Technical Assistance in Determining Options for

ENERGY EFFICIENCY in EXISTING BUILDINGS

CONSULTANT REPORT

Prepared for:
CALIFORNIA ENERGY COMMISSION

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Architectural Energy Corporation

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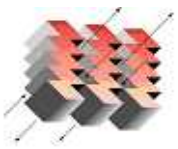

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Table of Contents

List of Tables

List of Figures

EXECUTIVE SUMMARY

California's existing building stock is vast and extremely diverse, with building types ranging from single family homes to high-rise multifamily buildings, and from small businesses in strip malls to skyscrapers and cavernous warehouses. More than half of existing buildings were built before the first energy efficiency standards were in place. Despite more than two decades of energy efficiency programs, a large reserve of potential energy and peak demand savings remains to be captured.

Assembly Bill 549 (Longville) Chapter 905, Statutes of 2001 directs the California Energy Commission to "investigate options and develop a plan to decrease wasteful peak load energy consumption in existing residential and nonresidential buildings" and report its findings to the legislature. The Energy Commission's initial response to this legislation was the report, *Assessing the Energy Savings Potential in California's Existing Buildings: An Interim Report to the Legislature in Response to AB 549* (December, 2003 Energy Commission Report #400-03-023F) which was sent to the legislature in late December, 2003. The work performed under this project was based in part upon the initial work completed for that report.

An advisory committee consisting of members from the Energy Commission, Pacific Gas and Electric Company, Southern California Edison, Sempra Utilities, and the California Public Utilities Commission was formed to oversee this project. This report provides a series of recommendations on steps that can be taken to improve the efficiency of existing residential and commercial buildings. The list of interventions is summarized in the following subsections and is also detailed within the body of the report.

Information Gateway

Energy efficient technology information should be provided to all residential households, including energy audits and referrals to existing energy efficiency programs. The intervention will be targeted at buildings with higher than average energy bills, geographic areas known to contain inefficient housing stock, low income households and homes in areas of transmission/distribution system congestion. Although customers will be targeted under this intervention, the information portal will be open and available to all customers, as strategies may be employed at any time to manage the population of residential buildings with the goal of constantly improving the efficiency of the existing building stock. Specific recommendations for implementation of this intervention include:

- Establish a centrally administered information portal for residential energy efficiency information with referrals to efficiency programs and services offered

by the Energy Commission, utilities and non-utility program implementers. Offer feedback on customer energy use through utility bill benchmarking and provide home energy audit information in a multi-level format that allows the customer to explore their energy use patterns and options for saving energy to the degree to which they have the time or the interest. Distribute energy efficiency program marketing materials and referrals that are tailored to customer needs along with the audit report.

- Specifically target buildings with the greatest potential for energy savings and/or the highest energy cost burden for energy audits and program services. Target residents, property owners and/or property managers as appropriate. Utilize local government and/or community-based organizations as necessary to reach targeted customers.
- Collect building description information and deliver audit results on-line, over the phone, through the mail or in person as necessary to reach targeted customers.
- Provide customers with opportunities for assistance in financing energy efficiency upgrades either through existing programs or a separate initiative.
- Utilize the statewide Flex-Your-Power media campaign to advertise and promote the central information portal.
- Authorize funding through the CPUC to provide the necessary capability within utility websites and online billing systems to implement this strategy.
- Investigate policies and procedures that allow the utilities to identify and claim energy savings for customer actions taken as a result of this intervention.
- Investigate policies and procedures that allow third party access to customer energy consumption data while providing reasonable protection of customer confidentiality.

Time-of-Sale Information Disclosure

Energy efficiency related information should be provided to prospective homebuyers during the home marketing and sales process. The information should include a compilation of utility bills for the past twelve months, a physical inspection of the energy features of the home, a home energy rating that indicates the relative energy efficiency of the home, and a list of cost-effective energy upgrades. The potential upgrades should be described in sufficient detail to allow the homebuyer to apply for an energy-improvement mortgage (EIM). Timely information combined with easy access to mortgage financing of energy efficiency improvements should facilitate improvements that will increase the energy efficiency and affordability of existing housing. The historical energy consumption and energy rating of the home are a material fact that should be disclosed during the sales process. Specific recommendations for implementation of this intervention include:

- Develop an overall approach to increase the frequency of energy ratings during time-of-sale and build capacity in the market place to provide this service. The approach should start as a voluntary pilot program in selected areas of the state, leading to future mandatory rating requirements.
- Target older, less-efficient homes for program participation and provide incentives to buy down the cost of energy ratings during the pilot phase.
- Require disclosure of historical energy consumption, energy ratings, availability of EIMs and energy efficiency program information as a material fact during the sales process.
- Change statutes governing home inspections to require energy efficiency assessments as a component of home inspection process
- Conclude the Energy Commission proceeding on Home Energy Rating Systems (HERS).
- Require training of real estate agents and appraisers on topics related to energy efficiency and EIMs as part of professional licensure requirements;
- Establish minimum portfolio standards for EIMs in the secondary mortgage market.
- Provide incentives to increase adoption of EIMs, including interest rate breaks and lender incentives.

Equipment Tune-Ups

The frequency and effectiveness of Heating Ventilation and Air Conditioning (HVAC) system tune-ups and maintenance services for single family and multifamily residential customers should be increased. The goal of this intervention is to improve HVAC system efficiency through enhanced HVAC system diagnostic testing and repair services. The enhanced service addresses issues such as improper refrigerant charge, improper unit airflow and excessive duct leakage that are beyond the scope of normal HVAC service and maintenance procedures. The success of this initiative will depend on training HVAC service contractors in advanced diagnostics and tune-up procedures; educating consumers about the benefits of enhanced HVAC service offerings; certifying contractors to enhance customer confidence in the quality of service provided, and providing long-term program support through continued incentives and training. Specific recommendations for implementation of this intervention include:

- Promote enhanced HVAC system tune-ups performed by certified contractors as a component of the time-of-sale initiative.
- Promote quality installation procedures by certified contractors during equipment replacement.

- Support technician training through community colleges and vocational education schools.
- Support technician certification through the North American Technician Excellence, Inc. (NATE) program.
- Provide marketing support for enhanced HVAC maintenance and service offerings through the Statewide Flex Your Power marketing campaign.

Integrated Whole Building Diagnostic Testing and Repair

To effectively evaluate and remediate design and installation defects in single and multifamily residential buildings, the building should be considered as a system of interacting components, rather than individual components functioning in isolation. Climate, building materials, the assembly of building materials, occupant interaction, mechanical equipment design and installation all affect building performance. This intervention strategy encourages the use of whole building testing procedures and diagnostic tools to identify flaws in building design or construction and to direct the correction of these flaws. A detailed diagnostic evaluation provides a comprehensive understanding of building performance and indicates strategies that can reduce energy consumption and improve occupant comfort, health and safety. A trained contractor performs the diagnostic testing, implements the upgrades, and verifies performance in a streamlined one-stop process. Homeowners that have participated in this service value non-energy benefits such as enhanced comfort and indoor air quality as much or more than the energy savings benefits. Specific recommendations for implementation of this intervention include:

- Provide training and marketing support for contractors entering the whole building diagnostic testing services market.
- Target severe cooling climate regions and buildings with excessive energy consumption.
- Coordinate with the home inspections and energy ratings conducted under the time of sale intervention to provide solutions for buildings with severe energy or construction defect issues.
- Allow energy efficiency programs to value non-energy benefits in cost-effectiveness calculations.
- Permit qualified contractors to self-verify energy savings based on documented testing protocols.
- Engage the insurance industry to explore the risk reductions benefits of improved occupant heath and safety resulting from whole building diagnostic testing services.

Assistance to Affordable Housing

To improve the energy efficiency and affordability of existing low income multifamily housing in California, a series of strategies are recommended. The interventions attempt to work within existing policies, procedures, and agencies to provide technical information and financial support for implementing efficiency improvements during building renovation and on an ongoing basis. Specific recommendations for implementation of this intervention include:

- Provide information, training and technical support services to multifamily housing property and asset managers, including tools for utility bill tracking, energy performance benchmarking, energy audits and technical assistance to implement cost-effective upgrade projects.
- Provide funding for HVAC system tune-up and operations and maintenance programs targeted at multifamily properties.
- Provide low-cost or no-cost financing of qualified energy efficiency improvement projects.
- Require energy ratings and energy efficiency upgrades for properties that participate in subsidized housing tax credit programs.
- Target housing rehabilitation projects for comprehensive energy efficiency upgrades.
- Use state housing agencies as a hub for providing energy efficiency program referral information.
- Develop interagency partnerships between state housing agencies and the Energy Commission to provide technical support services to local housing authorities and project developers.
- Revise utility allowances to account for energy efficiency and develop accurate and consistent methodologies for estimating utility costs in standard and energy efficient properties.

Commercial Building Benchmarking

Commercial building benchmarking should be used as a method to gain the attention of energy efficiency project decision makers and motivate these decision makers to seek additional information about improving the efficiency of their building. Specific recommendations for implementation of this intervention include:

- Require benchmarking by utilities. This element requires utilities to benchmark all commercial buildings. A mechanism should be provided for continuous updating of benchmarking scores with each billing cycle to track the effectiveness/impact of changes in building operations or installation of energy efficiency features. This service should be provided as a component of customer service.

Benchmarking reports should be directed at the appropriate decision maker, not just the person responsible for paying the utility bills.

- Provide referrals to retro-commissioning and retrofit programs. Benchmarking alone does not lead directly to energy savings. To motivate further investigation into cost-effective improvements, referrals to retro-commissioning and energy audit services should be made. Benchmarking is viewed as the first step in a process of further investigation and action.
- Target high consumption buildings. Benchmarking provides a means for utilities to target poorly performing buildings for retro-commissioning projects and/or energy audits.
- Require benchmarking during building financing and refinancing events. Buildings are financed/refinanced periodically throughout their lives. It is appropriate to consider the operating costs of the building and ways to reduce those operating costs at this time.

Retro-commissioning

Retro-commissioning is a process for detecting, diagnosing and correcting faults in commercial building systems and operations. It is recognized as a highly effective and economical strategy for improving the efficiency of commercial buildings. Retro-commissioning typically identifies no cost or low cost upgrades to building operations and control strategies, and low cost replacement of failed components, as well as recommendations for larger capital improvements and equipment replacements. Retro-commissioning projects typically result in a set of ongoing activities that provide continuous improvement in building efficiency and operations.

The objective of this initiative is to place retro-commissioning services into the market at key trigger points on an ongoing basis to maintain building system performance and reduce energy consumption. Specific recommendations for implementation of this intervention include:

- Develop case studies relevant to the commercial building business environment, particularly geared towards commercial building decision makers such as energy managers, financial managers, and property managers as well as building operations and maintenance personnel.
- Use risk management as a context for retro-commissioning case studies. Retro-commissioning buildings helps control risk from volatile energy costs, loss of tenants due to comfort issues and litigation stemming from indoor air quality problems.
- Build a retro-commissioning services infrastructure by developing the skills and expertise of retro-commissioning service providers and expanding the number of firms that offer retro-commissioning services.

- Stimulate interest and create demand in the market for retro-commissioning services through customer financial incentives such as rebates or tax credits.
- Coordinate with the benchmarking intervention by using the benchmarking system as an intake point to collect information needed to screen customers for retro-commissioning potential.

Commercial Leasing

Energy efficiency improvement clauses incorporated into commercial leasing contracts can help mitigate the split incentives between building owners and tenants caused when the tenants are responsible for paying the building energy costs. These split incentives are significant barriers to efficiency program participation by tenants and owners alike. This intervention includes the development of a standard set of energy efficient leasing agreements and promotional efforts to make these lease structures accepted as standard procedure. Specific recommendations for implementation of this intervention include:

- Use existing model leases, such as the Building Owners & Managers Association (BOMA) lease as a model for best leasing practices. The BOMA model lease has suggestions for clauses that encourage building owners to upgrade the energy efficiency of their properties. Movement from a net lease, where tenants pay all utility costs, to a fixed base lease, where energy costs and benefits from efficiency upgrades are shared between tenants and building owners, can accomplish this objective.
- Include a provision into the lease that requires the owner or property manager to benchmark the building energy consumption and report the benchmarking data to the tenants. The building owner will be exposed to a broad range of services through the benchmarking portal, such as retro-commissioning and building audits.
- Place content on the advantages of energy efficient buildings and the existence of model lease clauses into continuing educating classes required by the applicable state licensing boards for real estate agents, lawyers, property managers, and appraisers. Enlist industry groups such as BOMA and the California Association of Realtors® to develop curriculum and training.
- Educate real estate agents on the advantages of energy efficient buildings and lease arrangements that encourage investments in efficiency, as real estate agents are in a position to influence the tenant on property selection and lease terms.
- Use partner networks, such as ENERGY STAR and Leadership in Energy and Environmental Design (LEED), to educate building owners about model lease provisions that encourage investments in energy efficiency.

Demand Response

Deregulation of California's electricity market was marked by numerous problems including generation shortages, transmission congestion and wholesale price volatility. The 2001 energy crisis increased the importance of a demand response policy and program initiative. Demand response programs may be grouped into two broad categories: reliability-based and market-based programs. Reliability-based programs are triggered during emergency conditions when the stability of the electrical system is threatened. Market-based programs are triggered by wholesale electricity prices and offer incentives during general market conditions (also called price-response programs). Specific recommendations for implementation of this intervention include:

- Change rate structure in California to follow a time-of-use structure for low-to-medium energy use customers and a dynamic real-time pricing structure for large customers.
- Educate customers about peak and off-peak prices, what electricity costs at various points in time and the types of appliances or equipment that consume on-peak power. Educate consumers about real-time pricing and how it can help save them money.
- Provide a phase-in period for rate tariff changes, such as a six-month to one-year transition period where customers are provided with a "shadow bill" that shows them what they would be paying in the dynamic pricing rate structure compared to what they are currently paying.
- Promote technologies that read pricing signals and make use of these technologies commonplace. Reduce costs associated with metering technologies through public/private partnerships such as Energy Commission's Public Interest Energy Research (PIER) program.
- Offer incentive programs to encourage the installation or upgrade of building control systems that provide automated response to real time pricing signals.
- Expand their scope of building and appliance standards to address demand response programs. As automated load-shedding features are implemented into appliances, demand response pricing signals will be more fully used.

Upstream Interventions/Manufacturer Partnerships

Upstream interventions should be developed that provide incentives to manufacturers to reduce the risk and cost of producing and deploying energy efficient products. Such interventions should include financing for research and development (R&D) to develop new products, incentives to reduce the cost of goods sold, as well as dissemination of documentation, case studies and demonstration materials.

The initiative is designed to stimulate manufacturer interest in developing and marketing energy efficient technology. Procurement and purchase incentives, discussed separately, will also reduce product development risk and unit manufacturing and marketing cost through increased product sales.

Due to markups occurring throughout the distribution chain, incentives or initiatives applied at the manufacturer level may be more cost-effective than those applied at the consumer level. These upstream activities stimulate and accelerate the development of new energy efficient products with a higher efficiency level and lower manufacturing cost than would otherwise be achieved. Specific recommendations for implementation of this intervention include:

- Prioritize technology development opportunities by identifying needed products defining the desired performance characteristics and assessing the costs and market potential. Set product development goals including desired timing based on this assessment.
- Identify important manufacturers and their potential roles. Focus on key partners and develop manufacturer R&D partnerships.
- Prioritize upstream incentive opportunities by examining existing and past incentive programs to determine which end uses and product types are most amenable to upstream interventions such as rebates and other financial rewards.
- Create market connections and mobilize market connection efforts following the recommendations of the “Information, Case Studies and Demonstrations Initiative.”

Procurement

While energy efficient equipment is not new to California consumers, the procurement of such equipment is not aggressively pursued on a statewide basis, nor are there strong promotional efforts that keep attention focused on energy efficiency. Also, a lack of expertise within the California purchasing community prevents cost-effective products from being selected. The procurement intervention is targeted at all state agencies as well as local government and non-profit organizations eligible to purchase through state contracts. Specific recommendations for implementation of this intervention include:

- Develop mandatory energy efficient procurement policies for state agencies with clearly defined rules and procedures.
- Establish a strong central product assessment office to evaluate the energy efficiency, suitability and functionality of products purchased under the rules established by this initiative. The staff conducting assessments should be comprised of skilled scientific investigators who understand the products and principles of energy efficiency. Assessment should allow contract awards to be defensible during the bid process. The product assessment function should

reside within the Energy Commission or contracted to a third party with Energy Commission oversight.

- Develop a strong communications infrastructure to ensure the product testing assessment results are delivered to the thousands of state and local government organizations that could use the information. Disseminate information about product changes and updates. Provide feedback to participating organizations so that they know how much energy they are saving by using the energy efficient products.
- Make it easy to participate. The initiative will need to employ tactics that are user friendly and compatible with user needs and schedules.
- Coordinate, design, and launch with the cooperation of the U.S. Environmental Protection Agency (EPA) Environmentally Preferable Purchasing Team (EPPT), a federal-wide program that encourages and assists federal agencies in the purchasing of environmentally preferable products and services.

Branding

This initiative focuses on the use of energy efficient technology or technology-service branding and its potential to capture additional energy savings in the residential and nonresidential sectors. Although considerable interest in the use of branding and co-branding to capture additional market share for energy efficiency programs exists, the current brands may not reflect the most efficient product choices or cover all of the technologies and services needed in California. Specific recommendations for implementation of this intervention include:

- Continue to reference ENERGY STAR, but incorporate higher tiers to promote more efficient products.
- Limit incentives to higher tier products.
- Establish and use co-branding to promote product lines not covered by ENERGY STAR.
- Work with other states and organizations such as Wisconsin, New York, Vermont and the Consortium for Energy Efficiency to coordinate efforts to push efficiency levels and incorporate new products into the marketplace.
- Use ENERGY STAR as a minimum level for purchasing programs.

Information, Case Studies, and Demonstrations

Technology transfer materials are needed to overcome information-related market barriers that inhibit the market penetration and use of energy efficient products and services. This initiative supports all the other initiatives in the program. Elements of

the initiative include: identifying key market participants; determining related market barriers; designing and developing information products to overcome those barriers; and developing and executing a plan to get the information products to the relevant stakeholder. Specific recommendations for implementation of this intervention include:

- Identify market barriers associated with the targeted interventions and identify opportunities for information dissemination. Develop fact sheets, brochures, guidelines, training materials and training sessions, presentations, papers, and walk-through tours to overcome market barriers.
- Develop an information dissemination plan for distributing materials and conducting events. Use utilities and their energy centers; government organizations and their clearinghouses; manufacturers and their distribution chains; as well as industry trade associations and their channels to reach building owners, specifiers, facility managers, users, and energy efficiency and environmental advocacy groups.

Technical Training and Certification

Training and certification efforts should be expanded to develop energy efficiency awareness and technical skills in a variety of residential and commercial market participants to improve the quality of services and strengthen market confidence in the services. Market participants targeted include energy auditors, retro-commissioning service providers, whole building contractors, air conditioning contractors, property managers, building operators, and real estate professionals. Specific recommendations for implementation of this intervention include:

- Develop a central education, training, and certification office to coordinate efforts. An organization like the Energy Commission, an independent private sector organization, or nonprofit organization skilled in these approaches would need to champion the effort.
- Engage manufacturers, community colleges, vocational schools, utility education centers, union training programs, and professional training institutes to improve the likelihood of success.
- Work with existing trade associations, regulatory agencies, and certification programs to insert energy efficiency content into training materials.
- Coordinate this initiative with other efforts that build demand for efficiency programs to avoid mismatches in the number of trained professionals and the demand for services.

Risk Protection

Key market barriers to the adoption of energy efficiency products and services include risk avoidance, skepticism about benefits, reliability uncertainty, and performance uncertainty. These barriers limit market movement toward the energy efficient choice. This combination of barriers represents one of the most powerful influences in the market that significantly outweighs price or payback considerations. Incentive programs, which are the most common and popular type of program in California, primarily address the price barrier. Very few programs address these additional barriers individually and no programs address them as a group. This intervention addresses the additional barriers through the development of risk mitigation and protection strategies for efficiency program participants. Specific recommendations for implementation of this intervention include:

- Develop a risk assessment function that examines the technology mix covered by efficiency program offerings and determines the costs and benefits of reducing the financial risk associated with nonperformance of energy efficient technologies.
- Identify a set of programs that can benefit from the risk reduction initiative. This assessment would examine the risk inherent in the technologies promoted by the program including installation, maintenance, and operations issues.
- Develop a set of cost tables to drive decisions regarding how much of the financial value of the risk should be carried by the program and how much should be carried by the participant.
- Develop a pilot program to address and mitigate performance risk. Collaborate with product manufacturers, distributors, and dealers along with other industry stakeholders already in the business of providing product performance guarantees and insurance.

Interagency Program Coordination

Energy efficiency program delivery efforts are scattered through a host of organizations and agencies, including the Energy Commission, the CPUC, the Investor-Owned Utilities, municipal utilities, and non-utility program implementers. Program effectiveness could be improved through improved coordination within the set efficiency program offerings as well as with other agencies with policies and procedures that affect the delivery of these programs. Specific recommendations for implementation of this intervention include:

- Require a coordination plan as a component of an overall program implementation plan. Present plans on how program delivery and evaluation efforts will be coordinated with other related program efforts.
- Develop a central program referral system for customers and program implementers.

- Develop policy on how to share energy savings between programs offering and receiving referrals. There is no current policy to encourage programs to coordinate and provide referrals. A mechanism to account for and value inter-program referrals should be developed.
- Coordinate the efforts of the CPUC and the Energy Commission with state housing agencies.

Overall Intervention Portfolio

The electricity, peak demand, and natural gas savings for interventions expected to deliver direct energy savings[1] along with an estimate of the overall cost and cost-effectiveness are shown in Table ES-1. A range of values is reported based on the expected and maximum adoption rates estimated for each intervention. The interventions are ranked according to the estimated kWh savings at the expected program adoption rate.

The interventions developed in this report were chosen based their ability to address important trigger events, fill gaps in existing program offerings, reduce adoption barriers and build infrastructure to support widespread implementation energy efficiency programs throughout California. The interventions should be viewed as a set of mutually supportive activities, rather than as isolated interventions. The role of each intervention in the overall portfolio and the relationships and synergies between the interventions are summarized in Figure ES-1.

[1] Energy and demand impacts are expected from the Procurement and Demand Response interventions, but were not calculated due to limitations in the available data.

Table ES-1. Energy Savings, Demand Savings and Cost-effectiveness Summary

Intervention Strategy	Electricity Savings (GWh)	Peak Demand Savings (MW)	Natural Gas Savings (MTh)	Cost ($million)	Participant Benefit Cost Ratio	Total Resource Benefit Cost Ratio
Time-of-Sale Information Disclosure Voluntary Pilot Program	19 - 29	6 - 9	1.1 – 1.5	3.7 – 5.6	2.1	1.0
Phase 1 Mandatory Implementation (older homes)	164 - 174	49 - 52	9.3 – 9.9	15.1 - 16	2.0	1.0
Phase 2 Mandatory Implementation (all homes)	251 - 266	73 - 77	12.0 – 12.7	0 – 14.6	2.0	1.0 - 1.1
Upstream Interventions/ Manufacturer Partnerships	207 - 551	57 - 152	0.0	Not estimated	Not estimated	Not estimated
Retro-commissioning	152 - 182	77 -92	7.6 – 9.1	41.0 – 49.2	3.2	1.7
Information Gateway	73 - 307	19 - 80	6.6 – 27.8	28.0 – 117.9	1.9	1.0
Integrated Whole Building Diagnostic Testing and Repair	45 – 54	40 - 48	1.9 – 2.2	11.9 – 14.3	1.7	1.1
Commercial Benchmarking	26 - 33	6 - 8	0.4 -0.5	2.0 – 2.5	2.5	1.1
Assistance to Affordable Housing	17 - 35	27 - 56	4.4 – 9.2	44.5 – 93.1	3.6	1.1
Residential Equipment Tune-up	15 – 18	20 - 24	3.6 – 4.4	4.7 – 5.6	2.0	1.1
Branding	12 - 31	3 - 8	2.3 – 5.8	Not estimated	Not estimated	Not estimated
Commercial Leasing	4 - 24	1 - 5	0.0	0.7 – 4.1	4.6	1.9

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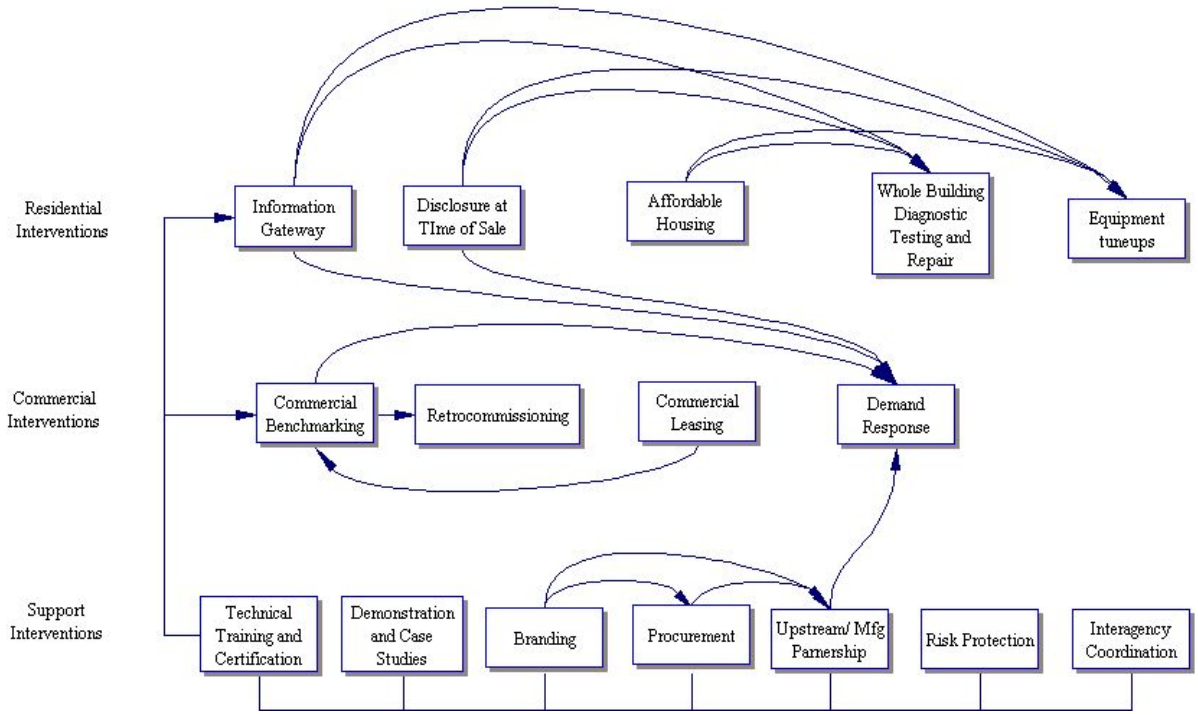

Figure ES-1. Relationships of Interventions Within Overall Portfolio

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1. INTRODUCTION

This project was led by Architectural Energy Corporation (AEC) under Contract Agreement No.: 400-04-001. Subcontractors assisting in this effort are TecMarket Works, Lutzenhiser Associates, RLW Analytics, Morton Blatt, and the Davis Energy Group.

A Project Advisory Committee comprised of members of the California Measurement Advisory Council (CALMAC), which includes representatives from the investor-owned utilities, the California Public Utilities Commission (CPUC) and the California Energy Commission (Energy Commission) guided this project. The Project Advisory Committee was also involved in the review of deliverables during the course of the contract.

This report, with a separate volume containing appendices, describes a series of activities undertaken during the course of the project, including literature reviews, program manager interviews, key informant interviews, expert panel discussions, and additional in-depth analysis of consumer opinion survey and appliance saturation survey data. Market barriers to adoption of efficient technologies are discussed, and a set of interventions aimed at reducing these barriers are suggested. The focus of these interventions is on initiatives that are outside the current reach of appliance or building energy efficiency standards.

For the purposes of this project, options capable of reducing peak energy consumption include those that increase the efficiency of equipment that uses electricity during peak periods and those that shift or shave peak demand. Options that reduce natural gas end-use consumption are included because they can help stabilize gas supplies and reduce price spikes in both electricity and gas markets—since a large and growing portion of California's electricity generation is fueled by natural gas.

The main report sections are as follows:

- Chapter 2: Market Barriers and Technology Adoption. A summary of the research on market barriers and a model for understanding how these barriers affect product choice decisions is presented.
- Chapter 3: Actor Networks. The use of Actor Networks theory to understand the complex interactions between interest groups operating within each intervention is discussed.
- Chapter 4: Interventions. A set of interrelated, mutually supportive interventions is described in this section, with the goal of increasing the efficiency of existing residential and commercial buildings in California.

- Chapter 5: Energy Savings and Economic Analysis. The electricity consumption, peak demand and natural gas savings for selected interventions are estimated, along with intervention costs and cost-effectiveness.
- Chapter 6: Policy Issues. A set of recommendations for legislative and policy changes are made, along with an action plan for implementing the interventions.

Report Appendices published under a separate cover are as follows:

- Appendix A: Existing Research Review. A review of efficiency program strategies and behavioral research relevant to the development of new initiatives. These results were developed early in this project.
- Appendix B: Sample Interview and Panel Discussion Guides.
- Appendix C: Primary Market Research. Based on the results of earlier work, additional primary research was conducted to answer key questions. The market research conducted included a series of key informant interviews and expert panel discussions.
- Appendix D: Behavioral Science Research. Additional research was conducted to address specific questions raised early in the project work regarding consumer opinions and market segmentation that may affect initiative design and targeting.
- Appendix E: Detailed Segmentation Tables. Data tables extracted from the Residential Appliance Saturation Survey (RASS) used in segmentation analysis.
- Appendix F: Energy Analysis Assumptions. Details on the energy impacts and cost-effectiveness calculation assumptions.

2. MARKET BARRIERS AND TECHNOLOGY ADOPTION

By reducing or eliminating the barriers that keep a customer from acquiring a product, a customer can be moved to more quickly purchase and use the product. This concept is as old as the first transactions between humans. It is the premise on which most energy efficiency programs are founded, indeed the foundation on which all product marketing is based.

If market barriers can be eliminated or reduced, then substantial portions of California's increasing energy demands can be met through energy efficiency. If not, new energy supplies, new power plants, and new distribution systems will be needed to meet growing demand. Energy-related costs and the effects of increased hydrocarbon use will characterize this trend. Because of these conditions, understanding and reducing market barriers to efficient energy use is a critical part of any program initiative.

