

Coping with the Unexpected- M&V Approaches for Non-routine Adjustments

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ENERGY TECHNOLOGIES AREA

Introduction

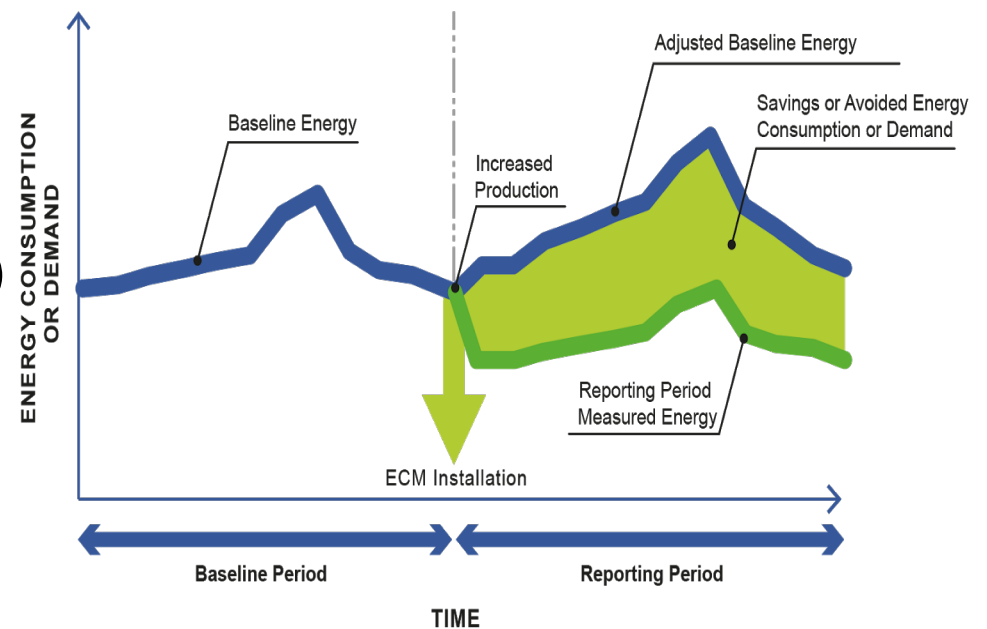
◆ M&V Options

- Retrofit Isolation (Option A, Option B)
- Whole Facility (Option C)

