Measure Savings Estimation: Current Practices & Proposed Guidance

CALIFORNIA
TECHNICAL FORUM

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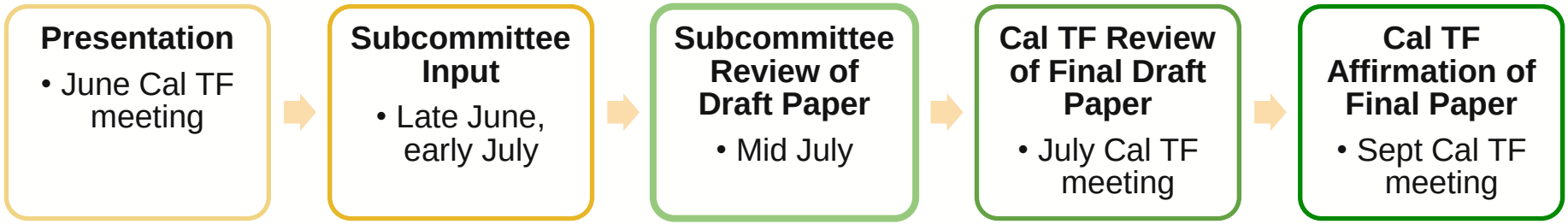
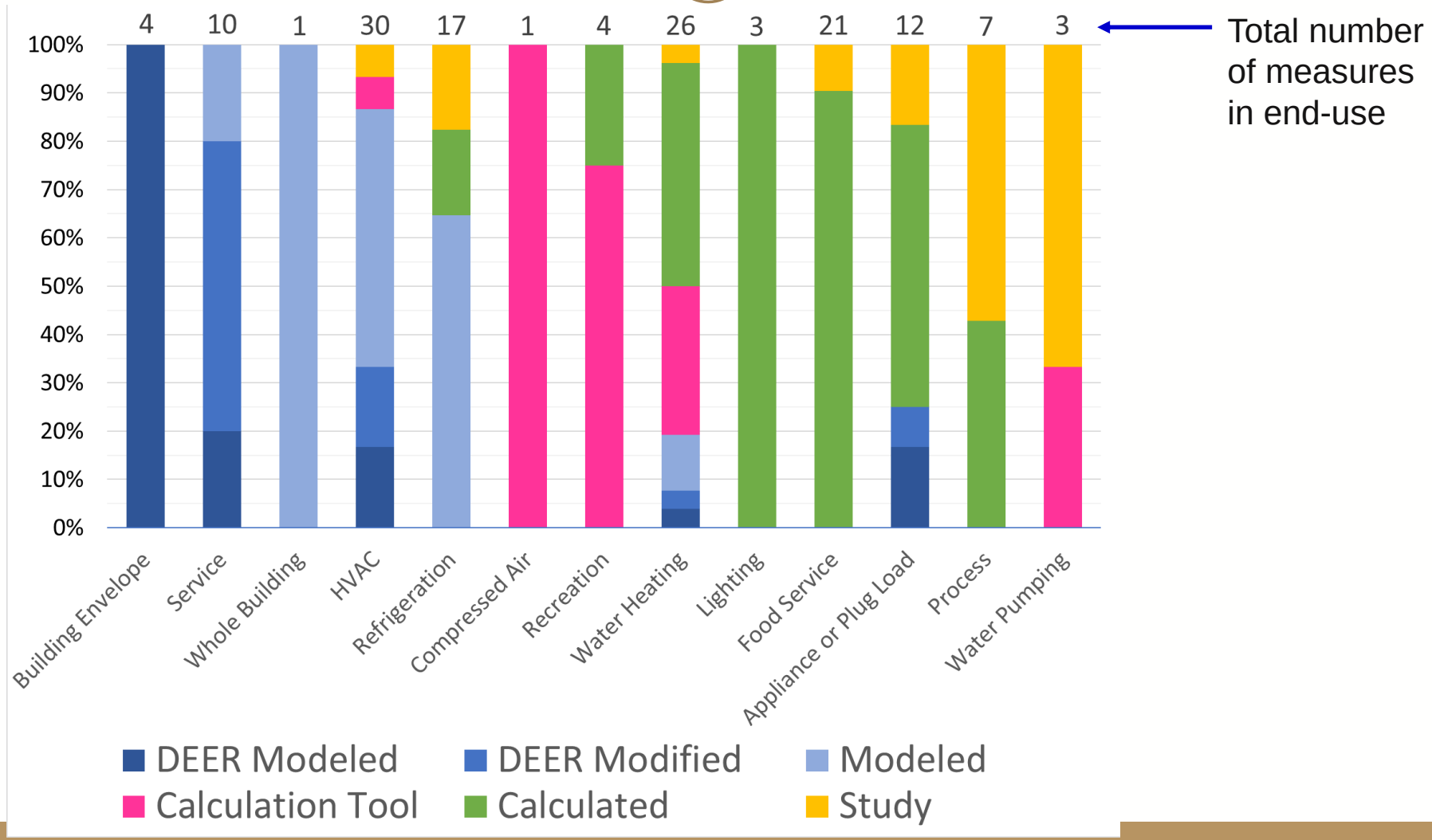
Overview

