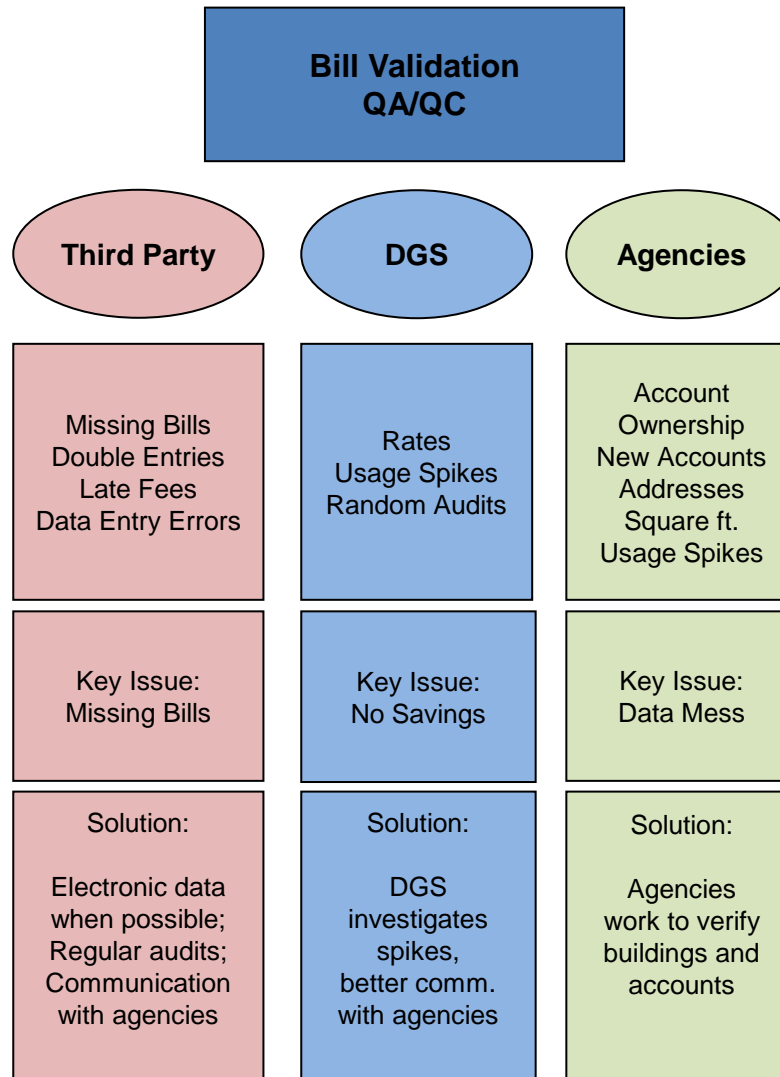
Account Code	Billing Period	Begin Date	End Date	Total Cost	Usage	Usage Unit
4954610060WG	Feb 2014	02/01/2014	02/28/2014	\$13,993.05		
4954631000	Feb 2014	02/17/2014	03/17/2014	\$2,515.75	121,800	kWh
4954610060WG	Jan 2014	01/01/2014	01/31/2014	\$29,528.95		
4954631000	Jan 2014	01/17/2014	02/17/2014	\$2,559.55	128,100	kWh
4954610060WG	Dec 2013	12/01/2013	12/31/2013	\$13,520.01		
4954631000	Dec 2013	12/17/2013	01/17/2014	\$2,424.39	115,500	kWh
4954610060WG	Nov 2013	11/01/2013	11/30/2013	\$12,463.09		
4954631000	Nov 2013	11/15/2013	12/17/2013	\$2,290.42	116,200	kWh
4954610060WG	Oct 2013	10/01/2013	10/31/2013	\$13,856.71		
4954631000	Oct 2013	10/17/2013	11/15/2013	\$2,661.03	117,600	kWh
4954631000	Sep 2013	09/18/2013	10/17/2013	\$2,927.71	145,600	kWh



STATE ENERGY DATABASE



STATE ENERGY DATABASE



DATA USES & APPLICATIONS

Energy Performance Contracts

- Identifying opportunities
- Establishing a baseline of usage
- Measurement & Verification of Savings / holding vendors accountable

Energy Planning

- Agencies identify their energy consuming entities and analyze their energy usage
- Track progress and results of initiatives

DATA USES & APPLICATIONS

Reporting

- Measuring savings & Progress towards goals
- Reporting to the Governor's Office

Competitions

- 16 Agency Energy Competition (State)
- EPA National Building Competition

Electricity & Natural Gas Purchasing

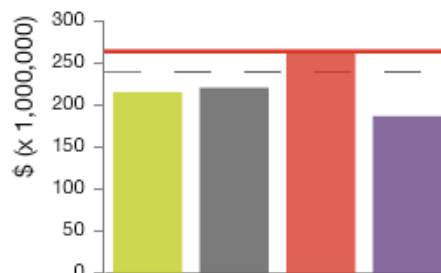
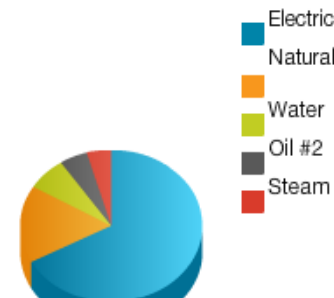
- Identifying State utility accounts and providing data to bidders
- Historical rate information for budget and forecasting
- Holding suppliers accountable

**Buildings & Meters****Actual Data****Organization Properties**

- State of Maryland
 - _State of Maryland - Other
 - _Unknown Accounts
 - Administrative Hearings, Office of (
 - Agriculture, MD Dept of (MDOA)
 - Archives, Maryland State (MSA)
 - Baltimore City Community College
 - Business and Economic Developme
 - Canal Place Preservation & Dev Au
 - Deaf, MD Schools for the (DEAF)
 - Education, MD State Dept of (MSD
 - Emergency Medical Services Sys. M

Summary | Commodity | Monthly | Greenhouse Gas

Last updated: 05/19/2015 1:13:15 AM

Total Cost Summary
(FY ends in Jun of year shown)**Energy Cost Percentage**

Public Facing Database:

<http://www.dgs.maryland.gov/Energy/Database/EnergyDatabasePublic.html>

QUESTIONS?

Emily Soontornsaratool

Energy Data Program Manager

Office of Energy Performance & Conservation

MD Dept. of General Services

Emily.Soontornsaratool@maryland.gov

(410) 767-3061



Anand Natarajan
City of Cleveland, OH

Energy Data Access & Tracking

Leveraging Resources

Public Sector Data Workshop

Better Buildings Summit
May 29, 2015

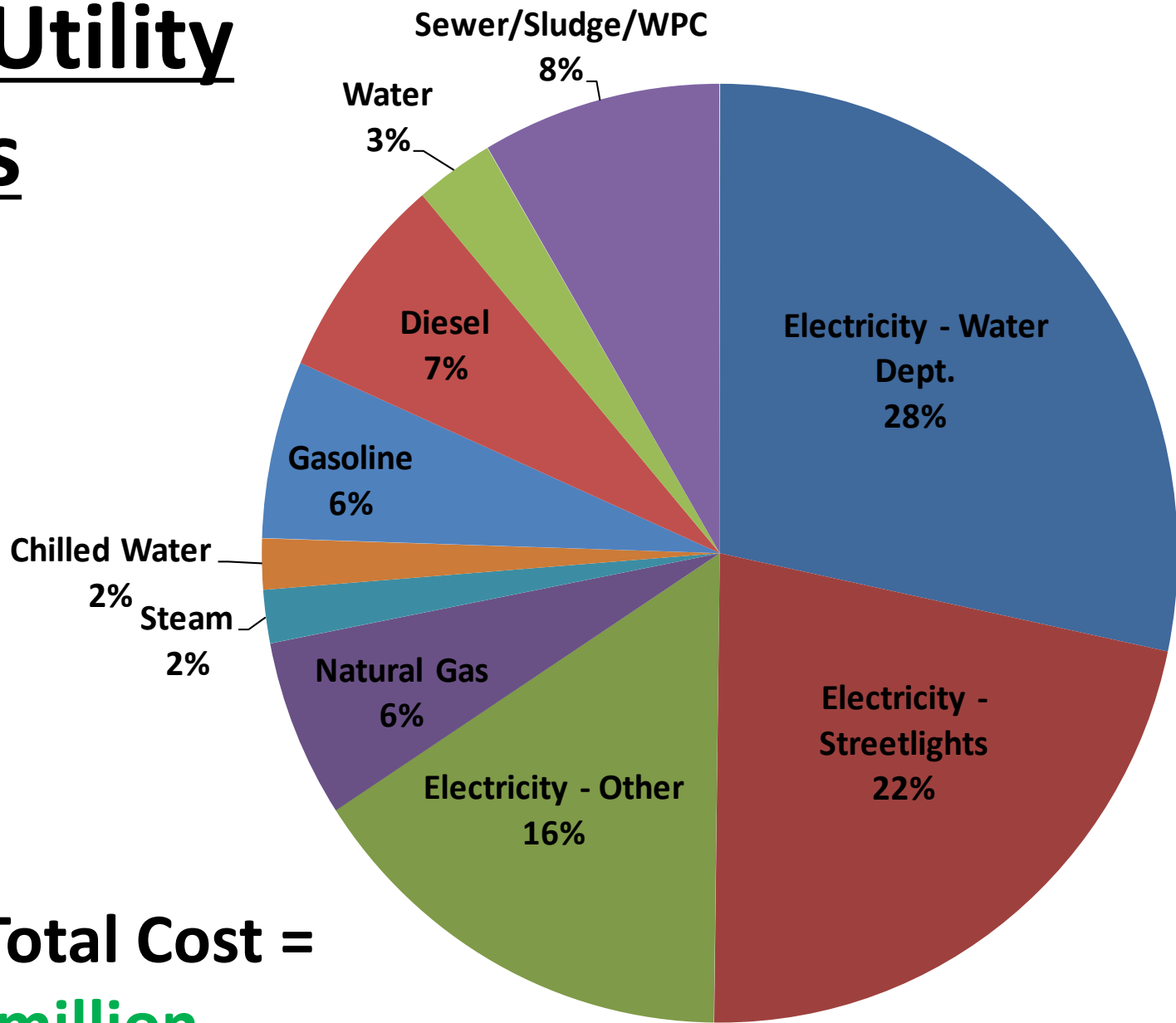


SUSTAINABLE CLEVELAND
TOGETHER, WE'RE BUILDING A THRIVING
GREEN CITY ON A BLUE LAKE



CITY OF CLEVELAND
Mayor Frank G. Jackson

City Utility Costs



2014 Total Cost =
\$66.8 million

Energy Data Management System - EnergyCAP

Buildings & Meters

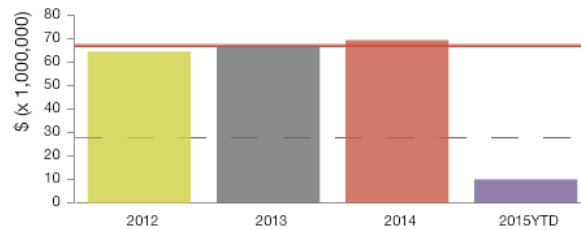
Actual Data | Calendarized Data | Normalized Data | Savings | Organization Properties

- Buildings
 - City of Cleveland
 - Aging (Department)
 - Building & Housing (Department)
 - Community Development (Department)
 - Finance (Department)
 - General Government (Department)
 - Office of the Mayor
 - Workforce Development
 - Law (Department)
 - Office of Capital Projects
 - Outliers
 - Port Control (Department)
 - Public Health
 - Public Safety
 - Public Utilities
 - Public Works (Department)
 - Streetlights & Traffic Lights
 - Courts
 - State of Ohio
 - Unknown

Summary | Commodity | Monthly | Greenhouse Gas

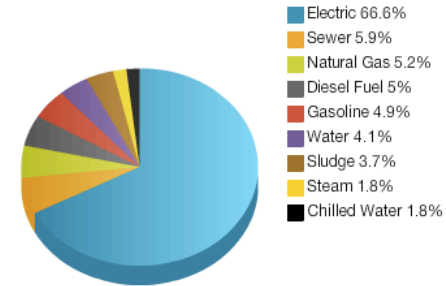
Last updated: 05/26/2015 1:04:01 AM EDT

Total Cost Summary
(FY ends in Dec of year shown)



2010 Baseline (2010 actual data)
 — Annual - - - YTD

Energy Cost Percentage



Daily Average Cost

Percentage Change from
**Previous Year To
 Current Year**

Current Year:
 Apr 2014 - Mar 2015
\$166,069.21

Previous Year:
 Apr 2013 - Mar 2014
\$186,023.20



10.7 %

Energy Data Management - EnergyCAP

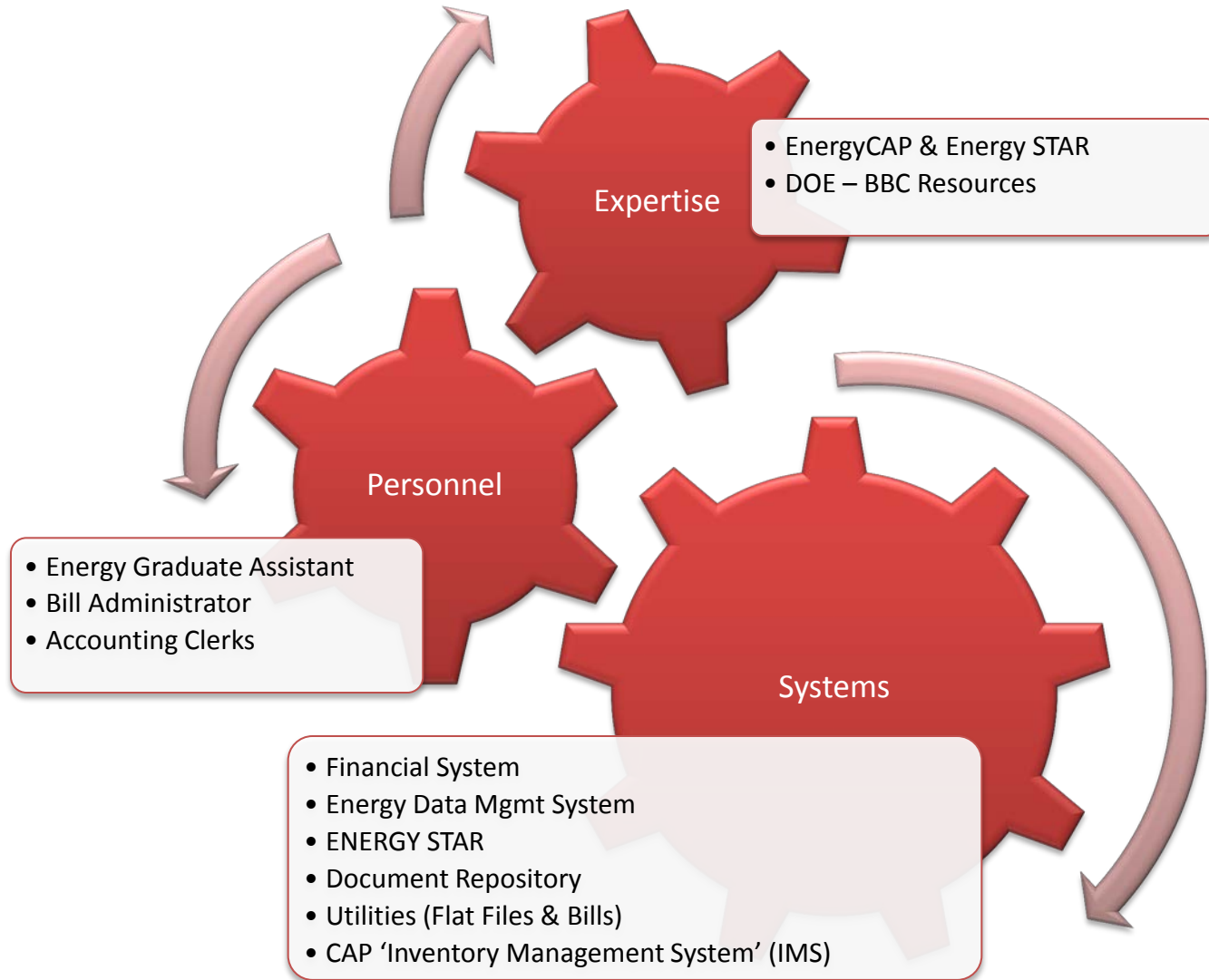
Utilities

- Electricity
- Natural Gas
- Steam
- Chilled Water
- Water and Sewer
- Fleet Fuel (Diesel, Gasoline)

