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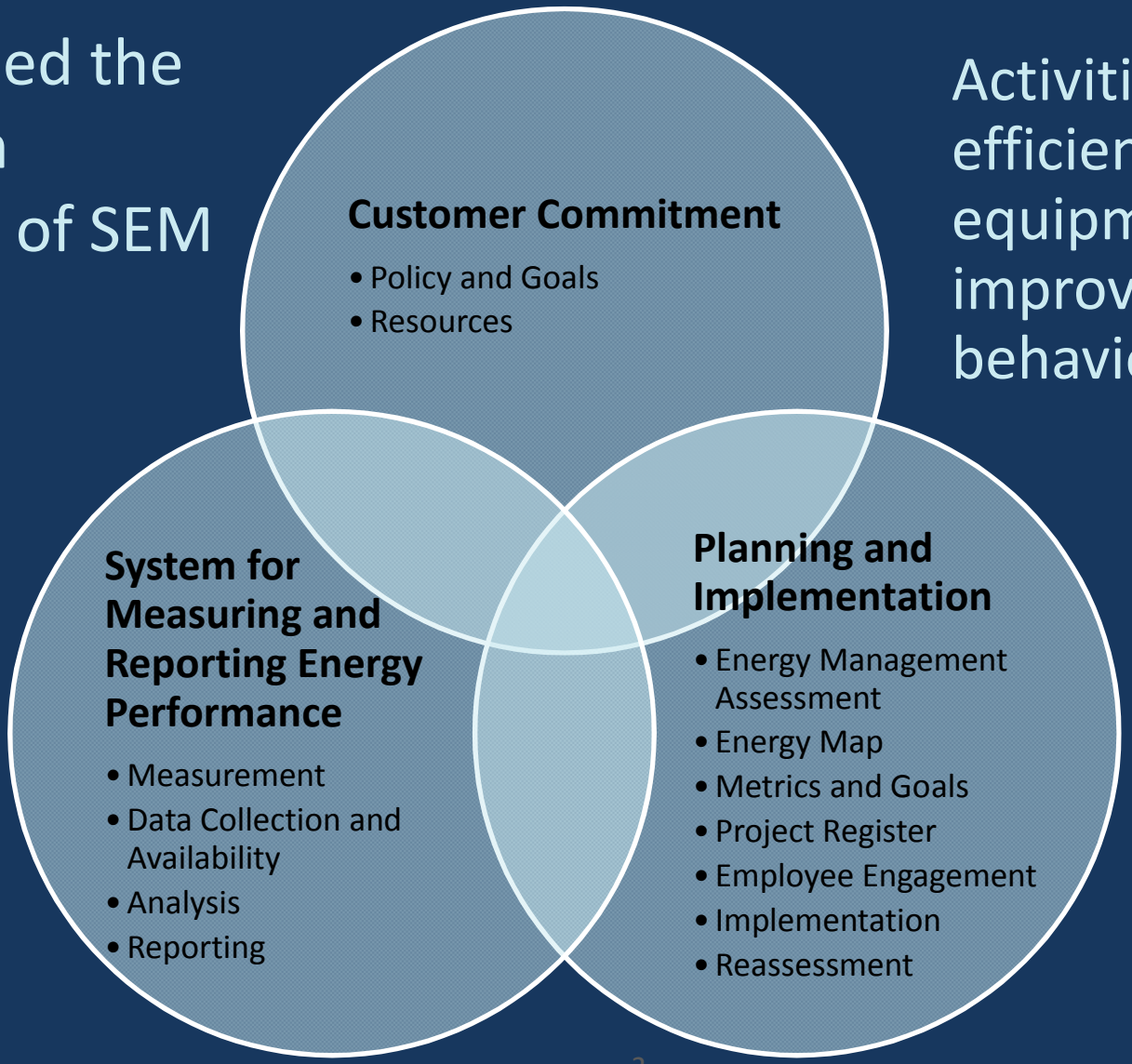
Improvements in SEM Program Impact Evaluation Methods

