Measure Savings Guidance: Subcommittee Meeting #1

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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	Subcommittee Input	Subcommittee Review of Draft Paper	Cal TF Review of Final Draft Paper	Cal TF Affirmation of Final Paper
• June Cal TF meeting	• Late June, early July	• Mid July	• July Cal TF meeting	• Sept Cal TF meeting

General Outline

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

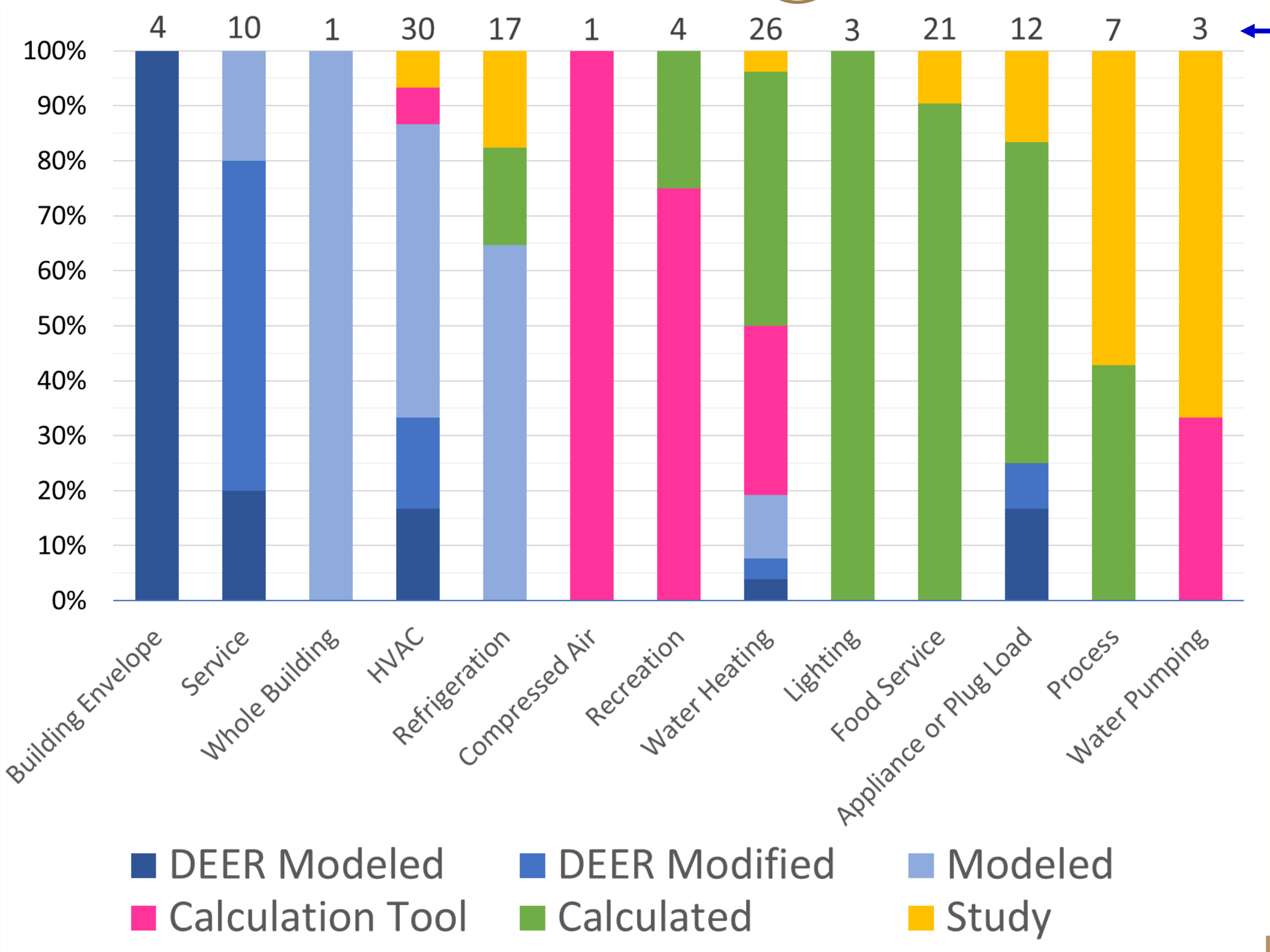
Current Methods - Categorization

RTF Classification

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

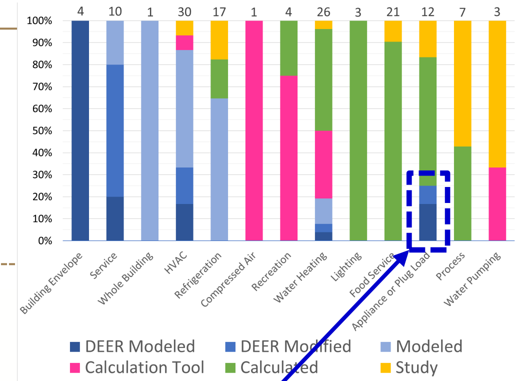
I will show you the current categorization that I showed at the Cal TF meeting, but we will circle back to ask:
- Should “Study” measure be rename/reclassified?

