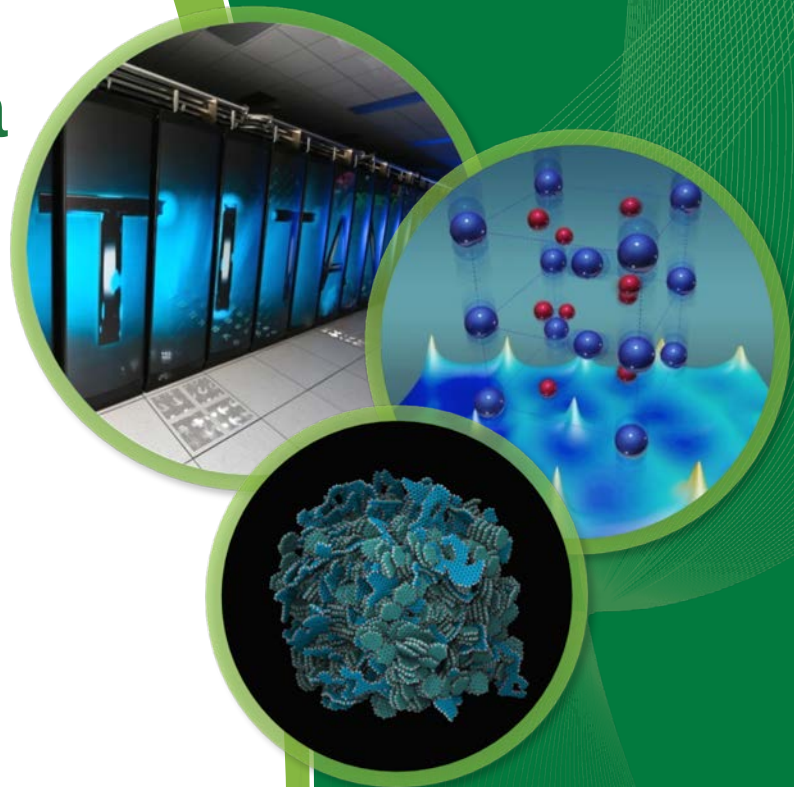


Utility Metering: When, Where, Allocations, and Simple Ways to Use Data

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When Should Meters Be Installed?

- 2014 guidance* *recommended* priority:
 - 1. New Construction and Major Renovations
- At planned service outages:
 - Maintenance/repair/replacement
 - Other renovations
 - Ideal time to replace existing mechanical meters

* Federal Building Metering Guidance 2014

Where Should Meters Be Installed?

- Appropriate – Exclude if disposing within 5 years, agency doesn't pay bill, ..., meets these thresholds:

Table 1 –Energy Metering Exclusions ^{7,8}	
Federal Building	Threshold
Food Service / Sales	< 1,000 square feet
Warehouses	< 25,000 square feet
All Other Building Functions	< 5,000 square feet

- Cost effective (priority per 2014 guidance)

- 1. New Constructions and Major Renovations

- UESCs, ESPCs, MILCON, ECIPs, ...

- 2. Covered Facilities

- 3. Non-Covered Facilities

**Cost
Effective?**

Very

Usually

Questionable

Where To Install: Evaluating Cost Effectiveness

- Past metering guidance has excellent approach (2006):

$$\frac{\left[\left(\frac{\text{Installed Cost}}{\text{Desired Simple Payback}} \right) + \text{Annual Cost} \right]}{\% \text{ Annual Savings}} = \begin{matrix} \text{Minimum} \\ \text{Annual} \\ \text{Electric Bill} \end{matrix}$$

$$= [(\$5,000) \div (10 \text{ years}) + (\$25 \text{ per month}) \times (12 \text{ months per year}) \div (0.02)] = \$40,000$$

