PY2013–2014 EMERGING TECHNOLOGIES PROGRAM TARGETED EFFECTIVENESS STUDY REPORT

VOLUME II: APPENDICES

Prepared by

Opinion Dynamics Corporation
Energy & Resources Solutions

For the

California Public Utilities Commission
Energy Division

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PY 2013–2014 EMERGING TECHNOLOGIES PROGRAM TARGETED EFFECTIVENESS STUDY VOLUME II

Prepared under the direction of the **Energy Division** for the

California Public Utility Commission

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Submitted by

Mary Sutter, Brian McCowan, Olivia Patterson, Michael Rovito, and Allison Donnelly

Opinion Dynamics
1999 Harrison Street, Suite 1420
Oakland, CA 94612
opatterson@opiniondynamics.com
510-444-5050

Energy & Resource Solutions
120 Water Street, Suite 350
North Andover, MA 01845-2648
adonnelly@ers-inc.com
978-521-2550

Additional staff contributing to the study

Paula Gruendling, CPUC Project Manager
Paula.Gruendling@cpuc.ca.gov
415-709-1925

Ralph Prahl, CPUC Advisor for the study
ralph.prahl@gmail.com
608-334-9942

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A.1. Assessment of Activities Interview Guides

Below we provide the following guides:

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1.1.1. ETP Program Manager Interview Guide

1. Can you describe the process by which you choose to undertake a specific project or projects for an emerging technology, solution, or practice? What factors contribute to that decision? [Probe: decision between TA/TDS/TIS, how are barriers to adoption assessed, how is budget allocated (i.e. by subprograms, activities, technologies, or as projects arise)]
2. What barriers are you trying to address when you work with an emerging technology? [Probe: how do you assess what barriers are facing a technology?] How do you select activities to address them?
3. How do you coordinate within ETP when you undertake multiple projects on the same technology? With the other IOUs?
4. Is there a way that you track how a technology progresses through the stages of product development? [For example, if there are multiple projects on ZNE, how do you assess its progress as a technology/solution?]
5. How do you judge whether a specific project (not the overall program) has been successful? Are there project- or technology-specific metrics you collect? Are the initial scanning & screening tools revisited?

1.1.2. Peer-Like Program Interview Guide

To help assess the effectiveness of the California Emerging Technologies Program (ETP) activity selection process, ERS will interview ten technology experts at other ETP-like programs across the US. This interview will consist of a single 1.5-hour interview with three parts. The third section will assess the project selection process by asking experts to comment on the barriers faced by specific technologies, providing a short snapshot of CA ETP-specific data via a GoToMeeting interface, and asking whether the activities chosen by ETP address those barriers.

For the purposes of this interview, ERS is interested in the following emerging technologies. The expert should choose three (or fewer, if necessary) of the technologies for which they feel sufficiently comfortable to answer the questions in part three of the interview guide. The options include:

1. Domestic hot water heat pumps
2. HVAC heat pumps (e.g., ground source, variable capacity…)
3. Plug-load efficiency
4. Smart thermostats
5. Commercial whole-building EMS/continuous commissioning systems
6. Advanced lighting controls for commercial spaces (i.e., multi-sensor control systems)
7. Screw-in LED lamps
8. Troffer LEDs
9. Residential Zero Net Energy retrofit
10. Boiler controls (reset/other load limiting control systems)

Background/Your Program (~30 minutes)

1. What is your role in your emerging technology program? How long have you been with your program? What is your background?
2. When was the program started?
3. What are the goals of your program? [Probe on: acting as feeder program to resource acquisition programs v. research program without link to portfolio of EE programs; commission goals/directives]
4. How does your program define an emerging technology? What phases of the technology development process does your program intervene? [Probe: commercially available or feasible, R&D phase or afterwards]
5. What types of activities do you deploy through your program? [Probe: program design program interventions, exploration of customer barriers, market barriers/potential, or gathering information about equipment parameters]
6. Can you describe the types of information and outcomes you like to obtain through the different activities? [Probe: goals of one activity vs. another]
7. Can you describe the process your program uses to decide what activities to use for a project? What factors contribute to that decision? [Probe: priorities, barriers, budget, top-down/bottom-up?] Do you

choose, budget, and manage via discrete and unique projects, or do you choose your research and budgets through an overarching mandate for a type of technology, or some other form of organization?

8. What is your annual budget? About how many projects does this budget tend to support? [Probe by type of activity with alignment to ETP subprograms]
9. How much funding does a typical project require? A range is fine. [Probe for differentiation by type of activity]
10. What success metrics are used?
11. Are there any regulatory or other constraints (e.g., charter) that limit how your program can approach projects? If so, what are they?

The California Emerging Technologies Program (~15 minutes)

12. Do you or your program have any relationship to CA's ETP? If so, what is it? [Probe: help setting up the program/advice; funding from ETP, CEC; letters of support; familiarity with ETCC/ETP website/reports]
13. Did you or your program collaborate or coordinate with CA's ETP on any of the technologies shown in the background sheet? What was the nature of the collaboration or coordination?
14. Based on your reading of the background sheet and your prior knowledge of the CA ETP, what is your understanding of the program? [Probe: purpose, goals, constraints]
15. Were you surprised by anything you learned from the background sheet?
16. What do you believe are the greatest differences, if any, between your program and the CA ETP?
17. Are there any ETP practices that your program has adopted? Is there anything your organization/program does that you think ETP should be doing? Is there anything ETP is doing that you wish your organization would start doing?

Technology-specific (~45 minutes; 15 minutes per technology)

For each of the three technologies selected:

18. What do you believe are (or were) the barriers to adoption faced by this technology?
19. If you were to name the biggest unknown about this technology and how it may save energy, what would it be?
20. Has your program done any work on this technology? If so, what types of activities did you deploy? For each activity, what was the objective?
21. [The interviewee will be shown the technology snapshot at this point in the interview] For this technology, the CA ETP is using (or used) the following activities [the snapshots will include project summaries for each technology type discussed].
    1. [For each barrier] How do the activities chosen by ETP for this technology target the barrier _____ you identified? (insert barrier that was mentioned, repeat for each barrier that was mentioned)
    2. [For each barrier] What other types of activities do you think could have yielded useful information?
    3. Do any of the ETP activities seem redundant or inappropriate? Why?

1.1.3. Background on CA ETP for Peer-Like Interviews

The following document outlines some of the key aspects of the ETP.

ETP's Mission

From the ETP program implementation plan: "The mission is to support 'increased energy efficiency market demand and technology supply' (the term supply encompassing breadth, depth, and efficacy of product offerings) by contributing to development, assessment, and introduction of new and under-utilized energy efficiency (EE) measures (that is, technologies, practices, and tools), and by facilitating their adoption as measures supporting California's aggressive energy and demand savings goals."

In plain English:

- ❑ To support IOU's energy efficiency programs by identifying and assessing the performance of emerging EE technologies that may be offered through these programs
- ❑ To support increased energy efficiency market demand and technology supply with targeted activities.
  - ➢ Upstream: Educate technology developers and communicate technical requirements for rebated measures (e.g., Technology Resource Incubator Outreach)
  - ➢ Downstream: Attempt to affect end user perceptions by exposing applications in real-world settings (e.g. scaled field placements)

ETP Basics

The Statewide ETP is implemented by the four investor-owned utilities (IOUs). Table 1 shows those utilities and their approved 2013-2014 cycle budgets

Table 1 – Summary of Statewide ETP Budget

IOU	Budget	
	Total (Million $)	Percent of IOU's Portfolio Budget
Pacific Gas & Electric (PG&E)	12.30	1%
Southern California Edison (SCE)	21.19	3%
San Diego Gas & Electric (SDGE)	2.70	2%
Southern California Gas (SCG)	2.52	1%
Total	**38.70**	**2%**

The Tools in the Toolkit

ETP is divided into three subprograms that have distinct goals, which are summarized in Table 2.

Table 2 – Summary of ETP Subprograms

Subprogram	Goals
Technology Development Support	Increase EE technology supply (Support the development of new technologies)
Technology Assessments	Increase number of measures offered by EE programs (Identify promising technologies for EE programs)
Technology Introduction Support	Support technology introduction and whole-building deep-energy reduction solutions ("Seed" market demand among targeted end users)

The programs deploy a range of activities in support of these goals and as part of these subprograms. Common activities include:

1. Lab evaluation: Laboratory testing of a technology to evaluate performance claims and overall effectiveness.
2. Field evaluation: *In-situ* testing of a technology to evaluate performance claims and overall effectiveness.
3. Behavioral study: Targeted research to understand customer needs, perceptions, acceptance, and 'decision triggers' towards new or underutilized technologies. This may be done through either primary or secondary research.
4. Market study: Targeted research to understand overall market readiness or potential for a new or underutilized technology. This may be done through either primary or secondary research.
5. Demonstration showcase: A real-world display of technologies at a site that is intended to expose target audiences to new measures. It is open to the public or an interest group, many viewers are encouraged to visit, and it highlights a systems approach rather than an individual measure.
6. Scaled field placement: Placement of a new technology in a customer's facility for the purposes of educating end-users or stakeholders through firsthand experience with the technology.
7. Paper study: Calculations, modeling, and/or literature review to evaluate performance claims and overall effectiveness. Desk review only.
8. Test standard development: Targeted opportunities to develop standard test protocols for energy efficient products in support of the statewide Codes & Standards Program.
9. Training program: Initial development of training materials or syllabi in response to a gap in existing training or knowledge among tradesmen/market actors.
10. Tool development and enhancement: Developing savings estimators or enhancing energy modeling to include new technologies in order to smooth adoption.

A.2. ETCC Dissemination Survey Instrument

Effectiveness of ETCC Subscriber ETP Dissemination Efforts
Internet Survey - DRAFT
November 2014

This is a web-based survey that will go to a census of 2,180 Emerging Technologies Coordinating Council (ETCC) subscribers.[1] We will send an email invitation to each email address provided through our sample request (DR#302) that includes a unique URL link to an Internet survey. In general, the survey seeks to assess the effectiveness of dissemination efforts, including who the subscribers are, the degree of engagement with information found through the ETCC, and any actions taken due to the ETCC dissemination efforts.

Areas of Research	Description
Reach	Who are ETCC subscribers?
Purpose	Why did they choose to subscribe?
Awareness of Dissemination Activities	Are ETCC subscribers aware of ETP activities and information?
Engagement	Do ETCC subscribers engage with available ETP information?
Actions Taken	What effect does the ETP information have on subscribers?

Email Invitation

From: Opinion Dynamics on behalf of the California Public Utilities Commission

Subject: Feedback on the Emerging Technologies Coordinating Council (ETCC)

The California Public Utilities Commission (CPUC) is interested in learning about your opinions regarding information you found on or through the Emerging Technologies Coordinating Council (ETCC), of which you are a subscriber.

The Emerging Technologies Coordinating Council (ETCC) provides a means to coordinate its members' energy efficiency work to facilitate the development, assessment and introduction of promising energy efficient emerging technologies that will benefit California customers. ETCC members are the four California's investor-owned utilities (IOUs), the Sacramento Utility District (SMUD), the Los Angeles Department of Water and Power

[1] We removed 21 contacts from the existing sample that are known affiliates of ETP.

(LADWP), and the California Energy Commission (CEC) with oversight of the California Public Utilities Commission (CPUC).

We hope you will take a few minutes to let us know about your impressions.

To ensure that your responses are anonymous, a third-party research firm, Opinion Dynamics, is conducting this survey. To confirm Opinion Dynamics is one of CPUC's approved contractors go to www.cpuc.ca.gov/eevalidation.

Please click on the link below to take this short survey: [INSERT UNIQUE URL TO SURVEY]

Your assistance is critical to this important study, and your participation will help the CPUC better understand the performance of this effort. If you have any questions or concerns about this study, please feel free to contact me. Thank you in advance for your assistance.

Sincerely,
Paula Gruendling
Energy Division
California Public Utilities Commission
paula.gruendling@cpuc.ca.gov

Survey Instrument

Thank you for your willingness to provide feedback about your experience with the Emerging Technologies Coordinating Council *(*ETCC).

Throughout this survey, we ask a series of questions regarding the Emerging Technologies Coordinating Council *(*ETCC). Some of the questions that we ask may not be relevant to your profession or interests. Please feel free to select the "Not Applicable" option where it applies.

Introduction

S1. Do you work for any of the following organizations?
1. I work for CEC, SMUD, LADWP, PG&E, SCE, SDG&E or SCG
2. I work for the California Public Utilities Commission (CPUC)
3. I am an evaluation contractor for the California Public Utilities Commission, the California Investor Owned Utilities (PG&E, SCE, SDG&E or SCG), LADWP, or SMUD
4. I do not work for any of these organizations

[ASK IF S1=1, 2, or 3]

S1a. Are you directly involved in administering, evaluating or overseeing ETP as a core part of your job responsibilities?

[**MORE INFORMATION [HOVER OVER DEFINITION]:** The Emerging Technologies Program is a ratepayer-funded program implemented by the four investor-owned utilities (IOUs): Pacific Gas & Electric, Southern California Edison, Southern California Gas, and San Diego Gas & Electric. The program supports the IOUs energy efficiency programs by identifying new technologies. It also supports increased energy efficiency market demand and technology supply by contributing to the development, assessment and introduction of new and under-utilized energy efficiency technologies. The program is responsible for running and maintaining the ETCC website.]

1. Yes **[THANK AND TERMINATE]**

2. No

S2. Do you recall subscribing to the ETCC? **[HOVER OVER DEFINITION ON ETCC:** Emerging Technologies Coordinating Council**]**
1. Yes
2. No

Reach

R0. Please indicate in what professional capacity you subscribed to the ETCC. *Please select all that apply*. [MULTIPLE RESPONSE]
1. I am an energy efficiency professional
2. I am an emerging technology consumer
3. I am an emerging technology developer, vendor, manufacturer or distributor
00. Other: Specify

R1. Please briefly describe your professional or personal interest in the ETCC. [OPEN END]

R2. Please select the most appropriate description of your professional status:
1. Employed
2. Unemployed
3. Retired
4. Student

R3. How did you learn about the ETCC? *Please select all that apply*. [MULTIPLE RESPONSE]
1. Attended an ETCC event
2. Attended a non-ETCC event
3. Through friends or co-workers
4. Through a utility
5. Internet search
6. Participated in a project
7. On-going involvement with the ETCC
00. Other, specify [OPEN END]

98. I do not recall

Awareness of the ETP Program

EA1. The Emerging Technologies Program is a ratepayer-funded program implemented by the four investor-owned utilities: Pacific Gas & Electric, Southern California Edison, Southern California Gas, and San Diego Gas & Electric. The program supports the IOUs energy efficiency programs by identifying new technologies. It also supports increased energy efficiency market demand and technology supply by contributing to the development, assessment and introduction of new and under-utilized energy efficiency technologies. The program is responsible for running and maintaining the ETCC website.

How familiar are you with the Emerging Technologies Program?

Not at all familiar	Slightly familiar	Somewhat familiar	Moderately familiar	Extremely familiar
1	2	3	4	5

P2. How interested are you in emerging energy efficiency technologies? [**MORE INFORMATION [HOVER OVER DEFINITION]:** FOR "emerging energy efficiency technologies" – "Emerging technologies are new energy efficiency technologies, systems, or practices that may have significant energy savings potential but have not yet achieved sufficient market share (for a variety of reasons) to be considered self-sustaining or commercially viable."]

Not at all interested	Slightly Interested	Somewhat Interested	Very Interested	Extremely Interested
1	2	3	4	5

[ASK IF R2=1]

EA2. Does your job require you to: [1=Yes, 2=No, 96=Not Applicable]

a. Learn about emerging energy efficiency technologies?
b. Purchase emerging energy efficiency technologies?
c. Recommend emerging energy efficiency technologies?
d. Use emerging energy efficiency technologies?

[**MORE INFORMATION [HOVER OVER DEFINITION]:** FOR "emerging energy efficient technologies" – "Emerging technologies are new energy efficiency technologies, systems, or practices that may have significant energy savings potential but have not yet achieved sufficient market share (for a variety of reasons) to be considered self-sustaining or commercially viable."]

