EM&V: We Are All In This Together

Perspectives on NMEC, Pay for Performance & Third-Party Implementation

January 31, 2019
San Francisco, CA
Welcome

Arthur Haubenstock
Executive Director
California Efficiency + Demand Management Council

Melanie Gillette
Senior Policy Director
California Efficiency + Demand Management Council
Today's Forum

We are delighted to provide this forum for the efficiency community, focusing on:

- NMEC
- Pay for Performance and
- Third Party Implementation

Today's theme, working and learning together, is particularly important in this time of great and rapid change. The agenda is remarkable, with a wide array of leaders in the field and important topics for the community to consider.

This is an opportunity to deepen our collective understanding of what is coming for efficiency on several fronts, including the regulatory and market environment. We will hear about what the regulators and program administrators are focusing on, what implementers are learning and what evaluators need.

We truly appreciate all of you being here to contribute to the conversation.
Today's Forum

Please note that neither the open solicitations nor the PG&E bankruptcy are on the agenda today.

• We request that everyone refrains from using this forum to ask questions about open solicitations, or about the PG&E bankruptcy (particularly with respect to PG&E representatives here today).

• The Council is providing other opportunities for its members to discuss appropriate solicitation and bankruptcy issues outside of this forum, and always mindful of our antitrust obligations as an association of competitors.
Antitrust Reminder

Antitrust Guidelines
The Council asks its members, and all present here today, to adhere to the highest standards of professional conduct, and to recognize and protect the need for confidentiality when dealing with client or private interests.

The Council is a trade association of competitors. Compliance with all federal and state antitrust and other laws is essential. We must avoid any communications among member companies that might be construed to involve competitively sensitive matters, including the following topics:

- Prices or costs of producing a product
- Terms and conditions of sales or purchases
- Limits on production or product lines
- Allocating customers or territories
- Marketing plans (other than Council marketing)
- Refusing to deal with a customer/supplier or agreeing to treat a customer/supplier in a certain way
- Bidding for, or solicitation of, particular customers or suppliers

Participants in today's EM&V Forum should not discuss any of these topics, whether during the event or any of its breaks, breakout sessions, or side conversations. If any of these topics are raised during the event, it will be paused, and if no remedy is available, the event will be terminated.
Thank You to our EM&V Forum Partners

PG&E

SDGE

Southern California Edison

SoCalGas

Advancing Our Clean Economy
Thank You to our Sponsors

- AESC
- Franklin Energy
- MCE
- Opinion Dynamics

Advancing Our Clean Economy
Thank You to our Staff

Melanie Gillette,
Senior Policy Director

Nate Kinsey,
Regulatory Affairs Manager

Ashleigh Spurgeon,
Member Services
CPUC Update
NMEC, Contracts, Coming Soon

Jeorge Tagnipes, California Public Utilities Commission Energy Division
Normalized Metered Energy Consumption – What’s New
Normalized Metered Energy Consumption – What’s New
Issued Four RFPs in 2018

~ Deemed
- Residential, Small commercial, HVAC, Lighting
- All workpapers, DEER, Load Shape Study, EUL study, ESPI

~ Non-resource
- WE&T, ME&O, ETP, Finance, LGP, CCA
- C&S, Finance

~ Custom
- Industrial, Agricultural, Large Commercial, SEM
- Custom Ex-Ante Review, NMEC approaches

~ Potential and Goals
- Also market studies
Last October – 2 Signed Contracts

Group A
- Pre-solicitation
- Procurement Review
- Award

Group B
- Pre-solicitation
- Procurement Review
- Award

Group D
- Pre-solicitation
- Procurement Review
- Award

Group E
- Pre-solicitation
- Procurement Review
- Award
3 Contracts Have Started Work – 1 at DGS
Year Ahead

Start research plans

Group A, D Evaluation

Group A and D evaluation for *2018 study* due March 2020

- 2019 Program Year Solicitations
- Group E Potential and Goals
  - Group A: Workpaper, DEER, ESPI work
- Group B Evaluations

2020

- Program recommendations
- EUL study
- Load Shape study
## Coming Up – Next 6 Months

*(Subject to Change)*

**W** = Workshop/Webinar  
**C** = Comments Due

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**Notes:**

- Potential and Goals Calibration
- REN/CCA/LGP Evaluation Plan
- DEER/Ex-Ante Cross-Cutting Research Plan
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<td>MAY</td>
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Resources

Public Documents Area
https://pda.energydataweb.com/#!/

Daily Calendar
http://docs.cpuc.ca.gov/SearchRes.aspx?DocTypeID=9&Latest=1

Service List (search R.13-11-005)
https://ia.cpuc.ca.gov/servicelists/sl_index.htm
Thank You!

Jeorge Tagnipes, California Public Utilities Commission Energy Division
IOU EM&V & Program Leadership Update on 3P Implementation Issues

Athena Besa, San Diego Gas & Electric

Meghan Dewey, Pacific Gas & Electric Company

Loan Nguyen, Southern California Gas

Shahana Samiullah, Southern California Edison

Moderator: Eddie Abadi, Southern California Edison
From Insomnia to Opportunity!

**CHANGE:**
Electric Utility industry is changing rapidly.

**Grid:**
Renewables and Duck Curve
Different needs from DSM: Energy vs. Capacity and Ramping
Implications for Program Cost-Effectiveness

**Customers:**
Customer needs are evolving
Technology changing the way customers interact with nearly all markets, electricity included!

**EE:**
New measures, and retirement of some old ones
Shift to Third-Party Design and Implementation of Programs
Refreshing EM&V

California Evaluation Framework (Original)
Published in 2004 by TecMarket Works

Framework Refresh Needs Assessment
Published in October, 2017 by Research into Action
For CA IOUs and CPUC

Refresh Needs Assessment does a thorough job of detailing the changing landscape, and how EE EM&V needs to be “refreshed.”

Improving timeliness and usefulness of evaluations
Embedded Evaluation
Real-time Evaluation
Developmental Evaluation

EM&V is evolving, along with market and policy change.
Thank You!

