The California Behavioral Gap Analysis

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Session Theme

☐ "Incorporating Behavior and Feedback into Efficiency Program Portfolios"

☐ Focusing on steps prior to development of programs

    ☐ California Energy Commission's Technology Pipeline Stages:

        • **Applied R&D and Pilot-scale Testing**

        • Full-scale Demonstration

        • Early Deployment

        • Market Facilitation

Acknowledgements

☐ Ayat Osman (ex-CPUC; Cadmac)

☐ Beth Chambers and Virginia Lew (CEC)

☐ Respondents from around the country (see later slide)

Disclaimer

This work does not represent the views of the CPUC, CEC, CIEE, LBNL, and USDOE

Caveats

☐ Conducted in April - May 2012:

  ☐ Treat this review as a snapshot of activity at that time - conducted in a brief period of time (one month) with limited resources

  ☐ Attempted to contact all of the key organizations, but did not heard back from everyone - may have missed certain research activities, projects, and other organizations

Topics

- Background
- Project activities
- Findings:
  - Research gaps
  - Research project highlights
- Evaluation challenges for energy efficiency behavioral change programs

California Energy Efficiency Strategic Plan

☐ "The development, enhancement, deployment and operation of more and better energy efficiency related technology is fundamental to achieving California's energy efficiency vision and goals."

☐ One of the key strategies in support of this objective is to "enhance market intelligence and behavioral research activities related to energy efficient technologies." [Strategy 1-3, Research and Technology Chapter]

Market Intelligence Research

☐ To accelerate the <u>adoption</u> of technology (especially, emerging technologies), there is a need to:

   ☐ Understand the motivations, desires and priorities of consumers (adopters) of energy technologies, in order to understand their needs and expectations and bring the most relevant and valued technologies and practices to market

Project Activities

- ☐ Identified those Market Intelligence (MI) research activities deemed to be critical for the implementation of the Strategic Plan
  - ☐ Research and Technology workshops (July and Nov. 2011)
  - ☐ Discussions with Steering Committee of the Market Intelligence Collaborative
- ☐ Identified MI activities conducted by California organizations and other organizations
- ☐ Identified gaps where more MI research is needed for supporting Strategic Plan

Steering Committee of the Market Intelligence Collaborative

- ☐ California Energy Commission
- ☐ California Public Utilities Commission
- ☐ California Institute for Energy and Environment
- ☐ Finelite
- ☐ Sacramento Municipal Utility District
- ☐ Southern California Edison Company
- ☐ Stanford University
- ☐ Sustainable Design + Behavior
- ☐ University of California, Berkeley
- ☐ University of California, Davis
- ☐ U.S. Department of Energy

Task 2 Respondents

☐ American Council for an Energy-Efficient Economy (ACEEE)

☐ BC Hydro (BCH)

☐ Cadmus Group

☐ California Air Resources Board (ARB)

☐ California Energy Commission (CEC) - PIER Program

☐ California Institute for Energy and Environment (CIEE)

☐ California Lighting Technology Center (CLTC) [at UCD]

☐ California Public Utilities Commission (CPUC) - California Solar Initiative (CSI), Research Development, and Deployment (RD&D) Program

☐ California State University, San Marcos (CSU/SM)

☐ Center for the Built Environment (CBE) [at UCB]

☐ Empower Devices / Earth Markets

☐ Energy Efficiency Center (EEC) [at UCD]

Task 2 Respondents Continued

- ☐ Finelite
- ☐ Lawrence Berkeley National Laboratory (LBNL)
- ☐ Navigant Consulting
- ☐ New York State Energy Research and Development Authority (NYSERDA)
- ☐ Opinion Dynamics Corporation (ODC)
- ☐ Pacific Gas & Electric Company (PG&E)
- ☐ Portland State University (PSU)
- ☐ Research Into Action (RIA)
- ☐ Southern California Edison Company (SCE)
- ☐ U.S. Department of Energy (USDOE)
- ☐ University of California, Irvine (UCI)
- ☐ WattzOn

Research Not Being Supported At All

☐ Residential Sector
   ☐ Assessment of green leases and other market mechanisms

Research Being Minimally Supported

- ☐ Residential Sector
    - ☐ Analysis of social structure factors affecting the development of a clean energy market
- ☐ Commercial Sector
    - ☐ Analysis of social structure factors affecting the development of a clean energy market
    - ☐ Assessment of contractor behavior
    - ☐ Assessment of green leases and other market mechanisms