Vendors

- Cleveland Public Power (CPP)
- Illuminating Company/First Energy, Deregulated Suppliers
- Ohio Edison
- Dominion
- Hess
- Columbia Gas
- Cleveland Thermal (Steam and Chilled Water)
- Cleveland Water Division (CWD)
- City's Motor Vehicles Maintenance (MVM) & Airports Fuel Management
- Water Pollution Control (WPC)
- Northeast Ohio Sewer District (NEORS)

Leveraging Resources



EnergyCAP – ENERGY STAR Interface

Bill Processing

- Bill Entry
 - Enter Bills
 - Bill Import Errors
- My Bill Lists
 - Default Bill List
 - Batches
- Bill Audits
 - Bills With Problem Flags
- Audit Groups
 - Default Group [DEFAULTGROUP]
 - Quick Check Audit [QUICKCHECK]
- Chargebacks
 - Process Chargebacks
- Problems
- Cost Avoidance
 - Calculate Savings
- ENERGY STAR

Email address to notify when results are available

mginn@city.cleveland.oh.us

- Submit all ENERGY STAR buildings
- Select buildings to submit

Selective Building Submittal

<input type="checkbox"/>	Code	Name	Status
<input type="checkbox"/>	CROWN_TREATMENT_PLANT	Crown Water Treatment Plant	OK
<input type="checkbox"/>	THURGOOD_MARSHALL_REC...	Thurgood Marshall Recreation Center	OK
<input type="checkbox"/>	COCHRAN_HARPER_INTERCO...	Cochran Harper Interconnect Vault	OK
<input type="checkbox"/>	J_GLEN_SMITH_HEALTH_CEN...	J. Glen Smith Health Center	OK
<input type="checkbox"/>	MCCAFFERTY_HEALTH_CENTER	McCafferty Health Center	OK

Submit

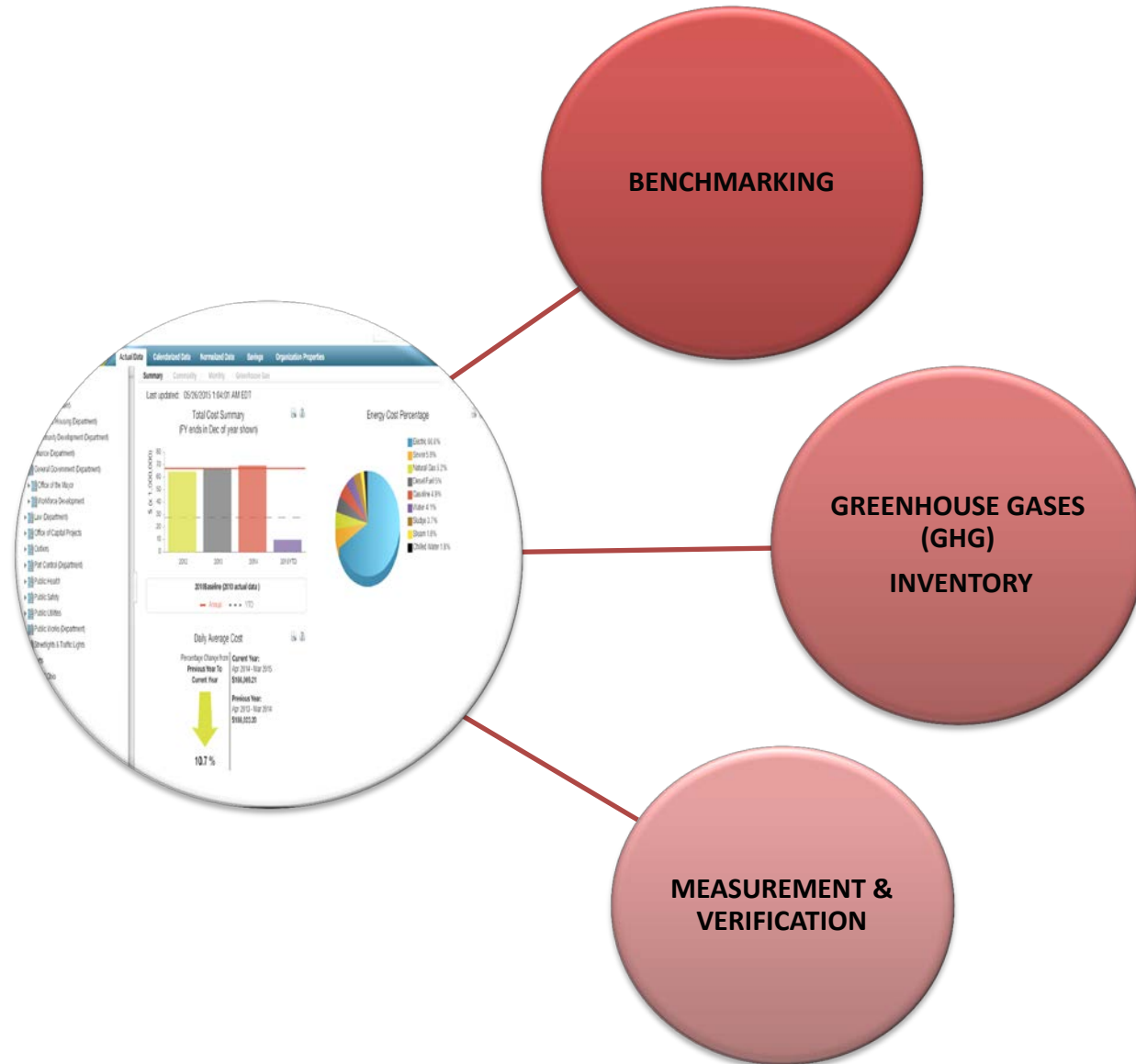
Submittal Log

Submit Date	Receive Date	User
04/10/2015	04/13/2015	Matthew Ginn
03/30/2015	03/30/2015	Matthew Ginn
03/26/2015	03/30/2015	Matthew Ginn
03/26/2015	03/26/2015	Matthew Ginn
03/26/2015	03/26/2015	Matthew Ginn

Get Available Ratings



Energy Data Access & Tracking - Applications



Thank You!

Anand Natarajan, Energy Manager

City of Cleveland, Mayor's Office of Sustainability
anatarajan@city.cleveland.oh.us

Join us at :
www.SustainableCleveland.org

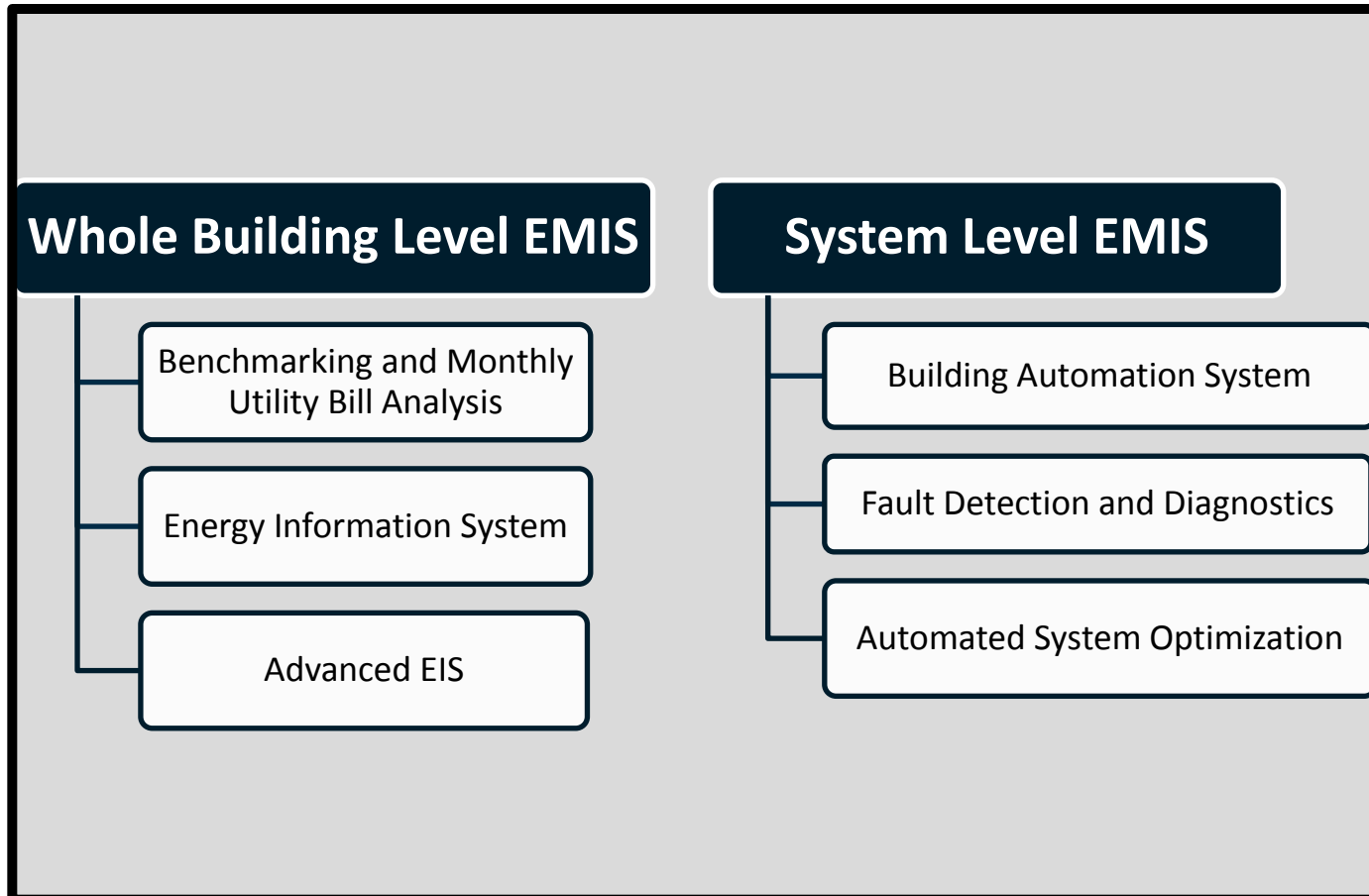


Jessica Granderson
Lawrence Berkeley National Laboratory

Energy Management and Information Systems: Performance Monitoring, Analytics, Diagnostics

Jessica Granderson
Lawrence Berkeley National Laboratory

Energy Management and Information Systems

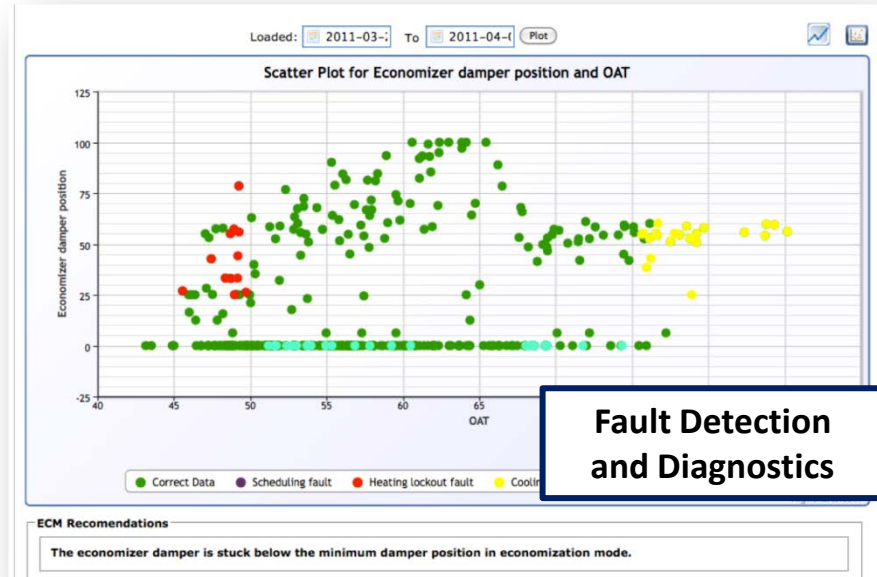


* The boundaries can be fuzzy; some tools cross categories, e.g., energy information systems with FDD and benchmarking capabilities