Athena Besa, San Diego Gas & Electric

Meghan Dewey, Pacific Gas & Electric Company

Loan Nguyen, Southern California Gas

Shahana Samiullah, Southern California Edison

Moderator: Eddie Abadi, Southern California Edison
Morning Break:
Please Return at 10:45am

Thank You To Our Sponsor!
First Take on Pay-for-Performance Program Launches (Res/NonRes)

Scott Broten, ICF

Jonathan Budner, Build It Green

Alison Erlenbach, Pacific Gas & Electric Company

Justin Kjeldsen, Franklin Energy

Leif Magnuson, Pacific Gas & Electric Company

Brian Maloney, Southern California Edison

Lisa Schmidt, Home Energy Analytics

Moderator: Hilary Polis, Opinion Dynamics
Residential Pay-for-Performance Program

Leif L. Magnuson
PG&E Customer Energy Solutions
Who’s idea was Pay for Performance?

Hayley Goodson, TURN
Cynthia Mitchell, TURN

Chuck Goldman, LBL

Matt Golden, CEO OpenEE

Merrian Borgeson, NRDC

Martha Brook, CEC
Res P4P – Origins and Timeline

- Spring 2015 - TURN and NRDC advocate for P4P approach in EE Rolling Portfolio Phase III Proceedings. PG&E also supports P4P approach.
- Oct 2015 - AB802 passes. CPUC to authorize the IOUs to run meter-based energy savings programs.
- Dec 2015 – CPUC issues HOPPs ruling
- May 2016 – PG&E’s Res P4P HOPPs proposal approved by the CPUC
- Nov 2016 – PG&E issues Res P4P RFP I
- Feb 2017 – Res P4P I bids submitted
- July 2017 – PG&E contracts with BIG and HEA
- Nov 2017 – PG&E issues Res P4P RFP II
- Jan 2018 – Res P4P II bids submitted
- Sep 2018 - PG&E contracts with Franklin and ICF
What is Res Pay for Performance (P4P)?

Aggregator

PG&E

District

Meter
Unlimited Interventions

Unparaleled flexibility to pursue a range of improvements and activities over time to achieve residents’ savings goals

Retrofit
- Whole House
- HVAC
- Lighting
- Outdoor/Pool Deck

Operational
- Smart Thermostats
- Home Energy Management Systems
- Smart Appliances

Behavioral
- Homeowner Incentives
- Demand Response
- Other specially designed programs
Payable Energy Savings

- Pre/post analytics
- Savings = pre usage billing data minus post (weather normalized)
- Each participating home is analyzed then summed together to determine portfolio performance. PG&E pays each aggregator for their total savings.

Determined at the meter via weather normalized pre/post billing analysis

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**Baseline** → **Customer Engagement** → **Monthly payments throughout the first two years** → **Continued Savings Measurement**

**Pre-Engagement** → **Year 1 Post-Engagement** → **Year 2 Post-Engagement** → **Year 3 Post-Engagement**

- 12 months
- 0-2 months
- 12 months
- 24 months
- 36 months
What are the Goals of P4P?

- Scalable Res EE Models
- Supportive Data Ecosystem
- EE as Grid Resource
Big energy bills? Not sure what to do?

Your home is unique. Effectively reducing energy use requires specific knowledge. HomeIntel is here to help. It creates a custom energy reduction plan based on how energy is used in your home.

You start by creating an energy profile of your home using SmartAudit, our proprietary smart meter analysis software. SmartAudit automatically accesses your PG&E account for energy data and then guides you through an interactive tutorial showing how energy is being used. From there we help you build a plan to save energy and money, and reduce GHG emissions. SmartAudit sends you reports each month showing your progress.

This is a new PG&E funded program available to all PG&E customers at no cost who:

- Have lived in their residence for a year or more.
- Do not have solar PV installed.

https://corp.hea.com/hintel/

Your Energy Loads

First, let’s see where you spent $1,860 over the past twelve months. Here’s the breakdown in different load categories:
Residential Pay-for-Performance Program

Lisa Schmidt
Home Energy Analytics
• Launched August, 2018
• As of 11/30/18
• 593 projects enrolled in our pool
• Savings
  • 4627 MMBtu
  • 9% electric, 15% gas
The Good

- We’re seeing expected savings
- Customers are happy

“We really didn’t expect much. Boy, were we wrong! Chris was smart and passionate about saving energy. He found a few areas that were big energy drains, helped us find ways to overcome them, and followed up with us as promised. We would highly recommend this program.”

Joan, Bay Area resident.

### Household Summary

| Number of Occupants: | 2.0 |
| Rent/Own: | Owner |
| Type of Home: | Single Family |
| Size of Home: | 3,200 sq.ft. |
| Pool: | No |
| Fountain, pond, etc.: | No |
| Year Home Was Built: | 1970 |
| Hot Tub/Spa: | Yes |
| Activation Date: | August 23, 2017 |

### How has my energy cost changed?

Each of the charts below compare information about your home across two different periods: (1) the Initial 12 month period just before you signed up for this service, and (2) the most recent 12 months.

Because both periods cover all seasons, we effectively “normalize” the two periods for variations caused by seasonal energy use.

However, we also need to adjust for the different weather conditions (for example a particularly cold winter or one summer that was hotter than the next) so we also normalize the energy use for the initial period to match the weather of the most recent period.

Since registering on 08/23/2017, on an absolute basis, your annual energy cost has gone down $2,417 (25%).

