# New Energy Auditing Standards for New York

## Energy Audit Levels 1, 2 and 3

Jim Kelsey, P.E., BEAP

President, kW Engineering

# kW & Jim

Commercial & Industrial

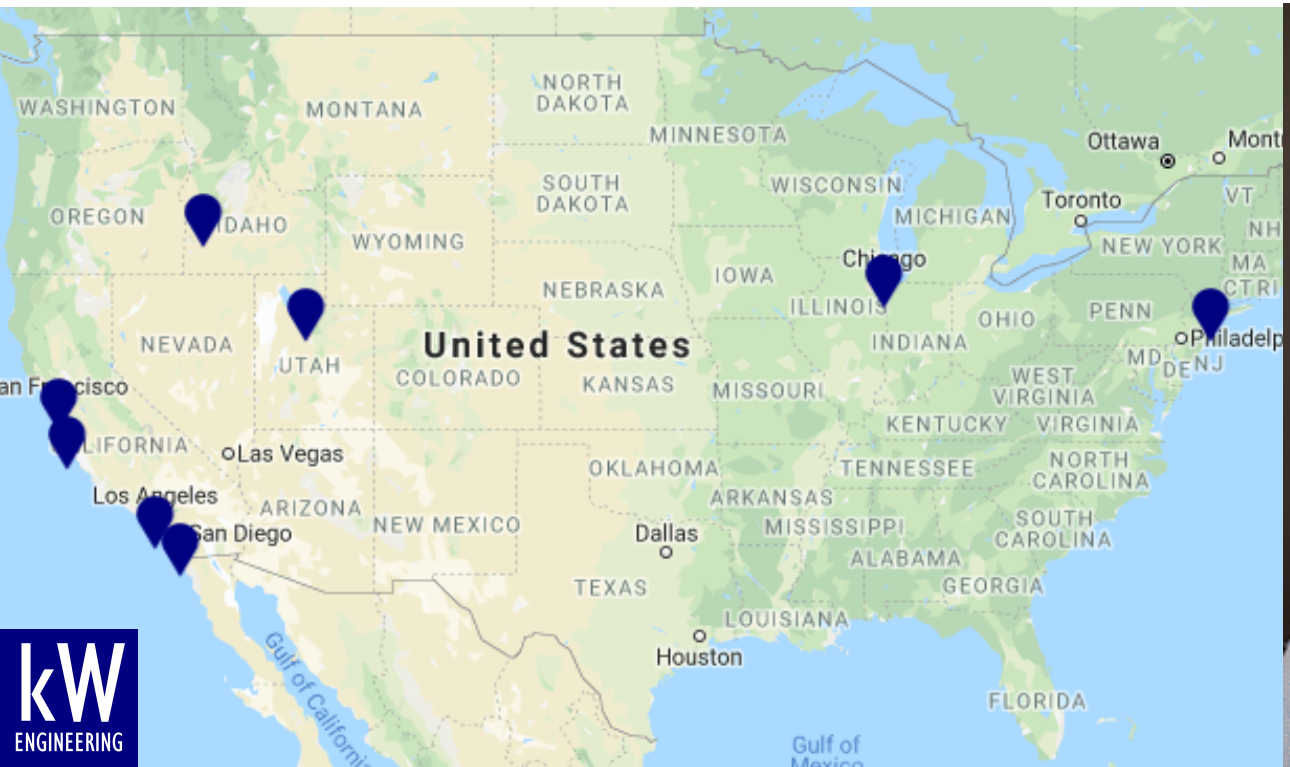
50% business = private

50% business = IOUs

Consulting Engineering

Building Data Science

- 30 years in practice
- Chair ASHRAE Audits Standard
- Founding Board Member CA EE Industry Council




# Acknowledgments

Many thanks to the members of SPC 211 who's work on Std 211-2018 has helped raise the bar for energy audits and from whom I've learned so much.

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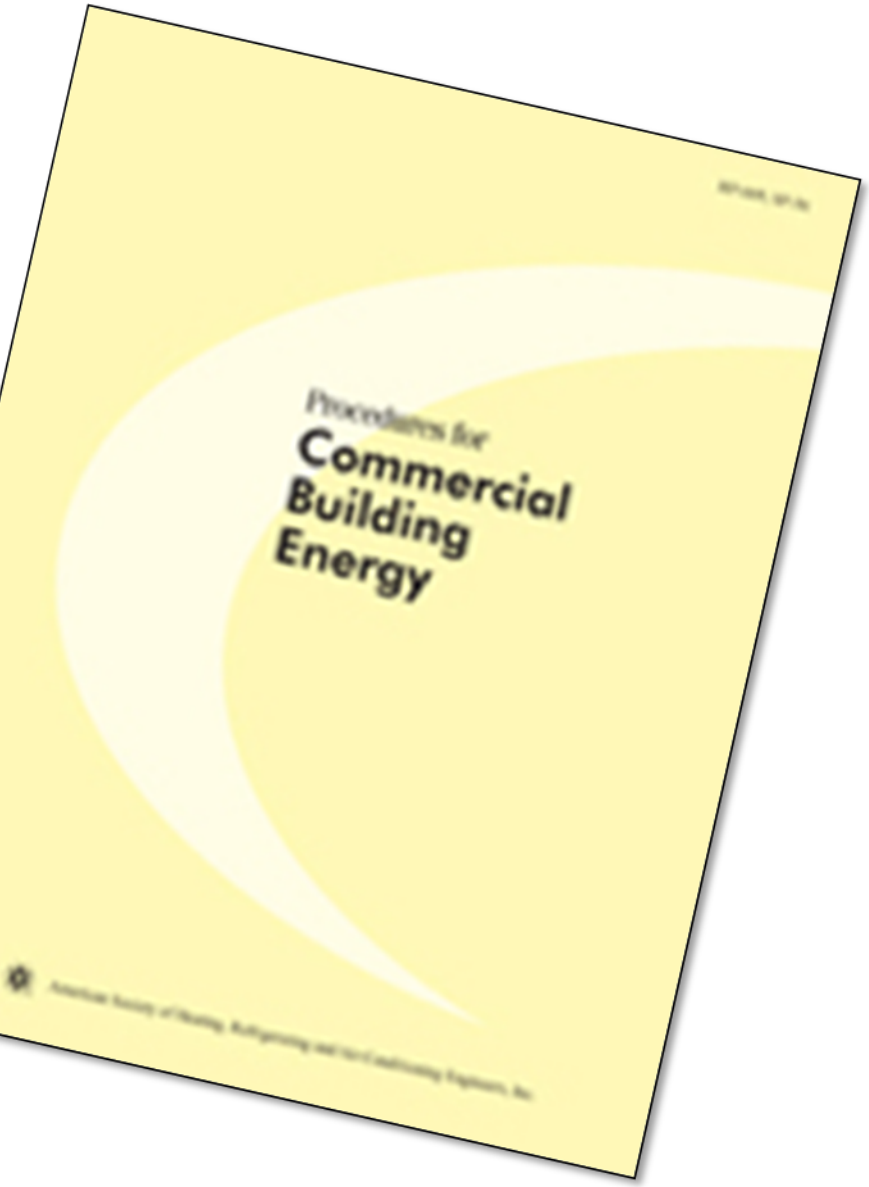
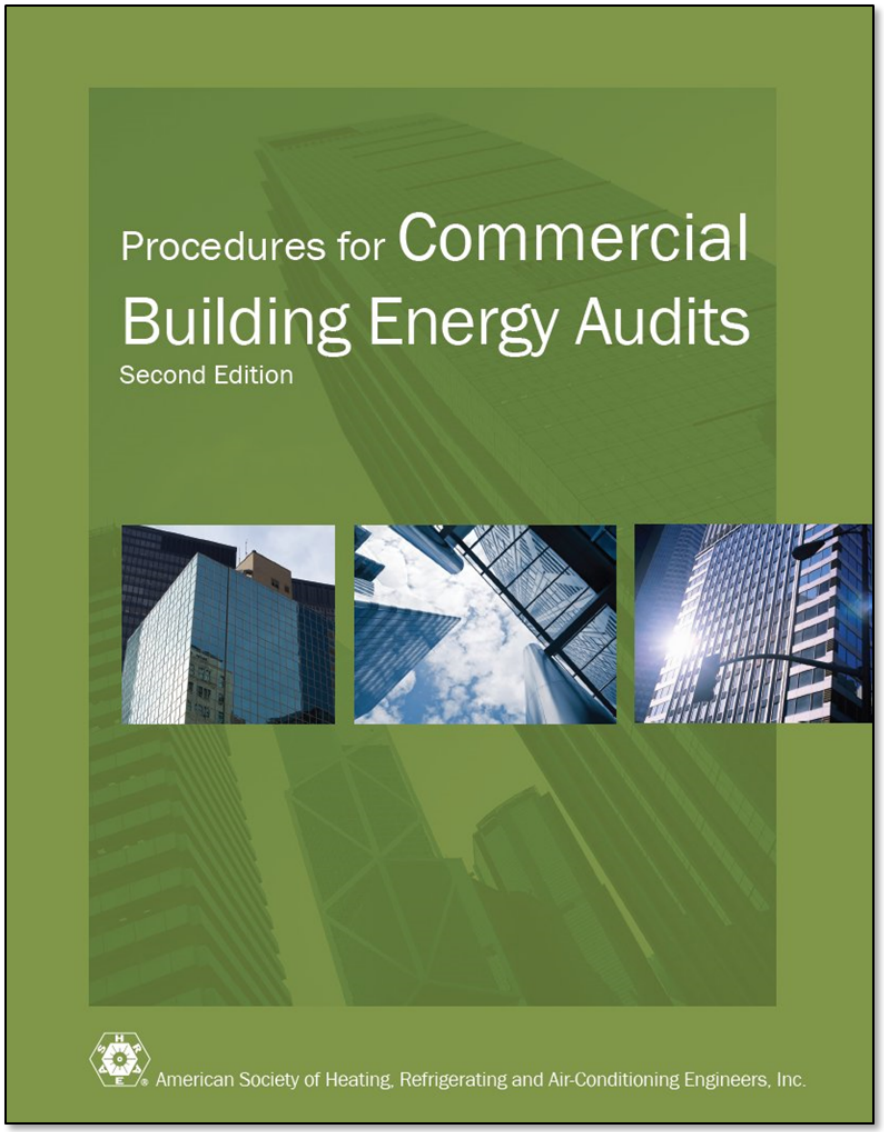



