



Electric Metering for EPACT: How Many, Where, When, and Where Am I

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Topics of Discussion

- Establishing a cost-effective threshold
- Quantifying meters required
- Prioritizing meter installs
- Computerization
- Improving your numbers

Step 1: Calculate Cost-Effective Threshold for Installing Meters

Formula and sample calculation:

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

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

SOURCE: Guidance for Electric Metering in Federal Buildings, DOE/EE-0312

Step 2: Identify Buildings Requiring Meters and Prioritize

- What is the annual electric bill for each of my 50/500/50,000 buildings?
- Brakes come on here!
- One way to estimate is to use average building electric use intensities (EUIs)
 - Annual electricity bill (\$/yr) =
EUI (kWh/sqft-yr) * sqft * \$/kWh



Calculate Building Electric Bills

Building Type	Average EUI (kWh/sf-yr)	Size (ksf)	Annual electric cost (\$k/yr)
Grocery	52	25	103
Cafeteria	38	20	61
Govt office	14	50	57
Repair Shop	7	40	22
Dormitory	7	50	27
Warehouse	5	120	52

NOTE: Average EUIs calculated from EIA's CBECS 2003. Electric cost assumed to be \$0.08/kWh



FEMP Metering Guidance Supports Use of Building EUIs

- Guidance states “In cases where buildings are not metered, electric energy use can be estimated using energy-use intensity (EUI) data appropriate for the building type”
- Guidance refers you to “DOE’s Buildings Energy Databook” for EUIs. Data there is not good enough.



EUI Resource for 51 Building Types

- <http://eber.ed.ornl.gov/benchmark/eui.htm>
 - Derived from EIA's 2003 CBECS Survey
- **CAUTION:** If you use EUIs, ensure they are for electric use only, not total energy use intensities.



Automate Calculations: The Prioritization & Assessment Tool

- Identifies go's/no go's
- Counts number of meters required
- Prioritizes meter installs (by bang-for-the-buck)
- Estimates metering costs
- Instant reruns: costs/assumptions will change
- Easy updating – FY to FY
- Rapid progress assessments - % buildings/ % kWh metered

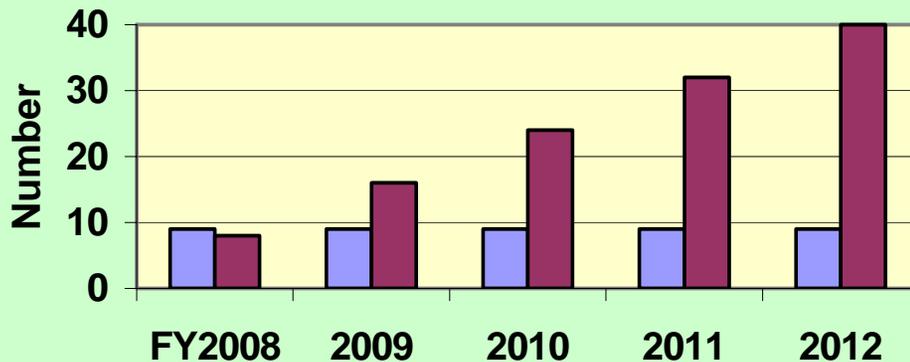
Meter Prioritization and Assessment Tool

GOALS

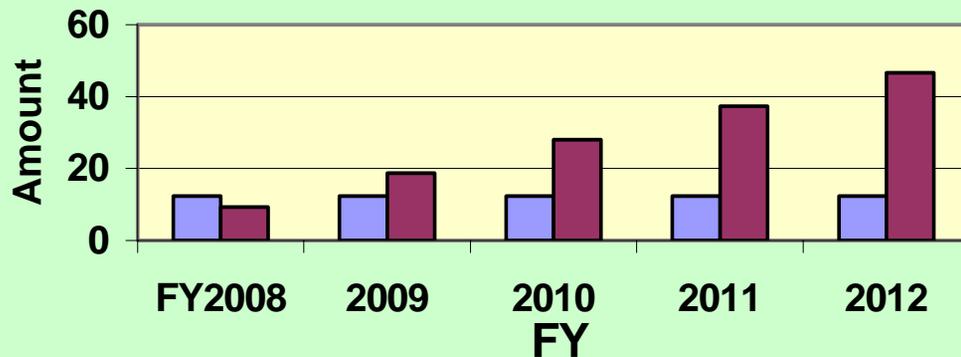
Building Metering Achieved
Electricity Metering Achieved