Taking weather differences into account, your annual energy cost has gone down $2,512 (25%).
The plumbing wasn’t ready
And we (HEA, PG&E and OpenEE) have been building it as we go

Data transfer points

Between PG&E and customer

• Customer authorizes data access to HEA

Between HEA and PG&E

• Initial access to historic customer data (electric and gas AMI data, monthly billing and usage, account data)
• Ongoing data access (AMI, monthly)
• Immediate eligibility checks (PV, EV, ESA, HUP, 12 months data)
• Monthly customer enrollment to PG&E

Between PG&E and OpenEE

• PG&E submits energy data to OpenEE
• CalTRACK analysis posted on HomeIntel dashboard

Smooth data transfer is necessary for scale.
Maximizing MMBtu/$

**Customer facing simplicity**
- Implementer – program design
- IOU – referee implementer messaging
- CPUC – allow multiple programs

**Frictionless data transfer**
- Implementer – automate
- IOU – automate
- CPUC – eliminate unnecessary eligibility requirements

**Maximize savings**
- Implementer – innovate
- IOU – own outreach
- CPUC – pave the way for accurate NMEC
Residential Pay-for-Performance Program

Jonathan Budner
Build It Green
About Build It Green

Build It Green’s Mission is to create a world of healthy and sustainable homes for all people.

BuildItGreen.org
Build it Green – Cool Savers

Seal Ducts

Smart T-Stat

High Efficiency AC

https://www.coolhomesavers.com/
Cool Savers P4P

- Opportunities
- PG&E Support/Additional Needs
  - Branding/Customer selection
  - Data Access issues
  - Risk Burden
- EM&V Impacts
  - Real-time feedback
  - Automate or Import?
- Lessons Learned
  - Risk Profile
  - Technical Partner
  - Uncertainty v Growth
  - Threat v Opportunity
Residential Pay-for-Performance Program

Justin Kjeldsen
Franklin Energy
Why did your company take a chance on the P4P/NMEC program and payment model?

- Leverage company resources and capabilities:
  - Customer engagement platform
  - On-line market place
  - Licensed field technicians

What are the biggest opportunities you see in P4P/NMEC for your company?

- Take successes back to other markets
What has PG&E done to help you?

• Moved payment model from annual to monthly payments
• Provided assistance with customer targeting

What more could PG&E and other implementers do to help ensure your success?

• Focus on data access
  -Targeting
  -Sharing contact info
  -Improving SMD
How does the P4P approach impact your EM&V?

• Simpler EM&V, from a measure tracking perspective
• Having defined CalTRACK methodology provides clarity
• Meter based savings reduce measure level debates

What information would you share with others considering P4P?

• Data access is challenging
• Use your PG&E resources
• Understand your requirements and approval timing
If the program works well, how will you leverage the results and lessons learned in the future?

- Use learnings and results to modify

How do you plan to scale this program model?

- Broader territory
- Different segments
Residential Pay-for-Performance Program

Scott Broten
ICF
Program Summary

- Direct Install
- Leverage PG&E's Data Team to Screen Potential Participants
- Install Measures (to the right)
- Enroll customers in CalTRACK
- Monitor/Additional Intervention
- Paid via NMEC-based Revenue
Why Did ICF Take a Chance on NMEC?

- NMEC Methodology Is Familiar to us (SEM and Custom)
- We’ve grown comfortable with the economics of more traditional Pay for Performance (deemed savings, milestone payments, etc.)
- We are believers in EE as a grid resource and NMEC as an enabler
- NMEC is a big part of procurements in CA (and growing across the nation)
- Consistent with ICFs culture of innovation we enjoy solving tough problems
- Winning this work demonstrates to CA that ICF is ready for NMEC
What Are The Biggest Opportunities?

• More freedom to save energy and generate revenue
  - Not restricted by code
  - Not tied to a work paper or a calculation
  - Not likely to take a big haircut on savings

• Potential Financial Upside

• Elevates EE to be considered as more of a grid resource
What has PG&E Done to Help Us?

- OPENNESS AND FLEXIBILITY
- Data Analytics for Customer Acquisition
- Much more hands off
How Does NMEC Impact Our EM&V?

• We have a defined methodology (CalTRACK) that is:
  - Straightforward
  - Clear
  - Variables we understand well and have some control over
• We “know as we go” – allowing for early intervention/changes
• NO BIG SURPRISES
What Information Would We Share?

• Follow The Risk
• We are all chasing the same customers – and now we all know who they are

How can all parties (including all implementers) work together to channel customers into the programs they are best-suited for?

From Opinion Dynamics EM&V Matrix

• NMEC participation locks customers out of other programs
• Low hanging fruit will run out quickly
How We’ll Leverage Results and Scale

• Proven savings and economic success will allow scaling (to the benefit of customers)
• Scale is a big part of the answer to risk
Public Sector Performance-Based Retrofit HOPPs

Brian Maloney
Southern California Edison
High Level Participation

Incentive Structure - Customer incentives are tied to savings persistence and can increase or decrease based on actual measured savings

- **Initial Incentive Payment:** 3 months after installation completed—up to 40 percent of total estimated customer incentive
- **First Persistence Payment:** 12 months after installation completed—customer eligible to receive an additional 40 percent of “trued-up” total estimated customer incentive
- **Second Persistence Payment:** 24 months after installation completed—customer eligible to receive remaining balance of “trued-up” total customer incentive

M&V Plan

- Use normalized pre and post meter data to determine baseline and project savings
- Trend for a period after project completion and provide a performance incentive for persistent savings
- After 24 month final payment, post trending will transition to Ex-Post EM&V to further evaluate EUL, savings persistence and other program metrics.

Incentive Rate

0.12 / kWh
$200 / kW
Project Initiation

Project Screening
- Review past participation
- Pull meter data if available
- Identify high level savings opportunity
- Provide Program requirements to customer to understand offering

Project Audit
- Identify Measures, saving projections
- Gain commitment from customer on group of measures to reach 10% overall savings reduction
- Use weighted average to create project level Effective Useful Life

Project Feasibility Study
- Include Audit findings
- Project level M&V plan
- Complete pre-trending NMEC analysis

Incorporate requirements at each stage to address conditions and concerns.
## HOPPs Approval Conditions

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<td>Past Program Participation</td>
<td>Part of screening process.</td>
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<tr>
<td>Savings Disaggregation</td>
<td>Only if practical &amp; significant, address on project level.</td>
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<tr>
<td>Building Level EUL</td>
<td>To be calculated from audit.</td>
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<tr>
<td>Achieving 10% Savings</td>
<td>To be identified from audit.</td>
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<tr>
<td>3 Year Maintenance Plan</td>
<td>Required to insure savings persistence.</td>
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<tr>
<td>Non Routine Event Notification</td>
<td>Requires reporting and adjustments for Non Routine Events.</td>
</tr>
<tr>
<td>Future Participation for BRO Measures</td>
<td>Will not be eligible for incentives for same measures for 5 years.</td>
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NMEC Good Model Fit