1st Edition emphasized:

- 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"**

# Victims of our own success


Level 1

Level 2

Level 3

# 3 Levels, What's the difference?

1

**Scoping**

How do you compare to peers?

Potential?

Qualitative

2

**Site specific**

Savings

Costs

Economics


3

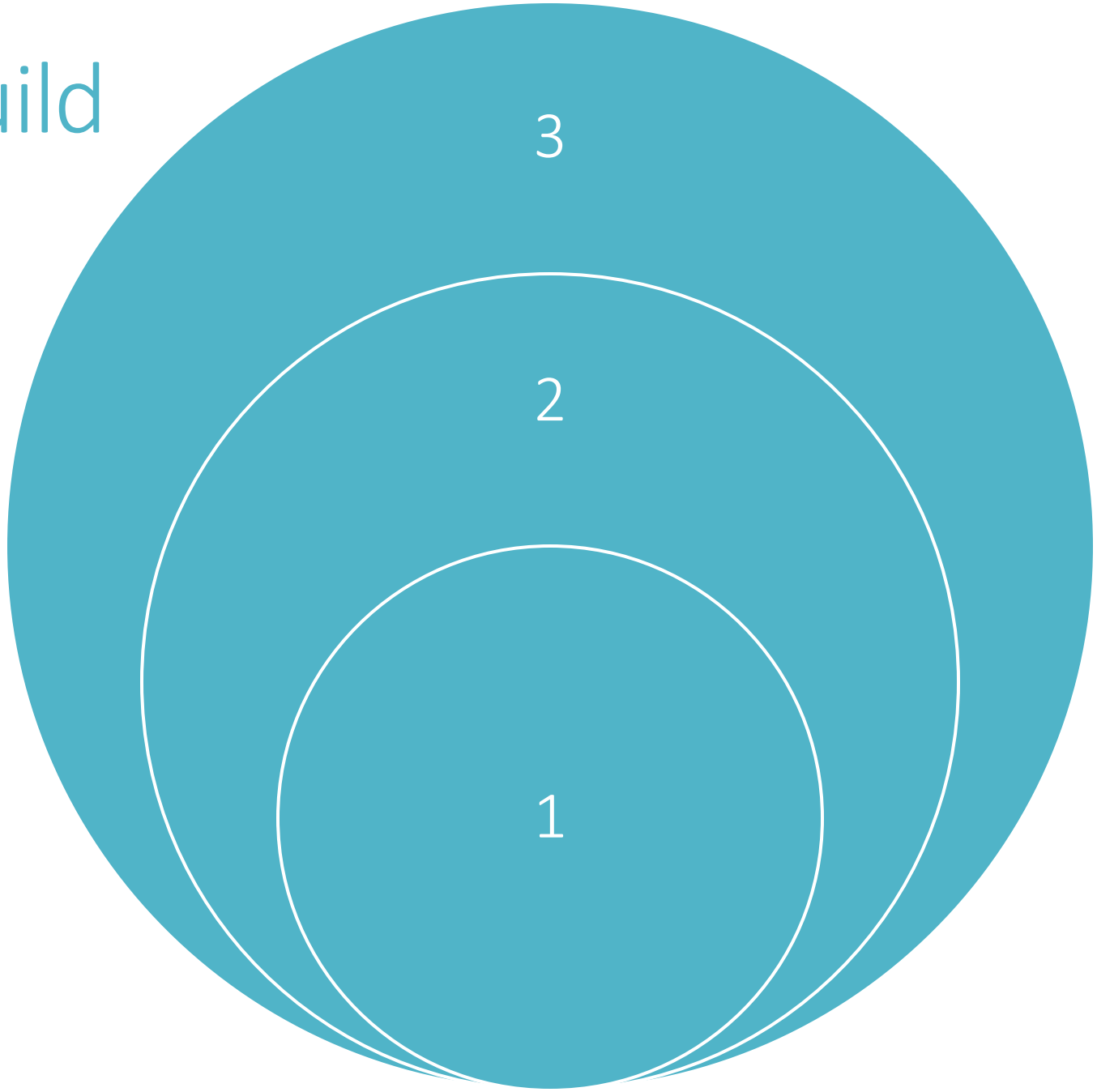
**Design Development**

Risk mitigation,

Best cost/impact estimates

Life-cycle costing

# Scopes build



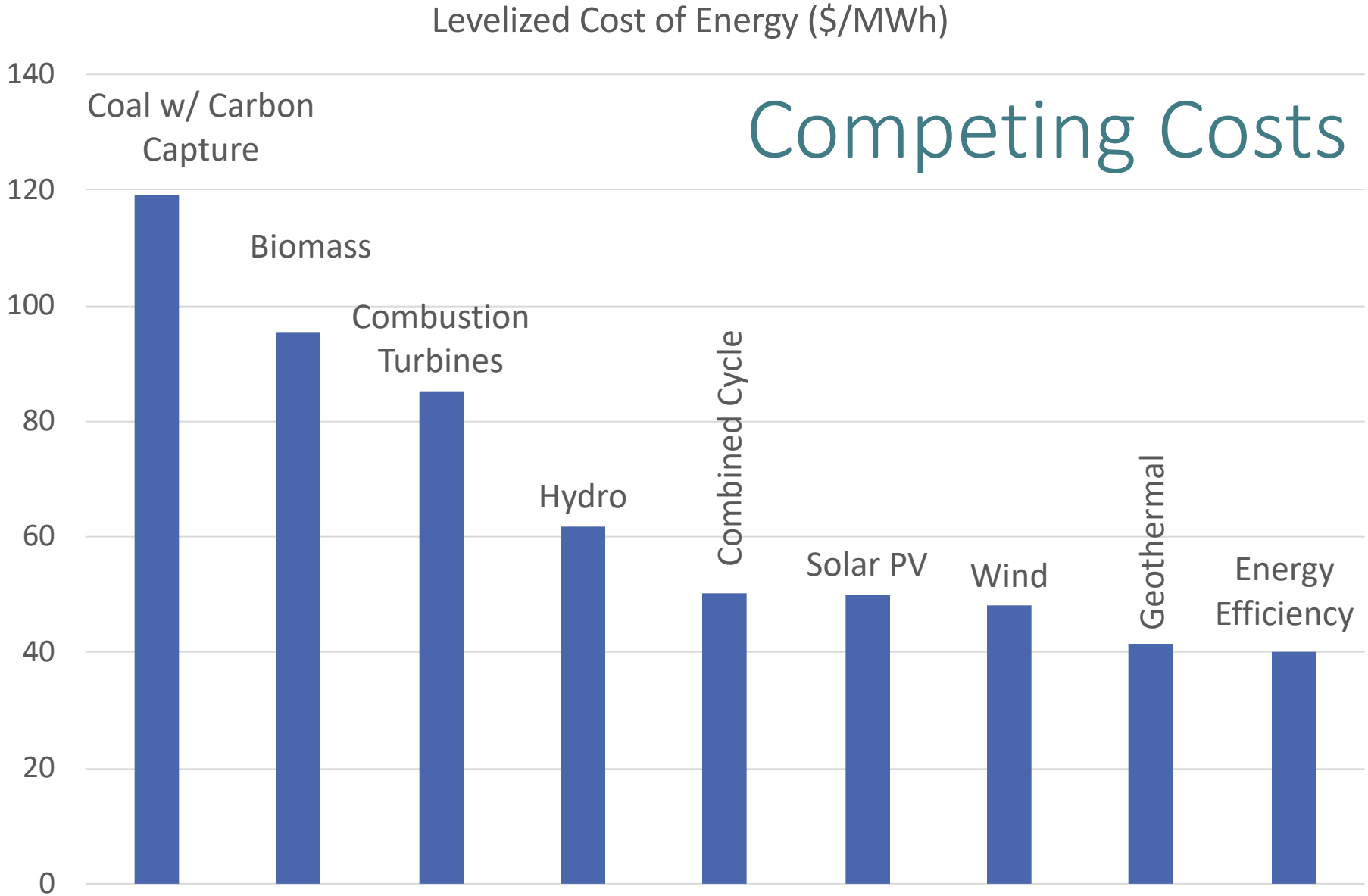
