AABC Commissioning Group
AIA Provider Number 50111116

Forthcoming Standard 211P Update
or
"How I Spent My Summer Vacation(s)"

Course Number: CXENERGY1805

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April 25, 2018

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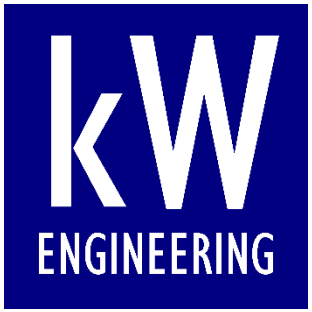

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Course Description

Standard 211P defines the procedures required to perform ASHRAE Level 1, 2, and 3 energy audits, provides a common scope of work for those audit levels for use by building owners and others, and establishes standardized industry practices and minimum reporting requirements for results.

Learning Objectives

At the end of the this course, participants will be able to:

1. Understand why the need for consistent practices for conducting and reporting energy audits necessitated the new standard.

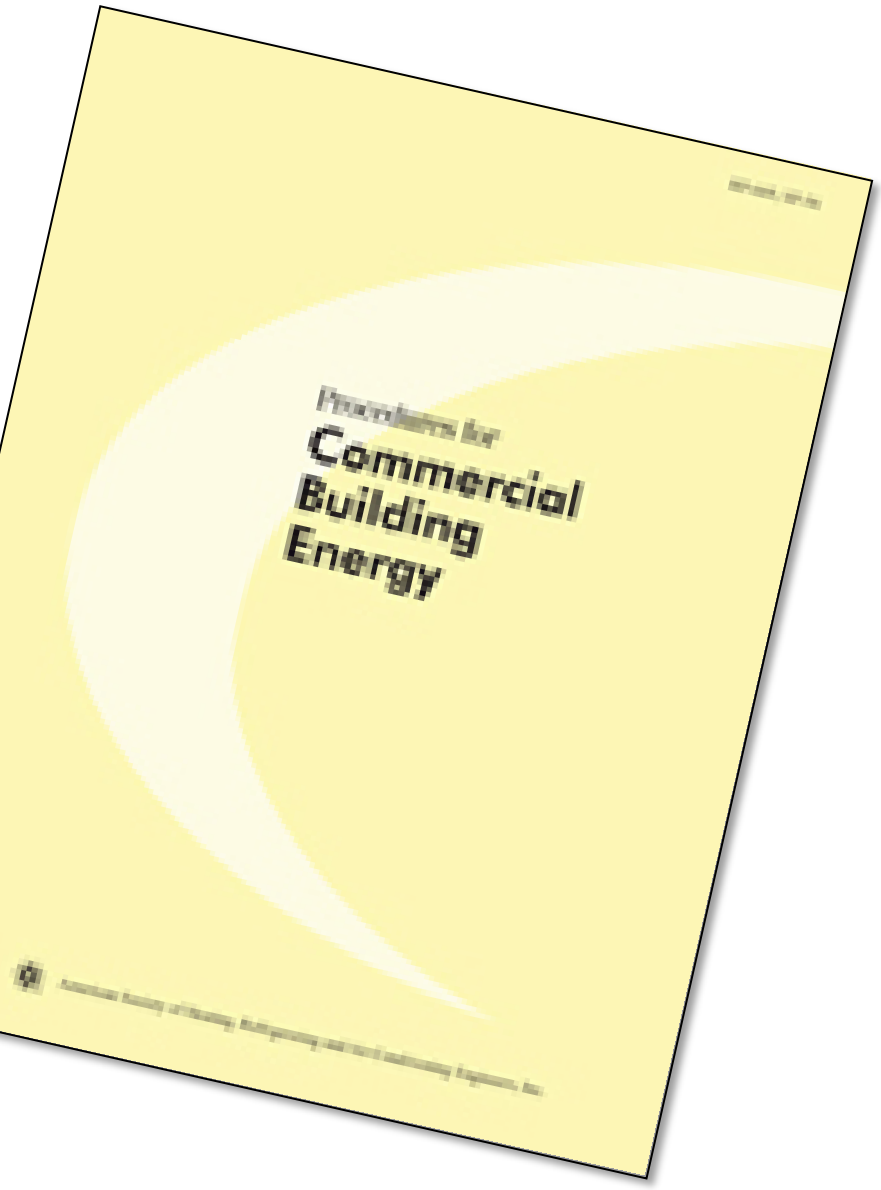
2. Learn the basic differences between a Level 1,2 and 3 Audit and what conclusions can be drawn from each.

3. Understand reporting formats for compatibility with BuildingSync, the DOE protocol for transmitting energy audit data with XML files.

4. Learn about updated procedures guidance to be more audit customer-oriented and measures for reasons beyond energy-savings benefits.

“I just want to thank everyone who made this day necessary.”

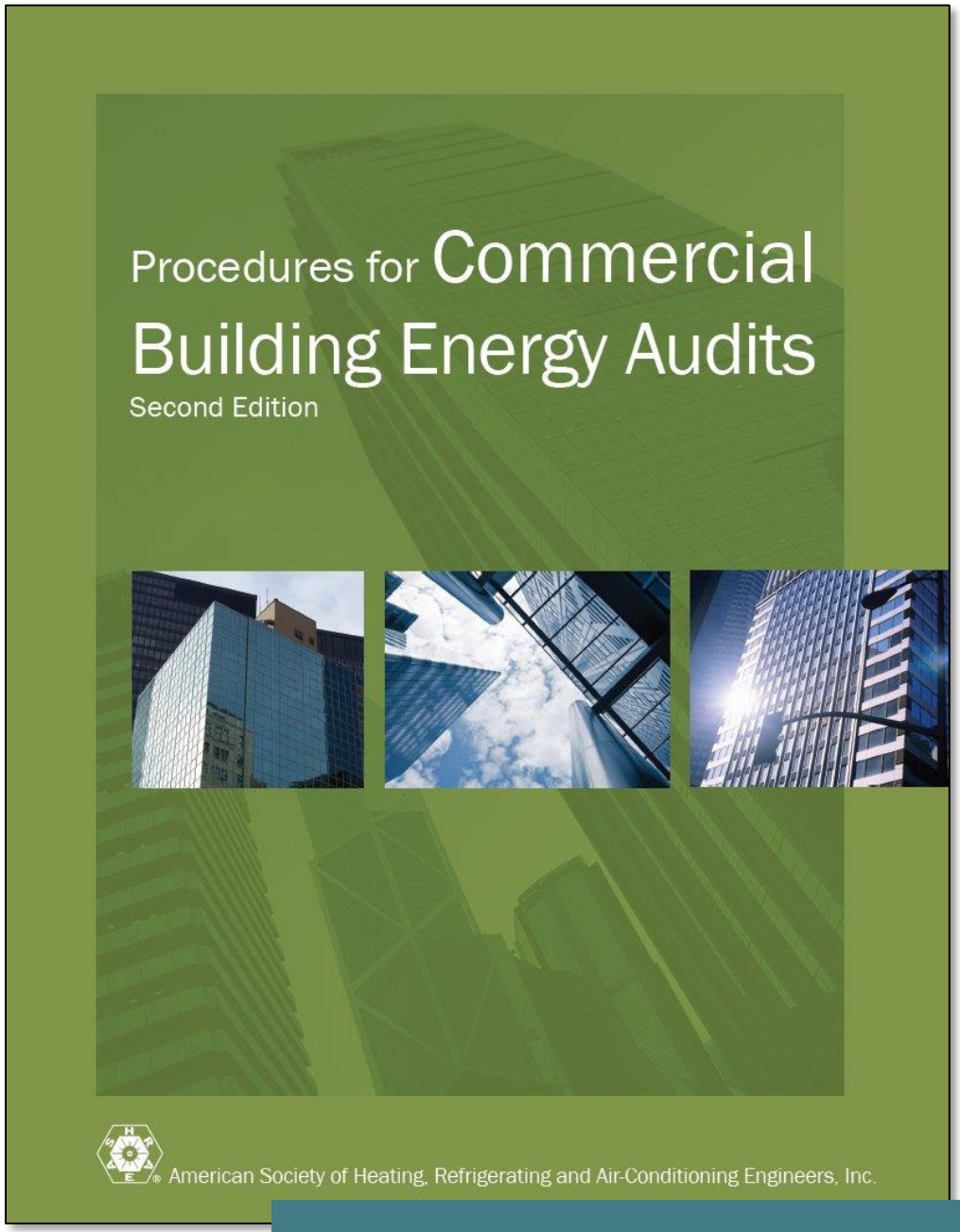
Yogi Berra



1st Edition emphasized:

- Levels of Effort
  - I, II, III
- Forms
  - Audit forms
  - Site use

Became de facto standard



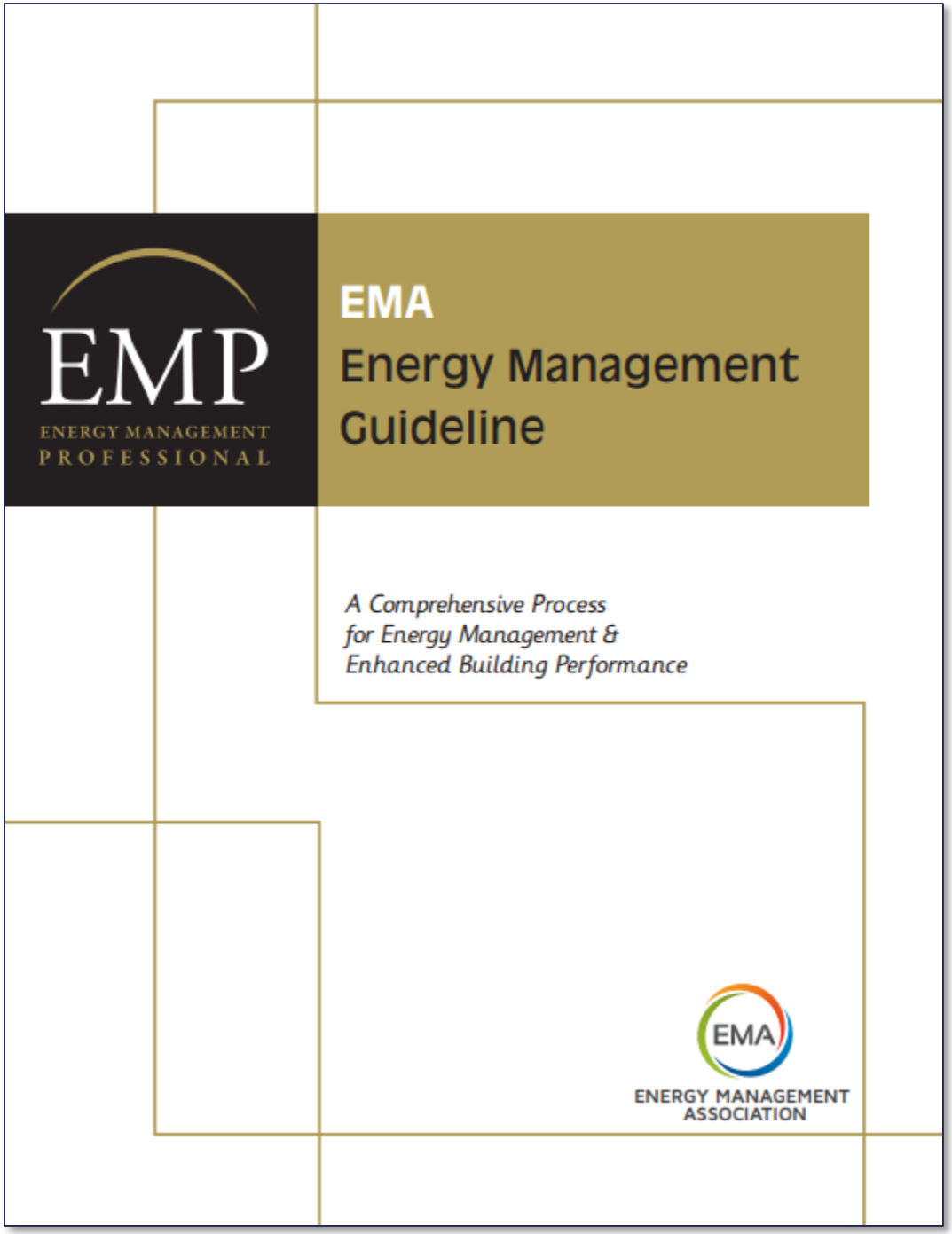
"De facto" standard

- Best Practice Methods
  - Site visit methods
  - Measurement methods
  - Economic evaluation
  - How to get a good bid
- Resources
  - Audit forms
  - EEM ideas
  - Simulation checklists

But way too much "leeway"

Guidance

- Great, real-world, how-to guidance
- Background for EMP
- References ASHRAE Levels 1, 2 and 3
- It's free!



Victims of our own success

Level 1

Level 2

Level 3

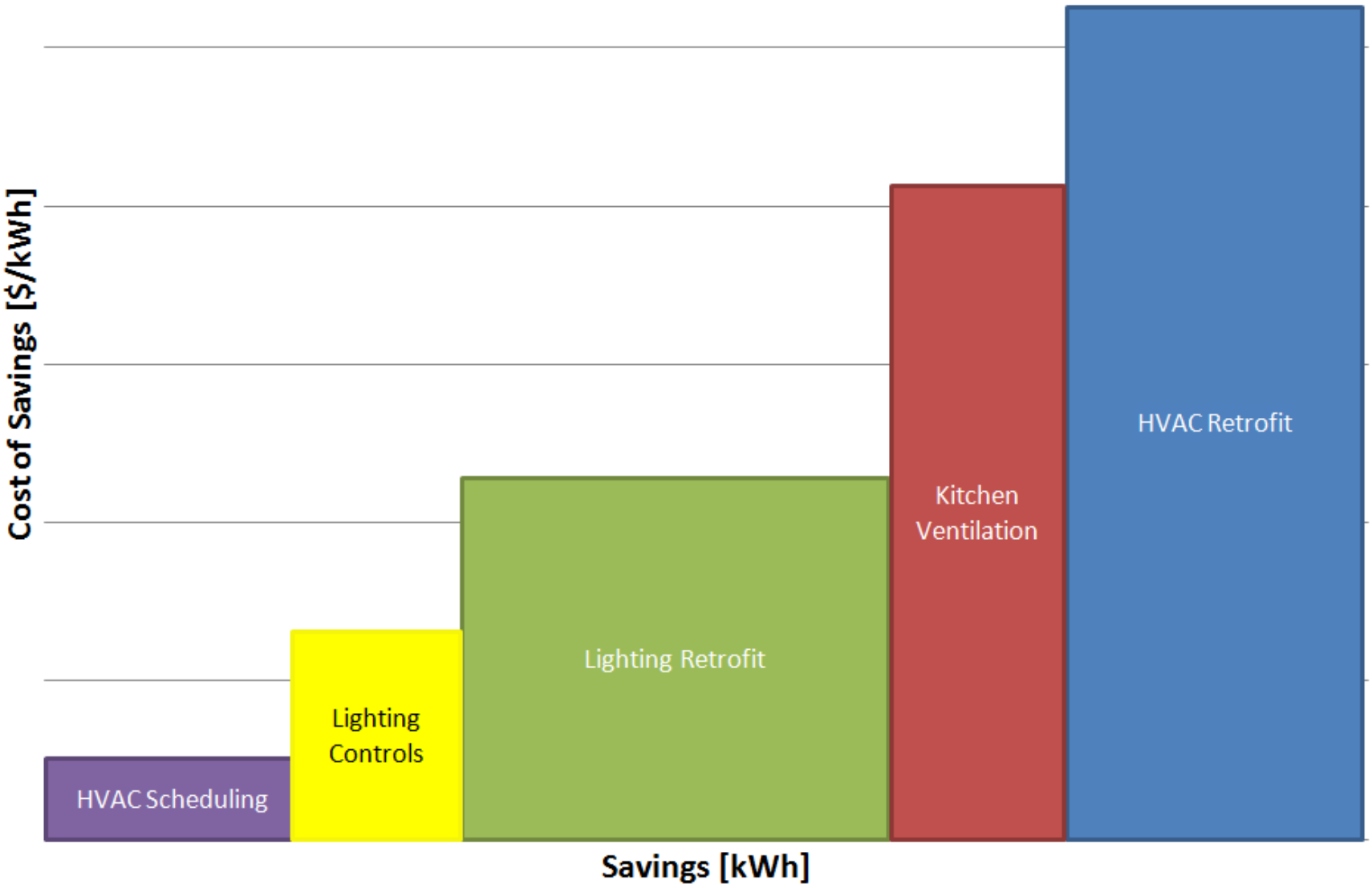
Why write a standard?