**Good Model Fit**
- Buildings with predictable schedules
  - Office, School, etc.
- Load driven by:
  - Weather (HVAC)
  - Other measurable data (flow)

**Poor Model Fit**
- Buildings with variable schedules
  - Convention Center, Sports Complex
- Load driven by:
  - Occupancy (hard to measure)
  - Intermittent Plug loads
PG&E Commercial Whole Building Demo

Alison Erlenbach
Pacific Gas & Electric Company
Commercial Whole Building Demo: Key Objectives

- Test the reliability of NMEC in EE programs for commercial buildings
- Recommend best methodology for estimating CWB savings in the future
- Assess evaluability of Commercial Whole Building
- Recommend improvements for scaling to full program
Commercial Whole Building Demo: Summary

- Invitation only, pay for performance incentive trial
- 12 medium-sized commercial buildings: five grocery stores, six office buildings, and a library
- Required a minimum of 15% savings
- Variety of measures included retrofitting lighting and HVAC equipment and improving controls settings.
- Compared proprietary and public domain algorithms
- Used two IPMVP approaches to estimate savings:
  - Option C: regression analysis of building energy meter data with independent variables, such as weather.
  - Option D: calibrated physics-based simulation of building energy use.
Key Findings & Lessons Learned
**Measurement Protocols: Key Findings**

- PAs should require the use of **transparent, open-source, Option C-based algorithms** for savings estimation in NMEC programs.
  - The Option D approach is too expensive to scale reliably and cost-effectively across a large portfolio of buildings.
  - Proprietary tools did not offer any advantages over open source.
- Compliance with Policy and Procedures is crucial.

- **Erroneous or missing data**
- **Poor goodness of fit**
- **Undetected NREs**
- **Bad program management**
- **Etc.**

---

**Any NMEC Methodology**
Projects are long and complex; thoughtful program and project-level planning is necessary.

Strong and consistent program management is critical.

Teams are cross functional and key roles include:

- Customer targeting and outreach
- Field engineering
- Project implementation
- Data science
- Project technical review
- Evaluation
- Policy
- Regulatory reporting
- Regulatory oversight
Project planning tools are essential to communication, recordkeeping, management and evaluability of a whole building program. These include:

- A cross-functional process flow chart, corresponding RACI
- A policy and procedures manual (living document)
- A data and file specifications and workflow requirements document
Program Planning: Lessons Learned

- **Embedded EM&V**
  - Include in-house and third party evaluators at program planning stages and all phases of project’s life-cycle

- **Data management**
  - Single repository of record for project files
  - Manageable structure for file storage
  - Protocol for cleaning of interval-level energy usage data
  - Standardized weather data
Prior to project acceptance
- Document existing conditions at a premise through an on-site inspection
- Establishing premise boundaries, meter mapping, and metering
- Ensure planned measures meet influence requirements and meet energy saving thresholds
- Understand any self-generation issues

During and after installation
- Document EE measures
- Conduct site inspections
- Track performance, provide feedback
Communication throughout the project is crucial

Before the project:
- Manage customer expectations, consider “invite only”
- Understand potential site or customer limitations
- Identify available data streams, explore unexpected usage patterns

During implementation:
- Continue periodic check-ins
- Identify any scope changes or NREs

Post-implementation:
- Maintain rapport, ensure persistence
- Flag and identify causes of NREs
How EE can be competitive as a DERs?*

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<th>Drivers</th>
<th>Existing Conditions</th>
<th>Transition Plan</th>
<th>Future State</th>
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<tbody>
<tr>
<td>SB350 AB802 DER RFOs</td>
<td>Implementers have no insight on their savings</td>
<td>Dashboards to provide Implementers insight on savings from our existing programs</td>
<td>Implementers are confident when, where and how much savings they can reliably deliver at a competitive cost</td>
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<td>Current incentives not aligned with metered energy savings</td>
<td>P4P Programs that emphasize and reward savings “at the meter”</td>
<td>EE competes successfully in DER RFOs due to track record</td>
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<td>EE not seen as a reliable DER (history of deemed savings)</td>
<td>EE gains recognition for delivering on metered savings</td>
<td>EE delivers savings as a reliable DER</td>
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*Distributed Energy Resources*
On March 22, 2018, the California Independent System Operator (CAISO) approved PG&E’s Oakland Clean Energy Initiative (OCEI) to provide a clean alternative to three 55-megawatt units at Dynegy’s Oakland plant in Jack London Square. PG&E’s plan is to replace the power demand with a mix of energy efficiency, DR and battery storage beginning in mid-2022.

On January 11, 2018 the CPUC approved a plan to close Unit 1 in 2024. Unit 2 is scheduled for retirement in 2025. Diablo Canyon generates almost 18,000 gigawatt-hours of power each year, powering 1.7 million homes.
Usain Bolt wins the 2008 Beijing Olympics 100M sprint in 9.69 seconds. In 2016, he won his “Triple-triple” – clean sweep of 100m, 200m and 4x100m gold medals at three successive Olympic Games. Doping by Carter undid his 3-3.
### CALTRACK Dashboard – AHUP Savings

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<tr>
<td>Projects Meeting Data Sufficiency</td>
<td>3,019</td>
</tr>
<tr>
<td>Electric EEMeters</td>
<td>2,278</td>
</tr>
<tr>
<td>Gas EEMeters</td>
<td>2,675</td>
</tr>
<tr>
<td>Annual kWh Saved per Project/Normal Year</td>
<td>598</td>
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<tr>
<td>Annual Therms Saved per Project/Normal Year</td>
<td>98</td>
</tr>
<tr>
<td>Annualized Electricity Percent Savings</td>
<td>7.1%</td>
</tr>
<tr>
<td>Gas Portfolio Percent Savings</td>
<td>16%</td>
</tr>
</tbody>
</table>
AHUP Resource Curve