Purpose

P1. Please select all of the reasons you chose to subscribe to the ETCC [ROTATE, KEEP I AT END, MULTIPLE RESPONSE]

Please select all that apply	(Hover over descriptions)	✓
a. To get information about the ETCC Open Forum	The ETCC Open Forum is a semi-annual forum that provides an opportunity for energy-efficient technology developers and entrepreneurs to present promising technologies in a brief, structured format.	
b. To get information about the ETCC Quarterly Meeting	This ETCC Quarterly Meeting convenes experts from industry, research centers, utility and government entities working to advance energy efficiency. The meetings focus on policy drivers, emerging technologies and cutting-edge industry initiatives.	
c. To get information about the Emerging Technology Program	The Emerging Technologies Program is a ratepayer-funded program implemented by the four investor-owned utilities: Pacific Gas & Electric, Southern California Edison, Southern California Gas, and San Diego Gas & Electric. The program supports the IOUs energy efficiency programs by identifying new technologies. It also supports increased energy efficiency market demand and technology supply by contributing to the development, assessment and introduction of new and under-utilized energy efficiency technologies. The program is responsible for running and maintaining the ETCC website.	

d. To get information about TRIO events	Technology Resource Innovation Outreach (TRIO) is a program offered through the Emerging Technologies Program, which focuses on providing training and networking for entrepreneurs and companies that provide energy saving technologies.	
e. To get information about a specific technology	ETCC provides information about a variety of new energy efficiency technologies, systems or practices.	
f. To get information on an upcoming event	Events could include an ETCC Open Forum, Quarterly Meeting, or TRIO, amongst others.	
g. To get general information about emerging energy efficiency technologies, systems or practices	Emerging energy efficiency technologies are new energy efficiency technologies, systems, or practices that may have significant energy savings potential but have not yet achieved sufficient market share (for a variety of reasons) to be considered self-sustaining or commercially viable.	
h. To submit and receive feedback on emerging energy efficiency technologies, systems or practices	Emerging energy efficiency technologies are new energy efficiency technologies, systems, or practices that may have significant energy savings potential but have not yet achieved sufficient market share (for a variety of reasons) to be considered self-sustaining or commercially viable.	
i. Other (please describe)		
j. I do not recall (code as 98)		

P3. Please choose the broader technology areas that are of interest to you and then the sub-categories that will show up underneath each area. *Please select all that apply*. [MULTIPLE RESPONSE] [PROGRAMMING NOTE, ONCE THEY SELECT THE LARGER END-USE AREA, THESE ITEMS WILL DROP DOWN AND THEY REFLECT ETCC SUBSCRIBER FORMS]

□ Lighting □ Lighting, Commercial □ Lighting, Residential □ Daylighting - Commercial □ Daylighting – Residential □ Other, specify_____	**□ Water Related** □ Hot Water, Commercial □ Hot water, Residential □ Wastewater Treatment □ Water Pumping □ Steam Boilers □ Other, specify_____	**□ Building Shell / Controls** □ Building Controls □ Building Envelope □ Design Tools □ Other, specify_____
□ Heating / Cooling / Ventilation □ HVAC, Commercial □ HVAC, Residential □ Compressed Air Systems □ Variable Frequency Drives, Commercial □ Underfloor Air Distribution System □ Evaporative Cooling □ Heat Recovery □ Heat Treatment □ Desiccant Systems □ Displacement Ventilation □ Other, specify_____	**□ Cooking / Refrigeration** □ Commercial Cooking □ Refrigeration, Commercial □ Other, specify_____	**□ Process Related** □ Integrated Design Process □ Electronics & Process Controls □ Industrial-processes-other □ Other, specify_____

□ Motors	□ Other	
□ Motors, Industrial □ Motors, small □ Swimming Pool Pumps, Residential □ Other, specify_____	□ Demand Response □ Energy Conservation □ Transformers □ Optical Sensors □ Power Supplies □ Electrochromic Glazing □ Drycleaning Technologies □ Other, specify_____	

Awareness of Dissemination Activities

W1. Have you visited the ETCC website (www.etcc-ca.com) or read the ETCC Insight Newsletter since January 2013? *Please select all that apply*. [MULTIPLE RESPONSE]
1. Yes, visited the ETCC Website
2. Yes, read the ETCC Insight Newsletter
3. I have not done either **[SKIP TO E3]**

[ASK IF W1=1]

W2. How often do you typically visit the ETCC website?
1. Several times a week
2. Several times a month
3. About once a month
4. Once every two months
5. A few times a year
6. I have not visited the ETCC website since I subscribed

[ASK IF W1=2]

W3. How often do you read the ETCC Insight Newsletter…?
1. Every time it is written
2. Almost every time
3. Occasionally
4. Almost never
5. Never

[ASK IF W1=1 & W2≠6]

W4. Since January 2013, have you ***downloaded*** any reports published on the ETCC website?
1. Yes
2. No

[ASK IF W4=1]

W4a. Since January 2013, have you ***used*** any of the information that you downloaded from the ETCC website?
1. Yes
2. No

[ASK IF W4a=1]

W4b. How did you use the information? [OPEN END]

[ASK IF W4=1]

W4c. Since January 2013, have you ***shared*** any of the information that you downloaded from the ETCC website?
1. Yes
2. No

[ASK IF W4c=1]
W4d. With whom did you share the information? [OPEN END]

W5. Did you read any of the following information through the ETCC. *Please select all that apply*. [ROTATE] [MARK AS 1 if checked and 0 if not checked]

Please select all that apply	✓
a. Overview of the Emerging Technology Program	
b. Emerging Technology Program project reports and fact sheets	
c. Information on upcoming meetings & events	
d. Information about proposing an emerging technology for ETCC consideration or utility review	
e. Emerging Technology News	
f. None of the above	

Engagement

[ASK FOR EACH W5a-e=1]
E1. How easy was it to find the **<INSERT W5a-e>** through the ETCC ?

Very Difficult	Difficult	Neutral	Easy	Very easy
1	2	3	4	5

[ASK FOR EACH W5a-e=1]
E2. How useful was the **INSERT W5a-e>**?

Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
1	2	3	4	5

E3. How often do you learn new information through the ETCC?

Never	Almost never	Occasionally	Almost every time	Every time	Not Applicable
1	2	3	4	5	96

E4. How much do you agree with each of the following statements. [ROTATE]

	Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5	Not Applicable 96
a. I would recommend the ETCC to others who are looking for information about emerging technologies.	○	○	○	○	○	○

	Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5	Not Applicable 96
b. Information or articles found through the ETCC are helpful for my day-to-day work.	○	○	○	○	○	○
c. Information found through the ETCC has increased my level of knowledge relating to emerging technologies.	○	○	○	○	○	○

E5. How often do you: [ROTATE]

	Never 1	Almost never 2	Occasionally 3	Almost every time 4	Every time 5	Not Applicable 96
a. Look to the ETCC when searching for information about emerging efficient technologies?	○	○	○	○	○	○
b. Send information that you found through the ETCC to friends or colleagues?	○	○	○	○	○	○

E6. Since January 2013, have you done any of the following? [RECORD 1=Yes, 2=No, 96= Not Applicable] [ROTATE]
- a. Attended a meeting, presentation or conference with representatives from the ETCC?
- b. Encountered emerging technology information through your utility's Energy Center?
- c. Attended any events (such as the ET Summit, Open Forum and TRIO) listed by the ETCC?

Actions Taken

A1. Have you taken any of the following actions related to technologies featured by the ETCC? [RECORD 1=Yes, 2=No, 96= Not Applicable] *Please select all that apply.*
1. Purchased a featured technology?
2. Recommended a featured technology?
3. Used a featured technology?

[ASK IF A1=1, 2, or 3]
A2. What technologies did you [READ IN BASED ON A1 responses: purchase, recommend, or use]? [OPEN END]

[ASK IF A1=1, 2 or 3]
A2a. When you [READ IN BASED ON A1 responses: purchase, recommend, or use] an emerging technology, how often do you use information from the ETCC to help make that decision?

Never	Almost never	Occasionally	Almost every time	Every time
1	2	3	4	5

[ASK IF A1=1, 2 or 3]

A3. How influential was the information you found through the ETCC on your decision to [READ IN BASED ON A1 responses: purchase, recommend, or use] this technology?

Not at all influential	Slightly influential	Moderately influential	Very influential	Extremely influential
1	2	3	4	5

[ASK IF A3=3,4,5]

A4. Why did you give this rating? [OPEN END]

A5. Have you or your organization submitted an emerging technology for ETCC consideration or utility review?

1. Yes
2. No
6. Not Applicable

[ASK IF A5=1]

A6. What technology did you submit? [OPEN END]

[ASK IF A5=1]

A7. Did you submit your technology through the ETCC website?

1. Yes
2. No

[ASK IF A5=1]

A8. How influential was the information you received through the ETCC on your decision to submit this technology?

Not at all influential	Slightly influential	Moderately influential	Very influential	Extremely influential
1	2	3	4	5

[ASK ALL]

A9. What, if anything, would you change about the ETCC website or newsletter to make them more useful for you?

1. [OPEN END]
2. I would not change anything

Company Information

[ASK IF R2=1, ELSE SKIP TO C5]

C1. What is the name of your company or organization? [OPEN END]

C2. What is your role at your company or organization? [OPEN END]

[ASK IF R0=1 OR 4, RESPONDENT IS ENERGY EFFICIENCY PROFESSIONAL or OTHER]

C2. Which of the following categories best describes your company or organization? *Please select all that apply*. [MULTIPLE RESPONSE]

1. Energy Efficiency Consulting
2. Energy Efficiency Implementation
3. National Laboratory

4. Research Institute
5. University/Academic Institution
6. Non-profit/Foundation
7. Utility
8. Government Agency
9. Investor (VCs, Angels, Corp Ventures, Private Equity, etc.)
00 Other, specify [OPEN END]
96. Not applicable

[ASK IF R0=2, 3, 4, RESPONDENT IS TECHNOLOGY CONSUMER OR DEVELOPER, or OTHER]

C3. Do you, or your company, [READ IN IF R0=3: develop, distribute, or sell emerging technologies, READ IN IF R0=2A; purchase emerging technologies, READ IN IF R0=4: work] for any of the following facility types?

1. Agricultural
2. Construction
3. Education - College or university, school
4. Food processing
5. Government Agency
6. Grocery or convenience store
7. Health Services (including medical office, dental office, hospitals, medical laboratory)
8. Industrial processing/manufacturing
9. Lodging / hospitality
10. Investors/Capital providers (VCs, Angels, Corp Ventures, Private Equity, etc.)
11. Manufacturing or assembly (including industrial-scale food or beverage)
12. Office, such as finance, insurance, real estate, or professional services
13. Property management
14. Retail
15. Restaurant or other food service (excluding industrial-scale food preparation)
16. Supermarket
17. Wholesale Trade or warehousing
00. Other, specify [OPEN END]
96. Not applicable

C4. What sector(s) do you work in? [MULTIPLE RESPONSE]

1. Commercial
2. Industrial
3. Residential
4. Agricultural
5. Government
6. Academic
00. Other, specify [OPEN END]
96. Not applicable

C5. What is <if R1=2,3,4 then "**your zip code**", if R1=1, then "the zip code of **your company where you work**">? [NUMERIC OPEN END]

Thank you for your participation in this important study!

Appendix B. PPM and PIP objectives

B.1. Statewide PPM and PIP Objectives

Below we provide the IOU PIP objectives as provided in the 2013–2014 PIPs.

Table 1. 2013–2014 ETP IOU PIP Objectives

2013–2014 Subprograms	Objectives	PG&E	SCE	SDG&E	SCG
Technology Development Support	Screen, select, and implement targeted technology development support projects to benefit EE measure development	2	18	2	2
	Conduct technology developer outreach through workshops	3	2	2	2
Technology Assessments	Assess EE measures, including IDSM measures	22	34	8	10
	Transfer measures from the ETP into the EE programs, with the goal of producing energy savings and/or demand reduction.	8	10	3	4
Technology Introduction Support	Conduct technology introduction activities	8	6	2	2
	Conduct Technology Resource Innovation Program (TRIP) Solicitations	1	3	1	1

Source: IOU 2013–2014 PIPs.

Below we provide the IOU PPM as provided in the 2013–2014 PIPs for each IOU.

Table 2. PG&E 2013–2014 ETP IOU PPM

Metric Type	Description	IOU Reporting Frequency
1. The number of new "proven" ET measures adopted* into the EE portfolio. * "Adoption" means measure is available to end-use customers through IOU programs. Adoption of a measure may be attributed to one or more ET subprograms		2b (2b=annually)
2. Potential energy impacts* (energy savings and demand reduction) of the adopted ET measures into the EE portfolio. * Potential energy impacts to be reported based on ET project findings and estimated market potential (reported through quarterly ET database updates)		2b
Technology Assessment (TA)	1. Number of ETP measures which have undergone TA that are adopted into the EE portfolio, including but not limited to each of the following: (a) Advance HVAC technologies (b) High efficiency plug loads and appliances (c) Advanced lighting technologies	2b
Scaled Field Placements (SFP)	1. Number of ETP measures that have undergone SFP and are adopted into the EE portfolio.	2b
Demonstration Showcases (DS)	1. Self-reported increase in knowledge by randomly selected sample of targeted stakeholders who either 1) visited the DS or 2) were informed about the DS in a workshop about benefits of the DS.	2b

PPM and PIP objectives

Metric Type	Description	IOU Reporting Frequency
Market and Behavioral Studies (MBS)	1. Self-reported increased in knowledge among internal ET stakeholders about the technologies targeted by the M&B studies.	2b
Technology Development Support (TDS)	1. Number of new performance specifications and/or Use Cases* produced as a result of TDS subprogram. * "Use Cases" describe the need for a technology or application.	2b
	2. Number of new performance specifications and/or Use Cases presented to manufacturers/private industry for possible action.* * "Possible action" means that the manufacturer/private industry considered TDS results in their product development efforts.	2b
Technology Resource Incubation and Outreach (TRIO)	1. Percent of attendees who voluntarily respond and self-report increased understanding on how to do business with utilities.	2b
Technology Testing Center (TTC)	1. Number of ETP measures evaluated at the TTCs in support of ET Assessments Subprogram that are adopted into the EE portfolio (and/or available in the market).	2b

Source: PG&E 2013–2014 PIP.

Table 3. SCE 2013–2014 ETP IOU PPM

Metric Type	Description	IOU Reporting Frequency
1. The number of new "proven" ET measures adopted* into the EE Portfolio. * "Adoption" means measure is available to end-use customers through IOU programs. Adoption of a measure may be attributed to one or more ET sub-programs		2b
2. Potential energy impacts* (energy savings and demand reduction) of the adopted ET measures into the EE portfolio. * Potential energy impacts to be reported based on ET project findings and estimated market potential (reported through quarterly ET database updates)		2b
Technology Assessment (TA)	1. Number of ETP measures which have undergone TA that are adopted* into the EE portfolio, including but not limited to each of the following: (a) Advance HVAC technologies (b) High efficiency plug loads and appliances (c) Advanced lighting technologies * "Adoption" means measure is available to end-use customers through IOU programs.	2b
Scaled Field Placement (SFP)	1. Number of ETP measures that have undergone SFP and are adopted* into the EE portfolio. *"Adoption" means measure is available to end-use customers through IOU programs.	2b
Demonstration Showcases (DS)	1. Self-reported increase in knowledge by randomly selected sample of targeted stakeholders who either 1) visited the DS or 2) were informed about the DS in a workshop about benefits of the DS.	2b
Market and Behavioral (M&B) Studies	1. Self-reported increase in knowledge among internal ET stakeholders about the technologies targeted by the M&B studies.	2b
Technology Development Support (TDS)	1. Number of new performance specifications and/or Use Cases* produced as a result of TDS sub-program.	2b

PPM and PIP objectives

Metric Type	Description	IOU Reporting Frequency
	* "Use Cases" describe the need for a technology or application.	
	2. Number of new performance specifications and/or Use Cases presented to manufacturers/private industry for possible action.* * "Possible action" means that the manufacturer/private industry considered TDS results in their product development efforts.	2b
Technology Resource Incubation and Outreach	1. Percent of attendees who voluntarily respond and self-report increased understanding on how to do business with utilities.	2b
Technology and Testing Center (TTC)	1. Number of ETP measures evaluated at the TTCs in support of ET Assessments Sub-Program that are adopted* into the EE portfolio (and/or available in the market). *"Adoption" means measure is available to end-use customers through IOU programs.	2b
Technologies and System Diagnostics	1. Status of progress towards completion of roadmap (i.e., plan and recommendations) to support the development of a national standard diagnostic protocol (activities, concrete actions taken).	2a

Source: SCE 2013–2014 PIP.