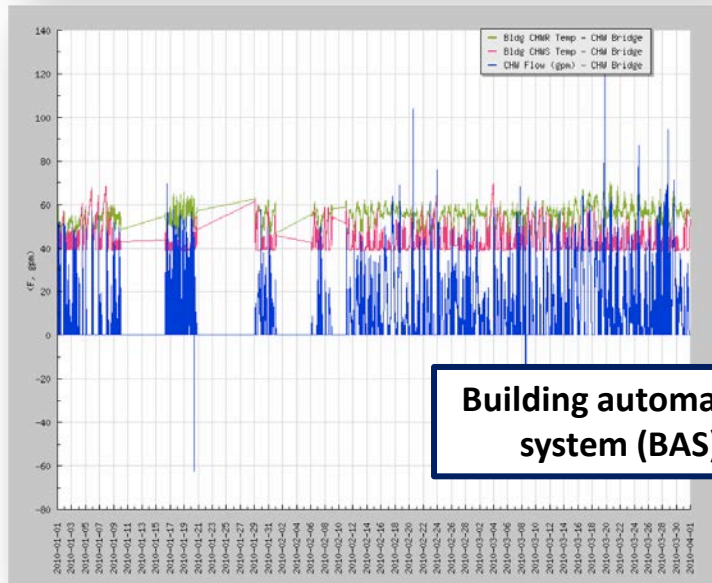
EMIS Examples



Benchmarking and Monthly Utility Bill Analysis

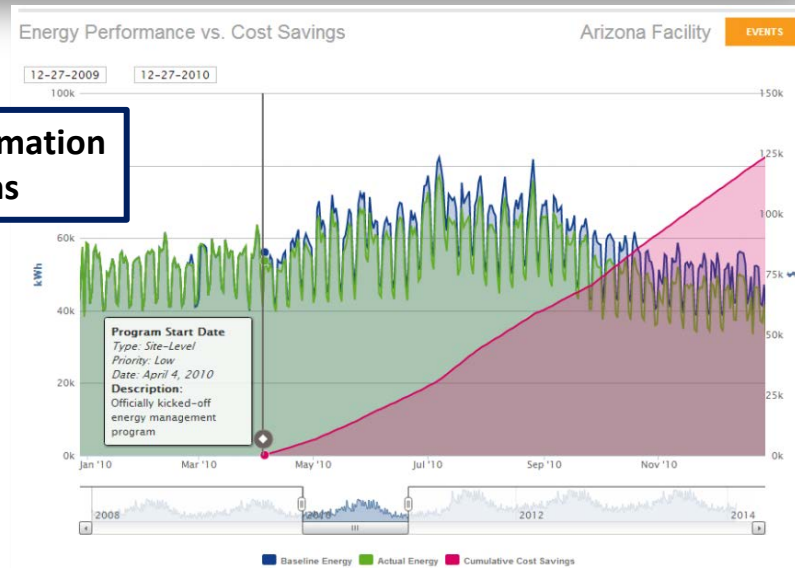


Fault Detection and Diagnostics



Building automation system (BAS)

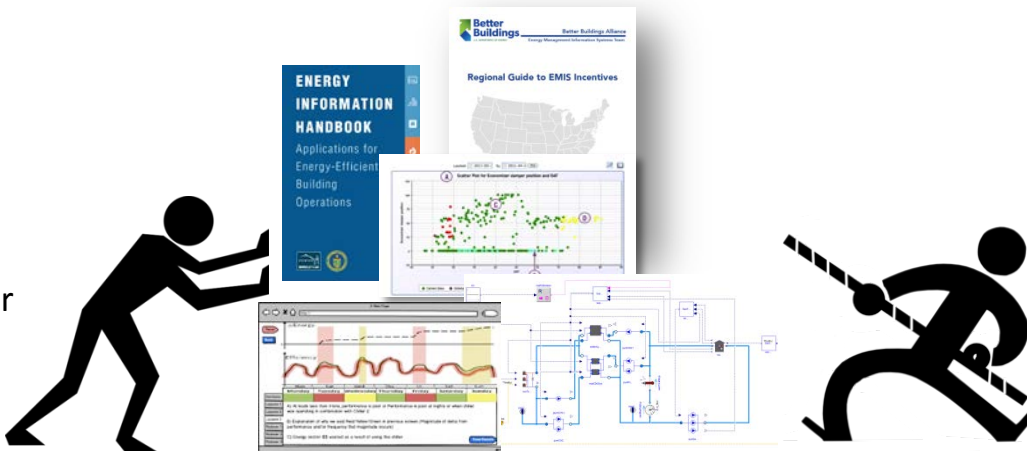
Energy Information Systems



LBNL's EMIS Program

- Accelerates *adoption* and *technical advancement* of monitoring, diagnostic, and control solutions that are under-utilized in national stock
 - Yet shown to enable up to ~20% site energy savings
- Laboratory technical expertise and market intelligence connects owner/operator community, vendors of commercial tools, and BTO program objectives
 - Development of new analytical approaches, **identification of best-practice uses**
 - **Knowledge and technology transfer to facilitate market push and market pull**

LBNL w/vendor
community



LBNL w Better Buildings Alliance
members, public sector,
GSA, DoD, vendor community

BBA EMIS Project Team Overview

- Activity: adopt or expand use of EMIS in your organization
- Members from public and private sector, retail, hospital, real estate
- Existing and ongoing resources
 - Peer learning, public/private/utility pilots and demos
 - Technology costs and benefits, business value proposition
 - Synthesis of existing EMIS resources, “Cliff’s Notes”
 - Regional guide to EMIS utility incentives
 - Vendor overviews and *guest login access*
 - Procurement support materials: master spec and RFP, selection guidance

Small Group Discussions Round 1

Discussion Format

Step 1: Pick a topic table

Step 2. Write down a question for the facilitator

Step 3: Facilitator reviews all questions and uses them as a guide for ensuing discussion

Step 4: Report Out (1 min each)

- **Barriers discussed**
- **Solutions/successes discussed**
- **Connections/contributions made, concrete action items or next steps**
- **Remaining questions**

Small Group Discussions: Data Access and Tracking

Round #1 9:30 AM to 10 AM

Table Topic	Facilitator
1. Perfecting the value proposition for energy data management	Steve Kismohr
2. How to pay for data management services	Jessica Granderson
3. Leveraging limited time and resources	Anand Natarajan
4. Working with utilities on automated data access	Zach Wilson
5. Working with third parties and across departments	Emily Soontornsaratool

**Kathy Pecora,
Will County, IL**

Zach Wilson
District of Columbia/New City Energy

Elena Alschuler
DOE



U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

Data Tools Overview

May 2015

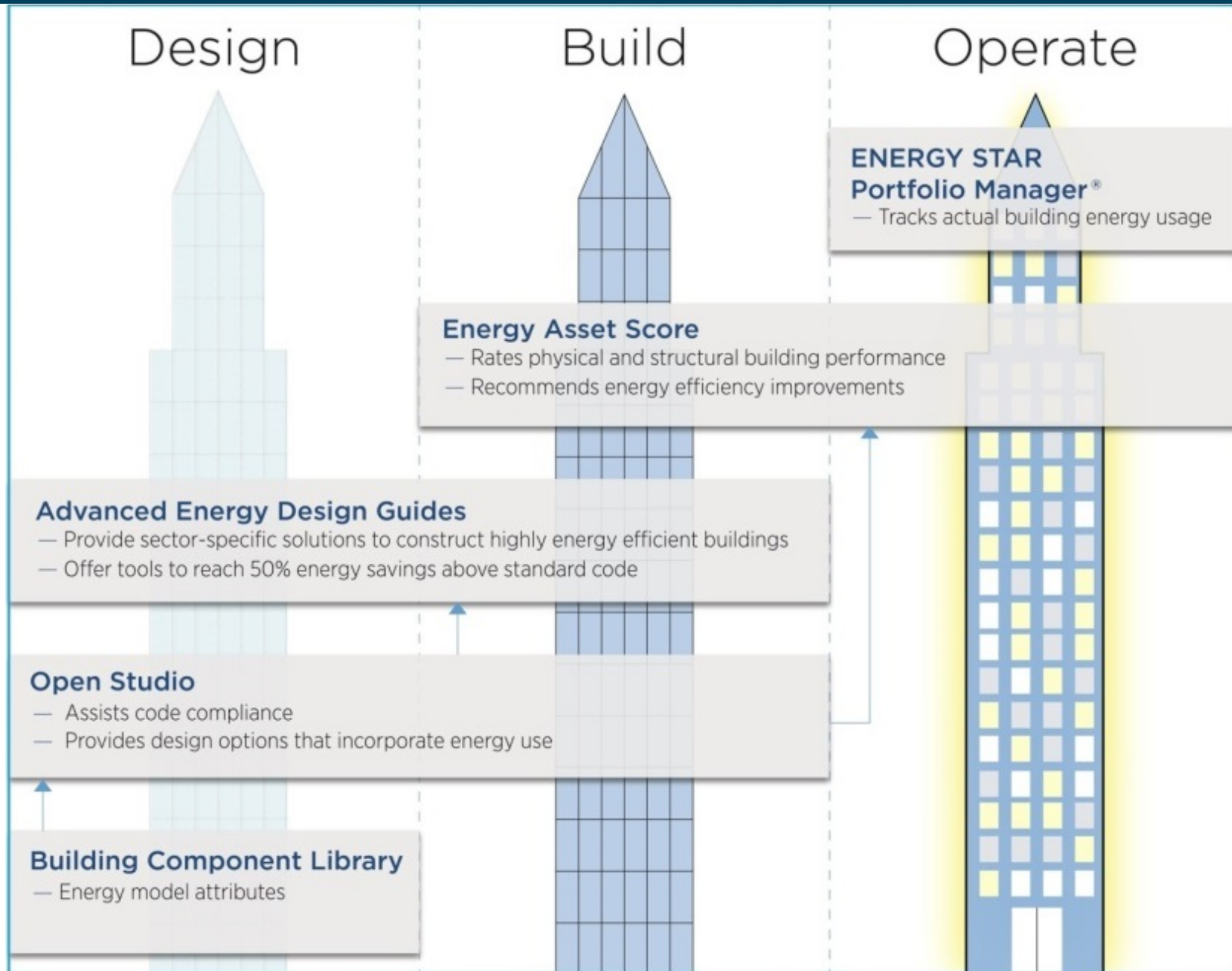
Elena Alschuler

Elena.alschuler@ee.doe.gov

Building Technologies Office

U.S. Department of Energy

Goals: Integrate energy-related information throughout building lifecycle



Goals: Increase availability & consistency of energy-related information

Transmit

HPXML Residential Audit

BUILDINGSYNC Commercial Audit

GREEN BUTTON Utility Energy Data

Combine



SEED
SOFTWARE ENERGY EFFICIENCY DATA
PLATFORM

Software platform for building portfolio data management

Compare



BPD
BUILDING PERFORMANCE DATABASE

Public database of building energy performance



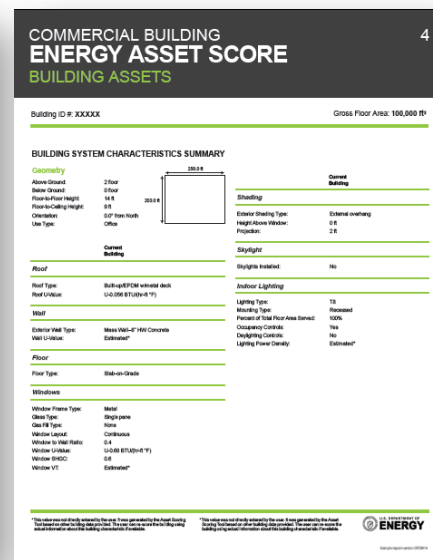
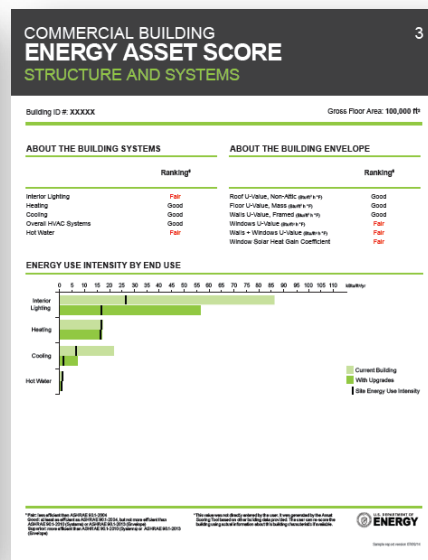
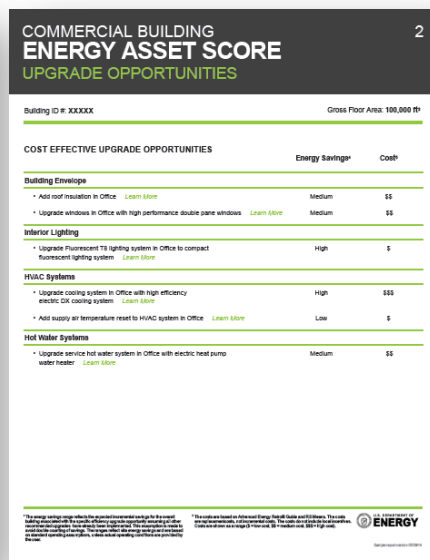
BEDES
BUILDING ENERGY DATA
EXCHANGE SPECIFICATION

Dictionary of common terms to ensure the interoperability between data tools



Building Energy Asset Score

- Rating tool that provides a whole-building score and identifies inefficient systems and potential capital upgrades, based on as-built physical characteristics (independent of operations)
- User input data is used to run an energy model, generate a 1-10 score, and identify opportunities to upgrade building efficiency



Standard Energy Efficiency Data Platform



- Open source software that manages data about large groups of private and/or public buildings
- Users can combine data from multiple sources, clean it, and share it with others
- The open source and extensible platform can support apps and connect to other software

PROJECTS 0

BUILDINGS 512

DATA 1

ORGANIZATIONS 47

CONTACT

ABOUT

512 Buildings

[Buildings List](#) [List Settings](#)

Building Actions ▾

<input type="checkbox"/>	ADDRESS LINE 1	ENERGY STAR SCORE		PM PROPERTY ID	PREMISES GROSS FLOOR AREA		PREMISES OCCUPANCY CLASSIFICATION	SITE EUI		TAX LOT ID
	Address Line 1	Min	Max	Pm Property Id	Min	Max	Premises Occupancy Classification	Min	Max	Tax Lot Id
<input type="checkbox"/>	198832 SE Arthur Loop	74		634829	68,177		COMMERCIAL	75		10101/132e1
<input type="checkbox"/>	90256 S Cantaloupe Court	86		413717	51,688		COMMERCIAL	62		10101/1f7f1
<input type="checkbox"/>	241773 W Apples Avenue	79		178388	59,341		COMMERCIAL	68		10101/230e0
<input type="checkbox"/>	4455 N Ash Lane			929775	330,369		COMMERCIAL	425		10101/2417d
<input type="checkbox"/>	162695 NW Monroe Alley	89		959006	323,725		COMMERCIAL	63		10101/25e4b
<input type="checkbox"/>	16643 W Ford Alley			956153	288,029		COMMERCIAL			10101/27d4b
<input type="checkbox"/>	181881 E Myrtle Street	79		451449	215,255		COMMERCIAL	77		10101/2b760
<input type="checkbox"/>	243909 SW Taft Boulevard	84		922911	234,831		COMMERCIAL	85		10101/2e66d
<input type="checkbox"/>	219222 SW Filbert Avenue	73		800676	142,331		COMMERCIAL	78		10101/34a5f
<input type="checkbox"/>	199110 W Myrtle Boulevard			391603	302,514		RESIDENTIAL-MULTI FAMILY	130		10101/36bfc