All Months

Summer Months Jun-Sep

Baseline Loadshape Over A Typical Day (Day Type(s): All, Month(s): All)

Baseline Loadshape Over A Typical Day (Day Type(s): All, Month(s): June, July, August, September)

Electric Load -> Shapes

Electric Savings -> Shapes

Powered By OpenEEMeter

CaITRACK-Compliant
Conclusions

The Pay for Performance approach addresses many State, CPUC, PG&E and customer objectives

- 3P: Programs are 3rd party designed and operated
- AB802: Incentives paid for savings at the meter, includes BROs
- SB350: Achieves significant site energy use reduction
- AB793: Includes EMSs
- Scalable from a market perspective: Aggregators are free to design and modify their program delivery model in response to market demands
- Scalable from a PG&E funding perspective: Incentive payments are fixed at prices that ensure a scalable and sustainable TRC and PAC
- Protects Public Purpose funding: incentives are only paid for realized energy savings
- Helps EE become a reliable DER (Distributed Energy Resource)
Thank You!

Scott Broten, ICF

Jonathan Budner, Build It Green

Alison Erlenbach, Pacific Gas & Electric Company

Justin Kjeldsen, Franklin Energy

Leif Magnuson, Pacific Gas & Electric Company

Brian Maloney, Southern California Edison

Lisa Schmidt, Home Energy Analytics

Moderator: Hilary Polis, Opinion Dynamics
DR Evaluation—Changing Landscape

Joshua Schellenberg, Nexant

Moderator: Greg Wikler, Navigant
IT IS ORDERED that:

1. The Demand Response (DR) Load Impact Estimation Protocols in Attachment A (Adopted Protocols) are adopted for use by Southern California Edison Company (SCE), San Diego Gas & Electric Company (SDG&E), and Pacific Gas and Electric Company (PG&E).

2. Within 90 days of the date of this decision, SCE, SDG&E, and PG&E shall file initial evaluation plans on all DR activities for the year 2008.

3. SCE, SDG&E, and PG&E shall follow adopted protocols 1 through 26 in preparing load impact estimates to be filed in their 2009-2011 DR Applications on June 1, 2008.

4. SCE, SDG&E, and PG&E shall perform annual studies of their DR activities using the adopted protocols, and shall file reports consistent with Protocol 26 annually on April 1 of each year in this or a successor proceeding. If this and all successor proceedings are closed, the utilities shall file these reports with the Commission’s Energy Division and serve them on the most recent service list for this, or a successor proceeding. The information contained in those reports may be used in other Commission proceedings, as appropriate.

5. SCE, SDG&E, and PG&E shall use the adopted protocols to estimate DR load impacts for long-term procurement planning and resource adequacy purposes, unless otherwise directed by the ALJ or Assigned Commissioner in the relevant Commission proceeding.
Ex Post and Ex Ante DR Load Impact Estimation Process

- **Historical Data**: Weather, Event days, Participant characteristics, Interval data (sample or population)

- **Statistical Analysis**: Evaluation planning, Methodology, Selection, Regression, RCT, Other

- **Forecast Data**: 1-in-2 and 1-in-10, Weather data, System load data, Day traits, Measurement and verification studies, Participation forecasts

- **Ex post load impacts**

- **Ex ante load impacts**

- **Ex ante adjustments**: Day types, 1-in-2 weather year, 1-in-10 weather year, Average weekday by month, Monthly system peak day, Weather, Participant characteristics, Other – e.g. switch failures

- **Cost-effectiveness tests**: DR costs, DR benefits

- **Comparison with other resources**: DSM alternatives, Generation alternatives

Process leverages **more than 1 billion** hourly meter reads from Advanced Meter data each year.
Consistent Evaluation Process and Output = Reliable Comparison and Aggregation of a Wide Variety of DR Resources

<table>
<thead>
<tr>
<th>Emergency</th>
<th>Price-responsive</th>
<th>Demand Response Aggregator-managed</th>
<th>SmartConnect®-enabled</th>
<th>Nonevent Based</th>
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</thead>
<tbody>
<tr>
<td>Base Interruptible Program with 15-minute advance notice (BIP-15)</td>
<td>Summer Discount Plan – Commercial (SDP-C)</td>
<td>Capacity Bidding Program with Day-ahead Notification (CBP-DA)</td>
<td>Save Power Day (SPD) - with enabling technology</td>
<td>Real Time Pricing (RTP)</td>
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<tr>
<td>Base Interruptible Program with 30-minute advance notice (BIP-30)</td>
<td>Summer Discount Plan - Residential (SDP-R)</td>
<td>Capacity Bidding Program with Day-of Notification (CBP-DO)</td>
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<td>Permanent Load Shifting (PLS)</td>
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<tr>
<td>Agricultural and Pumping Interruptible Program (AP-I)</td>
<td>Default Critical Peak Pricing (CPP) - Large</td>
<td>Aggregator Managed Programs (AMP)</td>
<td></td>
<td></td>
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<tr>
<td>Default Critical Peak Pricing (CPP) - Medium</td>
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<tr>
<td>Default Critical Peak Pricing (CPP) - Small</td>
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<tr>
<td>Demand Bidding Program (DBP)</td>
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</tbody>
</table>

SCE Example
SCE 2018 Portfolio Aggregate Ex Ante Load Impact Estimates

![Graph showing aggregate load impact estimates by month for 1-in-2 and 1-in-10 system conditions.](chart.png)
Demand Response Auction Mechanism (DRAM) Highlights Importance of Protocols

- Four-year “Pilot” (2016-2019)
- $63 million in contracts
- Effectively $0 for third-party evaluation (exempt from Protocols)
- Issues with long-awaited CPUC evaluation that does not follow Protocols and does not publicly release Audit reports
- SCE Audit (by Nexant) and PG&E Audit raise significant concerns that could have been identified much earlier if DRAM were subjected to the Protocols
- Current CPUC Staff proposal is to extend “Mechanism” for 5-6 more years with an independent evaluation report to be released in mid-2023
Thank You!