This section of the report examines the types of market barriers that restrict energy efficient product adoption and discusses how these barriers stand in the way of a more energy efficient future. By understanding barriers, program designers can design and implement programs that remove them, thereby achieving a more energy efficient future. Likewise, when policy makers better understand market barriers, they are better able to craft policies that help ensure that future energy needs will be met cost-effectively and with fewer environmental and economic impacts.

Barrier Classifications

This chapter divides energy efficiency and demand reduction/response program market barriers into five classifications. To reduce the repetition of specific barriers in more than one classification, individual barriers have been placed within the classification that best describes the barrier. For example, specific product cost barriers can be classified as either a product or a participant barrier. Considering product cost as a function of the product, the barrier is best classified as a product barrier. However, if cost is seen as an ability-to-pay barrier (such as in low income programs), then it is best classified as a participant barrier. Where the barrier is placed in the framework is less important than recognizing it as a key market barrier.

Figure 1 shows the overall framework used in this project to estimate the energy savings potential from the intervention strategies researched. The technical energy savings potential of a particular energy efficiency measure introduced within each intervention is assessed through a series of technical potential factors and applicability of the measure within the market from a purely technical perspective.

Once the technical potential of the measure is established, the barriers to adoption of the measure are assessed. The figure introduces the five types of barriers that limit the adoption of energy efficiency measures:

1. Product barriers.
2. Participant barriers.
3. Market barriers.
4. Purchase barriers.
5. Provider barriers.

A brief explanation of each barrier classification with an example of the specific barriers that are classified under that type follows Figure 1. The barriers most important to address within the program design and development process are cited as specific barrier examples.

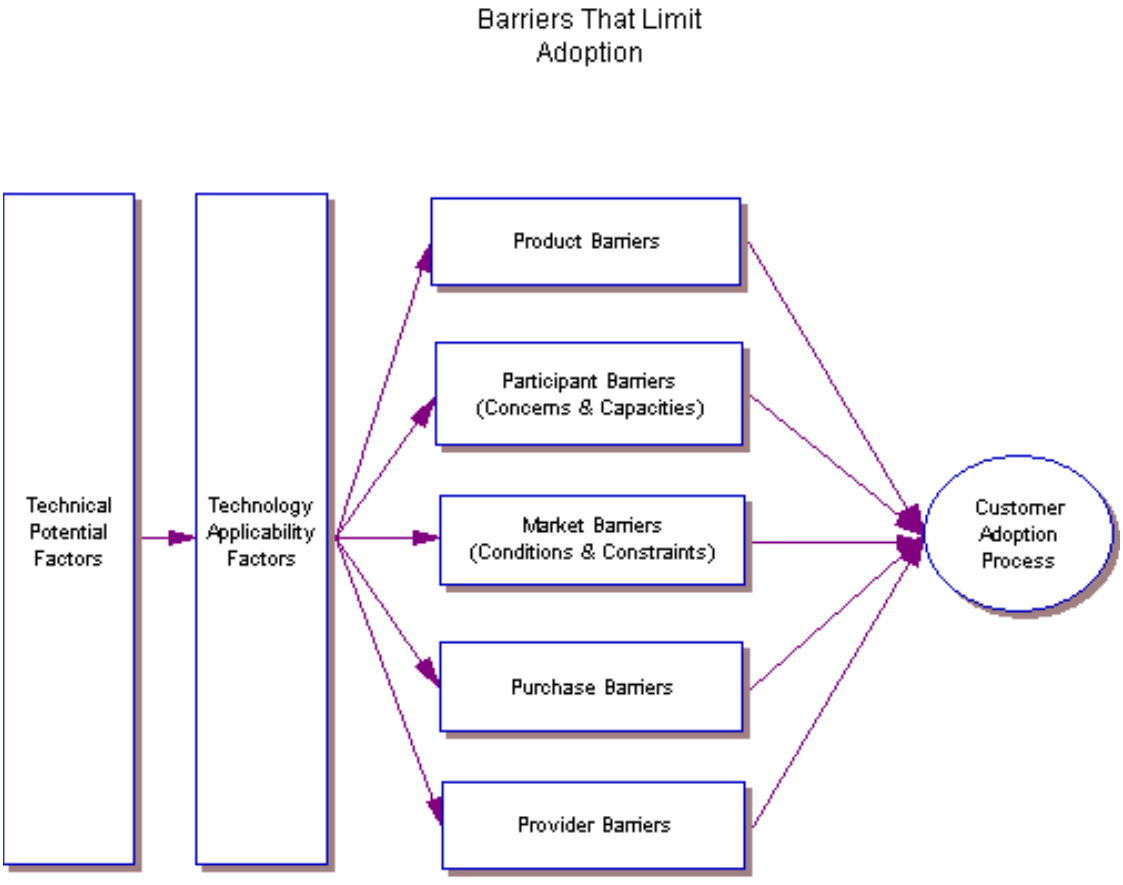

Figure 1. Market Barrier Classification Framework

Product Barriers

Product barriers are defined as those technical attributes, costs, and other characteristics of products and technologies that limit customer acceptance and adoption. From the adopter's perspective the product must be the right product for them. It must meet their needs and fill the necessary function. Otherwise, the customer will not purchase the product.

A good example of this barrier is product configuration. In one audit a company needed a 25 horsepower blower motor. However, the configuration of the motor limited installation to hardware available only in 125 horsepower models. As a result the 125 horsepower motor was placed in service. If the product does not meet the needs of the decision maker, alternative products and approaches will be used.

Key product barriers include:

1. *First cost*. What is the cost of acquisition? This is typically equivalent to the price of the product.
2. *Life-cycle cost*. What is the cost of acquiring, installing, using, maintaining, and disposing of the product?
3. *Payback period*. How long will it take to recover the cost of the product through the benefits provided by the product's use?
4. *Hidden or unexpected costs*. Are there added costs associated with the product not known or revealed during the purchase considerations?
5. *Reliability uncertainty*. How reliable is the product to use and/or operate? Expected downtime is a key component of this barrier.
6. *Performance uncertainty*. How does the product deliver on the reasons for which it was obtained?
7. *Configuration or product design*. Does the product meet design characteristic needs or expectations, including such qualities as size?
8. *Available options.* Does it come with the options needed or wanted? These can be hardware, software, or ancillary service options. They can be major or minor, such as color choice.
9. *Unwanted characteristics*. Are there any unwanted characteristics (not specified above) associated with the product?

These are the key barriers associated with the product itself. We have used the question format to highlight that these "barriers" could just as easily be beneficial attributes of the product. If the product is satisfactory in all these characteristics, they become beneficial attributes that help speed adoption instead of slowing adoption.

While few energy efficiency programs would argue with the premise that removal of barriers speeds adoption, most, particularly resource acquisition programs, have neglected to address product barriers. Only those energy efficiency programs

designed to transform the way in which markets work have focused on product barriers. For example, some programs work with compact fluorescent lamp (CFL) manufacturers to help make sure that the market has a selection of bulb sizes, types and pricing advantages. Another example is ENERGY STAR programs that work with manufacturers to get more energy efficient product designs into the market.

Participant Barriers

Participant barriers are defined as cognitive, cultural, organizational, financial, and other related factors internal to the firm or household that interfere with the decision to purchase an energy efficient product. These barriers pertain to the individuals and decisions makers within a targeted market or market segment. The top participant barriers cited include the following:

1. *Lack of awareness of a problem (or opportunity)*. They do not know that there is an issue, problem, or opportunity available to improve their life or the lives of others.
2. *Skepticism about benefits (including non-energy benefits).* The purchasing party is not sure or does not believe that the benefits predicted are real or that the benefits will be realized if they take the recommended action.
3. *Lack of personnel or time*. The consumer lacks the resources in terms of time, staff, or ability to research the issue in question. (Also called the “hassle” or “transaction cost” barrier.)
4. *Lack of perception of seriousness of problem*. The customer does not believe that the problem is real, or that there is justification or cause to fix a problem that may not be real.
5. *Inability to obtain financing*. The consumer lacks the ability to obtain the capital needed to take an action.
6. *Lack of ownership of the problem.* The potential purchaser believes that the problem belongs to someone else and, therefore, is not their responsibility or concern.
7. *Lack of sense of efficacy in possible actions*. S/he does not believe that s/he has the power or ability to make a change that provides benefits.
8. *Institutionalized procedures*. Procedures or decision systems within the individual’s decision networks block or are presumed to block the ability to respond to the problem or to react to capture a benefit. Sometimes these are as simple as rule-of-thumb decision systems that do not allow for change to easily occur, or that past approaches have worked and customers see little need to change. As such, these procedures can be formal or informal. (Also called “bounded rationality.”)
9. *Future uncertainties*. The customer is not sure about their future and is reluctant to make decisions that rest on their future position or condition.

10. *Risk avoidance*. Potential adopters of energy efficient technologies are often risk adverse for a host of reasons associated with several of the barriers identified in this chapter. However, there is also a barrier that is associated with making a wrong decision, and then enduring the consequences of that decision for an extended period of time. This is the risk factor that is in itself a barrier. While the technology may be sound, and provide promised performance or economic benefits, the risk associated with making that decision, especially if it is different from past or institutional procedures or rule-of-thumb precepts, may be too great for the decision maker.

Energy efficiency programs have typically focused significant resources on participant barriers. Informational and educational programs focus on these barriers by informing and educating customers on benefits or in helping them make purchase decisions. Programs that offer financial assistance that would otherwise be unavailable address this barrier. Programs that are designed to help make point-of-sale purchase decisions, such as the ENERGY STAR labeling programs, also address this barrier.

Market Barriers

Market and market operations barriers are defined as external resources, relationships, networks, and other factors in the environments in which households and firms are situated. Some of the key market and market operations barriers cited are listed below.

1. *Lack of professional expertise*. Customers have difficulty finding sources of help or information. This typically is seen as an absence of knowledge or skills about products or product issues.
2. *Equipment availability*. Consumers are not sure that the equipment is actually available in the market or is available for the conditions needed.
3. *Service availability*. Product services are unavailable, leaving the customer feeling that there is a risk in adopting the product because they will not be able to get it serviced or maintained.
4. *Parts availability*. The potential purchaser is not sure that parts for the equipment will be available under the conditions needed. This barrier is closely tied to a lack of professional expertise and service availability in the market.
5. *Lack of usable and/or trusted information*. The type of information needed either does not exist in the marketplace or is not made available. Alternatively, the information provided is not trusted. (Also called “asymmetric information.”)
6. *Financing availability*. This describes a situation where the market does not offer the financing or financing options needed by the customer (as opposed to the participant barrier of not being able to obtain available financing).

7. *Others receive benefits*. The benefits of the product are provided to others so that the decision maker does not receive the expected benefits. (Also called “split incentives.”)
8. *Market uncertainties*. Relative to the product or provider, this barrier is associated with the potential participant not being sure about the technology market or having concerns about the stability of the market and its ability to respond to their needs.
9. *Lack of market value*. The value of the energy efficient product or service in the market is lower than the cost, restricting placement in the market.

Energy efficiency programs have typically focused some level of resource on the first of these barriers through skill training for a limited set of program stakeholders, but for the most part have not addressed the other market barriers. Few programs focus on the ability to obtain fast, reliable service, nor have they focused on parts availability for the energy efficient products that were purchased because of incentives offered.

Purchase Barriers

Purchase barriers interfere with decisions being made about particular technologies and operational changes. The key barriers associated with purchase decisions include:

1. *Decision threshold requirements*. Technologies must fit within the decision thresholds (decision processes and requirements) of the customer. For example, if an industry must have technology upgrades that recover added cost in three years or less, the success of a program may hinge on the technology’s ability to meet this requirement.
2. *Need to see it and make it real (gain comfort with concept).* The decision maker needs to be able to see the technology in operation before they can make an adoption-related decision. Many decision makers need visual confirmation of a technology and need to see it in actual operation, delivering on the expected benefits, before they will adopt the approach.
3. *Need to have experience with it*. This is closely related to the need to make it real, but goes a step beyond. Many decision makers require actual hands-on experience with a technology before they consider a purchase decision. This is especially important in industrial-sector initiatives and, to a degree, the commercial sector. Within the industrial sector, a bad technology decision can have very significant implications and ruin careers. For decisions that have large dollar implications it is critical for some decision makers to not only see the technology, but also have direct experience with its operation.

Energy efficiency programs have not typically focused significant resources on these barriers other than to provide general information that customers can use in their decision process.

Provider Barriers

Product provider barriers are defined as considerations related to the suppliers of particular technologies and technology-related services. The product provider barriers cited include:

1. *Ease and speed of acquisition/availability*. How fast can the provider deliver or service the technology? For many, this question is critical. If the energy efficient product provider is not capable of high-speed delivery and service, the customer may not adopt that technology, but stay with a technology which meets their service speed needs.
2. *Familiarity and expertise with product*. How familiar is the provider with the energy efficient technology? If the provider possesses little to no expertise with the product, or if it is something new to their product line, the adopter is more likely to stay away from either the technology or that particular provider.
3. *Hidden or unexpected provider costs.* If the energy efficient product provider adds costs to the product or service that the adopter does not consider appropriate, s/he is likely to not go with that technology from that provider.
4. *Support for product*. This barrier is similar to the service provider barrier associated with the market, but it applies to a specific provider. If the technology provider cannot service and support the product and the needs of the customer adopting the technology, then that provider will not be as capable of moving the product in the market.
5. *Ability to service other needs*. Is the energy efficient service or product provider able to meet a host of other needs required by the adopter? This is especially critical in commercial and industrial businesses where business relationships are seldom established around a single product. The provider of the energy efficient technology must fit in with the package of services needed by the customer.
6. *Market professionalism and social acceptability*. Lastly, customers expect a level of professional service from their technology providers. Business relationships are important, and decision makers establish technology purchase and service relationships with businesses that meet the standards of professionalism required by the buyer, or by social consideration in addition to other decisions. These can be driven by objective assessments of the provider and the provider's organization, or by other criteria such as social relationships or other criteria.

Energy efficiency program designers often ignore the product provider barrier category, yet for a good percentage of customers, it is a critical barrier group.

These five barrier classifications represent the major barriers that need to be addressed in the program design process. While not all of these barriers apply to every program, they all typically apply to at least one program within a portfolio of programs. In understanding these barriers, it is important for the program designers to fully assess themselves and their programs in light of these barriers and not just think of these as barriers that apply to the market where their programs operate. The

program designer needs to ask, “How does our program score on these critical market barriers and what can our program offer to overcome these barriers?”

As part of the AB 549 research effort, a set of program interventions, or initiatives, have been identified that can be designed and implemented to capture additional California energy savings. These interventions must address market barriers to be able to capture the market potential associated with each initiative. Market barriers specific to the initiatives are presented in Chapter 4 along with the individual initiatives recommended for development and implementation. If the barriers are addressed in a way that successfully reaches and motivates customers to participate, the energy savings associated with those initiatives can be achieved. However, these achievements will not be easy. They will require expert program design, development, implementation, and evaluation for a number of years to be successful at capturing the available potential. Nevertheless, California is in a good position to launch these initiatives and achieve further energy savings.

The Market Adoption Model

Market barriers function within the confines of an adoption process. Over the years several models of the adoption process have been developed. However, one seems to have emerged as the dominant model in which most market research is supported. This model is called the “diffusion of innovation” model developed by E. Rogers (1995). This model (Figure 2) contains five steps that technology adopters move through as they are exposed and act to acquire and use new technologies or concepts that are placed in the market.

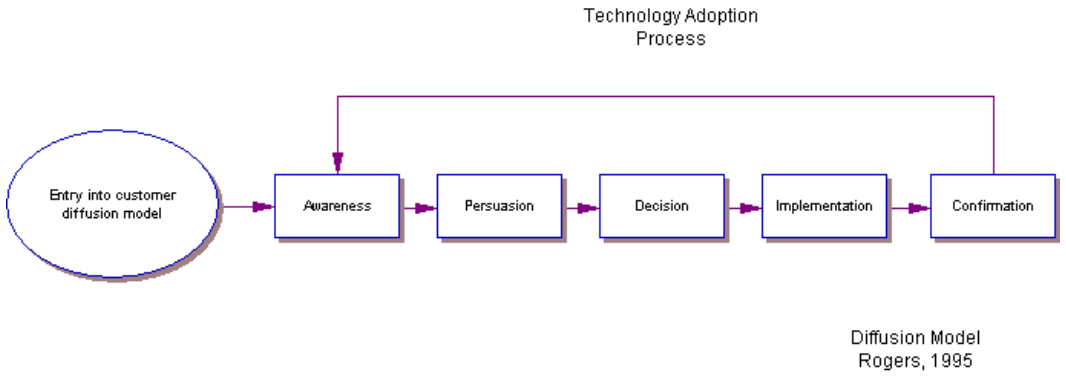

Figure 2. The Technology Diffusion Model

The first step in the product adoption process is to become aware of a product or service. Unless a customer is aware of the product, there is no market potential for that product. Product marketing efforts often focus on making people aware of products and services before they provide details concerning the product’s benefits or costs.

After a customer is aware of a product, the customer must then gain enough information about the product to be convinced that it is something s/he should consider. This is different than the decision that they should try it. Customers must first be persuaded to consider the product; this is called the persuasion stage. Marketing efforts that trumpet the characteristics of a product are designed to persuade customers that the product has unique advantages and should be considered over other products that may not have these advantages.

Once a customer is persuaded to consider the product, they go into the decision stage during which they will make a decision to try or not try the product. This is a critical point in the process and can end in a decision to not try a product more often than a decision to try the product. In this stage the customer considers the information gained during the persuasion stage and brings that information into a decision process. Sometimes the process is simple and is made after minimum information collection or exposure. In other cases, the decision process can be complex and take several years. If the customer decides not to try a product they can end all future consideration for a product. They may also decide to go back into the information gathering stage (persuasion) or the decision stage at a later date when the technology is better, cheaper, or when the customer's budget or planning process allows for reconsideration.

If the customer makes a decision to try a product, the customer then moves to the implementation stage. Again, this stage can be accomplished quickly, or can take several years.

Once the decision to buy a product is implemented (purchased, installed, and used) the adopter moves to the confirmation stage. In this stage the adopter evaluates his/her experience with the product and confirms that the decision was good and bears repeating or determines that his/her experience with the product was negative and decides not to repeat the decision. This last stage is one of the most important stages, and is the least considered in the energy efficiency program implementation process. If adopters are not satisfied with their decisions they will network this dissatisfaction in the market, making it extremely difficult to overcome market resistance. On the other hand, if they are satisfied, and the product, the provider and the performance all are satisfactory, this networking can also help substantially speed adoption. However, the speed of adoption depends to a large degree on a different set of product criteria.

Factors Affecting Speed of Adoption

There are a variety of factors that influence the rate of adoption of innovations that have a strong similarity to, and are linked with, market barriers. The rate of adoption of a product or innovation is often dependent on several conditions including the barriers discussed above and, of course, by the type and structure of the promotion systems. But often energy program designers need to consider that the primary driver of adoption, beyond those items discussed above, is the nature of the

communication system, and system networks and communication channels used to communicate.

A careful reading of the diffusion of innovation literature makes it clear that market barriers are not just "out there dangling in the market ready to be addressed" but may be triggered by the innovation itself. The nature or perceived nature of a product or service contributes to whether, and how quickly, it is adopted. The market research literature identifies five key attributes of products or services that drive the speed of adoption. These are very closely aligned with the barriers identified and discussed earlier and are worth briefly discussing here. These include:

1. Relative advantage (for example, initial cost).
2. Compatibility (with existing culture and practice).
3. Complexity.
4. Trialability.
5. Observability.

A product with relative advantage has characteristics such as price, profitability, reliability, aesthetics, and impact on productivity that make it desirable in comparison or as an alternative to other products. Compatibility is the degree to which a product can be integrated with current operations and systems and methods of installation. Complexity is the degree to which an innovation is easy to understand and use. Trialability is the degree to which a product can be tried or tested by a potential adopter. Observability is the degree to which the product can be observed in operation and the results of the operation determined. Of these, relative advantage and observability are known to be the most important for an adoption decision.

Trigger Events

Several of the interventions developed for this project focus on key trigger events. Trigger events are events that provide a unique opportunity for improving the energy efficiency of a specific type of equipment or a component of a building. For example, when a water heater goes out and needs to be replaced, this is a trigger event since it is an opportunity to affect the energy efficiency of the heater. Likewise, when a building is sold, there is an opportunity to finance energy efficiency during the mortgage process. The key trigger events associated with the interventions recommended by the project team are:

- Utility targeting of customers, such as those with higher than average energy consumption, geographic areas known to contain inefficient building stock, and buildings in areas of transmission/distribution system congestion.
- Building sale
- Building refinancing
- Leasing of space within a building or renewal of a lease
- Building remodeling or renovation

- HVAC system service and maintenance
- HVAC system replacement

Program Influenced Trigger Events

Energy efficient initiatives tend to influence trigger events by providing information, products, or decision choice information into the market, at key times when the intervention can be expected to be effective. As a result, the process of moving customers through the stages of diffusion is influenced by the initiatives themselves. Consequently, there are two routes into the diffusion of innovation model. These are the standard route that is taken without the initiative, or the non-program-influenced route. However, for the customers influenced by the program, there is the program-influenced route into the adoption process. The purpose of the program-influenced route is that it substantially speeds the adoption rate by moving decision makers into the diffusion process and speeding their movement through the five steps. In a nationally recognized study of the Federal Energy Management Program (FEMP), diffusion of innovation research documented that the FEMP substantially sped up the adoption process, moving decision makers thorough the five steps several times faster than decision makers who moved through the steps who were not program participants. Figure 3 demonstrates the two paths through the adoption model. The non-program assisted path is on the top of the adoption model while the program-influenced path is on the bottom. The goal of the typical energy efficiency program is to move as many people as the program budget allows through the expedited path on the bottom.

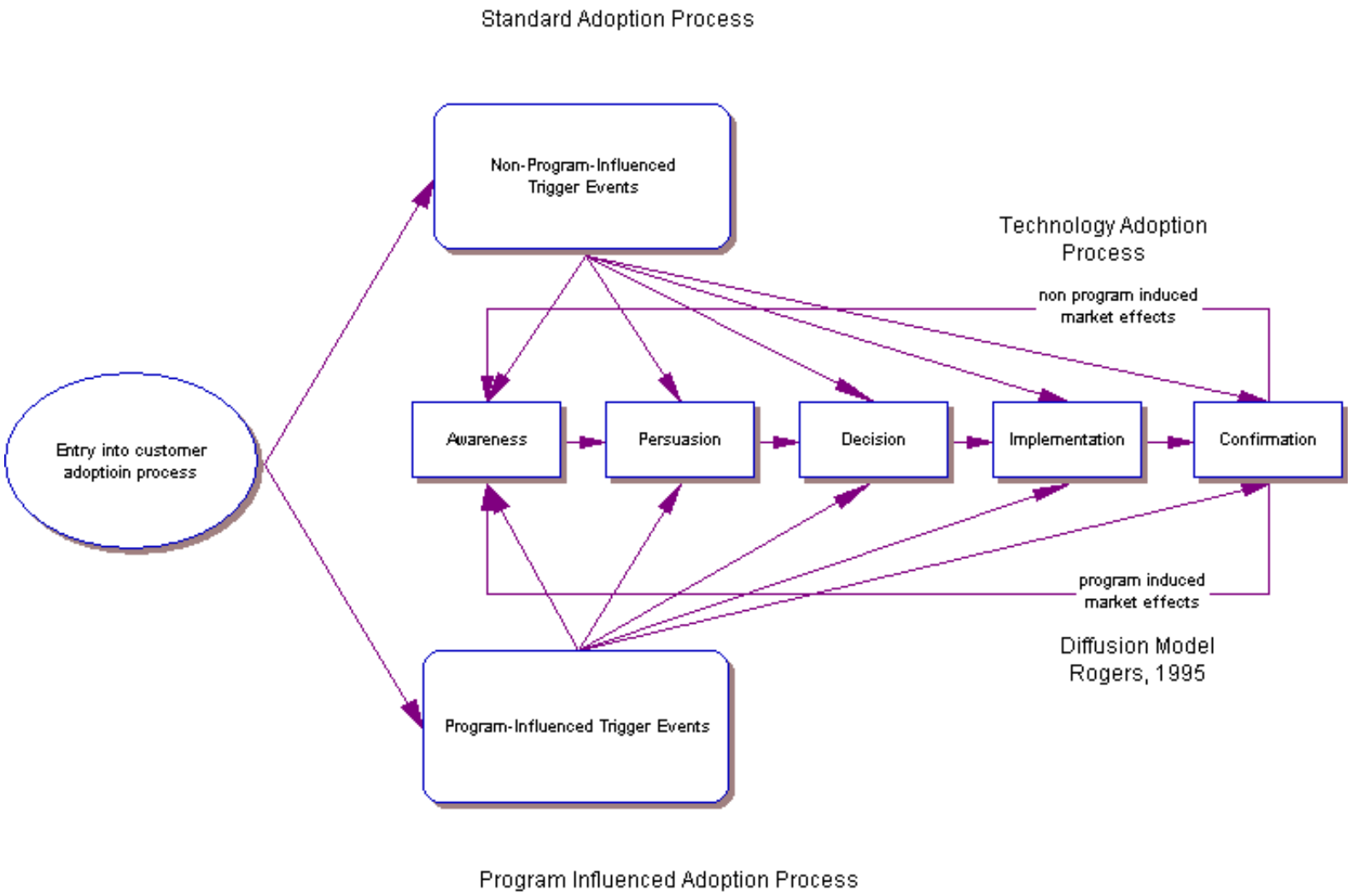

Figure 3. Program-Influenced Routes Through the Adoption Process

Trigger Points, Intervention Strategies, and the Adoption Model

As discussed in the previous section, there are two paths through the adoption model: the normal path and the program-influenced path. The normal path is influenced by a host of market information, communication, and other initiatives that are a normal part of the ever-changing markets in which programs operate. The other entryway to the adoption path is through the program initiative path as a program participant. While these paths are displayed differently to clearly demonstrate the different routes into the adoption path, in reality the same market initiatives that influence non-participants also influence participants. Referring again to Figure 3, the top path is the path associated with the normal operations of the market, but it does not include program participation. While customers entering the adoption path may be motivated to enter into the adoption path as a result of program or program-related efforts, they are not direct program participants, and as such, they do not enter the path directly via the energy efficient initiatives placed in the market. The bottom path represents program participants who enter the adoption process directly as a result of program participation.

Figure 3 shows how customers are influenced by a trigger event that causes them to consider a transaction or practice that influences energy consumption within their home or business. The water heater needs repair, the customer wants to upgrade an appliance, the building designer needs to specify an HVAC system, a broken window needs repair, or a business owner wants to reduce utility bills—are all examples of trigger points that cause a transaction to be initiated. If the program is not there to interact with the customer, the customer enters the adoption path without the benefit of a program intervention to help them make the energy efficient choice. If the program is there and the customer becomes a participant, then the initiative is there to help them make the energy efficient choice. The initiative might employ information transfer strategies, incentives to help offset costs, or other approaches. No matter what the intervention, if successful, the program helps the customer enter and move through the adoption path.

By examining Figure 3 and Figure 4 it becomes apparent that the two routes into the adoption path are exactly alike, except that the bottom route moves through the interventions provided by the energy efficiency program initiatives. Figure 5 located below combines Figure 3 and Figure 4 and shows the two different routes into the adoption path.