Table 4. SCG 2013–2014 ETP IOU PPM

Metric Type	Description	IOU Reporting Frequency
1. The number of new "proven" ET measures adopted* into the EE Portfolio. * "Adoption" means measure is available to end-use customers through IOU programs. Adoption of a measure may be attributed to one or more ET sub-programs		2b
2. Potential energy impacts* (energy savings and demand reduction) of the adopted ET measures into the EE portfolio. * Potential energy impacts to be reported based on ET project findings and estimated market potential (reported through quarterly ET database updates)		2b
Technology Assessment (TA)	1. Number of ETP measures which have undergone TA that are adopted* into the EE portfolio, including but not limited to each of the following: (a) Advance HVAC technologies (b) High efficiency plug loads and appliances (c) Advanced lighting technologies * "Adoption" means measure is available to end-use customers through IOU programs.	2b
Scaled Field Placement (SFP)	1. Number of ETP measures that have undergone SFP and are adopted* into the EE portfolio. * "Adoption" means measure is available to end-use customers through IOU programs.	2b
Demonstration Showcases (DS)	1. Self-reported increase in knowledge by randomly selected sample of targeted stakeholders who either 1) visited the DS or 2) were informed about the DS in a workshop about benefits of the DS.	2b
Market and Behavioral (M&B) Studies	1. Self-reported increased in knowledge among internal ET stakeholders about the technologies targeted by the M&B studies.	2b
Technology Development Support (TDS)	1. Number of new performance specifications and/or Use Cases* produced as a result of TDS sub-program. * "Use Cases" describe the need for a technology or application.	2b

Metric Type	Description	IOU Reporting Frequency
	2. Number of new performance specifications and/or Use Cases presented to manufacturers/private industry for possible action.* * "Possible action" means that the manufacturer/private industry considered TDS results in their product development efforts.	2b
Technology Resource Incubation and Outreach	1. Percent of attendees who voluntarily respond and self-report increased understanding on how to do business with utilities.	2b
Technology and Testing Center (TTC)	1. Number of ETP measures evaluated at the TTCs in support of ET Assessments Sub-Program that are adopted* into the EE portfolio (and/or available in the market). * "Adoption" means measure is available to end-use customers through IOU programs.	2b

Source: SCG 2013–2014 PIP.

Table 5. SDG&E 2013–2014 ETP IOU PPM

Metric Type	Description	IOU Reporting Frequency
1. The number of new "proven" ET measures adopted* into the EE Portfolio. * "Adoption" means measure is available to end-use customers through IOU programs. Adoption of a measure may be attributed to one or more ET sub-programs		2b
2. Potential energy impacts* (energy savings and demand reduction) of the adopted ET measures into the EE portfolio. * Potential energy impacts to be reported based on ET project findings and estimated market potential (reported through quarterly ET database updates)		2b
Technology Assessment (TA)	1. Number of ETP measures which have undergone TA that are adopted* into the EE portfolio, including but not limited to each of the following: (a) Advance HVAC technologies (b) High efficiency plug loads and appliances (c) Advanced lighting technologies * "Adoption" means measure is available to end-use customers through IOU programs.	2b
Technology Development Support (TDS)	1. Number of new performance specifications and/or Use Cases* produced as a result of TDS sub-program. * "Use Cases" describe the need for a technology or application.	2b
	2. Number of new performance specifications and/or Use Cases presented to manufacturers/private industry for possible action.* * "Possible action" means that the manufacturer/private industry considered TDS results in their product development efforts.	2b
NEW: Technology Introduction Support	Number of technology introduction support projects initiated.	2b

Source: SDG&E 2013–2014 PIP.

Appendix C. Detailed Aggregate Analysis Information

C.1. 2013–2014 Adoption and Technical Potential by ETP Database

As noted in the report, 44 ETP projects have been adopted[2] into EE programs in PY2013–2014. The majority of the adopted projects are from PG&E and SCE. There are no numeric adoption objectives overall or for the subprograms, but ETP had PPM to track and report measures adopted into the IOU EE portfolio. Below are the projects, by IOU, that were adopted into the EE programs.

C.1.1. PG&E Adopted Projects

- The 16 PG&E projects adopted are primarily in the C&I sector.
- All 16 projects have the EE program they were transferred to and all except one have the EE program measure number they were transferred to.

[2] Adoption metric is the cumulative number of new ETP-recommended measures that are adopted each year into the EE portfolio. "Adopted" means measure is available to end-use customers through IOU programs with a unique portfolio ID. Adoption of a measure may be attributed to one or more ET subprograms.

Table 6. 2013–2014 ETP PG&E Adopted Projects

ETP IOUs	ETP Project Number	Project Name	Subprogram	Technology	EE Program Recommended for Technology Transfer
PG&E	ET09PGE0917	Laboratory Testing of Heat Pump Water Heaters	Technology Assessment	Other	HEER
PG&E	ET10PGE1001	Heat Pump Water Heaters (HPWH) Field Study	Technology Assessment	Water Heating	HEER, 3P, Commercial
PG&E	ET11PGE2201	CLTC Lighting Demonstration Project	Technology Introduction Support	Lighting	Commercial
PG&E	ET11PGE3161	Pulse Energy -Dashboard w/Energy Mgr. Tech Assessment (Phase A)	Technology Introduction Support	Whole Building, Energy Management Systems	Commercial WB Program
PG&E	ET11PGE3162	Pulse Energy -Dashboard w/Energy Mgr. Tech Assessment (Phase B)	Technology Introduction Support	Whole Building, Energy Management Systems	Commercial WB Program
PG&E	ET11PGE3251	Follow Up Linear Panel and Controls Study (GSA)	Technology Introduction Support	Lighting	C,I,A
PG&E	ET12PGE1011	Assessment of Directional LEDs	Technology Assessment	Lighting	Lighting
PG&E	ET12PGE1031	Integrated Occupancy Sensor (Contra Costa Co.)	Technology Assessment	Lighting	Lighting
PG&E	ET12PGE1481	Fry's - Advanced LED Indoor fixtures and replacement lamps	Technology Assessment	Lighting	Commercial
PG&E	ET12PGE2201	Food Service Technology Demo Kitchen	Technology Introduction Support	Cooking	Commercial, Food Services
PG&E	ET12PGE3151	Food Service Tech Load Shifting Ice Machines (Phase A)	Technology Introduction Support	Cooking	Commercial, Food Services
PG&E	ET12PGE3152	Food Service Tech Load Shifting Ice Machines (Phase B)	Technology Introduction Support	Cooking	Commercial, Food Services
PG&E	ET12PGE3191	Water Heaters Alt. Technologies (Phase A)	Technology Introduction Support	Water Heating	HEER
PG&E	ET12PGE3301	PAR/MR LED Pilot	Technology Introduction Support	Lighting	Lighting
PG&E	ET12PGE3351	Safeway - Advanced LED Track Fixtures	Technology Introduction Support	Lighting	Lighting
PG&E	ET13PGE1101	Submersion Cooling for Data Centers	Technology Assessment	Data Center Cooling	Commercial, Customized Measures
PG&E	ET09PGE0917	Laboratory Testing of Heat Pump Water Heaters	Technology Assessment	Other	HEER
PG&E	ET10PGE1001	Heat Pump Water Heaters (HPWH) Field Study	Technology Assessment	Water Heating	HEER, 3P, Commercial

Source: IOU-Reported and ETP Database.

C.1.2. SCE Adopted Projects

- The 19 SCE projects adopted are primarily in the C&I sector.
- Only 4 of the 19 projects have the EE program they were transferred to, but all 19 have the EE program measure number they were transferred to.

Table 7. 2013–2014 ETP SCE Adopted Projects

ETP IOUs	ETP Project Number	Project Name	Subprogram	Technology	EE Program Recommended for Technology Transfer
SCE	ET10SCE1050	VSD Evaporative Fan Control for Walk-in Coolers	Technology Assessment	Process	Unknown
SCE	ET10SCE1110	VRF for Lodging Application	Technology Assessment	HVAC	Unknown
SCE	ET10SCE1130	LED Light for Commercial Pools	Technology Assessment	Lighting	Customized Program, Energy Efficiency for Entertainment Centers (ENTC) Multifamily Energy Efficiency Rebate Program (MEER), Lighting Innovation Program, School Energy Efficiency Program (SEEP), Adelanto Energy Leader Partnership (PADE
SCE	ET10SCE1190	LED Recessed Luminaire	Technology Assessment	Lighting	Unknown
SCE	ET10SCE1200	OTE Optimization for Waste Water Treatment Plants	Technology Assessment	Water Treatment, Process	Unknown
SCE	ET10SCE1220	L Prize A-Lamp for Hospitality Applications	Technology Assessment	Lighting	Unknown
SCE	ET10SCE1230	L Prize A-Lamp Laboratory Assessment	Technology Assessment	Lighting	Unknown
SCE	ET10SCE1290	LED A-Lamp Laboratory Assessment	Technology Assessment	Lighting	Energy Efficiency for Entertainment Centers (ENTC), Multifamily

ETP IOUs	ETP Project Number	Project Name	Subprogram	Technology	EE Program Recommended for Technology Transfer
					Energy Efficiency Rebate Program (MEER), Adelanto Energy Leader Partnership (PADE), Agriculture Deemed Energy Efficiency Program, Cal Dept of Corrections and Rehabilitation EE Partnership (PC
SCE	ET10SCE1450	Vacuum Sealing/Packaging Machines for Food Service	Technology Assessment	Process	Customized
SCE	ET10SCE2020	ZNE Home Retrofit	Demonstration Showcase	Whole Building	Unknown
SCE	ET11SCE1190	HVAC Electrostatic Filter	Technology Assessment	HVAC	Unknown
SCE	ET11SCE1220	LED Lighting for Cold Cases	Technology Assessment	Lighting	Unknown
SCE	ET11SCE1221	Exterior LED Lights with Occupancy Sensors	Technology Assessment	Lighting	Customized
SCE	ET11SCE2030	ZNE New Home Site 1	Demonstration Showcase	Whole Building	Unknown
SCE	ET11SCE3020	LED Downlights	Scaled Field Placement	Lighting	Unknown
SCE	ET13SCE1050	RTU Retrofit Technologies Assessment (RTU Supply Fan Cycling Control)	Technology Assessment	HVAC	Unknown
SCE	ET13SCE1070	RTU Retrofit Technologies Assessment (Stepped Fan Speed Control based on occupancy)	Technology Assessment	HVAC	Unknown
SCE	ET13SCE1160	Contact Toasters For Foodservice	Technology Assessment	Process	Unknown
SCE	ET13SCE7030	Development of an FDD Test Method for Commercial HVAC Packaged Units	Technology Development Support	HVAC	Unknown

Source: IOU-Reported and ETP Database.

C.1.3. SCG Adopted Projects

- The four SCG projects adopted are split between the residential and the C&I sectors.
- Of these four projects, all have the EE program they were transferred to, but none have the EE program measure number they were transferred to.

Table 8. 2013–2014 ETP SCG Adopted Projects

ETP IOUs	ETP Project Number	Project Name	Subprogram	Technology	EE Program Recommended for Technology Transfer
SCG	ET12SCG0017	MF VFD Recirc-Pump (TA)	Technology Assessment	HVAC	Residential energy efficiency
SCG	ET13SCG0002	Energy Star Fryers SFP	Technology Introduction Support	Process	Commercial energy efficiency
SCG	ET13SCG0003	Lang Demand Stove-top Field Testing	Technology Development Support	Process	Commercial energy efficiency
SCG	ET13SCG0004	i-O-Stat (Kur-A-Stat) Lab Testing	Technology Assessment	HVAC	Residential energy efficiency

Source: IOU-Reported and ETP Database.

C.1.4. SDG&E Adopted Projects

- The five SDG&E projects adopted are all in the C&I sector.
- Of these five projects, all have the EE program they were transferred to, but only one has the EE program measure number it was transferred to.

Table 9. 2013–2014 ETP SDG&E Adopted Projects

ETP IOUs	ETP Project Number	Project Name	Subprogram	Technology	EE Program Recommended for Technology Transfer
SDG&E	ET11SDGE0016	Demand Control Ventilation with Centralized Air Sensors	Technology Assessment	HVAC	EEBI
SDG&E	ET12SDGE0001	Bi-level Gas Station Lighting Technologies	Technology Introduction Support	Lighting	EEBI/EEBR
SDG&E	ET12SDGE0003	RTU Efficiency	Technology Assessment	HVAC	EEBI/Commercial HVAC
SDG&E	ET12SDGE0004	Shower Monitor and Alarm System	Technology Development Support	Water Heating	
SDG&E	ET13SDG7011	LED Strip Lighting for Alcoves	Technology Development Support	Lighting	EEBI

Source: IOU-Reported and ETP Database

Appendix D. ETP Tactic Definitions

ETP has ten tactics available for use for its projects. Short definitions of each are provided below.

- **Lab evaluation:** Laboratory testing of a technology to evaluate performance claims and overall effectiveness.
- **Field evaluation:** *In-situ* testing of a technology to evaluate performance claims and overall effectiveness.
- **Behavioral study:** Targeted research to understand customer needs, perceptions, acceptance, and 'decision triggers' towards new or underutilized technologies. This may be done through either primary or secondary research.
- **Market study:** Targeted research to understand overall market readiness or potential for a new or underutilized technology. This may be done through either primary or secondary research.
- **Demonstration showcase:** A real-world display of technologies at a site that is intended to expose target audiences to new measures. It is open to the public or an interest group, many viewers are encouraged to visit, and it highlights a systems approach rather than an individual measure.
- **Scaled field placement:** Placement of a new technology in a customer's facility for the purposes of educating end-users or stakeholders through firsthand experience with the technology.
- **Paper study:** Calculations, modeling, and/or literature review to evaluate performance claims and overall effectiveness. Desk review only.
- **Test standard development:** Targeted opportunities to develop standard test protocols for energy efficient products in support of the statewide Codes & Standards Program.
- **Training program:** Initial development of training materials or syllabi in response to a gap in existing training or knowledge among tradesmen/market actors.
- **Tool development and enhancement:** Developing savings estimators or enhancing energy modeling to include new technologies in order to smooth adoption.