Two easy approaches to implement

1. Automate Calculations To Determine Simple Payback For Meters Or Your Portfolio*

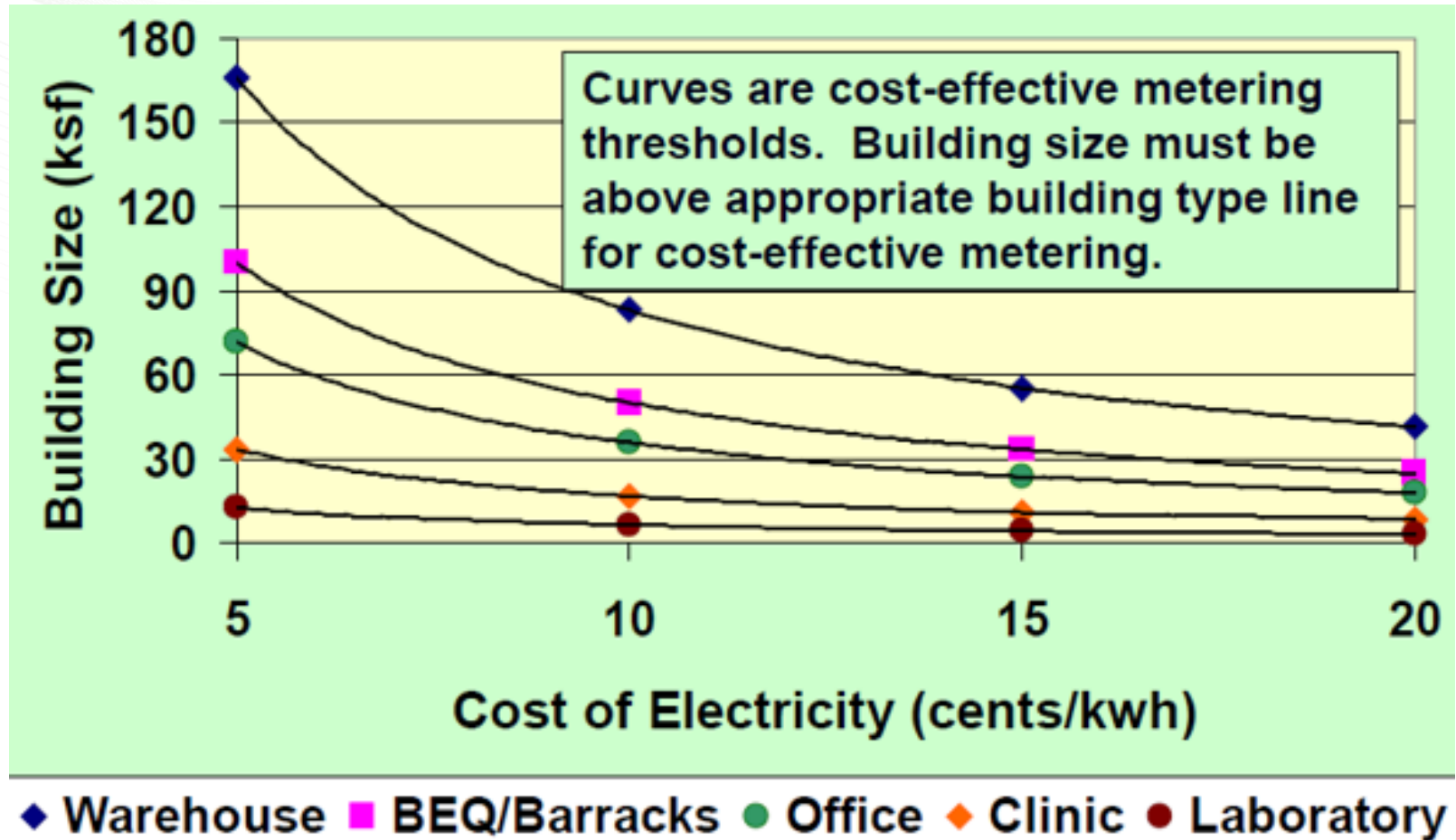
	Bldg Size	Electric Cost	# Meters		Estimated Electrical Use	Estimated Electric Cost	Estimated Electric Savings	Metering Simple Payback
Bldg #	(sq-ft)	¢/kWh		Building Use	(kWh/yr)	(\$/yr)	(\$/yr)	(years)
2389	81268	10	1	Data process	3331988	333199	6664	0.8
2327	85496	10	2	Mess hall	2479384	247938	4959	2.1
7961	67737	10	1	Office	745107	74511	1490	4.2
2021	46200	10	1	Clinic	693000	69300	1386	4.6
4770	132162	10	2	Dorm/BEQ/Ba	660810	66081	1322	9.8
121	43000	10	1	School/child c	344000	34400	688	12.9
1468	38000	10	1	Maintenance	228000	22800	456	32.1
1310	66577	10	1	Warehouse/st	199731	19973	399	50.3