- Leeway → “apples and oranges” bidding
- Cities with mandatory ordinances found difficult to enforce – wrote their own
- Efficiency from consistent reporting

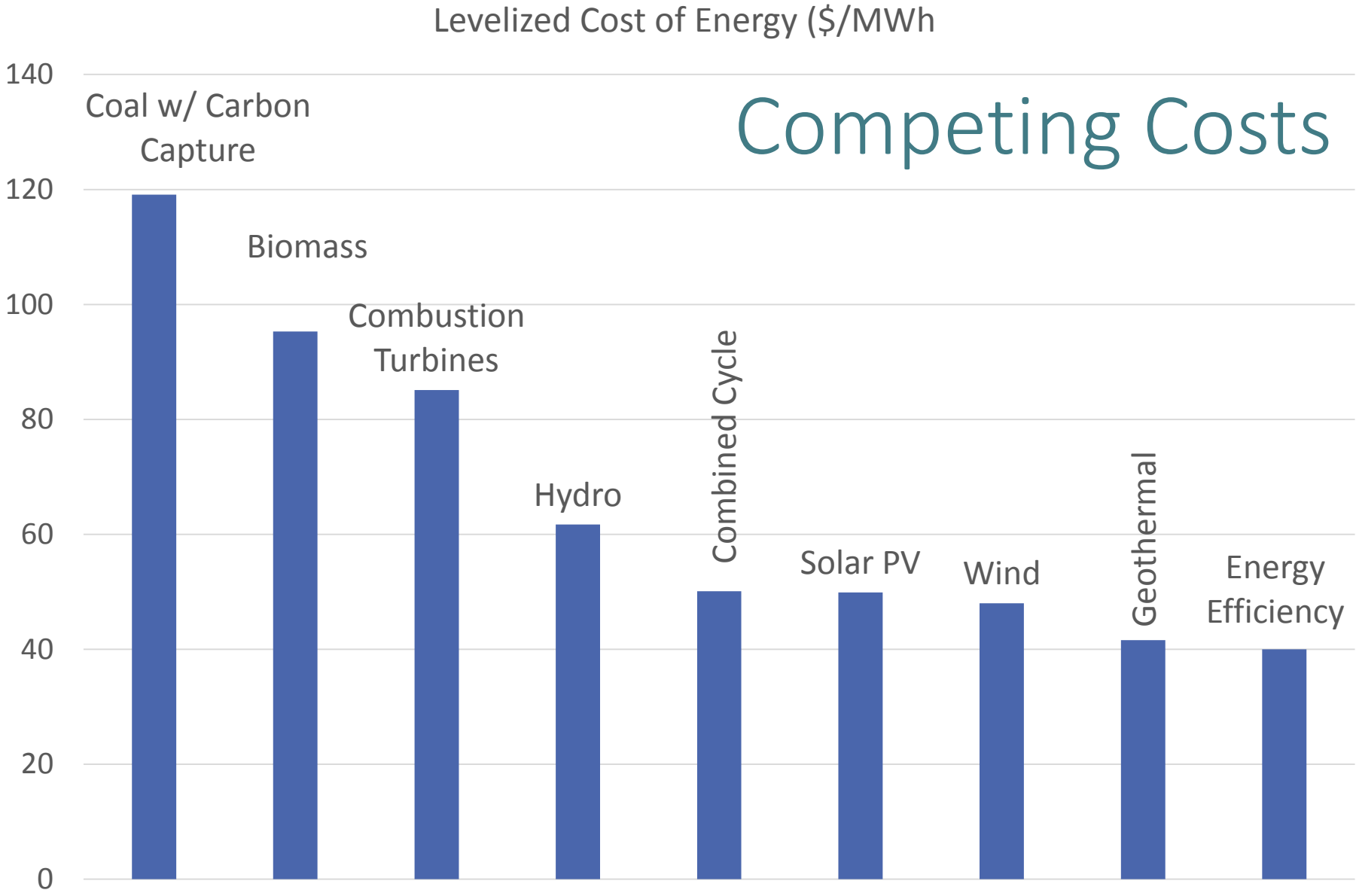
- Detail
- Accuracy
- Rigor
- Confidence
- Risk

- Cost of Service
- Cost of Saved Energy

EE is a diffuse resource

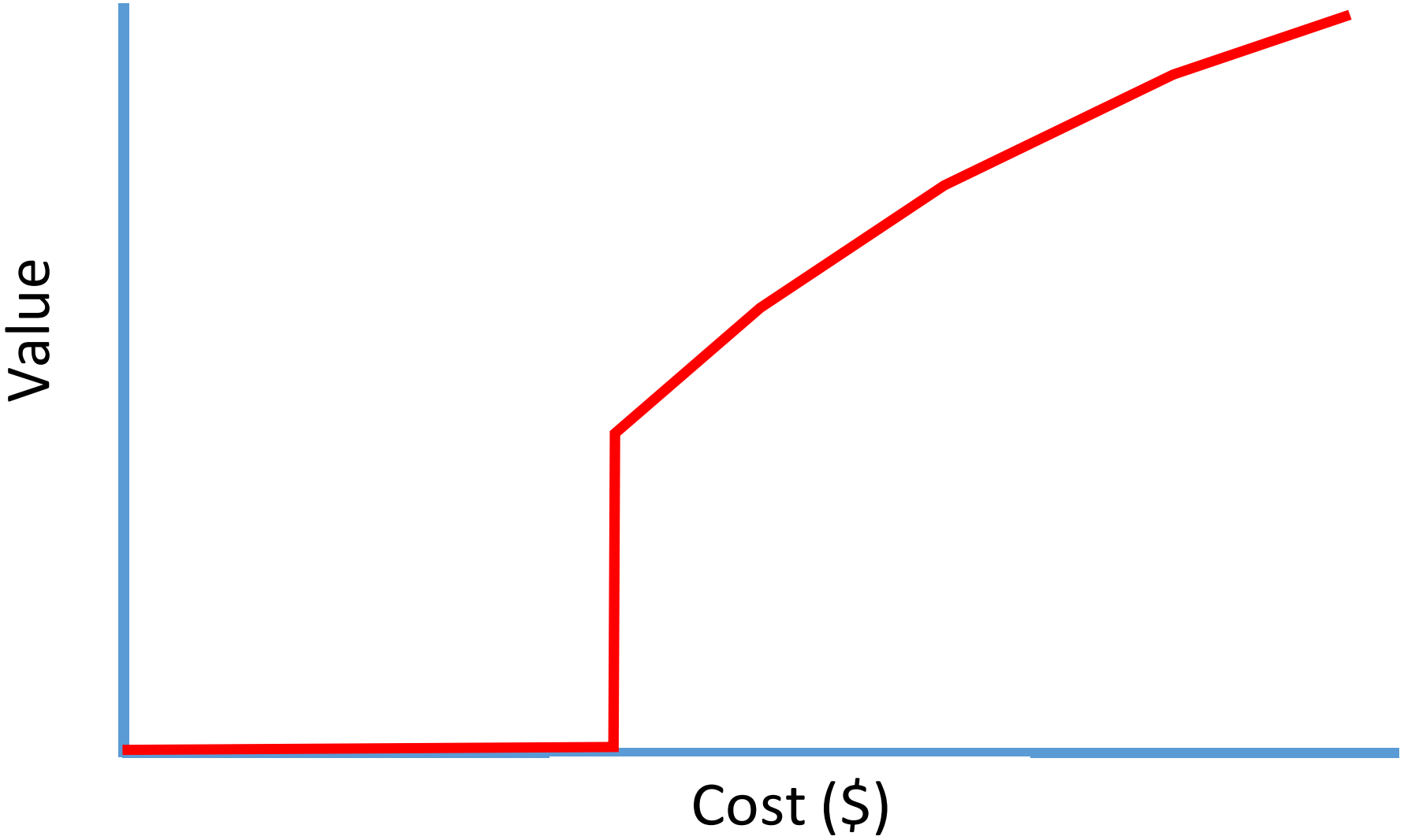


Competing Costs



SOURCE: 1) Generation: EIA,Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook March 2018
2) EE as a resource; Molina, M. 2014. "The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs". Report Number U1402. Washington DC: ACEEE.

Value of an audit



Purpose

The purpose of this standard is to establish consistent practices for conducting and reporting energy audits for commercial buildings. This standard

a. defines the procedures required to perform Energy Audit Levels 1, 2, and 3;
b. provides a common scope of work for these audit levels for use by building owners and others;
c. establishes consistent methodology and minimum rigor of analysis required; and
d. establishes minimum reporting requirements for the results of energy audits.

Not goals

- Best Practices
- Consistency of Measures [which is ≠ Quality]
- Overly prescriptive methods or recommendations
- “Virtual” or “Remote” audits
- Prescriptive actions for owners

Standard 211 Sets the bar for the minimum required procedures and reporting requirements that can be called “ASHRAE Level X”

Scope

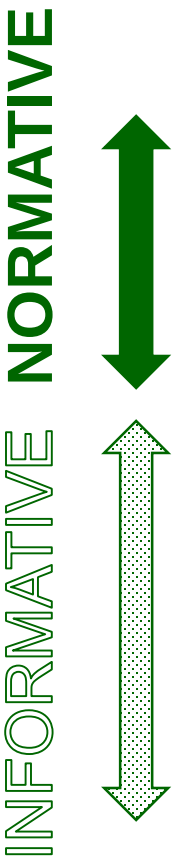
"This standard applies to all buildings except single-family houses, multifamily structures of three stories or fewer above grade, manufactured houses (mobile homes), and manufactured houses (modular)."

