Strategic Energy Management Models: Is a Simple Model Enough?

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ENERGY EVALUATION ASIA PACIFIC

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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

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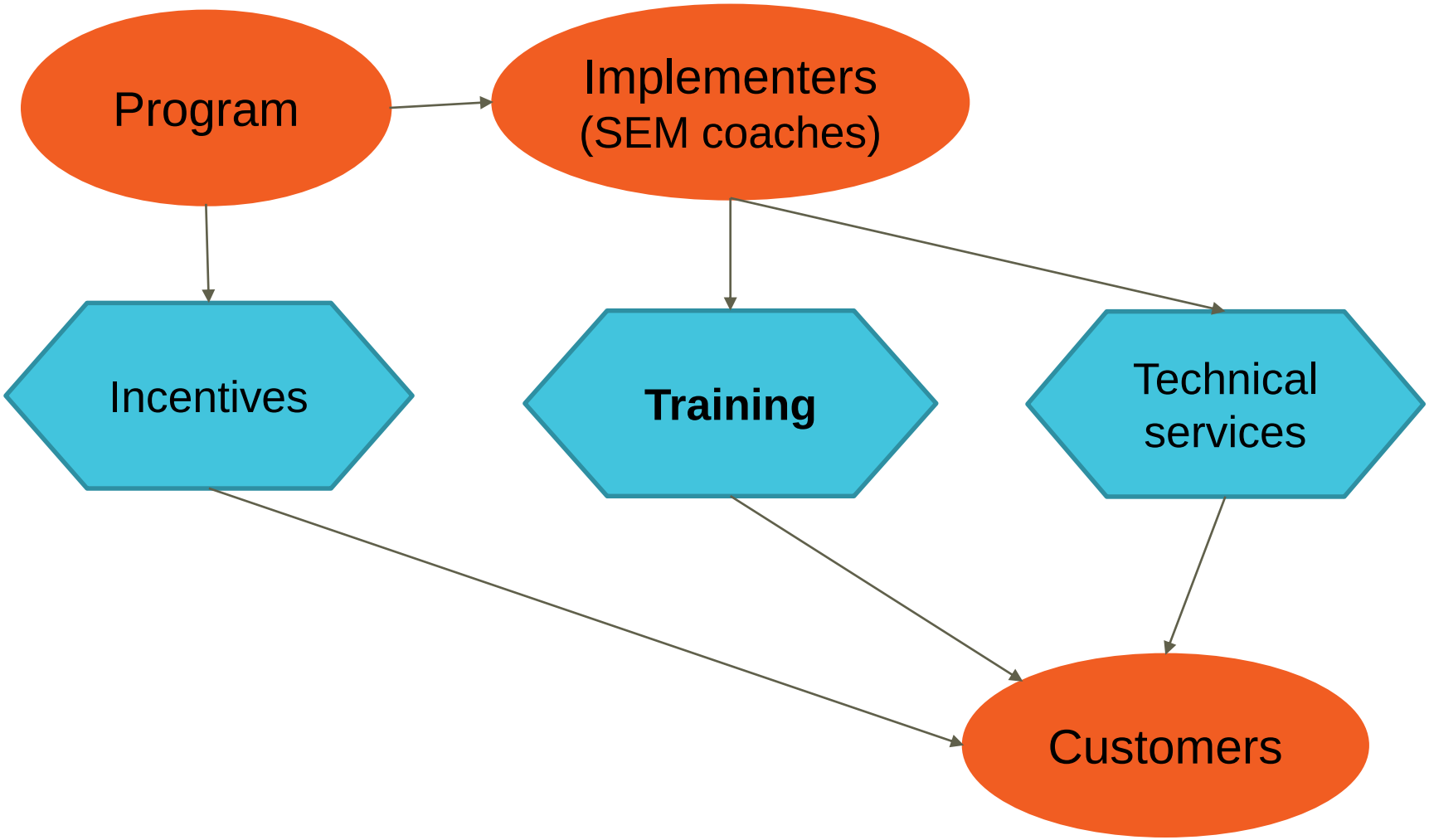
Strategic Energy Management