# Why write a standard?

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

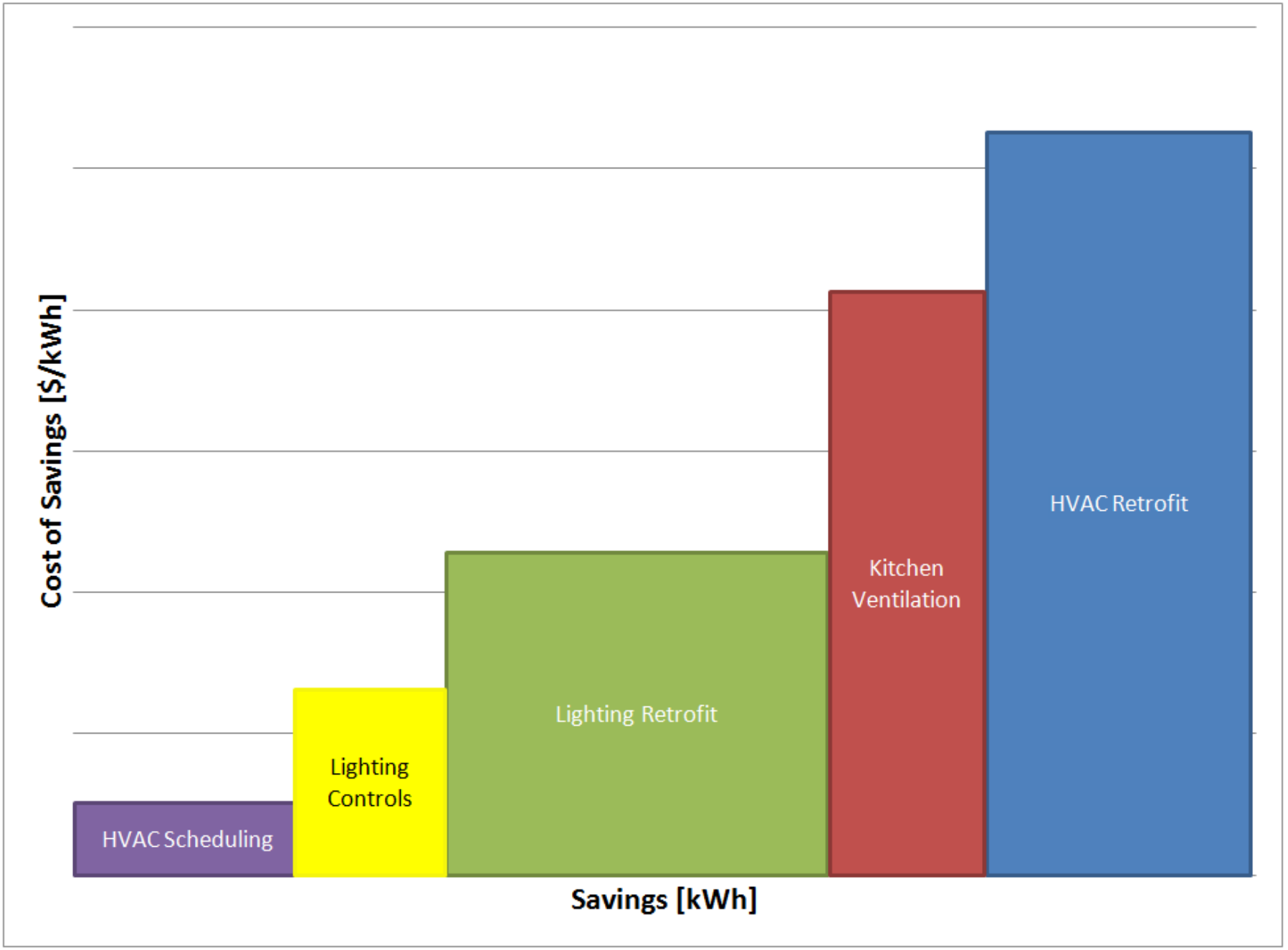
- Detail
- Accuracy
- Rigor
- Confidence
- Risk

- Cost of Service
- Cost of Saved Energy

# 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.


Cost of Savings [$/kWh]
HVAC Scheduling
Lighting Controls
Lighting Retrofit
Kitchen Ventilation
HVAC Retrofit
Savings [kWh]


Engineers?
PEs?
Contractors?
Most people reply, in effect, “me.”
Who’s qualified?