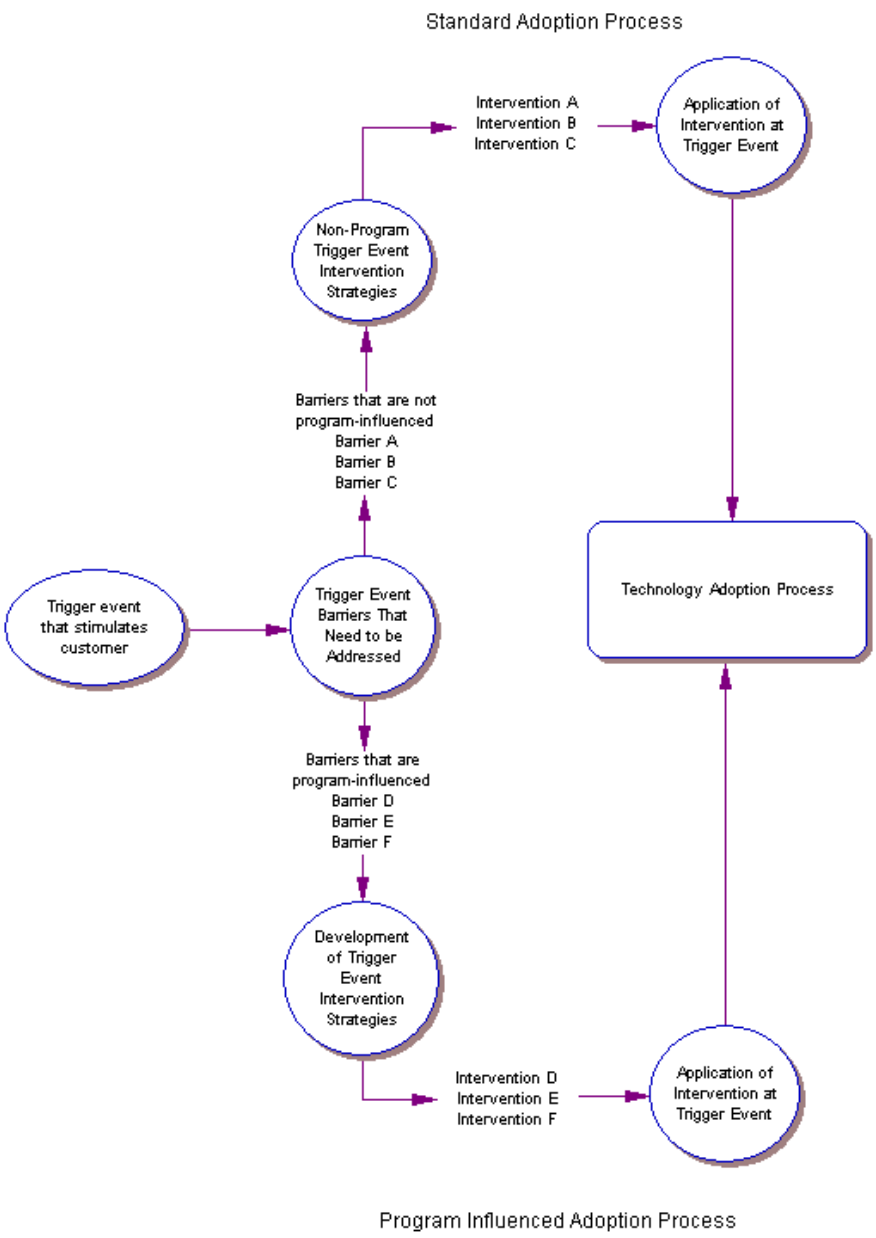

Figure 4. Non-Program- and Program-Related Routes into the Adoption Path

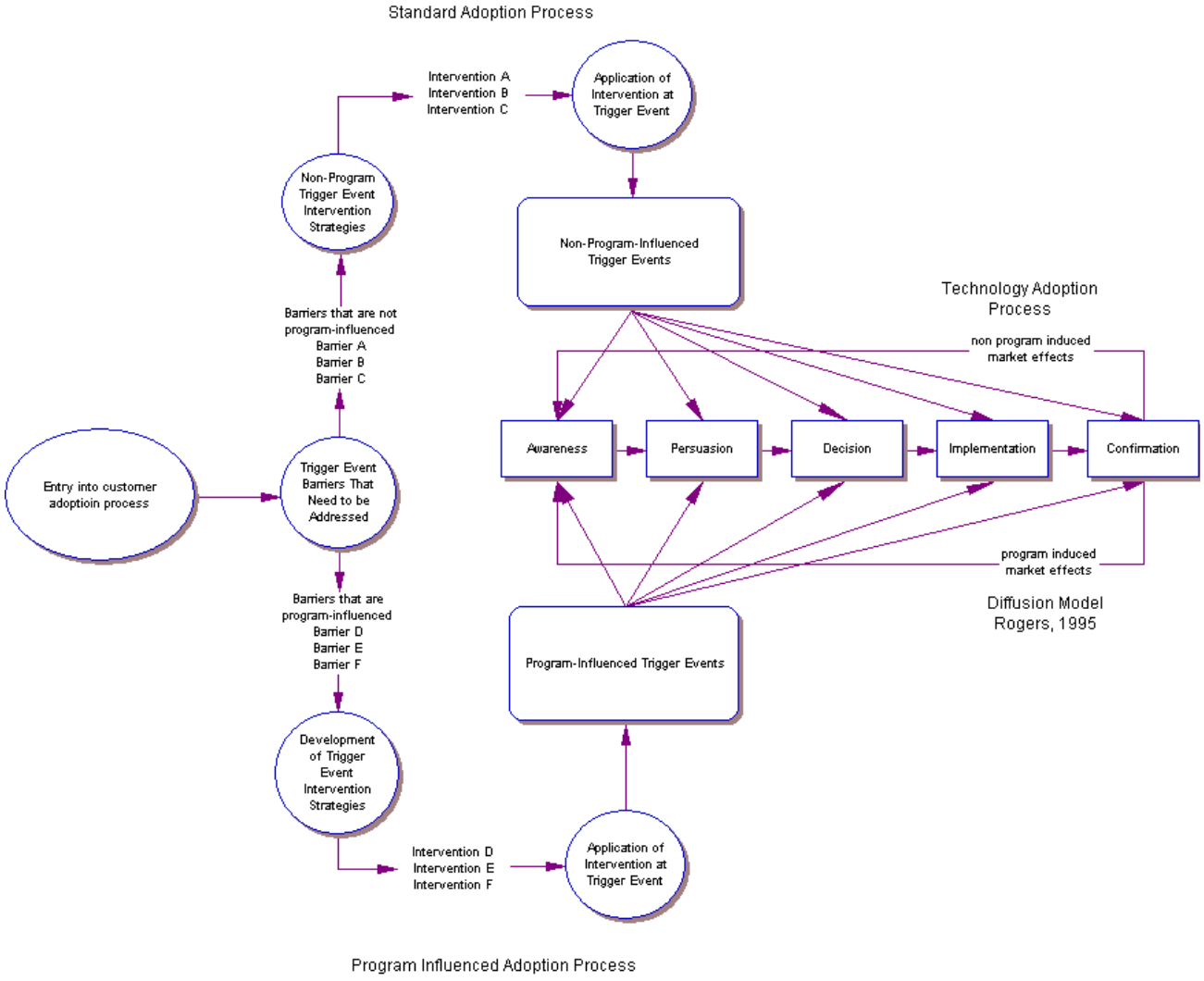

Figure 5. Normal and Program-Related Routes into the Adoption Path

While Figure 5 shows a more complete presentation of entry routes into the adoption path, it is not complete without the market barriers that need to be addressed by the program initiatives. By incorporating the barriers diagram in Chapter 2 of this report it is possible to see how the barriers fit into the adoption path. By placing the barrier classification groups in front of the trigger points and the program initiatives designed to address the barriers, it becomes apparent that the key component of any successful energy efficiency program is how well it addresses the market barriers that limit program participation and allows customers to enter the adoption path without the direct benefits of the program. This is not to suggest that customers will not make the energy efficiency decision without program participation, but it does indicate that via program participation, customers are more likely to make the energy efficiency choice because that route has fewer significant barriers. This is because of the program initiatives designed to reduce those barriers are not directly available to non-participants. puts the different pieces of the puzzle together and presents the way in which the markets operate with and without program interventions.

On the far left side of this diagram is a box that represents the technical potential associated with energy efficiency decisions in the market. Next are the technology applicability factors that limit the amount of energy efficiency actually available in the market. This is the level of efficiency that is achievable with well-designed energy efficiency initiatives. The next set of boxes provide the market barriers around which programs must be designed to achieve the savings that are available. If programs are designed and implemented so that the barriers associated with making the energy efficient choice are reduced, the achievable potential can be reached. However, this means that programs must be designed to address all market sectors and segments across all customer types. In reality, however, there will never be a condition in which all customers are influenced by programs that eliminate barriers to allow all of the achievable potential to be captured. While this is a worthy goal, it is also an impossible goal to reach. The best we can hope for is that good program designs will be developed and deployed in a way that captures as much of the potential as possible.

The degree of success the initiatives have in addressing the barriers through efforts that reach and capture the available potential will, in the end, determine how much of the achievable potential can be captured. The amount of energy resources that can be achieved in the market through energy efficiency initiatives is called the achievable market potential. This potential is dependent on the resources placed in the market to capture this potential and how well the initiatives reduce the market barriers limiting that potential.

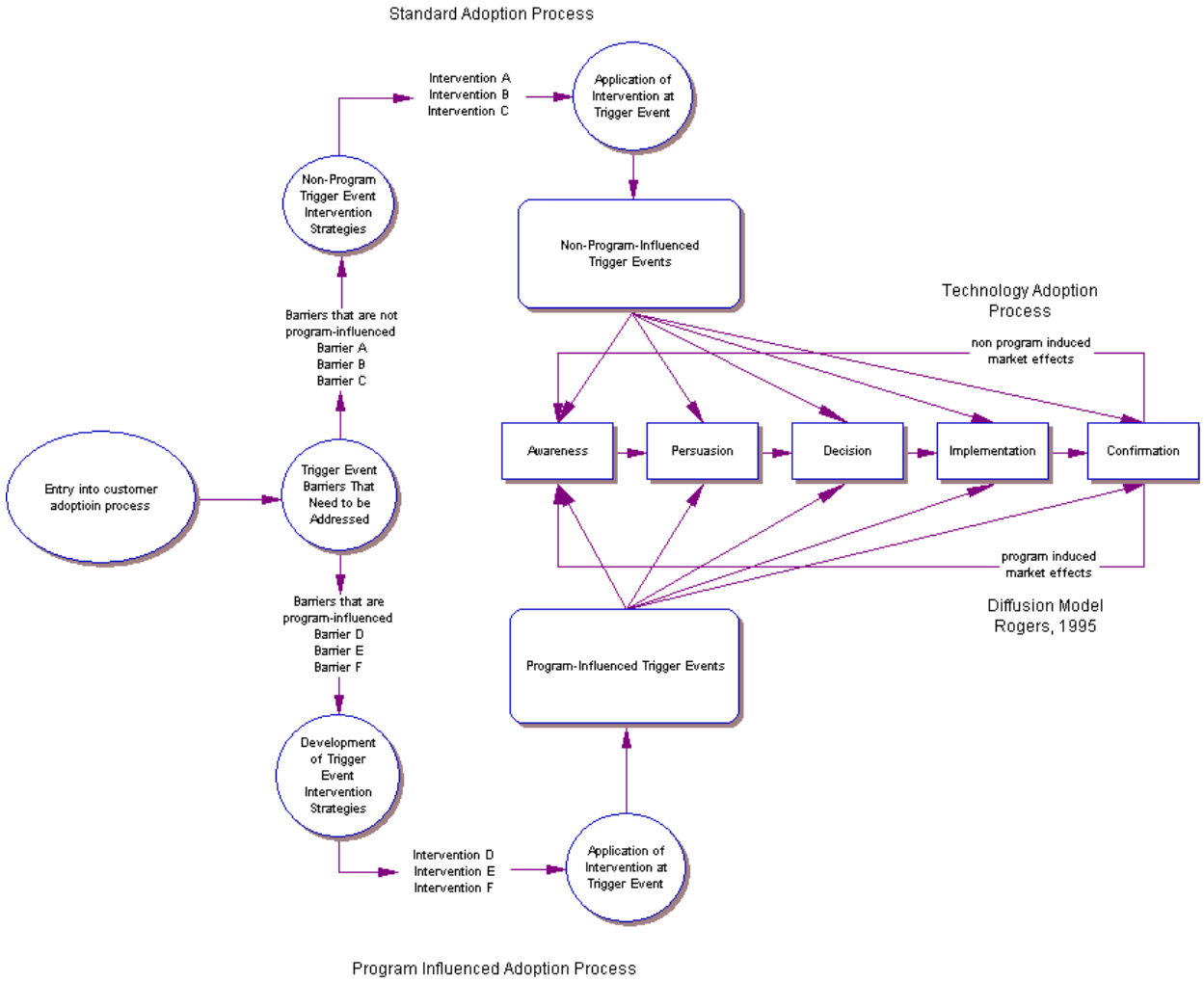

Figure 6. Barriers and the Routes into the Adoption Path

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3. ACTOR NETWORKS

In earlier AB 549 work, we reviewed the social and behavioral sciences literature related to energy efficiency. As a result of that review, we identified "actor network" dynamics as one of several potentially important areas for primary research and/or subsequent work. Actor networks can be defined as a system of interacting individuals that influence decisions affecting the efficiency of buildings. We concluded that:

> "An actor network approach … [would allow] actors and interests in the existing buildings systems (residential and commercial) to be identified and better understood. … studies have shown that unlikely actors have been found to play key roles in innovation and long-term change in technological systems. We do not know, with any clarity … who the salient actors are in existing buildings markets, or what the dynamics of those markets look like." (Lutzenhiser Associates 2004)

A series of expert interviews and panel discussions were conducted to explore issues related to current and proposed energy efficiency policies and program approaches. During those interviews and panel sessions, several questions were asked regarding key individuals and their roles in both business-as-usual and in energy efficiency innovation. While time and resource constraints prevented us from gathering comprehensive and detailed data on actor motivations and behavior from a wide range of knowledgeable observers, useful insights were gained regarding key actor types.

This chapter offers an overview of the actor network approach and offers a rationale for applying actor network theory and models in energy efficiency policy development. It is intended mainly as an orientation, and not as a comprehensive guide to actor network analysis.

Why Actor Networks?

When considering the range of human choices and actions related to energy use and efficiency, models that assume simple rationality and even the influence of psychological attitudes have fared poorly in predicting behavior. Energy use and efficiency adoption are group rather than individual processes, and a person's choices—whether in households or organizations—are influenced and constrained by the choices of others, both past and present.

In the energy efficiency market transformation tradition, these dynamics have been handled by the notions of market barriers (Eto et al. 1996) and market conditions. They also fall within the domain of "technology transfer" (Blumstein et al. 2001). In

the energy and behavior literature, they have often been framed as issues of culture, social structure, lifestyle, and consumer behavior (Lutzenhiser 1992, 1993; Lutzenhiser et al. 2001; Wilhite and Lutzenhiser 1999).

The actor network tradition, on the other hand, is rooted in social science studies of technology and innovation—mostly by historians, sociologists, and economists who are interested in explaining change in complex socio-technical systems through time. It is a fairly new theoretical approach and line of inquiry, and while it is being applied in various spheres of technology decision making, to date it has influenced energy studies only to a very limited extent (Shove 1997, Shove et al. 1998, Wilhite et al. 2001).

We do not propose it as a guiding model for the AB 549 project, or as a replacement for the more conventional market barrier/conditions frameworks and models. Just how all of these different approaches interrelate remains to be discovered. It is clear, however, that each offers a somewhat different view of the same phenomena—namely, complex technology decision making (in this case, energy efficiency decision making) within multi-actor systems. Therefore, they complement each other.

For the AB 549 research, actor network theory (ANT) has functioned largely as a heuristic—a set of insights and a sensitizing model (perhaps more of a sketch of a model) that keeps us mindful of the complexity and multi-actor nature of the systems we are interested in changing. This heuristic led us to ask expert interviewees and panel members about the different individuals involved, their interests, and their respective roles in decision making related to the intervention possibilities under consideration. It led us to assemble what data we could on different actor types, and it allowed us to offer some insights about those individuals to complement analyses of market barriers and conditions.

What are Actor Networks?

The technology studies literature examines questions of how and why certain technological changes occur while others do not and why some innovations succeed when others fail. These examinations have led to a series of explanations, which take particular technologies as their topics. We will not review the literature here, but rather point to some key ideas that most share.

Technologies are embedded in social systems that shape them, and societies are, in turn, embedded in technical systems that constrain and channel their development (Pacey 1991, Hughes 1993). This is as true for hunter-gatherers as it is for modern Californians (White 1976, Wilk 1996).

Choices related to the adoption of innovation are segmented, constrained, and influenced by social networks. It is from and within their respective social networks that potential adopters get information, observe other innovators, and check out their social status (Rogers 2003).

Modern innovation takes place within the contexts of very large, complex, socio-technical systems that exhibit inertia as well as activity—and sometimes unpredictable rates of change (Hughes 1989). The notions of "lock-in," "path dependency," and "technological trajectory" (Dosi 1982, Bijker 1997) all capture aspects of interconnection, dependency, and limits to control in such systems. [2]

At the same time, recognition of the complexity and ambiguity surrounding genuinely new developments (e.g., the VCR, cell phone, distributed generation, nanotechnology, ubiquitous remote sensing or "smart dust") points to the importance of meanings, interests, conflict, competition, and negotiation in the social shaping of technologies. This is the area where social construction of technology (SCOT) theorists have done their most productive work, and where the concept of actor networks began to emerge about 15 years ago (Bijker et al. 1989, Bijker and Law 1994).

So, it may be the case that—in addition to the problems of lock-in and path dependency—complex networks offer possibilities for multiple stakeholders to be effective, for multiple development paths to exist, and for multiple technological solutions to be possible.

Actor networks, in short, are systems in which interrelated and interdependent actors work to both stabilize and alter elements of those systems. Choices are contingent upon other choices made more or less invisibly, i.e., at a distance in geographic space, social space, and/or time. Outcomes are uncertain, but actively negotiated by different interests—who bring with them various concerns, motivations, stakes, perceptions, and degrees of risk or exposure.

Why are these arrangements called "actor" networks and not simply social networks, technology systems, or markets? All of these are acceptable terms, since they all somewhat hit the mark. However, the "actor network" term is a bit more spare (loaded with less baggage) and somewhat more precise.

- First, these systems are not accurately characterized as being composed only of their technical elements—although this is often what is figuratively done in appliance-saturation-based forecasting and technical-potential studies. How people use technologies results in vastly different energy flows through otherwise similar sets of devices and buildings.
- Second, these networks cannot be reduced simply to social networks, since they are not composed only of people. They are instances of what Hughes (1989) has labeled "socio-technical systems," and as such, they are made up of people, pre-

[2] "Lock-in" refers to processes in which past widespread choices (e.g., favoring compression-cycle refrigeration vs. ammonia absorption cycle) have led to the creation of a production and support infrastructure (e.g., refrigerant manufacture, motors development, HVAC services, et cetera) that locks one technology in and the other(s) out). Path dependency and technological trajectories are similar concepts. For example, the pattern of compressor air conditioning plus light-frame construction plus low-cost electricity plus private cars and a public highway system creates "paths" that become unquestioned common practice upon which the construction industry "depends." The resulting "trajectories" of historical development led inevitably to Sunbelt suburban development, with its attendant problems.

existing technologies (often termed “artifacts” in ANT), and widely held social agreements or “institutions” (conventional ways of proceeding, such as rules, that are human products, but are not human beings per se).

In the case of AB 549, the systems that we are interested in altering involve energy use and energy flows in dwellings and offices. Let us take the case of single family detached dwellings. The system of interest is composed of:

- The homeowner (or landlord/renter).
- Other family members.
- The building.
- The building’s systems (e.g., appliances, lighting, HVAC).
- The environment.
- The energy supplier.

There are certainly other influences on energy usage as well: neighbors, friends of children, work required by employers to be done at home, tiered power prices. But these are the elements of the core system. This system involves more than people. In fact, the workings of the building, its equipment, and natural conditions are all somewhat independent of, and at the same time placing constraints upon, the homeowner and his/her family’s choices and actions. In ANT, these “nonhuman” elements are also considered “actors.”

This is a slightly odd use of that term, since it is usually reserved for humans. But there is a good reason for this. It forces the analyst to consider a much wider range of “actors,” especially if the analyst is a social scientist. It requires us to think about the ways in which the characteristics of machines and buildings play important roles in what is going on in the system of interest. It also forces us to think “outside of the box” in other ways—to ask whether other nonhuman and non hardware elements may also play a part. The classic example is the role of rules and legal instruments in regularizing behavior, control technologies, and the built environment. These include contracts, building codes, due diligence requirements, appraisal forms, certification, apprenticeship standards, and engineering interoperability standards. Because all of these human and nonhuman elements are related in some way, and all “act” to some degree within the context of those relationships, they are said to be “networked”—and the entire collection has come to be considered an “actor network.”

We could call it something else, and, in fact, some alternatives (e.g., “heterogeneous system”) have been proposed. But “actor network” has stuck. It has the advantage of pointing toward sets of related, but also dissimilar elements. The formulation does not require assumptions of rationality. It does not assume the primacy of human choice. It is intervention neutral in a way that barriers analysis is not, as barriers analysis generally assumes “barriers” to something, most often a particular adoption choice or incentive offer. It does not assume that the most important features of the system involve buying and selling, as most market analyses must. So it is a somewhat broader formulation than the alternatives. Whether it is too broad to be useful depends on the analyst and the data, as do all of the alternative approaches.

At a minimum, it cautions analysts to be on the lookout for complexity and the unexpected, and also to be aware of stabilizing forces as well as change agents.

At this stage of ANT's development, there is no established methodology, and certainly no "cookbook" for actor network analysis. There are no established standards for identifying actor network elements, setting system boundaries, specifying (let alone classifying) relationships, or for depicting networks. In terms of the latter, we have seen everything from complex wiring diagrams to concentric circles with nodes to simple sets of connected symbols used to graphically model actor networks. Several of the examples that follow are pictorial rather than formally specified, as in a detailed logic model or process diagram. For the purposes of the AB 549 study, a concise pictorial representation is most appropriate, and more than adequate. It allows us to identify key actors—mostly human—and to keep in mind their interdependence.[3] We do not know enough from either the literature or our brief interviews and panel discussions to pretend that we have more than a rudimentary understanding of network dynamics. However, we have been able to identify salient actors and to gather some insights about them. As a result, we feel that the policy process is better informed than it would otherwise be.

Usefulness of Actor Network Thinking for Energy Efficiency Policy Development

As noted, at this stage actor network thinking is most useful as a heuristic or sensitizing device for policy research and formulation. Ideas about actor networks can complement, but are not intended to replace, analyses of barriers and market conditions in energy policy work. Each perspective brings different theoretical traditions and analytic approaches to the problem of understanding change in complex market and technology systems.

Some key insights from ANT are particularly valuable in creating an overarching framework for thinking about energy efficiency potentials in the policy context. For example, in complex systems with multiple interdependencies, ANT would suggest that it is quite reasonable to think about possible leverage points. Such leverage points would be places where strategic changes (e.g., rules, practices, funding streams, technical characteristics) could cause cascading effects through the system, creating new contingencies and constraints for actors and altering their energy usage patterns. The simplest of these is price. If energy prices were to rise rapidly, the effects on household and business budgets, rates of efficiency adoption and new technology innovation, new building patterns, et cetera; would spread and alter the system. Such an event would result in unwanted harms as well as benefits to people, the environment, markets, governments, and so on. So small changes can, in principle, have large effects if the conditions are right.

[3] Our earlier report on housing and appliance segmentation identifies many of the technological conditions and constraints that are at play along with the human actors in residential networks (Lutzenhiser Associates 2005).

However, in complex energy-using systems, it is also possible for inertial forces (including the built environment, technologies that are both sunk costs and have to be continuously manned, regulatory regimes, and key actors) to slow, block or even veto desired changes. Multiple vetoes are also likely, and sometimes by unlikely actors. For example, a study of government procurement (Kunkle et al. 2000) found that no fewer than five different types of organizational actors could block the implementation of green purchasing initiatives, despite widely recognized organizational and environmental benefits. This means that energy efficiency policy may have to take multi-pronged approaches, targeting different subsets of actors in networks in different ways. It also means that the negotiated solutions that are characteristic of much decision making about technological change may or may not involve the actors and considerations necessary to produce a result that significantly alters the system and reduces its waste of energy. In other words, the solution that's possible may not be the solution that actually solves the problem in anything like an optimal way.

4. INTERVENTIONS

This chapter describes the interventions recommended by the project team. This set of interventions was chosen based their ability to address important trigger events, fill gaps in existing program offerings, reduce adoption barriers and build infrastructure to support widespread implementation energy efficiency programs throughout California. The project team did not propose a comprehensive list of strategies to save energy in existing buildings, since the energy efficiency programs conducted by the IOUs and non-utility program implementers already cover a wide range of energy efficiency measures and delivery strategies. In selecting these strategies, the project team looked for opportunities to support existing programs, meet needs that are currently unmet or boost strategies that are currently underutilized. The sections that follow provide a description of each intervention, the groups affected by the intervention, market conditions influencing the success of the intervention, key barriers to success of the intervention, and strategies to address the barriers. The final section describes the role of each intervention in an overall portfolio of interventions and explains the dependent and synergistic relationships between each intervention.

Information Gateway

Sector:	*Trigger Event:*	*Intervention Type:*
Residential	Identification and targeting by utility as a high use customer	Voluntary

Under this intervention, key energy efficient technology choice information is made available to all single-family and multifamily residential households. Lack of information on appropriate actions to take is a key barrier to improving the efficiency of existing buildings. This intervention serves as a centralized information portal, directing homeowners and property managers to information and energy efficiency program services. Information will be provided primarily though a website or toll-free telephone service. Providing this at important trigger events gives the customer the motivation and decision making information they need to choose energy efficiency improvements. . The information would be provided in customer-friendly formats that allow the decision maker to see what benefits can be achieved through the energy efficient practice or decision.

The elements of the overall strategy are listed below.

1. *Targeting*. Target buildings that have the greatest potential for energy savings and/or the greatest utility cost burden. This includes buildings with higher than average energy bills, geographic areas known to contain inefficient housing stock, low income households and homes in areas of transmission/distribution system congestion. The serving utility would likely be involved in compiling the data required for identifying target residential and commercial buildings. Targeting specific customers should improve the near-term effectiveness of the intervention and provide a framework for gradually increasing participation. Data from approximately two million home energy audits performed in the past could be mined and aggregated at the census or block level to build a general targeting approach. Audit data often has vintage data for key targets such as appliances and older homes with older systems. Appliance-saturation survey data should also be used in the targeting approach when it can be linked to homes or census blocks.
2. *Energy consumption feedback*. By providing feedback information on customer energy use, customers will be able to compare their recent energy use to both other similar customers (e.g., size of house, neighborhood) and their own previous usage patterns. Access to this information could be through the customer service link on the utility website, or through hard copy reports for customers without internet access. The energy consumption information should be formatted so as to encourage customers to delve deeper (e.g., energy use by end use, ability to compare use before and after an event/purchase of energy using equipment). Information related to demand response opportunities during critical electricity system events and periods of high energy costs should be provided. The presentation of the information will allow the customer to focus on issues of interest such as energy efficiency potential or climate change issues, with links to more information on topics of interest. The system should be set up to notify customers if their home appeared to be a good candidate for energy efficiency enhancements and then invite them to take appropriate actions or to participate in one or more programs.
3. *Energy audits*. While California utilities currently offer internet, mail-in, and onsite energy audits in selected areas, expanded home energy audit information could be provided to all California households having a utility account. Home energy audits would be provided online in an effective format that would provide immediate information as soon as account information is provided, but also allow the customer further exploration of their energy use patterns and options for saving energy. Additional levels of energy audits (e.g., over the phone, mail-in, onsite) would be provided to targeted and/or interested customers. Local government agencies or community-based organizations may be used as appropriate to contact customers, conduct audits, and present audit results. The audits would improve awareness of efficiency opportunities and provide referrals to existing energy efficiency programs applicable to the targeted audience, such as home energy ratings, whole building diagnostic testing, incentive programs, direct measure installation programs, and demand response programs. For web-based audits, program enrollment could be handled electronically within the audit. For example, a homeowner with an old air conditioner could click and

enroll in the HVAC tune-up program or click and sign up for the rebate program for high efficiency AC units. Information from the online audit programs can be used to screen customers that might be good candidates for onsite audits, where more detailed measures can be identified.

4. *Financing*. Connect customers with opportunities for financing energy efficiency upgrades either through existing programs or through a separate initiative. Financing for residential energy efficiency improvements is not commonly offered through the utility and non-utility programs. This is an area where the Energy Commission might be able to fill a need. While financing initiatives have not typically had large enrollments the services could be offered to those who need it.
5. *Energy efficiency marketing*. The information portal will be used to distribute marketing materials for efficiency programs and services. Mass media campaigns and targeted outreach through local and community-based organizations will also be used to reach customers without internet access. These efforts will be coordinated with the statewide Flex-Your-Power media campaign.

Affected Groups

A range of individuals are involved in the residential buildings sector, some of whom occupy and manage dwellings and make decisions about efficiency improvements and investments. Others provide necessary services, play supporting roles in the network, and exert influence over efficiency choice. Interviews and panel discussions with expert industry observers, as well as a review of the literature concerning residential energy use and consumer behavior, allowed us to identify the following key groups.

- *Associations.* In addition to building industry and specialty contractor trade groups, other sources of consumer information include neighborhood associations and organized interest groups focused on related issues (e.g., environment, climate change). Some homeowner associations also provide information on particular retrofit issues and remodeling related to special housing types (e.g., Eichler, Streng, and other modernist designs). The web presence of all of these association types varies considerably, as does the usefulness and accessibility of information on their websites.
- *Consumers.* Information is needed by consumers to make informed decisions. In most instances, energy information is not readily available to them, and their knowledge of energy use and efficiency options is limited. For information to actually affect action, it needs to be intelligible, relevant, timely, and delivered by a trusted source. Current billing information does not allow utility customers to estimate how much they might save by upgrading their home or replacing older appliances. Consumer use of web-based energy information may be growing, but also is likely limited to certain market segments, for example, those who conduct

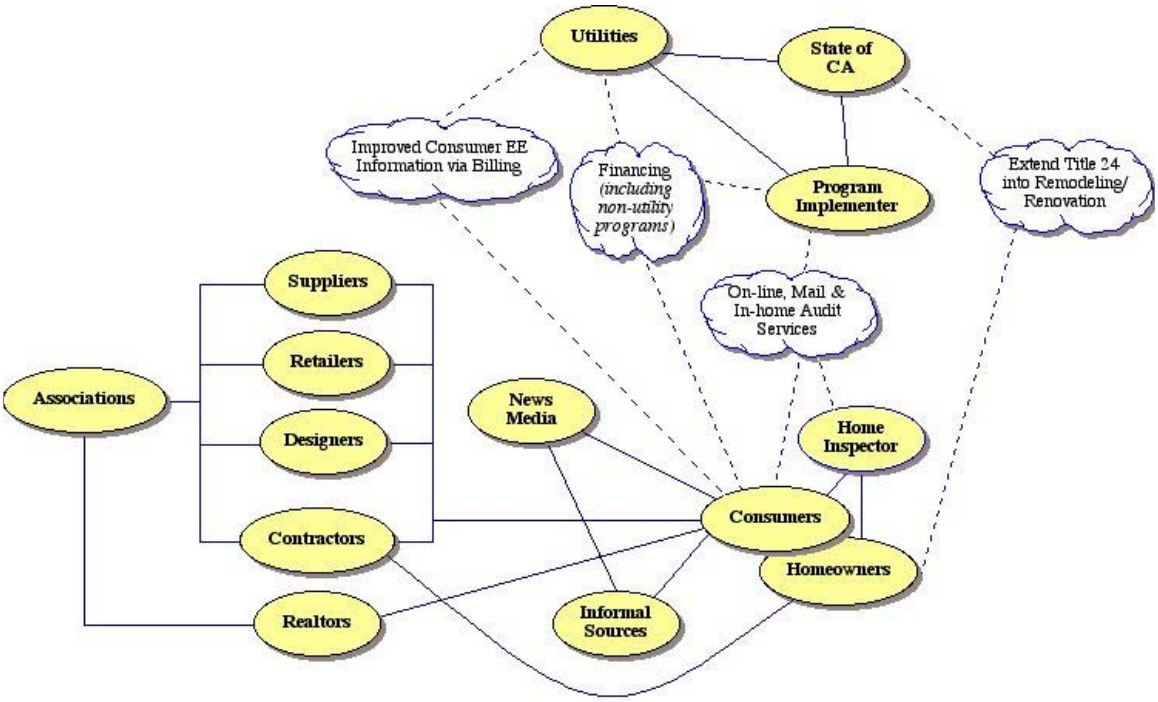
online research and are comfortable with online bill paying. Consumer information about energy and efficiency options comes from many sources other than the utility. Such sources include local programs, HVAC contractors, appliance retailers, sources of tax and incentive information, and friends and family. Consumers vary widely in their degree of concern, social orientation, income, housing conditions, appliance holdings, age, language, and so on. They differ in their energy usage patterns, in the efficiency of this usage, and in their energy conservation prospects and perspectives.