Display: buildings
Showing 1 to 10 of 512 buildings

« Previous
Next »

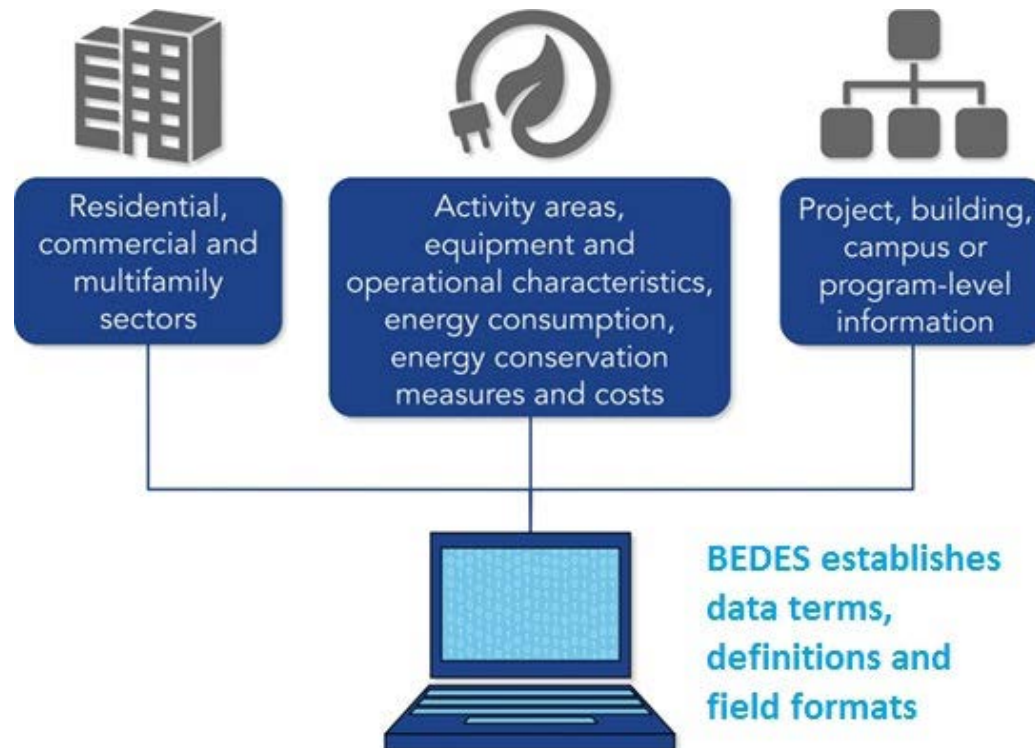
Buildings Performance Database

- The BPD is the largest publicly-accessible dataset of information about the physical and operational characteristics of real buildings
- Allows users to explore data across real estate sectors, compare trends in the energy performance, and tailor programs and policy design based on the conditions of the local building stock



Building Energy Data Exchange Specification

- Dictionary of terms, definitions, and field formats to facilitate the exchange of information on building characteristics and energy use
- Improve data quality and decrease the cost and time involved in aggregating and sharing data
- Support for industry-wide standardization increases the efficiency of business processes and helps grow the market of products and services that utilize energy data



Paul Mathew
LBNL



U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

Data Cleansing: Lessons from the BPD

Paul Mathew
Lawrence Berkeley National Lab

The Buildings Performance Database

- The BPD is the largest publicly-available dataset of information about the energy performance of real commercial and residential buildings.



Lots of data from many sources...

- >790,000 buildings from both public and private datasets. More datasets are being added regularly.
- Significant effort to map and cleanse data before it can be used.

Data contributors include...

U.S. Energy Information Administration

U.S. General Services Administration

U.S. Environmental Protection Agency

New York City Dept. of Citywide Administrative Services

Pennsylvania Keystone HELP Home Energy Loan Program

San Francisco Department of the Environment

State of California Public Utilities Commission

State of California Energy Commission

University of Arizona

University of Dayton

District Department of the Environment: Washington, DC

Vermont Energy Investment Corporation

Virginia Beach City Public Schools

Brandywine Realty Trust

Connexion Asset Group

Kohl's

EnergyIT.com

Liberty Property Trust

Lucid Design Group

Prudential

Related

Tishman Speyer

Transwestern

USAA

Vornado Realty Trust

Data analysis



Data cleansing



Data Cleansing: Why Do It?

- Bad data happens!
 - Errors in collection, collation, transmission, transformation...
- Bad data “contaminates” the data set and can lead to inaccurate analysis and erroneous decisions.
- Bad data can lead to lack of confidence in results, potentially undermining the credibility of the underlying program or policy.

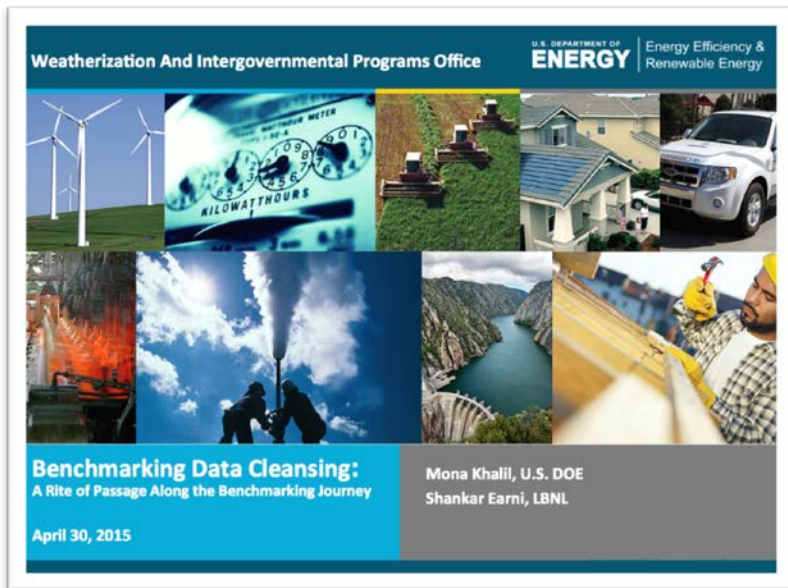
Data issues and cleansing actions...a selection

Data Issue	Cleansing Action
Inconsistent units of measure <i>(e.g. kBtu vs. therm)</i>	Convert to common units
Inconsistent formats <i>(e.g. 100,000 vs. 100K vs. 100000)</i>	Convert to common format
Inconsistent naming conventions <i>(e.g. RTU, Roof top unit, packaged unit)</i>	Convert to common terms
Missing data	Delete record or interpolate value
Obvious incorrect values <i>(e.g. Floor area < 0)</i>	Out-of-range checking, Delete or correct values
Possible incorrect values <i>(e.g. Hospital EUI < 10 kBtu/sf/yr)</i>	In-range checking, Delete or correct values

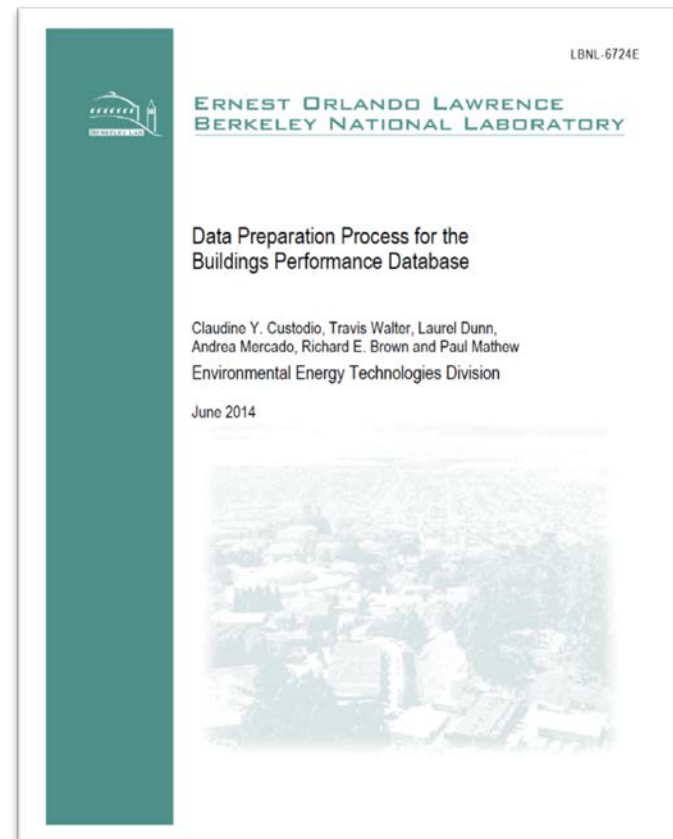
Tips for an effective data cleansing process

- Before you begin: Develop your criteria based on your use cases
 - Determine what rules to apply (e.g. minimum data to keep a record)
 - Determine tradeoff between accuracy and level of effort to cleanse
 - Determine cleansing options (e.g. Is interpolation ok? How much?)
- Allocate adequate resources
- Develop an explicit set of cleansing rules and procedures
 - “Checklist Manifesto”
- Automate as much as possible
 - But ensure automation is rigorously tested and periodically retested.
- If possible, quantify data quality and uncertainty
 - Or at least qualitatively characterize it
- Communicate!
 - Don’t be shy. Publish your cleansing rules.
 - Provide guidance on how it can/cannot support various types of analysis and decision-making.

DOE WIPO Benchmarking Data Cleansing Guidance



DOE BPD Data Cleansing Technical Report



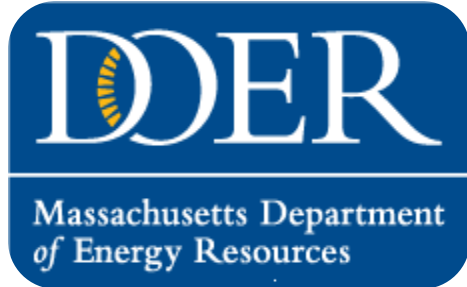
<http://energy.gov/eere/buildings/downloads/data-preparation-process-buildings-performance-database>

Thank you



Paul Mathew
pamathew@lbl.gov

Andrea Hassenius
Massachusetts Dept. of Energy Resources



Data-Based Program Design

Better Buildings Challenge Summit

May 29, 2015

Elise Anderson Andrea Hessenius
Massachusetts Dept. of Energy Resources

Key Discussion Points

- State Policy Drivers
 - Green Communities Division
 - Leading by Example Program
- Data Requirements
- MassEnergyInsight
 - An example of how DOER collects data
- DOER Data-Based Opportunity Design
 - Case Studies

State Policy Drivers

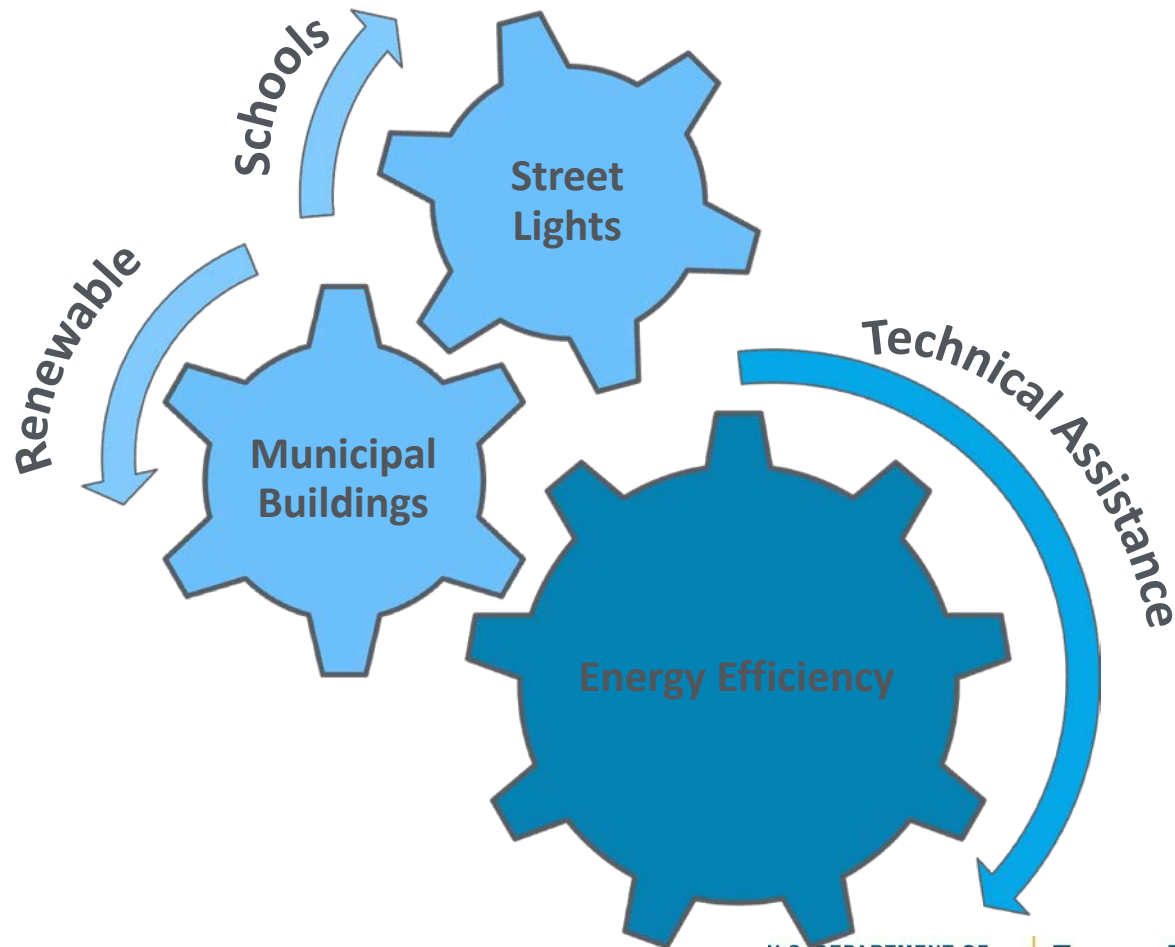
- **Global Warming Solutions Act (GWSA)**
 - Mandated 80% reduction of greenhouse gas (GHG) emissions from all sectors in the economy by 2050 (1990 baseline)
- **Clean Energy and Climate Plan 2020**
 - 25% interim target for GHG emission reductions by 2020
- **Green Communities Act (GCA)**
 - Assists all 351 Massachusetts cities and towns in finding clean energy solutions that reduce long-term energy costs and strengthen local economies
- **Leading by Example E.O. 484 (LBE)**
 - Sets GHG, renewable generation, and energy usage intensity goals for state facilities
- **Renewable and Alternative Portfolio Standard**
 - Electricity suppliers obligated to supply energy from renewable and alternative clean energy sources; increases annually.



