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

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2018 Federal Utility Partnership Working Group Seminar

April 19, 2018
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:

  - Cost effective (priority per 2014 guidance)
    - 1. New Constructions and Major Renovations
      - UESCs, ESPCs, MILCON, ECIPs, …
    - 2. Covered Facilities
    - 3. Non-Covered Facilities

<table>
<thead>
<tr>
<th>Federal Building</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Service / Sales</td>
<td>&lt; 1,000 square feet</td>
</tr>
<tr>
<td>Warehouses</td>
<td>&lt; 25,000 square feet</td>
</tr>
<tr>
<td>All Other Building Functions</td>
<td>&lt; 5,000 square feet</td>
</tr>
</tbody>
</table>
Where To Install: Evaluating Cost Effectiveness

• Past metering guidance has excellent approach (2006):

\[
\frac{\text{Installed Cost}}{\text{Desired Simple Payback}} + \text{Annual Cost} \times \% \text{ Annual Savings} = \text{Minimum Annual Electric Bill}
\]

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

Two easy approaches to implement
1. Automate Calculations To Determine Simple Payback For Meters Or Your Portfolio*

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

* 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

Curves are cost-effective metering thresholds. Building size must be above appropriate building type line for cost-effective metering.
Estimate Building Electric Use Using Typical Electric Use Intensities By Building Type

<table>
<thead>
<tr>
<th>Building Use</th>
<th>Weighted Electricity Use Intensities, kWh/yr per gsf</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10th</td>
</tr>
<tr>
<td>Admin office</td>
<td>3.5</td>
</tr>
<tr>
<td>Clinic/other health</td>
<td>4.9</td>
</tr>
<tr>
<td>Convenience store</td>
<td>20.1</td>
</tr>
<tr>
<td>Dormitory</td>
<td>2.2</td>
</tr>
<tr>
<td>Fast food</td>
<td>28.0</td>
</tr>
<tr>
<td>Warehouse</td>
<td>0.4</td>
</tr>
</tbody>
</table>

*Available for 51 building types at:
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

### Floor-Area Allocation vs. Energy-Cost-Based Allocation

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

*Available for 51 building types at:
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!