Measure Savings Guidance: Subcommittee Meeting #2

CALIFORNIA
TECHNICAL FORUM

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Overview

- Goal
  - 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

Presentation
- June Cal TF meeting

→

Subcommittee Input
- Late June, early July

→

Subcommittee Review of Draft Paper
- Mid July

→

Cal TF Review of Draft Guidelines / Paper
- July Cal TF meeting

→

Cal TF Affirmation of Final Paper
- Sept Cal TF meeting

General Outline

- Methodology
  - Categorization
  - Interactive Effects
    - Consistency
    - Simplifications (Examples)
    - Interactions Between Measures
- Documentation
  - Inputs and Outputs
  - Sensitive Variables
  - Data Collection
  - Permutation Number
- High Impact Measures

Meeting #1

Blue text has been added/changed

Current Methods - Categorization

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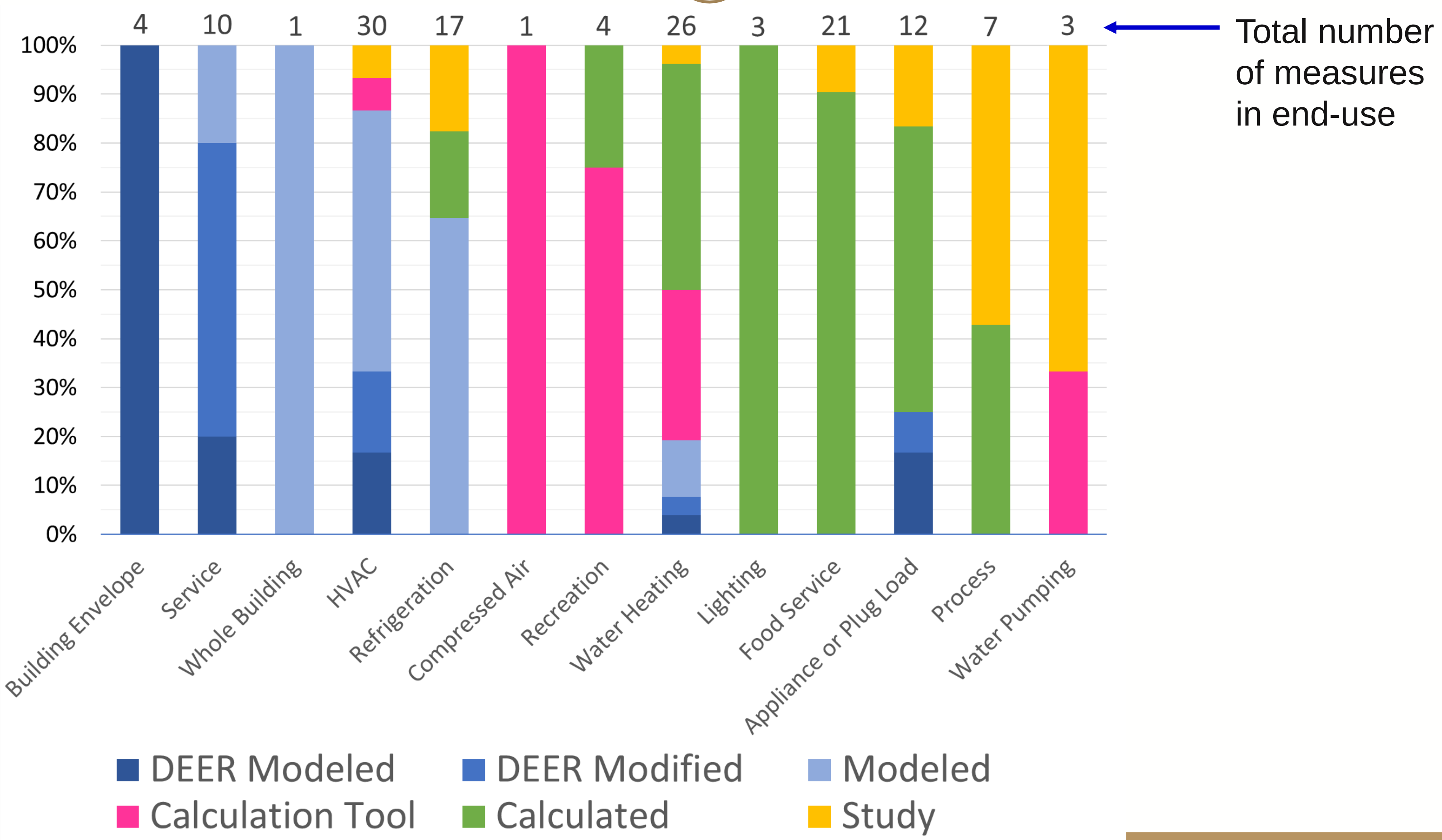
RTF Classification