23%
26%

Metered Buildings



Metered MWh



■ Metered ■ Goal

Calculate Average Electric Cost

Enter Annual Electric Bill (\$)	Enter Annual Electric Use (kWh)	Average Electric Cost (\$/kWh)
52500	657000	0.080
or		
Enter Average Electric Cost (\$/kWh)		0.080

Enter Savings From Metering

Assumed Savings from Metering (%)	2
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Average Electric Meter Cost (\$) 6000

RESULTS

No. Buildings		Electricity (MWh)	
Total	49	Total	49048
Target	40	Target	46703
Metered	9	Metered	12365
Metered %	23%	Metered	26%



Input to Tool (yellow cells)

PRIORITIZE

CLEAR

Obs	Building		Building Floor Area	Metered	Target	Annual Total Electrical Use	Estimated Annual Electric Cost	Annual Electric Cost Savings	Simple Payback from Metering
	ID	Type	(sq-ft)			(kWh)	(\$/yr)	(\$/yr)	
1	182	Office	112381	y	1	3820954	305676	6114	1
2	156	Office	106460	y	1	3619640	289571	5791	1
3	167	Warehouse	206426	y	1	3509242	280739	5615	1
4	132	Warehouse	168285	n	1	2860845	228868	4577	1
5	148	Barracks	97781	n	1	2346744	187740	3755	2
6	147	Dining	44091	n	1	2028186	162255	3245	2
7	114	Barracks	84249	n	1	2021976	161758	3235	2
8	123	Office	51886	n	1	1764124	141130	2823	2
9	139	Office	25550	n	1	868700	69496	1390	4
10	108	Storage	51774	n	1	621288	49703	994	6
11	100	Storage	29581	n	0	354972	28398	568	11