# 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:

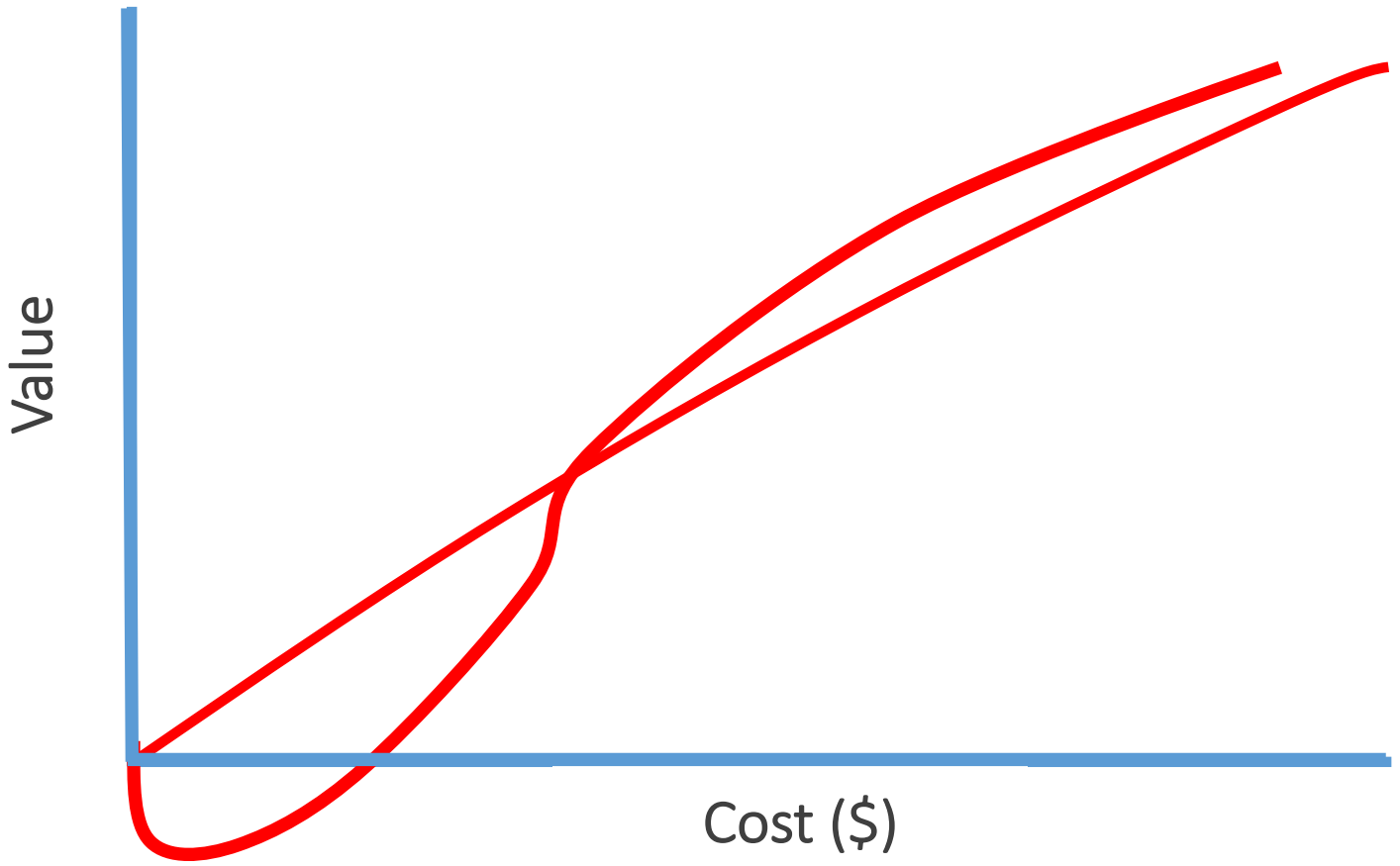
a) A person who holds a certification from a credentialing program approved by the U.S. Department of Energy Better Buildings Workforce Guidelines for Building Energy Auditors or Energy Managers.
b) A licensed Professional Engineer or a Licensed Contractor specifically approved to conduct energy audits 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 [URL omitted] . Only credentialing programs that specifically certify Building Energy Auditors or Energy Managers are applicable.*

betterbuildingssolutioncenter.energy.gov/workforce/participating-certifying-organizations

# Value of an Audit

Many share an implicit assumption…



# Not goals

Best Practices

Consistency of Measures
[ which is ≠ Quality ]