Lessons Learned from Several Recent Projects

August 11, 2015

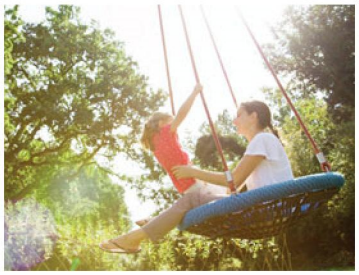
Strategic Energy Management

CEE defined the minimum elements of SEM in 2014



Activities include efficient equipment, O&M improvements, and behavioral changes

Quantifying Energy Savings



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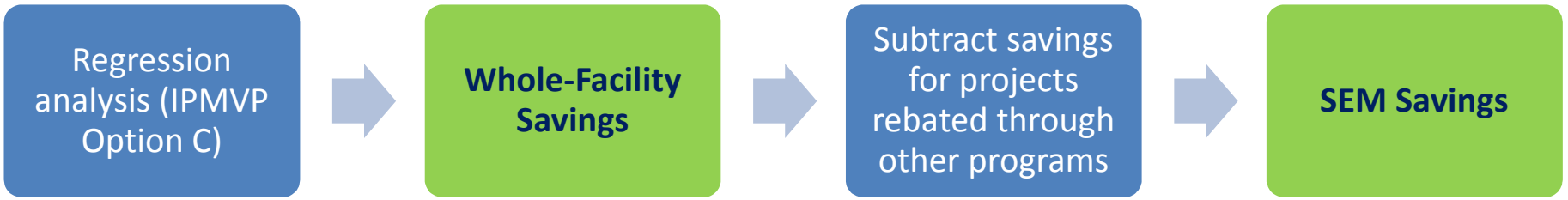
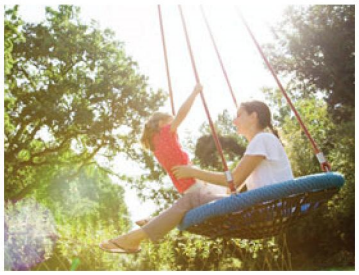
SEM Evaluation Method Overview



Challenges with Energy Savings Quantification



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Challenges

Timing of analysis	• What is the best timing to quantify energy savings that are representative of all activities implemented during the program?
Statistically detecting savings	• Savings must be large enough to detect amidst the noise • Unexplained variability can lead to large confidence intervals • Model may result in biased program results if unexplained changes in energy consumption coincide with the SEM engagement period

Challenges (cont.)

Risk of participants making changes that invalidate the baseline

- Significant changes affecting energy use during the engagement period that are unobserved or unmeasurable and not due to the program can bias savings estimates

Risk of finding negative savings (increase in consumption)

- Unobserved changes at the facility that caused consumption to increase
- Savings from the rebated measures were overestimated

Recommendations to Improve Likelihood of Detecting Savings

- Evaluability Assessment
- Fractional Savings Uncertainty
- Timing of Analysis and Length of Analysis Period
- Energy Management Information Systems
- Communication Between Evaluators and Program Staff

Evaluability Assessment

Collaborate with an experienced implementer or evaluator early on

- Understand and identify data needs for M&V
- Insight into scenarios where more data may be needed or where it may be difficult to quantify savings

Fractional Savings Uncertainty

Predicts whether savings can be estimated precisely

- Inputs include the RMSE, expected savings, and the desired confidence/precision level
- Ratio of the uncertainty about the savings to the total savings

For new participants - test whether the currently collected data are sufficient to detect expected savings

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Timing of Analysis / Length of Analysis Period

Consider best timing for the analysis to occur

Collect data for an additional 3 to 6 months after program engagement ends

Post-engagement data ideally covers at least one full year in order to capture weather-sensitive energy savings

Energy Management Information Systems

EMIS can collect data more frequently

- Higher frequency (daily or weekly) billing data and production data provide a higher likelihood that savings can be detected than monthly data

Additional functionality to help customer manage energy, which could increase savings

Communication between Evaluators and Program Staff

Program staff have worked closely with participants and have a greater knowledge of the activities

Important to consult program staff when:

- Questions about documentation
- Considering a very different model specification
- Re-baselining
- Site is difficult to model

Accept Some Uncertainty

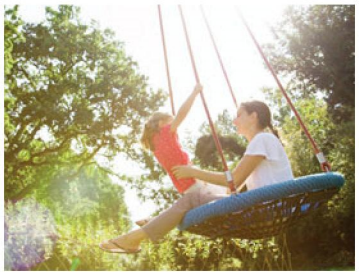
There will always be a handful of sites where savings cannot be detected

These recommendations minimize the risk of:

- Finding no savings
- Finding an increase in energy use
- Finding that the model is missing key inputs and the change in energy consumption cannot be explained

High likelihood that the program overall will show savings

Accounting for Measures Rebated through Other Programs



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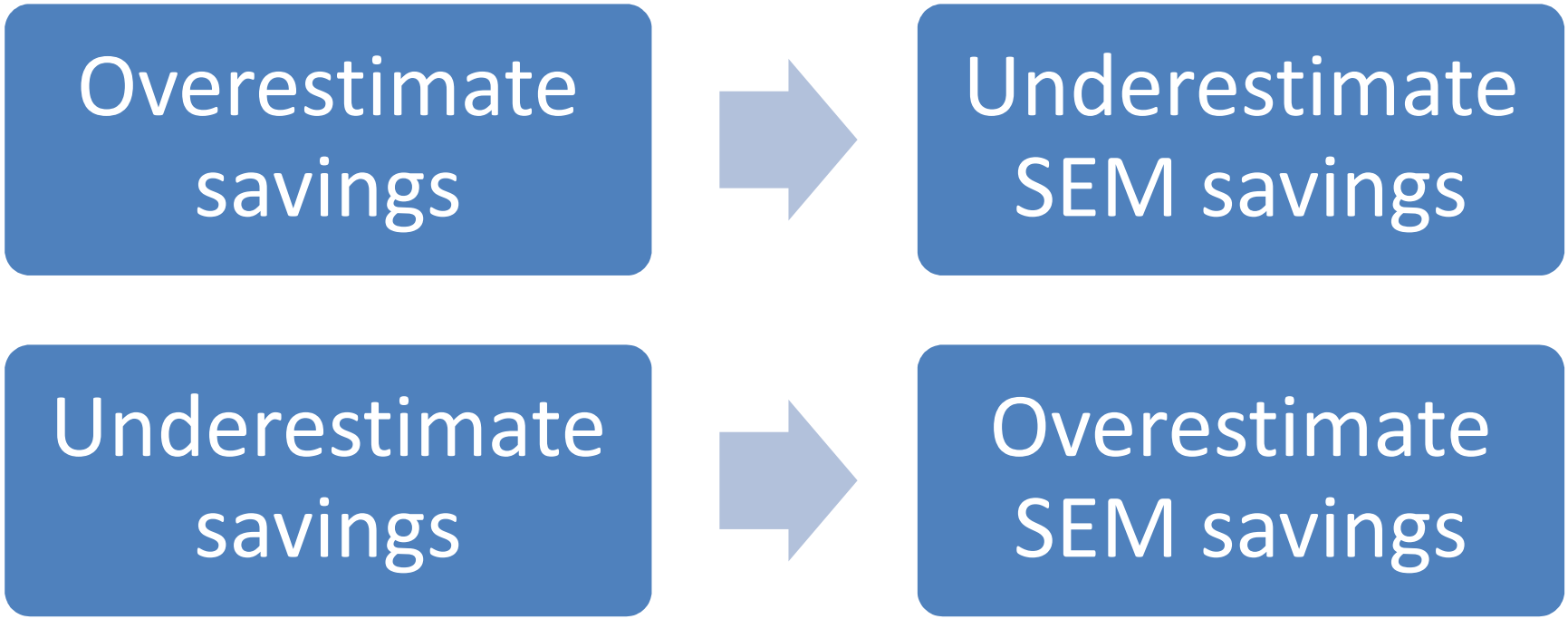
Importance of Accounting for Measures Rebated through Other Programs