Joshua Schellenberg, Nexant

Moderator: Greg Wikler, Navigant
Lunch Break:
Please Return at 1:15pm

Thank You To Our Sponsor!
Lessons from the Field: NMEC, P4P and Challenges of Real-Time M&V

Carmen Best, OpenEE

Jessica Granderson, Lawrence Berkeley National Laboratory

David Jump, kW Engineering

Moderator: Brian Arthur Smith, Pacific Gas & Electric Company
Site-Specific NMEC – An Overview

David Jump
kW Engineering
Who is kW?

- HQ in Oakland, Offices in Long Beach, Salt Lake City, Chicago, New York
- Energy Engineering
- Bay Area’s Top 50 Engineering firms
- Serving Clients since 1998

Services

<table>
<thead>
<tr>
<th>Energy Audits</th>
<th>Retro-commissioning</th>
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<tbody>
<tr>
<td>Commissioning</td>
<td>Renewable Systems</td>
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<tr>
<td>Measurement &amp;</td>
<td>Research</td>
</tr>
<tr>
<td>Verification</td>
<td>Demand Response</td>
</tr>
<tr>
<td>Management</td>
<td>Models / Simulation</td>
</tr>
<tr>
<td>ENERGY STAR</td>
<td>Training</td>
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</table>

www.kw-engineering.com
Baseline Period

1. Project Pre-Screening
   • Facility condition
   • Savings potential (e.g. deep savings)
   • ‘Predictable’ energy use patterns
   • Non-routine events (NREs)

2. Energy Audit / Energy Management Plan
   • Documentation of baseline equipment and conditions
   • List of measures, savings, costs, measure life

3. M&V Plan
   • Baseline period
   • Data to be collected
   • Analysis procedures (incl. NRE treatment)
   • Savings reporting & frequency

Installation Period

4. Measure Verification
   • Document installation & proper operation
     • Inspection
     • Functional testing
     • Trend analysis

Performance Period

5. Savings Performance Check
   • Periodically during performance period
   • QA check that savings are accruing
   • Detect presence of NREs

6. Savings Reporting
   • Per M&V Plan
   • A to Z report on savings
     • Raw data to final savings
     • NRE impacts included

[Graph showing timeline and performance periods]
<table>
<thead>
<tr>
<th>Phase</th>
<th>Program Design</th>
<th>Pre-Recruitment</th>
<th>Recruitment</th>
<th>Baseline</th>
<th>Installation</th>
<th>Performance</th>
<th>Program Wrap-Up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Customer Outreach present program - assess feasibility</td>
<td>Audit/ID Measures - Create M&amp;V Plan</td>
<td>- Provide implementation assistance - Verify installed measures</td>
<td>- Track and report savings - ID NREs, quantify impacts - NMEC Savings Analysis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Provide - Program status reports</td>
<td>Provide - participant data - ECMs - savings potential</td>
<td>Provide - participant data - ECMs installed - savings progress reports</td>
<td>Provide - program status reports - ECMs installed - savings progress reports</td>
<td></td>
</tr>
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</table>
## NMEC Resources

### Guidelines

- **SCE NME Savings Procedures Manual**

### M&V Tools

- **ASHRAE RP1050 Change Point Models**
  - Energy Explorer
    - [http://academic.udayton.edu/kissock](http://academic.udayton.edu/kissock)
  - Energy Charting and Metrics Tool (Excel add-in)

- **LBNL TTOW Model**
  - Universal Translator, v3
    - [www.utonline.org](http://www.utonline.org)
  - Various R, Python M&V Code
    - LBNL RM&V2.0

- **Proprietary**
  - BuildingIQ
  - Gridium
  - Etc.

- **Validation with test data sets and protocols (LBNL)**
Connecticut Advanced M&V Pilot

Jessica Granderson
Lawrence Berkeley National Laboratory
Status

• Commenced 2017
• Commercial pilot wrapping up
  - 34 pilot sites
  - Variety of measure types
  - Savings monitored for 9-12 months
  - Meter-based vs traditional calcs
• Residential pilot in early phase
Some In-progress Takeaways

• Advanced M&V method works as expected

• Building a library of examples with diverse project types, facility types, and data characteristics

• Advanced M&V and associated tool visualizations allow for
  - Early feedback on savings
  - Characterization of savings by hour/day/season
  - Investigation of possible NREs, underperforming projects

• Model fitness metrics and charting support confidence, transparency in results

• Data increases visibility into performance, and questions about what we see
Value of Continuous Insight, Example 1

Good model fit to baseline data using standard metrics

Believable post-install consumption profile

Clean savings profile
11.9% savings metered
12% estimated using traditional approach
Value of Continuous Insight, Example 2

Good baseline model fit, but metered savings far less than estimated, and metered savings stop accruing.

Zooming in to the period when something changed ....

... and zooming in further...
Lessons From The Field

Carmen Best
OpenEE
Primary Lesson:

We don’t have a methods issue

We have a market issue
Standardized **M&V is enabling market solutions**...

The plan to achieve the objectives include a couple of simple but impactful strategies: to **provide wraparound services and support**, and to test and demonstrate **innovative deployment methods**.

(SMB P4P Implementation Plan)

Thus, the core of the P4P model is the design and **alignment of the performance-based requirements** between the program administrator and the service provider as well as the corresponding services/requirements between the service provider and the customer. (New Efficiency: New York)

...expand meter-based savings pilot programs, including pay for performance pilot programs by January 1, 2019. (Executive Order No 17-20, Accelerating Energy Efficiency in Oregon’s Built Environment to **reduce GHG Emissions** and Address Climate Change)

...seeks to develop a **scalable model for residential retrofits** that leverages rapidly emerging market actors and products while minimizing administrative and implementation costs. (Original HOPPS advice letter Res P4P)
The energy efficiency savings and demand reduction .... achieving the targets established pursuant to paragraph (doubling of EE by 2030) shall be measured taking into consideration the overall reduction in normalized metered electricity and natural gas consumption where these measurement techniques are feasible and cost effective.” – SB 350
Methods

VISION: Meter-based savings & performance drives investment in grid impacts

STATUS QUO: Deemed savings & disconnect with grid impacts or performance
Many Challenges in P4P Setup are not the M&V

- Aggregators are still bidding in the dark
- Finance and performance risk insurance are still being set up
- Innovation still in earliest stages
- Edge cases are still being discovered and worked out
- Fit with other DER’s a big barrier to effective scale
One of NMEC’s key value points:

The opportunity to improve the regulatory paradigm

- + Policy direction & Forecasts
- + Embedded M&V
- + Real Time Adaptation
- + Scope of all DERs
- + Data & Analysis (not just reports)
- + Longer term trends
- + Longer term trends
Primary Action

Get practice through **doing**

**Iterate** to improve

Focus on the **market** challenges
Thank You!