Current Methods - Categorization



Total number of measures in end-use

Guideline: 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 (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				
Lighting			These measures involved relatively simple physics models or engineering calculations that are widely accepted.	
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: 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

- *RTF uses a 10% rule to signify if a change is significant.*
- *Can a table be used to help developers (ie, part of a two-step process)?*
- *Related issue regarding interactions between measures.*

End-Use	Approach
Bldg Envelope	Yes - through BEM
Service (ie, RCx)	
Whole Building	
HVAC	
Refrigeration	Yes - through BEM / Simplified
Compressed Air	No
Recreation (ie, Pools)	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

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

- *These are examples of where simplification could apply.*
- *Question: Do we want to try to define when we should simplify?*

Guideline: Use Average Interactive Effects Commercial Refrigeration

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- Currently not including weather dependency
  - SWCR014, Medium or Low-Temperature Display Case
  - SWCR018, Reach-In Refrigerator or Freezer, Commercial

  Study: DOE Rulemaking / Energy Star

  - SWCR019, Low-Temperature Coffin To Reach-In Display Case Conversion
  - SWCR020, Medium-Temperature Open Display Case Retrofit

  Calculation
- Measures not closely tied to weather dependency (<10%)
  - SWCR001, Anti-Sweat Heater Controls
  - SWCR002, Low-Temperature Display Case Doors With No Anti-Sweat Heaters
  - SWCR003, ECM Graphed examples ted Display Case
  - SWCR004, ECM Retrofit for a Walk-in Cooler or Freezer
  - SWCR008, Floating Suction Controls, Multiplex
  - SWCR021, Medium or Low-Temperature Display Case With Doors
- At least one offering with >10% change
  - SWCR005, Auto Closer for Refrigerated Storage Door
  - SWCR007, Floating Head Pressure Controls, Multiplex
  - SWCR012, Compressor Retrofit, Multiplex
  - SWCR015, Medium-Temperature Case Doors (very close)
  - SWCR022, Efficient Adiabatic Condenser