Appendix E. Technology Analyses

The evaluation team selected ten technologies ETP had performed several projects on to include in the analysis. Out of these ten, two LED technologies (screw-in LEDs and troffer LEDs) were not commented on by any of the experts, and these technologies were subsequently dropped from the analysis due to lack of data. The remaining eight technologies are:

1. Plug-load efficiency
2. Domestic hot water heat pumps
3. HVAC heat pumps (e.g., ground source, variable capacity…)
4. Smart thermostats
5. Commercial whole-building EMS/continuous commissioning systems
6. Advanced lighting controls for commercial spaces (i.e., multi-sensor control systems)
7. Residential Zero Net Energy retrofit
8. Boiler controls (reset/other load limiting control systems)

Information was gathered and analyzed for each technology individually and then aggregated to yield the results presented in the report (for more details, see Section 5.1). The analyses for each technology are included here. Each contains a number of pieces:

- Summary of the technology.
- Identification of barriers. Each expert was asked to describe the major barriers to adoption facing this technology. If multiple experts indicated the same barrier, it was tallied in the frequency of responses for each barrier. The evaluation team also categorized the barriers into six categories (savings, technical feasibility, costs, customer-side, supply-side, and grid effects).
  - (Table 1) Description of barriers and their frequencies from expert interviews
  - (Figure 1) Summary of barriers by category type
- Information on ETP Tactics. After identifying the barriers, the experts were shown a snapshot that provided brief information about each of the projects ETP performed for the technology and the tactics that were used. The summaries are derived from the Project Descriptions in the ETP Database. The experts were asked to comment if the projects matched the barriers they identified. They could also comment on if there were any gaps in the project coverage, redundancies, and projects that seemed unnecessary. The evaluation team used a "stoplight" system to sort the comments as either positive (green), neutral or a criticism with conditions (yellow), and negative or a direct criticism (red) to also assess the general tone of the experts towards ETP's activities for a technology.
  - (Figure 2) Snapshot of ETP projects and tactics performed on the technology
  - (Peer Comments) Expert comments on the ETP projects
- Project-Barrier Matching. After the interview was complete, the evaluation team put the identified barriers and the ETP projects together to assess how much ETP was addressing the barriers the experts noted for the technology. This was done by listing each of the barriers identified for the technology and the projects in a matrix. For each project, the evaluation team determined whether the description provided in the database showed the project to directly,

indirectly, or not address each barrier (see Section 1.4.1 for an explanation of direct/indirect matches).

- (Figure 3) Matrix of the identified barriers mapped to the ETP projects

- **Overall findings, takeaways, and missed opportunities**.

E.1. Plug-Load Efficiency

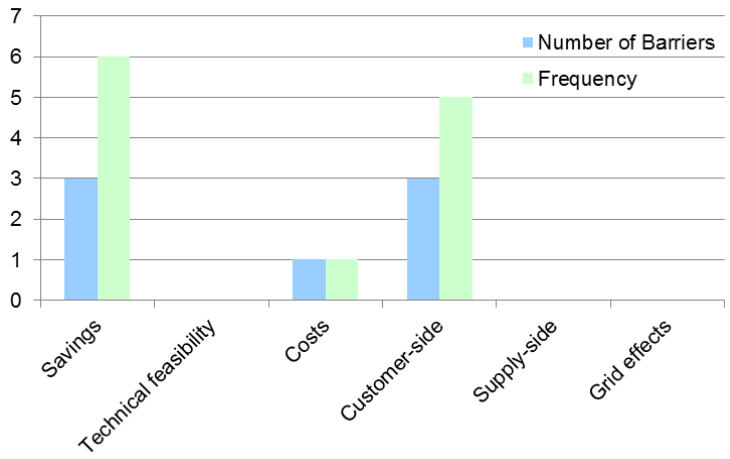
Plug-load efficiency refers to technologies that targets energy reductions from appliances and other end-uses that consumers plug directly into a wall socket. It is primarily comprised of plug-load controls, such as smart strips or smart sockets, but can also include appliance-specific efficiency efforts. These can include energy-saving computer modes or superefficient internal components. Three of the ten experts responded on this technology.

E.1.1. Identification of Barriers

Table 10. Summary of Expert-Identified Barriers for Plug-Load Efficiency

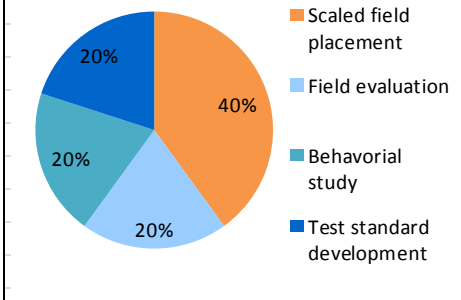
	Frequency	Category	Description
Persistence	2	Savings	Many devices in this category are impermanent and portable, so there is a question as to whether savings can be counted on after it is first installed
Macro savings potential	2	Savings	Uncertain how large the overall savings potential is - it might be minimal in the grand scheme of things from a program administrator's perspective, and there might be too much attention paid to it based on the level of savings
Diversity of loads	2	Savings	It's unclear what will be controlled and what loads will be included. The loads attached to the device may change over time, or the load use may change, which will change the savings expected. Like persistence, changes in the use of the device from the baseline alters the savings
Corporate policies	2	Customer-side	Disparate decision-making power impedes adoption, e.g. corporate vs. IT vs. facilities
Consumer education/behavior	2	Customer-side	The customer must be able to correctly install and use the device in order for it to save energy
Cost-effectiveness	1	Costs	Do the savings of the products justify the costs, or could a low-tech option or education result in similar savings?
Market fragmentation	1	Customer-side	There are a number of products available in this space and no clear ways to compare the products, which can lead to customer confusion

Figure 1. Summary of Barrier Categories for Plug-Load Efficiency



E.1.2. ETP Activities

Figure 2. Snapshot of ETP Projects for Plug-Load Efficiency

PLUG-LOAD EFFICIENCY		Number of Projects: **5**
Tactics		**Projects:**
Scaled field placement	2	Field evaluation
Field evaluation	1	1. Report the best data on energy savings from PC and imaging equipment (printer/scanner/fax/copier)
Behavorial study	1	Scaled field placement
Test standard development	1	2. Place smart strips in the field with two third party direct install contractors with enhanced M&V
		3. Create baselines for and validate new mid-stream incentive model for plug-load products, where retailers are paid incentives based on the savings achieved on a weighted average from the previous year
		Behavorial study
		4. Study satisfaction and experience with a smart strip delivered through a direct install program
		Test standard development
		5. Test power levels of internal components, such as graphics cards, to determine cost-effectiveness of requiring more efficient components in the initial assembly through T20 or Energy Star.

Note that one project included in the original snapshot was found to be cancelled through further research and was dropped from the analysis.

Peer Comments

- It's good they are looking at different delivery methods (2 direct install, one midstream, one codes & standards) because the technology itself isn't in question.
- This set of activities is comprehensive and right-on
- CA should consider expanding to code-oriented plug-load activities: how do we get these devices into the codes?
- Direct install can be problematic if there is no customer education built in
- CA should explore the use of plug-load controls as potential M&V tools
- The savings for these technologies might not justify the amount of work/effort/analysis
- There doesn't appear to be anything targeting persistence, but potentially the behavior study might look at that
- They are missing the cable box - the largest energy waster among plug-loads in homes.

E.1.3. Project-Barrier Matching

Table 11. ETP Project-Barrier Matching Matrix for Plug-Load Efficiency

Barrier/ETP Project	Category	1	2	3	4	5
Persistence	Savings		X	*		*
Macro savings potential	Savings	X	X			
Diversity of loads	Savings	X				
Corporate policies	Customer-side					
Consumer education/behavior	Customer-side		X		*	
Cost-effectiveness	Costs					X
Market fragmentation	Customer-side					

X	Directly addresses barrier
*	Indirectly addresses barrier

Note: the number and colors listed above correspond to the project and activity listed in the snapshot (

	Frequency	Category	Description
Persistence	2	Savings	Many devices in this category are impermanent and portable, so there is a question as to whether savings can be counted on after it is first installed
Macro savings potential	2	Savings	Uncertain how large the overall savings potential is - it might be minimal in the grand scheme of things from a program administrator's perspective, and

			there might be too much attention paid to it based on the level of savings
Diversity of loads	2	Savings	It's unclear what will be controlled and what loads will be included. The loads attached to the device may change over time, or the load use may change, which will change the savings expected. Like persistence, changes in the use of the device from the baseline alters the savings
Corporate policies	2	Customer-side	Disparate decision-making power impedes adoption, e.g. corporate vs. IT vs. facilities
Consumer education/behavior	2	Customer-side	The customer must be able to correctly install and use the device in order for it to save energy
Cost-effectiveness	1	Costs	Do the savings of the products justify the costs, or could a low-tech option or education result in similar savings?
Market fragmentation	1	Customer-side	There are a number of products available in this space and no clear ways to compare the products, which can lead to customer confusion

Figure 1) above.

Key Findings:

- There is significant alignment to savings-oriented barriers and remaining market questions (perhaps to a fault, according to one of the respondents).
- There is limited to no alignment on customer-side barriers.
- Although not specifically identified as a barrier, ETP made strong efforts at validating practical delivery methods.
- Plug-load efficiency supports the strategic goal of net zero buildings.

E.2. Smart Thermostats

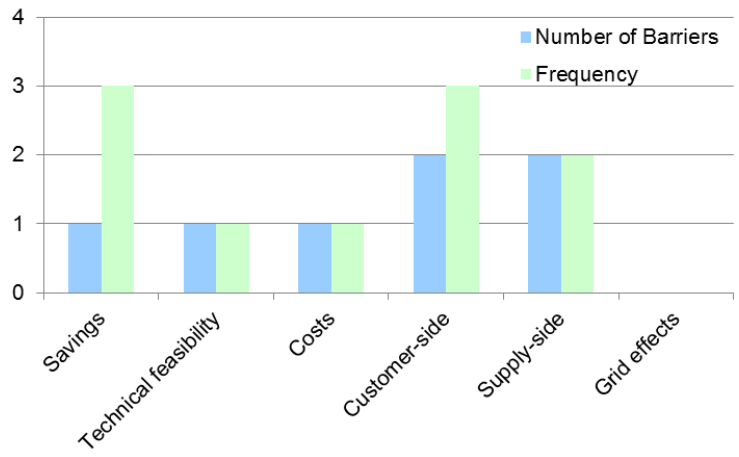
Smart thermostats are internet-connected thermostats, which allows for remote control through web or mobile interfaces making it easier to set and maintain proper set points and schedules and enabling automated demand response. Some thermostats have learning capabilities (e.g., self-scheduling) but that is not an essential characteristic. They apply to both residential and commercial setting, though the context of this particular project set was residential. Three of the ten experts responded on this technology.

E.2.1. Identification of Barriers

Table 12. Summary of Expert-Identified Barriers for Smart Thermostats

	Frequency	Category	Description
Savings uncertainty	3	Savings	Variability of consumer baseline usage and behavioral interaction with the unit; "over-the-air" updates may change how the unit operates
Market fragmentation	2	Customer-side	Many market players offering many different takes on this product category without simple ways to compare them, leading to customer confusion
Costs	1	Costs	Relatively costly compared to legacy technology - this is particularly problematic for single-fuel utilities that cannot claim savings from both electric and gas
Connectivity	1	Customer-side	Internet access is common but not ubiquitous
Product quality	1	Technical feasibility	Units not working out-of-the-box
Installation quality	1	Supply-side	Poor installation leads to product failure in the field
Value proposition	1	Supply-side	In some cases there may not be a compelling story from manufacturers on the technology

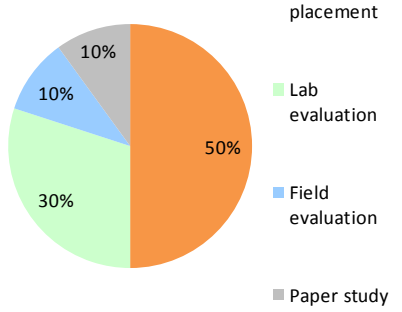
Figure 3. Summary of Barrier Categories for Smart Thermostats



E.2.2. ETP Activities

Figure 4. Snapshot of ETP Projects for Smart Thermostats

SMART THERMOSTATS		Number of Projects: **10**
Tactics		**Projects:**
Scaled field placement	5	Scaled field placement
Lab evaluation	3	1&2. (Two projects - phases 3 and 4 of 4-phase project) Test usability, savings, and functionality of a Wi-Fi enabled thermostat with behavorial software with two customer populations.
Field evaluation	1	
Paper study	1	3. Launch statewide trial to evaluate software that can be added to existing manufacturer products without forcing customers to purchase new products
		4. Test performance of NEST thermostats in homes
		5. Test savings/performance of several smart thermostats in homes
		Lab evaluation
		6. Phase 1 of 4 phase project - evaluate performance, communication, and interference issues of Wi-Fi thermostat with behavorial software
		7. Similar evaluation for the thermostat with a different algorithm software
		8. Establish smart thermostat test protocol to qualify new devices to participate in future incentive programs.
		Field evaluation
		9. Phase 2 of 4 phase project - evaluate thermostat at PG&E employee homes for performance and usability
		Paper Study
		10. Study potential energy savings from a vendor-agnostic residential incentive program using data from NEST and EnergyHub.



Peer Comments

- Test protocols should get at the market confusion/market fragmentation issue
- Appears to be a fairly comprehensive approach
- Many of the activities do get at user behavior
- Unsure if programs will ever be able to measure savings precisely enough to get to a deemed value (given behavior, product updates, etc) - fool's errand?
- Lab evaluations can't get at the customer behavior component and is a moving target due to software updates - won't tell you much about the actual savings in the field
- Where's the commercial?
- Nothing that tackles the question of market acceptance/lack of a compelling story from manufacturers

E.2.3. Project-Barrier Matching

Table 13. ETP Project-Barrier Matching Matrix for Smart Thermostats

Barrier/ETP Project	Category	1&2	3	4	5	6	7	8	9	10
Savings uncertainty	Savings	X	X	X	X	*	*	*	X	
Market fragmentation	Customer-side		*		*			X		*
Costs	Costs		X							
Connectivity	Customer-side	X		X	X					
Product quality	Technical feasibility	*		*	*	X	X	*	*	
Installation quality	Supply-side	*		*	*				*	
Value proposition	Supply-side									*

X	Directly addresses barrier
*	Indirectly addresses barrier

Note: the number and colors listed above correspond to the project and activity listed in the snapshot (Figure 4) above.

Key Findings:

- Invested a lot in investigating what was determined to be the primary barrier - customer use/trying to stuff customer behavior into a deemed savings measure
- A number of projects have indirectly yielded data on product quality (a technical feasibility barrier) and installation quality (a supply side barrier), but the projects did not directly address either of these barriers.
- One project that squarely addresses next-most significant barrier (market fragmentation) - difficult to tell if that is enough, but they are clearly paying attention
- Missing commercial sector entirely
- The CA activities did not touch on value propositions/business cases for the technologies, which was identified as one of the barriers, though ETP may disagree that it is its responsibility to deal with that barrier.

E.3. Heat Pump Water Heaters

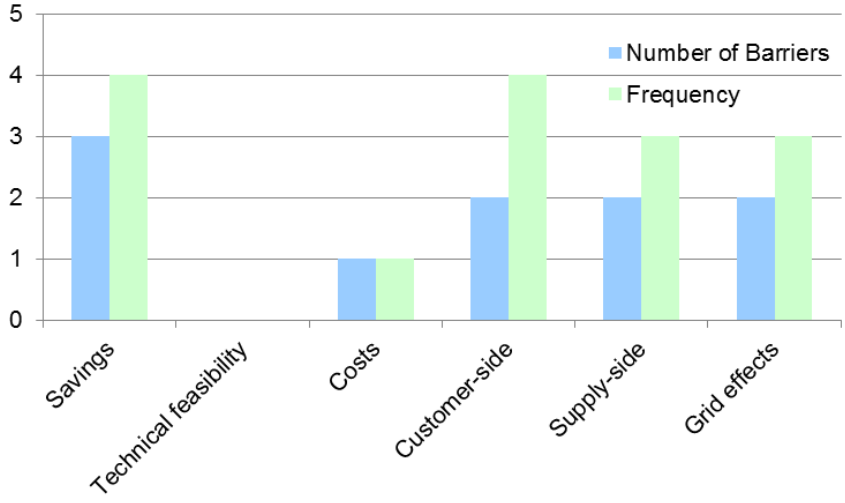
Heat pump water heaters (HPWHs) are heat pump technologies that are used for domestic hot water purposes. They replace traditional hot water heaters, which are either heated by burners or electric resistance heaters. Three of the ten experts responded on this technology.