Code-speak for "Commercial and Large Multifamily"

Organization

Body

1. Purpose
2. Scope
3. Definitions
4. Compliance
5. Procedures
6. Reporting
7. References

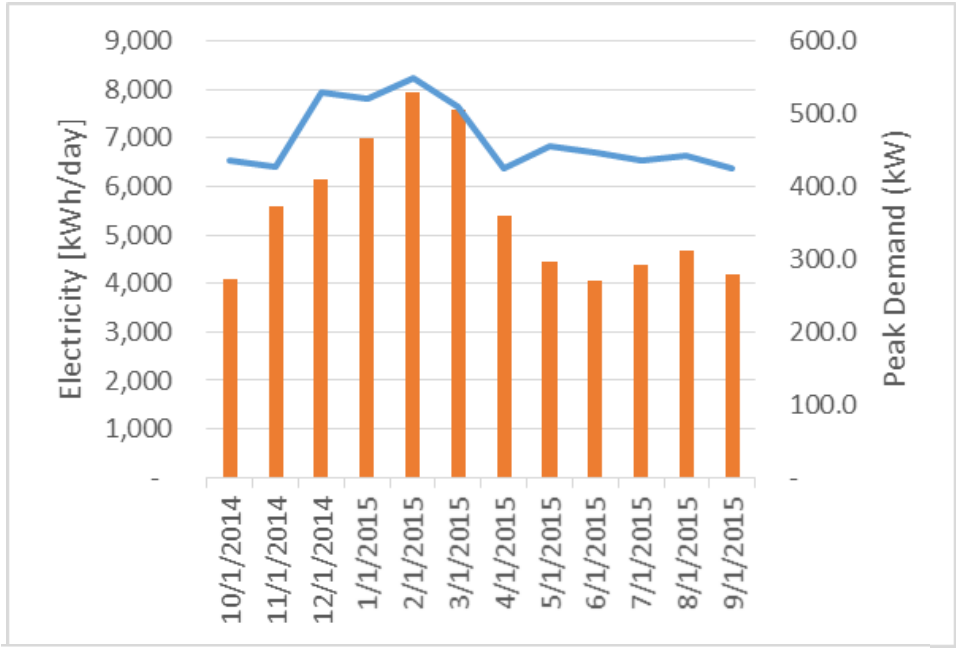


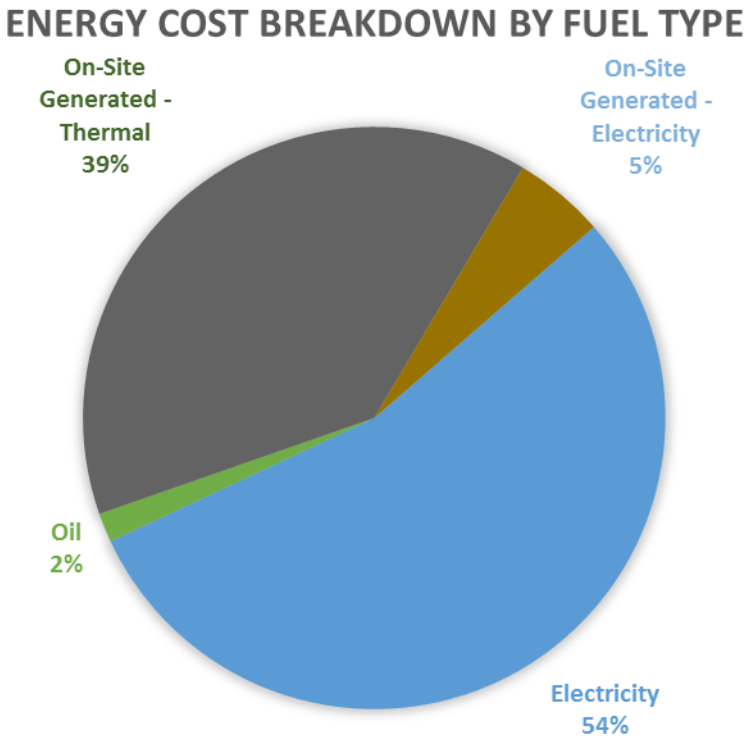
Annexes

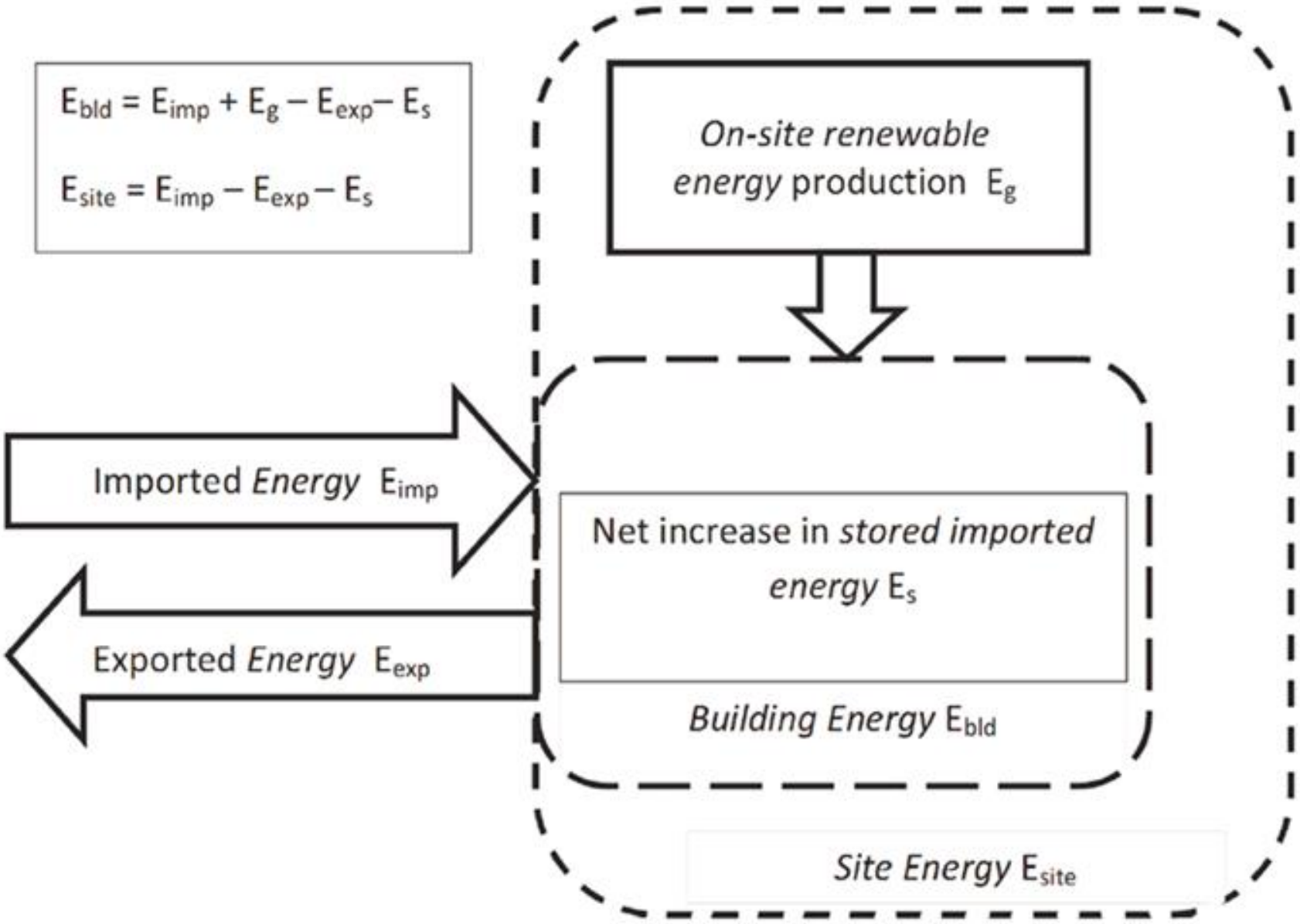
A. Compliance Form
B. Savings Calcs
C. Reporting Forms
D. Sample Outlines
E. Data Exchange
F. Model Calibration
G. Risk Assessment

Level “0”

- Billing data
- Metered and “delivered”
- Fuel cost breakdown
- Energy Use Intensity (EUI)
- Energy Cost Index (ECI)
- Benchmarking






$E_{bld} = E_{imp} + E_g - E_{exp} - E_s$
$E_{site} = E_{imp} - E_{exp} - E_s$
On-site renewable energy production E_g
Imported Energy E_{imp}
Exported Energy E_{exp}
Net increase in stored imported energy E_s
Building Energy E_{bld}
Site Energy E_{site}

EUI / ECI

Existing Building EUI/ECI

Building Name	Acme Rocket Skates
Gross Conditioned Square Feet	94,241
EUI_{BLD} (kBtu/sf/yr)	147.6
EUI_{SITE} (kBtu/sf/yr)	77.4
Site ECI (energy cost index or $/sf/yr)	$ 3.21

