

Performing High-Rigor Impact Evaluations Cost-Effectively in the COVID-19 Era

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04 November 2022



Studied technology

Retrofit add-on controls to PTAC and PTHPs installed in lodging guest rooms by

- Setting back temperature set points when rooms are unoccupied (PG&E)
- Varying the unit's supply fan speed to optimize efficiency (SDG&E)

Program year evaluated - 2019



Source: sylvane.com

Traditional M&V

- **High-rigor data collection** for EM&V in accordance with IPMVP requires
 - Selection of sites suitable for end-use measurement
 - **In-person site visits**
 - Temporary equipment decommissioning to install loggers
 - Subsequent removal
 - Data processing and analysis

Expensive and time consuming!



The challenge



COVID-19 lock-downs and shelter-in-place orders

Traditional **in-person data collection** made impossible after March 2020

How do we still verify measure installation and collect performance data for high-rigor evaluations?

The solution

Virtual site visits

- Remote data collection
- Fast
- Cost-effective

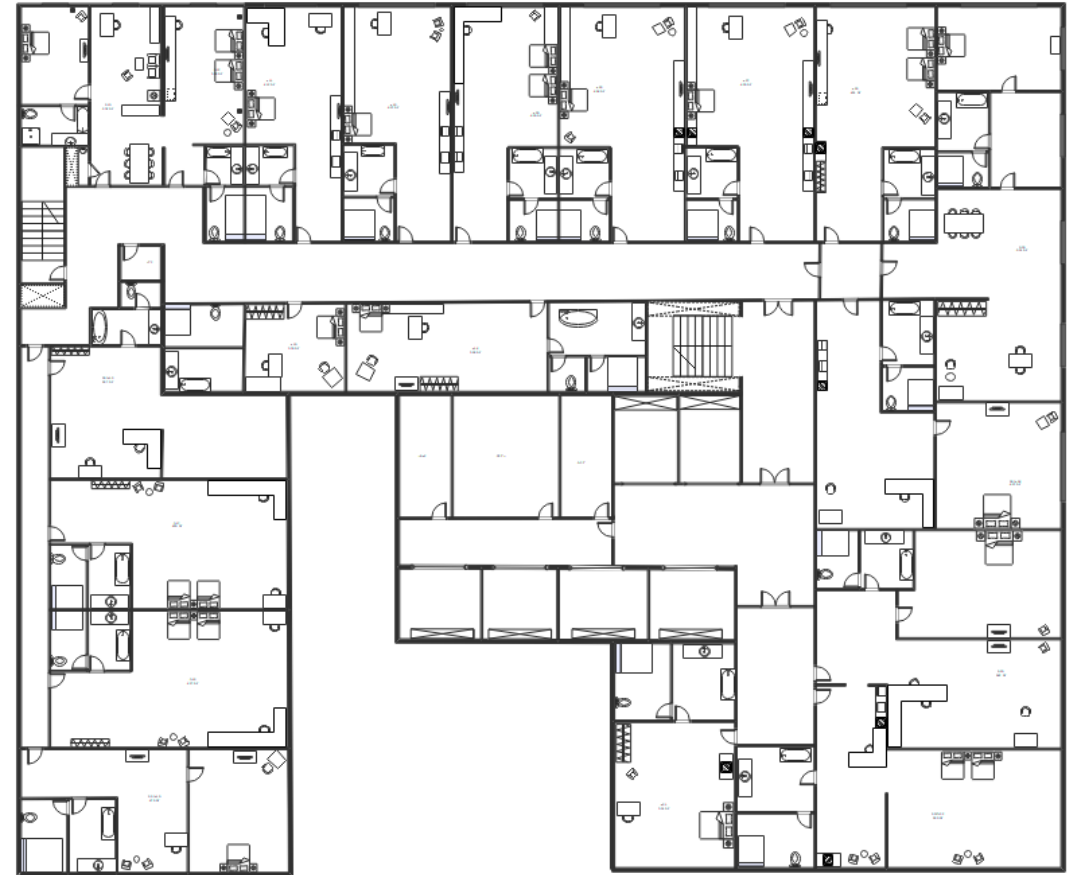
Led to templated “semi-custom” analysis approach

- Update parameters of greatest engineering uncertainty
- Calibrate baseline eQUEST models to pre-install bills
- Enhance confidence in achieved results