E.3.1. Identification of Barriers

Table 14. Summary of Expert-Identified Barriers for Heat Pump Water Heaters

	Frequency	Category	Description
Consumer apathy/ignorance	2	Customer-side	Consumers do not spend time thinking about their hot water unless their current system breaks
Consumer satisfaction	2	Customer-side	Concerns about HPWHs not delivering hot enough water; also makes noise, requires maintenance, etc.
Unknown interactive effects	2	Savings	Uncertainty on interactions between expelled cool air from water heating and HVAC
Installer inventory	2	Supply-side	Suppliers haven't fully embraced the technology; they need to have HPWHs on the truck when they go to replace a broken system
Fuel switching	2	Grid effects	Baseline water heaters are typically gas-fired, so switching to a heat pump adds load
Electric resistance DR	1	Grid effects	HPWHs erode a large installed base of DR-enabled electric resistance WHs
Cost	1	Costs	High first cost to consumer compared to conventional technologies
Low temperature performance	1	Savings	HPWHs are less efficient at low temperatures
Savings persistence	1	Savings	Some units offers offered a HP override function that consumers could select and forget to undo if they wanted the unit to stop expelling cold air
Supplier investment	1	Supply-side	No interest in a mature industry to retool for a new technology

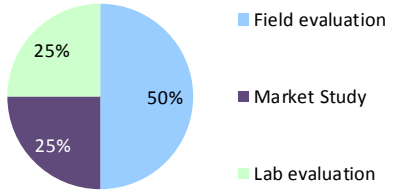
Figure 5. Summary of Barrier Categories for Heat Pump Water Heaters



E.3.2. ETP Activities

Figure 6. Snapshot of ETP Projects for Heat Pump Water Heaters

DOMESTIC HOT WATER - HEAT PUMP WATER HEATERS (HPWH)		Number of Projects: 4
Tactics		**Projects:**
Field evaluation	2	Field evaluation
Market Study	1	1. Demonstration of a multi-family HPWH - 2014 TDV calculations tended to favor HP heating over propane, so the utility is presenting the demonstration in preparation.
Lab evaluation	1	2. Understand HPWH technologies, estimate life cycle cost, determine energy savings potential, and market feasibility.
		Market Study
		3. Conduct a paper-based market study to assess barriers in adoption of EnergyStar rated high efficiency gas storage and heat pump water heaters.
		Lab evaluation
		4. Evaluation of two new HPHWs to investigate the operating characteristics compared to other types, energy savings potential, and cost effectiveness.



Peer Comments

- HPWHs do help achieve ZNE goals
- No projects addressing supplier issues, but anecdotally the expert believes SCE is aware/involved in this issue
- Are there even products for multifamily buildings? It's not the typical target market for heat pump water heaters
- Does not appear to be much data gathered on contractor/distributer level in any of the projects
- No review of interactive effects mentioned in field studies
- No review of customer behavior, satisfaction
- Nothing here on the supply chain

E.3.3. Project-Barrier Matching

Table 15. ETP Project-Barrier Matching Matrix for Heat Pump Water Heaters

Barrier/ETP Project	Category	1	2	3	4
Consumer apathy/ignorance	Customer-side			X	
Consumer satisfaction	Customer-side				
Unknown interactive effects	Savings				
Installer inventory	Supply-side			X	
Fuel switching	Grid effects				*
Electric resistance DR	Grid effects				
Cost	Costs		X	X	X
Low temperature performance	Savings				
Savings persistence	Savings				
Supplier investment	Supply-side				

X	Directly addresses barrier
*	Indirectly addresses barrier

Note: the number and colors listed above correspond to the project and activity listed in the snapshot (Figure 6) above.

Key Findings:

- Completely missing customer and supplier barriers
- Appear to address basic energy savings, which experts identified as being relatively well-established, but don't address complex related topics (e.g., interactivity and persistence)
- Did address costs directly in two of the four projects
- Big-picture grid effects don't show up in the work

E.4. HVAC Heat Pumps

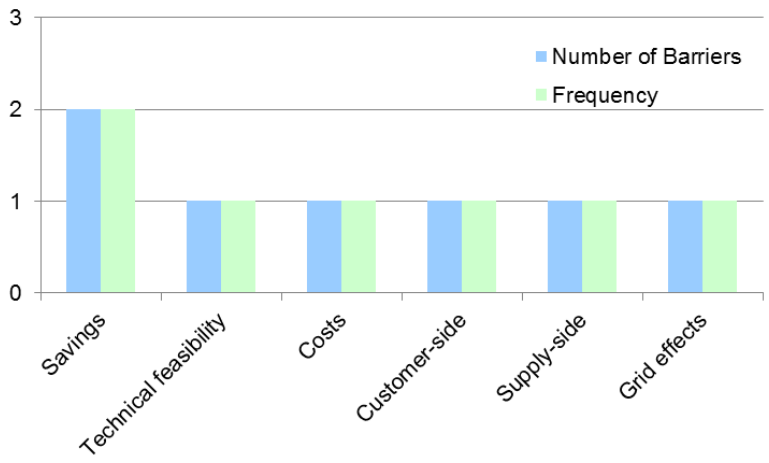
This category looks at advanced heat pump technologies, specifically ground-source (geothermal) and variable-capacity heat pumps in both residential and commercial settings. One of the ten experts responded on this technology.

E.4.1. Identification of Barriers

Table 16. Summary of Expert-Identified Barriers for HVAC Heat Pumps

	Frequency	Category	Description
Savings variability	1	Savings	Savings varies by application and by the secondary system used for heating
Cost	1	Costs	High first cost to consumer compared to conventional technologies
Consumer awareness/ perception	1	Customer-side	Lack of understanding of HP technologies, or poor perceptions of their quality/ability to meet heating needs
Contractor awareness/ perception	1	Supply-side	Lack of understanding of HP technologies, or poor perceptions of their quality
Incompatibility with legacy infrastructure	1	Technical feasibility	HPs may not be compatible with many previously installed technologies (e.g., radiators, ducts)
Fuel switching	1	Grid effects	Baseline heating technologies are typically gas-fired, so switching to a heat pump adds load
Low temperature performance	1	Savings	HPs are less efficient at low temperatures

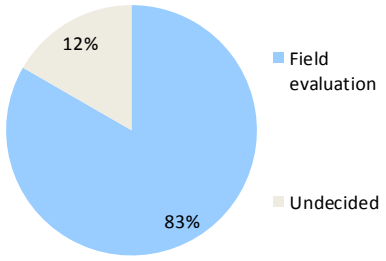
Figure 7. Summary of Barrier Categories for HVAC Heat Pumps



E.4.2. ETP Activities

Figure 8. Snapshot of ETP Projects for HVAC Heat Pumps

HVAC HEAT PUMPS (e.g. ground source, variable capacity…)		Number of Projects: **6**
Tactics		**Projects:**
Field evaluation	5	**Field Evaluation**
Undecided	1	1. Savings validation from a variable capacity HP controlled by a smart thermostat.
		2. Field eval + energy simulation: does a geothermal HP in Southern California achieve 30-50% energy savings over a traditional HVAC system?
		3. Field evaluation of a 3-ton "American Style" split system variable capacity HP.
		4. Evaluate performance of a ground-source heat pump at a multifamily residential site that uses a shallow well/water-filled sump to transfer heat.
		5. Drill two test wells at the San Mateo Correctional Facility to analyze the geothermal temperature and use to evaluate energy savings.
		Undecided (Modeling, Lab or Field Testing)
		6. (Study in conceptual planning stage) Evaluate and compare performance, equipment and system efficiency, constraints, and applications of a number of heat pumps in order to inform future codes and standards. The project may use modeling, laboratory testing, or field evaluations.



Note that one project included in the original snapshot was found to be cancelled through further research and was dropped from the analysis.

Peer Comments

- Good that they are studying HPs in ducted systems, as this addresses legacy technologies
- Where are the air-source heat pumps?
- Lack of a discussion on grid effects/demand impacts of HPs
- Missing behavior/customer satisfaction piece

E.4.3. Project-Barrier Matching

Figure 9. ETP Project-Barrier Matching Matrix for HVAC Heat Pumps

Barrier/ETP Project	Category	1	2	3	4	5	6
Savings variability	Savings	X	X	X	X	X	X
Cost	Costs						
Consumer awareness/perception	Customer-side						
Contractor awareness/perception	Supply-side						
Incompatibility with legacy infrastructure	Technical feasibility		*	X	*		*
Fuel switching	Grid effects	*	*	*	*		
Low temperature performance	Savings						

X	Directly addresses barrier
*	Indirectly addresses barrier

Note: the number and colors listed above correspond to the project and activity listed in the snapshot (Figure 8) above.

- Key Findings:
- Strong focus on energy savings
- Indirectly addresses legacy infrastructure compatibility and fuel switching by collecting data through field studies, but unclear if the data is being used
- Missing customer and contractor awareness and perception issues
- Missing air-source HPs
- Low-temperature performance was brought up as a barrier, but this issue is less prevalent in CA.

E.5. Advanced Lighting Controls

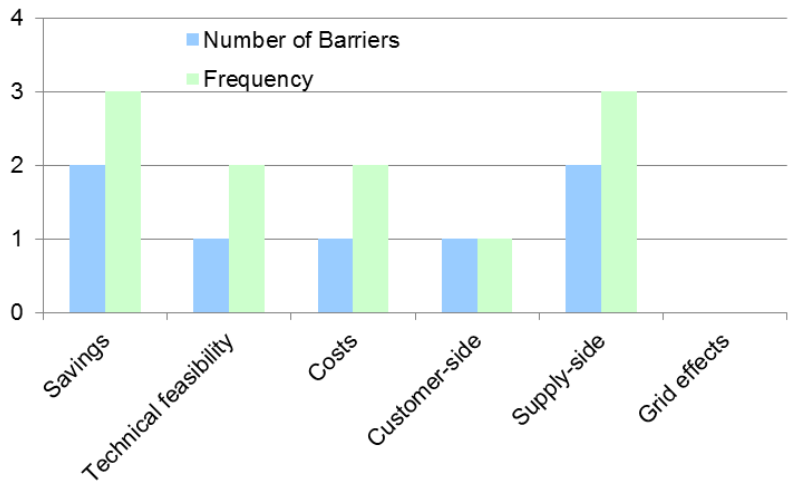
Advanced lighting controls are networked, often multi-sensor, controls for space lighting in commercial settings. Example features include internet connectivity, scheduling, occupancy and vacancy sensing, dimming, and daylighting. Three of the ten experts responded on this technology.

E.5.1. Identification of Barriers

Table 17. Summary of Expert-Identified Barriers for Advanced Lighting Controls

	Frequency	Category	Description
Savings persistence	2	Savings	Even if installed and programmed correctly, there are questions as to whether a consumer will continue to use the controls if dissatisfied with automation
Communication standard fragmentation	2	Technical feasibility	Standards and protocols are still in development; many products still use proprietary communications platforms
Installer familiarity with advanced lighting concepts	2	Supply-side	ALCs are complex and require an additional skill set that installers do not typically have (e.g., networked controls, light levels, etc.)
Cost-effectiveness	2	Costs	These technologies are significantly more expensive than lower-tech alternatives, and only certain situations will have enough savings to justify the costs
Installer apathy	1	Supply-side	Installers are uninterested in learning the new technology and its benefits
Customer installer preference	1	Customer-side	Customers exhibit a preference for lower-end installers who can get a basic lighting job done but may not have the understanding of more sophisticated technologies like ALCs
Behavior impact on savings	1	Savings	End-users may not be savvy or care enough to use the controls in a way that saves energy

Figure 10. Summary of Barrier Categories for Advanced Lighting Controls

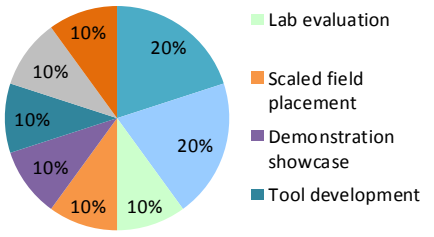


E.5.2. ETP Activities

Figure 11. Snapshot of ETP Projects for Advanced Lighting Controls

ADVANCED LIGHTING CONTROLS FOR COMMERCIAL SPACES Number of Projects: **10**

Tactics	
Behavorial study	2
Field evaluation	2
Lab evaluation	1
Scaled field placement	1
Demonstration showcase	1
Tool development	1
Paper study	1
Training program	1



Projects:
Behavorial study
1&2. (2 joint projects) Begin creating a certification training course for architects/ designers by developing a needs analysis and a curriculum outline
Field evaluation
3. Evaluate ALC system/integration services to provide additional HVAC savings
4.Evaluate controls for linear fluorescents
Lab evaluation
5. Evaluate several technologies to understand metering capabilities
Scaled field placement
6. Test effectiveness of hard-wired building control systems for daylight, occupancy, and temperature
Demonstration showcase
7. Demonstrate use of daylighting, other high efficiency lighting technologies in a warehouse and office environment
Tool development
8. Develop calculation for estimating savings from advanced lighting control systems (esp. daylight harvesting) for use in utility programs
Paper study
9. Conduct a series of industry meetings, field placement studies and identify market/technology strategies that enable development of lighting control standards by manufacturers and stakeholders
Training program
10. Finalize development of the California Advanced Lighting Control Training Program by finding an administrator to run/report on program

Peer Comments

- Good to see them directly addressing supplier knowledge through the training program
- Paper study on standards development might address the communication standard fragmentation issue
- Technologies do provide AC savings, so good they're looking at interactive effects
- Showcases good way to teach end-users about the benefits and ensure persistence
- Tool development - this wasn't a barrier, but calculating savings for programs is valuable
- Supports ZNE goals
- Training is good, but gets at designers and architects rather than installers
- The training program created through ETP here was a good idea, but impractically expensive
- Training low-end installers to be high-end installers is a fool's errand - it's a demand issue, not a supply, and the market often wants low-end installation
- ETP's activities are a scattershot of many different things that are not well coordinated.

E.5.3. Project-Barrier Matching

Table 18. ETP Project-Barrier Matching Matrix for Advanced Lighting Controls

Barrier/ETP Project	Category	1&2	3	4	5	6	7	8	9	10
Savings persistence	Savings				*	*	X			
Communication standard fragmentation	Technical feasibility					*			X	
Installer familiarity with advanced lighting concepts	Supply-side	X					*			X
Cost-effectiveness	Costs		*	*				*		
Installer apathy	Supply-side	*					X			X
Customer installer preference	Customer-side									
Behavior impact on savings	Savings				*	*	X			

X	Directly addresses barrier
*	Indirectly addresses barrier

Note: the number and colors listed above correspond to the project and activity listed in the snapshot (Figure 11) above.

Key Findings:

- Broad coverage - at least one project directly addresses each barrier, with the exception of cost-effectiveness
- Five projects don't directly address any of the barriers (there may be disagreement among the experts as to the usefulness of targeting the two supply-side barriers here, however)

- Mixed assessment of the value of training suppliers in this technology
- Inverse of many other technologies in that the projects are equally focused on non-savings barriers as they are savings barriers
- Approach appears uncoordinated - good projects that cover many things but no overarching goal to progress

E.6. Residential Zero Net Energy Retrofits

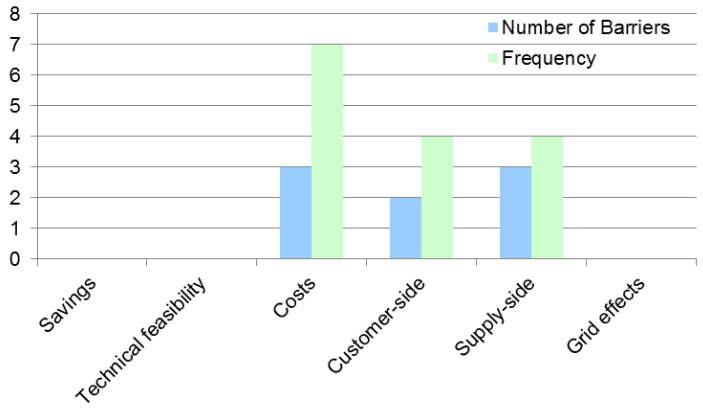
This category is the retrofit of single family homes to zero net energy status. Zero net energy means that the building generates as much energy as it consumes in a year. In retrofit, this requires deep whole-building renovation to reach low enough energy use. Four of the ten experts responded on this technology.