Overly prescriptive methods or recommendations

“Virtual” or “Remote” audits

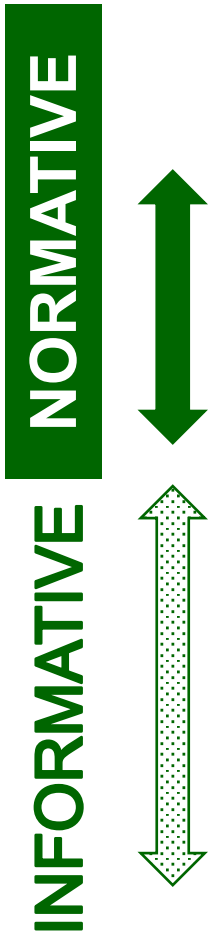
Prescriptive actions for owners

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

# Organization

## BODY

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

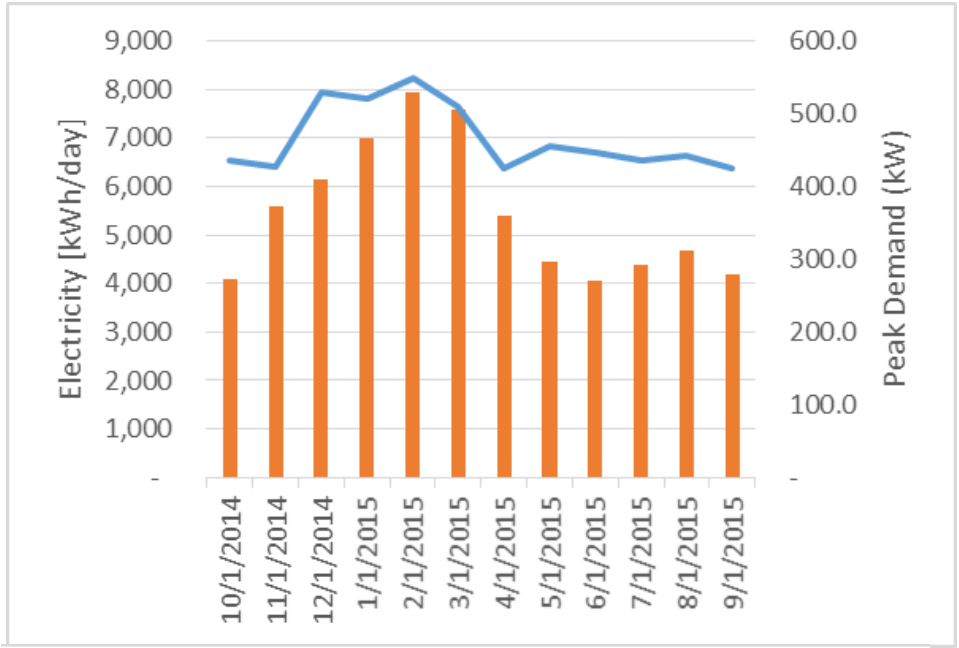


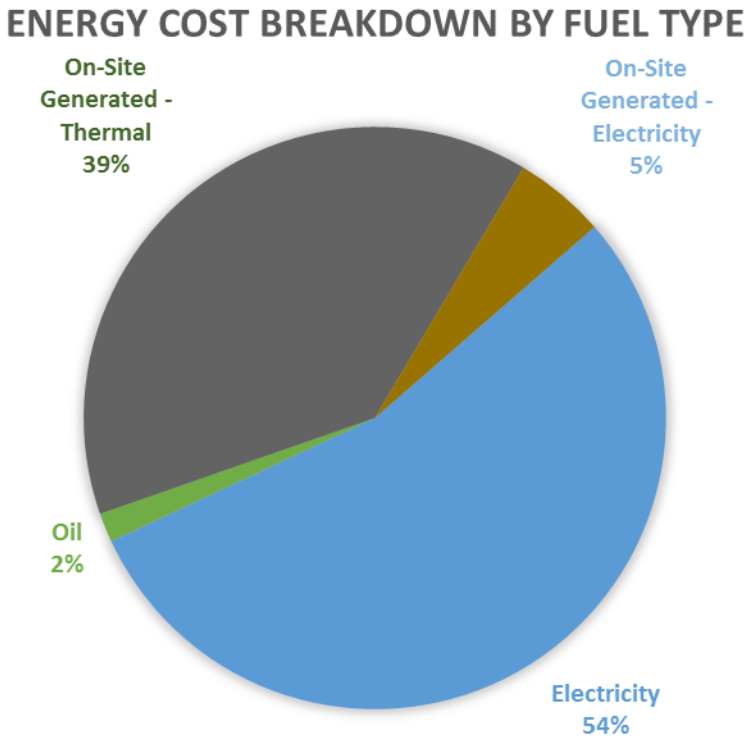

## ANNEXES

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

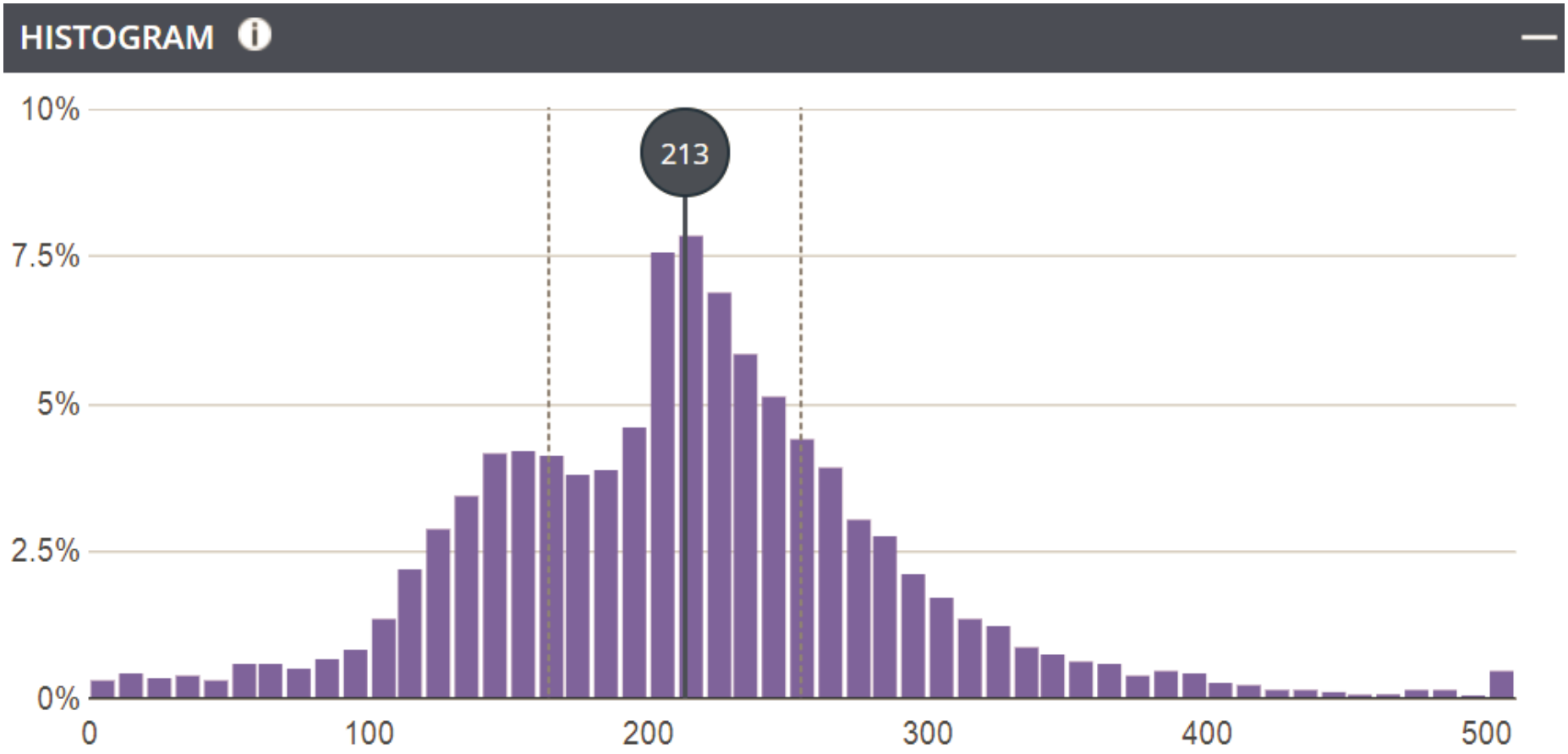
# Level “0”