Phase 1 – Virtual site visits

- Combination of videoconferences, telephone calls, emails, and photograph exchanges with the building staff
- Verification of measure installation
- Confirm key project tracking details:
 - Project location
 - Facility type
 - Quantity of installed controls
 - Overall facility area
 - Number of floors in the building
 - Average guest room size



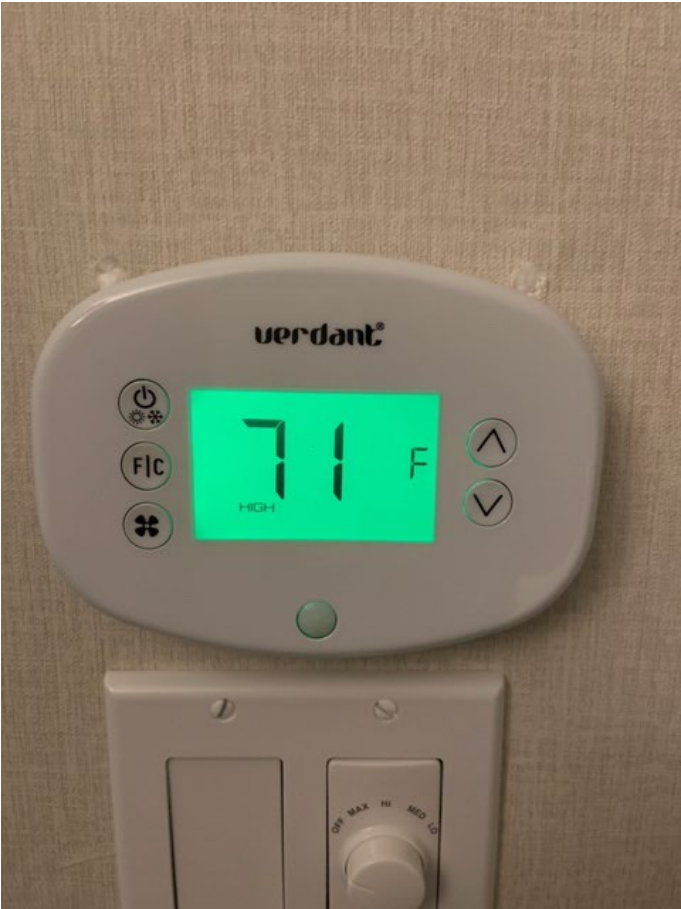
Source: [edrawsoft.com](https://www.edrawsoft.com)

Remote visual inspections



- Sample of guest rooms determined by engineer
 - Various room types
 - Locations (core vs. perimeter)
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- Remote inspection of controls via live video feed (e.g., FaceTime™, Zoom™, and Microsoft Teams™)
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- Follow up with photos of PTAC/PTHP nameplates and controls back to the engineer

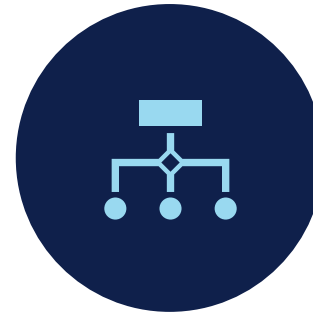
Relevant photos from inspections



Other facility data to inform simulation



Preexisting control types, setpoints, usage patterns



Post-project control schemes - occupied and unoccupied setpoints, override patterns



Pre- and post-project occupancy



Common area information for HVAC and lighting along with other end-uses (e.g., elevators, swimming pools, fitness centers, etc.)

Data from controls manufacturer

Controls transmitted data to EMS and uploaded to cloud-based servers

DNV collected cloud-based temperature and occupancy trend data from controls manufacturer