Carmen Best, OpenEE

Jessica Granderson, Lawrence Berkeley National Laboratory

David Jump, kW Engineering

Moderator: Brian Arthur Smith, Pacific Gas & Electric Company
Non-Routine Events: What’s the Big Deal?

Todd Amundson, BPA
Faith DeBolt, SBW Consulting
Jessica Granderson, Lawrence Berkeley National Laboratory

Moderator: Christie Torok, California Public Utilities Commission, Energy Division
Non-Routine Events

Jessica Granderson
Lawrence Berkley National Laboratory
Definition

NREs cause changes in consumption that are not related to the installed measures, or variables already normalized for
Why Are NREs Important?

- Present potential risk to NMEC savings claims
  - Over/under estimating savings
  - Cost and uncertainty associated with making complex adjustments

- We have collective experience, but not comprehensive data/research to assess risk
  - How frequently do NREs occur (and what types)?
  - Magnitude of impact?
  - Impact of aggregation to mitigate risks?
State of Guidance

• Some guidance frameworks exist, e.g.
  - CPUC site-specific NMEC technical guidance
  - Investor confident program
  - IPMVP subco work in progress

• Can be characterized
  - Temporary/permanent
  - Load added/removed
  - Constant/variable load impact

• Can be monitored/tracked
  - Periodic/continuous data and savings analysis
  - Periodic site contact

• Can be foreshadowed based on measure, building type

• Should be transparently documented

<table>
<thead>
<tr>
<th>Services</th>
<th># of rooms/beds</th>
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<tbody>
<tr>
<td></td>
<td>food cooking/preparation</td>
</tr>
<tr>
<td></td>
<td># of registers</td>
</tr>
<tr>
<td></td>
<td># of workers</td>
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</table>

<table>
<thead>
<tr>
<th>Equip. loads</th>
<th># of computers</th>
</tr>
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<tbody>
<tr>
<td></td>
<td># of walk-in or standard refrigeration units or open and closed cases</td>
</tr>
<tr>
<td></td>
<td># of MRIs</td>
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<tr>
<td></td>
<td># or capacity of HVAC units</td>
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</table>

<table>
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<tr>
<th>Operations</th>
<th>hours of operation</th>
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<tbody>
<tr>
<td></td>
<td>weekend operations</td>
</tr>
<tr>
<td></td>
<td>heating and cooling setpoints</td>
</tr>
<tr>
<td></td>
<td>system control strategies</td>
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<thead>
<tr>
<th>Site charact.</th>
<th>size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of building heated and cooled</td>
</tr>
<tr>
<td></td>
<td>envelope changes</td>
</tr>
</tbody>
</table>
Active Research

- Statistical analytics being researched to flag/account for NREs based on meter data
- Visualization methods also being explored
Non-Routine Events

Faith DeBolt
SBW Consulting
Findings from Our Study

• NMEC models consistently produce accurate estimates of changes in whole building energy use
  -Proprietary models do not produce better results than transparent open-source, public domain models
• Calibrated simulation models had many issues which introduce significant uncertainty in savings estimates
• 2-3 times more expensive to estimate savings from calibrated simulation models than NMEC models
• Neither implementers nor vendors adequately monitored for non-routine events
Non-Routine Events??

- Log building changes!!
- Statistical detection
  - Anomalous data compared to model (high residuals)
  - Single point outliers vs. series of anomalies over days or weeks
  - Are series anomalies indicators of NREs?
- Series anomalies detected in relatively small fraction of year (<5%) for all but 2 electric models
- Statistical approach identified reported NREs
  - More work needed to estimate impact statistically
Results - Overview

- **Graphs showing electric savings**
  - Grocery Sites
  - Non-Grocery Sites

- **Percentage Electric Savings**
  - ECAM
  - Proprietary A
  - Proprietary B
  - TTOW
  - MW
  - Option D

- **Graphs showing gas savings**
  - Grocery Sites
  - Non-Grocery Sites

- **Sites and Locations**
  - Office 1, Office 24, Office 44, Office 51, Office 54, Office 60, Library 52
Non-Routine Events

Todd Amundson
BPA
BPA Energy Smart Industrial SEM

• 2017 Impact Evaluation Affirmed ESI Monitoring, Targeting and Reporting (MT&R) methodology
Scenarios for Model Re-assessment

Static adjustment

- Change in electrical load within a well-defined boundary and with minimal interactive effects.
- Example: Addition of scrubber equipment to meet safety requirement

Minor Process Change

- Distinct change in operations without fundamentally changing the process itself.
- Example: Pulp and paper – new product type requiring additional refining

Major Process Change

- A fundamental change energy consumption characteristics of the facility, rendering the original model specification invalid.
- Example: Sustained increase or decrease in the observed level of an independent variable, outside the range for which the baseline model was established.

NRE Review and Documentation

- Energy Performance Tracking Team Review
  - Completion Report Documentation
  - Incorporation into Tracking Workbook
- MT&R Guidelines are updated routinely to incorporate new developments
- 2017 Evaluation Finding:

  Evaluation Findings

  Finding 1. The EPT team carefully documented the program implementation and collected the data required for evaluation. Overall, the EPT team’s EM Program data collection and documentation can serve as an industry standard for SEM programs. The EPT team’s ongoing

Thank You!