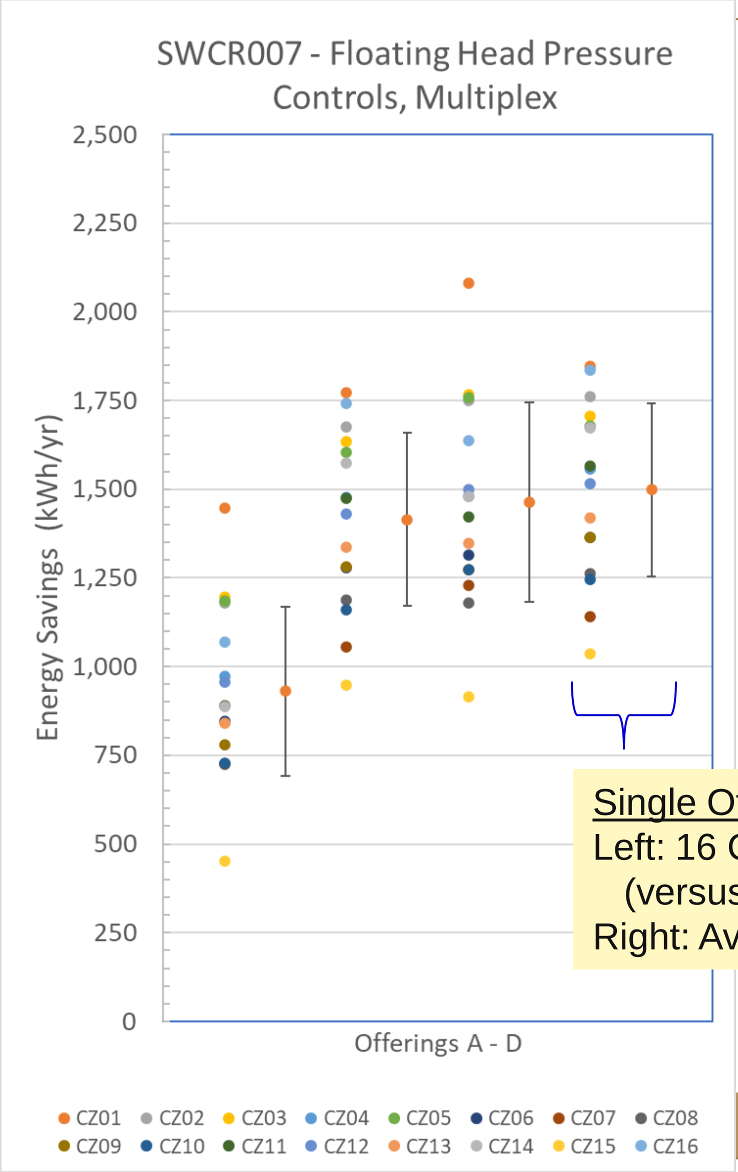
  Modeled

  - SWCR010, Bare Suction Line Insulation
  - SWCR017, Ultra-Low Temperature Freezer