Creating A Cleaner Energy Future For the Commonwealth

Green Communities Division

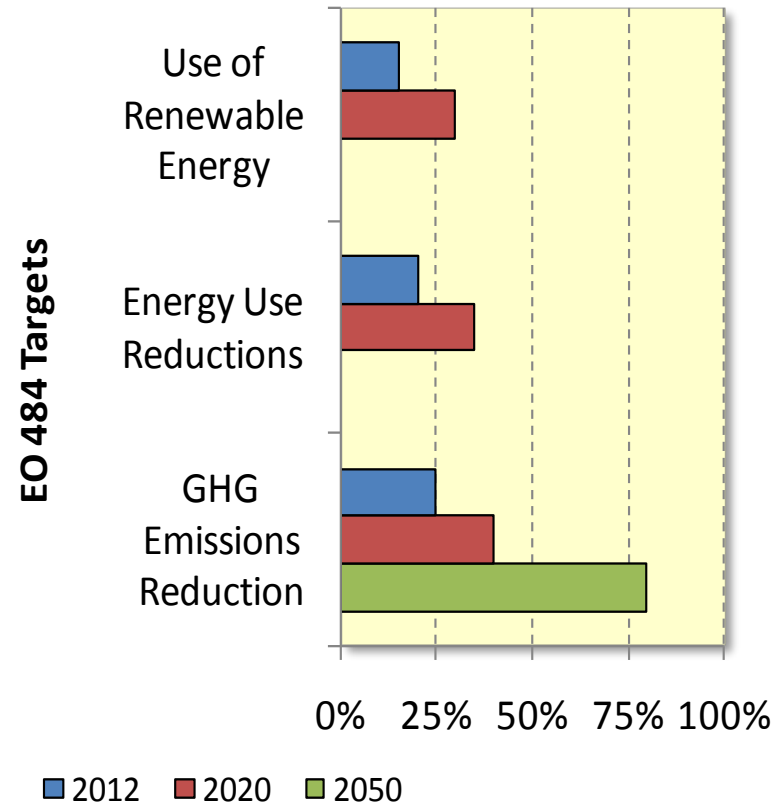
The energy hub for *all* Massachusetts cities and towns, not just designated “Green Communities.”



Leading by Example (E.O. 484)

LBE—Clean Energy and Efficient Buildings

- Sets short, medium, and long-term goals for state agencies:
 - GHG emission reductions
 - Energy reductions
 - Renewable energy
 - Water conservation
- Requires all new construction to meet Mass. LEED Plus Standard
- Includes executive agencies, community colleges and university campuses, Trial Court



Green Communities & LBE

Programs & Resources for Municipalities & State Facilities

- Green Communities Designation and Grant Program
- Leading by Example Program Grant Opportunities
- MassEnergyInsight energy tracking and analysis tool
- Municipal Energy Efficiency Program
- Energy Management Services Technical Assistance
- Clean Energy Results Program (CERP)
- Dedicated Regional Coordinators for municipalities
- Collaboration with multiple state partners for E.O. 484

Website filled with tools & resources:

www.mass.gov/energy/greencommunities

www.mass.gov/eea/leadingbyexample

Data Requirements

For Municipalities

Provides grants to *qualifying Green Communities* to fund energy efficiency initiatives, renewable energy, innovative projects

1. Adopt as of right siting for RE/AE generation, R&D, or manufacturing
2. Adopt expedited permitting process
- 3. Create an Energy Reduction Plan to reduce energy use by 20% in 5 years**
4. Purchase only fuel efficient vehicles
5. Minimize life cycle cost in new construction -- adopt the Stretch Code

For State Agencies

Leading by Example, LBE

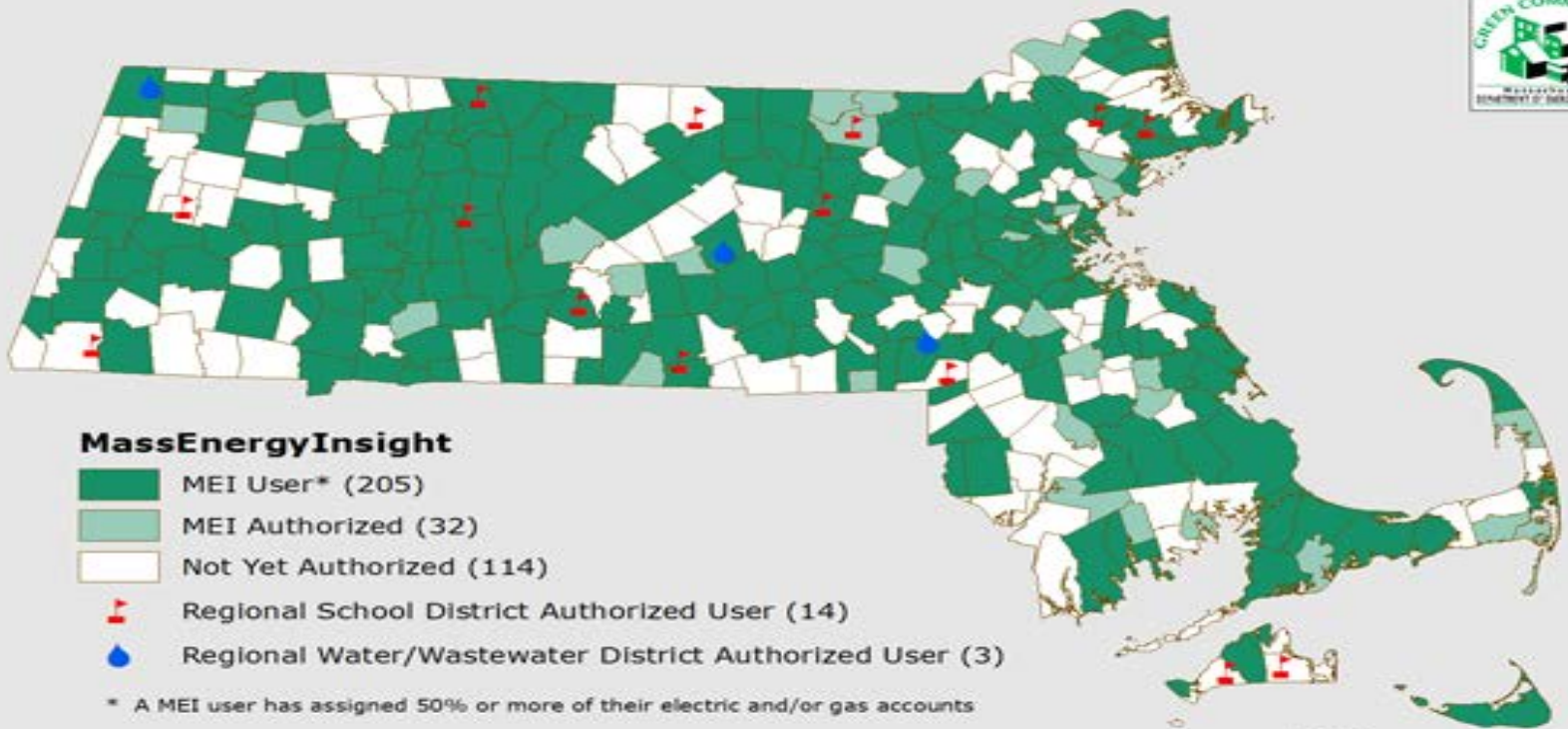
- EO requires reporting and collaboration on data with LBE Program
- Requires annual reporting by LBE staff
- Track progress toward goals
- Better Buildings Challenge annual reporting

MassEnergyInsight (MEI)

A web-based tool fine-tuned for municipal energy data management, analysis, and reporting

Municipalities Tracking Energy Use Using

MassEnergyInsight
POWERING EFFICIENCY



4-3-2013

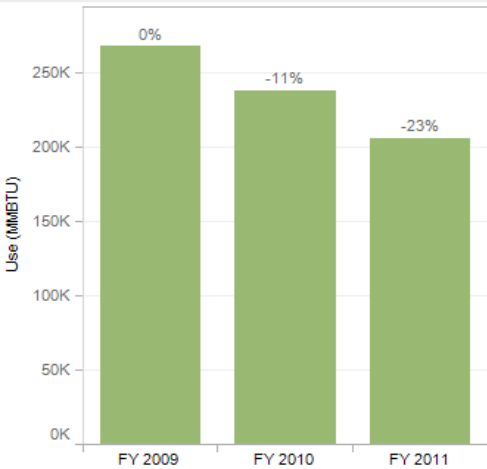
How MEI Works

MEI provides users with a platform to do the following items:

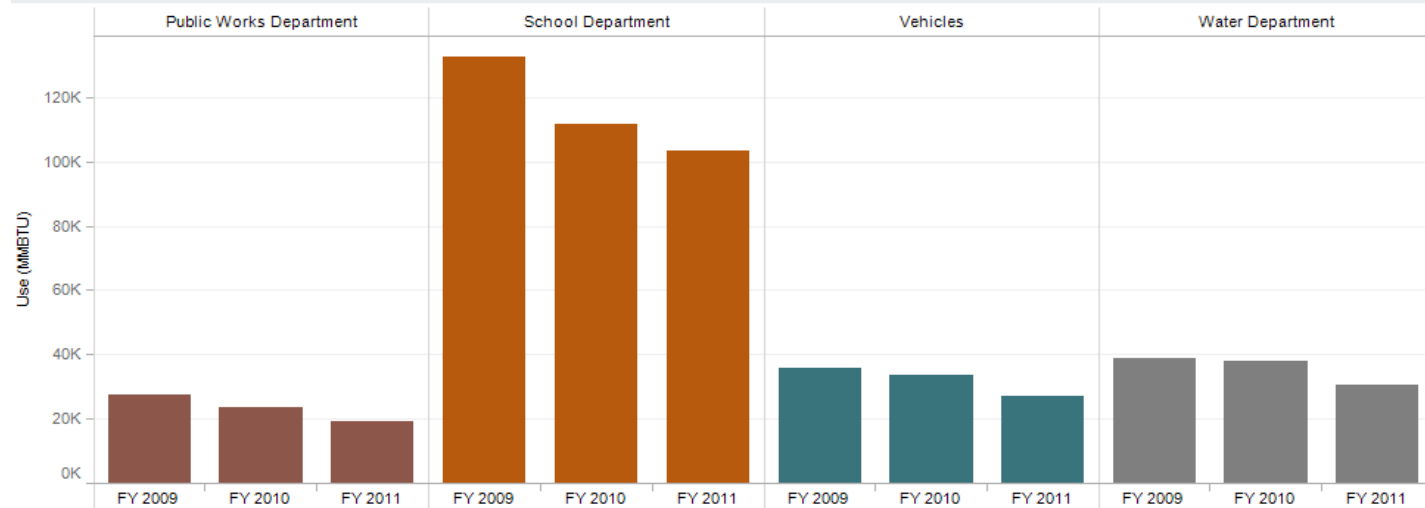
- Identify utility accounts
- Align accounts with facilities
- Gather building information
- Collect utility data
- Gathers various fuel data (fuel oil, propane, gasoline/diesel, biomass, renewable generation)
- Assigns all accounts to a Category
- Provides graphs for data

Baseline Dashboard

Overall Use (with % Difference from Baseline Year)

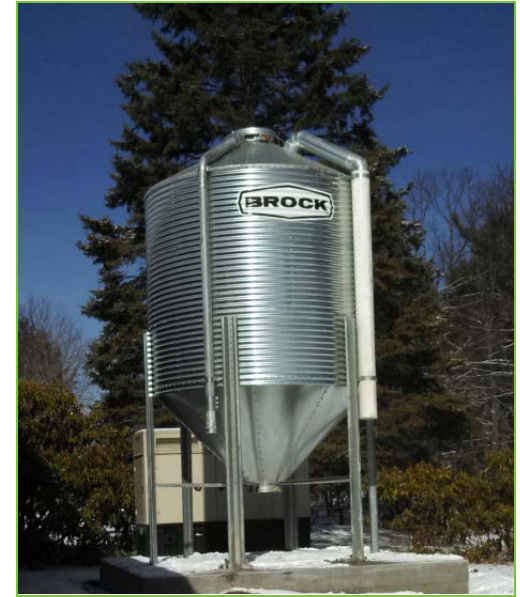


Use by Department



DOER Data-Based Opportunity Design

- Create grant initiatives based on energy trends
- Find sites/ projects open to grant opportunities
- Establish baselines
- Implement projects



Program Opportunity	Example Projects	Data Sources
<ul style="list-style-type: none"> • Renewable Thermal at state facilities 	<ul style="list-style-type: none"> • State Parks • Trial Courts • Fish Hatcheries 	<ul style="list-style-type: none"> • MassEnergyInsight • Statewide contracts • Feasibility Studies
<ul style="list-style-type: none"> • Green Communities Competitive Grants 	<ul style="list-style-type: none"> • Municipal Facilities • Public Schools • Police Stations 	<ul style="list-style-type: none"> • MassEnergyInsight • MassSave • Portfolio Manager • Feasibility Studies
<ul style="list-style-type: none"> • SAPPHIRE 	<ul style="list-style-type: none"> • Regional School Districts • Public Housing 	<ul style="list-style-type: none"> • MassEnergyInsight • Portfolio Manager • Feasibility Studies
<ul style="list-style-type: none"> • Energy Leaders Roundtable 	<ul style="list-style-type: none"> • WWTP • DWTP • DW/WW Districts 	<ul style="list-style-type: none"> • MassEnergyInsight • MassSave • Portfolio Manager

Case Study #1

Leading by Example established Renewable Thermal Implementation Grants targeting projects displacing electric, oil, or propane heating for renewable thermal technologies.