◆ Savings = (Baseline Period Energy – Reporting Period Energy) ± Adjustments

◆ Variables

◆ Adjustments



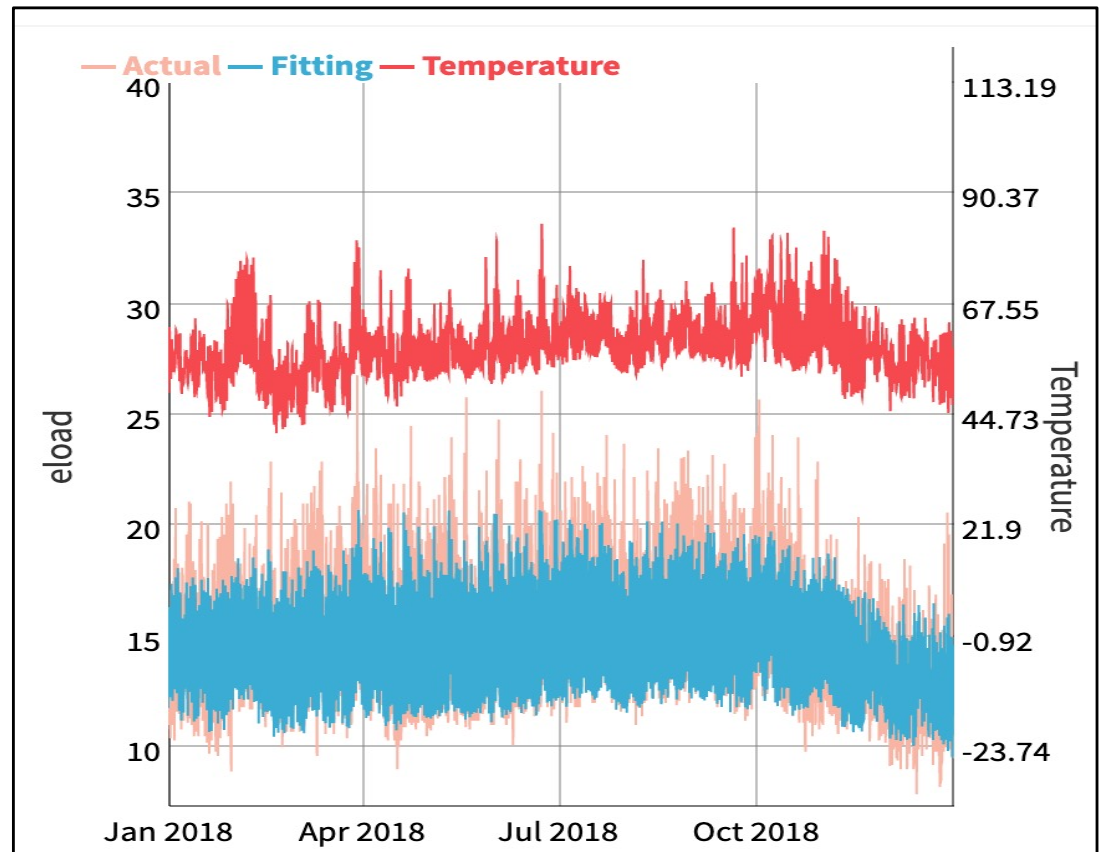
Routine Adjustments

◆ Independent Variables

- change routinely and have a measurable impact on *energy consumption*
- OAT, Production, TOW

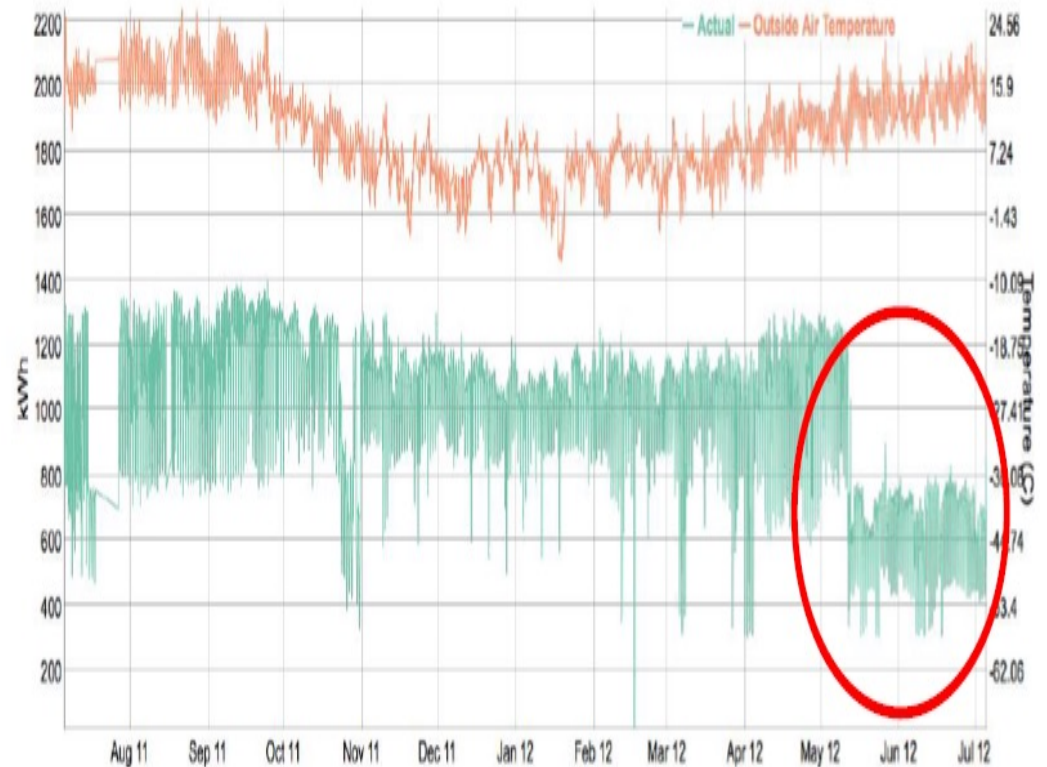
◆ Routine Adjustments

- account for the expected energy effects due to changes in the *independent variables*