* Assumptions in table: cost \$5k/meter, 2% savings from using metered data, \$300/meter per year for meter O&M/data collection/analysis

Cautions:

1. Use local costs of energy, not regional/state/national averages
2. Don't forget – bigger buildings cost more (have multiple meters)

2. Create Size Threshold Curves



Estimate Building Electric Use Using Typical Electric Use Intensities By Building Type

Electricity Index Percentiles from 2012 CBECS*					
Building Use	Weighted Electricity Use Intensities, kWh/yr per gsف				
	Percentiles				
	10th	25th	50th	75th	90th
Admin office	3.5	6.7	11.0	15.0	24.1
Clinic/other health	4.9	9.4	15.2	20.7	27.3
Convenience store	20.1	43.3	65.3	78.7	107.4
Dormitory	2.2	3.3	5.1	6.6	16.6
Fast food	28.0	48.0	81.8	131.2	168.1
Warehouse	0.4	1.0	2.9	5.9	10.7

*Available for 51 building types at:

1. <https://eber.ed.ornl.gov/benchmark/eui.htm>

2. To be published in update of ASHRAE Handbook of HVAC Applications.

Available for 15 building types from CBECS website

(<https://www.eia.gov/consumption/commercial/reports/2012/energyusage/>)

Allocating Campus Energy Use To Buildings

- Energy use intensity varies by building type
 - Simple floor-area-based allocation ignores this
 - Annual-energy-cost-based allocation accounts for this

Simple, more
accurate

	Floor-Area Allocation		Energy-Cost-Based Allocation		
Building Type	Floor Area (SF)	Calculated allocation	Calculated allocation	Annual Energy Cost (\$) [=SFx\$/SF]	Annual Energy Cost Intensity* (\$/SF)
Office	100000	37%	28%	136000	1.36
Clinic	30000	11%	9%	45900	1.53
Convenient store	5000	2%	5%	26300	5.26
Elem school	50000	19%	11%	54500	1.09
Fast food	3000	1%	5%	26610	8.87
Hospital	80000	30%	40%	196800	2.46
Totals:	268000	100%	100%	486110	

*Available for 51 building types at:

1. <https://eber.ed.ornl.gov/benchmark/eui.htm>
2. To be published in update of ASHRAE Handbook of HVAC Applications.

Sources of Savings for Installed Metering

- Identify your strategy(s) and estimate savings:
 - Identifying and correcting billing issues
 - City of Boston achieved savings of \$1.2 mil within 18 months of a \$250k contract with a 3rd party validator (3,000 bills, \$40 mil utility budget)
 - At federal campuses, tenant bills for individual buildings are often allocated. This offers great opportunity for metering to identify overbilling.
 - At federal campuses, tenant sewer bills are frequently based on 100% of water bills (overpaying if using water-based cooling towers or boilers)
 - Demand control, load shifting, demand ratchets, time-of-day rates
 - Optimizing required energy audits
 - In a federal portfolio of 48 covered facilities, metered data were used to identify 310,000 sf of high performing buildings and remove them from 2018 planned audits (reducing audits costs ~\$100,000/yr at \$0.30/sf)

Some Simple Ways To Use The Data

- At a minimum, calculate an annual use.
 - Use it to find billing anomalies
 - Use it to calculate annual energy and water use intensities (EUI/WUI). Benchmark EUIs/WUIs against similar building types*
 - Use benchmarking results to:
 - Set auditing priorities
 - Remove high performers from your audit list
 - Track performance
- If your meters aren't reporting (snap/text a picture yearly)
 - From these you can:
 - Do everything above and
 - Identify if your meter is working, if your meter has been changed, if your meter is an advanced meter...

* Via metrics in the ASHRAE Handbook of HVAC Applications (51 buildings types) or Energy Star Portfolio Manager (~15 building types can be scored).

Questions?

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Thank you!