Highlights of Research Activities

Market Segmentation and Analysis

☐ Some studies are confidential and proprietary, but others are publicly available

☐ Variety of metrics

    ☐ **Residential**: demographic, psychographic, geography, ethnicity, lifestyle, energy consumption, energy burden, energy insecurity, technology

    ☐ **Commercial**: industry/activity type, technology, ownership, energy consumption, size, tenant loads

☐ Focus on consumer attitudes and behavior of specific population segments

    ☐ **Residential**: low income, middle income, low energy users

    ☐ **Commercial**: Industry segments (e.g., glass, paper, plastics)

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Market Alliances

☐ No research on **developing** market alliances, but residential and commercial programs have **relied on market alliances to:**

   ❑ Promote specific energy efficiency technologies (e.g., lighting, appliances and consumer electronics)

   ❑ Promote energy efficiency in specific market segments (e.g., low income households, communities, local government, and corporations)

Modeling of Technology Adoption and Behavior Change

- ☐ Discrete choice analysis, based on consumer behavior
- ☐ Diffusion curves for emerging technologies, based on consumer behavior
- ☐ Market adoption models for emerging technologies
- ☐ Theoretical papers by social scientists
- ☐ Field studies of consumer preferences
- ☐ Pilots and demonstrations that assess consumer adoption of new technologies (e.g., in-home displays, ZNE buildings)

Analysis of Social Structure Factors

☐ **Context**: Household energy use is highly structured by household composition/dynamics, dwellings, appliances, and lifestyle-based behavior patterns

☐ **Residential**: Some research at the international level but only a few studies have done this systematically

☐ **Commercial**: None

Analysis of Market Actor Needs, Behavioral Drivers and Decision-making Processes

☐ **Residential**:

- ☐ Consumers, sales, contracting, installation, innovators, manufacturers, policy makers, regulators
- ☐ See market segmentation studies, process evaluations, and pilots and demonstrations
- ☐ Noteworthy: ethnographic research, audit-to-retrofit studies, and new IEA project

☐ **Commercial** (less activity):

- ☐ Multi-lab study on organization behavior and ZNE studies

Analysis of User Interface and Impact of Quality of Interface Capability on Energy Use

☐ **Residential**:

  ☐ Thermostats, power controls in electronic devices, feedback devices (including in-home displays)

  ☐ See pilots and demonstrations (two-way communication technologies and home area networking, and demand response and nornative messaging programs)

☐ **Commercial** (less activity):

  ☐ Lighting and building commissioning (optimization)

Analysis of Energy Efficiency Measures and Service Delivery Mechanisms

☐ Assessment of contractor behavior:

  ☐ **Residential**: Ongoing inspections of retrofits to assess the performance of contractors, process evaluations; HVAC maintenance behavior; audit-to-retrofit process; contractors participating and not participating in energy efficiency programs

  ☐ **Commercial** (less research): Ongoing inspections of retrofits to assess the performance of contractors, process evaluations

☐ Assessment of green leases & other market mechanisms

  ☐ **Commercial** (little research): USDOE, California Sustainability Alliance, and UC Davis Energy Efficiency Center

☐ Assessment of financing solutions

  ☐ Extensive research in both **residential and commercial** areas; CPUC workshop and CA IOUs proposed programs for 2013-2014

Pilots and Demonstrations for Enhancing Market Intelligence

☐ **Residential**:

  ☐ US DOE's Smart Grid demonstrations, home area networks and in-home displays

  ☐ Targeted: Single-family homes, military homes, neighborhoods, and communities

  ☐ Demand-response programs

☐ **Commercial** (less pilots):

  ☐ College and university (dorm) competitions and community interventions

  ☐ ZNE pilots

Analysis of Customer Needs in Analysis of Emerging Technologies

☐ **Residential and Commercial**:

- ☐ ZNE buildings
- ☐ Smart Grid
- ☐ LEDs
- ☐ Integrated classroom lighting
- ☐ In-home displays
- ☐ Home Area Networks
- ☐ Modeling of diffusion curves for emerging technologies based on consumer behavior

Continued Push for Behavior

☐ **CPUC**

- ☐ The CPUC has required the IOUs to offer behavioral programs to at least 5% of their ratepayers in the 2013-14 timeframe. Currently all three California IOUs are operating comparative energy usage pilots, with a range of program size and scope. But they are **encouraged to do more behavior programs**.