- Using MEI and other data sources, LBE collects monthly utility consumption, fuel oil deliveries, geographic location, and square footage
- For a portion of the grant funds, LBE focused on agencies that consumed over 5,000 gallons of fuel oil annually for operations and would be open to biomass fuels and other renewable thermal technologies
- By targeting sites through data, LBE was able to design projects that would benefit the most from alternative fuel sources



Use Table

This table shows use in native units by fiscal year for a chosen fuel or fuels. To expand or collapse the table, hover over the words Agency, Site, Account, etc., then click the plus (+) or minus (-) symbols. You can do the same for years, quarters and months.

Agency	Site	Fuel	FY 2010	FY 2011	FY 2012
Dept. of Fish and Game	Mclaughlin State Hatchery	Oil (Gallons)	5,925	8,082	7,183
	WMA Westborough/Field HQ	Oil (Gallons)	3,411	4,699	3,754
	FWF District Office - CT Mill	Oil (Gallons)	2,374	2,656	2,111

Case Study #2

*Green Communities Division provides cities and towns with **Designation and Competitive Grants** for energy projects. To date, more than \$40M awarded in designation and competitive grants.*

- Projects include building EE measures, LED streetlights, solar PV, incremental costs for hybrid vehicles, and more
- As a GC, municipalities submit energy use baselines and inventories to reach their 20 percent Energy Reduction Plan. Many municipalities use MEI to track their energy
- As different grant rounds open to municipalities, past data and performance help GC find new opportunities for energy efficiency opportunities



Case Study #3

DOER established the SAPHIRE program (“Schools and Public Housing Integrating Renewables and Efficiency”) providing dedicated assistance and funding support for renewable thermal & energy efficiency at public housing and regional school districts.

- Department of Housing and Community Development (DHCD) manages capital planning and pays energy costs for public housing
- Better access to data on entire building portfolio to compare similar buildings
- Target buildings with relatively high EUIs
- Scheduled HVAC replacement, evaluate renewable options



Winthrop Public Housing: Outdoor Condenser Unit for Heat Pumps



Case Study #4

In partnership with U.S. EPA, MassDEP, MassSave[®], and multiple state partners, DOER was a part of the Massachusetts Energy Management Pilot for Drinking Water and Wastewater Treatment Facilities (Energy Leaders Program) as a multi-pronged approach to reach statewide energy goals .

- Set out to identify how the state could achieve a higher level of energy efficiency at water and wastewater utilities
- The pilot program was designed to: reduce the amount of energy that municipal facilities use in treating the water that flows through the plant by 20%; reduce greenhouse gas emissions by 20%; and save communities money
- The program transformed the wastewater and drinking water sector to act as clean energy resource for the community, even as they continue to deliver clean water as part of their primary mission

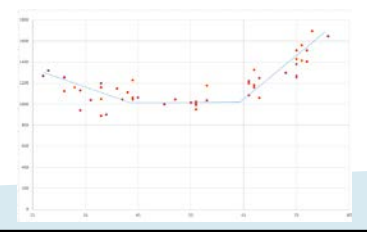
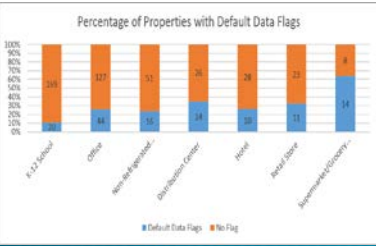
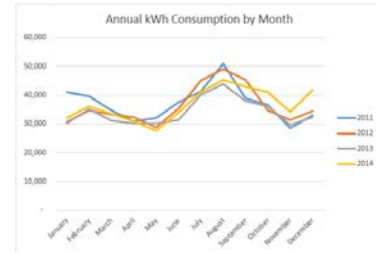
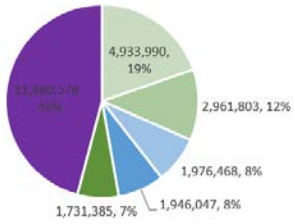


**Ben Cohen
Consortium for Building Energy Innovation**



Better Buildings Summit

Benchmarking Data Analysis From Broad to Narrow

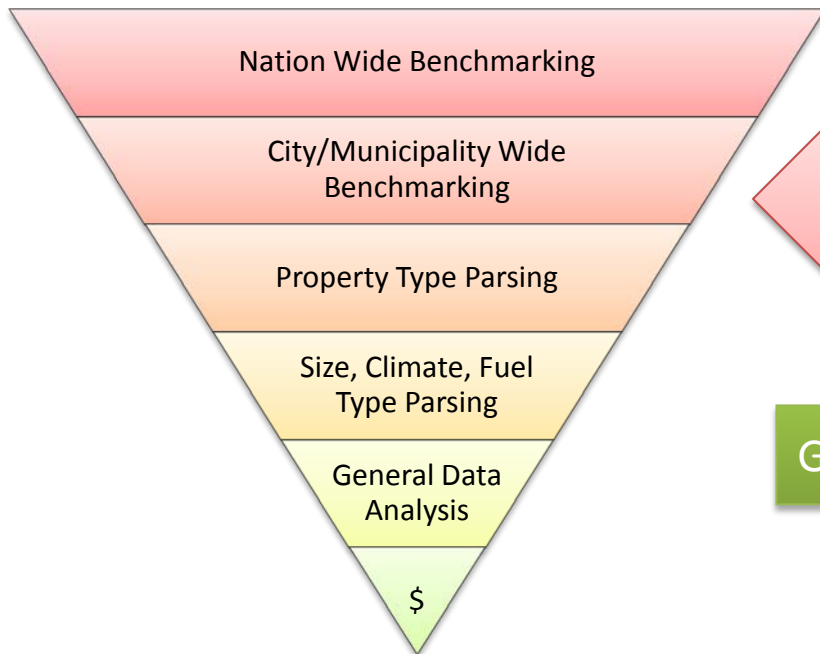


May 29, 2015



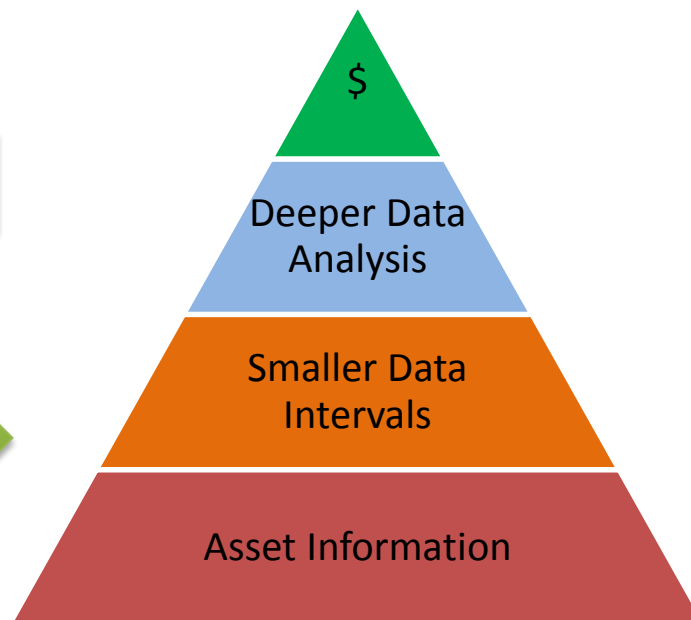
Broad Vs Narrow Benchmarking Considerations

Benchmarking Data
as Whole Dataset



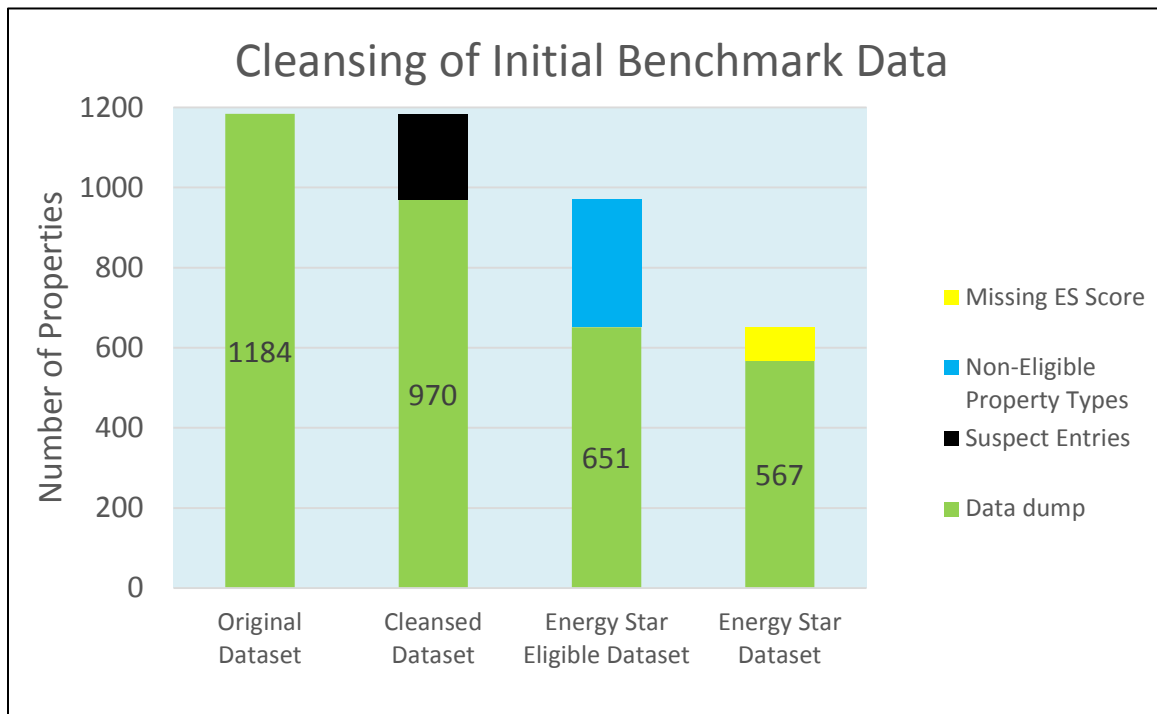
Less Specific Energy Information
Broader Communication Required

Individual Buildings
Within the Dataset



More Specific Energy Information
Targeted Communication Possible

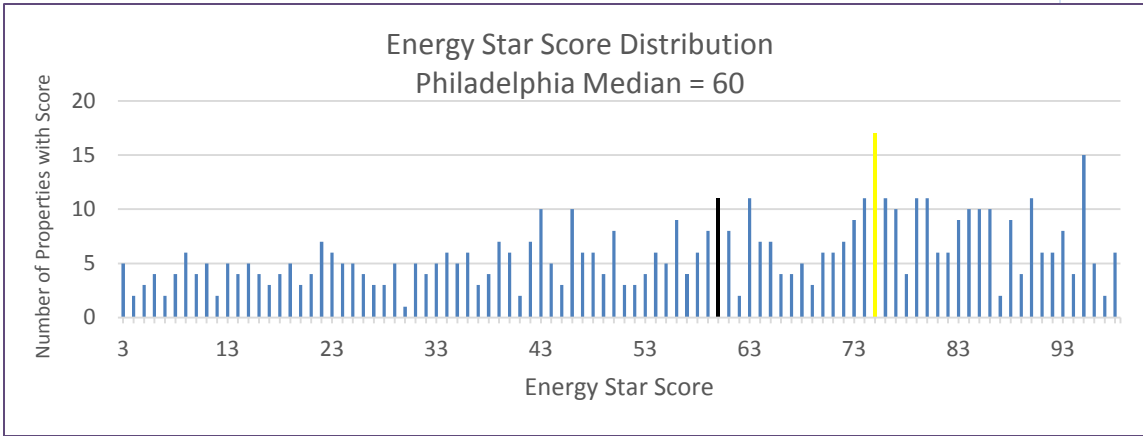
Philadelphia Benchmarking Dataset



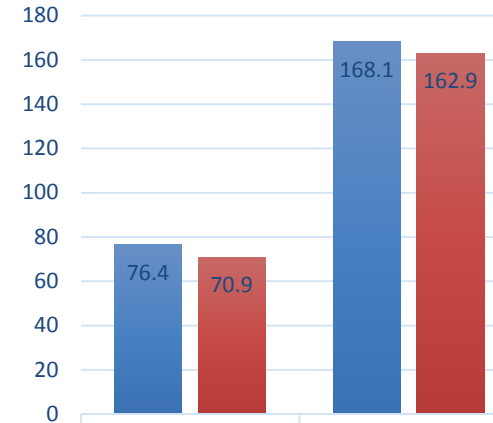
Suspect Entries Removed

Type of property removed	# Removed	Notes
Duplicate entries	16	5 exact duplicates, 11 properties with multiple entries
Small buildings	65	Any property under 50, 000 square feet
No property type	17	Reclassified to "Not Available" in the EPA calculated field
No EUI	32	Not studied regardless of other information entered
Extremely high and low ES scores	73	100's, 99's, 1's, and 2's removed
Extremely high and low EUI's	9	Under 2 and over 1000 (property type dependent – industrial and utility related properties remained)
Zero electric use	2	29 other zero electric sites already removed from above cleansing

Simple High Level Analysis

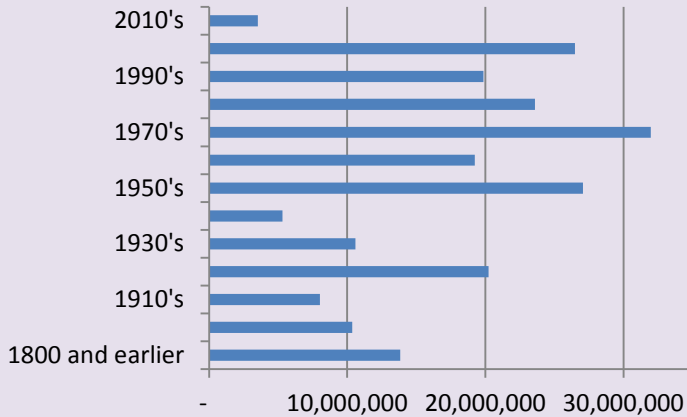


Median Site and Source EUI for all Properties with Weather Normalized Values

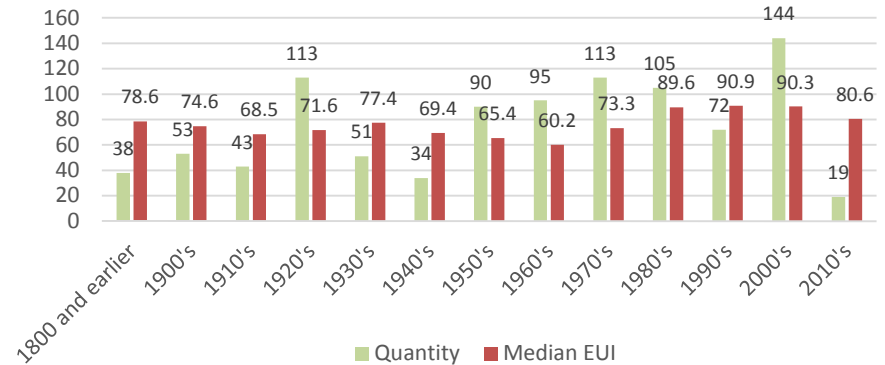


	Site EUI	Source EUI
Median EUI	76.4	168.1
Weather Normalized Median EUI	70.9	162.9