Non-Routine Events and Adjustments

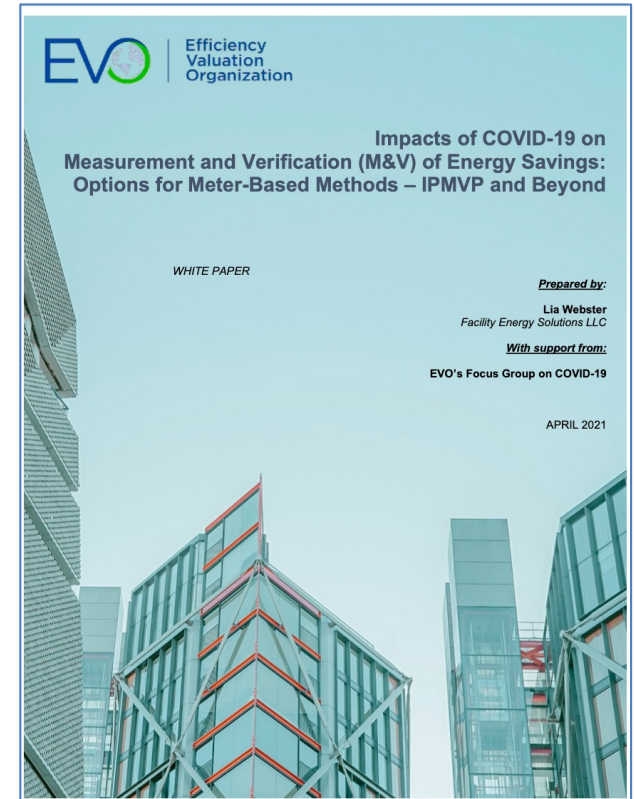
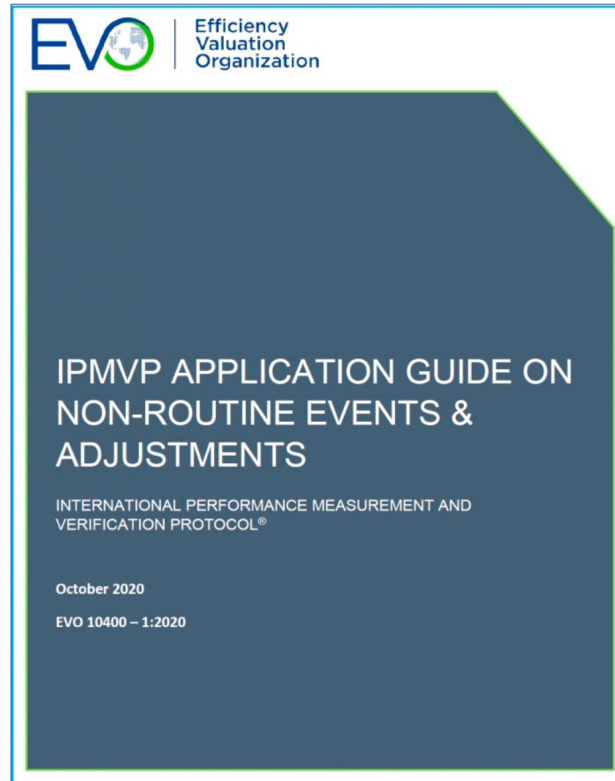
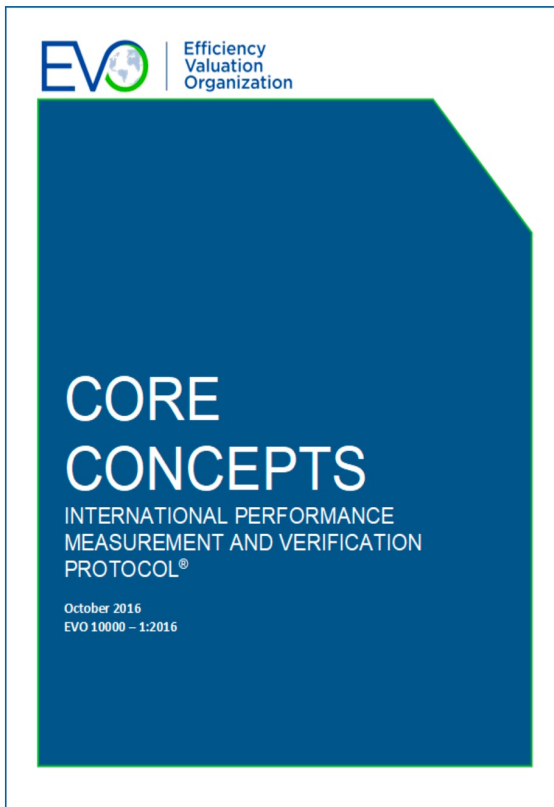
- ◆ Static factors
- ◆ Non-Routine Events (NRE)
 - changes in energy use
 - that are not attributable to installed efficiency measures
 - not accounted for in the baseline model's independent variables
 - related to facility equipment or operations, including but not limited to renovations, facility expansion, equipment addition or removal
- ◆ Non-Routine Adjustments (NRA)
 - account for the energy effects due to changes in the *Static Factors* within the *Measurement Boundary*.