- 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



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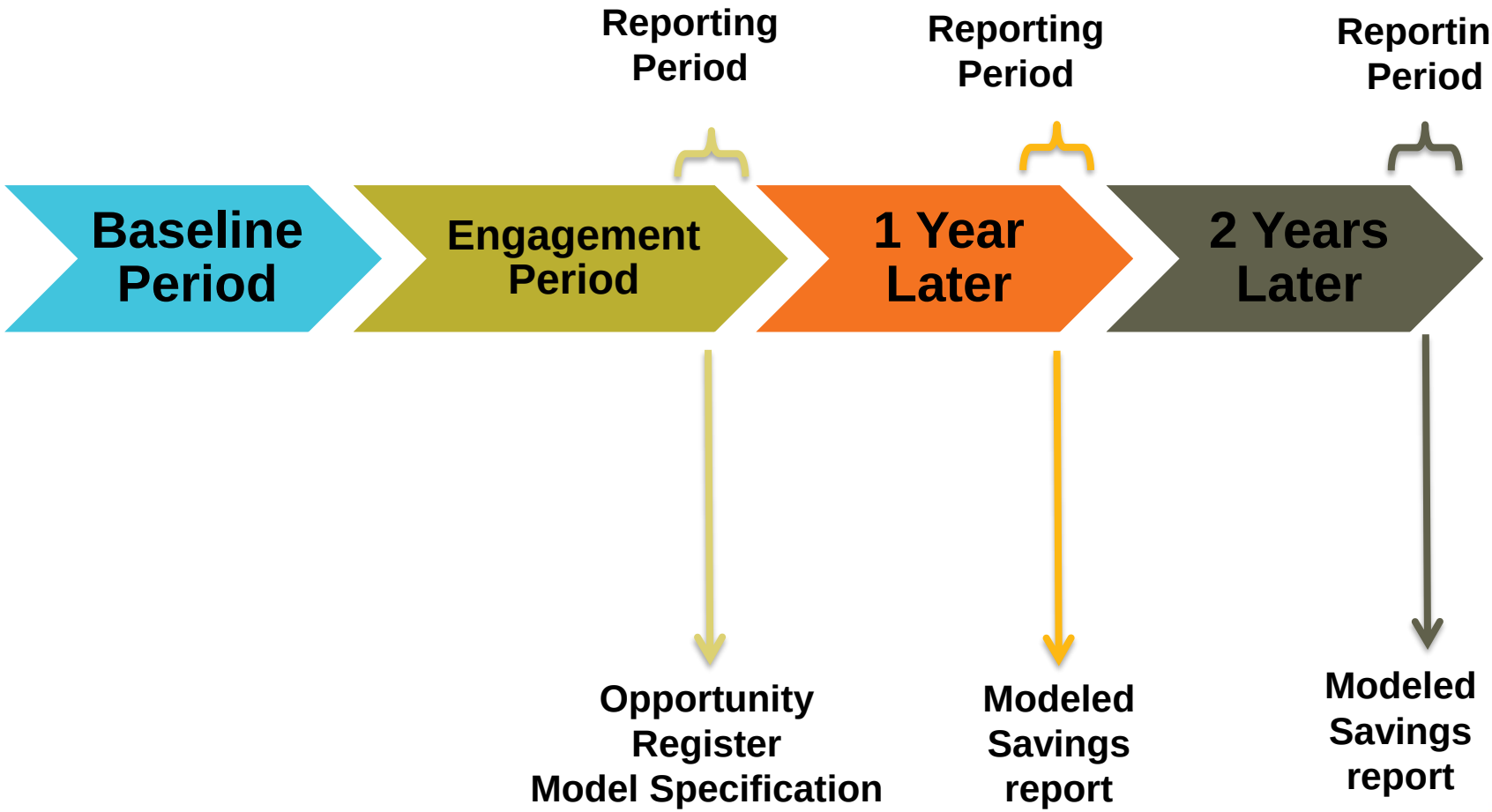
Timeline of SEM Engagement



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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