- Goal
  - Characterize current practices for developing savings by end use
  - Create best practice guidelines and templates for developing deemed savings
- Value
  - Facilitate the consistency of methods by end use
  - Ensure savings calculations are transparent and reproducible
  - Provide measure developers with trade-offs associated with each method to ensure accuracy and cost-efficiency
- Next Steps

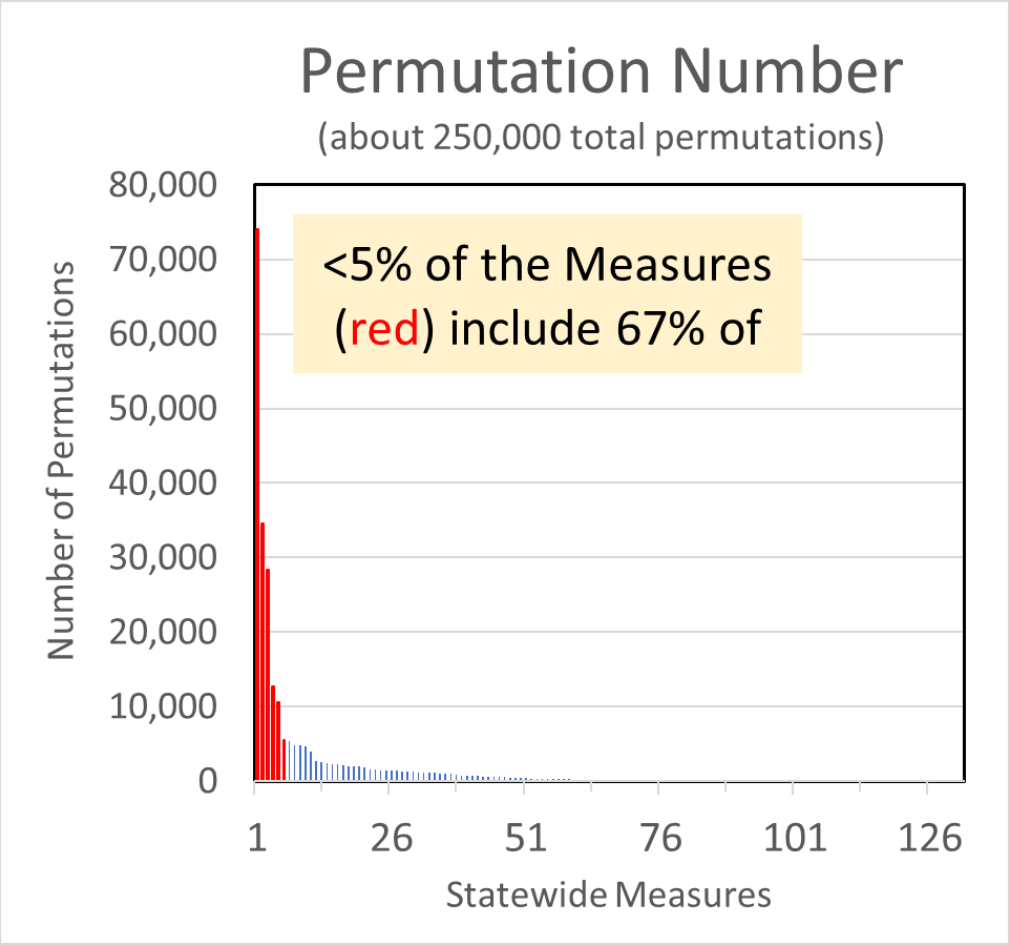


Current Methods - Categorization



Total number of measures in end-use

Current Methods – Permutation Analysis



- Four factors dramatically effect the number of permutations
  - Building Types (24)
  - Climate Zones (16)
  - Delivery Types (3)
  - Offerings (varies)
  - *Vintages (in the future)*