E.6.1. Identification of Barriers

Table 19. Summary of Expert-Identified Barriers for Residential Zero Net Energy Retrofits

	Frequency	Category	Description
Cost-effectiveness	4	Costs	In a retrofit context, renovating key home features, e.g., windows, insulation, etc., is very expensive
Customer interest	3	Customer-side	Customers with fairly efficient homes see no need, especially when the expense and comfort tradeoffs are considered
Custom delivery	2	Costs	Homes are all different, which precludes economies of scale
Lack of qualified contractors	2	Supply-side	Ultra-low energy requires advanced techniques that most contractors are not sufficiently versed in to do well
Poor business model	1	Supply-side	Lack of a no-money-down model (similar to SolarCity or Enernoc) to make this more attractive; high upfront costs for lifetime savings is unrealistic
Fragmentation of codes and zoning	1	Costs	Jurisdictions are different with regards to zoning and permitting, which precludes economies of scale
Missed asset value	1	Customer-side	Customers view other investments (e.g. hardwood floors) as a better investment in their homes because EE is not included as an asset value
Siloed contractor models	1	Supply-side	Customers must interact with a variety of entities; consolidation is necessary to simplify the process

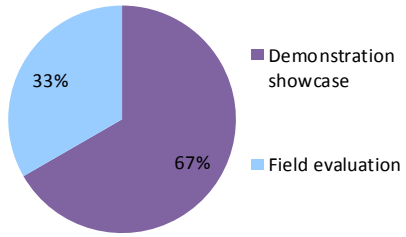
Figure 12. Summary of Barrier Categories for Residential Zero Net Energy Retrofits



E.6.2. ETP Activities

Figure 13. Snapshot of ETP Projects for Residential Zero Net Energy Retrofits

RESIDENTIAL ZERO NET ENERGY RETROFIT		Number of Projects: **6**
Tactics		**Projects:**
Demonstration showcase	4	Demonstration showcase
Field evaluation	2	1. Retrofit several homes to reach ZNE - include a simulation, installation, measurement, recalibration of simulation models, and evaluation of progress towards ZNE after one year.
		2. Demonstrate Near Zero Energy home in retrofit application
		3. Identify lessons learned while retrofitting homes to ZNE in a report
		4. Demonstrate opportunities in building performance and energy use from a combined package of efficiency, smart appliances, and on-site renewable energy with the objective to achieve ZNE at a San Bernardino residence.
		Field evaluation
		5&6. (2 projects) Two-phase project to develop and test ZNEH retrofit strategies at a single-family home and a student coop residence at UC Davis.



Peer Comments

- "I'm jaded on this stuff, and I love efficiency." (This peer found ZNE retrofits to be very frustrating and not very feasible due to the costs).
- There are no tactical problems with their projects, but strategic ones.
- Every 5-10 years we have to paint the house and do other upgrades, but we haven't gotten close to thinking of EE retrofits as part of basic maintenance
- All fine, but show me the cost-effectiveness
- All the right words, but they're missing the point - the business models.
- You can prove the technologies, but access to capital is the bigger barrier.
- We're not short of case studies. The challenge is how to move from case studies and how to scale up.

E.6.3. Project-Barrier Matching

Table 20. ETP Project-Barrier Matching Matrix for Residential Zero Net Energy Retrofits

Barrier/ETP Project	Category	1	2	3	4	5&6
Cost-effectiveness	Costs					*
Customer interest	Customer-side	X	X		X	X
Custom delivery	Costs					*
Lack of qualified contractors	Supply-side			X		
Poor business model	Supply-side					
Fragmentation of codes and zoning	Costs					
Missed asset value	Customer-side					
Siloed contractor models	Supply-side			*		

X	Directly addresses barrier
*	Indirectly addresses barrier

Note: the number and colors listed above correspond to the project and activity listed in the snapshot (Figure 13) above.

Key Findings:

- Miss on all supply side issues
- Insufficient attention paid to the cost question
- Doing demonstration showcases is an effective way of generating interest on the consumer side
- None of the experts questioned that this can be done, only the cost at which it is achieved

E.7. Commercial Energy Management Systems

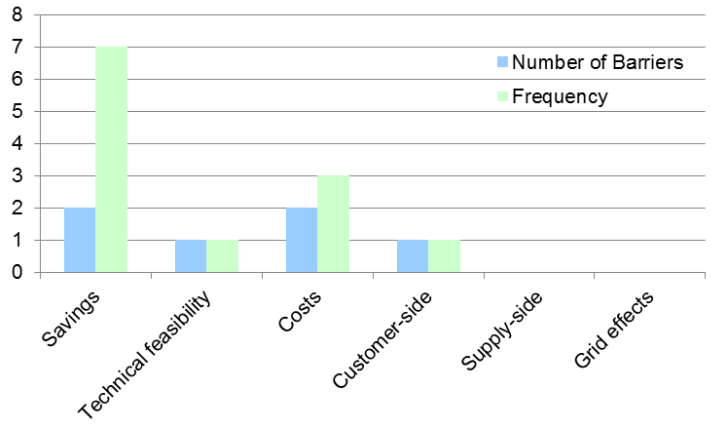
This category refers to whole-building monitoring and controls solutions in commercial settings. They are used to ensure persistently optimal energy performance of the base building systems. Four of the ten experts responded on this technology.

E.7.1. Identification of Barriers

Table 21. Summary of Expert-Identified Barriers for Commercial Energy Management Systems

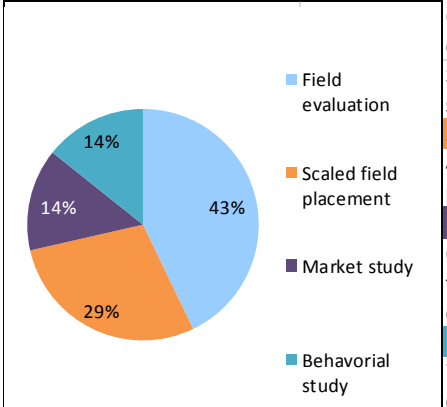
	Frequency	Category	Description
Information-action gap	4	Savings	Knowledge of building operations does not directly translate into savings
Black box savings estimates	3	Savings	Vendors do not reveal the inner workings, making it difficult to estimate savings; often claims exceed reality
Market gap for small/medium buildings	2	Costs	The costs of EMS are often prohibitive for small/medium buildings
Ongoing costs of software	1	Costs	EMS software often requires a license that must be renewed annually
Integration with legacy equipment	1	Technical feasibility	Existing base building systems do not always integrate well into a modern BMS
Complexity of operation	1	Customer-side	Building engineers may not understand the complex systems and have to call the vendors to fix/calibrate it

Figure 14. Summary of Barrier Categories for Commercial Energy Management Systems



E.7.2. ETP Activities

Figure 15. Snapshot of ETP Projects for Commercial Energy Management Systems

COMMERCIAL WHOLE BUILDING EMS / CONTINUOUS COMMISSIONING		Number of Projects: 7
Tactics		**Projects:**
Field evaluation	3	Field evaluation
Scaled field placement	2	1. Study benefits of continuous commissioning strategies applied to existing BMS data
Market study	1	2. Evaluate a carbon and energy management software (CEMS) that combines GHG reporting, energy dashboarding capabilities, and strategic planning capabilities from enterprise resource planning software.
Behavorial study	1	3. Evaluate IT Energy Monitoring (aka Data Center Infrastructure Management) software in a real data center setting.
		Scaled field placement
		4&5. (Two projects) Two-phase project to test efficacy and energy savings potential through an EMS and energy coaching
		Market Study
		6. Research potential and applicability of EMS for commercial buildings, focusing on market penetration of EMS and studying where EMS technology is currently in use.
		Behavorial study
		7. Identify barriers to accelerating adoption of wireless, web-based and conventional energy management system for commercial and industrial customers

Peer Comments

- Energy coaching is great!
- First five are all about understanding savings, which is good
- The market study can be useful to understand why people use the technology and leverage that.
- Don't get distracted by other things; focus on quality of product and energy savings
- Nothing with cost-effectiveness unless it's buried in the market study.
- Tough technology for IOUs because the PUC wants energy savings and savings aren't guaranteed
- Not enough focus on the skills gap. Energy coaching gets at that, but there are other places to do training
- What about the small guys? Maybe in the market study, but need to be supporting things that are 80% as good but 20% as expensive.

E.7.3. Project-Barrier Matching

Figure 16. ETP Project-Barrier Matching Matrix for Commercial EMS

Barrier/ETP Project	Category	1	2	3	4&5	6	7
Information-action gap	Savings	X	X	X	X		X
Black box savings estimates	Savings	*	X	X	X		X
Market gap for small/medium buildings	Costs						
Ongoing costs of software	Costs						
Integration with legacy equipment	Technical feasibility	X					
Complexity of operation	Customer-side				X		X

X	Directly addresses barrier
*	Indirectly addresses barrier

Note: the number and colors listed above correspond to the project and activity listed in the snapshot (Figure 15) above.

Key Findings:

- Efforts seem appropriately focused on savings, which appears to be a major issue for this technology
- In particular, appropriate attention paid to the information-action gap through energy coaching and other related activities

E.8. Boiler Controls

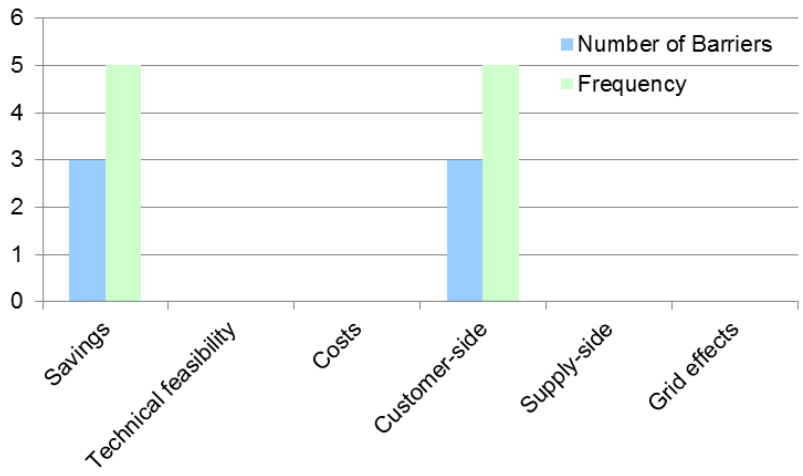
This category refers to retrofit controls that reduce overall runtime in response to some kind of demand monitoring. Reset controls are the most common example, but other load-limiting technologies fit as well. Three of the ten experts responded on this technology.

E.8.1. Identification of Barriers

Table 22. Summary of Expert-Identified Barriers for Boiler Controls

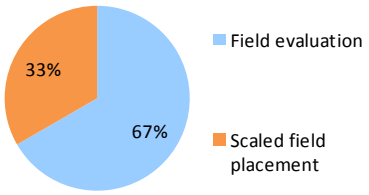
	Frequency	Category	Description
End-user education on benefits	2	Customer-side	Customers don't realize they have a problem and that better alternatives exist
Market fragmentation	2	Customer-side	Many different technologies are offered with little ways to help customers compare
Black box savings estimates	2	Savings	Vendors do not reveal the inner workings, making it difficult to estimate savings; often claims exceed reality
Variability of savings	2	Savings	Different applications will result in different savings, making it difficult to fit into a deemed measure
Customer mistrust	1	Customer-side	Black-box savings has led to mistrust of the product category
Behavior impacts on savings	1	Savings	Customers may bypass controls once installed, leading to a drop in savings

Figure 17. Summary of Barrier Categories for Boiler Controls



E.8.2. ETP Activities

Figure 18. Snapshot of ETP Projects for Boiler Controls

BOILER CONTROLS (reset/other load-limiting control systems)		Number of Projects: 3
Tactics		**Projects:**
Field evaluation	2	Field evaluation
Scaled field placement	1	1. Evaluate an advanced load monitoring device at two customer sites; measure boiler system efficiency with and without the device.
		2. Validate the performance of a boiler control that measures the building load in real time and signals the boiler system to put out only as much energy as the building load requires
		Scaled field placement
		3. Evaluate a boiler reset controller to reduce cycling losses in a number of buildings

Peer Comments

- Good at drilling down on black box performance
- The scale of these projects may not be sufficient to identify the preferred load profile that leads to savings
- Need training for end-users on how to effectively use these

E.8.3. Project-Barrier Matching

Table 23. ETP Project-Barrier Matching Matrix for Boiler Controls

Barrier/ETP Project	Category	1	2	3
End-user education on benefits	Customer-side			
Market fragmentation	Customer-side			
Black box savings estimates	Savings	X	X	X
Variability of savings	Savings			X
Customer mistrust	Customer-side	*	*	*
Behavior impacts on savings	Savings			*

X	Directly addresses barrier
*	Indirectly addresses barrier

Note: the number and colors listed above correspond to the project and activity listed in the snapshot (Figure 18) above.

Key Findings:

- Is CA doing enough on this technology or is it just not worth their time?
- Focus here is on savings and not the other impediments, such as training of end-users and developing standards to reduce market confusion

Appendix F. Peer Program Descriptions

The ten peer programs included in this study are:

1. Bonneville Power Authority (BPA) – Emerging Energy Efficiency Technology (E3T)
2. MassSaves – Massachusetts Technology Assessment Committee (MTAC)
3. New York State Energy Research & Development Authority (NYSERDA) – Emerging Technologies and Accelerated Commercialization (ETAC)
4. Sacramento Utility District (SMUD) – Energy Efficiency R&D
5. Nicor Gas – Emerging Technology Program
6. Northwest Energy Efficiency Alliance (NEEA) – Emerging Technologies (Product Management)
7. Gas Technology Institute (GTI) – Emerging Technology Program
8. Northeast Energy Efficiency Partnership (NEEP) – Market Strategy; EM&V Forum
9. Pacific Northwest National Laboratory (PNNL) – Multiple groups
10. Lawrence Berkeley National Laboratory (LBNL) – Building Technology and Urban Systems

Each is described in more detail below.

F.1. BPA – Emerging Energy Efficiency Technologies (E3T)

Based/operates in: Pacific Northwest	**Organization type**: Power Administration
Year started: 2009	**Annualized budget**: $1m + $1m with NEEA
Goal: More reliable savings by any method (market transformation or transfer to resource acquisition)	
Key activities: Sequential – lab, field evaluations and scaled field placements	

Development Cycle Focus:

Research & Development	Development Support	Performance Validation	Technology Demonstration	Commercialization and business planning	Program Implementation	Codes & Standards
		X	X	X		

Overview

BPA sees its program as one step along a technology diffusion curve from R&D to emerging technologies to incentive programs to codes and standards. Within that framework, the emerging technology portion is used to validate reliable savings and begin deploying/demonstrating the technology, product, or service. The long-term goals can be summarized as "more MW, faster, cheaper" and so its activities can be broad, including building markets and trade ally networks. This philosophy of a technology progression leads to a different approach and set of goals than other organizations.

The program uses a unique set of metrics for its projects – technology, measure, and program readiness levels (TRL, MRL, PRL). TRL is measured on a numerical scale, whereas MRL and PRL are checklists of key factors. Project selection is ultimately a mix of these RLs (and how much BPA thinks

a project can improve the RLs) and expert opinion from internal and external advisory committees. These are revisited during/after the projects to see how far the needle has moved.

BPA partners with NEEA, actively coordinates with ETCC, and the CA IOUs often participate in advisory committees for BPA. They may also collaborate with IOUs through third-party research firms on larger regional projects and national coordination (i.e. EPRI, CEE).

Activity selection process: The activities performed for emerging technologies are sequential rather than standalone, moving from lab evaluation to field evaluation to scaled field placement. Using advisory committees and the developed TRL/MRL/PRLs for the project, BPA will assess the technology's maturity and set it on one of the steps of the sequence.