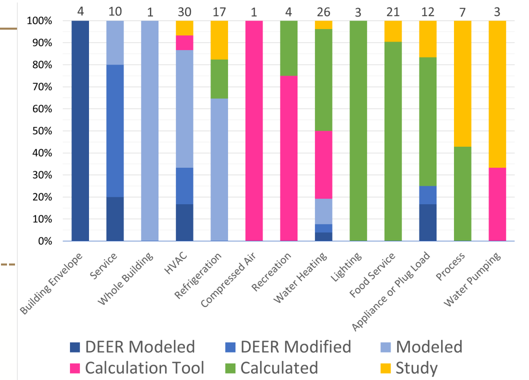
- Unit Energy Savings (*Deemed*)
  - Statistical
  - Meta-Statistical
  - Calibrated Engineering
- Standard Protocol (*Hybrid*)
- Custom Protocol (*Custom*)
- Program Impact Evaluation

I will show you the current categorization that I showed at the Cal TF meeting, but we will circle back to ask:
- Should "Study" measure be rename/reclassified?

Current Methods - Categorization



Guideline: Recommended Methodology by End Use



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

Guideline: Recommended Methodology by End Use

- Consider changing "Study" to:
  - "Statistical" (copied from RTF "Complete Operative Guidelines"

2.3.1. Statistical

The UES estimate may be derived from statistical analysis of baseline and efficient-case energy use for reliable samples of relevant end users or end uses. Such measurements of energy use can be used to estimate typical savings for a population that are representative of the likely future participants. Statistical designs can include comparison of randomly selected treatment and control groups or pre/post data collection for a treatment group. The quality of these estimates is judged primarily by the relative error of the mean savings estimate. It is also critical to determine whether there are systematic errors (biases) associated with sampling or data collection procedures that reduce or increase savings for all or a portion of the sample studied.

  - "Adopted from Another Source"
    - In this case, the definition should state that findings are pulled from another study without modification.
    - If values were modified, the methodology would be classified as Calculated with the study supporting a particular value.

Guideline: Apply Interactive Effects Consistently

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

> - *RTF uses a 10% rule to signify if a change is significant.*
> - *Use a table to provide initial guidance on whether Interactive Effects are typically included.*

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

Interactive Effects: Simplification Use Cases to Consider

- When other calculation inputs have large errors
  - Consider applying an average interactive effect value
  - Not climate zone specific interactive effects
- Modeled Results
  - Commercial Refrigeration
- Using the Interactive Effects table
  - Lighting
- Water Heating – Flow Restrictors

(IE simplification will be removed.)

Summary points:
- Consideration – if simplification made, important to remember detailed values used in EM&V.
- If the distribution is wide, consider choosing more conservative rather than average to hedge against some of the variation.
- Simplification might not be an appropriate approach to High Impact Measures (HIMs).

Guideline: 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.