Todd Amundson, BPA
Faith DeBolt, SBW Consulting
Jessica Granderson, Lawrence Berkeley National Laboratory

Moderator: Christie Torok, California Public Utilities Commission, Energy Division
Afternoon Break: Please Return at 3:30pm

Thank You To Our Sponsor!
From the Shadows to the Spotlight: Impact Load Shapes

Special Introduction: Meghan Dewey, Pacific Gas & Electric Company

Paula Gruendling, California Public Utilities Commission

Manisha Lakhanpal, California Public Utilities Commission

Adam Scheer, Pacific Gas & Electric Company

Moderator: Jarred Metoyer, DNV-GL
What are Load Shapes?

• System 24-hour load shape = Duck Curve
• Whole Building – AMI data
• End use load shape – typical profile for HVAC, lighting, etc.
• Measure load shape – difference in baseline and post-intervention load shape

• CEDMC Fall Conference made many references to need for load shapes
Solar PV & AC are drivers of “Duck Curve” – 2018 was 4 years ahead of CAISO forecast
Cost-Effectiveness Trends Drive a New Paradigm

Load shapes obtained from: the Database for Energy Efficiency Resources; DEER 2011 Non-Res Indoor_Non-CFL_Ltg
Beyond Annual Savings – What is the Load Shape Impact?

Phase 2 DR Quantity Findings:
By 2025, Medium DR Scenario Suggests...

**Shape:** Conventional TOU / CPP rates effectively provide **1 GW Shed** & **2 GWh Shift** at ~zero cost. Deeper potential?

**Shed:** Generation overbuild means ~zero need for system-level shed, but **2-10 GW** in cost-effective local Shed & distribution system service.

**Shift:** **10-20 GWh** of cost-effective daily Shift (2-5% of daily load), with opportunity for system value at ~$200-500+M/year.

**Shimmy:** **300 MW** Load-following & **300 MW** Regulation. Opportunity for system-level total value is ~$25 M/year.
Current State of Load Shapes
Current “State” of Load Shape Information

DEER Peak
- Originally defined 2004
- Update of 2012 Weather
- Revised 2018 – Stakeholder push for no definition (could work if load shapes accurate)
- Complex - hundreds of measures and each can have a few thousand variations for building type, building vintage, climate zone, and heating fuel

Currently there is a Mix of different age information
- “E3” Avoided Cost Loadshapes in past and present Cost effectiveness Tool (CET) –
  - Oldest - Hours of use categories aligned with rates – Peak, Partial-peak, off-peak
  - Some – End use shape from IOU load research
  - Some – Measure load shapes from DEER

No clear path to push Ex ante or EM&V load shapes into cost effectiveness and IRP
Current state presents an issue to consider EE as a Resource

Staff Proposal for Incorporating Energy Efficiency into the SB 350 Integrated Resource Planning Process (EE-IRP)

Senate Bill (SB) 350 requires the CPUC to adopt an integrated resource planning (IRP) process to meet the greenhouse gas reducing targets set by the California Air Resources Board to achieve economy-wide greenhouse gas (GHG) reductions of 40% below 1990 levels, including a mechanism for load serving entities (LSEs) to file integrated resource plans that achieve these objectives. The CPUC in Decision D.18-02-018, which set requirements for LSEs filing integrated resource plans, directed staff to make data and modeling improvements for the optimization of distributed energy resources, including energy efficiency. This staff proposal aims at starting the discussion of EE integration in the IRP. Initial informal comments will inform staff led discussions on the various questions raised in this paper. These are yet to be scheduled. EE-IRP

*Attachment:* E3 EE Optimization Technical Analysis (FINAL).pdf
Options to Address Load Shape Needs
Duct Replacement

Before:

After:
Needs and Opportunity

Savings Load Shapes:

• Major factor in cost-effectiveness and GHG savings
• NMEC capabilities are here!
• Integrated offerings will bring new load shapes (load shifting)
• Need Cost Effectiveness Tool functionality upgrades
• Only half the story – Accurate avoided costs are vital
Arrival of Metered Load Shapes

Advanced Home Upgrade: Metered Savings

Savings highly dependent on time and season
**AHUP vs. Commercial Deemed**

**AHUP**

AHUP Savings more variable by time and season

**Commercial Deemed**

High portion of AHUP savings during summer peak hours

Comm Deemed: Baseload (24 x 7) savings
Avoided Costs

AHUP

AHUP savings largely during peak. Targeting can enhance further.

Avoided Cost Curve (CZ 4, 2024)

More grid-aligned locational avoided costs needed

3x P4P kicker for summer peak savings!
Putting it Together

Benefits = Savings Load Shape x Avoided Cost Curve (8760 Basis)

- High portion of benefits from avoided “grid” costs (capacity, T&D)
- Comm Deemed: 6% savings during summer peak = 37% of avoided costs; 30% of savings from 8 am – 3 pm = 5% of avoided costs
Options and Considerations

- AMI option for whole building retrofit and some interventions and end uses
- Calibrating building simulations or other models to AMI data or end use metering for measures that AMI cannot isolate or are masked by typical variation (noise)
- Upstream delivery is cost-effective and requires a non-AMI approach
Considerations

• How do we favor methods that deliver load shape impacts, whether in program planning or EM&V?
• How can programs incentivise load shape changes beneficial to reducing costs, emissions, and other need?
• How can emerging technology and new measures provide load shape shapes and incorporate them into filings, workpapers, and claims?
Thank You!

Special Introduction: Meghan Dewey, Pacific Gas & Electric Company

Paula Gruendling, California Public Utilities Commission

Manisha Lakhanpal, California Public Utilities Commission

Adam Scheer, Pacific Gas & Electric Company

Moderator: Jarred Metoyer, DNV-GL
Q&A

Moderator: Sharyn Barata, Opinion Dynamics
Concluding Statements

Melanie Gillette
Senior Policy Director
California Efficiency + Demand Management Council
Networking Happy Hour
Co-Hosted by the Council & AESP

Thank You to Our Sponsor!