Success metrics: Long term: increase in reliable savings and/or uptake of technology, product, or service. Short term: Improvement of TRL/MRL/PRL metrics, delivery of successful projects

Unique/interesting feature: BPA develops cradle-to-grave roadmaps for technologies using the results of its emerging technology activities, often through collaboration with other regional entities. This cradle-to-grave assessment looks at the lifecycle costs of moving the technology to the program and attempts to create a clear deployment path to the programs or codes and standards.

F.2. SMUD – Energy Efficiency R&D

Based/operates in: Sacramento, CA	**Organization type**: Municipal Utility
Year started: 2003	**Annualized budget**: $2.5 million
Goal: Transfer to resource acquisition programs	
Key activities: Lab evaluations, field evaluations, emerging technology incentives (pilot rebates)	

Development Cycle Focus:

Research & Development	Development Support	Performance Validation	Technology Demonstration	Commercialization and business planning	Program Implementation	Codes & Standards
X		X	X		X	X

Overview

SMUD is a member of the ETCC and collaborates with the CA IOUs on co-funded projects as well as by sharing results. As a municipal utility, it operates under somewhat different parameters than the IOUs. Emerging technologies at SMUD are considered part of the R&D team. Although R&D in many places refers to technologies that are pre-commercialization, SMUD's R&D department includes technologies that are or are close to being commercially available and underutilized. The program uses lab and field evaluations to validate a technology's savings, in addition to other factors such as cost-effectiveness, ease of implementation, customer acceptance, and reliability with the ultimate goal being transferring the technology into its customer incentive programs.

Projects may come in through a variety of means, including applications from a manufacturer/vendor or through an internal interest from ETCC meetings or other conferences. The program is moving to formalize its screening process into what they are terming a "project charter". Before it is approved, the project manager will fill out a charter for each potential project that provides a roadmap for the

project and its anticipated outcomes. This charter includes info on the project's purpose, description, deliverables, schedule, budget, and the authorization.

Activity selection process: The program does lab and field evaluations, with the type dependent on the technology's maturity/needs and the project's origination. Typically lab evaluations are done in collaboration with national or California labs. For field evaluations, referred to as field tests or pilot projects, customers will receive the technology for free or a greatly reduced cost in exchange for a two-year monitoring agreement. The program managers have a lot of flexibility in choosing which projects to pursue, though there is a movement towards a more formalized process (the charter). Although there is not a technology-specific allocation of projects, the program managers tend to be focused on an overall technology type (i.e. lighting, HVAC, ZNE, other) and funding is ultimately allocated to the program managers – so there is an implicit allocation of funding to technologies.

Success metrics: number of reports completed on products, transfers to customer programs (but not necessarily a specific number required).

Unique/interesting feature: SMUD offers incentives that are greater than market value in order to bridge the gap between the emerging technology stage and the resource acquisition programs.

F.3. Nicor Gas – Emerging Technology Program

Based/operates in: Illinois	**Organization type**: Utility
Year started: June 2011	**Annualized budget**: $976,000
Goal: Resource acquisition	
Key activities: Field evaluations; some lab evaluation and single training events	

Development Cycle Focus:

Research & Development	Development Support	Performance Validation	Technology Demonstration	Commercialization and business planning	Program Implementation	Codes & Standards
		X				

Overview

Nicor Gas' program is designed to seek out and validate technologies that are commercially available – or available within six months – but not broadly implemented for eventual inclusion in one of its customer incentive programs. The program is implemented by the Gas Technology Institute, which also runs its own emerging technology collaborative (detailed in Section 8 of this Appendix) in which Nicor Gas is a participating member. The Nicor Gas program utilizes mainly field evaluations in order to validate savings and look out for other factors that might affect a technology's future success in a program (i.e. installation and operation best practices, preferred application profiles, etc.), though it has also done some lab evaluations and a training workshop. There are a number of steps before a technology reaches that phase, however: the program first goes through a scoring process to screen and select technologies of interest, then a more comprehensive due diligence phase; if there is potential, GTI creates a work plan for activities which is evaluated by a technical review committee at Nicor Gas.

In designing the program, GTI and Nicor Gas researched and spoke to managers at the CA IOUs, along with other utilities nationwide. Nicor Gas also interacts with PG&E, SDG&E, and SCG through GTI's collaborative where program results are often shared.

Activity selection process: Based on the due diligence work GTI does, it will make a recommendation to Nicor Gas when a technology appears promising and devise an action plan, including the chosen activity. Most projects will be comprised of field evaluations, though the number of sites can vary widely. Sometimes the program may partner with other organizations on evaluations, and if a technology appears far enough along to already be used in its custom programs, they have started using one-off training workshops for the other program implementation contractors to promote the technology.

Success metrics: Number of technologies transferred from the Emerging Technology Program to offerings in the Energy Efficiency Program at Nicor Gas.

Unique/interesting feature: While there are not specific criteria in place, Nicor Gas tries to keep the portfolio of projects balanced in a few ways: first, between heating and non-heating gas technologies (as heating technologies can only be validated during the winter); second, between the commercial, industrial, and residential end-use sectors; and third, between technologies that are larger capital projects and smaller budget projects.

F.4. MassSave – Massachusetts Technical Assessment Committee (MTAC)

Based/operates in: Massachusetts	**Organization type**: Utility collaboration
Year started: 2009	**Annualized budget**: $0
Goal: Technology transfer to resource acquisition programs	
Key activities: Due diligence, recommendations for pilot field studies	

Development Cycle Focus:

Research & Development	Development Support	Performance Validation	Technology Demonstration	Commercialization and business planning	Program Implementation	Codes & Standards
		X				

Overview

MTAC is a voluntary committee formed by the eight program administrators in Massachusetts to scan for new technologies that can be recommended to resource acquisition programs. It is unique among the emerging technology programs included in this study in its sole focus on acting as a first filter into the programs – while it may recommend a technology for a pilot field study, it does not perform any activities itself. It is also unique in that it has no budget – all efforts are "in kind" – and is voluntary on the part of its members. The committee receives technology applications from vendors on its website and can also suggest technologies internally; it reviews them on a monthly basis and may embark on a three-month fact-finding phase where engineers from the efficiency programs, outside consultants, and the vendor can weigh in if the technology shows some promise. Afterwards the committee decides whether to recommend the technology based solely on its energy savings – it does not look at technical

or market feasibility, or cost-effectiveness – and it is up to each of the utilities to decide whether the technology is of interest to one of its programs.

Activity selection process: Based on what the committee finds during its fact-finding phase, it may recommend that a product be introduced as a pilot in a utility territory. Out of the ten or so technologies that MTAC has recommended, two residential and one commercial technologies have been turned into pilot studies.

Success metrics: Technologies referred to and taken up by resource acquisition programs.

Unique/interesting feature: MTAC has a laser focus on savings and lacks a budget.

F.5. NYSERDA – Emerging Technologies and Accelerated Commercialization (ETAC) Program

Based/operates in: New York	**Organization type**: Statewide
Year started: May 2013	**Annualized budget**: $5 million
Goal: Market transformation	
Key activities: one tactic – multisite demonstration with performance validation and outreach	

Development Cycle Focus:

Research & Development	Development Support	Performance Validation	Technology Demonstration	Commercialization and business planning	Program Implementation	Codes & Standards
		X	X			

Overview

ETAC aims to bring commercially available but underutilized technologies into greater acceptance by the market. To do so, ETAC uses multi-site demonstrations of technologies and strategies, combined with in-depth performance validation and targeted outreach is used to share results. The program is organized by sector: commercial & institutional, residential, and multifamily, of which C&I has the largest focus and budget. The residential and multifamily programs have issued competitive solicitations while the C&I program has issued both an open enrollment RFP (for smaller projects) and a competitive solicitation (for larger projects). The program currently has 15 demonstrations in progress.

The program interacts with a number of other programs within NYSERDA that perform other activities contained within CA ETP or otherwise related to emerging technologies, for example advanced buildings R&D, building codes, the Business Partners Program (which incorporates training), and ad hoc market studies from the energy analysis group. ETAC was created in 2013 to fill a gap between NYSERDA's R&D arm and its commercial deployment/rebate program, as many solutions are commercially available but not well enough understood to be supported by rebate programs yet.

Activity selection process: As all projects through ETAC use the same activity (demonstration projects with performance validation), the activity selection process is simply part of the project selection

process. Projects are solicited via RFP for the program for open enrollment and competitive routes. Each sector program also has an advisory group that offers guidance on technology focus areas.

Success metrics: Number of projects, energy savings, leveraged co-funding, number of technologies adopted by the market or further supported by deployment programs, replication savings and leveraged co-funding impacts, technology transfer activities to deployment programs or other market activities.

Unique/interesting feature: ETAC is solicitation-based, using RFPs rather than applications or internal scanning.

F.6. NEEA – Emerging Technologies (Product Management)

Based/operates in: Portland/Northwest	**Organization type**: Trade organization
Year started: 2010	**Annualized budget**: $20 million (2015)
Goal: Market transformation	
Key activities: Developing manufacturing specifications, lab/field testing, market characterization studies	

Development Cycle Focus:

Research & Development	Development Support	Performance Validation	Technology Demonstration	Commercialization and business planning	Program Implementation	Codes & Standards
	X	X	X	X	X	X

Overview

NEEA's market transformation activities are designed to remove barriers to the natural adoption of a technology, with the ultimate goals of affecting federal standards, state building codes, and market common practices. They see utility incentive as a key intervention to endorse products and help remove the first-cost barrier, so NEEA focuses on other barriers in its programs. They characterize the organization's emerging technology efforts in three phases – scanning, which is comprised of non-statistical exploratory research to find energy efficient products, services and best practices; due diligence, which involves a deeper dive to understand the technology's savings/market potential and may include some market tests; and a full program phase, which can involve any number of activities determined to meet barriers. NEEA looks at three areas in determining a technology's readiness – the potential energy savings, whether the product is attractive to the consumer, and whether the supply chain is willing to manufacture and distribute it. It designs its activities accordingly. NEEA typically has 19-20 programs in development or in the market and 15-20 projects in the scanning phase at any given time.

Activity selection process: Once the team has developed a concept for a technology and a formal request to start program development, the Regional Portfolio Advisory Committee – staffed by portfolio managers at utilities – makes a formal vote on whether they think it's worth the investment. This request includes the activities that would be performed as part of a program, which may involve developing manufacturing specifications, testing products in the lab or field, and/or market characterization studies (especially of the supply chain).

Success metrics: NEEA estimates and refines the technical and market potential for its technologies in MW at various stages along its process. Once the technology reaches the market development stage, NEEA tracks the market's progress towards the MW market target it sets. The MW technical potential is also useful for comparing the scale of the opportunity across potential projects.

Unique/interesting feature: Quantified metrics based on savings potential

F.7. NEEP – Market Strategy; EM&V Forum

Based/operates in: MA, Northeast	**Organization type**: Non-profit trade organization
Year started: 1996	**Annualized budget**: $1.2m*
Goal: Market transformation	
Key activities: Field evaluations, market studies, demonstrations, tool development, standards implementation, policy dialogue, standardizing evaluation methods	

Development Cycle Focus:

Research & Development	Development Support	Performance Validation	Technology Demonstration	Commercialization and business planning	Program Implementation	Codes & Standards
	X	X	X			

*Estimate includes emerging tech projects in both the Market Strategy and EM&V Forum

Overview

NEEP has no single group working on emerging technologies, but a few – Market Strategies and the EM&V Forum in particular – whose work is well-integrated across the organization. The technologies focused on are commercially available, superefficient (30-50% savings), and have low market penetration; while the ultimate goal is to transform the market through codes and standards development, NEEP uses a broad toolkit of activities to move them in that direction. The Market Strategy group does market characterization for technologies through collaborative reports that identify the state of the technology, key barriers, strategies to accelerate market transformation regionally, and further activities that NEEP can participate in. The EM&V Forum validates technology performance, including savings and other research on relevant parameters, e.g. product costs, for a number of technologies that can include emerging ones. On both fronts, the technologies they study are ones that their members – mostly program administrators and states in the northeast – have an interest in.

Activity selection process: The Market Strategy team researches and provides information on the technology to the leadership advisory committee, which includes the current barriers to adoption, any current activities attempting to address them, opportunities for NEEP to partner with others (including their utility members), potential activities for NEEP and a roadmap beyond. Any number of activities may be involved – market studies in the form of Market Strategy reports are key, and projects can include demonstration projects, tool development, paper studies, and informing policy. In the EM&V Forum, the committees look at what key pieces of information are missing or not well represented, and design their studies to collect that data through field evaluations, meta studies, or other consultant research.

Success metrics: Number of projects or parameter updates incorporated into TRMs, number of market strategy recommendations from reports that are implemented, number of technologies implemented into program administrator portfolios.

Unique/interesting feature: NEEP sees informing policy as a key consideration that other groups may not be involved in until codes and standards work. They've participated in hearings for state appliance standards and other relevant topics like fuel switching and grid impacts of new technologies.

F.8. Gas Technology Institute – Emerging Technology Program

Based/operates in: Illinois/National	**Organization type**: Nonprofit research organization
Year started: 2012	**Annualized budget**: $2.5-3.5 million
Goal: Identify technologies for ultimate inclusion into resource acquisition programs	
Key activities: Secondary research into technologies; field testing in partnership with member IOUs	

Development Cycle Focus:

Research & Development	Development Support	Performance Validation	Technology Demonstration	Commercialization and business planning	Program Implementation	Codes & Standards
		X	X		X	

Overview

GTI is a nonprofit independent R&D organization that works on gas technologies for everything from exploration and production to the end-use of natural gas. The program, on the end-use side of the organization, is a collaborative of 20 gas and combined utilities from across North America with an interest in working together to develop emerging technologies for use in their energy efficiency and marketing programs. GTI performs the scanning and screening function, which involves research into technologies to create "technology snapshots" presented to the members. These are four-page summary documents that include information on what the technology does, its target markets, if it is used in programs, what the savings and costs are, whether savings have been validated, and what the remaining barriers are. GTI then works with the utilities to develop a scope of work that includes projects addressing the key barriers. These projects might then be funded by an individual utility, group of utilities, or state organizations as part of their own emerging technology or pilot programs, and they may retain GTI to help perform the field studies or other chosen activities (these represent $2-3 million of GTI's annual budget). These studies typically look at both the savings and the non-energy details of how a technology would be implemented, including the application, acceptance, best practices, etc. The results are detailed in summary reports, which are distributed to the members. GTI has done over 70 technology snapshots, and last year generated summary reports for over 15 demonstration and pilot projects. GTI is a member of the ETCC advisory committee and has participated directly in CA ETP projects with the three IOUs that are members in the collaborative (PG&E, SDG&E, and SCG).

Activity selection process: Once a technology has been identified, GTI and the utilities work together to determine potential projects, and utilities individually decide which projects they would like to fund and how. The activities used are dependent on the toolkit of the utility performing the project.

Success metrics: Number of technology snapshots and summary reports created, hit rate with projects transferred into member programs.

Unique/interesting feature: It is a consortium, helping to coordinate disparate research bodies and projects, including multi-site scaled field placements, nationally. Technology snapshots provide a succinct guide that aide member organizations in planning the next steps for a technology.

F.9. PNNL – Multiple Groups

Based/operates in: WA/National	**Organization type**: National Lab
Year started: -	**Annualized budget**: $12m
Goal: Dramatic energy savings through market transformation	
Key activities: Demonstration projects, tool development, lab and field evaluations, codes and standards development	

Development Cycle Focus:

Research & Development	Development Support	Performance Validation	Technology Demonstration	Commercialization and business planning	Program Implementation	Codes & Standards
X	X	X	X			X

Overview

PNNL has multiple efforts that contribute to advancing emerging technologies through the Department of Energy's Building Technology Office. The solid state lighting team conducts research and works with manufacturers on advancing LED technologies into the marketplace, which can include lab and field evaluations. There are two lab homes on campus used for experiments on residential building technologies, including windows and smart appliances. The Building Energy Systems Group develops tools for monitoring and analyzing building energy use. Other teams collaborate with national retailers for demonstration projects that may lead to corporate building standards. PNNL also contains a technical group, the Building Energy Regulatory Analysis Group. This group support DOE's Building Energy Codes Program (BECP) and Appliance and Commercial Equipment Standards Rulemaking Program. The PNNL codes team uses knowledge gained through all of the other groups, and development of their own tools, for the ultimate goal of saving 1 quad of energy annually by 2020 through the adoption of more efficient building codes. Unlike any other emerging technology entity, PNNL also contains a team within the regulatory analysis group with some activities in the federal regulatory process – the analysis for federal appliance and equipment standards rulemaking is performed here.