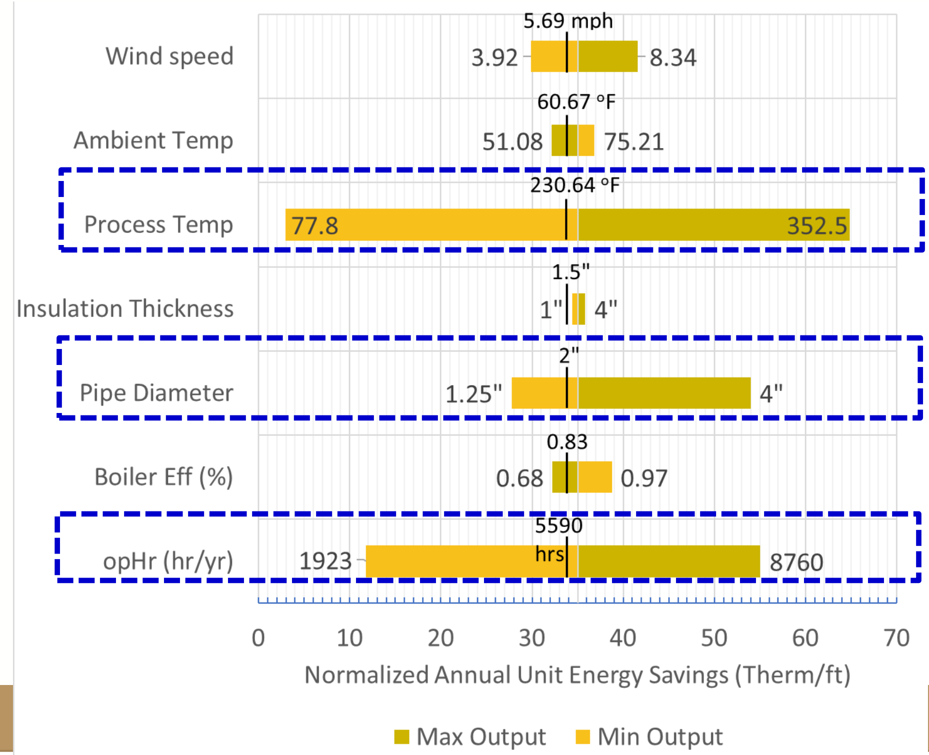
** *Modeled Measure Documentation Template* provides additional guidance specifically for modeled measures.

Guideline: 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*

Consideration – Review evaluation protocol to document guidelines for uncertainty:

- Not applicable for BEM (agree?)
- Basic (30% precision with 90% CL)
- Enhanced (10% precision with 90% CL)



Guideline: 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

> - *When does it make sense to include Program Data Collection?*
> - *Ex: New measures, accelerated replacement measures, add-on equipment/to-code, etc.*

Interaction Between Measures

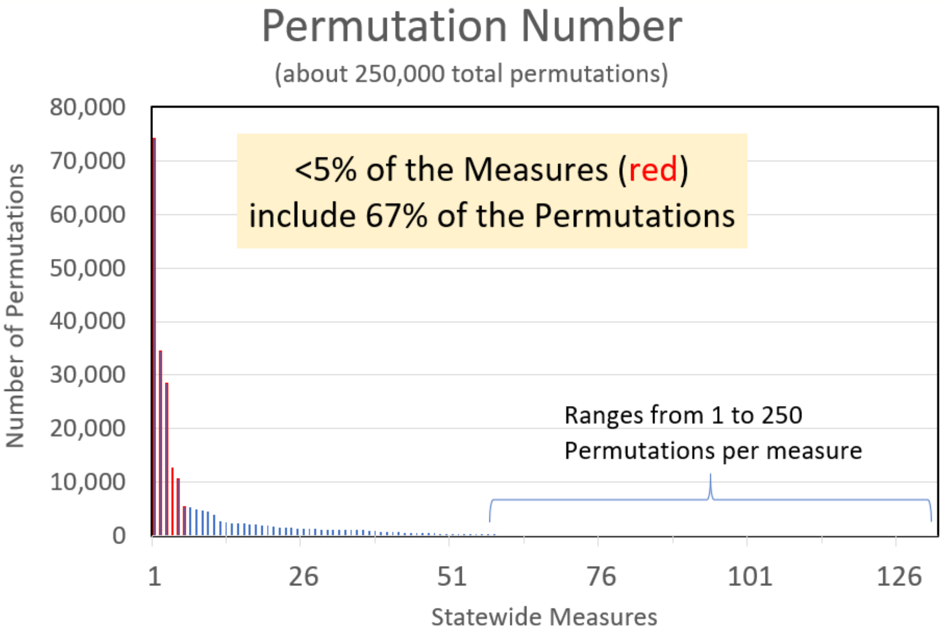
- Measure Identifiers ("parameters") should be defined if they impact the savings by more than 10%.
- Example: Enhanced Ventilation (SWHC023-02)