Controls data processing

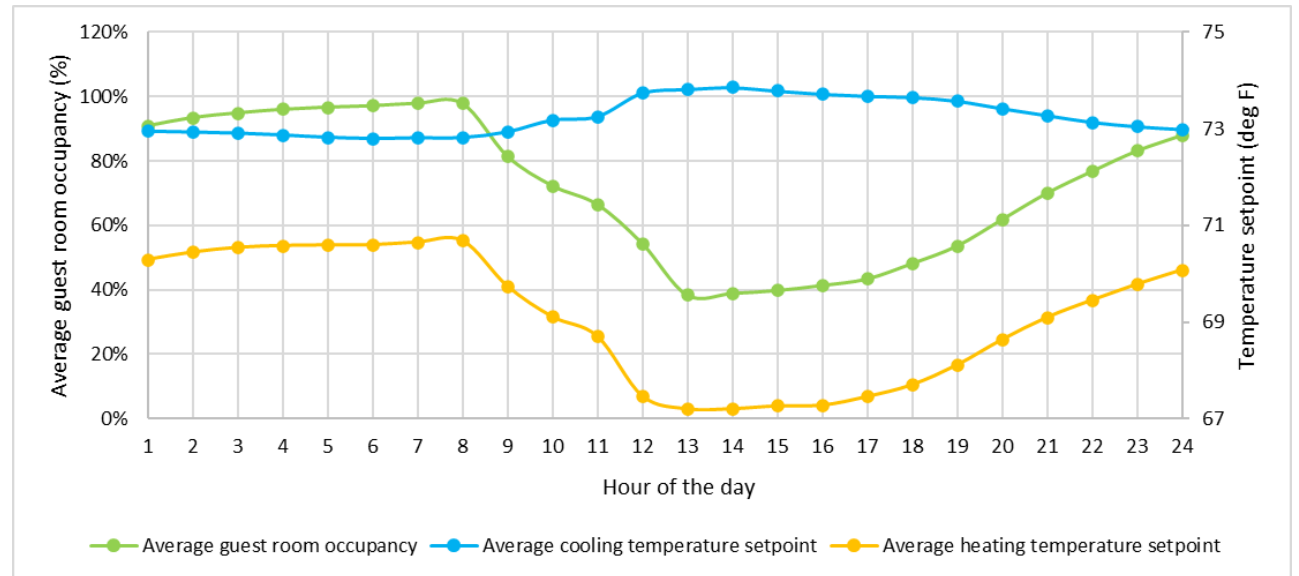
10 months of post-install data obtained

- Temperature set points
- Occupancy status

Erroneous values parsed out

Cleaned, processed, and filtered to include only periods that were not affected by COVID-19

Daily profiles aggregated for rented and non-rented rooms



Example of daily average profiles generated for a rented room at a sampled site

Phase 2 – Semi-custom analysis

Site-specific building simulation models

Not developed from scratch!

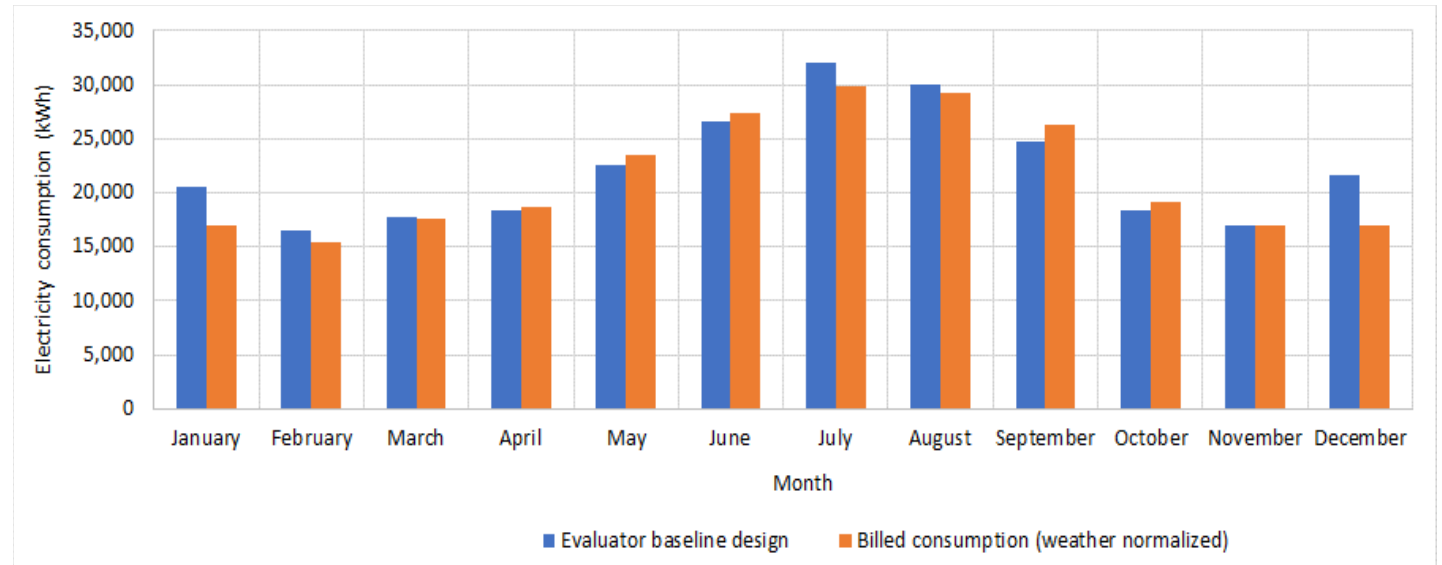
1. Starting point - DEER prototype building models
2. Update parameters within DEER prototype model's library files (*DEER_geom_tables.xlsm*)
 - Building geometries to reflect actual facility area
 - % area contributions space types (e.g., guest rooms vs. common areas)
3. Generate '*.inp' templates using MASControl3.
4. Update critical input parameters for guest rooms and facility from remote data collection using eQUEST