Challenges

- ◆ Defining a change that warrants adjustment
- ◆ Detecting that there is a change that needs an adjustment
- ◆ Identifying what static factor or factors caused the change
- ◆ Ensuring that change in energy consumption is worth quantifying
- ◆ Gathering detailed data related to the static factor or factors in question during both the pre and post retrofit conditions
- ◆ Evaluate options to quantify the effect of the static factors depending on available resources and proficiency.

EVO Guidelines

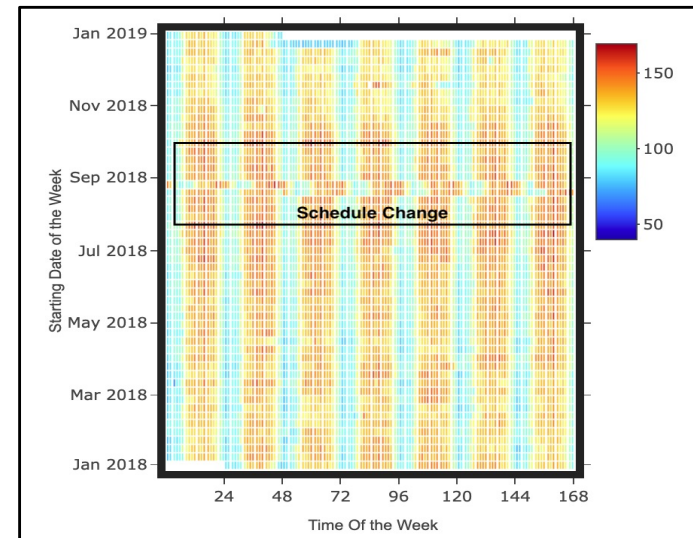
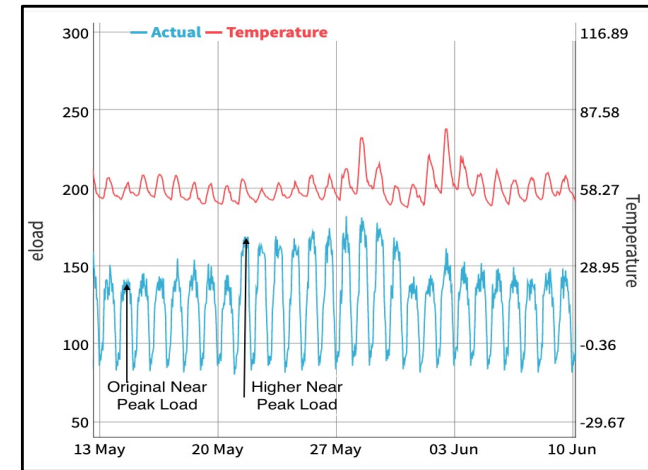
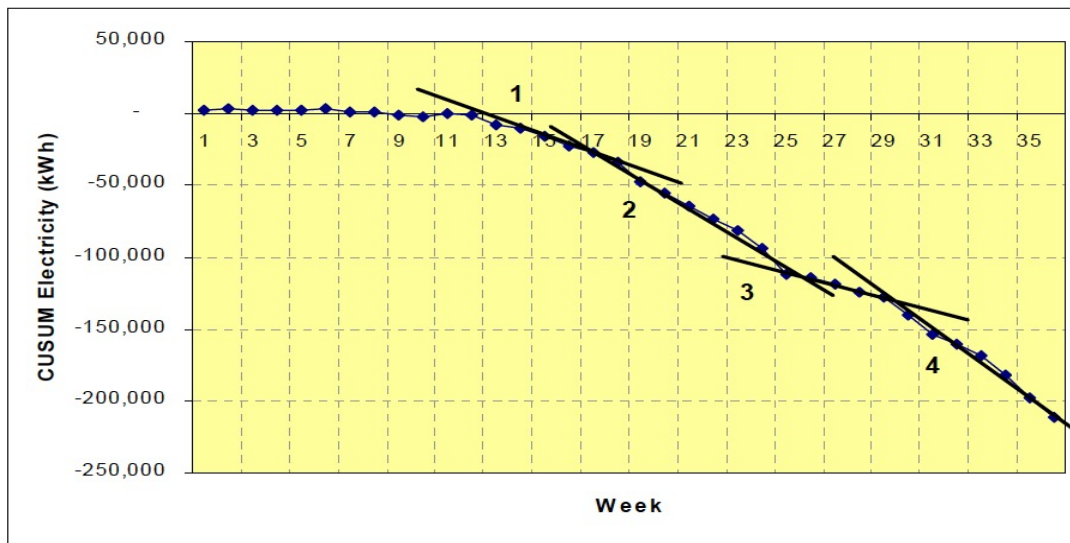