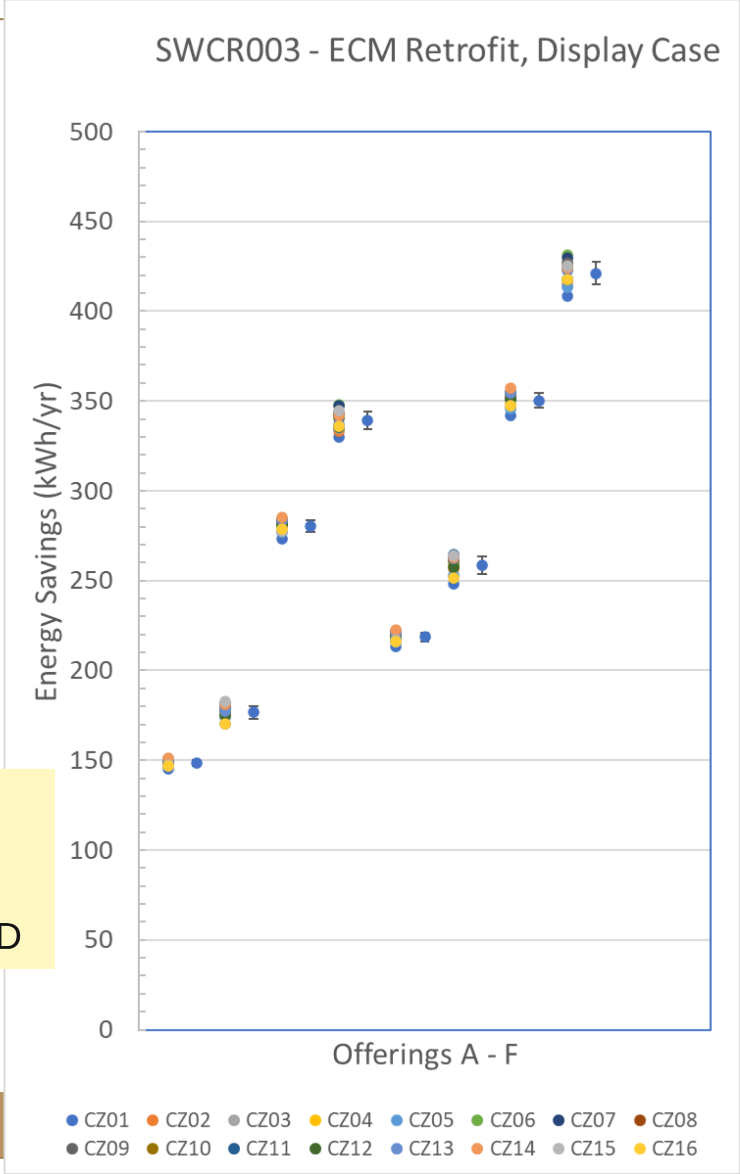
  Study / Calculated

Graphed examples, next slide

Guideline: Use Average Interactive Effects Commercial Refrigeration

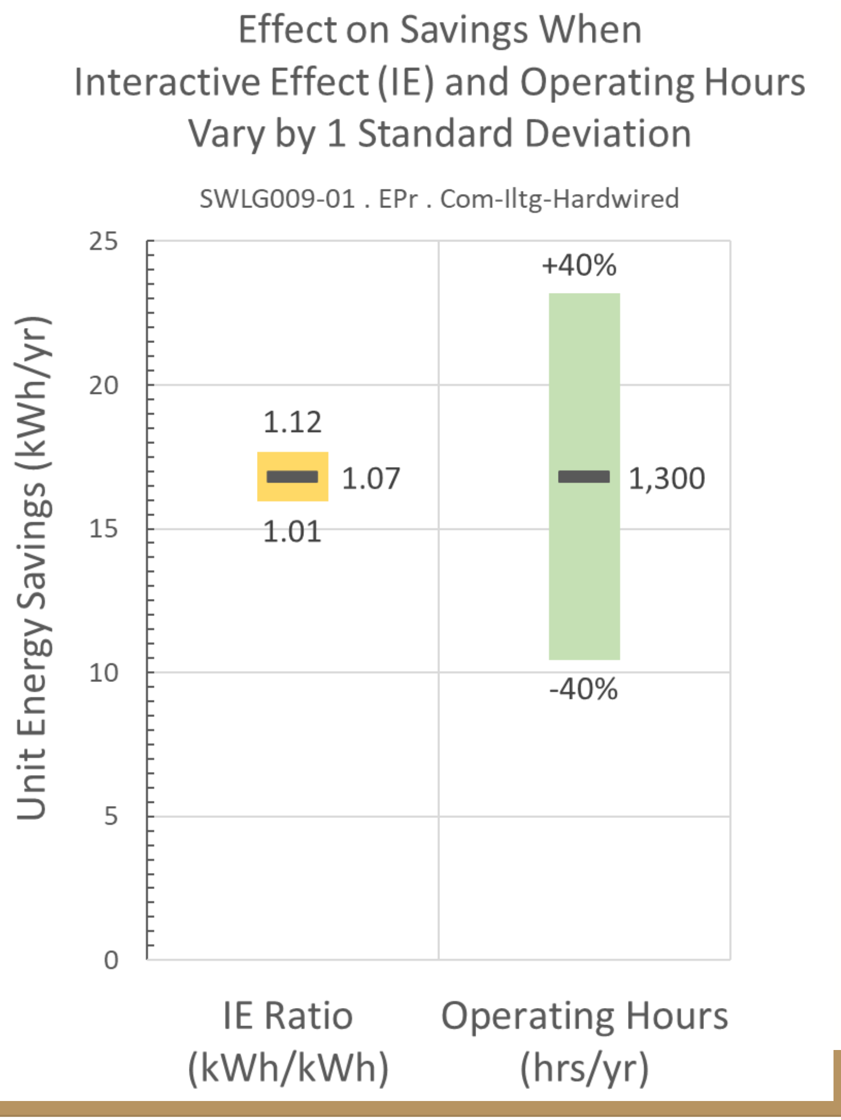


Single Offering:
Left: 16 CZ values
(versus)
Right: Avg with ± 1 SD



Guideline: Use Average Interactive Effects Lighting

- 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)



Lighting Analysis – Operating Hours

- Light level logger data from Small Commercial Contract Group evaluation report (SCCG 2010) – available on DEEResources.com.
  - Data presented for each Building Type, Activity Area, Schedule Type and Site:
    - As hourly averages for each day-type (ie, weekday, weekend, holiday).
  - Calculated standard deviation across day-types for a specific Building Type, Activity Area, and Schedule Type
  - Combined standard errors to get the standard deviation for an Activity Area.
  - Combined standard errors of Activity Areas to get standard deviation for a Building Type.

Monitored Data Activity Area Lighting Hours of Use | **Data from Activity Area Schedules tab:**

Building Type	Activity Area	Hrs/yr LF		ActArea Fraction	Sched: 0 Hrs/sched LF	Sched: 1 Hrs/sched LF	Sched: 2 Hrs/sched LF	Number of Loggers LF	Lighting fraction by ActArea LF	CFL	HB
EPr	Classroom	1133	= 1047 + 86 + 0	56%	1047	86	0	215	0.922	0.067	0.000

DayType	Monitored Data Approx.Sites	Sum N	Days /Sched	Lighting Hrs/day	Hrs/sch	TotHrs/sch		HR00	HR01
SatSun	7	13	72 *	0.7 =	47			0.009	0.008
Weekday	7	35	188	5	996	1047		0.008	0.007
Holiday	1	1	7	0.6	4			0.011	0.011