Baseline model calibration

Weather-normalized pre-install facility bills used for calibration (within 10%)

Calibration instilled confidence in baseline model

Led to refinements of inputs to better reflect real-world operating conditions



Example of a site-specific baseline model calibrated to facility consumption

As-built models development

PG&E measure

- Modify independent variables in eQUEST based on processed controls data
 - COOL_TEMP_SCH
 - HEAT_TEMP_SCH
 - PEOPLE_SCHEDULE

SDG&E measure

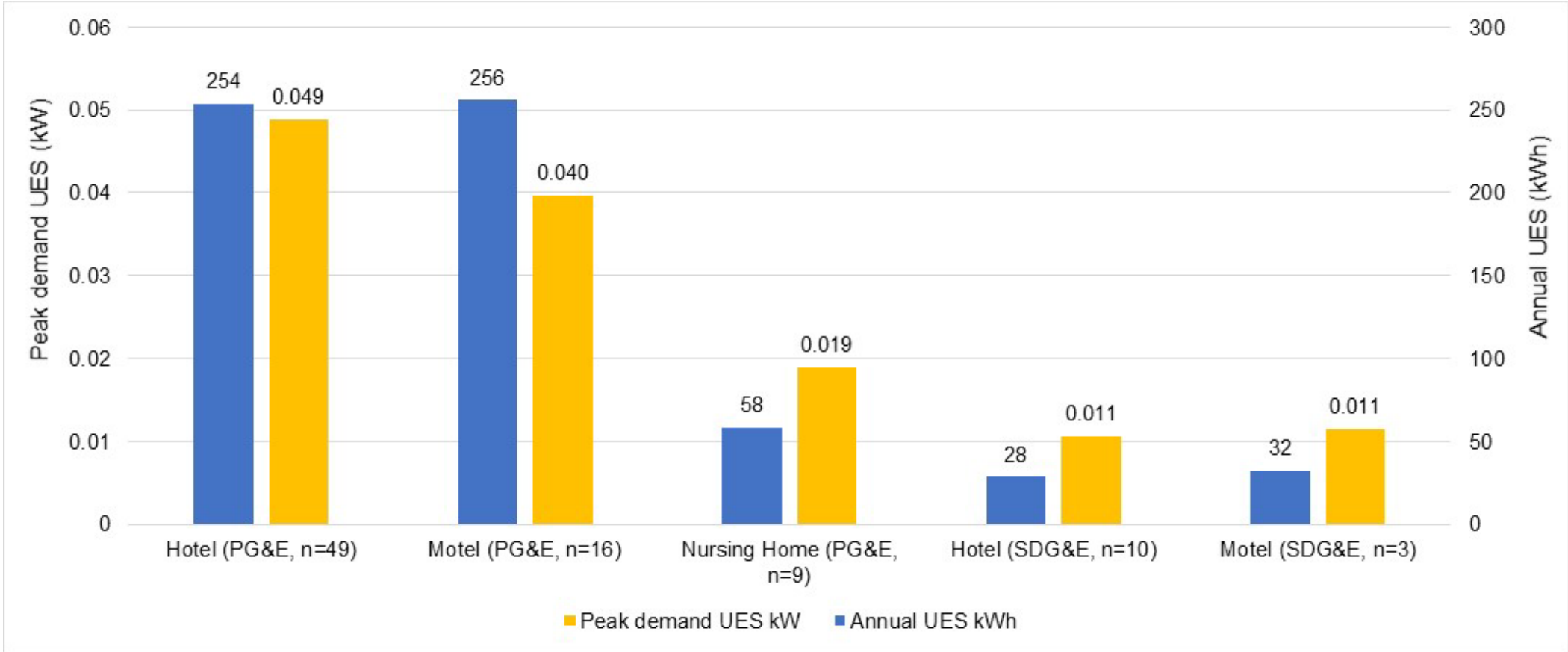
- Modify FAN_CONTROL to “continuous” fan operation instead of “intermittent”
- Used parametric runs in eQUEST