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



# Benchmark




Source: bpd.lbl.gov

# 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 |

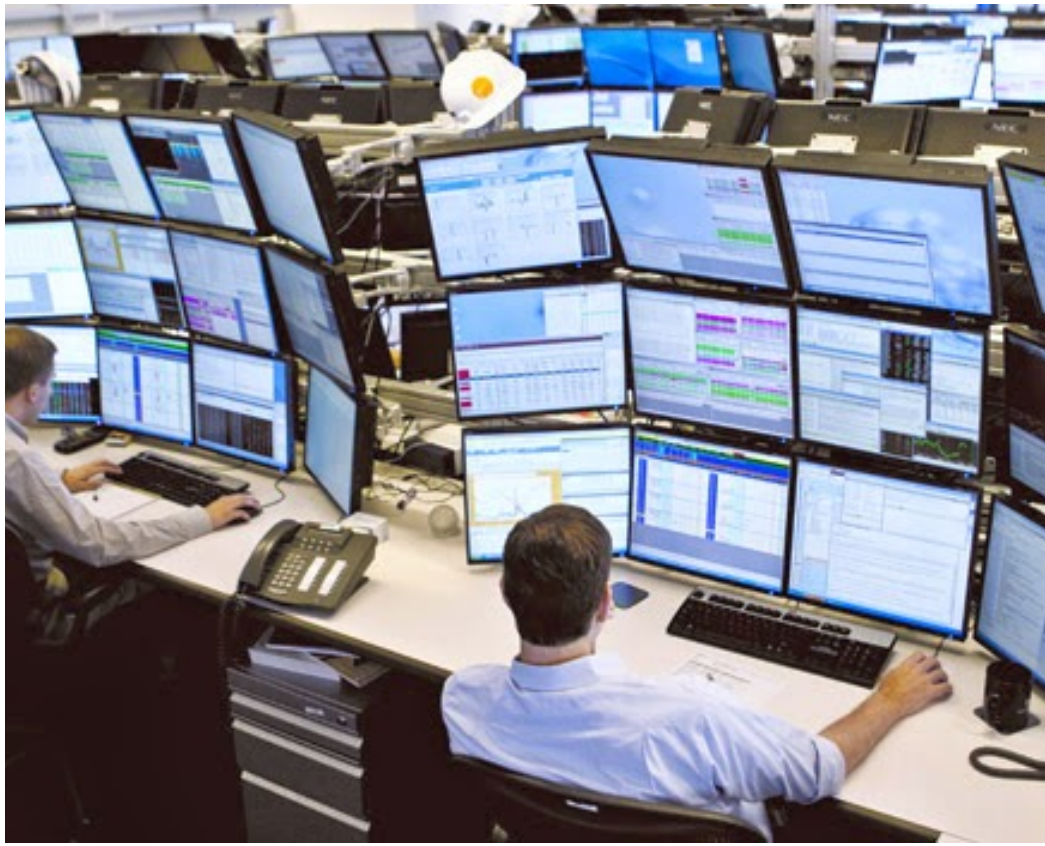
OR

*EUI: Energy Use Intensity

Which begs the question…

# Energy Efficient?

# 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 disaggregation, 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 | |

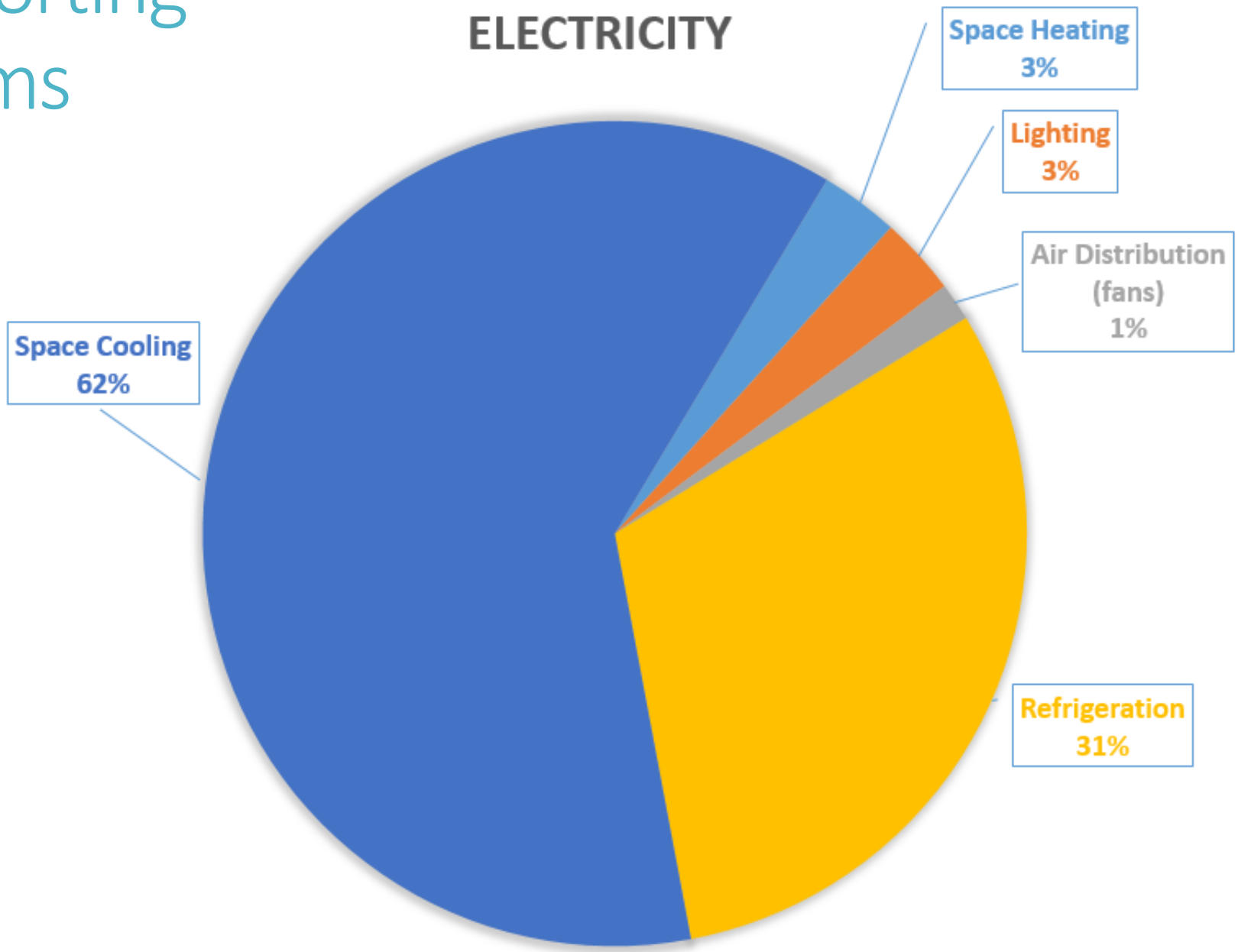
# Reporting Forms

## Level 2 Audit - HVAC System

HVAC Properties (check all that apply)

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

# 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”


# Where does your audit end up?

# Or here?


Inbox 930
!NYSERDA 1
°megan
ASHRAE 14
BidSync
Bills 6
BLDG SIM
CA CEC CPUC 156
CEM
Cycling 2

# 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

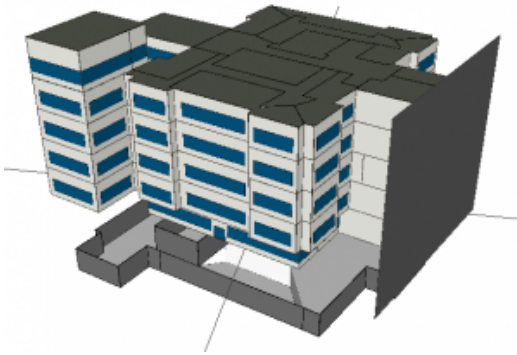
# No more data dead ends!

**Energy Audit Report Forms**

- EEM 1
- EEM 2
- EEM 3

.
.