- *Contractors.* In addition to utility companies, likely commercial sources of consumer information include general contractors, designers, architects, real estate agents, and HVAC contractors—particularly during home renovation projects or at the time of an appliance change-out.
- *Informal Sources.* Friends, neighbors, family, and coworkers are often the most available and trusted sources of information about innovation, products, and choices being made in the surrounding area. This is likely true of energy efficiency and conservation information as well, particularly in cases where whole house diagnosis and possible retrofits have taken place. The quality of this information is not necessarily reliable and accurate.
- *Home Inspectors.* Information provided by home inspectors at the time-of-sale can be used by homeowners and home buyers to direct replacement and/or remediation efforts. Because the new homeowner has purchased this information by paying for the inspection, they are likely to find it trustworthy, and are likely to use it as a “watch list” or improvement list for upgrade decisions.
- *News Media.* The news media periodically reports on home energy, efficiency upgrades, green building innovations, solar retrofits, higher efficiency new homes, and related topics. This happens more often during energy supply emergencies or “watch” conditions.
- *Program Implementers.* Program implementers usually have to design programs based on general population data and previous program data without the benefit of knowing where their target population lives or how to reach them for efficient service delivery. As a result, their efforts to communicate with preferred customers may not be as effective as possible. As one observer put it: “… [we need to] know more about the home in any targeting effort…. and while there is a wealth of program and public information (e.g., the census block level data) we do not use these data well.” Customers can be grouped in many ways for program targeting, but typically they are segmented by demographic characteristics (income, household composition, ethnicity and race, education, language spoken at home, homeownership, et cetera). The strategic use of population data sources is uncommon in efficiency programs, unlike commercial marketing efforts.
- *Real Estate Agents.* At the point of sale, not all information about the house is treated equally. Good features are selling points, while substandard features like old appliances may not be mentioned. In an effort to cultivate future clients and listings, real estate agents often maintain contact with persons they have worked

with in the sales process. Industry newsletters sometimes mention issues related to home maintenance and repair, and possibly energy related topics.

- *Retailers.* Retailers provide potential customers with general energy efficiency information as well as appliance-specific information. Typically, information is collected from customers as well as provided to them during sales or demonstration transactions. In terms of energy efficient products, “an incentive is a stimulation message” used by retailers as part of a process intended to move people to retire older appliances.
- *State of California.* The State of California operates the Flex-Your-Power campaign to inform citizens of energy system conditions and energy efficiency alternatives. This high-visibility effort was credited with significant energy savings during the 2000–2001 California energy crisis. Several observers noted that because the impacts of information programs are difficult to evaluate, they might be likely targets for program reductions. One went into detail, saying that: “Information programs are now viewed as overhead and no energy savings are applied to them. … and they are seen as low performers. Yet they have not been effectively evaluated to get at the impacts of these services.” The California Evaluation Framework, a study conducted for the California Investor Owned Utilities on principles and techniques for conduct energy efficiency program evaluation studies (TecMarket Works, 2004) specifically addresses the need to quantify the effects from these programs.
- *Utilities.* Utilities possess an enormous amount of information about their customers (e.g., usage, appliance stock, shell, and demographics). However, to date, there has been little or no uniform effort by the utilities to maximize the use of residential data to address gaps in information related to conservation and efficiency. One observer noted that; “some utilities do target their internal mailing to energy consumers using gross kWhs … but not always and not across all types of programs.” And since the utilities treat most customer information as proprietary, it has not been available to current program implementers for the purposes of directing limited resources to consumers best suited to their service. As one program operator put it; “… we cannot target our programs to be cost-effective because we cannot get the utilities to give us house-specific consumption levels.” Utilities have invested heavily in billing systems designed to provide usage and cost information that is aggregated at the household level. Other information provided on utility bills is either specific to the household (e.g., a chart of monthly usage for the past 12 months) or utility-wide, general customer information. Little effort has been made to provide comparisons to similar households. One observer noted that billing system innovations often require the utility to outsource their billing services.

The actor network diagram for this initiative is shown in Figure 7.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 7. Actor Network Diagram for Information Gateway

Market Conditions

Market conditions that can potentially affect the success of this initiative are listed below.

- *Energy Prices*. Energy price trends and the implementation of time-of-use electric rates are two market factors that could encourage customers to act on the recommendations provided in their audit report. Rising gas and electric costs will create larger financial incentives for homeowners to implement energy efficiency options.
- *Interest Rates.* Interest rates affect the ability of homeowners to finance energy efficiency improvements, as well as obtain a favorable cash flow situation.
- *State of the economy.* The general state of the economy may influence the willingness of customers to make energy efficiency investments.
- *Socio-economic status of targeted customers.* Targeted customers may not have the ability to pay for the improvements suggested in the audits, due to their location on the socio-economic scale.

- *Program availability.* Customers may need financial incentives and encouragement to overcome the first-cost barrier of taking the efficiency actions recommended in their audit reports. Availability of incentives or direct-install programs to service customers referred by the program will influence the adoption of measures.

Key Barriers

Barriers associated with the success of this intervention were compiled from the literature and other research. These barriers include:

- *Lack of information.* The primary barrier that this program is addressing is the lack of information or awareness of opportunities that may exist for improving efficiency.
- *Capacity to provide services.* The availability of trained auditors, energy assessors/inspectors, and installation contractors is a critical factor affecting how broadly this initiative is implemented.
- *Availability of materials.* If the initiative is rapidly successful, there may be a shortage of the energy efficient technologies and products in the market. A concurrent oversupply of inefficient choices could cause their price to drop, thereby potentially boosting their market demand, causing more of the lower cost items to be sold.
- *Reduced emphasis on information programs.* Information programs offered through utility and non-utility implementers are not credited for their resultant energy savings. CPUC policy regarding “hard” savings and the role of information programs in the overall portfolio may influence the importance of this initiative. It may be important for policy makers to realize the benefits of information programs and to more fully understand their value in the portfolio structure.
- *Investment in billing infrastructure.* Utilities have invested millions of dollars in their bill processing systems and would have to outsource billing to provide innovative meter-interactive billing reports and other information to customers. The utilities may not be in the position to provide these services without large investments in interactive systems. Online billing can be linked with meter analysis and services. Though utilities currently have very low levels of online billing, many promote online billing because it saves them money.
- *Efficiency upgrade costs.* First cost is a barrier to many customers. Low and moderate income customers may lack the funds to make efficiency upgrades. Direct-installation programs are effective at enrolling these customers and can be cost-effective due to streamlined installation and volume acquisition processes.
- *Trade-off between simplicity and accuracy.* Audits that are too generic do not offer information that is specific enough or credible enough for customers to act on. Utilities currently offer online audit programs that allow consumers to assess their consumption and efficiency potentials easily, but in a fairly crude manner. As one observer put it “This is a cheap, effective, screening process that allows

contact with people who need services." However, "Online audits can often give bad information and they should let people know that this is a first step in the information process."

- *Confidentiality of billing data.* Lack of access to billing data by non-utility program implementers due to confidentiality issues is a key barrier to developing targeting strategies.

Strategies for Overcoming Key Barriers

Strategies developed under this initiative to reduce barriers include the following.

- *Provide information.* Engage customers in assessing their home's energy consumption and then provide recommendations on the immediate, short- and long-term changes that can be made to reduce energy consumption. An array of online, mail, and in-home audit services would allow the customer to be engaged at an appropriate level while screening customers for additional services.
- *Linkage to programs.* Information needs to be linked to follow-up services. These services need to focus on providing fast and effective remedies when an audit or information indicates a solution is needed. There needs to be strong linkages to existing programs and services to assist in overcoming first cost barriers, including direct installation services as appropriate. The California portfolio needs to be administered as an integrated single-service portfolio of solutions, rather than a collection of over 80 independent programs.
- *Financing.* Develop strategies in conjunction with the utility and non-utility programs to offer zero- or low-cost financing for energy efficiency upgrades to compliment incentive programs. Financing programs could be targeted to address localities with peak load problems. Make financing options available to all programs that have technology installations as the needed action. Work with lenders to develop energy efficient mortgage products applicable to refinancing.

Time-Of-Sale Information Disclosure

Sector:	*Trigger Event:*	*Intervention Type:*
Residential	Time of property sale	Voluntary to Mandatory

This intervention seeks to bring residential building energy characteristics information into the home marketing and sales process. Timely introduction of this information allows homebuyers to understand the energy efficiency of the home before they make a purchase offer and apply for mortgage financing of energy efficiency improvements. Homebuyers shopping for a home need comparative information on building efficiency to assist in their decision process. Sellers of efficient homes will have the opportunity to highlight the efficiency of the home, while

sellers of inefficient homes will have the incentive to improve the efficiency of the home before sale. Purchasers of inefficient homes will have information disclosed at the time-of-sale that will allow them to understand the expected energy costs of the home as well as opportunities to improve the efficiency and affordability of the home. In addition, the information will be provided to help them take advantage of energy improvement mortgages (EIMs) to finance energy efficiency improvements and participate in energy efficiency programs offered throughout the state. Adding the cost of energy efficiency upgrades to the mortgage has several advantages. The term and interest rate of mortgage financing is generally much more favorable that general consumer financing. The utility cost savings generally exceed the additional monthly payment for cost-effective efficiency upgrades, providing immediate positive cash flow, thus improving the overall affordability of the home.

Homebuyers currently have very little information available to them to judge the energy efficiency of a prospective property. Prior utility bills, when available, can be used to document the energy costs of the home to the existing homeowner. These data, though very useful, are dependent both on the physical characteristics of the building and lifestyle of the existing occupants. Thus, they are an indirect measure of the efficiency of the building. Utility bills do not indicate specific deficiencies in the home, such as lack of insulation, poor windows, old air conditioning and so on, and do not give the homebuyer information on steps to take to improve the efficiency and the cost-effectiveness of the improvements.

Home energy rating systems (HERS) were developed to provide this information. A physical inspection of the energy-related attributes of the home such as insulation levels, window type, age and condition of the HVAC systems and appliances are combined with computer modeling of the energy use of the home to generate a uniform rating score that allows homebuyers to compare the relative energy efficiency of properties under consideration. The computer modeling also identifies potential energy efficiency upgrade opportunities and calculates the cost-effectiveness of these upgrades. HERS automatically generate the forms necessary to apply for energy improvement mortgages offered through HUD and FHA. HERS, though currently available, are not widely used due to the costs and time required to schedule and receive a rating. Ratings are generally requested by the purchaser, after the purchase decision has been made and the home is under contract. It is costly and impractical for individual purchasers to request ratings on each home under consideration for purchase. Home energy ratings conducted by the seller prior to listing the home for sale and disclosed to potential homebuyers provide the needed information in a timely manner.

The long-range goal of this intervention is to make energy ratings available to homebuyers, appraisers, and lenders in a timely manner and mandate the disclosure of energy-related information as a material fact in the transaction. The intervention is designed to take advantage of existing market infrastructure and have a minimal impact on the normal sales process. It is important not to further slow a sales transaction process that many consider to already be too time-consuming. The intervention applies to single family and multifamily residential properties.

Affected Groups

On the basis of interviews and panel discussions with expert industry observers, as well as a review of the literature concerning residential energy use and consumer behavior, the following key interest groups have been identified in the areas of energy audits and ratings of residential buildings.

- *Associations.* A variety of trade groups represent the interests of the professionals and businesses involved in real estate transactions, energy services, finance, et cetera. These trade groups provide market trend information, training, certification, policy analysis, and lobbying on behalf of their members. Important trade associations in California represent real estate agents contractors, lenders, appraisers, home inspectors, energy services providers, organized labor, and local government. All can provide support for energy efficiency policies. Some can lobby effectively against changes (e.g., that would materially change and/or slow the transfer of real estate, or might be construed as an unnecessary intrusion into private lives). Key observers stressed the importance of "buy-in" by various industry groups as essential to the success of this initiative.
- *Appraisers.* The appraiser is considered the field representative of the lender. Currently the appraiser has little or no role in assessing building energy efficiency. Appraisals are ordered by lenders and increasingly do not involve in-depth, onsite investigation. More and more appraisals are database-driven, relying on data collected previously for other purposes. In determining dwelling value relative to comparable sales, appraisers could consider energy efficiency, if the information were available. They would be able to incorporate that information into the appraisal process with a fair amount of ease if it were available, and without objection, particularly if it were recognized or requested by the real estate agents. Appraisers are now required to take continuing education every four years, which is being pushed up to every two years in some areas. This training could include energy efficiency assessment methods.
- *Energy Auditors.* In the rare occurrence of being hired by a homeowner or prospective buyer, the energy auditor evaluates building systems and shell conditions and "basically…starts the engine …[telling] the customer everything that's wrong, and who to call if they choose to do so." Energy auditors have a strong interest in having every home be inspected at the time-of-sale or having a referral service so that they can be called in if a preliminary real estate appraisal notes improvement opportunities.
- *Consumers.* Consumer demand drives the actions of all service providers in the market, including the energy efficiency market, particularly since "some of the greenest consumers will purchase products based on their energy-related environmental benefits." However, consumer knowledge of energy efficiency, building efficiency potential, and energy systems is quite limited. One panel member interviewed for this project noted that "people genuinely want to do things to improve their home, but are uneducated about what to do." Consumers also see energy supplies and prices as long-term problems, but access to

efficiency-related information in general is limited. Trust in contractors and providers of unfamiliar energy services (e.g., energy auditors or raters) is not high in many cases. The home inspector, as an impartial third party, may be an exception to this rule. Stakeholders report that home energy inspections are not typically ordered in the transaction process; and when they are, they are typically ordered only after the buyer has made or is close to making a decision. Consumers have developed some level of trust in the ENERGY STAR brand. Also, there seem to be some levels of trust in the Flex-Your-Power campaign, and with local programs and utility programs. This trust should be used at the time-of-sale.

- *Contractors*. Contractors are in the business of providing product installations and property upgrades of various types. In a small percentage of cases, these are accomplished as a result of an energy audit or an energy-related assessment. A few contractors can provide energy or energy-related assessments and make recommendations that, when taken, can reduce utility costs. Contractors that can have an effect on the energy efficiency of a home include general contractors; remodeling specialists; and HVAC, electrical, and plumbing contractors. However, these contractors do not often see a need to change their business approach to provide services that focus on energy efficiency upgrades without some sort of a market push to create the demand for energy efficiency across a wider market.
- *Home Inspectors.* Third-party home inspections are used in approximately 80 percent of all residential real estate sales transactions. Home inspectors conduct onsite inspections of characteristics such as the foundation, structure, roof, flooring, plumbing, electrical, HVAC, and water heating systems. The results of the inspection are disclosed to all parties in the transaction. Home inspectors are currently certified through the California Real Estate Inspectors Association (CREIA) and are tasked to provide independent assessment of the condition of the home. This voluntary process protects several parties. The homebuyer has a better understanding of the physical condition of the home and can factor that information into the purchase decision and price negotiations. The seller and selling agent are also protected from possible litigation resulting from nondisclosure of a defect in the home.

  The inspection of the building, appliances, and home condition is viewed as a buyer's right. However, energy performance analysis is not ordinarily included in this assessment, leaving the buyers unaware of the energy efficiency of the home. According to interviews and expert panels conducted for this project, "Typically the buyer's broker orders the home inspections and they usually request it as part of their offer." The home inspector is usually "one of the last people to enter the transaction process, often after the deal is made." However, there are "more pre-offer/presale inspections being done," where the results of the inspection can better influence the transaction process.

  The current home inspection process can be expanded to include a basic energy inspection/assessment of the home. Important energy features, such as attic and floor insulation levels, window type, type and age of the heating and air

conditioning system, water heater and major appliances, and the characteristics of hardwired lighting systems can be observed during the course of the home inspection. Once the home inspector collects these data, the data can be transferred to a service that conducts the computer modeling of the building and identifies cost-effective improvements. The basic energy inspection component adds an extra 15 to 20 minutes to the home inspection process, and the inspection report can be delivered within a few hours of the data submittal.

- *Insurers.* Providing coverage and setting homeowner insurance rates will take building conditions into account. However, these conditions typically focus on smoke detectors, sprinklers, security systems, alarms, and other such items. As it stands, an energy system or appliance would only be considered in the insurance calculus if the equipment was significantly outdated to the extent it is a safety factor or is potentially dangerous.
- *Legislature*. The Legislature can provide tax and other incentives for energy efficient equipment and renewable energy technologies. It can also set inspection policy to include energy efficiency assessments so that the buyer is aware of the energy-related conditions of the home.
- *Lenders.* A number of interviewees noted that it is important to work with lenders to try to get them involved in energy efficient transactions and conditions, but also noted that it is difficult to get them involved in these aspects. The lender supplies financing to homebuyers and in the process imposes a number of requirements on the transaction to minimize risk and reduce the potential for loss (e.g., from default, and hazards). However, the lender is also subject to a number of influences from other parties. One observer noted that “the lender, in essence, works for the real estate agent rather than the other way around.” In other words, the real estate agent will often recommend a lender to a buyer. As a result, the lender considers the real estate agent as a valued customer. This relationship can be used to help move lenders’ interests. The real estate transaction process is highly structured, with inflexible timelines in an effort to minimize risk from constantly changing interest rates and costs to the lender (and buyer) for borrowed money. One observer noted “you’re dooming yourself … if you try and figure out a way to get to the front of the line at the escrow.” Lenders are also strongly dependent upon, and influenced by, the secondary mortgage market and national regulators. For example, one market actor observed that “HUD could put pressure on Fannie Mae to generate a certain number of energy efficient mortgages and that would produce a tremendous amount of results, that would vibrate through the lending community and all of a sudden you’d see a tremendous changeover.”

  However, HUD does not see this as one of their key objectives. “Most of the federal guidelines from FHA, VA or Fannie Mae/Freddie Mac … put the transaction power in the hands of the underwriter. The underwriter must use whatever information they can obtain including energy efficiency information. If the underwriter had information from which to base an energy-related financing decision, they could use it to help guide the rates and payment structure to include the efficiency upgrades in the agreement. There are also jumbo lenders

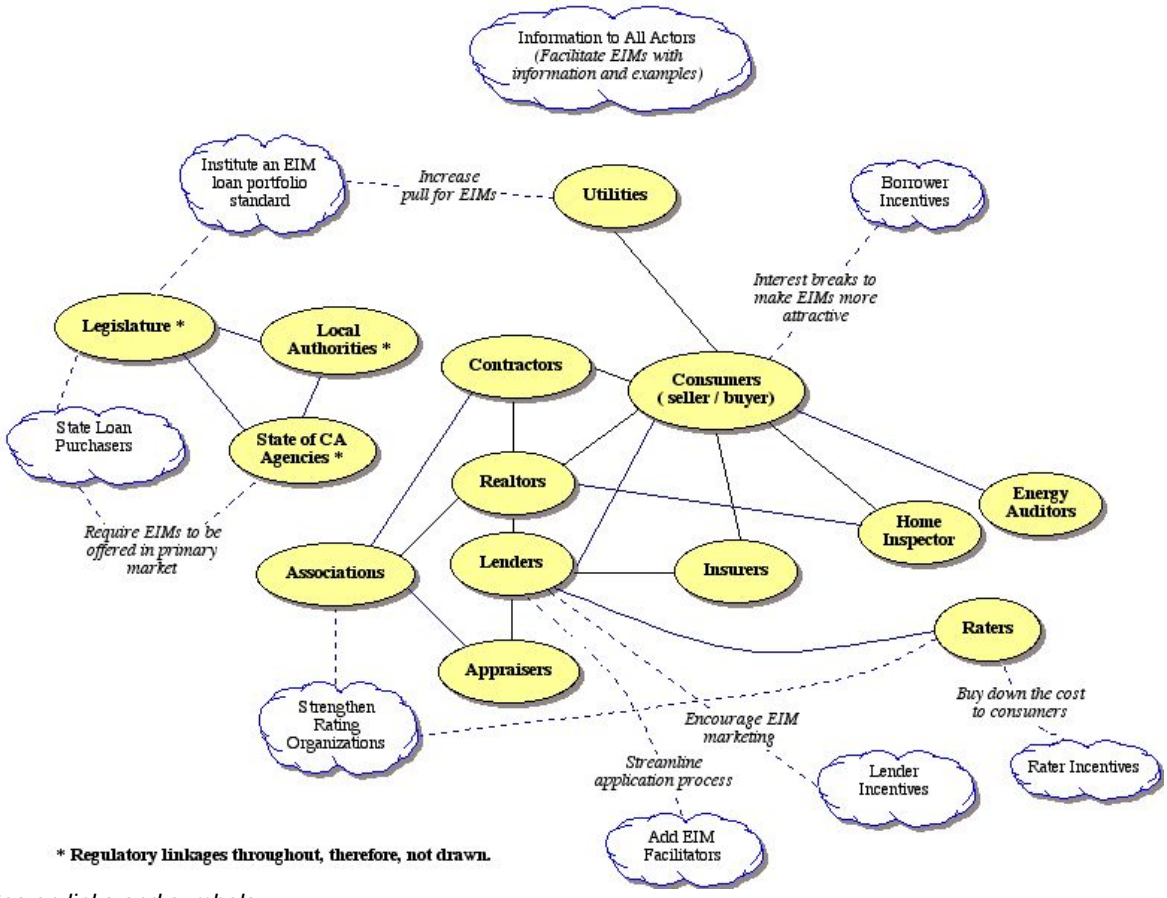
who are working outside of the Fannie Mae and Freddie Mac limits who may need to be pressured to include energy efficiency upgrades in the deal when it is cost-effective and lowers monthly payments and loan risk.

Lenders are also influential in the time-of-sale transaction. They possess information that others do not. They ultimately have the power to move the sale along, and they can represent a trusted source of advice to borrowers. “Loan officers can be influential at the point of sale and throughout the loan process. They also act as an information source to real estate agents. The real estate agents are often educated by the loan officers they work with about what rate products are available.” There are three major types of lenders: savings and loan associations, banks, and mortgage brokers. Many loans processed through the first two types are actually produced by mortgage brokers.

- *Local Authorities.* Local governments (cities and counties) regulate building practices and issue permits for new construction and major renovation/remodeling projects. Salient officials include building inspectors and planners. Some local governments also operate energy-related programs. Others function as electric utilities selling power as well as issuing permits. They generally represent a trusted source of information about home improvement options.
- *Raters.* When (generally new) homes are assessed for energy efficiency for purposes of securing energy improvement mortgage benefits, certified energy raters are employed to conduct the assessments. This group of professionals represents a resource that can be used and expanded to provide home energy assessments at the time-of-sale, or provide follow-up detailed assessment when a time-of-sale energy assessment indicates a problem that needs professional investigation. Several interviewees noted that “If the rater is separate from the home inspector, that is where the costs jump up to a degree.”
- *Real estate agents.* There are a large number of real estate agents working to connect buyers and sellers within the existing homes market. Because of their large numbers, the area across which they are dispersed, and the independence of their operations, it has been difficult to get them involved in past energy efficiency initiatives. Real estate agents control consumer access to listings, establish personal relationships with sellers and buyers, manage the intricacies of the real estate transaction, and manage the emotional dimensions of the transaction. At the same time, real estate agents have significant legal obligations to discharge their responsibilities effectively and professionally, and are guided by prescribed procedures for representing the buyer’s or seller’s interests and the disclosure of pertinent information. If the real estate agent knew that there were energy efficiency issues with a home, they would be required to disclose that information, thereby supporting the goals of this initiative.
- *State of California.* The Department of Real Estate (DRE) licenses brokers and real estate agents, and provides oversight of training and best practices. They would have an interest in an effective statewide time-of-sale initiative.
- *Utilities.* The electric and natural gas utilities have the most fundamental relationship with customers, as providers of basic utility services. They provide

energy resources on a continuous basis; deliver monthly bills; deal with outages and equipment safety issues; and represent a generally trusted source of information about energy usage, conservation options, prices and rates, and renewable energy alternatives. This relationship should be put to use in establishing an initiative, especially as an information source to their customers.

The interactions of these interest groups are shown in Figure 8.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 8. Actor Network Diagram for Time-of-Sale Information Disclosure

Market Conditions

Market conditions that will affect the success of the initiative are listed below.

- *Buyer's market vs. seller's market*. Seller's markets place additional pressure on the sales process, which could further inhibit the inclusion of home energy ratings and EIMs due to real or perceived time constraints. On the other hand, real estate agents may see energy ratings and EIMs as a means of differentiating themselves in a buyer's market.
- *Competitiveness of financing market.* EIMs provide a loan qualification and structure approach to fund the additional energy improvements. Lenders in a competitive market may already be willing to make that stretch to qualify more buyers.
- *Home prices, affordability.* Affordability is a major issue in the California real estate market. EIMs are designed to reduce the total cost of home ownership, through lower utility bills, thus improving housing affordability. This fact is not well-understood by real estate agents, lenders and the public.
- *Interest rates.* Higher interest rates place more pressure on home affordability. As interest rates move up, there is more of a need to minimize operational costs to be able to afford the payments.
- *Energy Prices.* Increasing electric and natural gas rates improve the cost-effectiveness of energy efficiency measures.
- *Capacity in the industry.* At this time energy, ratings and EIMs represent a small fraction of the market. Although about 500 home energy raters and 350 home inspectors have been trained to provide inspection and rating services, additional capacity will need to be built to service widespread adoption of these services. The expansion of energy-related inspections and the ability to process energy-related loans will require adjustments in these service structures.

Key Barriers

Barriers associated with the use of this intervention were compiled from the literature and other research, as described below:

- *Cost of Ratings.* The cost of a home energy rating was cited as a barrier. The cost of the rating, which is usually borne by the buyer, was cited as a barrier to pursuing and obtaining a rating; which then precludes applying for an EIM. Purchasers also resisted the relatively modest incremental cost of adding an energy inspection to a standard home inspection report. These costs are negligible in the context of the cost of the home when rolled into the purchase price and/or financed through the mortgage, however, unless subsidized in some way, these costs will show up as an added cost in the transaction process. The costs of the rating may need to be rolled into the loan amount as an option for the buyer. The inspection should also be established as a opt-out part of the transaction. That is, the buyer must specifically check a box on the loan application form that indicates that an energy inspection is not requested by the buyer. If the opt-out box is not checked, then the inspection would go forward.

- *Rating Report Complexity.* Feedback from homeowners suggests that the energy rating reports are too long and complicated. Homeowners suggested improving the information on energy savings and costs to make the report easier to understand. The buyer just needs to know if the home/equipment is efficient, and if not, what they need to do to lower ownership costs, what it would cost, and how much they would save by taking the actions.
- *Lack of Time.* The process of obtaining a home energy rating and applying for an EIM takes more time. The real estate market is not supportive of requirements that add time to the transaction. The energy-related inspection must not unduly lengthen the time between the acceptance of an offer and the closing date.
- *Lack of Information About Ratings And Efficiency Upgrade Options.* The general public is not well informed on what can be done to improve their home in terms of energy efficiency. Homebuyers cite a general lack of information about energy saving opportunities, a lack of specific information about what needs to be done, and a lack of information about how changes should be made or who to contact. These information barriers have the affect of lowering penetration rates and delaying transaction processes.
- *Lack of Information About Energy Improvement Mortgages.* Homebuyers generally look to their real estate agent and then to the loan officer for information about the home purchase and financing process. Real estate agents and lenders may not know about EIMs, or if they do, they may not have sufficient information to direct homeowners to the appropriate resource. In this situation, a standard loan option becomes the path of least resistance.
- *Lack of Market Viability for Service.* Although homeowners resist the costs of a home energy rating, home energy raters are having a difficult time staying in business on what they can charge for a rating and the number of ratings that are requested. Due to a lack of sustainable market support for the home energy ratings, many raters are forced to do other types of work. Energy rating services are often a low profit line that is offered with a set of other services to be profitable. Prices paid for providing audits and energy ratings that are set to induce consumer participation may be set too low for service providers, and not yet seen as a high-value item by the homeowner.
- *Lack of Proof That Concept Works.* There are few success stories in the marketplace for home energy ratings and energy improvement mortgages. Similarly, there is a lack of information and case studies on the effectiveness of energy efficiency upgrades. This is not because the mortgages and assessments are not valuable or do not work. It is because these topics are not placed in social information systems and market networks do not often address these subjects. Without an information push to move this information in the market there will be limited examples of this concept within social networks.
- *Lack of Real Estate Agent Support.* Real estate agents may generally view home energy ratings and energy improvement mortgages as additional steps in the already extensive process of completing the sale. Many may not understand the benefits to their customers and do not recommend that buyers investigate these options. In addition, as real estate agents generally work closely with a particular

lender, the lenders suggested by the real estate agent may not offer loan products that support EIMs. Lack of buyer interest in energy efficiency and EIMs feeds the lack of interest on the part of real estate agents to promote these services.

- *Lack of Familiarity with Energy Improvement Mortgage Process.* Loan officers may not have experience with applying for EIMs, or have an impression that the application process takes too long or complicates their job. EIM facilitators familiar with the process report that they can complete the paperwork in minimal time. These facilitators may not be available to recommend EIMs to buyers. Loan officers at the local level may support the EIM products, but face opposition from officials higher up in the organizations who may look at this as one more thing to keep track of and to overcome.
- *Energy Improvement Mortgage Limitations*. EIMs are available through a limited set of loan products. Loan products such as interest-only mortgages and adjustable-rate mortgages may not be available with EIM options. Lending limits on products available with EIM options may be set too low for California markets. The additional funding available through the EIM process may not be sufficient to cover the cost of otherwise cost-effective improvements. Homebuyers in strong real estate markets may try to pre-qualify for a loan to make their offer more attractive to a seller. The prequalification process may not consider loans with an EIM option.

Strategies for Overcoming Key Barriers

Achieving the goals of this intervention will require a series of voluntary and mandatory actions designed to transform the home energy rating market over time. A phased approach is recommended, to build confidence in the market on the efficacy and feasibility of time-of-sale energy ratings, and build the infrastructure needed to provide the needed services.

Near term strategies

- *Utility bill disclosure.* Utility bills, despite their limitations, are a fundamental starting point for understanding energy and affordability issues by purchasers, appraisers and lenders. Disclosure of the utility energy consumption and cost data for previous twelve months by the seller to prospective buyers and other parties in the transaction should be encouraged.
- *Energy efficiency opportunity disclosure*. Disclosure by real estate agents or lenders to prospective buyers that residential housing built prior to 1982 were not subject to energy efficiency requirements, and housing built prior to 2001 may not include energy efficiency features currently required under Title 24. Since utility costs affect affordability, homebuyers should be encouraged to request an energy inspection. The existence of financing opportunities such as EIMs and the utility program opportunities should be disclosed.