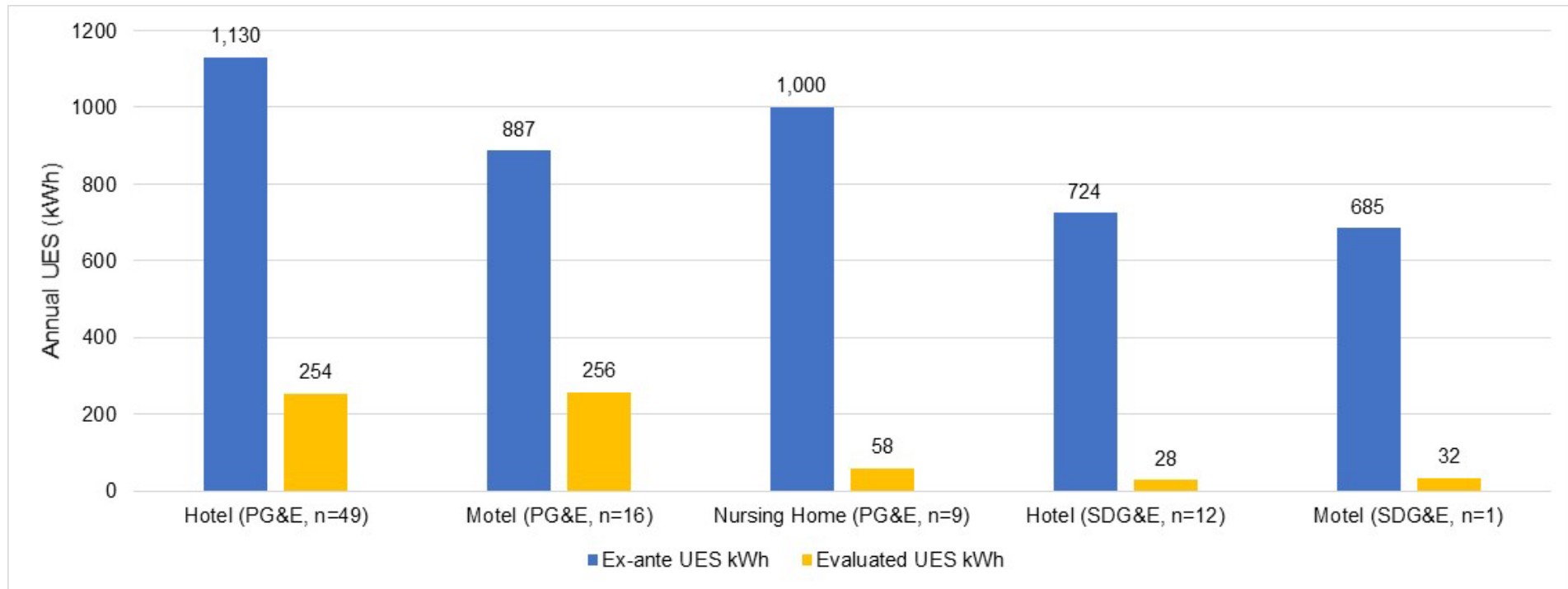
Results



Savings by facility type (annual kWh and peak kW)



Comparison with reported savings



- Operational updates ~**25%** reduction in savings
- **Major source of discrepancy** – Title 24 2013 controls requirements for guest rooms. Multiple sampled sites were either constructed, majorly renovated, or had all guest room HVAC systems replaced after July 2014

Conclusions

It is feasible to leverage existing HVAC control measure characteristics and utilize novel data collection methodologies to perform high-rigor evaluations

High-rigor evaluation results can be achieved at significantly lower-costs than traditional M&V, without making compromises to data collection

Methods can be applied to other similar measures where a prototypical model starting point is available

Virtual M&V is here to stay – methods from this study can be applied even after pandemic

Questions?

Thank you!

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