Activity selection process: Roadmap analyses are used to help proposals. These identify the market barriers to a technology, what research is needed, and what paper analysis PNNL has done. As a national lab, funding and project approval are done at a more top-down level than at other emerging technology entities, with specific budgets allocated to groups (e.g., the solid state lighting team).

Success metrics: Each group has its own metrics. BECP has a quantified goal to save 1 quad of energy annually/cumulative 14 quads through codes that were directly attributable to PNNL work.

Unique/interesting feature: No single emerging technology program, but a number of groups that contribute to advancing emerging technologies.

F.10. LBNL – Building Technology and Urban Systems Division/ Electronics, Lighting, and Networks Group

Based/operates in: CA/National	**Organization type**: National Lab
Year started: -	**Annualized budget**: $1-6m per project
Goal: Market transformation	
Key activities: Large-scale demonstrations, tool development, lab evaluation	

Development Cycle Focus:

Research & Development	Development Support	Performance Validation	Technology Demonstration	Commercialization and business planning	Program Implementation	Codes & Standards
X	X	X	X			X

Overview

Unlike other national labs, LBNL has a heavy focus on promoting implementation of technologies in the marketplace as well as fundamental research and development, a focus that fits well with other emerging technology programs across the US. The overall mandate is to "provide the technologies needed to operate buildings at 50 to 70 percent less energy use than average today." Building Technologies and Urban Systems (BTUS) Division's seven research groups focus on various technology or solution types, including Commercial Building Systems; Electronics, Lighting, and Networks; High Technology and Industrial Systems; Residential Building Systems; Windows and Envelope Materials; Simulation Research; and Sustainable Federal Operations. Across the board, emphasis is placed on a holistic systems view where technologies are networked (i.e., monitoring and BMS), with intelligent controls and sensing capabilities. Projects – which can include very large-scale demonstrations, tool and software development, lab evaluations, and integrated technology development – frequently assist codes & standards development, including CA's Title 24 standards.

Activity selection process: As a national lab, funding and project approval are done at two levels: 1) a more top-down level than at other emerging technology entities, with specific budgets allocated to groups (e.g., the electronics, lighting, and networks team); and 2) a project-specific level with funding generally among cross-disciplinary technology teams. The project selection process differs among each team.

Success metrics: Depending on the group within BTUS, both qualitative and quantitative metrics are used to look at how much traction is their work getting within a defined time frame in the marketplace.

Unique/interesting feature: Focus on systems and networked technologies rather than standalone gadgets

Appendix G. Emerging Technology Programs Considered

The evaluation team researched twenty-four programs that do work with emerging technologies. The ten closest to ETP in terms of scope were chosen for this study, but the full list of twenty-four is presented below.

1. Bonneville Power Authority (BPA) – Emerging Energy Efficiency Technology (E3T)
2. Sacramento Utility District (SMUD) – Energy Efficiency R&D
3. Nicor Gas – Emerging Technology Program
4. MassSave – Massachusetts Technology Assessment Committee (MTAC)
5. New York State Energy Research and Development Authority (NYSERDA) – Emerging Technologies and Accelerated Commercialization (ETAC)
6. Northwest Energy Efficiency Alliance (NEEA) – Emerging Technologies (Product Management)
7. Northeast Energy Efficiency Partnership (NEEP) – Market Strategy; EM&V Forum
8. Gas Technology Institute (GTI) – Emerging Technology Program
9. Pacific Northwest National Laboratory (PNNL) – multiple groups
10. Lawrence Berkeley National Laboratory (LBNL) – Building Technology and Urban Systems
11. Regional Technical Forum (RTF) subcommittees
12. Silicon Valley Power (SVP) – Emerging Technologies Grant Program
13. Midwest Energy Efficiency Alliance (MEEA) – Emerging Technology
14. Advanced Energy – Energy Technology Testing Center (ETTC)
15. Utilization Technology Development
16. National Renewable Energy Laboratory (NREL) – Buildings Research
17. DTE Energy – Emerging Technologies
18. Canadian Gas Association – Energy Technology Innovation Canada (ETIC)
19. Department of Energy (DOE) – Building Technologies Office, Emerging Technologies
20. Advanced Research Projects Agency – Energy (ARPA-E) – multiple solicitations
21. State of Texas – Emerging Technology Fund, Commercialization Awards
22. California Energy Commission – Electric Program Investment Charge (EPIC)/Buildings
23. Northwest Energy Efficiency Task Force – Emerging Technologies and Solutions

Appendix H. ETP Projects Used for Analysis

The table that follows provides the names and project numbers for the projects used for the snapshots in Appendix E.

Program Funding Cycle	IOU	Project Number	Project Name
Advanced Lighting Controls			
2010-2012	SCE	ET10SCE5020	Automatic Lighting Controls for Office Applications
2010-2012	PGE	ET12PGE1031	Integrated Occupancy Sensor (Contra Costa Co.)
2010-2012	SCE	ET12SCE4020	Advanced Lighting Controls Training Program - Needs Assessment
2010-2012	SCE	ET12SCE4021	Advanced Lighting Controls and Commissioning Training for Lighting Designers/Engineers
2010-2012	SDGE	ET12SDGE0005	Advanced Lighting Controls - Lab
2013-2014	PGE	ET13PGE7401	Calculator for Advanced Lighting Control Systems
2013-2014	PGE	ET13PGE8141	Redwood Controls + LED Lighting
2013-2014	SCE	ET13SCE8020	California Advanced Lighting Control Training Program
2013-2014	SDGE	ET13SDG8021	Food Bank Office of the Future
2013-2014	SDGE	ET14SDG1061	ALCS Characterization and Bench Testing with CLTC
Boiler Controls			
2010-2012	PGE	ET09PGE0910	Greffen M2G Boiler Control
2010-2012	SCG	ET10SCG0013	Thermodynamic Process Control (TA)
2013-2014	SCG	ET13SCG0009	M2G Scaled Field Placement
Comm. Whole-Building EMS			
2010-2012	PGE	ET10PGE1031	Carbon and Energy Management Systems
2010-2012	PGE	ET11PGE1051	Data Center Infrastructure Management
2010-2012	PGE	ET11PGE4211	M&BS EMS Systems
2010-2012	PGE	ET11PGE4221	M&BS Building Stock Study
2013-2014	SDGE	ET14SDG1101	Continuous Commissioning Assessment
2010-2012	PGE	ET11PGE3161	Pulse Energy -Dashboard w/ Energy Mgr. Tech Assessment (Phase A)
2010-2012	PGE	ET11PGE3162	Pulse Energy -Dashboard w/ Energy Mgr. Tech Assessment (Phase B)
HVAC Heat Pump			
2010-2012	SCE	ET11SCE4080	Ground Coupled Space Conditioning Technical Potential
2010-2012	PGE	ET12PGE1501	San Mateo Jail - Geothermal Water Cooling Technology Assessment
2010-2012	SCE	ET12SCE1090	Testing of Commercial Variable Capacity Heat Pump (VCHP) Systems for Small Commercial Office Buildings
2013-2014	SCE	ET13SCE1010	Ground-Coupled (Geothermal) Heat Pump Field Assessment
2013-2014	SDGE	ET13SDG1011	EPRI Advanced Climate Specific HVAC Systems - Residential VCHP
2013-2014	SDGE	ET13SDG1051	Innovative Ground Source Heat Pump
2013-2014	SCG	ET14SCG0013	Heat pump competitiveness - C&S SUPPORT
Heat Pump Water Heater			
2010-2012	PGE	ET10PGE1001	Heat Pump Water Heaters (HPWH) Field Study

ETP Projects Used for Analysis

Program Funding Cycle	IOU	Project Number	Project Name
2010-2012	PGE	ET12PGE3191	Water Heaters Alt. Technologies (Phase A)
2013-2014	SDGE	ET13SDG1061	Commercial/MFR HPWH
2010-2012	PGE	ET09PGE0917	Laboratory Testing of Heat Pump Water Heaters
Plug Loads			
2013-2014	PGE	ET13PGE1441	Advanced Power Strip (APS) Tier 2 IR
2013-2014	SDGE	ET14SDG8021	TRIP - Tier 2 Power Strip Scaled Field Placement
2013-2014	PGE	ET13PGE8052	Retail Plug Load Portfolio Program Trial
2010-2012	PGE	ET12PGE5251	Computer Efficiency Testing
2010-2012	SDGE	ET11SDGE0015	Software-Based Energy Reduction for Windows (TA)
2010-2012	PGE	ET09PGE0920	Thin Client
Residential ZNE Retrofit			
2013-2014	SCE	ET14SCE8010	Residential ZNE Retrofit - Lessons Learned
2010-2012	SCE	ET10SCE2010	ZNE Tract Home Retrofit
2010-2012	SCE	ET10SCE2020	ZNE Home Retrofit
2010-2012	SCG	ET11SCG0019	Near Zero Energy for Existing Home (TA/DS)
2010-2012	PGE	ET12PGE1441	ZNEH Retrofits at UC Davis (Phase 1)
2010-2012	PGE	ET12PGE1442	ZNEH Retrofits at UC Davis (Phase 2)
Smart Thermostats			
2013-2014	PGE	ET13PGE1462	Smart Thermostats Lab Testing
2010-2012	PGE	ET11PGE1071	ET Home Energy Management Lab Tech Assessment Smart Thermostats (Phase 1)
2010-2012	PGE	ET11PGE1072	ET Home Energy Management Field Tech Assessment Smart Thermostats (Phase 2)
2010-2012	PGE	ET11PGE3073	ET Home Energy Management Scaled Field Placement Smart Thermostats (Phase 3)
2010-2012	PGE	ET11PGE3074	ET Home Energy Management Scaled Field Placement Smart Thermostats (Phase 4)
2010-2012	PGE	ET12PGE1141	Optimization/Learning Thermostat Assessment Phase 1
2013-2014	PGE	ET13PGE1461	Smart / Learning Thermostats EM&V Study
2013-2014	PGE	ET13PGE1463	Optimization Thermostats EM&V Study
2013-2014	SCG	ET13SCG0017	NEST Thermostat Scaled Field Testing with PoF Navigant
2013-2014	SCG	ET13SCG0018	Advanced Thermostat Scaled Field Testing with EPRI

Appendix I. Responses to Public Comments

Below we provide responses to public comments on the report.

Table 24: Evaluator Response to Public Comments

#	Commenter	Comment	Evaluator Response
1	SCE	In the Assessment of ETP activities, most of the technology assessment reports that were reviewed by the evaluators were dated from the 2010-2012 program cycle (see Appendix H). The evaluators were trying to gauge ETP's understanding of the appropriate barriers to assess by comparing the barriers addressed in the 2010-2012 projects with barriers as described by ETP peers in 2015, and found that the 2010-2012 projects addressed fewer barriers. Why did the evaluators choose to disregard barriers addressed by the ETP projects that were not mentioned by the peers? (p. 17, Objective 2, Bullet 2). Could it be that there is a mismatch between the two because our collective understanding of any technology's barriers has evolved since 2010? We suggest that the evaluators add a brief statement that an alternative explanation for their results could be that the evaluators were judging ETP's past selection of barriers against current understandings of the barriers, and that hindsight is 20/20. It would not be surprising that older projects did not address the same barriers with the same frequency as those that are considered most pressing today. In light of this significant confound we would appreciate if the evaluators reconsider their conclusion that ETP is "hitting" the wrong barriers.	The study concluded that ETP focused more on technical barriers than on market barriers and could benefit from incorporating the latter more into its projects, not that the barriers hit were wrong. Note also that two of the points brought up in this comment - that the study may have missed barriers that ETP projects intended to hit but were not listed by the peers, and the historical look at ETP projects - were acknowledged and discussed in the limitations section (3.4).

#	Commenter	Comment	Evaluator Response
2	SCE	On page 4 is the statement: "Actual savings from measures adopted into the portfolio may be a better proxy for program effectiveness rather than technical potential." We wish to remind the evaluators again that ETP is a non-resource program, and cannot control a number of key factors that affect the amount of "actual savings". For example, the resource program managers are the ones who decide on the level of incentives and marketing for those measures, both of which strongly affect customer interest and ability to purchase. Furthermore, a large part of ETP's value is in screening out inappropriate technologies. Therefore, "actual savings" is not at all an appropriate measure of ETP effectiveness. We would welcome other suggestions from the evaluators on metrics that might replace technical potential.	We acknowledge that ETP is a non-resource program and cannot affect a number of key factors that affect claimed savings. Regardless, the use of ETP measures in the portfolio is one of the primary objectives of ETP and is one of many indicators for program effectiveness. We believe that determination of metrics is best done in conjunction with the IOUs, and had suggested this as a recommended task moving forward.
3	SCE	Recommendation # 3 mentions "Consistent with regulatory guidance, ETP could benefit from shifting from a project-level to a technology-level focus". Can you please cite the reference for this regulatory guidance?	The regulatory guidance is interpreted from R.09-11-014, which presents challenges from the PY2010-2012 program cycle, is that 'the current program design is that there is no clear mapping of program activities (as reflected in the PIP) to target specific markets and end-uses particularly to achieve the Zero Net Energy goals of the Strategic Plan. In other words, program budgets and activities are allocated by program elements and do not necessarily link pre-defined sets of technology development milestones to advance the Strategic Plan." Pp. 260.

#	Commenter	Comment	Evaluator Response
4	SCE	Regarding Section 5.1.3, the description of the technology section of the interviews is confusing. Can the evaluators state explicitly that the peers' subjective perceptions of ETP were not used in any subsequent data analysis and did not inform the final conclusions? At the public webinar, the evaluators explained that they only used the peers' opinions on what they thought were the current barriers were for each technology. We suggest that the evaluators describe this task more accurately as a peer survey of perceived barriers of some sort, rather than a "peer review", as the peers ended up not reviewing any ETP work in a usable manner. Their other contributions are highly appreciated, and we look forward to more evaluations that look beyond California programs for lessons.	Please see the final line of the section: "The peer comments from the "Technology" section are provided in Volume II, Appendix E for completeness, but due to the fact that they are subjective, they are included in the results when they aligned with evidence or when they represented a significant trend."
5	SCE	Could the evaluators include copies of each Peers' technology roadmaps in an Appendix? This would help the reader better understand the types of roadmaps that the evaluators are recommending.	The evaluators do not have these documents. Each peer described their documentation during the interviews.

#	Commenter	Comment	Evaluator Response
6	Steve Schmidt	From Page 2 of the report: > Current data tracking systems, and poor data quality, hampers the ability to quantify savings from Emerging Technologies assessed by ETP in the EE portfolio. This is a surprising comment for two different reasons: 1. Smart meters were installed in California well before this program cycle, but the field of smart meter data analytics was entirely ignored as an M&V resource during the 2013-2014 cycle, even in the highlighted category of "Plug-Load Efficiency", where it has since been shown to be particularly useful for analyzing plug loads in a highly cost-effective manner (reference: 2015 NRDC report on Home Idle Loads). 2. Innovative services were available during this entire program cycle that utilized this new wealth of market-transforming data. Some achieved excellent results (12% average savings) as early as 2012 (reference: CEC EECBG program "High Energy Homes"), and were presented to but ignored by IOUs. Not a single smart meter data analytics program was included in the IOU's Emerging Technology Programs during this program cycle. This oversight should be highlighted in your evaluation to avoid recurrence.	Noted. It was not the task of this evaluation to determine what ETP should be assessing.