Current Methods – Claims Data Analysis

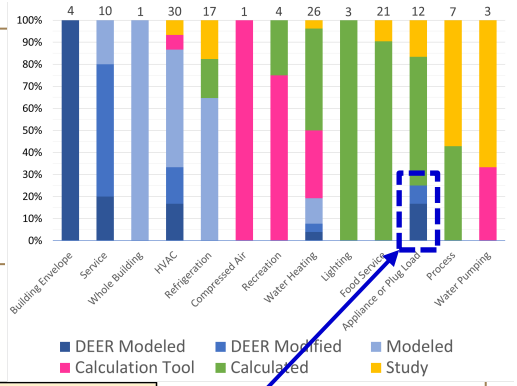
- Claims data from 2018 (Q1-Q4) correlated to statewide measures.
- No significant correlation to calculation methodology or permutation count.

Recommended Guidelines

1. **Methodology:** Choose a calculation methodology that aligns with the measure end-use
2. **Documentation:** Document both the base case and measure case energy use
3. **Documentation:** Document sensitive variables for each measure
4. **Interactive Effects:** Include interactive effects consistently
5. **Interactive Effects:** Use average interactive effects versus climate zone specific values of variables have large error bands
6. **Permutations:** Eliminate permutations when they do not vary by more than 10% (except for HIMs)
7. **Program Data Collection:** Identify which inputs should be collected through programs so that savings can be refined later
8. **High Impact Measures (HIMs):** Additional considerations for HIMs

Feedback Request – Now or during the subcommittee.

Guideline 1: Recommended Methodology by End Use



End-Use	Modeled	Calculation Tool	Calculated	Study
Bldg Envelope	Whole-Building Energy Modeling (BEM) tools provide accepted packages to evaluate the energy usage between complex, interacting building systems.			
Service				
Whole Building				
HVAC				
Refrigeration				
Compressed Air		Simulation tools for specialized end-use categoires are available when interactions with other systems is not required.		
Recreation				
Water Heating			These measures involved relatively simple physics models or engineering calculations that are widely accepted.	
Lighting				
Water Pumping				ET Studies, custom projects, or regression models constitute a large portion of these categories.
Food Service				
Appl / Plug Load				
Process				

Is there any reason not to convert the remaining Appliance measures to a calculated approach?

- Res Refrig/Freezer
- Res Clothes Washer
- Res Dishwasher

Guideline 2: Document Base and Measure Case Values

Whole Building Energy Modeling (BEM)	Calculation Tool	Calculated	Study
Follow Measure Characterizaton Template.* Include base and measure case energy usage.			
Follow *Modeled Measure Documentation Template* **: **- Document base and measure case usage before weighting and after weighting.** - Document inputs. - Document hourly results. - Document of how savings are normalized. - Document post-processing.	Document inputs.	Document inputs. Document whether interactive effects are applied.	Document how the study applies to the measure.