- *Voluntary, incentive-based Time-of-sale rating programs*. Financial incentives should be offered through utility or third-party programs to offset the incremental cost of home energy inspections and home energy ratings. Incentives should be paid to the raters or inspectors to encourage marketing of the service. Incentives for inspectors training should be included.
- *Real estate agent and appraiser energy efficiency training*. Improve real estate agent and appraiser awareness of energy efficiency issues and EIMs through mandatory energy efficiency training requirements for obtaining or renewing state licenses.
- *Real estate agent partnerships*. Establish partnerships with real estate agents to encourage the promotion of energy ratings and EIMs. Provide marketing, brand support and recognition to real estate agents participating in the partnerships.
- *FHA partnerships*. Establish partnerships with the Energy Commission, efficiency program implementers and the FHA to offer buyer or lender incentives on EIM products.

Mid term strategies

- *Mandate Phase 1 energy ratings at time-of-sale for older buildings.* Develop a Phase I mandatory energy ratings at time-of-sale requirement as the efficacy and practicality of this approach is demonstrated through a pilot program and the capacity to deliver the service is sufficiently developed. Limit the requirement initially to homes built prior to the introduction of energy efficiency standards. Remove incentives for the mandatory program, and phase out support for rater training as the industry gears up for a mandatory program.

Long term strategies

- *Mandate Phase 2 energy ratings at time-of-sale for all buildings.* Mandate energy ratings at time-of-sale as the capacity to deliver the service to all buildings is sufficiently developed.
- *Investigate EIM portfolio standards*. Instituting an EIM loan portfolio standard can increase the pull for EIMs. EIMs are inherently less risky loans, since they are designed to reduce total cost of ownership, and thereby strengthen the portfolio of loans on existing buildings. The Energy Commission should engage in discussions with state agencies that purchase mortgage loans on the feasibility of implementing an EIM portfolio standard for their loan portfolio.
- *Implement EIM portfolio standard*. Implement EIM portfolio standard on state-owned mortgage portfolios, pending successful conclusion of interagency discussions on this concept.

Equipment Tune-ups

Sector:	*Trigger Event:*	*Intervention Type:*
Residential	Equipment replacement, time-of-sale, service call.	Mandatory for equipment replacements due to Title 24 requirements, voluntary otherwise

Residential space cooling represents roughly 15 percent of California peak electrical demand. A significant factor affecting residential air conditioner demand is the inefficiency of old equipment as well as performance issues related to equipment that was improperly installed or serviced. Once installed, residential HVAC and other energy-consuming equipment (e.g. pool pumps) are generally ignored unless there is a catastrophic failure. This is due to a variety of factors including:

- Lack of occupant knowledge of expected equipment performance.
- Inability of owners to evaluate performance.
- A general lack of confidence in the service industry to effectively identify and remedy equipment problems.
- A general perception that equipment performance is defined by the nameplate rating, not by how it was installed.

Equipment performance problems are compounded by an installation and service industry that relies on approximate (and often inaccurate) rules of thumb for commissioning equipment. The highly cost-competitive replacement and service markets use these rules of thumb as a rough indicator of installation quality with little meaningful performance data obtained and recorded. It is very difficult for the homeowner to gauge how well their HVAC system is operating. Their perception is if cool air is supplied from the registers and comfort is generally being maintained, the system must be operating properly. (Interestingly, cooler air from registers could be symptomatic of a problem such as reduced system airflow, a phenomenon that reduces cooling system capacity and efficiency.) Equipment failure is frequently the only time a service call is initiated.

This intervention strategy looks at improving how the HVAC and related industries interact with their customers. By increasing the training and certification level of contractors; educating consumers about issues and solutions; and providing long-term program support through incentives and training, this initiative aims at transforming the residential tune-up and O&M market. Requiring these services makes sense, since a properly installed and maintained system will offer lower life-cycle costs than an improperly installed and more frequently serviced system. This initiative is primarily directed at HVAC services and would address airflow requirements, refrigerant charge, and duct leakage. This intervention is particularly attractive for multifamily applications where the cost per transaction can be much lower than in the diffuse single family market.

Affected Groups

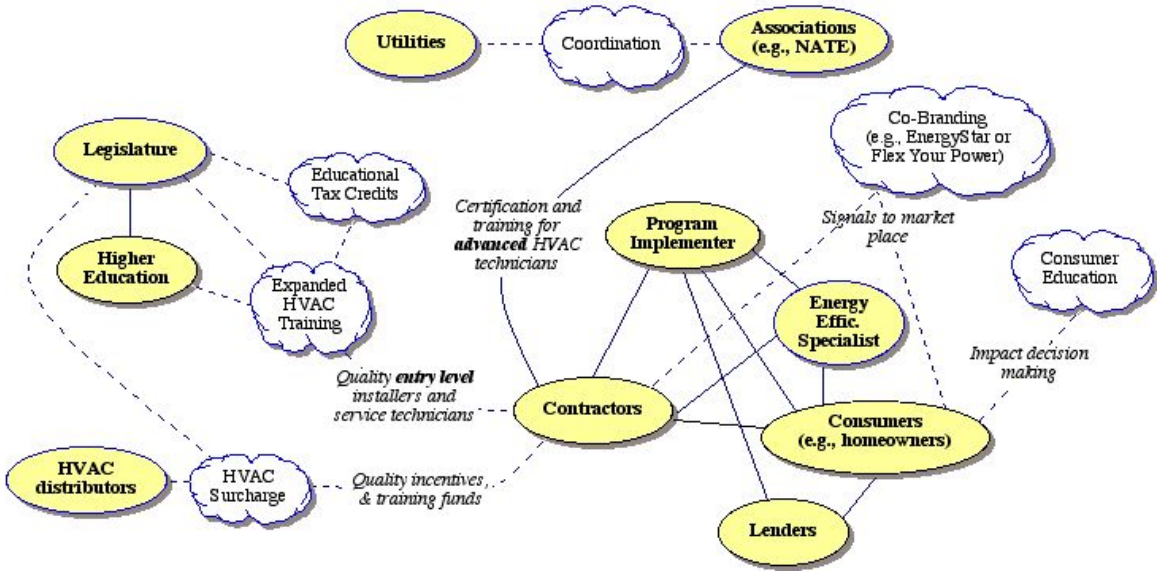
On the basis of interviews and panel discussions with expert industry observers, as well as a review of the literature concerning residential energy use and consumer behavior, the following key groups have been identified in the areas of equipment tune-ups and operations and maintenance services.

- *Consumers.* Homeowners and renters are generally not well informed about their building systems and operation and maintenance issues. They have misconceptions about equipment, as well as about contractors (e.g., thinking that one is as good as another). Consumers are also less concerned about energy costs than other energy-system-related issues (e.g., health and comfort). They look first and foremost to the utility for information, as well as to some contractors.
- *Contractors.* Most contractors are not trained or equipped to provide state-of-the-art residential equipment performance assessment and fine-tuning. A handful of contractors are, however, very committed to a building science approach to O&M and are successful in providing high quality services. However, this requires more effort and use of skilled personnel than can normally be applied in the cost-competitive HVAC market. Cost competition is a major impediment for these contractors. In many cases, the contractors have found ways to contact and establish lasting relationships with customers through their own marketing and customer satisfaction efforts.
- *Energy efficiency service providers.* There are several CPUC third-party public-purposes programs that are working with contractors who understand this market. These firms have experience in this field and have a stake in the market and incentives. This stake in the industry can help ensure that a broader intervention will not fail. They may have the ability to implement these programs more cost-effectively than the utilities, but also may not be able to wind the programs up to a statewide effort as quickly as the utilities.
- *Training and certification.* Community colleges and technical training programs provide basic education related to building science, HVAC technology, energy auditing, et cetera. The training infrastructure is not very well developed compared to other education areas. This is due in part to the higher costs of technical training (e.g., labs, shops, and hands-on learning opportunities) and to the limited demand for trained technicians during the past decade of relatively low energy prices and less concern for energy efficiency in the business, government and consumer sectors. NATE could logically become the certification mechanism for this initiative. On the contractor level, it is reasonable to expect that not all contractors will pursue the training and certification requirements entailed in this initiative. Only progressive contractors and those contractors able to see value in differentiating themselves from their competitors will likely follow this path.
- *Legislature.* The legislature enacts laws regarding building and equipment standards (e.g., Title 24). The legislature could mandate energy efficiency

inspections for houses at time-of-sale and/or during major equipment installed for retrofit.

- *Lenders.* Home improvement loans can be made available by a wide range of lenders to finance energy efficiency upgrades.
- *Program Implementers.* Information program providers (e.g., Flex-Your-Power campaign) offer a range of specific messages and information to the customer on energy problems and conservation/efficiency options. These efforts could include real world data as well as examples, case studies, and/or success stories.
- *Utilities.* Although utilities can be reluctant to associate themselves with particular programs, approaches or contractors, they typically have established consumer trust and can therefore play a key role in building a program. California utilities would likely be more active participants in this initiative since the benefits have a significant peak load component. Utilities could be active in training and disseminating information to the public.
- *HVAC Industry.* This initiative will have a significant impact on the HVAC industry, from individual manufacturers, to trade organizations such as the Air-Conditioning and Refrigeration Institute (ARI), to certification groups such as NATE, and ultimately to individual contractors. In response to this initiative, individual HVAC manufacturers would need to enhance their training programs, in terms of service offerings and in their operation and installation manuals. They would also need to build up their field training efforts. ARI, as the major industry trade group, would be actively involved in the development and advancement of this initiative.
- *Other Energy Efficiency Advocacy Associations.* If successful, the impact of this initiative will grow in the market as other associations partner with the California strategy to further leverage the initiative. These associations could include the U.S. Department of Energy, the Consortium for Energy Efficiency (CEE) other state energy organizations such as New York State Energy Research and Development Authority (NYSERDA), Florida Solar Energy Center (FSEC) and Association of State Energy Research and Technology Transfer Institutes (ASERTTI) and its other members.

The actor network diagram for this initiative is shown in Figure 9.



Notes on links and symbols:

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- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 9. Actor Network Diagram for Equipment Tune-up Intervention

Market Conditions

There are a number of market conditions that will affect the success of this initiative. These include:

- *Public awareness*: The 2001 energy crisis was effective at raising peak demand as an important issue. The Governor has also made this issue a centerpiece of his position on energy. With air conditioning a key component in statewide peak demand, this intervention has a high visibility in the public eye.
- *Available information.* A coordinated "Information Gateway" effort is a critical component in the success of this intervention. This effort would play a vital role in defining issues related to installation problems and documenting projected energy and demand benefits of a tune-up and O&M program. Field data collected before and after the intervention would be especially valuable in conveying program benefits to the general public.
- *Existing infrastructure*: There are several elements currently in the market that represent a good starting point for the proposed initiative. Third-party programs have focused on HVAC system airflow and refrigerant using advanced diagnostic systems. Utility training programs have been developed to train HVAC contractors in improved installation and service procedures. Finally, some of the

progressive HVAC contractors in California are working towards advanced procedures that insure optimal system performance. This existing environment should be beneficial in nurturing the proposed initiative.

- *Long-term approach.* A focused, long-term approach to this intervention is needed to send a consistent signal to the marketplace and give contractors assurances that investments in service provider training will result in increased revenue down the road. A well-designed program should be implemented on a small scale and fine-tuned before being expanded into the broader market. Early feedback should be used to optimize the implementation of the program. The program should have a strong quality control component to closely monitor results and identify contractors not meeting the project standards. Contractors will likely be hesitant to embrace the intervention approach without an extended project duration that would make the intervention worthwhile as a business venture.
- *Energy prices.* Increasing energy prices and the implementation of time of use electric rates are two market factors that would help spur this initiative.
- *CEE, ACCA initiative.* The Consortium for Energy Efficiency (CEE), along with Air Conditioning Contractors Association (ACCA) is sponsoring a national initiative on residential quality installation (QI). The success of this initiative and the spillover into service and maintenance activities will affect this initiative.

Key Barriers

There are several barriers that currently impact the potential effectiveness of the proposed intervention strategy. These include:

- *Lack of expert advice and information.* The residential customer needs better information to understand what factors affect HVAC system performance and how their system is performing. Only as an educated participant can a homeowner know what to ask for and how to interpret verification results the contractor is collecting. Once the homeowner or building owner is educated, they will likely look for trained and certified HVAC service technicians.
- *Lack of HVAC service technicians.* The HVAC industry as a whole is experiencing a labor shortage. In this environment it is difficult to retain qualified workers to either train new recruits or to advance their own skills.
- *Lack of trained field personnel.* Although there is a mechanism in place to train contractors, a strong market-based demand for services does not currently exist. When the marketplace is competing almost exclusively on initial cost, it is difficult for a contractor to increase the training of their employees for services that go beyond first cost concepts. In a differentiated market, the trained contractor would be valued more highly, increasing the value of his/her services.
- *Nature of the HVAC service and equipment replacement cycle.* The residential retrofit and service HVAC industry is characterized by seasonal cycles. In peak

times, contractors are unable to keep up with demand, and their goal is to install or service equipment as quickly as possible. Most equipment is installed and serviced during these frenzied times, resulting in additional problems relating to the quality of the installation effort to be addressed at a later time when time pressures are reduced.

- *Program cost.* Proper program implementation will require significant time and money. A long-term commitment is needed to educate the public, convince contractors that the intervention will exist year after year, and to provide incentives to complete the tune-ups and other necessary remediation measures.
- *Historical lack of long-term planning.* A focused, long-term approach to this intervention is needed to send a consistent signal to the marketplace and give contractors assurances that investments in service provider training will result in increased revenue down the road. A well-designed program should be implemented on a small scale and fine-tuned before expanding into the broader market. Early feedback should be used to optimize the implementation of the program. The program should have a strong quality control component to closely monitor results and identify contractors not meeting the project standards. Contractors will likely be hesitant to embrace the intervention approach without an extended project duration.

Strategies for Overcoming Key Barriers

- *Consumer awareness*. The barriers to implementing a residential equipment tune-up and O&M intervention strategy are significant. The HVAC industry is firmly entrenched in a first-cost competitive environment where life-cycle costs are typically not considered. For this intervention strategy to succeed, progressive contractors need to be able to achieve market share by offering a better product with a higher price. For the market to desire improved service and installation practices, consumers and building owners must be made aware of what makes a good installation or service call and how to gather data to evaluate the procedure.
- *Training and certification*. Expanded community college and vocational school training is a critical element for quality entry-level HVAC installers and service technicians. Educational tax credits could be implemented to support this effort. Utilities and organizations such as NATE could collaborate to provide training and certification for the advanced HVAC technicians. Co-branding with ENERGY STAR or Flex-Your-Power would send a powerful signal to the marketplace.
- *Long-term program commitment*. Utilities, third-party implementers, and contractors would all benefit from an intervention strategy that has a longer program commitment period, compared to traditional program cycles. A longer term planning horizon is essential for developing an effort that includes consumer education, training and certification, and marketing efforts. Long-term program

planning conveys confidence to the HVAC service industry that the initiative is fully supported.

- *Marketing*. Utilize existing energy media avenues (e.g., utility resources, Flex-Your-Power) to further educate the market on the factors affecting residential air conditioner performance and what can be done to improve system performance. Case studies documenting performance before and after are useful tools.
- *Reimbursable wholesale equipment surcharge*. An HVAC equipment surcharge at the distributor level could be added to the price of air conditioning equipment. If the equipment is installed per the required installation standards, the HVAC contractor would be directly reimbursed. If not, the money could be used to fund training and certification efforts.

Integrated Whole Building Diagnostic Testing and Repair

Sector:	*Trigger Event:*	*Intervention Type:*
Residential	Major remodel, HVAC replacement	Voluntary

Whole building diagnostic testing involves evaluating house performance as an integrated system as opposed to a number of unrelated parts. Such an approach should be used to evaluate and remediate energy-related design and installation defects in homes. Climate, building materials (and the way they are assembled), occupant interaction, and mechanical equipment design and installation all affect the house performance. This intervention strategy allows the practitioner to both identify flaws in construction or operation, and use the diagnostic tools to direct repairs correcting the flaws. A detailed diagnostic evaluation approach allows the practitioner to understand building performance issues and implement strategies that improve building comfort, safety, and energy efficiency. With a "house as a system" approach to remodeling, synergistic benefits are more likely to be realized. For example, when coupled with a HVAC retrofit, other energy efficiency improvements may contribute to reduced replacement equipment size, saving the homeowners money.

The whole building diagnostic approach represents a new way of thinking in addressing household energy issues. Instead of looking at energy problems from a piecemeal approach, a whole building assessment allows the trained practitioner to:

- Fully understand homeowner energy/comfort/health issues
- Evaluate in situ “system” performance
- Implement appropriate remediation efforts, and
- Verify performance

The energy implications of whole building diagnostic testing services are important; but generally, secondary to issues of comfort, health and safety. Significant non-

energy benefits provide leverage in implementing energy efficiency, since comfort, health, and safety enhancements are not typically viewed from a cost-effectiveness perspective.

Affected Groups

On the basis of interviews and panel discussions with expert industry observers, as well as a review of the literature concerning residential energy use and consumer behavior, the following key groups have been identified in the area of whole building diagnostic testing.

- *Associations.* There is one statewide association of whole building diagnosis and retrofit contractors. There are several HVAC contracting, design, and building science groups at the state and national levels that are cognizant of and interested in promoting systematic whole building analysis.
- *Contractors*. There is currently a small number of trained contractors and technicians in California who are involved in whole house testing and retrofit activities. A few are large integrated firms, where marketing, testing, HVAC installation, shell improvements, and other building upgrade services are performed by a single contracting organization. Other whole building contractors specialize in HVAC, remodeling, insulation, et cetera, bringing in other specialists as the jobs require. Several general contractors manage retrofits entirely through specialty subcontractors following the initial testing. A few energy raters also do whole building testing and refer their clients to general and specialty contractors to perform recommended retrofit work. More contractors have been trained than are currently performing whole building services in California. It is likely that their training has also had a beneficial effect on the quality of the customary services they provide (e.g., HVAC, insulation, remodeling) and on their referrals to other specialty contractors who can help to remedy significant building system problems related to health, safety, comfort, and energy efficiency.
- *Consumers.* Interest in whole house testing services seems to result from homeowner concerns about health, equipment performance, safety concerns, and interest in energy savings (the latter rarely is the first mention by consumers and most often in combination with other motivations). Many who have purchased the service, report high levels of satisfaction, and there is evidence of significant homeowner investments in retrofits as a result of testing.
- *News media*. In some cases, newspapers and television newscasts have covered local whole house diagnostics programs, reporting on dramatic improvements in indoor air quality, occupant health, homeowner satisfaction, and energy savings associated with retrofits.
- *Trainers.* Fairly extensive training is required to learn building science basics, testing procedures, proper use of test equipment, whole building analysis, retrofit recommendations, and quality installation techniques. There are few sources of whole building diagnosis and retrofit training, and only a small number of qualified trainers currently practicing in California. In California, the CBPCA was

developed in 2001 to promote the whole house diagnostic testing approach in residential construction. The CBPCA provides low cost training to interested contractors. Training includes four days of classroom activities (whole house principles, use of diagnostic tools, and software training) and two days of field training. Follow-up training in business model development and marketing is also available, as well continuing field mentoring as the contractor begins to implement the whole building approach in the field. The program marketing effort also benefits from use of the ENERGY STAR brand and labeling. The Home Performance with ENERGY STAR model allows the homeowner to have a single point of contact for testing, recommending, and implementing measures. To date, the CBPCA has trained roughly 100 contractors. Affordable Comfort is another organization dedicated to improving the knowledge and capabilities of building contractors throughout the U.S. Affordable Comfort holds several regional conferences a year providing classroom and field training. Both of these organizations could be expanded to handle a greater number of contractors.

- *Real estate agents*. Real estate agents would need to become better educated on this intervention strategy if it achieves or is to achieve significant market share. Improved real estate agent training in basic energy efficiency would provide them the skills to assist homeowners in evaluating the merits of whole house diagnostic testing, as well as assisting them with the potential time-of-sale audit or energy inspection intervention.
- *Insurance industry*. The insurance industry should be favorably affected by increased use of whole building diagnostics and remediation. With mold and indoor air quality problems becoming an increasing problem, the insurance industry should value customers who have not only improved the durability and energy characteristics of their home, but also improved the indoor environment.

The actor network diagram for this initiative is shown in Figure 10.

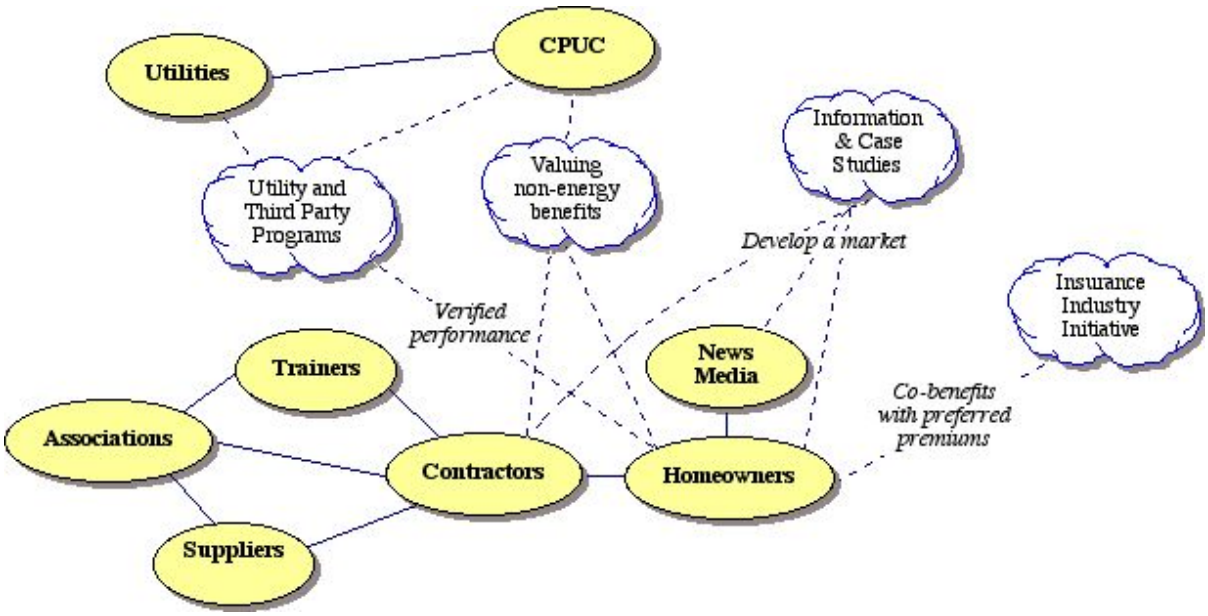

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Figure 10. Actor Network Diagram for Integrated Whole Building Diagnostic Testing and Repair

Market Conditions

There are a number of market conditions that will affect the success of this initiative. These include:

- *Increasing homeowner health and safety concerns*. Homeowner health and safety concerns represent a significant market force that will affect the implementation rate for this initiative. Indoor air quality and mold problems are a major driving force in the remodeling market in California. The whole building initiative is geared towards addressing these problems and verifying the effectiveness of the remediation effort. Non-energy benefits such as improved indoor environmental conditions and lower greenhouse gas emissions may likely be the dominant driving force for this intervention strategy.
- *Energy prices*. Energy price trends and the implementation of time-of-use electric rates are two market factors that could help drive the whole building intervention. In a similar manner to Sport Utility Vehicle sales falling with rising gas prices, rising gas and electric costs will create a larger financial incentive to implement energy efficiency options.

- *Available information*. Information provided by local media and other sources is an important factor in promoting new approaches to energy efficiency. Demonstration project results should be disseminated to the public. Since whole building efforts typically involve fairly standard solutions to building performance problems (from the viewpoint of materials), homeowners may be attracted to the simplicity of the approach.

Key Barriers

There are several barriers that could reduce the effectiveness of a whole building diagnostic testing intervention strategy. These include:

- *Lack of expert advice and information.* Without better education of the residential customer as to how energy is consumed in the home, this initiative will likely flounder. This initiative is closely tied to the "Information Gateway" intervention since only an educated homeowner can make an informed decision on the potential benefits of the whole building diagnostic testing strategy.
- *Lack of trained and certified contractors.* Although there is a mechanism in place to train contractors, significant statewide demand for services does not currently exist. Without the demand from the marketplace, it is difficult for a contractor to justify the expense of having their employees go through the training and purchasing the diagnostic equipment. This barrier is closely linked to the barrier above.
- *Segmented nature of state contractor licensing.* Contractors holding a C-20 license may not be able to do all work covered under a whole building approach.
- *Inertia.* In boom cycles, contractors have little motivation to differentiate themselves from their competitors since work is abundant. Changing a contractor's business model from the status quo to a performance-based approach has an element of risk. Each contractor needs to determine the costs and benefits of undergoing this transformation.
- *Lack of valuing non-energy benefits.* Much of the benefit of whole house diagnostic services is an improvement in indoor comfort, indoor air quality, health and safety, and overall aesthetic improvements to the structure. These benefits are very real to the homeowner and typically of more significance than the potential energy savings. Unfortunately, CPUC Total Resource Cost (TRC) test methodologies do not value the non-energy benefits.
- *Lack of valuing performance verification.* Utility programs offering incentives to homeowners for installation of energy efficiency measures do not regularly verify that the installed measure performance is consistent with the design intent. The whole building approach involves performance verification resulting in documented value to both the homeowner and the utility.
- *First cost.* Cost is certainly a barrier to this approach. With the comprehensive nature of this approach and the expense associated with the diagnostic testing,

whole building remediation may only be cost-effective to customers who possess three key characteristics: above average energy use, high valuation of non-energy benefits, and disposable income to pursue the remediation effort. Likewise, the first cost of making whole house retrofits can be prohibitive for many families.

Strategies for Overcoming Key Barriers

The barriers to transforming the whole building diagnostic testing initiative to a mature industry are significant. Key barriers and strategies for overcoming the barriers are discussed below.

- *Develop a market.* A primary barrier that needs to be addressed is the push/pull dynamic between homeowners and contractors. If homeowners do not see value in this initiative, contractors will not have motivation to differentiate themselves from their competition to provide the services. The broad marketplace needs to be educated on the comprehensive benefits whole house diagnostic testing and remediation offers. Case studies documenting remediation efforts on homes with significant problems (e.g., health and safety, energy, and comfort) must be disseminated through various media forms. The “Information Gateway” intervention is therefore critically important to jump-start the marketplace. Utilities and the state can take the lead in this effort. Once the market has created demand, training efforts can grow to supply certified professionals to meet the demand.

  From the customer perspective, the whole building diagnostic initiative offers the potential for an improved remediation process. In dealing with a single, certified contractor, the homeowner will experience a streamlined process from design through verification. Instead of dealing with multiple subcontractors who have little or no knowledge of each other’s work or responsibilities, this integrated approach should result in an improved environment. Since the certified contractor has adopted a holistic approach to the home and its occupants, the interaction between contractor and client should benefit.
- *Value non-energy benefits.* Anecdotal evidence from whole building diagnostic testing programs operated in California and in other states is that homeowners are willing to spend significant sums of money to have the defects in their homes remedied, and that energy cost savings are only a portion of the benefits derived by consumers. This issue requires additional study to document consumer motivations for contracting this service, the level of expenditures consumers are willing to pay, the benefits derived and a means to value these benefits in the context of traditional cost/benefit analysis.
- *Value field verification data*. Existing utility and third-party programs should also recognize the benefit of field verification data provided by the testing activities. Unlike other measures, which may or may not have limited field verification, this intervention will have documented performance improvement.

- *Program development.* Develop utility or third-party programs with enhanced incentives for this intervention strategy. Include comprehensive contractor training, monitoring of the quality of contractor work and development of best practices for conducting the technical work and business operations. Verified performance improvements and the comprehensive benefits offered by this strategy need to be recognized and valued. Work with the insurance industry to recognize the mutual benefits of this intervention strategy. Valuing of the benefits should result in preferred insurance premiums for these customers. A before and after case study of a sample of homes might make a convincing argument for such an approach. These efforts will substantially reduce the barriers identified above and, if effectively implemented, will allow the initiative to succeed and grow in its impacts.
- *License whole building contractors.* Recognize whole building contracting as a unique discipline under the state contractor licensing system. This will relieve the requirement to obtain multiple contractor licenses to conduct whole building services. It will also help establish the legitimacy of this approach in the contracting industry.

Assistance to Affordable Housing

Sector:	*Trigger Event:*	*Intervention Type:*
Residential	HVAC service, building sale, refinance, property rehabilitation	Mandatory and voluntary components

To improve the energy efficiency and affordability of existing low income multifamily housing in California, we propose a series of elements to this strategy. The interventions will attempt to work within the labyrinth of existing policies, procedures and agencies to the maximum extent possible. Typically, a multifamily housing developer applies to the California Department of Housing and Community Development (HCD), the California Tax Credit Allocation Committee (CTCAC), the California Housing and Finance Association (Cal HFA), probably a local funding source, a private bank, and possibly other sources for project financing. Resources for affordable housing developers include the tax-exempt bonds of which Cal HFA is one of the main providers, the CTCAC, and the multifamily housing program that is administered by HCD. Nearly every type of affordable housing goes through one, if not multiple, agencies. In almost all cases, developers use both the tax-exempt bonds from the California Debt Limit Allocation Committee (CDLAC) and the tax credit financing to preserve the project as affordable. According to key informant interviews conducted for this project, tax credits are probably involved in close to 80 percent of affordable housing projects.