OR

*EUI: Energy Use Intensity

Which begs the question…

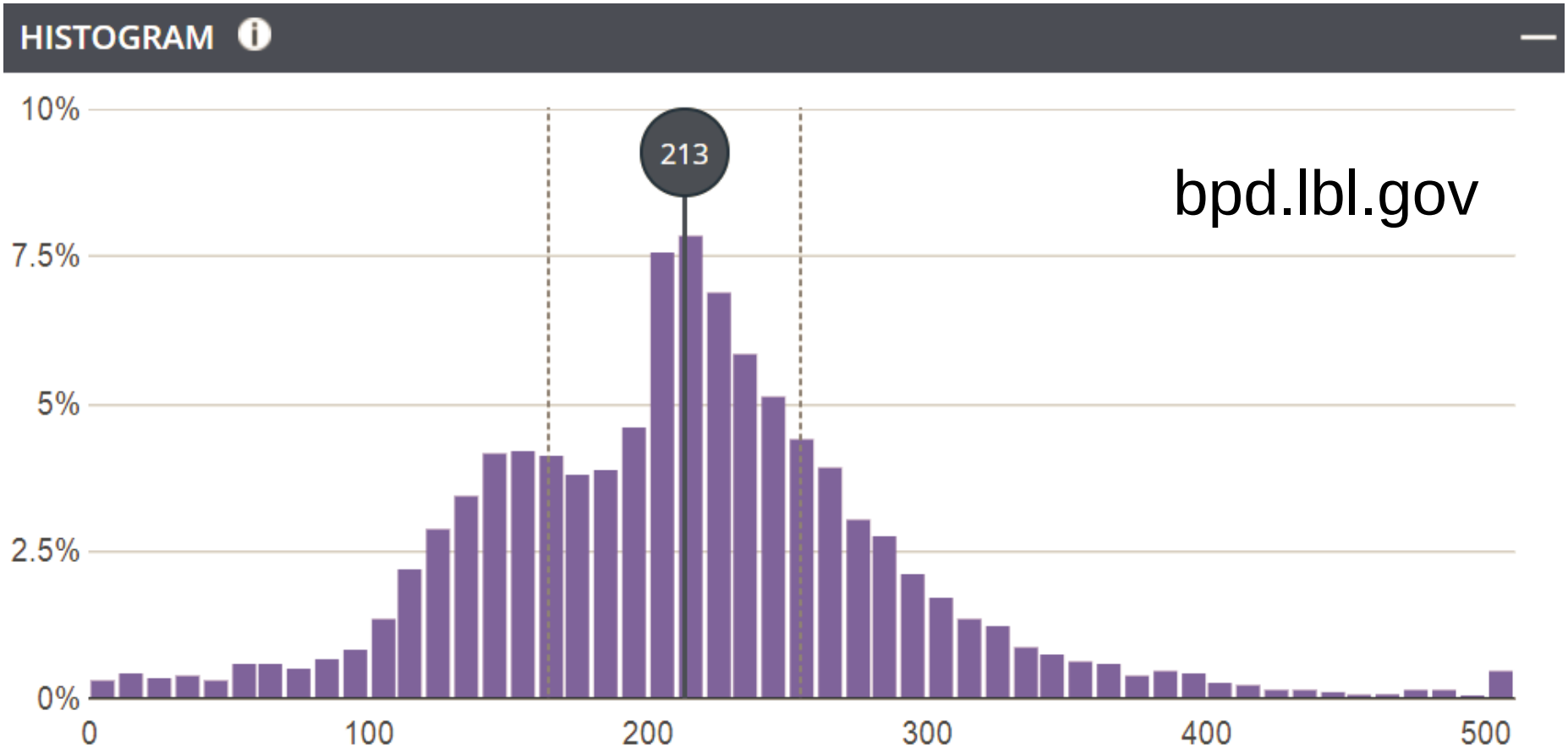
Energy Efficient?

Benchmarking – Comparing to Peers

OR

- ANSI/ASHRAE/IES Standard 100-2015,
- DOE Commercial Building Energy Consumption Survey (CBECS)
- CIBSE benchmarks
- RECS statistics (EIA 2013) or EPMI 2016 (multifamily)
- ENERGY STAR
- ASHRAE Building Energy Quotient (Building EQ) In Operation Rating
- DOE Building Performance Database (BPD)
- Your favorite benchmarking system or peer sample (with selection criteria and total buildings in the sample)

Benchmark



But do simple EUI's encourage the right behavior? What is green?

Level 1

Purpose: To assess the potential at a given sites with a brief, low-cost, qualitative study

Changes

- Qualitative only
- Did not make lower qualifications “bar”

Level 1 Audit - Recommended Energy Efficiency Measure Summary

Low-Cost and No-Cost Recommendations	Modified System	Impact on Occupant Comfort or IEQ	Other Non-Energy Impacts	Cost	Savings Impact	Typical ROI	Priority
Add VFD to Chilled Water Pumps	Ventilation	None	None	low	high	high	high
Convert manual radiator valves to thermostatic models	Space Heating	Improved occupant comfort	None	medium	high	medium	medium
Demand Controlled Ventilation	Ventilation	e.g., None	None	medium	low	medium	medium
Repair Steam Leaks	Space Heating	Improved occupant comfort	Increase equipment longevity	low	high	high	high
Potential Capital Recommendations	**Modified System**	**Impact on Occupant Comfort**	**Other Non-Energy Impacts**	**Cost**	**Savings Impact**	**Typical ROI**	**Priority**
Replace Boiler	Space Heating	Setpoint maintenance improvement	Reduced maintenance costs	high	medium	low	medium

Cost	Savings Impact	Typical ROI	Priority
low	medium	high	high

Level 2

What didn't change

- All the basics;
  - site-specific cost savings,
  - energy savings,
  - project costs,
  - Simple economic reporting (Payback, ROI)
- Avoided any responsibility for IAQ/IEQ or hazardous conditions

  "if you see something, say something"

Level 2

Changes

- Quality Assurance / Quality Control
- Distributed Energy Resource Evaluation
- Reporting Form Standardization

Calculations

- Have to use the same methods consistently, for energy dissagregation, savings, and demand savings calcs

Simplified Example

Basis of "energy balance" 

Base Case		
	100	fixtures
	90	W each
	9	kW
	2,000	hrs
	18,000	kWh

Proposed Case		
	100	fixtures
	60	W each
	6	kW
	1,500	hrs
	9,000	kWh

Savings		
	3	kW
	9,000	kWh

Level 2 QA/QC

Level 2 Audit - QA/QC

user input
calculated

Projected EEM Savings Levels QA/QC

	Savings by End Use				End Use Savi	
	Utility 1	Utility 2	Utility 3	Total Energy	Utility 1	Utility 2
End Use Category*	Electricity (kWh)	Natural Gas (therms)	Purchased Steam (lbs District Steam)	Total Energy [kBtu]	% Electricity Savings	% Natural Gas Savings
s						
Air Distribution (fans)	9,000			30,708	38%	0%
Space Heating	11,000	8,000	40,000	885,292	22%	53%
Lighting	25,000			85,300	50%	0%
Space Heating		(200)		(20,000)	0%	-1%
Air Distribution (fans)	9,000			30,708	38%	0%
Space Heating	11,000		40,000	85,292	22%	0%
Refrigeration	510,000			1,740,120	102%	0%
Space Cooling	20,000			68,240	2%	0%
Digital PRV Upgrade				-	0%	0%	0%	0%
Replace Roof				-	0%	0%	0%	0%
Total Savings (QA-QC)	604,000	7,800	80,000	2,936,368	60%	30%	54%	47%
Total Savings (EEM Summary)	604,000	7,800	80,000	2,936,368				
Total Historical Use	1,000,000	25,740	148,500	6,191,109				

Level 2 Distributed Energy

- Qualitative Assessment only

Requires

- One Distributed Energy Resource (e.g. cogen)
- One Renewable Energy Resource (e.g. Solar PV)
- Include an estimate of the system size, configuration, savings, cost, and simple payback

Reporting Forms

Level 2 Audit - Building Envelope Characteristics

Total exposed above grade wall area		sq ft	Insulation level (R-value)	
Below grade wall area		sq ft	Insulation level (R-value)	
Roof area		sq ft	Insulation level (R-value)	
Cool Roof (Y/N)				
Roof condition				
Fenestration Seal Condition				
Overall Enclosure Tightness Assessment				
Description of Exterior doors**				

Cool Roof: Yes = White, not asphalt shingle; No = Other, including all asphalt shingles

Glazing area, approx % of exposed wall area [10, 25, 50, 75, 90, 100]*	
Above grade wall common area with other conditioned buildings (ft2)	

General Building Shape*	

Construction Properties (check all that apply)

Roof Construction*	Floor Construction*	Wall Construction(s)*
☐ Built up with metal deck	☐ Concrete (above unconditioned space)	☐ Brick/stone on steel frame
☐ Built up with concrete deck	☐ Slab on grade	☐ Brick/stone on masonry
☐ Built up with wood deck	☐ Steel joist	☐ Brick/stone on wood frame
☐ Metal surfacing	☐ Wood frame	☐ Metal panel / Curtain wall
☐ Shingles/Shakes	☐ Other	☐ Sliding on steel frame
☐ Other		☐ Sliding on wood frame
		☐ Other
Fenestration Frame Type(s)*	**Fenestration glass type(s)***	**Foundation Type***
☐ Metal	☐ Single pane	☐ Slab on Grade
☐ Metal with thermal breaks	☐ Double pane	☐ Crawlspace
☐ Wood/Vinyl/Fiberglass	☐ Double pane with low e	☐ Basement
☐ Exterior Glass Doors***	☐ Triple pane	☐ Unknown
☐ Other	☐ Triple pane with low e	☐ Other
	☐ Other	