☐ **CEC**

- ☐ "Electric Program Investment Charge - Proposed 2012-14 Triennial Investment Plan" (Oct. 2012; submitted to CPUC for approval)

  - ◆ **Behavior is one of the proposed funding initiatives** (S1.4): "Investigate and Improve Understanding of Building Occupant Behavior and Related Consumer Choice Motivations to Increase and Sustain Energy Efficiency Improvements in Buildings."

  - ◆ Behavior is also explicitly mentioned in other areas, including plug loads (S1.6).

Evaluation Challenges for Energy Efficiency Behavioral Change Programs

☐ **Key issues**:

  ☐ **Examine if, how, when and for how long behavioral programs truly impact energy consumption behavior**

  ☐ Separate out effects that can be attributed to that program

☐ Attribution

☐ Double counting

☐ Persistence

☐ Applying savings to other populations

Attribution

☐ **Problem: Can we attribute all impacts to one program?**

☐ **Methods**:

　☐ Deemed (stipulated)

　☐ Surveys (self reports) corroborate with market data

☐ May only be possible to estimate market effects (not program savings) from a *portfolio* of programs

☐ **Recommendation**:

　☐ Gather data close to point of decision

　☐ Use **experimental design**

　　• Random assignment into treatment and control groups:

　　• Alternative: Quasi-experimental studies (comparison group)

Double Counting

☐ **Problem**: Savings claimed by multiple programs

- ☐ Example: a behavioral program & appliance rebate program both claim savings from appliances

☐ **Recommendation:** Estimate "double-counted savings" by comparing control to treatment group

- ☐ Easier for programs that can be *tracked* (e.g., installation of insulation by a contractor)
- ☐ More difficult for programs that cannot be tracked (e.g., upstream CFL rebates)
- ☐ Make sure program costs are allocated as well

Persistence

☐ **Problem**: How long will impacts last?

☐ Very few studies (e.g., SMUD) on retention or persistence of savings from behavior/education programs

☐ Identifying persistence is complicated as media messages on energy efficiency "bleed" across territories

☐ **Recommendation**:

  ☐ Maintain a control group for every year in which program impacts are estimated

  ☐ Evaluate new behavioral programs each year initially, and every few years after it has been running for several years

Applying Savings to Other Populations

☐ **Problem**:

    ☐ Can we apply savings to other populations in different geographical areas?

    ☐ Can we apply savings to the same population over time?

☐ **Recommendation**:

    ☐ **Be Careful!!!**

    ☐ Create and maintain a control group that is representative of all of the different participating populations, for every year

    ☐ Evaluate new behavioral programs each year initially, and every few years after it has been running for several years