Asset Score (online)



**OpenStudio EnergyPlus**

City's database

# 211 – What we didn't spec

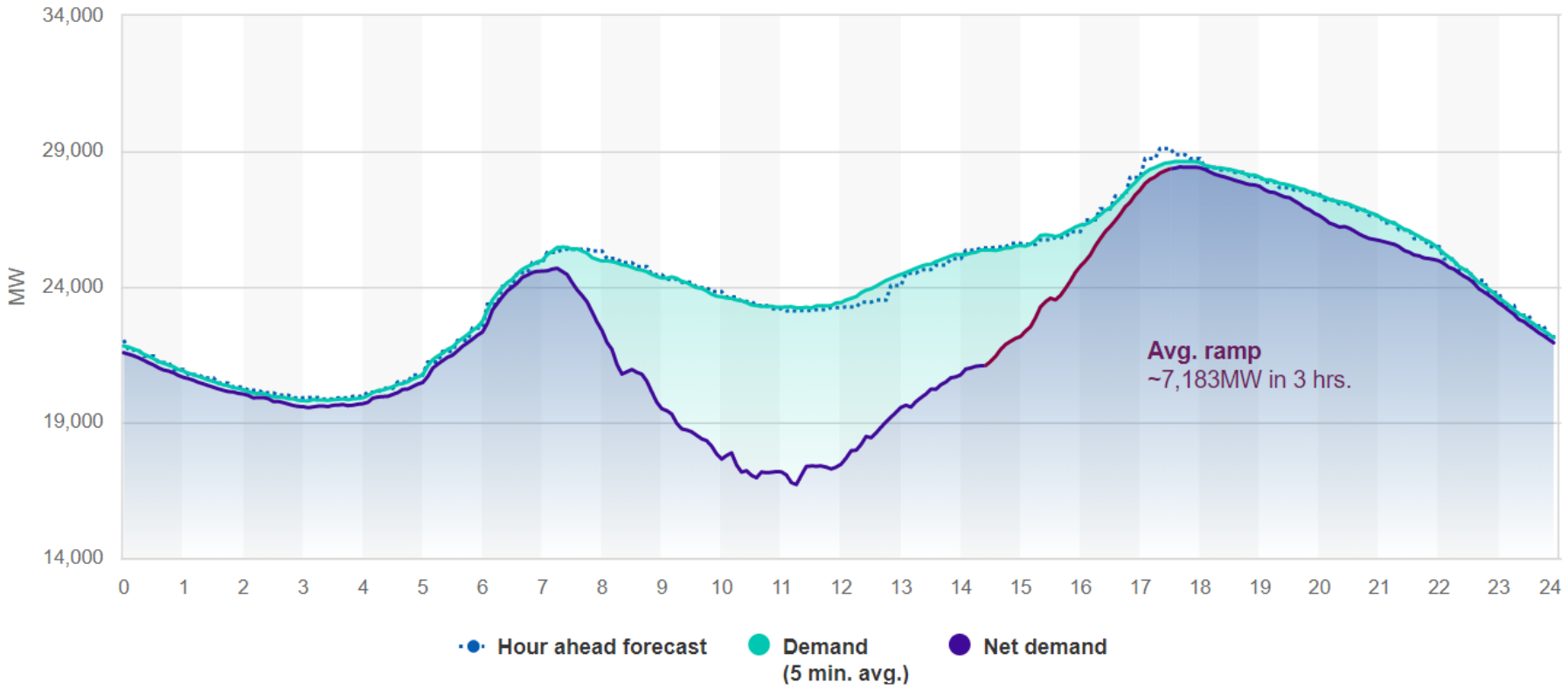
Tried to limit burden & increase options for owners

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!)

If the standard makes it hard to get your customer what they want, we're doing something wrong




# Trends

$CO_2$

HFC phase outs

Emphasis on building value

Emphasis on whole buildings

M&V 2.0

Emphasis on kW = f(t)

# Next Steps

Green book → users guide (in progress)

Forms are online, expect changes

Alternate focus on CO2 / GHG (?)

Enhanced focus on demand, DERs

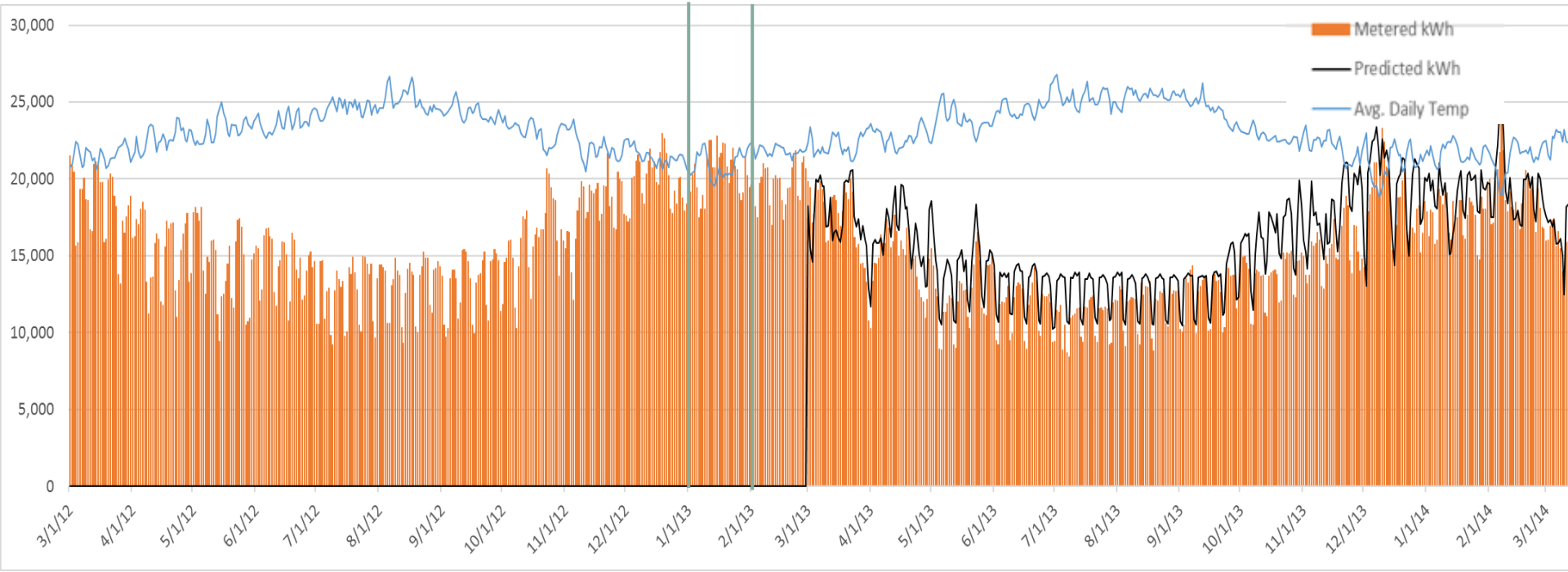
# Questions?