Reporting Forms

Level 2 Audit - HVAC System

HVAC Properties (check all that apply)

Zone Controls	☐ Direct Digital (DDC) ☑ Pnuematic ☐ Progammable tstats ☐ Manual tstats	**Central Plant Controls**	☐ Building Automation System (BAS) ☐ Direct Digital (DDC) ☐ Pnuematic ☐ Other
Outside Air*	☑ Temperature Economizer ☐ Enthalpy Economizer ☐ No Functioning Economizer ☐ Dedicated OA System	**Heat Recovery**	☐ Enthalpy ☐ Sensible (Temp Only)
Exhaust Fans	☐ No Mechanical Exhaust (natural only, i.e. windows, doors or gravity shafts) ☐ Exhaust Fans Only ☑ Supply and Exhaust Fans		
Cooling Distribution Equipment Type*	☑ Air Handler Unit (AHU) ☐ Constant Volume ☐ VAV ☐ Hydronic to zone equipment (e.g. fan coil units, packaged terminal units or radiators) ☐ Refrigerant to zone equipment (e.g. fan coil units, packaged terminal units or radiators) ☑ Hydronic AHU ☑ DX AHU ☐ Other ☑ None (i.e. electrically driven PTAC, baseboards)		
Heating Distribution Equipment Type*	☐ Air Handler Unit (AHU) ☐ Constant Volume ☐ VAV ☐ Hydronic to zone equipment (e.g. fan coil units, packaged terminal units or radiators) ☐ Steam to zone equipment (e.g. fan coil units, packaged terminal units or radiators) ☐ None (i.e. electrically driven PTAc, baseboards) ☐ Other		
Cooling Source*	☐ No cooling ☐ DX cooling ☐ Central plant ☐ Chiller ☐ District chilled water ☐ Water-side Economizer ☐ Other (specify) ____________	**Chiller Input***	☐ Electricity ☑ Gas Absorption ☐ Gas ☐ Steam Absorption ☐ Oil (specify grade) ☐ Steam Turbine ☑ Other
		Compressor*	☐ Reciprocating ☐ Scroll/Screw ☐ Centrifugal ☐ Other
		Condenser*	☑ Air ☑ Water ☐ Ground ☑ Indirect Evaporative ☐ Direct Evaporative
	☐ No heating		☐ Electricity

Reporting Forms

Level 2 Audit - Equipment Inventory

Inventory of equipment

The equipment inventory below shall include equipment that represents, in aggregate, 80% or more of the energy use allocated to HVAC & SHW/DHW in the end-use allocation

ID	Description	Location	Type	Units	Rated efficiency (as applicable)	Output Capacity	Area Served	Approx Year Installed	Condition (excellent, good, average, poor)

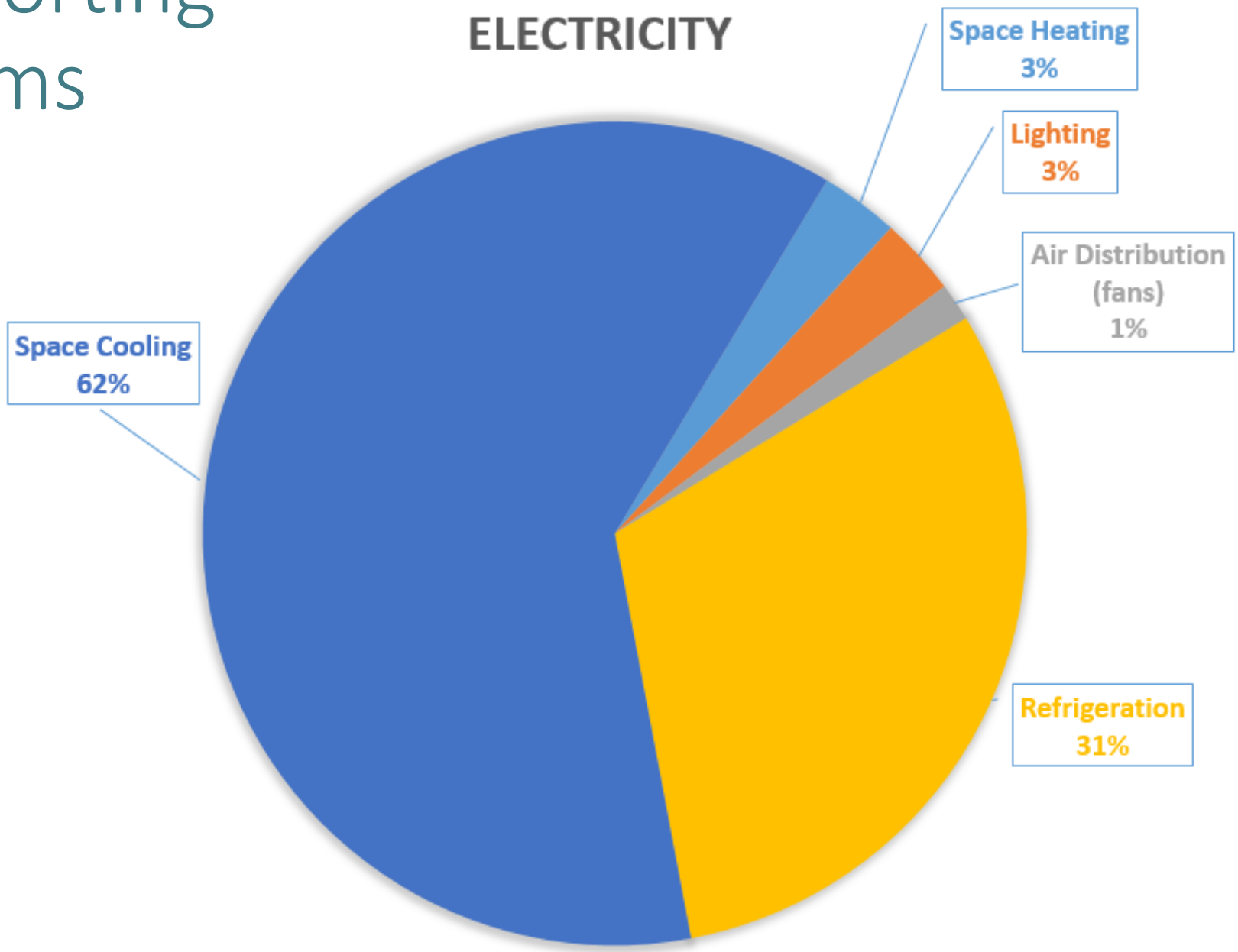
Reporting Forms

Level 2 Audit - Lighting, Electrical, & Plug Loads

(group by lighting types / fixtures that collectively make up the largest fraction of gross floor area)

Lighting Source Type(s)	Ballast Type(s)	Control(s)	Space Type(s)*	Approx % Area Served
Fluorescent T12/High output T12	Electronic	Occupancy sensor		90