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Verifying Measures Rebated Through Other Programs

Same methods used for standard incentive programs

- Desk Review
- Phone Interviews
- Site Visits

Other considerations

- Balance with the costs of the regression modeling
- Reporting / evaluation requirements for both programs

Recommendations

- Review types of measures rebated through other programs to determine the most cost-effective approach or mix of approaches
- Prioritize sites to visit based on budget and on measures installed

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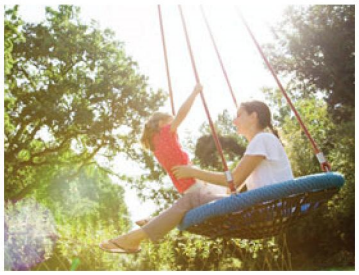
Sample Design



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Sample Design Challenges

So far, evaluations have looked at a census of SEM participants

SEM programs are growing

At what point can we sample and be confident in the realization rate?

- Industrial participants are all unique, realization rates from site to site can vary immensely
- If sample is not large enough, RR can greatly depend on the sites chosen
- See simulation study in the paper

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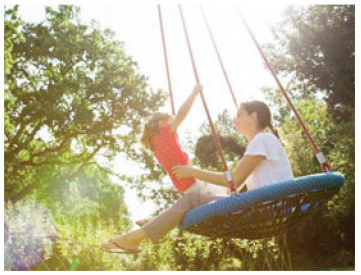
Other Evaluation Recommendations



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Standardizing Evaluation Reporting

- Few SEM evaluations to-date and currently difficult to compare results

Results often not reported in a way that's meaningful beyond the program's needs

- Report savings as a % of consumption or as an EUI
  - A kWh savings value isn't translatable to other programs or participants
- Report confidence intervals
  - Are savings significant? What is the uncertainty around the result?
  - Are evaluated savings statistically different than reported savings?

Different methods used

- Provide context
  - Are results higher/lower than other programs due to the method used to measure savings? Or due to other factors? Both?

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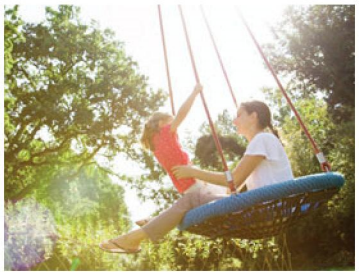