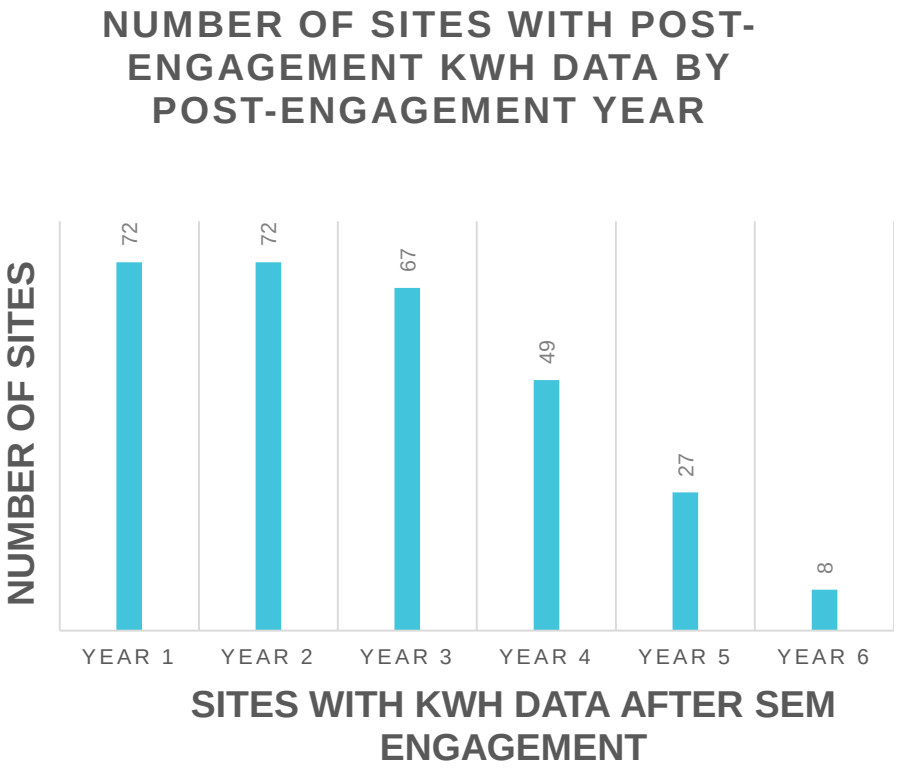
- Significant resources are still used to develop and maintain energy models
- One of the key model inputs is production which is often difficult to obtain post-SEM engagement
- Issues with managing models as number of models and length of engagement grows with continuous SEM
- Desire to see impacts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

Estimated SEM Model

$$kWh\_per\_day_{it} = \alpha + \beta_e engagement_{it} + \sum_{y=1}^{6} \beta_y post\_year_{yit} + \varepsilon$$

- 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 β_{yit}

Analysis Dataset



- 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

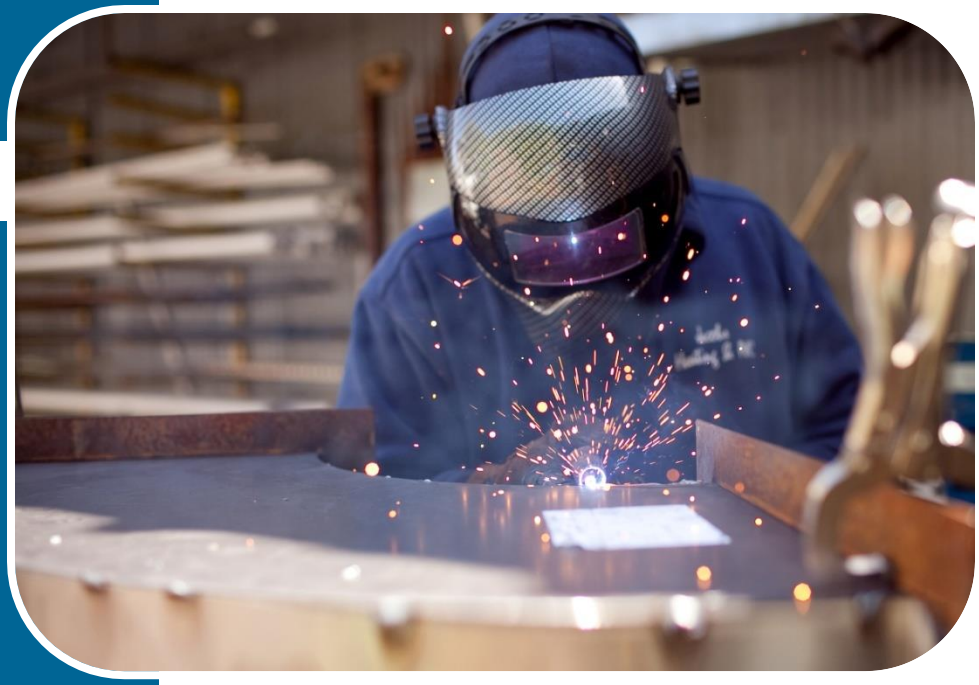
Variable	Estimated Average Daily kWh Reduction	Capital Projects Average Daily kWh Reduction	SEM Average Daily kWh Reduction	Percent Reduction Relative to Baseline	Number of Sites
post_year1	-1,096	-239	-857	-3.6%	72
post_year2	-2,840	-649	-2,191	-9.2%	72
post_year3	-4,133	-894	-3,238	-13.6%	67
post_year4	-6,943	-985	-5,959	-25.1%	49
post_year5	-10,284	-1,114	-9,170	-38.6%	27
post_year6	-12,973	-1,407	-11,566	-48.6%	8

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:
    - "Strategic Energy Management in the Maturing Marketplace: Case Studies and Field Notes", 2019 ACEEE Summer Study on Energy Efficiency in Industry Proceedings
    - "Growing Pains: Lessons from the Edge of SEM Program Evaluation", 2017 International Energy Program Evaluation Conference Proceedings
- 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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