Reporting Forms

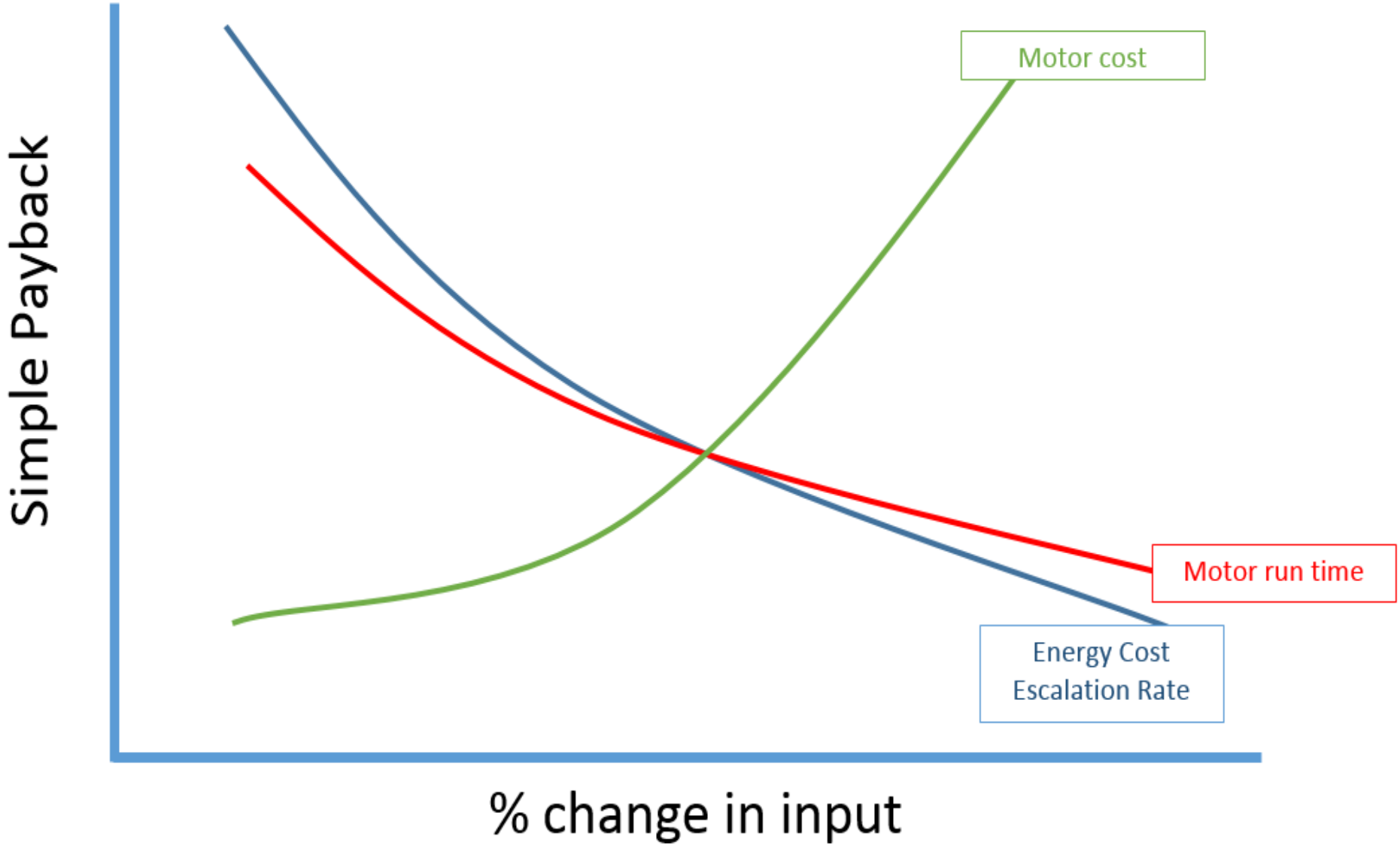


Level 3 Requirements

Reducing risk through project development

- Schematic diagram for the EEMs
- Analyze either
  - measured data; or
  - building energy modeling; or
  - engineering calculations
- Envelope measures must use building energy modeling
- Costs must be:
  - quotes from vendors willing to do the work; or
  - based on actual previous project costs for similar projects
- Life-cycle cost analysis is required for all measures
- A simplified risk assessment approach based on the impact of “key assumptions”

Sample “Spider Chart”



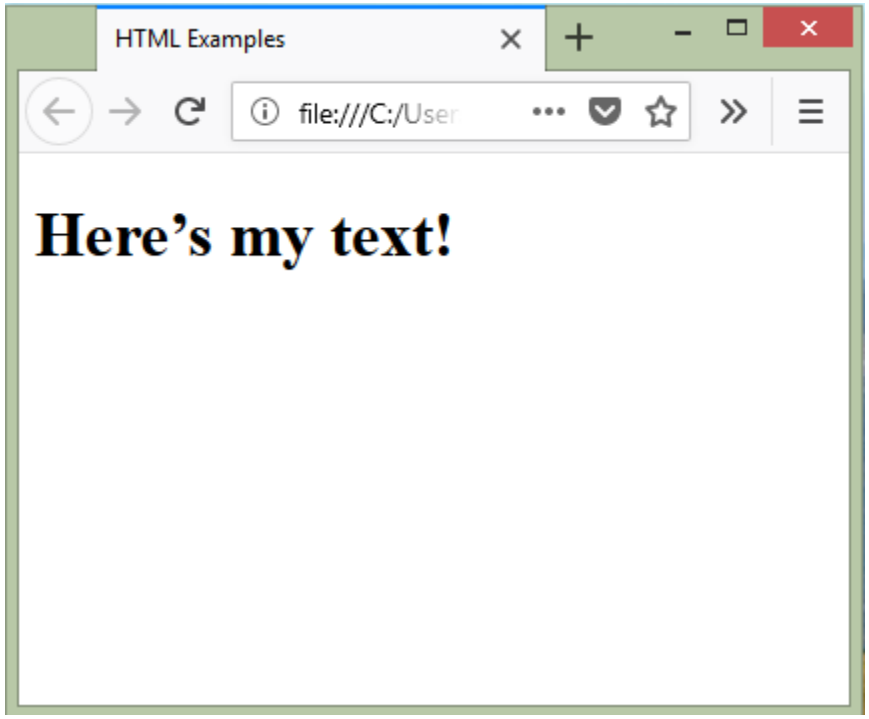
BuildingSync Schema: What is it

"A standard language for commercial building energy audit data that software developers can use to exchange data between audit tools."

∴ It's language, not a tool

It’s kind of like HTML…

```
<!DOCTYPE html>
<html lang="en-US">
<head>
<title>HTML Examples</title>
<body>
<H1>Here’s my text!</H1>
</body>
</html>
```



BuildingSync: How is it used

```
<xs:element name="PumpControlType"
minOccurs="0">
<xs:annotation>
<xs:documentation>
        Type of pump speed control
</xs:documentation>
</xs:annotation>
<xs:simpleType>
<xs:restriction base="xs:string">
<xs:enumeration value="Constant Volume"/>
<xs:enumeration value="Variable Volume"/>
<xs:enumeration value="VFD"/>
<xs:enumeration value="Multi-Speed"/>
<xs:enumeration value="Other"/>
<xs:enumeration value="Unknown"/>
</xs:restriction>
</xs:simpleType>
</xs:element>
```

First App: Asset Score

Asset Score Inputs

Building Geometry

Floor to Floor Height	
Floor to Ceiling Height	
Orientation	

Building Footprint Dimensions

Option 1

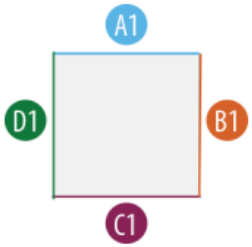
Glazing area, approx % of exposed wall area [10, 25, 50, 75, 90, 100]*

North	
South	
East	
West	

Option 2

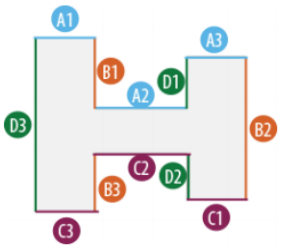
Provide building footprint dimernsions and approximate window to wall ratio for each side.

Rectangular Shape



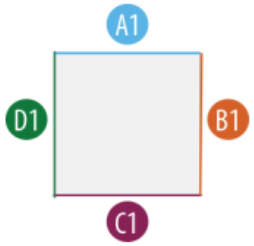
Surface ID	Length (ft)
A1	
B1	
C1	
D1	

H-Shape



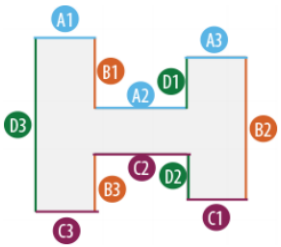
Surface ID	Length (ft)
A1	
A2	
A3	
B1	
B2	
B3	
C1	
C2	
C3	
D1	
D2	
D3	