Measure Parameters:						
VFD	Enhanced Ventilation	CO2 Sensor	System Type	Motor	Electric	Gas
Add VFD	No	No	AC Unit with Gas Heat	Induction Motor		
				NEMA		
				PMM	[illegible]	
			Heat Pump	Induction Motor	[illegible]	
				NEMA	3	
				PMM	3	
	HVAC Enhanced Vent	CO2 Sensor	AC Unit with Gas Heat	Induction Motor	[illegible]	
				NEMA	3	27.1
				PMM	3	27.1
			Heat Pump	Induction Motor	465	
				NEMA	487	
				PMM	507	

Are there cases when Measure Parameters cannot be created?

Guideline: Permutation Number

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



- *When and how should permutations be collapsed?*
  - *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: 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

Additional considerations for HIMs?

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

Appendix Slides

- Evaluator’s Protocol: Gross Impacts
- Interactions Between Measures
- Support for Current Methods chart
- Simplifying Interactive Effects

Evaluator's Protocol: Gross Impacts

Evaluators' Protocols — Sampling and Uncertainty

Table 19. Required Protocols for Gross Impacts[120]

Rigor Level	Gross Impact Options
Basic	**Simplified Engineering Models**: The relative precision is 90/30[121]. The sampling unit is the premise. The sample size selected must be justified in the evaluation plan and approved as part of the evaluation planning process.
	Normalized Annual Consumption (NAC) Models: There are no targets for relative precision. This is due to the fact that NAC models are typically estimated for all participants with an adequate amount of pre- and post-billing data. Thus, there is no sampling error. However, if sampling is conducted, either a power analysis[122] or justification based upon prior evaluations of similar programs must be used to determine sample sizes. The sample size selected must be justified in the evaluation plan and approved as part of the evaluation planning process.
Enhanced	**Regression**: There are no relative precision targets for regression models that estimate gross energy or demand impacts. Evaluators are expected to conduct, at a minimum, a statistical power analysis as a way of initially estimating the required sample size.[123] Other information can be taken into account such as professional judgment and prior evaluations of similar programs. The sample size selected must be justified in the evaluation plan and approved as part of the evaluation planning process.
	Engineering Models: The target relative precision for gross energy and demand impacts is 90/10. The sampling unit is the premise. The sample size selected must be justified in the evaluation plan and approved as part of the evaluation planning process.

Interactions Between Measures

When measure identifiers do not account for all significant interactions, the savings can be estimated using the following steps:

1. Estimate baseline energy use of the measure-affected systems for typical adopters at the time of RTF approval.
2. Estimate efficient-case energy use assuming the delivery of the measure and full adoption of all cost-effective current RTF approved interactive measures. This is referred to as the full package. To avoid multiple iterations of the analysis to determine the full package, cost-effectiveness of the interactive measures may be estimated.
3. Compute full-package savings as the difference between the baseline energy use and efficient-case energy use of the full package.
4. Marginal savings for any measure is defined as the difference between the full-package energy use and the energy use of the full package without that measure. Compute marginal savings of the measure and each measure that interacts with it in the full package.
5. Compute the total marginal savings as the sum of the marginal savings for the measure and the marginal savings for each measure that interacts with it.
6. To estimate the measure's savings, compute the ratio of full-package savings to total marginal savings and multiply this ratio by the measure's marginal savings.

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.