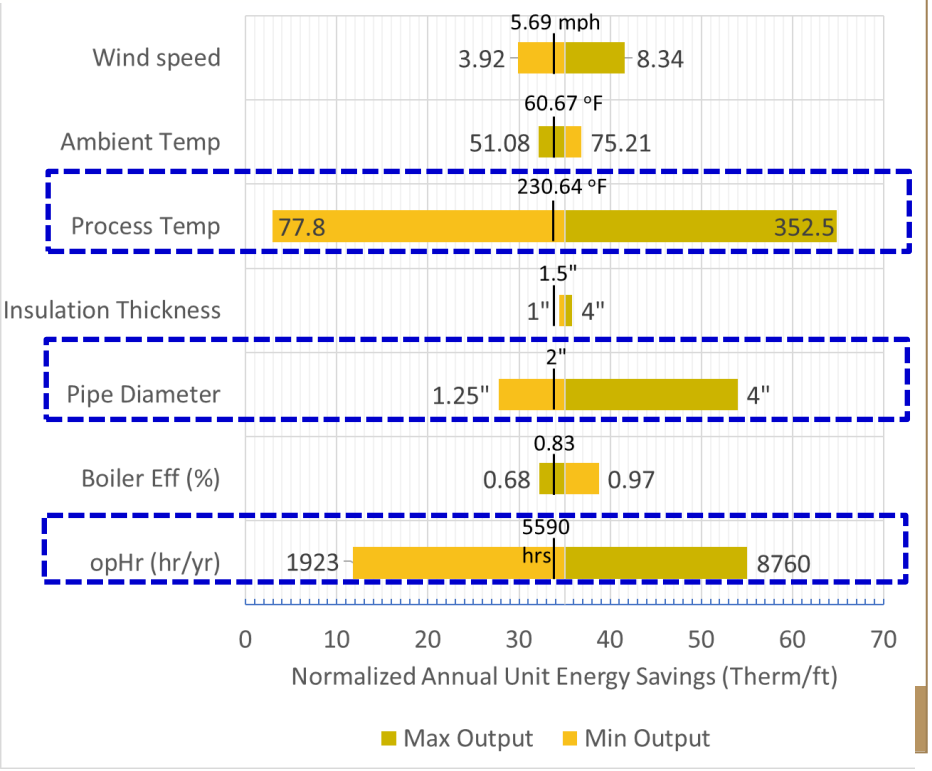
* *Measure Characterization Template* should be followed to guide developers to that documentation is created and presented consistently.

** *Modeled Measure Documentation Template* provides additional guidance specifically for modeled measures.

Guideline 3: Document Sensitive Variables for Each Measure

- Document sensitive parameters
- Why
  - Understand which permutations are more cost effective
    - Goal: Rehabilitate sunset measures and provide easy insight for implementers
  - Clearly identify evaluation variables to provide smoother feedback to improve measures
- Example: Pipe Insulation
  - Basic Calculations: $Savings = \frac{(Q_{base} - Q_{meas}) * opHr}{Boiler\ Eff} * length$
  - Heat Loss, Q, is dependent upon:
    - *Wind Speed*
    - *Ambient Temperature*
    - *Process Temperature*
    - *Insulation Thickness*
    - *Pipe Diameter*

Feedback:
What do you think of this approach?



Guideline 4: Apply Interactive Effects Consistently

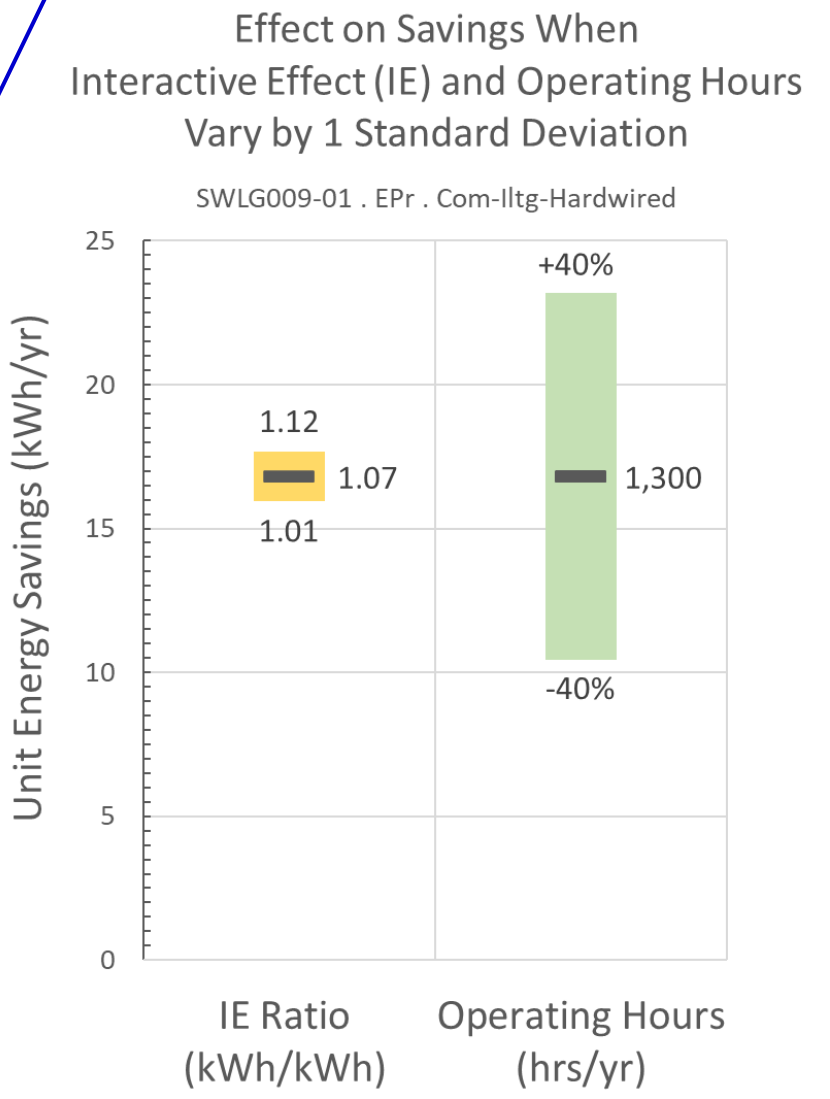
- Apply interactive effects when significant
  - Though Building Energy Modeling (BES)
    - Some cases may allow for a simplified approach
  - Through Interactive Effects tables