Square Footage of all Properties by Decade Constructed

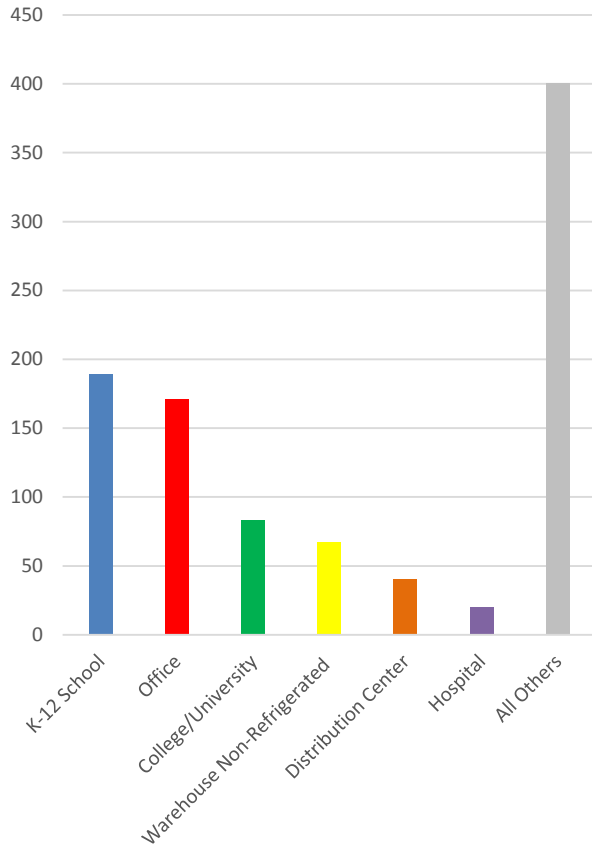


Quantity and Median EUI of all Properties by Decade Constructed

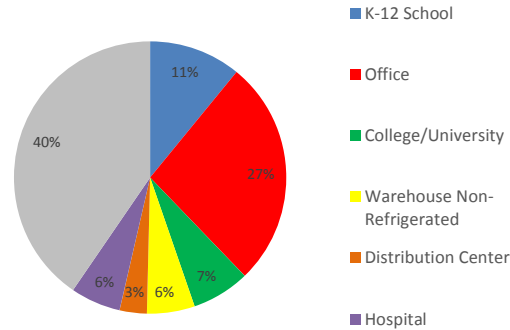


Simple Mid Level Analysis

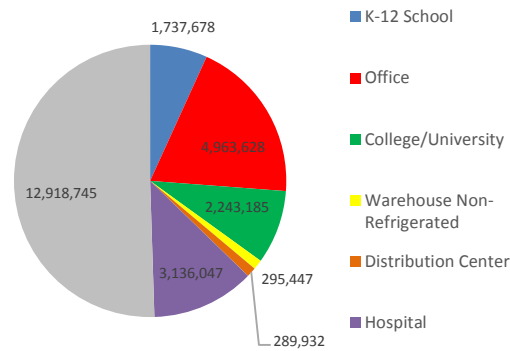
Quantity Parsed by Property Type



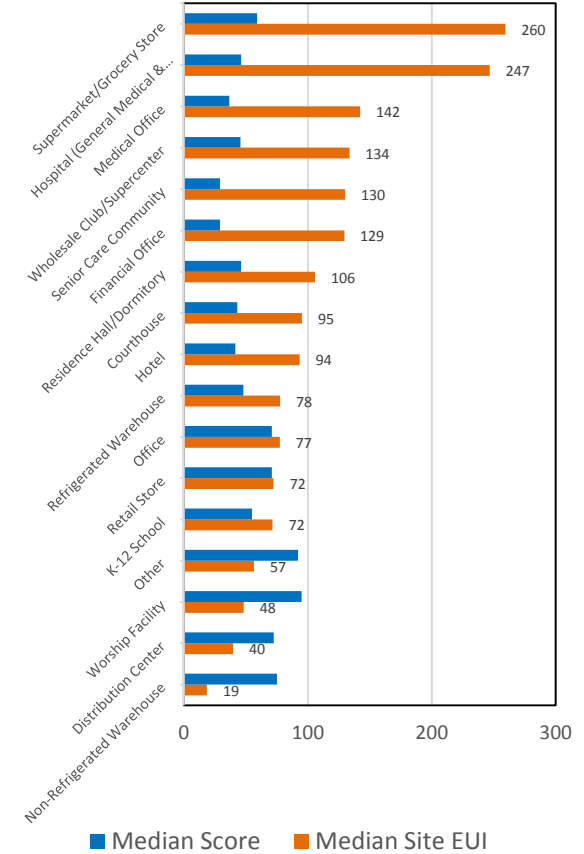
Area Parsed by Property Type



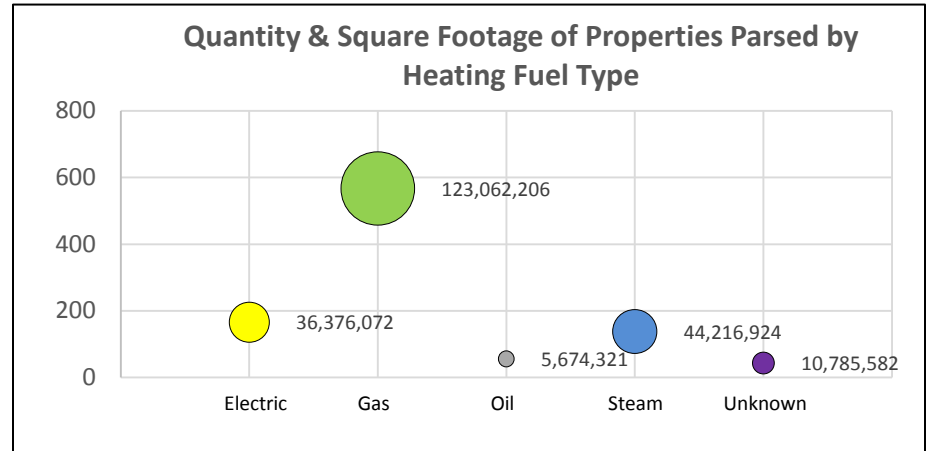
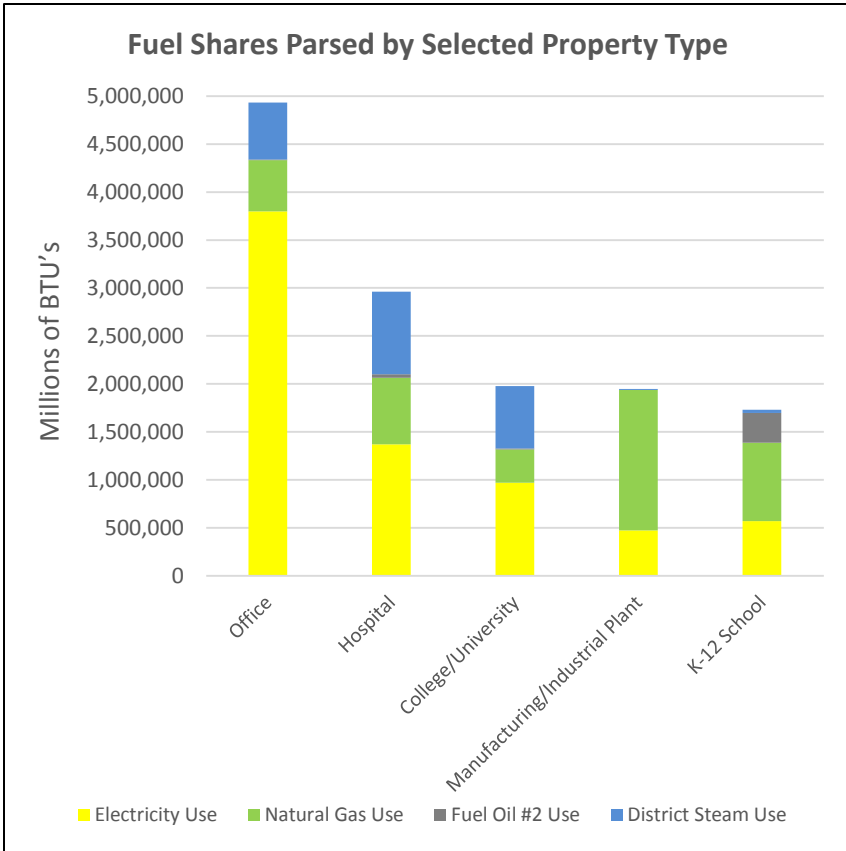
Energy Use Parsed by Property Type



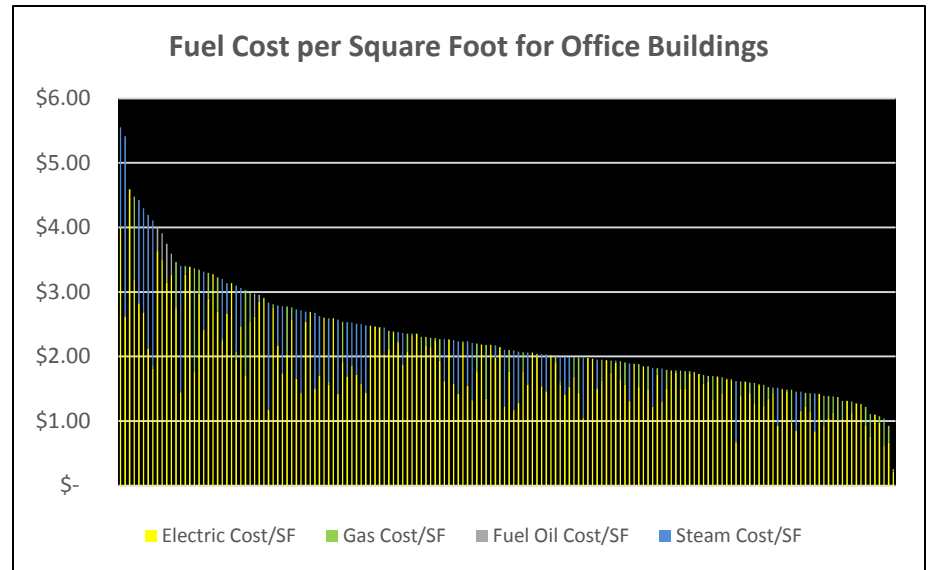
Median ES Score and Median Site EUI Parsed by Property Type



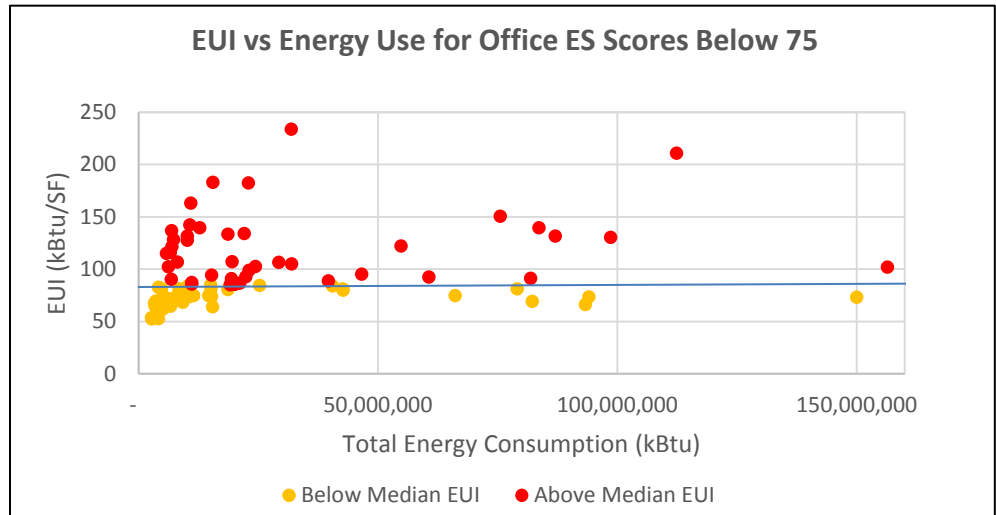
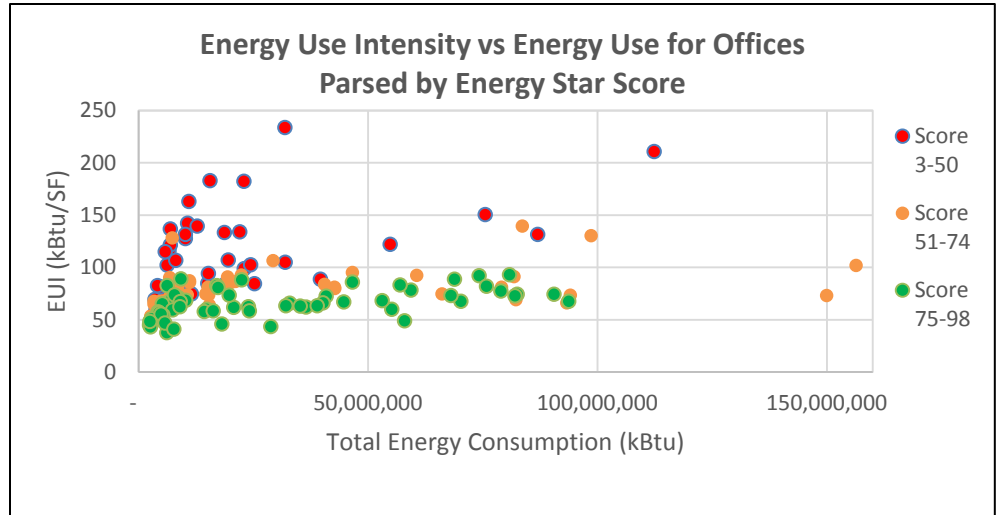
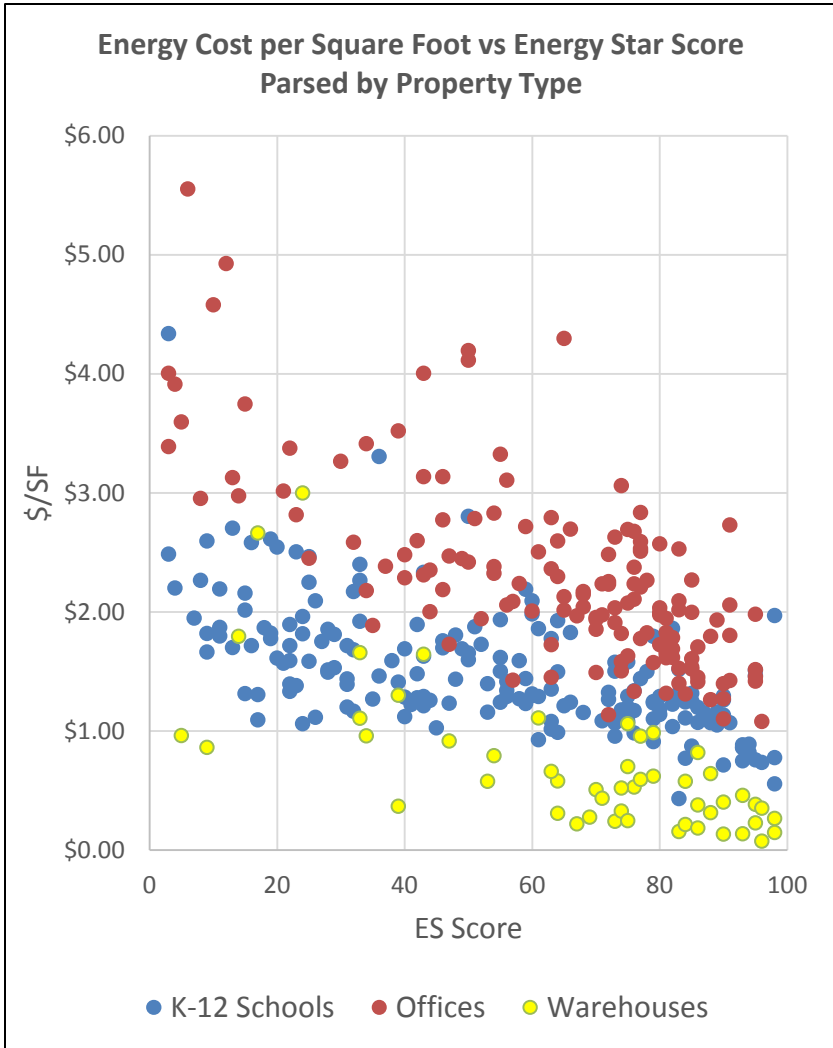
Broad Energy Analytics