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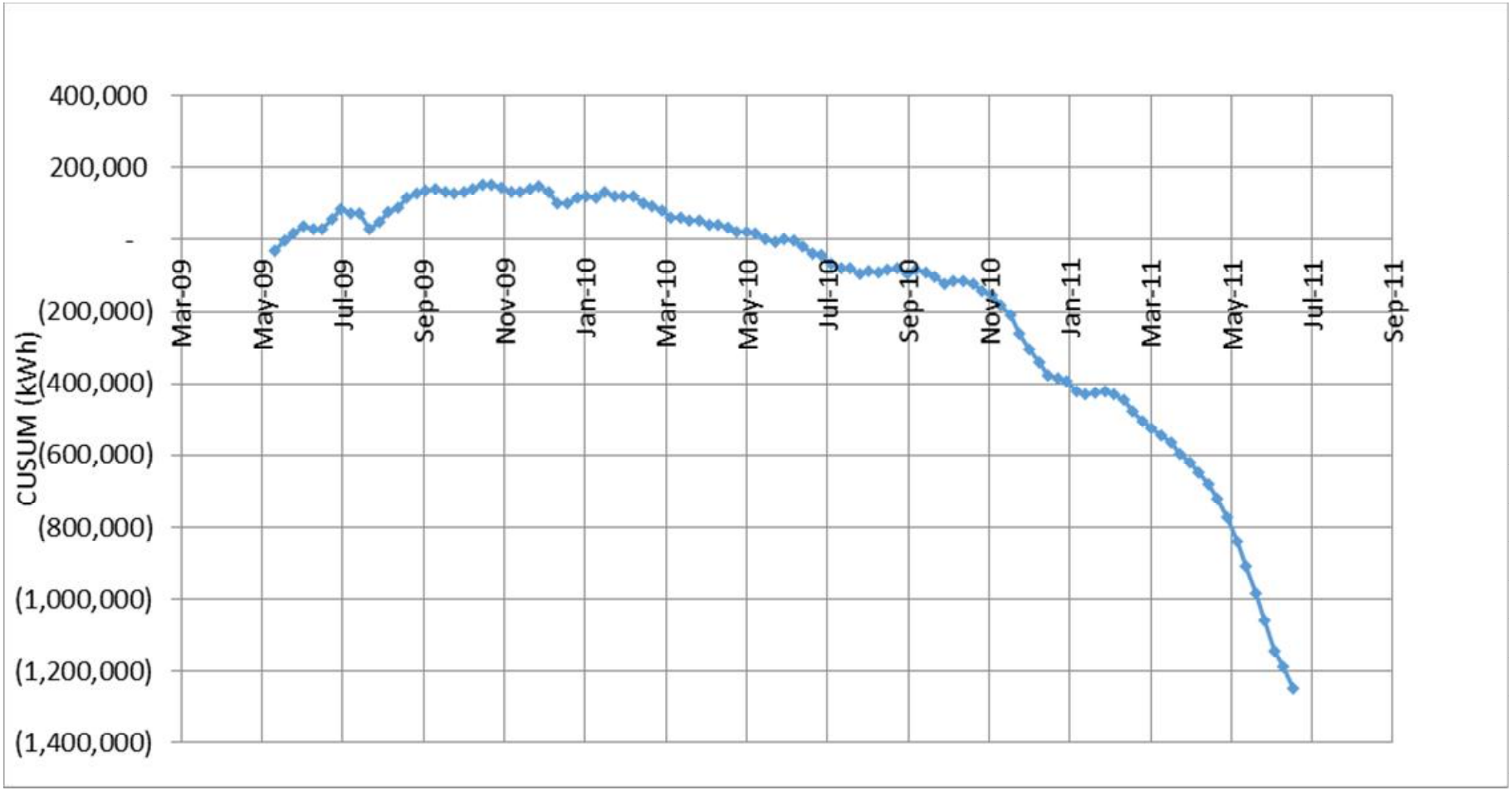
Strategic Energy Management

- SEM programs provide long-term technical support to help customers:
  - Develop a long-term energy planning strategy
  - Integrate energy management into their business planning
- Offered to industrial and commercial customers