Characterizing NRE

Characteristic	Options	Details
Magnitude	Low High	Can be defined by specifying a threshold in relation to the magnitude of the baseline energy consumption, proposed savings and model uncertainty
Duration	Temporary Permanent	To be defined and its relation in relation with a threshold and frequency of the data that's available for analysis
Frequency	Often	Important aspect to identify how often does this change happen and with identifying any cyclicity (e.g., every summer, September, 3rd week, Sunday)
Phase	Baseline Interim Post retrofit	Defining when this change occurred – baseline, interim post retrofit, middle of the baseline
Type	Structural, Operation (Load, Schedule) End Use	Specify if the NRE is related to the load or schedule change or both. Also, in terms of CL or VL or loads; TS and VS for schedules
Impact Correlations	Time Variant Weather Variant Other Independent variable dependent (Production) Combination	Specify if the event has any characteristics that can be correlated with any of the independent or other variables.

Detecting NRE

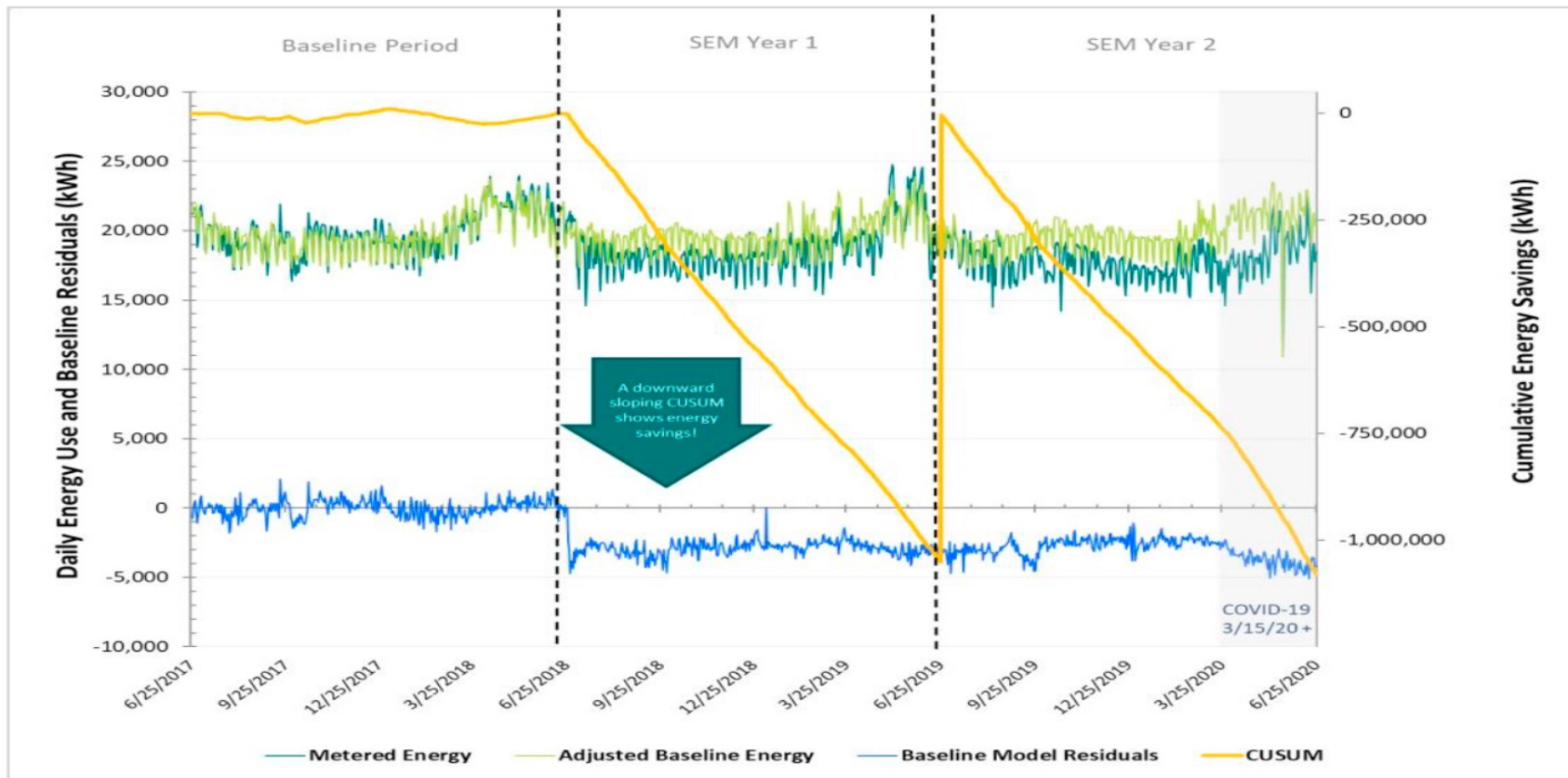
- ◆ Human feedback- Direct knowledge of the building or from the customer
- ◆ Statistical based approaches



NRA-Quantifying the effects of NREs

- ◆ Sub-metering affected systems or equipment
- ◆ Redefine baseline model with new independent variables
