Strategic Energy Management Models: Is a Simple Model Enough?

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Energy Trust of Oregon

• Founded in 2002 and based in Oregon, USA
• Offers electric and gas energy efficiency and renewables programs to ~80% of Oregon ratepayers
• 2019 annual budget ~$200 million
Strategic Energy Management

• SEM is a holistic approach to managing energy use in order to continuously improve energy performance over the long-term
  – SEM focuses on business practice changes from senior management to the shop floor staff
  – SEM emphasizes behavioral and operational changes
  – SEM principles and objectives do not focus on, but lay the infrastructure for, larger energy efficiency projects that require capital investment

• Three categories of elements that characterize SEM
  1. Customer commitment
  2. Planning and implementation
  3. Measurement and reporting
Parallel Initiatives

• ISO 50001
  – 22,870 certifications in 2017
  – 83% Europe and 15% Asia

• Energy Efficiency Networks
  – Started in the late 1980s and greatly expanded in Europe and China after 1997 with a total of 1,295 networks formed representing 15,620 firms
Industrial SEM Overview

Program

Implementers (SEM coaches)

Incentives

Training

Technical services

Customers
Timeline of SEM Engagement

- **Baseline Period**
- **Engagement Period**
- **1 Year Later**
- **2 Years Later**

**Reporting Period:**
- Opportunity Register
- Model Specification
- Modeled Savings report
- Modeled Savings report

EnergyTrust of Oregon
Industrial SEM at Energy Trust

- Energy Trust has been implementing industrial SEM since 2009
- Industrial SEM has had 212 participating sites since its inception
- SEM has been responsible for ~16% of the industrial program's electric savings and 5% of the program’s gas savings through 2018
Measurement and Reporting

• This element involves the “regular analysis of actual performance against modeled performance”

• This has typically entailed the development of one or more energy models for each SEM participant that “capture all key factors that influence energy consumption and production”

• Includes tracking of O&M and capital investment energy efficiency actions

• Estimated changes in energy consumption, net of capital project savings, are attributed to SEM
Reasons for Model Simplification

- Significant resources are still used to develop and maintain energy models
- One of the key model inputs is production which is often difficult to obtain post-SEM engagement
- Issues with managing models as number of models and length of engagement grows with continuous SEM
- Desire to see impacts at a portfolio level with one consistent model
**Estimated SEM Model**

\[ \text{kWh\_per\_day}_{it} = \alpha + \beta_{\text{engagement}}_{it} + \sum_{y=1}^{6} \beta_y \text{post\_year}_{yit} + \epsilon \]

- Unbalanced cross-section times-series pre/post model
- Generalized least squares with heteroskedastic but uncorrelated error structure was used to estimate the coefficients
- Average daily SEM savings for each of the six post-SEM engagement years are estimated by \( \beta_{yit} \)
108 industrial sites participated between 2012 and 2017
- Limited to kWh data
- 36 of these sites were not included in the analysis for a variety of reasons such as:
  - Addition of renewable generation
  - Plant closures
  - Insufficient kWh data
  - Large known production and structural changes at the site
  - Large (>50%) changes in first year kWh consumption
- Final sample included 72 sites, all of which had two years of post-SEM engagement data
## Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimated Average Daily kWh Reduction</th>
<th>Capital Projects Average Daily kWh Reduction</th>
<th>SEM Average Daily kWh Reduction</th>
<th>Percent Reduction Relative to Baseline</th>
<th>Number of Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>post_year1</td>
<td>-1,096</td>
<td>-239</td>
<td>-857</td>
<td>-3.6%</td>
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</tr>
</tbody>
</table>
Conclusions

- On average, SEM participants are increasingly reducing their energy consumption
  - Due in part to SEM and to capital projects
  - Results supported by other recent studies:

- Using a model to estimate aggregate program savings has resulted in first year savings estimates relatively close those estimated by the individual models, 3.6% vs 5.6%
  - Model allows program to estimate savings in future years with little additional data collection

- Later year savings estimates appear to be unrealistically high – e.g., 39% in Year 5 and 49% in Year 6
  - Might be due to nonprogrammatic effects such as changes in the production process production levels or structural changes at a site.
  - The number of sites in those last years is much smaller (27 in Year 5 and 8 in Year 6) and might not be representative of the general population
Next Steps

• Obtain production data for a subsample to determine how inclusion of production variables will impact estimates

• Develop a database that contains all SEM model data to simplify portfolio level analysis
Questions?

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