The following elements are envisioned for a coordinated strategy for low income multifamily housing:

- *Technical assistance*. Provide information, training and technical support services to multifamily housing property and asset managers, including energy audits and technical assistance to implement cost-effective upgrade projects. State housing agencies, local housing authorities and non-profit agencies generally do not have the expertise necessary to properly evaluate and manage energy efficiency improvement projects. Introduce utility bill tracking software to the property managers and train them on how to use it.
- *HVAC tune-up opportunities*. Provide new funding for HVAC system tune-ups, retro-commissioning and operations and maintenance initiatives targeted at multifamily housing projects. Low income housing authorities generally lack the funding for HVAC tune-up projects.
- *Provide low-cost or no-cost financing of qualified energy efficiency improvement projects*. Housing authorities are often not able or unwilling to take on additional debt to finance energy efficiency improvement projects. A financing program targeted at low income multifamily efficiency improvement projects should be developed to provide the funding needed to implement cost-effective efficiency upgrades.
- *Subsidized housing tax regulatory process is key lever*. Developers that participate in subsidized housing programs generally receive tax credits and other financial incentives for their investments in low income housing. Energy ratings and energy efficiency upgrades should be required as a condition of participation in these programs. It does not make sense for California to be subsidizing lower efficiency construction practices when better practices are cost-effectively available that help lower tenant costs.
- *Property rehabilitation is key trigger event*. Housing rehabilitation projects provide an important opportunity for improving energy efficiency. The projects are generally invasive to the point where tenants are relocated during renovation, providing the opportunity to upgrade major building systems such as windows, shell insulation, common area lighting, HVAC and water heating. At this trigger point, diagnostics and measure verification can be completed done quickly and efficiently, reducing “per unit” costs. Again, California should not subsidize rehabilitations that are not at least ENERGY STAR equivalent.
- *Use state housing agencies as hubs for efficiency program referral information.* State housing agencies can be used to provide program and rebate information to developers. Create linkages between the Cal HFA, CDLAC, and CTCAC funds, and the available funds for energy upgrades. Include energy efficiency programs as part of the standard application process for other funding sources.
- *Develop interagency partnerships between state housing agencies and the Energy Commission to provide technical support services to local housing authorities, non-profit organizations and project developers*. The Energy Commission technical assistance program for public facilities is a model that should be replicated for low income housing applications.

- *Energy ratings.* Develop incentive programs that provide funding for conducting energy ratings and whole building energy audits. An energy efficient pricing scheme for multiunit developments should be created to capture savings. Initiative services should include filling out the program participation forms for a developer, arranging for a rating, arranging for an energy consultant as necessary, and advising the developer on equipment choices. Incentive payments should be fast and focus on cost-effective measures and whole building performance. Use existing state funding sources or Public Goods Charge funding to cover the cost of the rating and audits. Cal HFA has a predevelopment loan program, which covers both preconstruction and/or preacquisition expenditures. Make energy ratings and audits an eligible cost under this program; or make the audits cost a reimbursable item for successful projects. When a loan is closed with Cal HFA, the costs can be folded into the financing package without requiring a separate application for predevelopment. Require energy ratings as a condition for receiving the energy efficiency funding.
- *Utility allowances*. The costs to implement energy efficiency projects can be recovered by allocating more money to rent and less to utilities. Efforts to establish utility allowances that recognize the lower utility costs of energy efficient buildings should be encouraged by state agencies and should be undertaken as part of a broader strategy. Consistent and accurate methodologies need to be developed for estimating utility costs in standard and energy efficient buildings.

Affected Groups

On the basis of interviews and panel discussions with expert industry observers, as well as a review of the literature concerning residential energy use and consumer behavior, the following key interest groups have been identified in the area of low income multifamily housing.

- *State housing agencies.* These agencies include the California Housing and Finance Association (Cal HFA)—a provider of tax exempt bonds for affordable housing developments; California Tax Credit Allocation Committee (CTCAC); California Debt Limit Allocation Committee (CDLAC); California Housing and Community Development (HCD). For the most part, non-profits look to the state housing agencies for construction or rehabilitation-related information. Multifamily owners and construction contractors do not typically rely on information from the CPUC, the Energy Commission or the IOUs.
- *HUD*. U.S. Department of Housing and Urban Development (HUD) is a key stakeholder in the multifamily market.
- *Developers*. Both non-profit and for-profit housing developers who build and renovate properties are affected.
- *Asset managers.* Many of the non-profits have an asset manager making capital improvements and investments decisions for the properties they own.

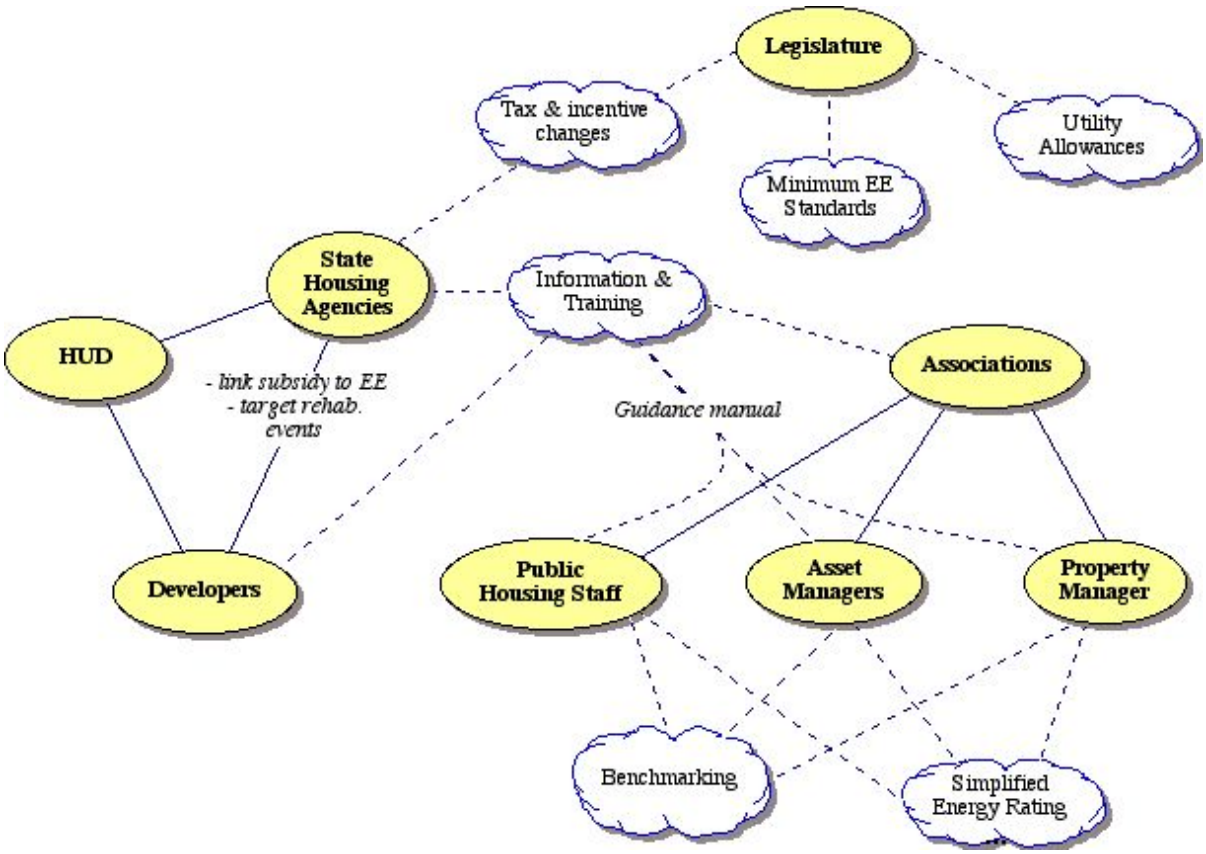
- *Trade associations.* Associations include: Affordable Housing Management Association (AHMA), which primarily focuses on Section 8 projects and is made up largely of for-profit organizations and asset managers. The other major multifamily related trade associations for the non-profits are: Non-profit Housing Association of Northern California, San Diego Housing Federation, the Southern California Association for Non-profit Housing, and the California Coalition for Rural Housing.
- *Public housing staff.* Public housing staff is generally under-funded and overworked. Over the past five years, public housing authority budgets have been cut about 20 percent to 35 percent while the number of low income families in California has increased. Yet these authorities and their staff play an important role in determining what kinds of project are built and the energy efficiency of these projects. This group needs to be supported through this initiative.
- *Property managers*. Property managers make many day-to-day decisions that affect energy efficiency of the properties they manage. These individuals may not have the skills or knowledge necessary to understand the energy implications of their decisions. Education and training programs targeted at property managers may help improve the efficiency of their properties.

An actor network diagram for the low income multifamily housing market is shown in Figure 11.

Market Conditions

Market conditions affecting the success of the initiative include:

- *Energy prices.* Energy price trends and the implementation of time-of-use electric rates are two market factors that could help encourage agencies to improve the efficiency of their properties.
- *State of the economy.* The general state of the economy is one of the factors contributing to the number of residents living in low income housing and has a direct bearing on the amount of property needed. The more pressure on property development, the less resources and time are available to focus on energy efficiency. However, the more units needed, the stronger the need for energy efficient units.
- *Capacity to provide services.* The availability of trained auditors and installation contractors is a critical factor affecting how broadly this initiative can be implemented.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 11. Actor Network Diagram for Assistance to Affordable Housing

Key Barriers

The key barriers associated with the success of this initiative include:

- *Inconsistency in funding.* Funding for multifamily efficiency programs has been inconsistent over the years. Developers may avoid these sources based on prior bad experiences when there has been the promise of program initiatives and expanded efficiency options only to have those resources be spent in other sectors.
- *Low priority for energy projects.* Project funding allocated for energy efficiency may get traded away to make the project workable from an overall financial perspective. While project funding facilitators have supported energy efficiency in the past, in many cases, these desires have dissolved away when project

funding is reduced or does not fully materialize. The energy efficiency measures are then cut so that the project can move forward. The choice by many of the funding facilitators has been to get the structures build and give up the efficiency measures to move the projects forward.

- *Lack of information.* Developers and owners often do not know what the energy efficiency alternatives are when the need to remodel or renovate a property arises.
- *Difficulty in applying for funding.* The process and structure for getting funding for energy efficiency upgrades may not be worth the time invested to procure that funding. Energy efficiency is generally not an important criterion for obtaining funding and developers are more interested in getting the project done.
- *Timing issues.* Efficiency program timing may not be consistent with multifamily funding and project development timelines. Long-term programs with funding consistency and continuity are needed.
- *Uncertainty in policies and regulations.* Housing authorities are reluctant to act without written approval from HUD. If the authority is audited and the audit finds dollars spent on energy efficiency, they can be penalized if they do not have expressed written consent for the efficiency expenditures. HUD has been reluctant to provide energy efficiency approvals in writing. There may not be a strong enough commitment to energy efficiency until HUD commitment leads to an energy efficient funding stream or written project approvals.
- *HCD + HUD rent guidelines.* Energy efficiency does not show up in net rent calculations. All HUD buildings have the same utility allowances credits per type of unit. As a result, no energy efficiency price messaging is sent back to the developer or tenant. The allowance is the same for all units.
- *Insufficient focus on multifamily populations.* Multifamily low income energy efficiency programs are generally less cost-effective than programs serving other markets, due to the need for higher incentive levels and greater administrative support. Although current CPUC policy has considerations for hard to reach customers, the emphasis on low income multifamily housing could be increased.
- *Lack of financing.* There is a lack of financing for improvements done between renovation events, since these projects are not tied to special financing programs for affordable housing.
- *Lack of property manager knowledge.* Property management core competencies do not typically include expertise in planning and implementing energy efficiency projects. In particular, developing sources and use plans that tie together multiple financing resources to fund comprehensive projects, (a key activity for developing a project) is outside of the skill requirements of many property managers. Many multifamily properties stall or undergo only partial implementation after completion of an energy audit because the property manager may not have the experience or resources to develop an action plan.

Strategies for Overcoming Key Barriers

- *Simplify rating application process.* Make the energy rating a simple, over-the-counter product, where a developer sends in a request and a rater does the rest. Make energy efficiency assessments and project development a part of the standard funding application process. However, the process needs to be kept very simple to operate and not add costs or time delays to the project. Where possible, make fast-track review and approval processes available for the high efficiency structures and renovations so that the higher the building's energy efficiency level, the faster the project approval process. Put the highest efficiency projects at the top of the approval process.
- *Minimum efficiency standards.* California should have a minimum standard for energy efficiency for housing that receives public support that is at least consistent with other high efficiency structures.
- *Develop case studies.* Develop case studies to demonstrate successful energy efficient housing projects.
- *Education and training.* Develop stakeholder training programs for the existing affordable housing market. Training for property managers on energy efficient property design, management and inspection practices should be considered. Training on inspection and maintenance protocols for HVAC equipment should also be included. Training can be developed in partnership with housing management associations and utility energy training centers
- *Property manager guidance manual.* Develop an energy efficiency guidance manual for property managers. The Manual should be developed in partnership with HCD and housing management associations. The manual should cover topics such as energy efficient lighting and appliances, building operations and maintenance, utility bill tracking, and no cost or low cost strategies for energy efficiency.
- *Financing.* Financing incentives and wider access to direct install services are also an essential component to putting together financing strategies and plans for multifamily projects. Create a multifamily financing component of the initiative within the Energy Commission using income guidelines for energy programs that are coordinated with California's financial guidelines for housing programs
- *Turnkey services.* Develop the initiative so that it can function within the established multifamily development arena. Install within this market a full-service approach so that the same people who are approving and funding projects have a direct interest in making sure the projects are efficient. Build within the established framework, but bring energy efficient to a higher level of importance.

Commercial Building Benchmarking

Sector:	*Trigger Event:*	*Intervention Type:*
Commercial	Building sale or refinance	Voluntary

This intervention involves the use of commercial building energy consumption benchmarking as a means to gain the attention of decision makers who can influence the energy efficiency of a building and to motivate these decision makers to implement measures that will improve energy efficiency. Benchmarking involves placing comparative energy consumption information into the nonresidential market in a form that building owners and operators can use to easily see how their buildings perform relative to other similar buildings in similar weather and use conditions. Benchmarking should be viewed as the initial step in a comprehensive efficiency upgrade program. Follow-up steps include auditing of building HVAC systems and controls, retrofit of inefficient systems with more efficient technology and retro commissioning to ensure that upgrades have been made successfully.

Existing commercial building benchmarking systems include the EPA ENERGY STAR benchmarking system and the LBNL Cal Arch California Building Energy Reference Tool. Both of these systems use a web interface and compare the energy consumption data of a particular building to a database of building consumption data for a large number of other existing similar buildings. The EPA tool uses the federal Commercial Building Energy Consumption Survey (CBECS) data, while the current CalArch tool uses data from the Commercial Building End Use Survey (CEUS) that is specific to California buildings. The CEUS data was first collected in the early 1990's and is updated periodically—a current survey is now being conducted with building data being available for use by CalArch in late 2005. Development of the CalArch tool was funded by the Energy Commission's PIER program.

In its simplest form benchmarking compares energy consumption per square foot of floor space for comparable classes of buildings or Standard Industrial Code (SIC) designations. To calculate a "first level" benchmark requires a very limited set of information that should be readily available without requiring energy audits of the building. This first level benchmark is useful for identifying the worst performing buildings for targeted attention. However, there are many variables that determine the relative energy performance of buildings, and by considering more detailed information about a building and comparison information for buildings in a benchmarking database, more insightful comparisons can be made. Obtaining this more detailed information requires onsite investigation, which is time consuming and may be difficult to accomplish for all buildings. To address this issue, the benchmarking tool should be designed to have multiple levels of increasing detail so that both the simplest benchmarking and potentially more meaningful comparisons could be done by drilling down into building details or identifying specific end uses.

Benchmarking buildings in terms of a total energy consumption metric combines the impact of how the building(s) is (are) operated and what energy efficiency features

are present. It is difficult to separate equipment/facility efficiency from the operational issues without additional building descriptive information. To address these possible differences a comparison of the energy consumption of the building to a minimally Title 24 compliant version of the same building under as-operated conditions should isolate efficiency issues from operations issues. Although a substantial amount of information is needed regarding the features of the building to make this comparison, this is one of the more detailed levels of comparison envisioned.

The overall elements of the benchmarking intervention are as follows:

- *Financing or refinancing should be important as a trigger event*. Building financing and refinancing are proposed as key trigger events at which benchmarking will take place. Financing/refinancing occurs periodically throughout the life of a building, starting at time-of-sale and is a time when it is appropriate to consider the operating costs of the building and ways those operating costs can be reduced. Other trigger events may include benchmarking the building as a condition for leasing of space within the building (see the commercial building leasing intervention). Benchmarking is required as a condition for recognition under the EPA ENERGY STAR and LEED Existing Building rating programs.
- *Benchmarking could be accomplished by utilities in conjunction with utility bills*. This element requires utilities to benchmark all buildings. This benchmarking would logically take place as part of the utilities' function to provide energy bills. Benchmarking would provide additional information that would allow owners of buildings to compare their building's energy use to similar buildings in the general population as well as comparing the energy consumption of a group of buildings under the same management. This would require the utility to collect enough information about building characteristics (both equipment and usage) to permit these comparisons to be accurately made. A mechanism should be provided for continuous updating of benchmarking scores with each billing cycle to track the effectiveness/impact of changes in building operations or installation of energy efficiency features. Benchmarking also provides a means for utilities to target poorly performing buildings energy audits. Energy efficiency marketing information will also be provided in conjunction with benchmarking to communicate the benefits of further investigation/action and to inform building owners about incentives and services they can obtain from the utilities and other sources.
- *Referrals to energy audit programs and to retrofit improvement programs*. Benchmarking alone leads to only limited energy savings (perhaps to a change in operating practice based on a consciousness that consumption can be lower). Also, benchmarking can be misleading—if a building scores in what is viewed as a satisfactory range, the building owner or manager can be discouraged from looking deeper and substantial potentially cost-effective actions may not be pursued. To motivate further investigation into what may be cost-effective for the individual building, referrals to energy audit programs should be made. This would be followed by appropriate actions to address the problems and opportunities found in the audit. Retro-commissioning should then be undertaken

to ensure that the upgrades have been successfully accomplished. Benchmarking is viewed as the first step in a process of further investigation and action. Employing auditors, contractors and commissioning agents should direct owners to a comprehensive solution to improve their benchmarking score.

- *Energy efficiency marketing information*. With benchmarking, the user of the benchmarking tool would be provided with effective marketing information to encourage further investigation and action to achieve energy efficiency in the building. This information would include information regarding the likely benefits of particular measures, avenues to further investigation/action, and identification of additional sources of incentives or information regarding specific actions. The provision of this information is an integral part of an overall benchmarking program.
- *Periodic benchmarking*. The benchmarking tool will be designed to encourage repeated uses of the tool to track the progress of improvement in the energy efficiency of the building. The benchmarking tool will be designed to facilitate and guide this periodic benchmarking based on updated information about the building's energy consumption, operating practices and energy efficiency features.

Affected Groups

On the basis of interviews and panel discussions with expert industry observers, as well as a review of the literature concerning commercial buildings and general supply chain dynamics, the following key groups have been identified in the area of commercial building benchmarking.

- *Building owner.* Commercial buildings are owned and operated through a wide variety of arrangements. Small buildings may be owned and managed by a sole owner. Management may be done by a specialized firm for a portfolio of buildings having different owners. The very largest owners tend to be real estate investment trusts (REITs), pension funds, and insurance companies, although there are some notable large private commercial real estate owners.

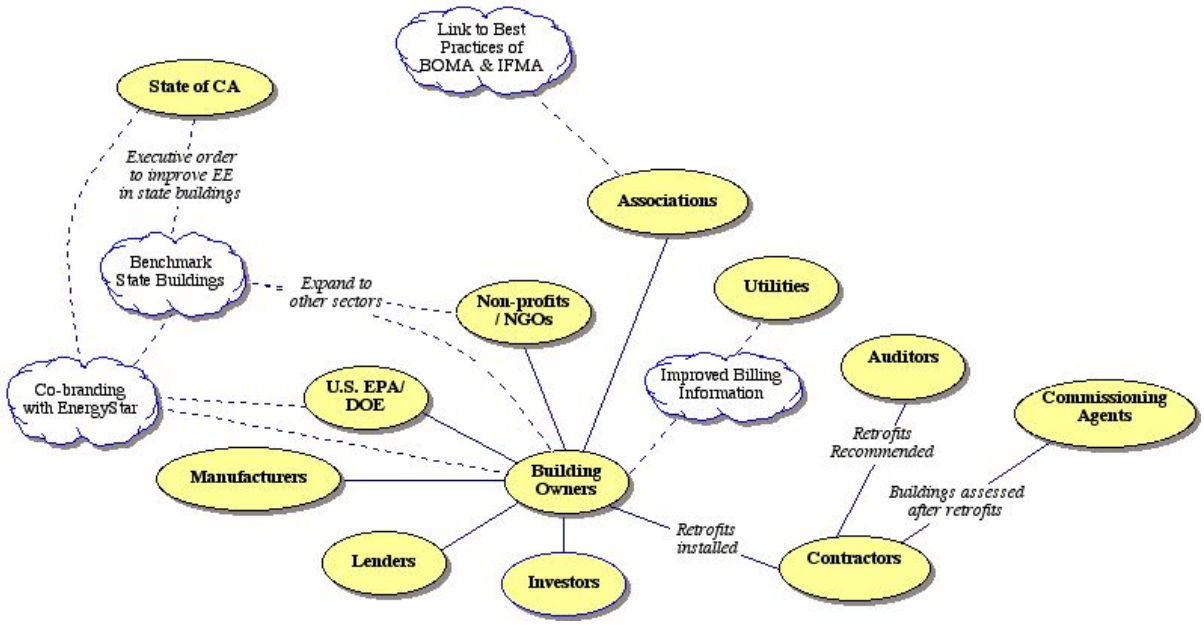
  Arrangements for maintenance, improvement and operation of the physical properties is also highly varied. These range from no onsite presence (with HVAC contractors and other trades called in when a tenant reports a system failure), to a large staff both on- and off-site that may include building operators, technicians, licensed engineers and energy specialists.

  For most building owner/operations types, however, there seems to be a lack of objective and credible ways to assess the energy performance of their buildings. As one observer noted, owners who are informed by contractors or energy services companies (ESCOs) of efficiency potentials quite reasonably ask "Is what they're telling me real?"
- *Investors.* In publicly traded companies and pension funds, ownership is diffuse, but not necessarily irrelevant to the problem of building energy performance.

Observers noted that investors can have real leverage over decisions, whether these investor are large stockholders, or the analysts that write the reports that the stockholders use in making decisions.

- *Lenders.* In cases where borrowed capital is used to finance building purchase or renovation, lenders review the detailed return on investment (ROI) calculations, including energy cost estimates and plans for the allocation of those costs.
- *Manufacturers.* Manufacturers provide equipment for space conditioning, lighting, controls, and production processes for use in new and renovated commercial buildings. Performance claims for equipment and systems are made and competitive advantage is sought.
- *Auditors.* Auditors act to identify ways to improve benchmarking results.
- *Contractors.* Contractors incorporate retrofits to address issues identified in the audit.
- *Commissioning agents.* Commissioning agents assess the building situation after retrofits to determine whether upgrades have been made successfully
- *Nonprofits/NGOs.* Nonprofit and nongovernmental organizations promote energy conservation, green buildings, greenhouse gas reduction, and "social choice" and "environmentally preferable" investing, focus attention on both high-performing and poorly performing firms, including the use of energy in their buildings. They also contribute to overall environmental awareness and demands from customers, clients and employees.
- *State of California*. The State of California supports research and development on benchmarking and commercial building technologies that have improved energy performance characteristics, e.g., through the Energy Commission Public Interest Energy Research (PIER) program. Plays a role as objective third-party actor that, as one observer put it, can "package things up and weed through the claims. Government folks are the objective credible screen on all of this."
- *U.S. EPA/DOE.* The U.S. EPA/DOE operates a building benchmarking system through the ENERGY STAR commercial buildings program.
- *Utilities.* Utilities have multiple points of interaction with building owners and operators, through account representatives, efficiency programs, and high level executive contacts. Although, as businesses, the motives of utilities are often closely examined by customers, they are also a familiar source of financial incentives for efficiency improvement.

The actor network diagram for this initiative is shown in Figure 12.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 12. Actor Network Diagram for Commercial Benchmarking

Market Conditions

Benchmarking is a key element of the Green Building Initiative and the Energy Commission PIER programs. Given this level of support, benchmarking will likely be implemented within California. The nature of the benchmarking program interface with the customer and the links to other programs under the GBI have not been established.

The commercial building leasing market can have an effect on benchmarking. In a "buyers/renters" market tenants will look to buildings that are comfortable and energy efficient. Benchmarking and the logical implementation steps previously outlined can uncover issues that should provide these qualities and result in a better, more rentable building.

Key Barriers

The key barriers associated with the success of this initiative include:

- *Lack of awareness of relative building performance.* Building owners and managers may not have any idea on how well their building is performing from an energy consumption standpoint. Without some awareness of whether or not the building is a good performer there may not be much incentive to take action.

- *Lack of detail in billing information.* Billing data may show a comparison of the energy consumption from one year to the next, but does not tell the customer if the building is efficient.
- *Information alone does not spur action.* Even with an awareness of the relative energy performance of a building, many owners and managers do not have much of an idea about what to do next. A lack of information about efficiency options and their benefits is a barrier
- *Lack of organizational commitment to energy management.* Energy benchmarking data along with programs to improve efficiency may not spur action within organizations for which energy efficiency is not an important consideration. The best possible programs need an organizational commitment to be effective.
- *Lack of a standard metric for comparison.* The CalArch and EPA ENERGY STAR tools use different metrics of comparison. The EPA has a simple numerical score, while the Cal Arch tool places buildings within a range of comparison (upper quartile, low quartile et cetera). The EPA scoring algorithms also change over time. This lack of consistency may cause confusion in the marketplace.
- *Nonuniformity in benchmark definition.* Benchmarking is a generic term that has been implemented in different ways by the different tools available in the marketplace. This is also a source of confusion in the marketplace.
- *Mismatch between person receiving the bill and the decision maker.* Benchmarking data delivered through the paper utility bill may not be seen by the appropriate decision maker, since these are generally sent to the accounting department for payment and are not seen by the building manager or owner. Even if the billing data reaches a knowledgeable person, a poor benchmarking score may be hidden from upper management by the energy manager.
- *Utility investment in paper billing systems.* Utilities have a large investment in current paper billing systems. Any changes to billing format or content will need to overcome institutional momentum.
- *Lack of building characteristics data in utility customer information systems.* For benchmarking scores to be meaningful, some customer specific data such as building type, operating hours, square footage, and businesses type is necessary. These data, when they exist, may not be updated.
- *Need for follow-up.* Benchmarking and energy consumption tracking are ongoing activities requiring ongoing attention by the customer or a service provider. Resources should be provided to make this practice business as usual. The buildings should be benchmarked periodically, at least semiannually. The initial benchmarking analysis will likely need some involvement from the building owner or manager to get the process started.
- *Lack of reasonable comparison group.* Certain unique building types may have no peers in the comparison group. Benchmarking of these buildings against other similar buildings may not be possible.

- *Time required to see response after taking action.* Once a building undergoes an upgrade, it may take some time for the results of the upgrade to be evident in the utility bills. This may frustrate customers who want more immediate feed back after they make an investment in building improvements.
- *Brand recognition and momentum of ENERGY STAR.* The ENERGY STAR brand and the current ENERGY STAR benchmarking system has significant recognition and momentum in the market. California buildings score fairly well in the ENERGY STAR system compared to buildings around the country. Property owners and managers that currently use ENERGY STAR to market their properties may resist attempts to make a more stringent California benchmarking tool.
- *Program funding constraints.* Utilities are currently funding efficiency programs out of PGC and resource procurement funds. If the utilities are required to implement benchmarking on a large scale without additional resources this will shift funds away from existing programs.

Strategies for Overcoming Key Barriers

Strategies to overcome these barriers include:

- *Progress tracking.* The executive order issued by the governor's office requires efficiency improvements in state buildings. Benchmarking of existing state buildings can serve as a means to track progress in meeting this order. Beyond buildings that house state government functions, several state pension funds such as CALSTRS own significant real estate investment property. A state directive to begin to benchmark these buildings and track consumption could bring a significant number of buildings into the system.
- *Goal setting.* Beyond the executive order covering state buildings, other organizations or municipalities may create similar goals for improving energy efficiency. As these organizations make these commitments, baselining can be an effective way to track progress against these goals.
- *Program participation requirement.* Utility efficiency programs provide incentives for energy improvements at various points along the lifetime of a building. As these improvements are made, benchmarking and tracking of utility bills within the system could be a requirement of program participation.
- *Work with ENERGY STAR.* Work with ENERGY STAR to improve tool for California, or co brand a California specific tool. ENERGY STAR is a powerful brand with recognition and a track record in California. Creating a new benchmarking system and brand could be counterproductive. A California tool should be created in cooperation with the EPA and use the ENERGY STAR name if possible.
- *Link to best practices.* Work with the Building Owners and Managers Association (BOMA) and the International Facilities Management Association (IFMA) to get

benchmarking listed as a best practice for building property management. Enlisting these powerful trade organizations can be very helpful in promoting the benchmarking concept.

Retro-commissioning

Sector:	*Trigger Event:*	*Intervention Type:*
Commercial	Benchmarking referral	Voluntary

This initiative focus on services that can be offered in the market to correct faults in building systems operations and helps keep systems operating at their peak efficiency. The objective of this initiative is to place retro-commissioning services as well as tune-up and operations and maintenance (O&M) services into the market at key trigger points and on an ongoing basis to maintain building system performance and reduce energy consumption. Likewise individual equipment assessments that emphasize planned cost-effective replacements over “replace on failure” strategies may offer advantages for California’s energy markets especially if these initiatives are coordinated with applicable rebate programs.

The retro-commissioning process is recognized as one of the more cost-effective strategies available for improving the efficiency of existing commercial buildings. Retro-commissioning programs are often seen in the context of an ongoing or periodic relationship with a customer rather than a one-time short-term interaction. Generally, the retro-commissioning process as envisioned in this intervention consists of activities that flow naturally from benchmarking and energy audits that result primarily in low cost upgrades to building operations and control strategies and replacement of failed components. Subsequent steps may involve larger capital improvements and equipment replacement, some of which may qualify for efficiency program rebates. Ultimately, this may lead to retrofits of the building lighting and envelope along with HVAC improvements. O&M is certainly an ongoing process. Maintenance ensures equipment is capable of delivering savings; operations makes sure savings are delivered once maintenance is done. Retro-commissioning itself is the existing building corollary to commissioning for new buildings. Retro-commissioning involves assessing existing building performance and equipment, often after a major remodel or retrofit or operational enhancement, The efforts herein stress low-cost operational upgrades as the area where the most cost-effective improvements can be made. This however does not mean that equipment upgrades should be ignored once the most cost-effective operational measures have been implemented. Elements of a retro-commissioning intervention should include:

- *Case studies relevant to commercial building business environment.* The commissioning literature contains case studies that document the costs and benefits of building commissioning. Most of this literature studies commissioning of government or institutional buildings. Commercial building owners and

property managers operate in an environment that is much different from the government or institutional environment. Case studies about commissioning in a commercial building context should be developed that are relevant to commercial building decision makers.