= Sum of logger data for each HR / 100 / Sum N

= Sum of logger data for each HR / 100 / sum of weight

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

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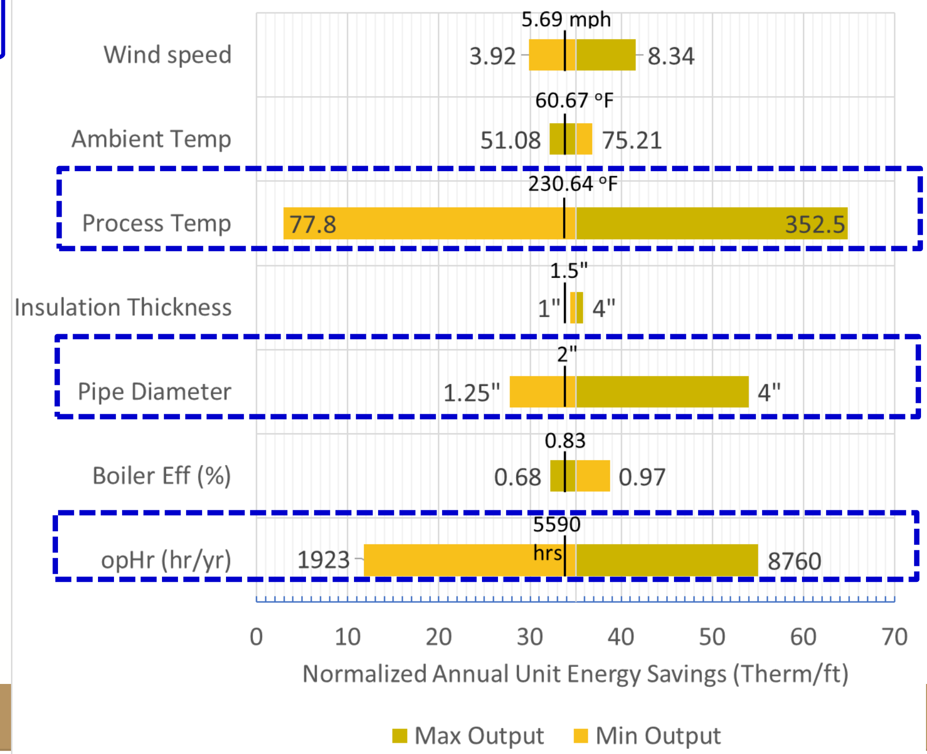
- Document sensitive parameters
- Why
  - Understand which permutations are more cost effective
    - Goal: Rehabilitate sunset measures and provide easy insight for implementers
  - Clearly identify evaluation variables to provide smoother feedback to improve measures

- *What is the best way to document sensitive variables (list, visually, etc)?*
- *Is there a systematic way to evaluate risk?*

- 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*



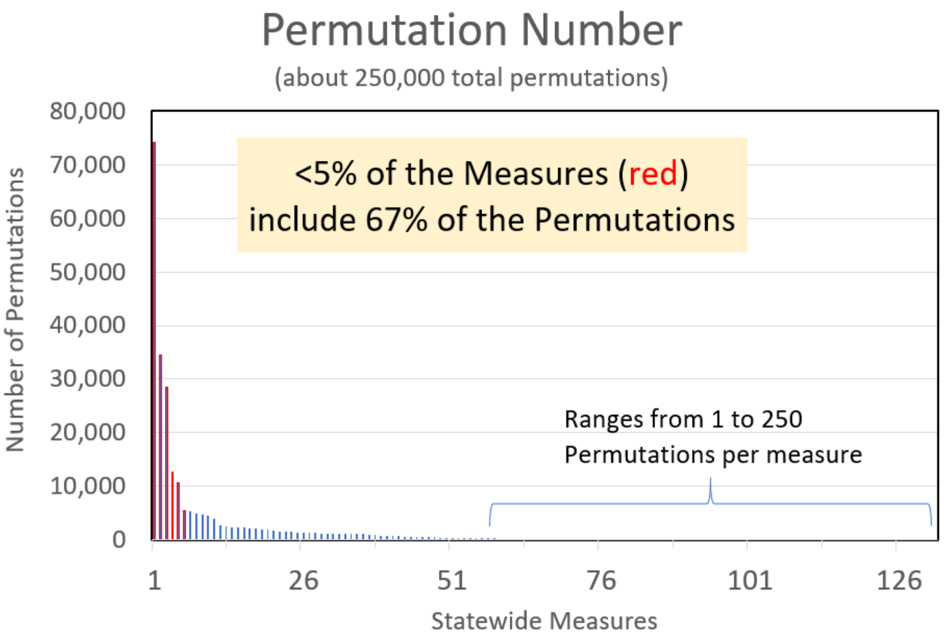
Guideline: Program Data Collection

- 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.*

Guideline: 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)*



- *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?

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.