Philadelphia Average Utility Costs
Electric Rates = \$0.0293/kBTU = \$29.30/million BTU
Gas Rates = \$0.0136/kBTU = \$13.60/ million BTU
Fuel Oil Rates = \$0.0205/kBTU = \$20.50/ million BTU
Steam Rates = \$0.0340/kBTU = \$34.00/ million BTU

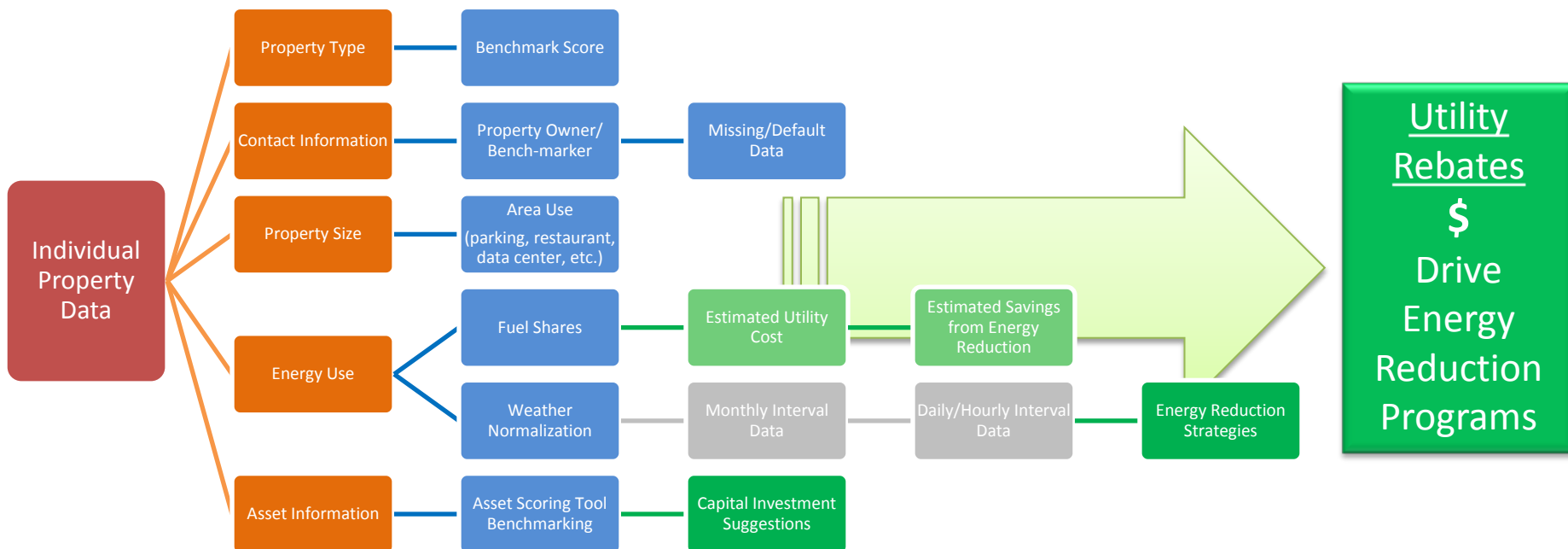
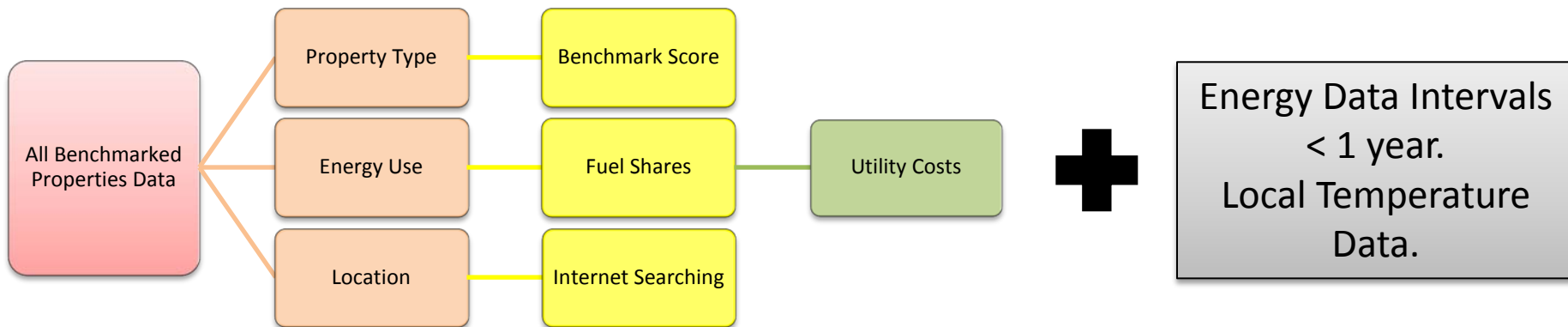


Narrowing the Analysis



Benchmarking Data Analysis Better Buildings Summit

Getting to Individual Building Analysis



Analyzing Interval Data by Load Shape

ECAM Analysis

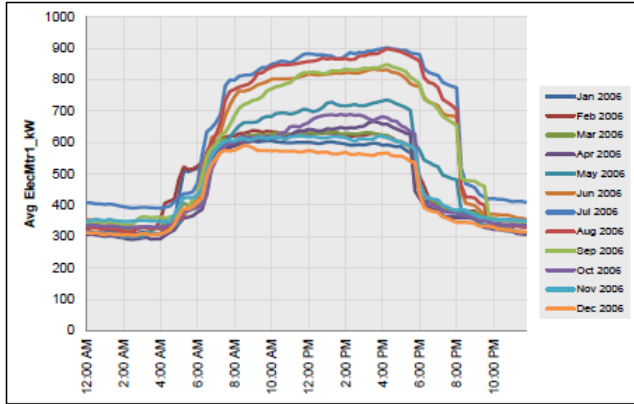


Figure 3-8: Load profile by month-year time series chart in ECAM+.

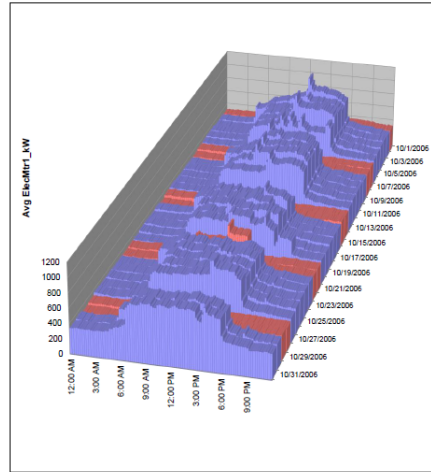


Figure 3-12: 3D load profile time series chart in ECAM+.

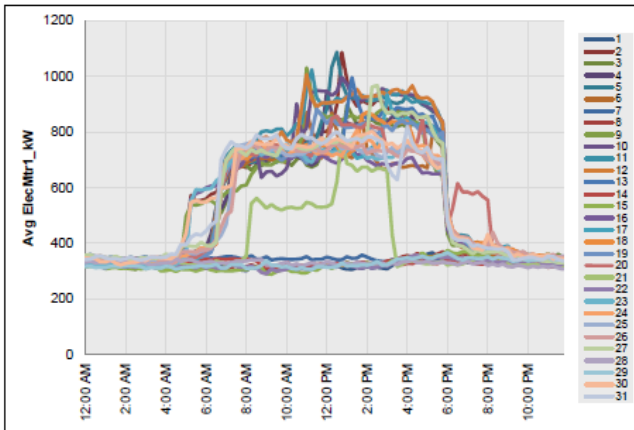


Figure 3-11: Load profile by day time series chart in ECAM+ for 1 month.

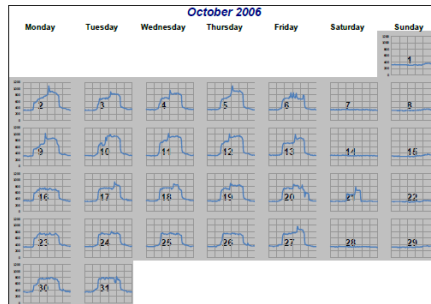
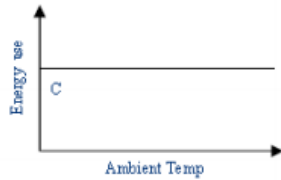


Figure 3-14: Load profile calendar created from the "Load Profile by Day" chart in ECAM+.

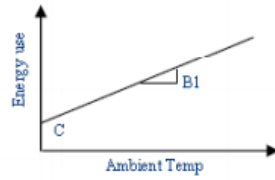
Green Button Utility Data



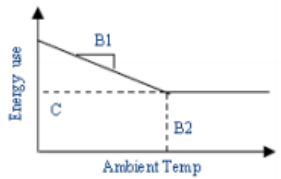
Predictive Analysis Using Inverse Modeling Toolkit



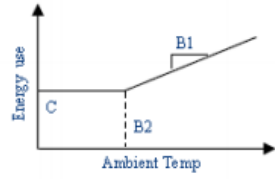
1-parameter



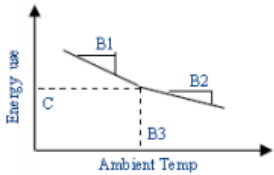
2-parameter model



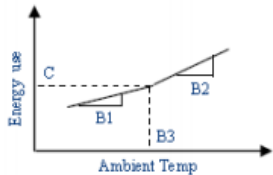
3-parameter model (heating)



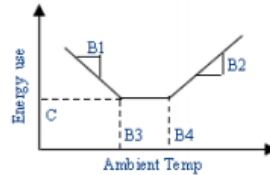
3-parameter model (cooling)



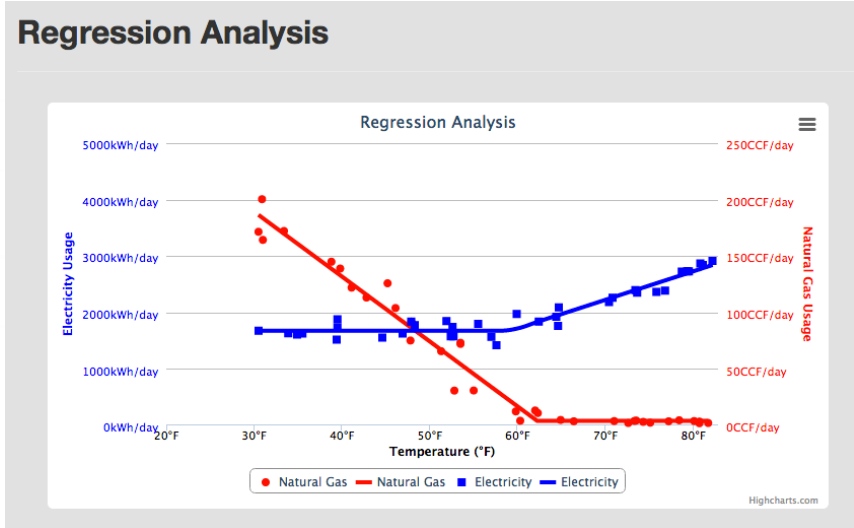
4-parameter model (heating)



4-parameter model (cooling)



5-parameter model



Common Findings

- Benchmark score is being artificially increased
- Benchmarking data was not properly entered
- Benchmarking data was missed or defaults were used
- Building sectors to focus rebate programs on
- Fuel type prevalence
- High building resting loads
 - Occupancy hours need adjustment
 - Setback points not enabled
 - Lighting retrofit opportunities
 - Continuously running equipment
- High loads during occupancy
 - Set points can be tweaked
 - Building envelope needs sealing
 - AHU economizing not enabled
 - Simultaneous heating and cooling
 - Equipment failure
- Predictive modeling can help reduce energy consumption
 - Peak load shaving
 - Preventive maintenance scheduling
 - Retrofit timing optimization
 - Retrofit savings validation

Small Group Discussions Round 2

Small Group Discussions: Data Cleansing, Analysis and Reporting

Round #2 11:30 AM – 12:30 PM

Table Topic

Facilitator

1. Data cleansing

Paul Mathew

2. Benchmarking data analysis

Ben Cohen

3. Interval data

Zach Wilson; Charlie Taylor

4. DOE data resources

Elena Alschuler; Leslie Cook

5. Data-driven program design

Andrea Hessenius

Buildings Performance Database Live Demo

Paul Mathew
LBNL