End-Use	Approach
Bldg Envelope	Yes - through BES
Service	
Whole Building	
HVAC	
Refrigeration	Yes - through BES / Simplified
Compressed Air	No
Recreation	No
Water Heating	No
Lighting	Yes - through IE table / Simplified
Water Pumping	No
Food Service	No - (may be changing)
Appl / Plug Load	Yes - through IE table / Simplified
Process	No

Guideline 5: Use Average Interactive Effects

Feedback:
Thoughts about simplifying IE values?

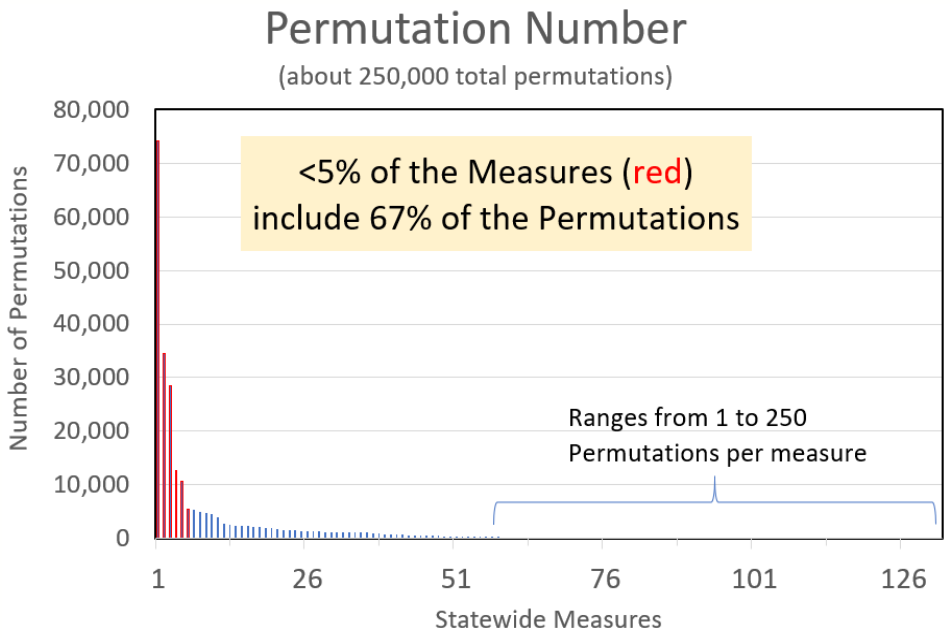
- When other calculation inputs have large errors
  - Consider applying an average interactive effect value
  - Not climate zone specific interactive effects
- Interactive Effects Factors
  - Shows 1 standard deviation calculated across the 16 climate zones
- Hours of Operation
  - Shows 1 standard deviation calculated across the DEER2016 light logger data set
  - Measured at the Area Type (subset of Building Type)