- *Develop infrastructure to provide commissioning services.* Developing infrastructure is an important requirement for any commissioning intervention. There are currently relatively few high level commissioning service providers. Developing the skills and expertise of commissioning service providers is a key element.
- *Create demand through incentives and/or tax credits.* Although the energy savings potential for commissioning is strong, the market demand for these services is weak. Building managers and occupants for the most part get along fine working in poorly performing buildings and do not see the need for the service. Financial incentives in the form of rebates or tax credits may be needed to stimulate interest in the market.
- *Investigate risk issues and highlight case studies in the context of risk management.* Risk management is an important operating principle for many companies. Casting commissioning as a risk management tool rather than strictly an energy savings tool may provide traction for the service in the commercial building owner and manager community. Retro-commissioning of buildings helps control risk from volatile energy costs as well as loss of tenants due to comfort issues and risks of litigation stemming from indoor air quality problems.
- *Screen customers for retro-commissioning potential.* Not every customer is a good prospect for retro-commissioning; the buildings must have a good combination of technical potential and a management structure that is willing to examine the issue and make decisions. Very old buildings with systems that are near the end of their service life may not make good candidates for operational upgrades. It may not be worth spending money fixing a system that will need to be replaced soon. In that case it might be worth considering equipment system upgrades as part of the building improvement program.

Affected Groups

On the basis of interviews and panel discussions with expert industry observers, as well as a review of the literature concerning commercial buildings and general supply chain dynamics, the following key groups have been identified in the areas of building commissioning, tune-ups and operations and maintenance.

- *Associations.* Industry associations involved include those representing: the design professions (architecture, interiors), building operations and maintenance, building owners and operators (e.g., BOMA), facilities managers (IFMA), O&M and facilities publications, and real estate organizations. The work of the US Green Building Council on LEED for existing buildings is particularly relevant. Trade organizations representing commissioning service providers include the

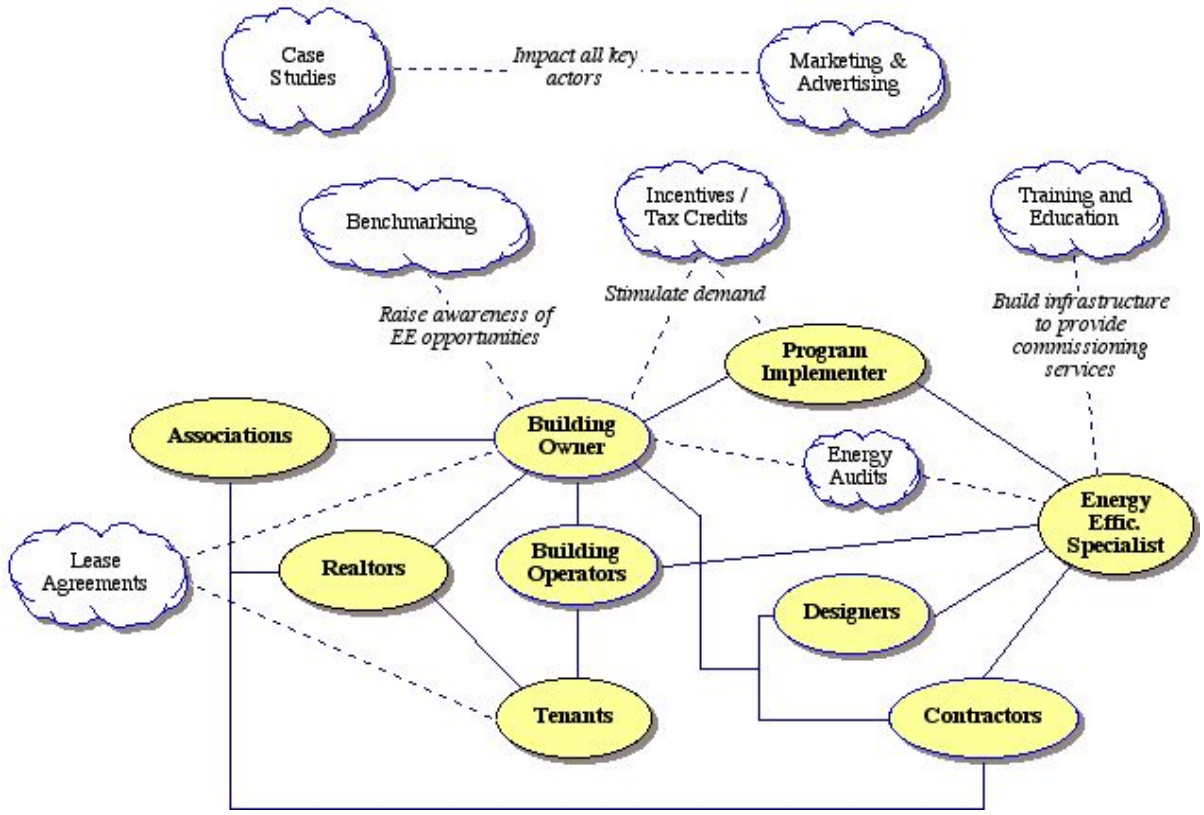
California Commissioning Collaborative and the Building Commissioning Association. The tenant is often left out, since their trade organizations are oriented to their core businesses, and not to their workspace considerations.

- *Building operators.* These actors are highly variable in terms of skills and training (and access to training). Building operators are particularly interested in efficient energy use to the degree that they have responsibility for the energy costs for a building. Some have considerable energy efficiency experience and training.
- *Building owners.* Again, lack of information and questions about the reliability of expert advice is endemic. When told "your building isn't fine like you thought it was," that assessment is not always believed, nor is it always clear what to do if it is believed. For commissioning and routine tune-ups and O&M, the size of the building and ownership structure may be highly correlated with energy performance—smaller buildings and smaller ownership being the most likely to under-perform.
- *Contractors.* HVAC contractors, commissioning agents, lighting specialists, and general contractors are all potentially involved in routine replacement and upgrade of equipment and systems.
- *Designers.* Where tenant improvements and major renovations are involved, designers are also likely participants.
- *Energy efficiency service providers.* Specialized property managers, ESCOs, manufacturer's representatives, retailers, are included in this category. They may be doing the testing and providing the recommendations and making the changes, or just providing parts of that continuum of services. A newly emerging group is the "systems integrator"—a specialist that can look at buildings from the system perspective.
- *Program implementers.* Current program implementers are in contact with building owners and operators, targeting decision-makers, supplying information, and recruiting businesses (and public sector properties) in terms of their degree of readiness to participate.
- *Real estate agents.* Commercial real estate brokers are sources of information about properties and are involved in facilitating some landlord/tenant lease arrangements.
- *Tenants/occupants.* Most are not in the business of running their buildings. They simply lease space and focus on their core business activities. It was noted that they are concerned that their space be up to par with peers and competitors (at least in visual terms). Unless they have significant energy costs as part of their lease (and few do) and/or their space costs are a significant part of their overall expenses (very rare), they have little reason to be concerned about energy consumption or efficiency.

  In addition, problems for tenants can arise in the disruption caused during the installation phase of efficiency measures or in the operations of the actual measure itself. At the same time, tenant concerns for employee and client values (e.g., related to environment and waste of natural resources) can motivate a greater level of everyday concern. Also, there is some recognition of the benefits

to productivity and employee welfare of some efficiency alternatives. . As the building occupant the tenant (and the customer) are important market actors, and can be influenced to rent a space, or patronize a business in a space, that provides comfort and services and reasonable prices—all factors that can be enhanced by an effective retro-commissioning program. Tenant firms and other building occupants have to be aware of efficiency measures in order not to use systems in such a way as to defeat their energy benefits

The actor network diagram for this initiative is shown in Figure 13.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 13. Actor Network Diagram for Retro-commissioning

Market Conditions

Market conditions that affect the success of this initiative include:

- *Green Building Initiative.* Executive Order S 20-04 requires the Energy Commission to propose building commissioning guidelines to increase energy

efficiency in government and private commercial buildings by July, 2005. This executive order will increase the visibility and interest in retro-commissioning of existing buildings.

- *Energy prices.* Energy price trends and the implementation of time of use electric rates are two market factors that could stimulate interest in energy efficiency among commercial property owners and managers.
- *Program availability.* Retro-commissioning services may require financial incentives to gain a strong footing in the market. Retro-commissioning programs are a small component of the current portfolio of efficiency programs in California.
- *Capacity to provide services.* The availability of trained commissioning agents and contractors is a critical factor affecting how broadly this initiative can be implemented.
- *Real estate market.* Retro-commissioning can positively differentiate a building as providing lower energy costs and better comfort and productivity for its prospective tenants

Key Barriers

Key barriers associated with this initiative include:

- *Lack of awareness of equipment condition.* Nonresidential energy equipment maintenance and degradation is often ignored after installation unless there is a breakdown causing equipment to stop running.
- *Lack of understanding about implications of poor maintenance.* There is a general lack of understanding about the impact of poor maintenance practices on equipment efficiency. This barrier is especially true for smaller businesses that do not have system maintenance staff or who do not employ knowledgeable contractors to maintain their systems.
- *Insufficient documentation.* Buildings are often turned over to new owners with a lack of documentation on the design intent of the systems, the intended operation of the control system and the maintenance requirements of the equipment.
- *Lack of training.* Building operators are rarely trained on how to operate the systems they inherit. Training materials are often lacking.
- *Lack of feedback on building performance.* Energy bills may not be available to the people making day to day decisions on how to operate a building. The only feedback that an operator may get is comfort complaints; thus decisions are made principally to minimize these complaints.
- *Lack of consistency in building O&M.* O&M practices vary widely within companies that occupy or operate commercial buildings. Lack of maintenance causes equipment to degrade with attendant loss in efficiency.

- *Operator skill levels.* Operators are tradesmen, but often need professional level skills. Building maintenance and operations are becoming more and more sophisticated, however building operators generally come from a trades background. Operators need more professional level skills in areas such as electronics, control system programming, energy engineering, and electrical troubleshooting.
- *Split incentives between renters and owners.* Like many investments that are intended to reduce energy consumption, a split incentive may exist between the building owner and the occupants when the occupants are responsible for the utility costs. Building owners are reluctant to make investments in energy savings when these costs are not passed along to the tenants. Tenants may be unwilling to pay for investments in a building they do not own. Lease arrangements designed to share the costs and benefits of energy upgrades equitably between owners and tenants are needed to address this issue.
- *Lack of information, case studies.* Commercial building property managers are risk averse and are generally reluctant to try new things without some evidence that trusted peers in their industry have done so successfully. Positive experiences from relevant peers in their business are required to motivate property managers to innovate. Property owners and managers look to manage risk at a reasonable return, rather than maximize return.
- *Lack of awareness and urgency.* Although buildings seldom function optimally, most decisions makers are unaware of the problems or do not feel much urgency to correct a problem.
- *Consistency in marketplace.* Programs placed in the market need time to become established. Commissioning processes will take time to get established and the interaction with the customer may have a longer “learning curve” than with strictly hardware focused programs. Sustained efforts are needed. Short term efforts that come and go may cause more harm than good. .
- *Lack of quality commissioning agents.* Capacity in the marketplace for commissioning service providers is limited.
- *Profit model for HVAC service.* HVAC service companies are an important component of O&M programs. Capacity in the market for HVAC service companies is generally quite good, but the profit models of these businesses do not encourage quality maintenance services.

Strategies for Overcoming Key Barriers

Strategies planned under this intervention for overcoming these barriers include:

- *Training and education for building operators and commissioning agents.* There is a need to build capacity in the commissioning service provider market. Training materials and associated programs for building operators and independent commissioning agents need to be provided.

- *Benchmarking.* Wide spread use of benchmarking tools with appropriate marketing messages encouraging building owners and managers to have their buildings audited, upgraded and retro-commissioned will help to reduce the lack of awareness of the opportunity.
- *Lease agreements.* Tenants may be able to negotiate upgrade provisions into their lease agreements, obligating building owners and property managers to conduct a retro-commissioning process in their buildings on a periodic basis.
- *Case studies.* Case studies highlighting the costs and benefits of commissioning in the commercial marketplace should be developed and presented to key decision makers in a format that they can understand and use.
- *Incentives.* Depending on CPUC policy regarding support for retro-commissioning projects, the Energy Commission may need to address this issue directly with the Legislature.
- *Marketing and advertising.* Executive Order S 20-14 should raise the awareness of retro-commissioning opportunities in the marketplace. This message should be supported through additional marketing and advertising to commercial building owners and managers.

Commercial Leasing

Sector:	*Trigger Event:*	*Intervention Type:*
Commercial	New lease or lease renewal	Voluntary

This initiative focuses on pushing the market to incorporate energy efficiency improvement clauses into commercial leasing contracts as one of the primary contractual leasing approaches[4]. The split incentives that exist in commercial lease agreements where the tenants are responsible for the energy costs are a barrier to efficiency program participation. This effort would include the development of a standard set of energy efficient leasing agreements that could apply to a wide range of business types, and promotional efforts to place these agreements into the market in a way that moves the market toward these lease structures as an accepted and standard procedure. Leases are generally characterized as:

- *Gross leases.* The owner pays energy and other building operating and maintenance costs. The owner pays for and reaps the benefits of energy efficiency upgrades to the building. The benefits include improved profitability and net operating income, along with increased property valuation. The owner has no control of the tenant's energy consumption, and is at risk if the tenants operate their space in a manner that causes excess energy consumption.

[4] Cliff Majersik of the Institute for Market Transformation had major input into this section.

- *Net leases.* The tenant pays the energy and other operating costs. This places the owner in the position of the least risk, since the tenants pay the consequences of their energy behavior. The owner however gives up the opportunity for reaping the benefits of efficiency upgrades.
- *Fixed base lease.* Existing model leases contain provisions that encourage building owners to make investments in building upgrades and recover these costs from their tenants. The fixed base lease is an arrangement where the owner pays expenses up to certain fixed amount, and the tenant pays any remaining costs. This provides the incentive for the owner to make efficiency upgrades, while limiting the risk if the tenants cause excessive energy consumption. A tenant cost recovery clause attached to net leases allows the owner to recover the costs of the improvements from the tenant energy savings with no net increase in the tenant cost. It is a matter of making these arrangements known to the parties involved in the commercial leasing transaction and educating owners and tenants in general about the benefits of energy efficient buildings.

Nonresidential remodeling and renovation is an important opportunity for making energy efficiency upgrades. According to a recent study, in the first half of the 1990s, nearly 25 percent of all construction dollars went for alterations and another 20 percent for additions. The study projected that by 2010 the market for work on existing buildings will be even larger than it will be for new construction. The primary driver for remodeling and renovation is a change of tenant, or a tenant changing their operations. Most commercial remodeling and renovation is completed in buildings occupied by firms leasing space. Working with leasing agents who specialize in commercial lease space may help implementers to identify space that is coming into the market in sufficient time to promote energy efficiency when subsequent changes to space are being made. An important consideration is the understanding of when leases are about to expire, so that new lease arrangements can be negotiated and efficiency upgrades can be planned.

The elements of this intervention are as follows;

- Use existing model leases, such as the BOMA model lease as a model for best leasing practices. The BOMA model lease has suggestions for clauses that encourage building owners to upgrade the energy efficiency of their properties. Use a fixed base lease arrangement for allocating utility costs. Incorporate these provisions into a standard lease template.
- Place content on the advantages of energy efficient buildings and the existence of model lease clauses into continuing education classes required by the applicable state licensing boards for real estate agents, lawyers, property managers and appraisers. Make the energy efficiency modules one of the mandatory classes.
- Market the advantages of energy efficiency buildings and lease arrangement that encourage investments in efficiency to real estate agents, who are in a position to influence the tenant on property selection and lease terms.

- Use partner networks, such as ENERGY STAR and LEED to educate building owners about model lease provisions that encourage investments in energy efficiency.
- Include a provision into the lease that the building owner or manager should have the building benchmarked at least twice per year, and the benchmarking data shall be reported to the tenants. By engaging in the building benchmarking intervention, the building owner will be exposed to a broad range of services through the benchmarking "portal," where information on retro-commissioning services and building audits will be available.

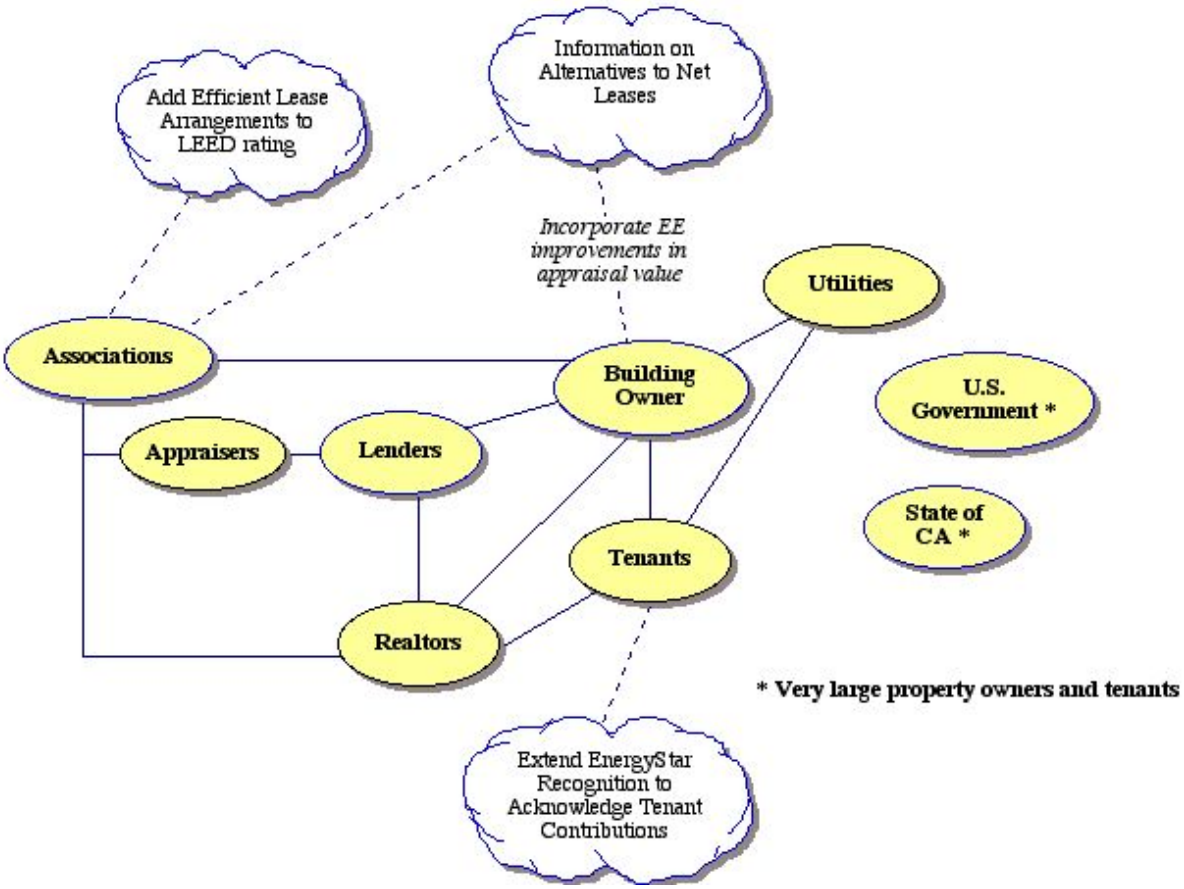
Affected Groups

On the basis of interviews and panel discussions with expert industry observers, as well as a review of the literature concerning commercial buildings and general supply chain dynamics, the following key groups have been identified in the area of energy efficient commercial leasing.

- *Appraisers.* Appraisers play a key role when borrowed capital is used to finance significant tenant improvements or extensive renovations that will attract and benefit long-term tenants. One observer noted that the appraiser "holds the keys to letting the improvement project go forward."
- *Associations.* The Building Owners and Managers Association (BOMA), with local chapters in large cities, works to advance industry best practices, including "model leases" for use by members and nonmembers.
- *Building owners.* The building owner is the "distributor of the energy to the building." Owners and/or property managers typically propose the lease, and they are the parties most interested in buildings and energy use. One large owner noted that "We do what we can by prohibiting electric heaters in their space, et cetera. They [tenants] get a set amount of power for their space, and if they exceed it they have to pay their fair share." However, cases where energy costs are either completely passed along to tenants, where energy sales by owners to tenants represent a profit center (and disincentive to promote efficiency), and where energy costs are invisibly bundled into "common area" expenses, are also prevalent. The practices of large property owners (e.g., REITs and others) are used as role models by other smaller property owners and managers.
- *Lenders.* Lenders use appraisal information and business plans to assess the likely ROI for the project, the creditworthiness of the borrower, the loan rate and repayment terms. Also "holds the keys."
- *Real estate agents.* In some cases, real estate agents can influence the adoption of the lease by the prospective tenant. Provides information on competitive market conditions for leased space to owners and property managers that influences leases offered, including price and terms.

- *State of California.* The State of California is a very large owner and tenant of commercial real estate.
- *Tenants.* Tenants are most interested in their core businesses. However, they also are the primary consumers of energy in commercial buildings. Observers noted some instances of shared savings arrangements between owners and tenants when energy efficiency improvements have been adopted. In these cases, tenants have been "willing to participate because they are looking to save money too." On the other hand, there seems to be a very widespread lack of tenant awareness (let alone detailed knowledge) of energy issues and energy efficiency potential and benefits. One observer pointed to "ignorance of energy costs as a number one operating expense." Another identified "ignorance of lease terms" as a more basic problem that is quite common among tenants. At the same time, there is in some quarters a "…desire of business owners to tell their employees they're doing the right thing and are being green." Also, there is some awareness of non-energy benefits related to worker productivity and reduced absenteeism.
- *U. S. Government.* The federal government is another very large owner and tenant of commercial real estate.
- *Utilities.* Utilities have multiple points of contact with large property-owning customers. Observers note that utility and user/owner interests may not coincide. An example given was utility interest in peak demand reduction, which almost always comes at peak business times of day for commercial property owners and tenants. Also, another noted that "anyone that has some experience with utility programs will be skeptical that participation is going to require too much paperwork, that the program won't stick around, and that rebates will never get processed."

The actor network diagram for this initiative is shown in Figure 14.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 14. Actor Network Diagram for Commercial Leasing

Market Conditions

Market conditions that affect the success of this initiative include:

- *Energy prices.* Energy price trends and the implementation of time of use electric rates are two market factors that could stimulate interest in energy efficiency among commercial property owners and managers.
- *Vacancy rates.* Competitiveness in the market for commercial building space will affect the ability of tenants to negotiate specific terms and conditions in the lease agreement.

Key Barriers

Key barriers that affect the success of the initiate include:

- *Tenant lack of knowledge.* In general, tenants lack knowledge of lease provisions, what is a fair lease, and how energy costs are allocated. Tenants tend to rely on their real estate agent to advise them on lease terms.
- *Lease writer lack of knowledge.* Leases are generally written by real estate lawyers that do not have ongoing interactions with landlord or tenant and do not understand the dynamics of energy use within the various tenants in the building
- *Property tax concern.* Property owners have a concern that efficiency improvements will cause property taxes to go up.
- *ENERGY STAR focus on building owners.* Tenants who participate in the process of efficiency upgrades should be able to gain recognition for their contributions. Currently, the ENERGY STAR designation is provided to the building owner. Acknowledgement of the tenant contributions and duplicate recognition materials such as certificates, plaques, and building registry should be provided.

Strategies for Overcoming Key Barriers

Strategies to overcome these barriers include:

- *Encourage owners to move away from net leases.* Net lease energy costs do not show on building owner balance sheet, so it is hard to incorporate the improvements in net operating income from energy efficiency in the building appraisal value. Convince owners that it is in their best interest to move to a different lease arrangement through marketing and training.
- *Incorporate leasing provisions into LEED.* Increase the penetration of efficient lease arrangements by making these a component of rating systems such as LEED. It may not be practical to modify leases for all tenants during the building application process, but the rating requirements could offer optional credits for using this type of lease in newly leased space.

Demand Response

Sector:	*Trigger Event:*	*Intervention Type:*
Residential and Commercial	Utility service connection.	Both voluntary and mandatory

Deregulation of the electricity market has been accompanied by numerous problems including generation shortages, transmission congestion, and wholesale price volatility. The 2001 California energy crisis was, in part, a result of deregulation that allowed for market manipulation that inevitably lowered available generation capacity resulting in increased wholesale prices and reduced system reliability.

Following the 2001 energy crisis, demand response in California has become an increasingly important policy and program initiative. Demand response refers to customer-side actions taken to reduce facility usage and demand in response to signals or rates or other means provided by the serving utility. Demand response can act to reduce and/or shift load from the electrical grid during periods of electrical system instability, and prevent a consequent breakdown of the electric system. The CPUC and the Energy Commission are currently developing a real-time demand-side infrastructure to respond to supply-side problems and prevent further blackouts in California. We believe that policy initiatives should be put forth to expedite this process.

There are two parts to demand response, first a signal must be issued that demand response is needed, and second, there must be “technology” in place to respond to the signal. The consensus within the demand response arena is for this signal to be the price of electricity, and that consumers should be permitted to act accordingly. The options to reduce energy use or correspondingly, demand, may be a number of things ranging from people manually turning off their air conditioners and clothes dryers to use of thermal storage technologies as well as automated demand response technologies for larger buildings. Large potential demand reductions seem to be likely by using automated demand response to activate enabling technologies that reduce end-use energy consumption in conjunction with demand response pricing signals. Dynamic pricing rates (real-time pricing or RTP) offer consumers the incentive to shift load, especially during peak emergency times when the price can several times higher than standard rates.

The dynamic nature of pricing in a real-time market will cause concern among consumers who are unwilling to adapt to dynamic rates. The unwillingness stems from a number of sources including a lack of education, as many consumers are afraid they will end up paying more for energy bills, although surveys have shown that the average bill actually falls. Lack of operational flexibility is a real issue of significance for many commercial establishments. Furthermore, for larger corporations, proper hedging options to buy electricity ahead of time may mitigate potential problems and help those businesses that are unable to curtail electricity demand during peak hours. Helping businesses and residents understand the options available to them to permit normal functioning while helping to reduce electrical demand is a service that should be facilitated by this initiative.

Demand response programs may be grouped into two broad categories: reliability-based and market-based. Reliability-based programs are triggered during emergency conditions when the stability of the electrical system is in threat. Market-based programs are triggered by wholesale electric prices and offer incentives

during general market conditions. The ideal situation is to use both programs in tandem, using market-based programs as a tier one program in which all consumers (including businesses) are enrolled, and reliability-based programs as a second tier in which as many consumers as possible are voluntarily enrolled. Eventually, it should be the goal of California to have all consumers enrolled in both programs where applicable. The following are examples of reliability-based and market-based demand response programs taken from the paper published by Heffner

Reliability-Based Demand Response Programs

For reliability-based demand response programs, customers have no override capability; that is, there is already a preset amount of reductions that will take place at their facility and these reductions are tripped with a specific signal. This method is more expensive to implement, and many customers do not like it because they are not in control of the load reduction. However, it is also the mandatory element is a key feature of reliability-based demand response. The reduction controls are fixed and the customer must give up the power. Only a few customers are in a position to agree to this type of structure, and it is therefore hard to recruit customers for reliability-based demand response programs described. Savings can be impressive, as programs that have used this approach have reported:

- Record setting peaks occurred throughout New England and the Mid-Atlantic regions during the week of August 7, 2004. The Contingency programs of the New York Independent System Operator (NYISO), PJM Interconnection (PJM), ISO-New England (ISO-NE), and Baltimore Gas and Electric (BG&E) were all operated during this period, providing critical relief to the strained grid. The NYISO Emergency Demand Response Program (EDRP) provided an average demand response of 425 MW on four occasions, equivalent to approximately 25 percent of the total system reserve requirement. An analysis of the program impact estimates that, for a single hour during this period, the EDRP likely provided reliability benefits of between $870,000 and $3,484,000. The program is estimated to have resulted in an additional $16.8 million dollars in collateral benefits, associated with reductions in electricity prices and volatility, over the duration of the summer.
- The big surprise was California, with only one contingency event throughout the entire summer, despite the North American Electric Reliability Council's (NERC) prediction of more than 260 hours of rolling blackouts. A major contributing factor was the extensive level of peak demand reduction (on the order of 10 percent) resulting from a combination of energy efficiency and demand response programs, voluntary initiatives, increases in electricity rates, and widespread media attention on the state's electricity crisis. On the single curtailment day, approximately 800 MW was curtailed, the majority of which is attributable to the interruptible and direct load control programs of Southern California Edison.
- Xcel's Electric Reduction Savings Program (U1) also operated quite frequently in the Summer of 2001, with 20 events. However, the program was not generally

operated in response to explicit reliability conditions (e.g., generation shortages or transmission constraints), but was, instead, operated so that Xcel could avoid exceeding Mid-Continent Area Power Pool (MAPP) authorization levels and paying the associated fines.

Market-Based Demand Response Programs

Market-based demand response programs are also known as price response programs. The single most important factor for market-based programs is the belief that price change or benefit is real. Most programs need some sort of automated response to take full advantage of the price changes. There also needs to be some sort of forecast with enough notice to allow customers without automated devices to take some action. Price forecasts may occur a day ahead and still provide a more accurate real-time pricing scheme. Benefits also need to be known to the customer, and if such programs are implemented, customers should receive some sort of validated savings report. Some examples are:

- In the Pacific Northwest, several day-of and day-ahead bidding programs had high activity levels during the Winter and Spring of 2001, driven by high wholesale electricity prices. However, in the Summer of 2001, there was a dramatic drop-off in demand response program activity, apparently driven largely by the impacts of Federal Energy Regulatory Commission (FERC) price mitigation measures. Many programs base the incentive for participants on roughly a 50/50 sharing of the avoided wholesale purchase cost. With the soft price cap of approximately $92/MWh, the incentive available for participants dropped down into the $40–50/MWh range, which is well below the level at which most end-users would be willing to bid in load. For example, the day-ahead bidding component to Portland General Electric's (PGE) Demand Buy Back Program (Q), which had been active up until that point, received no bids once the price caps were implemented. However, PG&E's program did provide curtailments on an almost daily basis during the summer through "term" events that had been procured before the drop in wholesale prices (i.e., demand buy-back initiatives). In California, participants submitted bids for the Demand Bidding Program regularly throughout the summer, but none were accepted by the California Department of Water Resources because prices remained below the minimum available bid price of $100/MWh.
- In the Midwest, program activity was low as a result of the soft wholesale electricity prices throughout the region. Wabash Valley Power Authority's Customer Payback Plan was originally offered with a $200/MWh strike price, but prices remained well below this level, and the strike price was dropped to $50/MWh.
- During the August 2004 heat wave on the East Coast, real time electricity prices reached $1000/MWh in both ISO-NE and NYISO markets, and more than $900/MWh in PJM's region. All three programs provided load relief during these periods, although the level of load curtailment was generally small. The NYISO's

Day Ahead Demand Response Program (L1) was available for bidding on a continual basis and operated throughout the summer on 24 occasions.