(Industrial) Program Approach to Quantifying Savings

- CUSUM is most commonly used approach
- Easy for participants to understand

CUSUM Plot



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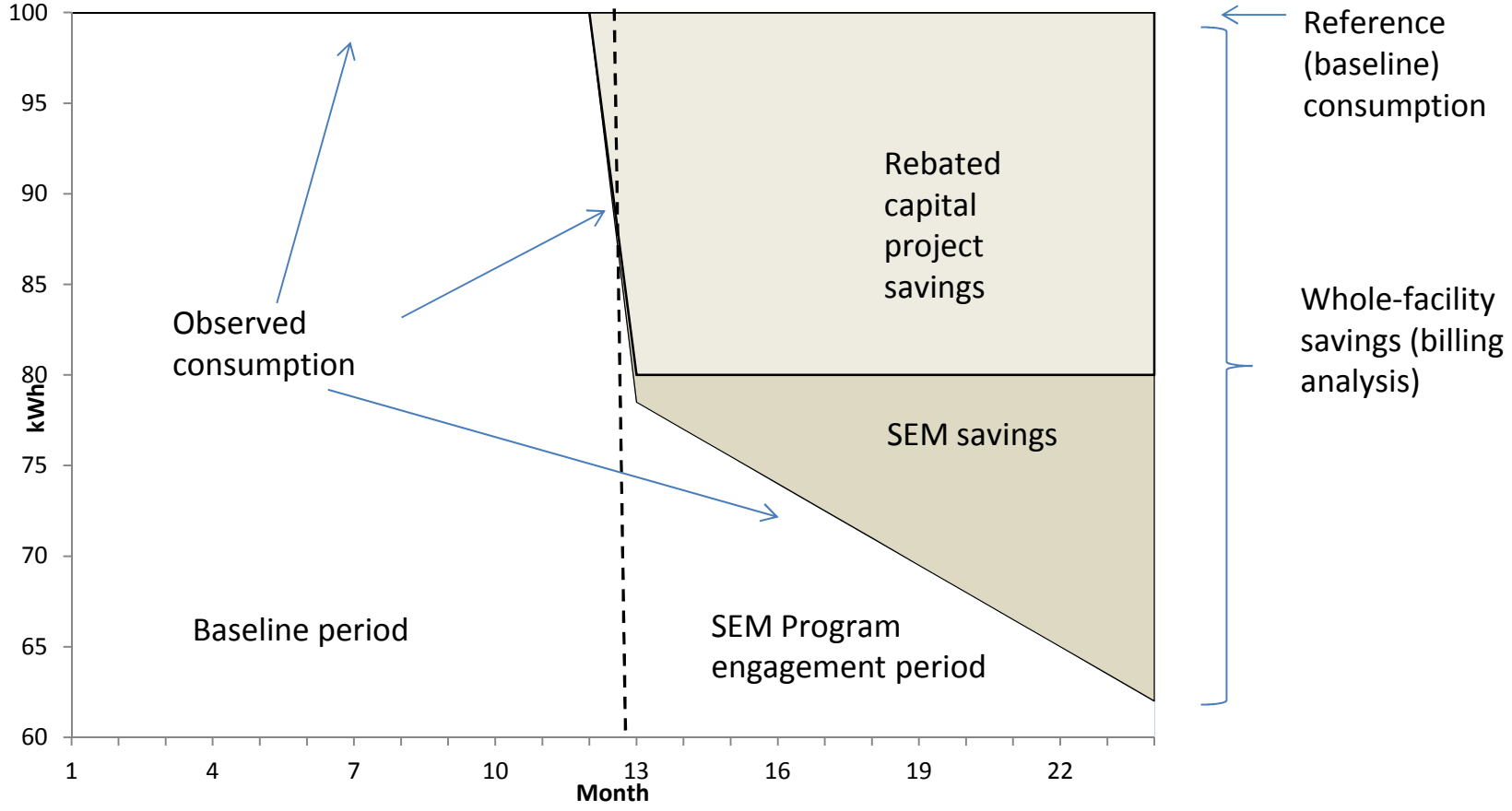
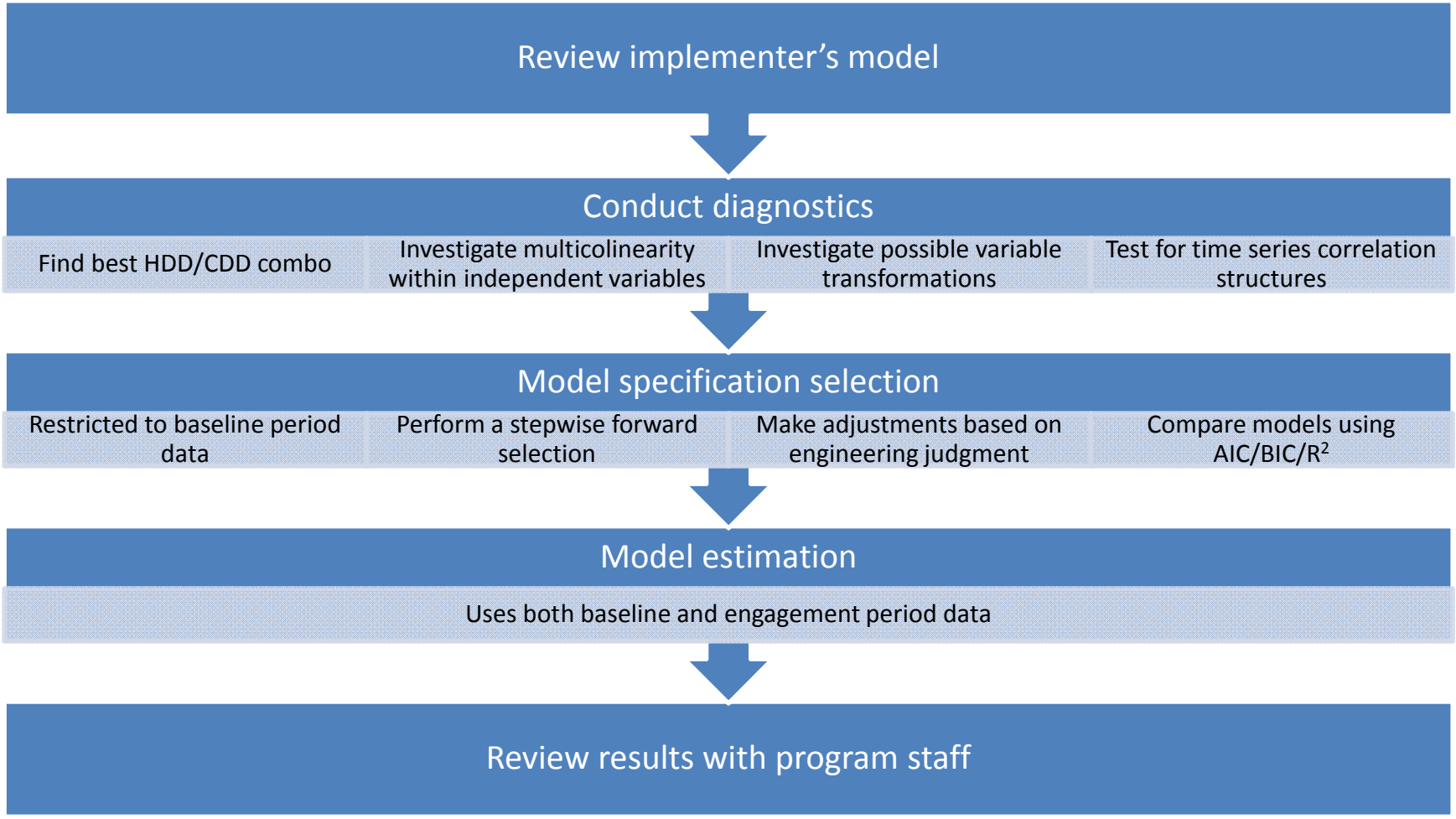
Overview of Evaluation Method