- ◆ Pre-Post model - Addition of an “indicator variable” in the model
- ◆ Analysing residuals for a model that includes the time period of change to estimate the magnitude of NRE
- ◆ Use ‘mini pre-NRE’ and ‘mini post-NRE’ models
- ◆ Develop model excluding the portion of the data that includes NRE
- ◆ Engineering calculations
- ◆ Simulation based approaches

COVID Impacts on Energy Consumption



Source: EVO's Impacts of COVID-19 on Measurement and Verification (M&V) of Energy Savings: Options for Meter-Based Methods – IPMVP and Beyond



Summary

- ◆ Meter based M&V approaches – normalizing energy consumption to calculate energy savings accurately
- ◆ COVID-19 exacerbated some of these challenges by skewing savings
- ◆ Accounting for NRE and adjusting for these events is critical
- ◆ EVO has established guidelines to standardize NRA
 - standardized definition and framework to characterize and document NREs
 - detection approaches and their applicability
 - quantification for adjustments

Thanks

- ◆ EVO's IPMVP Application Guide on Non-Routine Events & Non-Routine Adjustments
- ◆ EVO's Impacts of COVID-19 on Measurement and Verification of Energy Savings: Options for Meter-Based Methods – IPMVP and Beyond
- ◆ Non-routine adjustments – towards standardizing M&V approach for quantifying the effects of static factors." eceee Industrial Efficiency 2020 - DECARBONISE INDUSTRY!.