Jim Kelsey, PE
kelsey@kw-engineering.com

# How we're advancing EE in CA

## Normalized Metered Energy Consumption

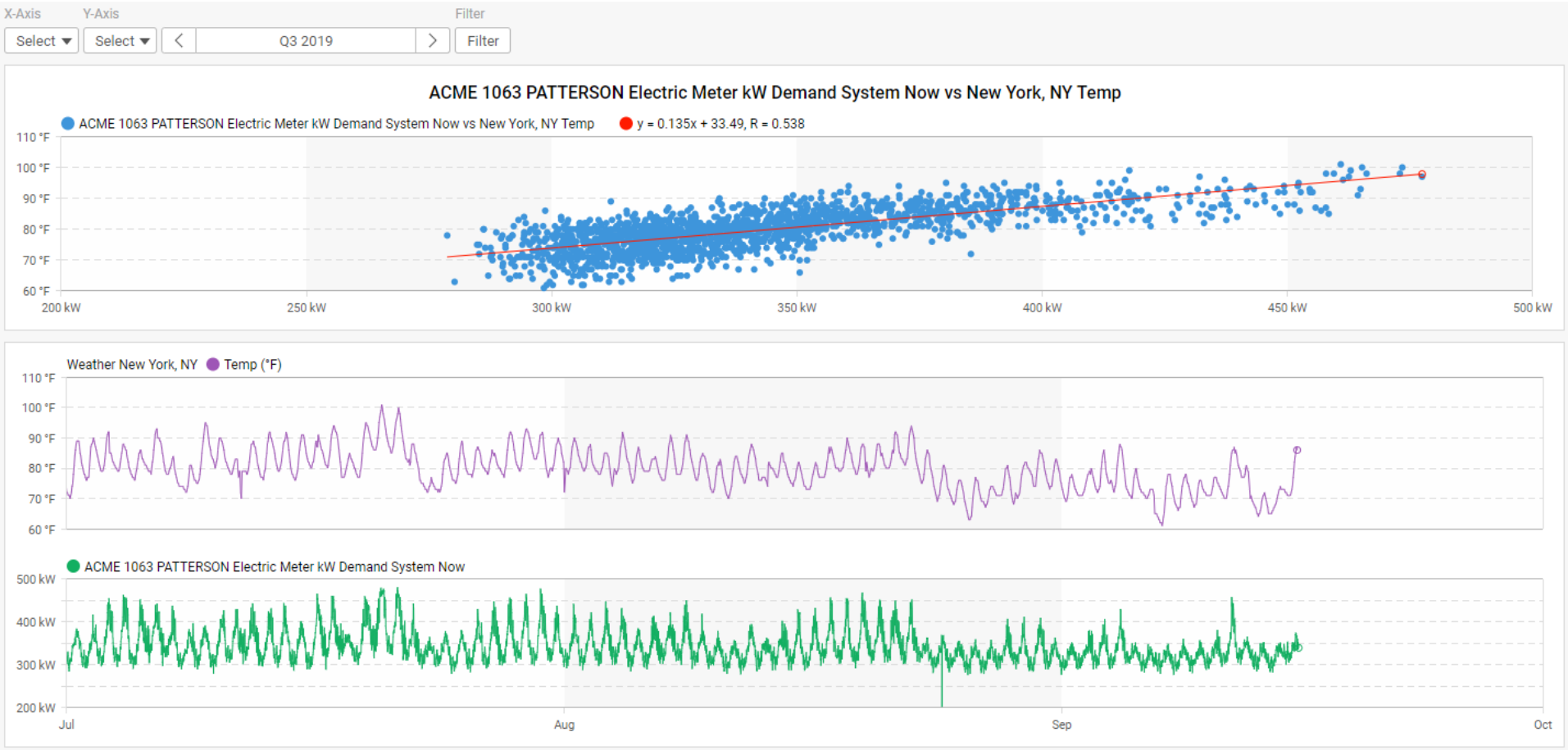
Baseline | Install | 1st Performance Period



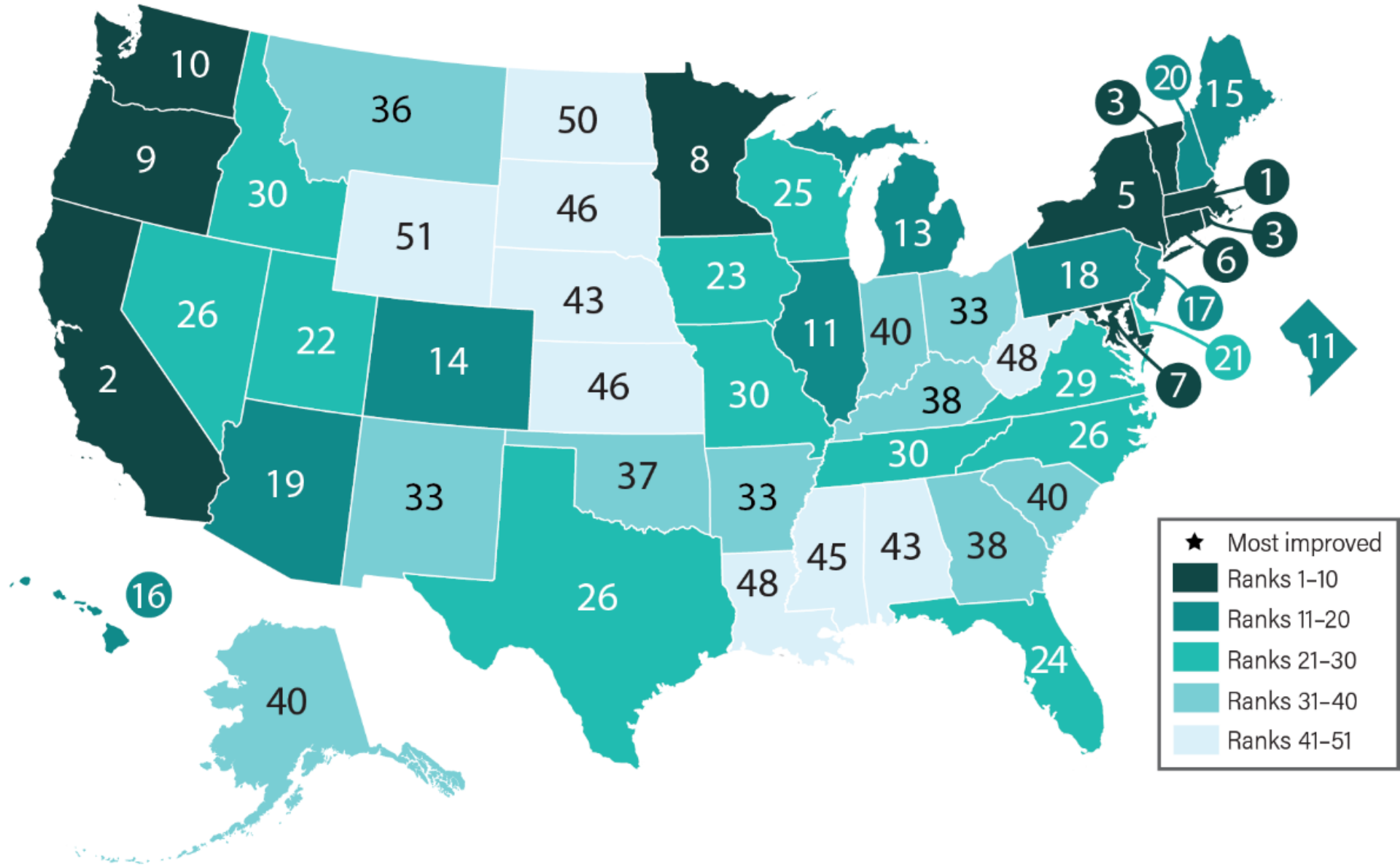

→ Open source methods, transparent savings estimates

Emphasis on actions that result in savings, not "bean counting"

# NYSERDA REM Pilot



# Now's your chance



# “Virtual” Audits?

## POTENTIAL

Lower cost

“Scale”

“We’re still telling people they are doing simultaneous heating and cooling”

- Swapnil Shah, CEO, FirstFuel

## DRAWBACKS

Recommendations are often vague – leave customers wanting

No standard – omitted from ASHRAE process

Disaggregation ≠ Recommendation

“Generic” recommendations