Cadmus Evaluation Method – Whole Facility Savings



Evaluation Apprpoach Advantages

- Follows IPMVP Option C which is widely accepted for evaluation
- Confidence intervals are easy to calculate
- Modeling flexibility
  - Interact production variable with engagement period indicator variable
  - Can eliminate re-baselining

Sample Design - Simulation Study

- Used results from BPA's pilot, where a census of the 15 participants were evaluated
- Sample design
  - Certainty stratum: 6 sites that made up 65% of the reported savings
  - Random sample of 5 additional sites
- Simulated selection of 10 samples
- Compared to actual program results

Sample Design - Simulation Study

Simulation	Realization Rate	Study Level Estimated Verified Savings (kWh)	Relative Precision	Does Confidence Interval Contain Census RR result?
1	91%	9,650,107	13%	Yes
2	83%	8,820,294	14%	Yes
3	90%	9,483,861	12%	Yes
4	86%	9,070,269	12%	Yes
5	100%	10,567,872	1%	**No**
6	86%	9,115,166	13%	Yes
7	88%	9,356,357	12%	Yes
8	86%	9,129,230	14%	Yes
9	86%	9,116,314	13%	Yes
10	108%	11,402,619	3%	**No**
Census	**94%**	**9,922,931**	**N/A**	**N/A**

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Sample Design - Takeaways

- 8 of 10 simulations resulted in a RR within the CI of the actual RR
- The 2 that did not
  - Precision was tight, giving the false impression that there is little uncertainty about the true savings
- Need to conduct more simulations on larger populations to understand which characteristics we can stratify by