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Time for Questions

Contact information: 510-486-6047 or elvine@lbl.gov

Backup Slides

Coding Scheme

	Number of research projects
■	0
■	1-5
■	6-10
■	More than 10

Residential Sector

			Status
1.		Market segmentation and analysis	**Completed**: PG&E, SCE, BCH, UCI, NYSERDA & Navigant, Cadmus, ODC, RIA, Other **Planned**: ARB, CEC, BCH, UCD/EEC, CSUSM, PSU, Empower Devices/Earth Markets, ODC, RIA, WattzOn, Other
2.		Development of market alliances (for engaging customers - e.g., multifamily, low income, etc.)	**Completed**: SCE, BCH, CIEE, NYSERDA, Navigant, ODC **Planned**: Other
3.		Modeling of technology adoption and behavior change, using "socially-realistic models"	**Completed**: BCH, LBNL, CIEE, PSU, Navigant, ODC, Other **Planned**: SCE, BCH, LBNL, UCI, PSU, Empower Devices/Earth Markets, ODC, Other
4.		Analysis of social structure factors affecting development of a clean energy market	**Completed**: PSU, Navigant, Other **Planned**: PSU
5.		Analysis of market actor needs, behavioral drivers and decision-making processes (includes residential consumers, sales, contracting, installation, innovators, manufacturers, policy makers, regulators, researchers, etc.)	**Completed**: CEC, SCE, BCH, CIEE, UCI, ACEEE, NYSERDA, Navigant, ODC, RIA, Other **Planned**: ARB, BCH, LBNL, CSU/SM, PSU, ACEEE, Cadmus, EMpower Devices/Earth Markets, WattzOn, Other
6.		Analysis of user interface and the impact of the quality of interface capability on energy use	**Completed:** LBNL, Navigant & Opower **Planned**: SCE & UCD/EEC, LBNL, UCI, Navigant & Opower, ODC, Other
7.		Analysis of energy efficiency measure and services delivery mechanisms	
	a.	Assessment of contractor behavior	**Completed:** SCE, BCH, CIEE, NYSERDA & Navigant, ODC **Planned**: SCE & UCD/EEC, BCH, CSU/SM & NYSERDA, PSU, Cadmus, Empower Devices/Earth Markets,
	b.	Assessment of green leases and other market mechanisms	**Completed:** **Planned**:
	c.	Assessment of financing solutions	**Completed:** PG&E, SCE, LBNL, CIEE, NYSERDA, Navigant, WattzOn, Other **Planned**: PG&E, SCE, LBNL, Cadmus, ODC
8.		Pilots and demonstrations for enhancing market intelligence	**Completed:** ACEEE, NYSERDA, Navigant & Opower, Other **Planned**: ARB & UCB, PG&E & SCE & ODC, LBNL, NYSERDA, Navigant & Opower, ODC, RIA, WattzOn, Other
9.		Analysis of customer needs in analysis of emerging technologies	**Completed:** CEC/PIER, PG&E & SCE & ODC, UCI, PSU, ACEEE, Cadmus, Navigant, ODC, RIA **Planned**: CEC/PIER, PG&E & SCE & ODC, LBNL, UCD/EEC, PSU, RIA

Commercial Sector

1.	Market segmentation and analysis		**Completed**: PG&E, SCE, BCH, CIEE, UCB/CBE, UCD/EEC, NYSERDA **Planned**: UCD/EEC, Cadmus, ODC, WattzOn
2.	Development of market alliances (for engaging customers - e.g., multifamily, low income, etc.)		**Completed**: SCE, CIEE, NYSERDA, Navigant **Planned**: UCD/EEC, Empower Devices/Earth Markets, Navigant, Other
3.	Modeling of technology adoption and behavior change, using "socially-realistic models"		**Completed**: BCH, Navigant **Planned**: BCH, UCB/CBE, UCD/EEC, PSU, ODC, Empower Devices/Earth Markets,
4.	Analysis of social structure factors affecting development of a clean energy market		**Completed**: **Planned**: LBNL
5.	Analysis of market actor needs, behavioral drivers and decision-making processes (includes residential consumers, sales, contracting, installation, innovators, manufacturers, policy makers, regulators, researchers, etc.)		**Completed**: BCH, CIEE, PSU, ACEEE, NYSERDA & Navigant, Cadmus, Other **Planned**: ARB & UCB/CBE, SCE & UCD/EEC, BCH, LBNL, UCB/CBE, UCD/EEC, PSU, Other
6.	Analysis of user interface and the impact of the quality of interface capability on energy use		**Completed**: SCE, BCH, LBNL, ODC, Other **Planned**: BCH, LBNL, UCB/CBE
7.	Analysis of energy efficiency measure and services delivery mechanisms		
	a.	Assessment of contractor behavior	**Completed:** BCH, CIEE, NYSERDA & Navigant **Planned**: SCE & UCD/EEC, BCH
	b.	Assessment of green leases and other market mechanisms	**Completed:** **Planned**: UCD/EEC, Navigant, Other
	c.	Assessment of financing solutions	**Completed:** PG&E, SCE, LBNL, NYSERDA, Cadmus **Planned**: LBNL, UCD/EEC
8.	Pilots and demonstrations for enhancing market intelligence		**Completed:** ACEEE, NYSERDA, Cadmus, Other **Planned**: PG&E & SCE & ODC, RIA, WattzOn, Other
9.	Analysis of customer needs in analysis of emerging technologies		**Completed:** CEC/PIER, UCD/EEC, PSU, Cadmus, Finelite, Navigant **Planned**: CEC/PIER, PG&E & SCE & ODC, LBNL, UCB/CBE, UCD/EEC, PSU

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