Example of Tool Feedback

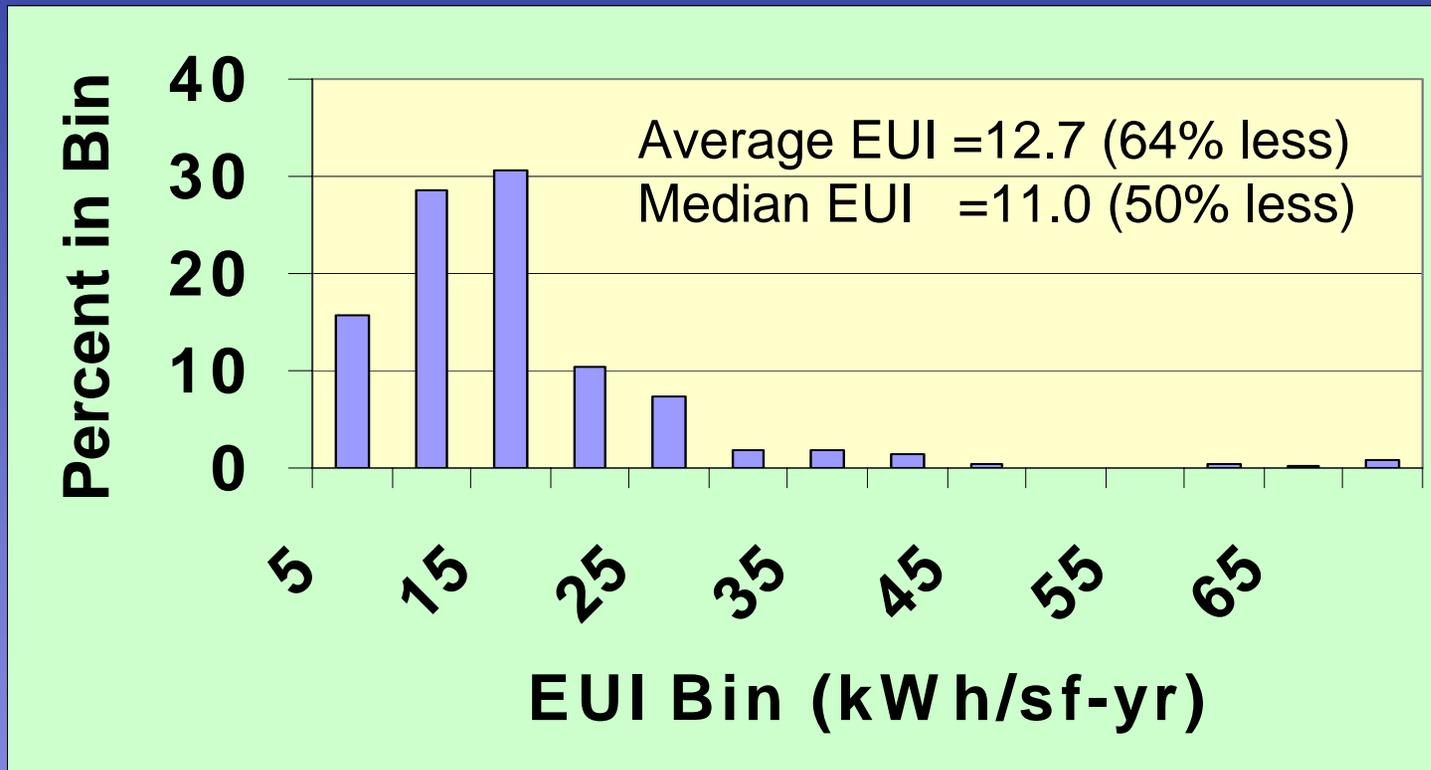
- 54 buildings need new meters
- 48% of buildings are metered (50 of 104)
- 30% of electric use is metered (building level)
- 32 office, 10 warehouse, 12 labs need meters
- At \$5k/meter our expected budget is \$270k
- Plan: Install 20 per year, in priority of largest users, have metered 90% of electric use in 2 years, finish in FY2010.
- We're looking good/OK/in trouble



Improving Your Results: You May Over-Estimate Your Need

- You will install too many meters if you use average EUIs to estimate building annual electricity bills
- The problem will be worse if your buildings are in a cold climate

Average EUI: Distribution of EUIs for 510 Office Buildings



SOURCE: Non-govt office building data in EIA's CBECs 2003 buildings survey.

Average EUIs Almost Always Far Exceed Median Values

Building Type	Average EUI (kWh/sf-yr)	Median EUI (kWh/sf-yr)	Difference (%)
Grocery	51.7	42.4	22
Cafeteria	37.9	28.7	32
Govt office	14.3	10.7	33
Repair shop	6.8	6.1	11
Dormitory	6.7	5.1	31
Warehouse	5.4	2.9	84

SOURCE: Analysis of EIA's CBECS 2003 buildings survey data.