Rectangular Shape



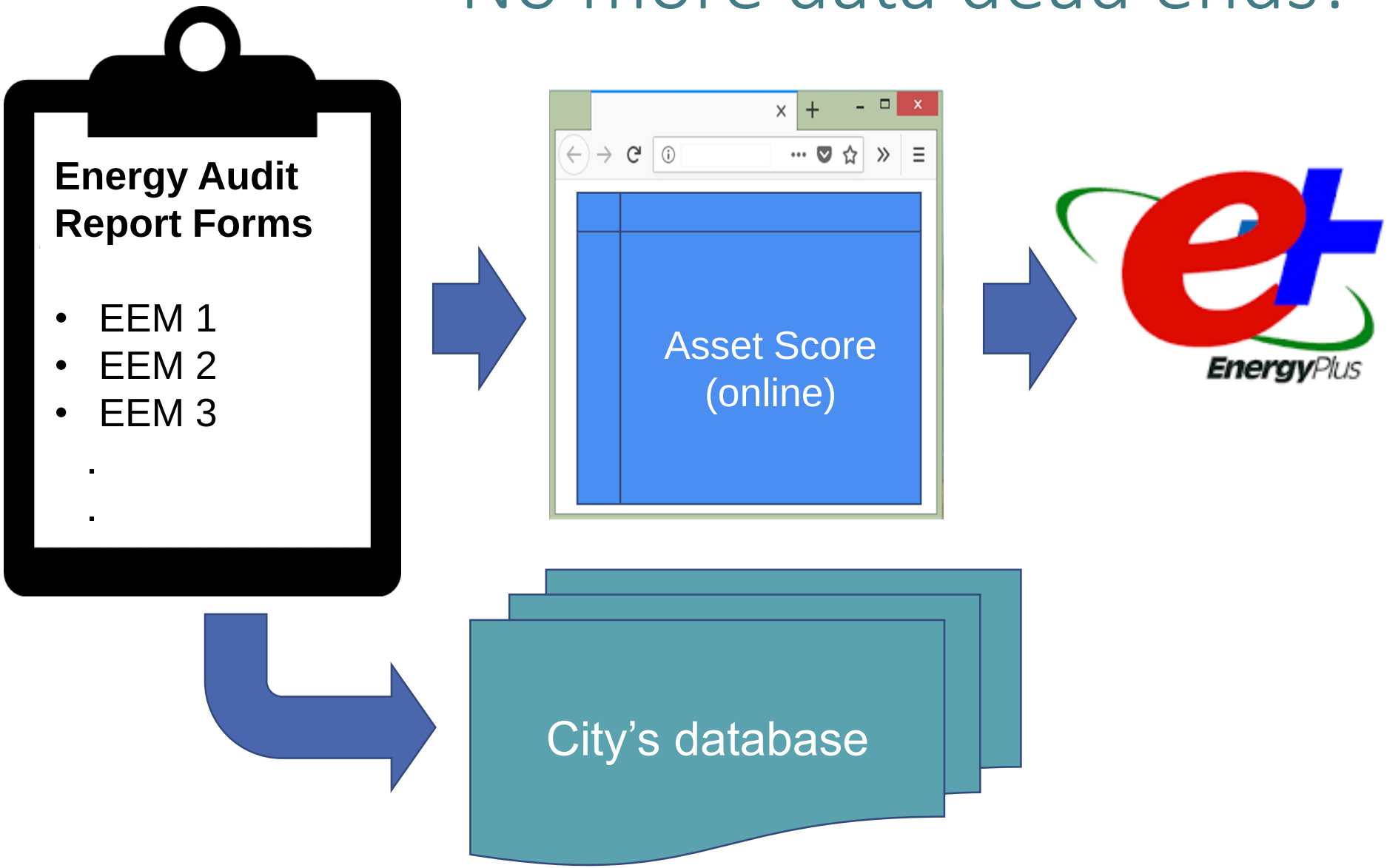
Surface ID	Length (ft)	Glazing Area %
A1		
B1		
C1		
D1		

H-Shape



Surface ID	Length (ft)	Glazing Area %
A1		
A2		
A3		
B1		
B2		
B3		
C1		
C2		
C3		
D1		
D2		
D3		

No more data dead ends!



Tricky Parts

- How detailed to make buildingsync?

  e.g. list all HVAC types or have open fields?

  Set defined measures or free-form?

- It's of no value if nobody uses it

  (trial uses with City of SF, Asset Score…)

What we didn't specify and why

- Tried to limit burden & increase options for owners
- EE for $ cost savings is over-rated
- Many users (most?) implement measures for "non-energy-saving benefits"
  (aka for any other good reasons – not our biz!)

Compliance

Form A - Compliance with Standard 211					
Name of Facility					
Street Address					
City		State		Zip Code	
Building Owner or Representative, Title, Affiliation:					
Name of *qualified energy auditor*:					
Street Address					
City		State		Zip Code	
Telephone No.					
Qualifying Certification:					
Has the Preliminary Energy Use Analysis been completed? [ ] Yes [ ] No					
Have the requirements of **Section 5** been met? [ ] Yes [ ] No					
Have the requirements of **Section 6** been met? [ ] Yes [ ] No					
Date the Level 1 Audit was completed.					
Date the Level 2 Audit was completed.					
Date the Level 3 Audit was completed.					
I state that the attached Energy Audit Report complies with ANSI/ASHRAE Standard 211:					
Signature of *qualified energy auditor*: _____ Date: _____					
Signature of *Authority Having Jurisdiction*:					
Compliance _____ Date: _____					

Who's qualified?

- Engineers?
- PEs?
- Contractors?

Most people reply, in effect, "me."

Who's qualified?

qualified energy auditor: an energy solutions professional who assesses building systems and site conditions; analyzes and evaluates equipment and energy usage; and recommends strategies to optimize building resource utilization. Experience must include completion of five commercial (non-residential) building energy audits within the past three years or a cumulative completion of ten or more commercial building energy audits. The auditor must be one of the following:

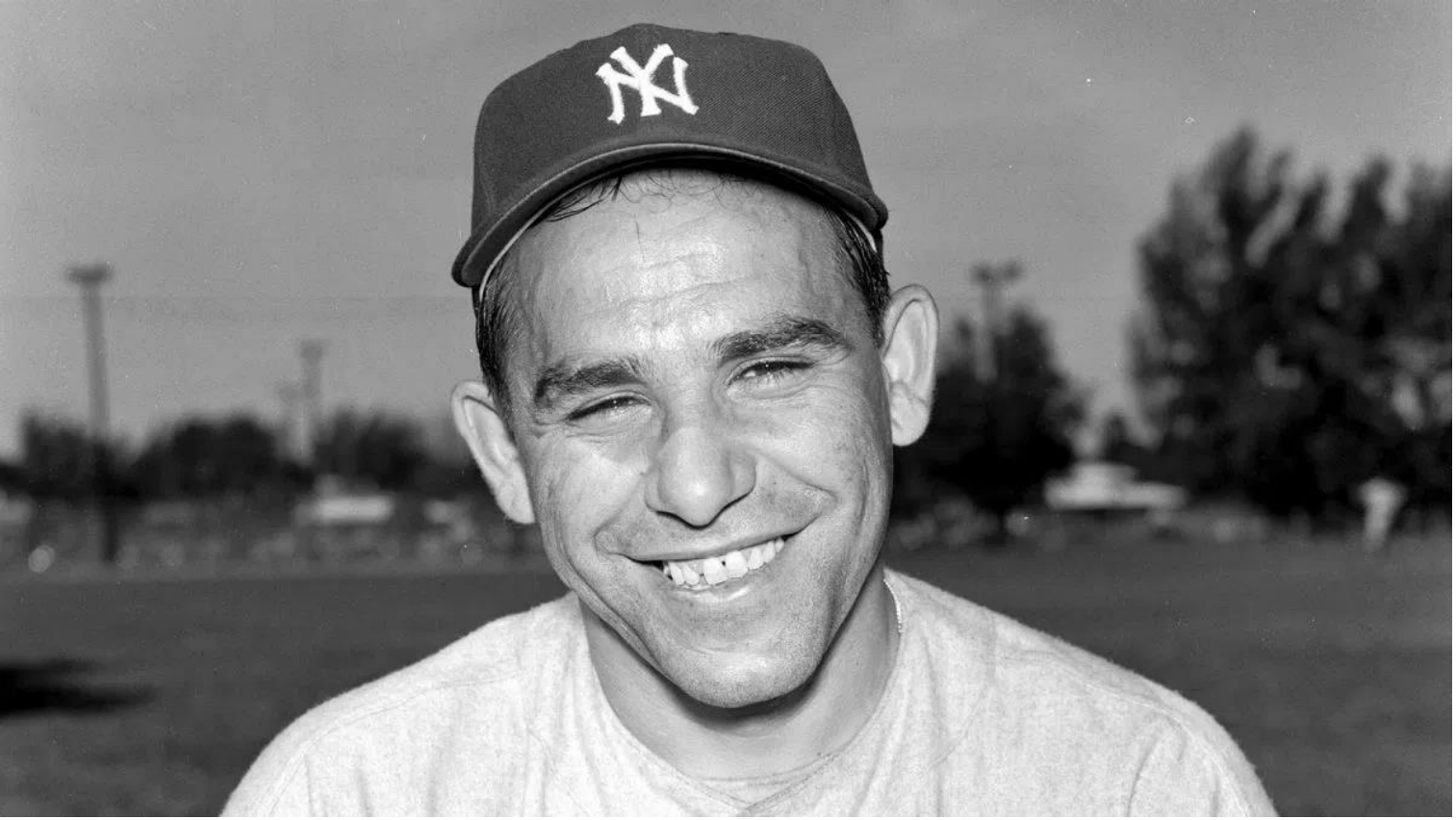
a) A person who holds a certification from a credentialing program approved by the U.S. Department of Energy Better Buildings Workforce Guidelines for Building Energy Auditors or Energy Managers.
b) A licensed Professional Engineer or a Licensed Contractor specifically approved to conduct energy audits by the *authority having jurisdiction (AHJ)*.
c) A person approved as qualified by the *authority having jurisdiction (AHJ)*.

Informative Note: For a current listing of certifications that meet the requirements of the DOE's Better Building Workforce Guidelines see the DOE's website at https://betterbuildingssolutioncenter.energy.gov/workforce/participating-certifying-organizations . Only credentialing programs that specifically certify Building Energy Auditors or Energy Managers are applicable.

Per SPC vote Oct 16, 2017

Next Steps

- Publishing in progress
  (no substantive changes since public review)
- Green book → users guide (in progress)
- Forms will be online, expect changes



Questions?

“If you ask me anything I don't know, I'm not going to answer.”

Yogi Berra

Thanks!

This concludes The American Institute of Architects
Continuing Education Systems Course

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CONTINUING EDUCATION AIA