Guideline 6: Permutation Number

- If permutations vary by less than 10%, collapse them
  - Avoid false precision
- Four factors dramatically effect the number of permutations
  1. Building Type
  2. Climate Zone
  3. Delivery Type
  4. Offering
  - *Vintage (in the future)*

Feedback:
10% is used by the NW RTF.
Is this the correct value?
Should this be 10% of savings (or should other impacts like cost/life be considered)?



Guideline 7: Program Data Collection

- Identify which inputs should be collected through programs so that savings can be refined later
  - Sensitive variables that affect impacts should be well documented.
  - These should include not just savings, but also cost and life.
- Impose a “Sunset” date to reevaluate

Feedback:
When does it make sense to include Program Data Collection?

Guideline 8: High Impact Measures (HIMs)

- Understand which parameters most impact savings and cost
  - Make sure that high impact parameters have robust sources
- Mix methodologies / spend more resources
  - Smart thermostat mixes Study results with Modeled results to support and calibrate savings
- Could be important to increase permutations
  - Lighting measures (*historically*) included small wattage bin offering to improve savings accuracy
- Update triggers to be set more frequently

Feedback:
Additional considerations for HIMs?

Next Steps

Sign up for the subcommittee! (Contact Ayad Al-Shaikh)

- Subcommittee will meet ~2x in next 2 weeks

Potential Subcommittee topics:

- Is there any reason not to convert the remaining Appliance measures to a calculated approach?
- What do you think of the approach to document sensitive variables?
- Thoughts about simplifying IE values?
- 10% is used by the NW RTF for collapsing permutations. Is this the correct value? Should this be 10% of savings (or should other impacts like cost/life be considered)?
- When does it make sense to include Program Data Collection?
- Additional considerations for HIMs?

Appendix Slides

- Support for Current Methods chart

Current Methods

Current Methods	Primary End-Use	System Interaction	Flexibility	Consistency	Transparency	Calibration*	Cost-Development	Cost-Maintenance
Whole Building Energy Modeling (BEM)	HVAC Building Envelope Service (ie BRO) Whole Building Comm Refrigeration	1	1	2	4	5	5	5
Calculation Tool	Compressed Air Recreation (ie Pools) Water Heating (ie Appliances)	5	4	1	3	4	3	1
Calculated	Lighting Water Pumping Food Service Appliance or Plug Load Process	3	1	3	1	2	3	1
Study		3	3	3	2	1	4	4

- Notes:
  - Key: Advantage | | | | Disadvantage
  - Description of the boxes are included in the Appendix for more detail

Current Methods

Current Methods	Primary End-Use	Advantages	Drawbacks
Whole Building Energy Modeling (BEM)	HVAC Building Envelope Service (ie BRO) Whole Building Comm Refrigeration	Ability to model complex interaction of systems. Allows for flexibility to model simple and complex measures. Promotes consistency across measures.	Transparency of inputs decreases due to model complexity. Transparency of model results decreases due to weighted approach. Weighted approach introduces additional error. Development and maintenance cost is the highest. Calibration is difficult because models represent a market average building. Calibration can be supplemented by Studies.
Calculation Tool	Compressed Air Recreation (ie Pools) Water Heating (ie Appliances)	Ability to model a single complex system. Inputs are clear so they can be well documented. Inexpensive to create measures (once the tool is developed).	Transparency of the approach may be hidden. Limits may be placed on calculation inputs. Calibration can be supplemented by Studies.
Calculated	Lighting Water Pumping Food Service Appliance or Plug Load Process	Fully transparent methodology and inputs. Interactive effects estimated to simulate complex interactions. Inexpensive to maintain. Development cost can vary depending upon complexity.	Complex systems are difficult to model. Additional quality control needed initially to validate. Calibration can be supplemented by Studies.
Study	Any	Leverage tested and trusted results for low cost. Provides calibrated results. Results and methods are well explained.	Applicability to the broader market must be documented. The cost can be high but varies dramatically. Scope can be limited but varies dramatically.