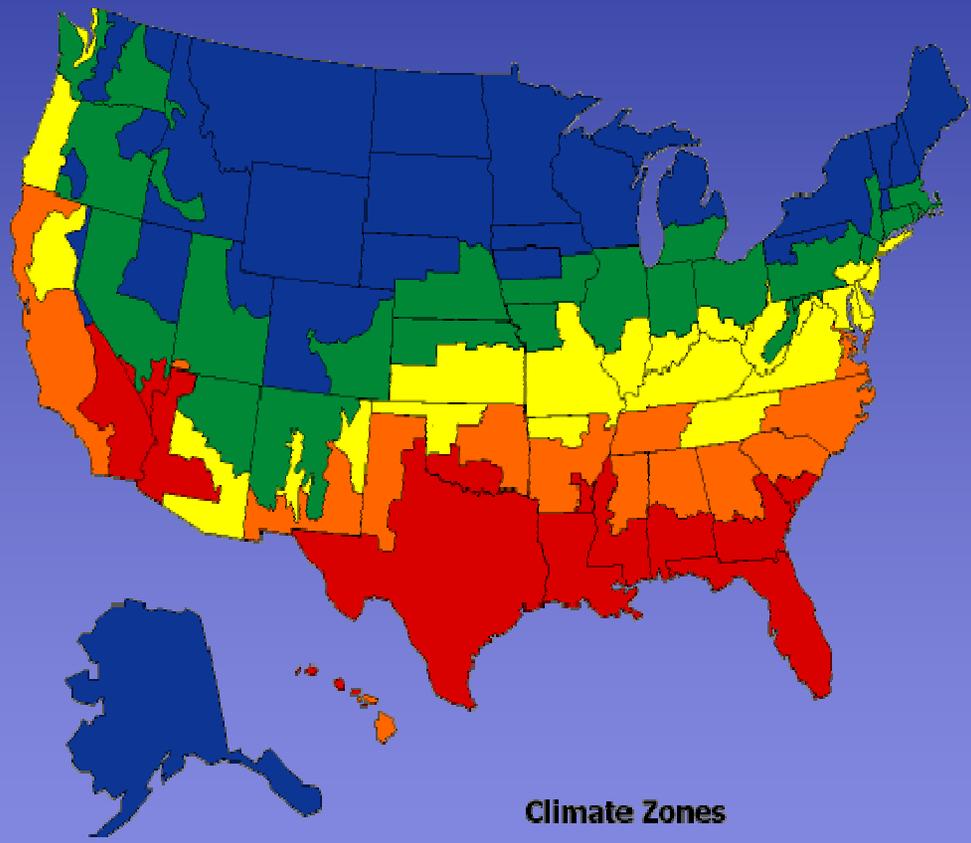


Use Median EUIs Instead of Average EUIs For More Reliability

- Averages most always strongly influenced by extreme users
- Typically, 60-70% of buildings will use less than the average EUI
- Using average EUIs will result in many cost-ineffective meter installations
- Using a “typical” (median) EUI is recommended



Climate Zones



Climate Zones

Zone	CDD	HDD
1	<2000	>7000
2	<2000	5500-7000
3	<2000	4000-5499
4	<2000	<4000
5	>=2000	<4000



For Office Buildings, Adjust Estimates Based on Climate Zone

Climate zone	Median EUI (kWh/sf-yr)	Electric use multiplier (ratio)
1	8.2484	0.75
2	9.2104	0.84
3	10	0.91
4	11.8207	1.07
5	14.1966	1.29
All	11.026	

Based on nationally-representative sample of 510 office buildings in CBECS 2003



Climate Zone Summary

- Buildings in cold zones use less electricity
- Using a single EUI across zones will install too many meters in cold zones and too few in hot zones
- An adjustment to electric use or cost estimates is recommended for office buildings due to location
- Recommendations for other building types are not available to date.



Conclusions

- FEMP metering guidance supports the use of electric use intensities (EUIs) to estimate building annual electric bills
- If simple average EUIs are used to estimate building electric bills, major labor and dollar resources will go to cost-ineffective metering
- Better electric use intensities (EUIs) should be used
- From here, you can easily quantify needs, estimate a budget, prioritize meters, and plan installs
- Automate via easy-to-use spreadsheet: things will change!
- Estimate bills very carefully: Better estimates = better planning, less work, lower cost, faster success



For More Information

- Would you like to know more about this session?
- Terry Sharp
- Oak Ridge National Laboratory
- sharptr@ornl.gov

Don't forget to fill out and drop off your session evaluations!



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