Rate Structure

Rate structures have an important impact in the area of demand response by varying peak and off-peak rates to offer consumers an incentive to shift electric use from peak to off-peak hours. In order for the rate structure to be effective, consumers must be educated about the rate structure and be willing to respond accordingly. Currently, there are three typical rate structures that have been developed, time of use (TOU), critical peak pricing (CPP), and real-time pricing (RTP).

TOU rates typically breakdown the rate structure into three time blocks: peak, shoulder, and off-peak with peak at a higher rate and off-peak at a lower rate. The TOU rates are published in advance for an entire season, and cannot adapt to changing weather conditions and grid reliability issues in real-time. CPP occurs only one percent of real-time, and comes into effect a few days a year when energy is expensive or systems are critical or near critical to failure. RTP is the most dynamic solution for rate structure, and provides hourly real-time marginal cost of kWh. RTP is capable of responding to weather conditions, wholesale energy rates, and equipment failure. Both critical peak pricing and real-time pricing rates may use a day-ahead notification to allow consumers more response time. Furthermore, CPP may be used in conjunction with either TOU rates to offer stability of rates except during emergency periods.

Currently, the Energy Commission and the CPUC are jointly developing policy relating to rate structure. The vision is for CPP to become the default rate for residential, small commercial, and large customers (<200 kW to one MW) and RTP to become the default rate for very large customers (> 1MW). The shift to CPP and RTP would seek to prevent a breakdown in the electricity network. As mentioned earlier, consumers need to be educated on the potential financial benefits from a demand rate structure, as many are unwilling to take on the risk of having a higher energy bill.

Another consideration is that many consumers do not see price response as demand response, even though they are coupled together. There is also a need to develop demand response programs alongside demand response pricing to bring out its full effect. We believe that there should be movement for a mandatory demand response rate structure.

A study conducted by the Electricity Markets and Policy Group on RTP in New York showed that commercial customers are least responsive to demand response in connection with rate structure. Overall, government and institutions are the most responsive to real-time pricing.

Automated Demand Response Technologies

Technology advances enable the use of automated demand response programs by allowing buildings to automatically respond to changes in electric system reliability. The idea is that a control system such as an energy management system (EMS) or energy information system (EIS) can receive signals to shed load and can then execute an automated load shedding schedule/program that turns off or modulates building systems to achieve the desired load reduction. This information can be sent in numerous formats, including as price signals via RTP. The signal, in this example a price signal, would be sent from the utility to an EMS or EIS. The EMS or EIS will be able to read the price signal and perform a number of automated building functions such as reduce lighting power, increase thermostat setpoint temperatures, or reprogram chiller activity to perform at a later time. The automated demand response program would ensure that load shedding is occurring during an energy crisis in real-time, and would not be dependent on human involvement. Although there are currently technologies to support demand response programs, since this is a new field, more enabling technologies need to be developed to support this initiative so demand response may achieve its full potential of curtailing demand during times of crisis. Currently, automated demand response programs have been tested successfully in larger facilities. However, as technology improves and cost reductions occur in providing and operating automated devices, the scope for these programs should start to include smaller commercial facilities and residences.

Enabling Technologies Development

To take advantage of demand response pricing, enabling technologies must be developed. Some of the technologies are as follows:

- Interval meters with two-way communications capability which allows custom utility bills to reflect the customer's actual usage pattern rather than an "average" load profile for that customer class
- Multiple, user-friendly communication pathways to notify customers of load curtailment events
- Energy information tools that enable near-real-time access to interval load data, analyze load curtailment performance relative to baseline usage, and provide diagnostics to facility operators on potential loads to target for curtailment
- Demand reduction strategies that are optimized to meet differing high-price or electric system emergency scenarios
- Load controllers and building energy management control systems that are optimized for demand response, and which facilitate automation of load curtailment strategies at the end use level
- End-use equipment that can operate with reduced power and can therefore provide facility HVAC, water heating or other functions during the demand crisis. Storage technologies are well suited to "riding out" and emergency. How these

storage technologies can enhance a modern demand response program is an overlooked question that will receive attention in this initiative

- Onsite generation equipment used with appropriate interconnect devices and controls to meet the needs of the facility under the load curtailment conditions imposed on the facility

There are also several technologies that are currently being researched under the PIER program. These enabling technologies essentially receive a price signal and are able to adjust loads accordingly. For example, the temperature set point for a smart thermostat might vary as a function of the price signal.

Affected Groups

There are several interest groups that are vital to produce the results necessary for demand response in rate structure. The legislature must provide policy leadership and direction with support from the Energy Commission and the CPUC. After legislation is passed, the utilities must work with consumer groups and industry associations to develop and implement the appropriate rate structures. A key role for consumer groups and industry associations is to help educate residential and commercial customers, allowing them to overcome their fear of uncertainty.

Education is a key component of a successful demand response rate structure. However, there are differences between residential, small, and medium commercial customers and largest commercial and retail customers. The information required by the residential customers is educational in the sense that they need to understand the pricing structure and what demand response is. One way to achieve this is better information incorporated into the utility bill. It has been found that smaller utility customers generally do not understand the billing format, and just pay the bill. Larger customers usually understand the concept of demand response and the corresponding financial incentives, but require education on what actions to take and how to maximize the benefits. Technology vendors also need the sales volume and motivation to reduce the price of advanced meter products to allow for widespread adoption of demand response technology. Furthermore the California Independent System Operator (CA ISO) would need to coordinate with the utility and customer metering to send consistent, appropriate signals about real-time demand and system reliability. Key interest groups and their contributions are discussed below.

- *Associations.* Some key consumer watchdog groups and low income advocacy organizations have strong criticism of equity impacts of demand response.
- *CA ISO.* CA ISO is responsible for the electric system loads. They have the authority to recognize a variety of approaches to the management of those loads, including various forms of demand response.
- *Customers.* Both residential and commercial customers are likely unfamiliar with system capacity issues and demand response alternatives. Uptake on TOU rate offerings has been small. Participation in experimental TOU programs has been low (although consumers who did participate understood their bills better and

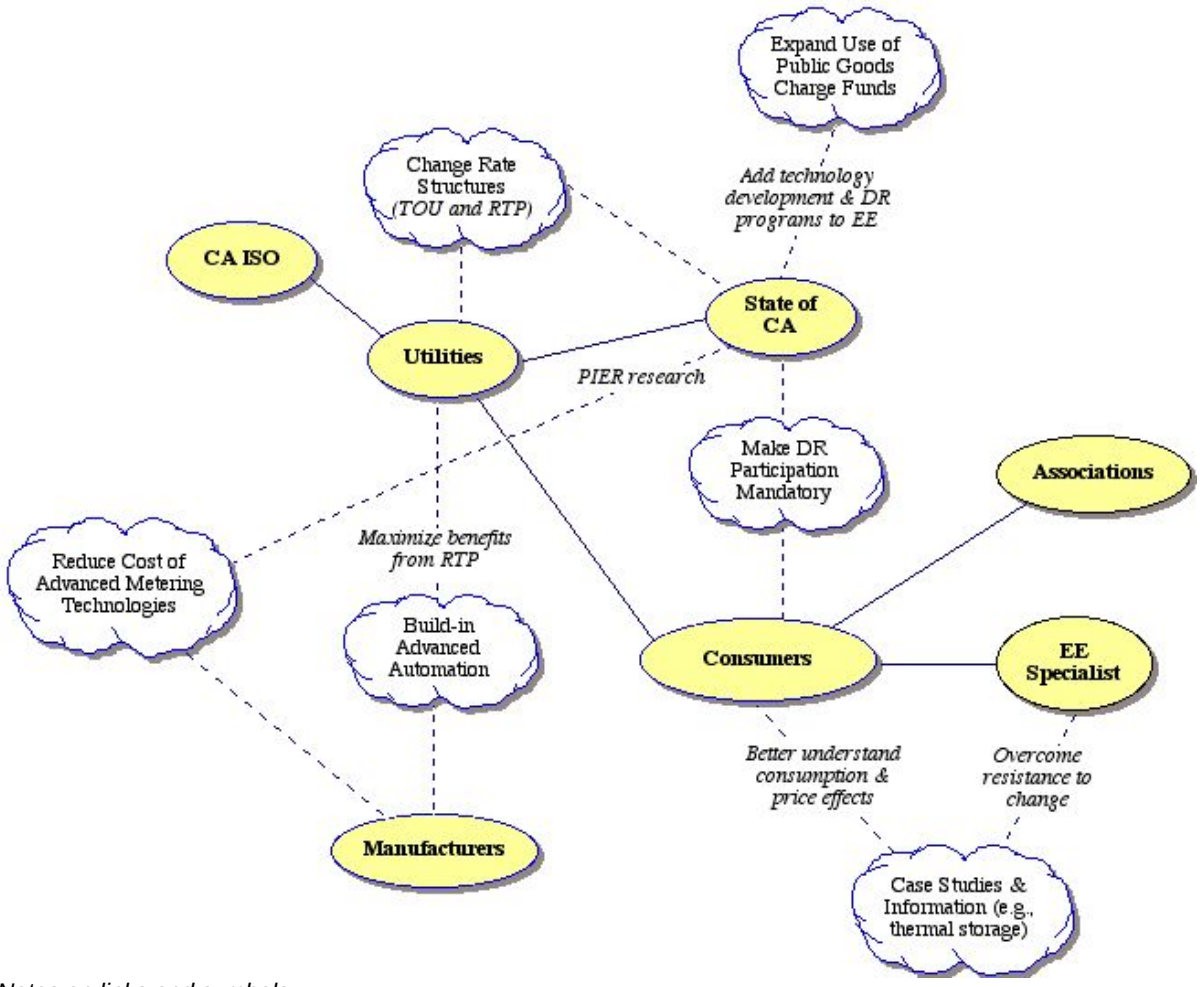
liked rates more than had been expected). As one observer noted: “It all comes down to cost for the customer. Many customers will find this to be a favorable change, but customers that cannot change their load will not like it. Those customers that are putting extra pressure on the system at peak times (i.e. those that will have higher bills as a result of the change) should probably be paying for it.” It is also the case that some consumers’ energy use patterns are already largely “off peak”, (.e.g. as a result of work schedules). In these cases, TOU tariffs would provide immediate rewards. In most cases, however, it is expected that behavior changes, hardware improvements, and new control systems would be adopted to cut on-peak loads at the household or firm level.

In terms of nonresidential consumers, it was noted that small commercial energy users may be unlikely to feel that turning down their air conditioning can make a significant difference. In addition, they have reasonable concerns about losing sales, producing lower quality products, increasing their energy costs, and being inconvenienced. However, there was also a sense among interviewees and panel members that there can be some significant benefits to small commercial customers from enhanced automation associated with demand response, and that there is a willingness in the sector to “do the right thing”, as long as their needs and circumstances are taken into account.

- *Energy efficiency service providers.* Energy raters, auditors, consulting engineers, HVAC contractors, and building control firms compose the limited existing technical assistance infrastructure for demand response.
- *Manufacturers.* Technology developers and vendors are offering an increasing number of metering, control, data acquisition, and analytic products and services to support demand response. Several observers noted the relatively high costs of installing some of the technology needed to fully implement demand response on a building, let alone on an enterprise scale.
- *State of California.* Evaluate and approve time-dependent tariffs through the CPUC. Conduct demand response experiments and demand response hardware research and development and policy analysis through the Energy Commission. While the relative role of the two agencies is fairly distinct and complementary, several observers expressed concern about coordination of policies and programs in the future. For example, one interviewee noted “I only worry about conflicting legislation or policies because they are throwing too many things on the table that are conflicting and confusing to everyone.”
- *Utilities.* They implement time-dependent rate structures and provide interval metering and billing services. Utility demand response initiatives and rates are negotiated with the CPUC. Over the past two decades, California utilities have implemented a variety of load-shedding, load-shifting, remote load-control programs, and time-of-use rate tariffs. They have also experimented with demand markets and smart control technologies. There are good reasons for this. As one observer noted, “the utility is the one that is avoiding the cost that your load creates”. Within the utility, a variety of individuals are involved in demand response, including resources acquisition, transmission, dispatch, key accounts management, and energy efficiency units. Utilities also maintain a

variety of communications channels with customers of various sizes and load profiles.

The actor network diagram for this initiative is shown in Figure 15.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 15. Actor Network Diagram for Demand Response

Market Conditions

The market conditions affecting the success of this initiative are listed below:

- *California electricity market.* California's short-term success (or lack thereof) in managing peak electrical demand and obtaining sufficient electrical supply is the primary factor affecting the potential success of a demand response initiative.

The sooner this issue comes to a head, the sooner it must be dealt with to avoid a repeat of the 2001 crisis.

- *Customer motivation.* Ample reserve margins and problem-free summers may have lulled some market participants into complacency. Experience shows that supply and demand are cyclical. It is almost certain that problems will arise unless actions are taken to increase supply or to reduce demand. Far thinking participants will promote the lowest cost, most environmentally beneficial approaches and develop and implement an integrated resource plan that includes aggressive demand response efforts.
- *Political will.* California's energy future is one of the largest issues confronting the Governor and lawmakers in Sacramento. Many forces are at work influencing the direction of California's energy policy and the level of investment in California's energy future. The level of activity in Sacramento is strongly tied to the stability of the California electricity market.
- *Energy prices.* Rising energy prices will increase the pressure to develop and implement time-of-use and real time electricity pricing.
- *Availability of demand response technologies and metering equipment*. Additional product development and R&D are needed to provide the equipment, controls, and metering devices for implementing a demand response initiative.

Key Barriers

Key barriers to the success of this initiative are:

- *Customer knowledge.* Consumers do not understand the potential financial benefits of being involved in a demand response program. As a result, consumers are unwilling to take on the risks of having higher energy bills as a result of taking on demand response responsibilities. Information initiatives need to be implemented so consumers are aware that they can potentially save more by embracing demand response.
- *Partitioning energy efficiency and demand response.* Policy makers tend to think of energy efficiency and demand response as separate issues. Demand response addresses load reduction during critical time intervals, whereas energy efficiency addresses total energy consumption regardless of time of use. However, in order for demand response to be most effective, it needs to be tied into energy efficiency measures. Currently, funds from the Public Goods Charge (PGC) are unable to fund demand response programs. We believe that the PGC funds scope should be expanded to allow for technology development and programs for demand response in addition to energy efficiency.
- *Policy toward thermal energy storage systems.* Thermal storage technologies have great potential to provide demand reductions in commercial facilities but have been largely overlooked in recent years. Several reasons are likely for the lack of reliance on thermal storage (particularly cool storage) as a viable option.

Some of these may be: poor experience with early versions of the technology; overselling by overzealous, less capable practitioners; customer angst regarding lack of stability of utility programs (including changes in rates or incentives that make it difficult to operate a system economically); and lack of documentation of successful installations as a cost-effective means of reducing both peak demands and energy bills.

- *Varying ability to respond*. Consumers may also be unwilling to compromise comfort for monetary savings. For example, large customers in the service industry like hotels and restaurants are not likely to want to take on the risk of having facility comfort conditions that would create unfavorable guest satisfaction and would thus be unwilling to lower air conditioning set point during occupied periods. These consumers are most likely to oppose the peak rates; however, hedging options mentioned earlier may provide a way out for these consumers who have more inelastic demand for energy.
- *Meter readers*. Labor unions for those workers that read meters will most likely oppose the change to RTP. RTP requires the use of pricing signals which must be sent in real-time. As a result, the utility sending the pricing signal must also be able to remotely record electric use in real-time and would have no need for meter readers. Meter readers argue that they also provide safety benefits by being at the home once a month and can therefore check for gas leaks and other safety issues. Labor unions believe that automated systems will put people out of work.
- *Program design issues*. Some programs actually counteract the notion of demand response. For example, the Standard Performance Contract incentives provide rebates for high efficiency chillers. If a building uses an alternative method such as thermal energy storage, the owner gets a lower incentive from the program because the owner installed fewer chillers. However, more chillers actually raise the demand for electricity and put pressure on the system. Eliminating this disincentive may help reduce load in California, or may just increase energy usage by having less energy efficient chillers installed. A better strategy might be to keep the high efficiency chiller incentive in place but to provide even greater incentives for cool storage.

Strategies for Overcoming Key Barriers

Strategies to overcome the barriers listed above include:

- Overcome customer reluctance to embrace demand response by making demand response participation mandatory rather than have it as an optional program.
- Capture the benefits of both energy efficiency and demand response by expanding the scope of PGC funds to allow for technology development and programs for demand response in addition to energy efficiency.

- Provide case studies of successful energy storage facilities to help overcome customer and specifier resistance to change. Encourage rates and signals that permit effective charging of storage to enable subsequent cost-effective demand response. Provide assurances that rates and conditions will remain in place for sufficient duration to permit cool storage systems to make it economically attractive to construct and operate these systems. Develop standards for installation and operation that will prevent unqualified practitioners and poorly designed and constructed systems from entering the market in California. Eliminate disincentives to installing cool storage and its smaller chillers vs. larger non-storage chillers.
- Provide strategies and disseminate information on how to embrace demand response without affecting occupant comfort and productivity. These would include case studies that use occupancy sensors, cool storage and other technologies for maintaining the occupied facility conditions within acceptable limits.
- Change rate structure in California to follow a TOU for low to medium energy customers and a dynamic RTP structure for large customers.
- Advance technologies that are enabled to read pricing signals and make commonplace. Reduce costs associated with metering technologies.
- Offer programs such as enhanced automation that help companies maximize benefits from RTP and build in automation to buildings where possible.
- Develop informational programs to educate consumers about RTP and how it can help save money.
- Continued research for technologies through PIER and other programs.
- Building and appliance standards should also address demand response programs aside from energy efficiency. That is, if we slowly implement automated load shedding features into appliances, then demand response pricing signals will be more fully used.
- There should be a phase in period for rate tariff changes. That is, there could be a six month to one year transition period where customers would be provided with a “shadow bill” that shows them what they would be paying in the dynamic pricing rate structure and what they are currently paying. Furthermore, the bill can point out the peak times that consumers can save money, and would allow them to tweak their load profiles accordingly and see for themselves if savings can be achieved. For those customers that see their shadow bill increasing during the transition period, it gives them an opportunity to understand why their bill is changing and think of ways to change their usage patterns to reduce costs.
- Provide consumers with information on what appliances consume the most on-peak power that could drives up their bill.
- Educate people about peak and off-peak prices, and why electricity costs vary with time.

Upstream Interventions/Manufacturing Partnerships

Sector:	*Trigger Event:*	*Intervention Type:*
Residential and Commercial	No specific trigger event	Voluntary

This initiative uses upstream interventions that focus on the manufacturer. Elements of the initiative include R&D to develop new products, and incentives provided to the manufacturer to reduce the cost of manufacturer goods sold. Information dissemination, including documentation and distribution of case study and demonstration material driven by manufacturer efforts to market the energy efficient technology is another key element of the initiative. Procurement and purchase incentives are another upstream intervention, discussed separately, that will reduce unit manufacturing and marketing cost through economies of scale.

All of these interventions are designed to reduce the risk and cost of producing and deploying new energy efficient products. Due to markups occurring throughout the distribution chain, incentives or initiatives applied at the manufacturer level may be more cost-effective than those applied at the consumer level. These upstream activities stimulate the development of new energy efficient products at an accelerated pace, with a higher efficiency level and lower manufacturing cost than would otherwise be achieved. In a reasonably functioning market, expenditures applied to upstream participants to reduce manufacturing costs would be leveraged by avoiding the markups that would otherwise be applied to these costs.

Linkages to other initiatives include a description of the role of information products needed to maximize market penetration of energy efficient products that are the focus of these partnerships. Other issues addressed in the following sections include the importance and potential of the initiative to affect California's energy supplies, the interest groups that most influence and are most affected by the initiative, market conditions and key barriers that will affect the success of the initiative, and strategies for overcoming the barriers and maximizing market penetration and participation.

Initiative Elements

The following paragraphs describe three initiative elements; R&D partnerships, upstream incentives, and upstream technology transfer. A brief description of a closely related intervention, upstream procurement support is also included.

R&D Partnerships

This part of the initiative discusses the establishment of statewide R&D partnerships with key manufacturers to increase the availability and to reduce the cost of high efficiency products in California. The Energy Commission/PIER program and others

have been providing financial and management support for development projects with manufacturers for many years. Products such as horizontal axis clothes washers, high efficiency heat pumps and furnaces, advanced lighting controls and fixtures and electronic thermostats are a few that come to mind that were jump-started with R&D funds provided to manufacturers from government or private research management organizations. Funds can be provided for efforts ranging from proof of concept to bench testing to pilot production and field demonstration. Developing effective cost-shared product R&D programs with major manufacturers requires some legwork, patience and perseverance in getting to know the decision makers in these organizations and developing a sense of trust between the manufacturer and the funder. Both parties need to understand and respect each other's objectives.

The funds provided by Energy Commission/PIER, for example, helps offset some of the financial risk and opportunity risk of manufacturer's efforts to develop higher efficiency products that will benefit the public at large. The structure of the partnerships has taken on several forms, including cost-shared development projects. Financial arrangements for these partnerships can include an exclusive royalty-bearing license between the manufacturer and funder with a due-diligence clause to protect both parties. Other efforts have included design competitions with a monetary reward or a large purchase order as the prize. Some of these high profile "golden carrot" efforts have succeeded in accelerating the development of much higher efficiency products such as domestic refrigerators.

While California is a large market and can be a lucrative market for some products and manufacturers, it would be desirable to attract national partnerships with manufacturers and national R&D organizations (such as the U.S Department of Energy (DOE), the Electric Power Research Institute (EPRI), the Gas Technology Institute (GTI) or the Association of State Energy Research and Technology Transfer Institutions (ASERTTI) to defray the costs of development and to increase the market opportunity to attract aggressive efforts by prominent manufacturers.

Some activities of this type are currently underway in the Energy Commission PIER program in areas such as power supplies, residential and commercial heating, ventilating and air-conditioning, lighting, and controls and should continue to be encouraged. The PIER program has the infrastructure in place to continue to look for opportunities to create these partnerships to provide energy efficient products in areas that have high improvement potential and that can also satisfy customer needs. Additional funding is recommended to define these opportunities in the areas that have the greatest potential to reduce energy use and peak demand.

Upstream Energy Efficiency Incentives

Rebates or other incentives should be provided to the manufacturer rather than to the consumer as is often the case. There are price markups in each step of the product distribution chain to afford each market participant a profit. Reducing the price of a manufactured article through manufacturer rebates should logically result in a "retail" price reduction that includes all the markups that would have otherwise

been applied to the original manufacturer's price (without the rebates). In other words, each rebate dollar provided to the manufacturer would be equivalent to reducing the consumer price by perhaps $1.50 to $2.00 after all the markups. This argument could be extended to the "outside" investments in product R&D, and technology transfer as well, where the application of "upstream" funding support reduces the manufacturer's costs. If these cost economies are passed on to the distribution chain by the manufacturer and the distribution participants add only their normal markup, the consumer should benefit by a price reduction that reflects a leveraging of the R&D and technology transfer funding provided by the "outside" agencies.

Upstream Technology Transfer Efforts

After the products are developed and demonstrated, technology transfer assistance should be applied. One of the main flaws in programs to develop energy efficient products in the past has been a lack of aggressive, continual promotion of the merits of the technology well beyond the initial market introduction of the product. A measured ongoing investment in technology transfer materials and mechanisms that differentiate the advantages of the energy efficient product from its less efficient (and likely a lower cost) competitive product, can substantially increase the market penetration of the energy efficient product. These outlays are likely to be modest compared to the initial R&D investment applied to develop the product, but in the past these outlays have not been deemed research outlays consistent with the charter of the research organization and therefore have received a low priority for funding. The Energy Commission PIER program budgets market connection funds for each R&D project that, in part, addresses this issue. One problem is that these funds are usually applied concurrently with the R&D funds with perhaps a few months additional time to complete the technology transfer activities and deliverables.

What is needed is a technology transfer/market connection effort that extends well beyond the completion of the RD&D (research, development and demonstration) for perhaps two years or more to ensure that the energy efficient products get a chance to "grow up" before they are overwhelmed by cheaper, otherwise easier to sell less efficient products. Within narrow limits manufacturers will sell whatever is easiest to sell. It is up to the energy efficiency advocates to provide the information and the infrastructure support to make efficiency an easy sell. The technology transfer products should be designed to overcome market barriers, including a lack of familiarity with the equipment, uncertainties in how the equipment will perform, lack of knowledge of product or service availability, lack of understanding of installation, operating and maintenance issues, transaction costs, and resistance to change with well designed and presented product directories, case studies, and guidelines for specifying, buying, installing, operating, monitoring, maintaining and servicing the energy efficient products developed in this upstream initiative.

The technology transfer materials can be disseminated by the manufacturers and their distribution networks or through industry channels (see Information, Case

Studies and Demonstrations). The upstream products should be designed to mesh with the manufacturers sales efforts and should be jointly “branded” by the manufacturer and the funders. Joint presentations and meetings should also be encouraged to increase the leverage of the partners in attracting buyers and specifiers to accept the new products.

Upstream Procurement Support

Purchasing standards and procurement programs can provide a platform that encourages manufacturers to produce energy efficient products in sufficient quantities to ensure that costs can be kept down while allowing a reasonable profit to be made. Federal, state, and local governments can join together with utilities and other major organizations to determine reasonable product specifications that can satisfy their needs and will have high enough production volume to provide economies of scale for the manufacturers. Purchase contracts for products meeting these specifications can allay much of the tooling and production risk. Getting product volume up and unit cost down would have a snowball effect where, as price comes down, other consumers enter the market and increase sales volume, further reducing cost and price. Products such as low-voltage power supplies for consumer electronics, dimmable electronic ballasts, or demand responsive thermostats that are sold or could be sold in large quantities and can be readily specified in ways that meet a broad set of purchaser needs are well suited to this type of effort. Corollaries of these programs could include design competitions such as the “golden carrot” refrigerator program of the 90’s where manufacturers competed to produce the best product and the winner(s) would be guaranteed a reasonable level of sales to offset the R&D costs. For more details see the Energy Efficient Procurement initiative.

Affected Groups

This program, if successfully implemented, will have an effect across the market. Product manufacturers will be stimulated to produce and promote lower-cost, energy efficient products. Associations of manufacturers, such as ARI (Air-conditioning and Refrigeration Institute, CRMA (Commercial Refrigeration Manufacturer’s Association), AHAM (Association of Home Appliance Manufacturers) and GAMA (Gas Appliance Manufacturer’s Association) and others will be encouraged to develop test procedures, training materials, courses and ratings for the energy efficient products. The initiative will make it easier for distributors and dealers to sell high efficiency products by reducing their cost and providing ancillary materials and support to facilitate sales. Consumers and specifiers will be provided with cost-effective, higher efficiency products and the information needed to select, install and operate this equipment. Organizations such as ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers), and ACCA (Air Conditioning Contractors of America) that represent these market participants will play key roles in providing this information and monitoring its utilization. Utilities such as PG&E, SCE, and SDG&E will be able to satisfy their demand-side management objectives

more readily as an array of cost-effective, energy efficient products issues from this initiative.

As more energy efficient products are placed in the market, suppliers and service contractors will obtain more experience with the energy efficient choices, creating a stronger service sector for the energy efficient choices. These changes should take place in the entire market, and thereby affect all market participants and technology consumers. The result will be increased efficiency across the product stream. If successfully launched, many product lines should be impacted by this initiative. If successful, the impact of this initiative will grow in the market as other R&D organizations partner with the Energy Commission to further leverage this initiative. These organizations could include the U.S. Department of Energy, other state energy R&D organizations such as NYSERDA (New York State Energy Research and Development Authority), FSEC (Florida Solar Energy Center) and ASERTTI (Association of State Energy Research and Technology Transfer Institutes) and its other members, as well as private R&D organizations such as EPRI and GTI.

The following tabulation identifies the key groups that are affected by this initiative and influence this initiative. A range of interests are involved in upstream product development, manufacturing and distribution activities that have implications for energy efficiency interventions.

- *Associations.* Industry groups and trade associations will need to support the technology transfer marketing efforts to encourage market penetration, and to encourage training of their constituents to adequately deploy new technologies.
- *Contractors and specifiers.* Contractors often select the product to be installed in a retrofit, major remodel situation. This initiative will provide an increased array of energy efficient product offerings from which the specifier can select to provide the most value to their client. They will also benefit from the information provided to assist in product selection and utilization. Upstream rebates and incentives should result in distribution efficiencies that translate into lower product costs.
- *Distributors.* The distributors of any products developed with outside R&D funding or rebates provided to the manufacturer would have a lower cost due to the reduced cost of manufacturing and therefore should have a lower retail price. Furthermore, it is likely that technology transfer and promotional materials and activities would accompany these programs making it easier to sell these products.
- *Manufacturers.* Manufacturers will provide the R&D, personnel, infrastructure and knowledge that will be the backbone of this initiative. Manufacturers will be the focal point for distributing the technology transfer materials developed to overcome the adoption barriers of market participants. Manufacturers are expected to respond favorably to producing efficient, cost-effective products in response to volume demands from combined purchasers.
- *Nonresidential customers.* Nonresidential customers will benefit from increased availability of energy efficient products and the information needed to make informed market decision and to use the product effectively. Upstream rebates

and incentives should result in distribution efficiencies that translate into lower nonresidential customer costs.

- *Residential customers.* Residential customers will benefit from increased availability of energy efficient products and the information needed to make informed market decision and to use the product effectively. Upstream rebates and incentives should result in distribution efficiencies that translate into lower residential customer costs.
- *State of California, Energy Commission (PIER).* The Energy Commission (in partnership perhaps with DOE, ASERTTI and other R&D funders) organizations would provide funding for R&D to provide or accelerate the development of new energy efficiency products that would benefit their constituents. Targets of opportunity would be developed from the ongoing planning efforts of the PIER program with input from the other initiatives outlined in this report.
- *Utilities.* Utilities provide funds to support PIER R&D efforts and serve on project advisory panels to manage the research. They provide incentives for energy efficient products and design services and technology transfer products and service to encourage the adoption of energy efficient technologies. Utilities are often logical partners in government and private sector purchasing initiatives. Utilities should be one of the best sources of product and performance information that can complement manufacturer promotion of energy efficient products.

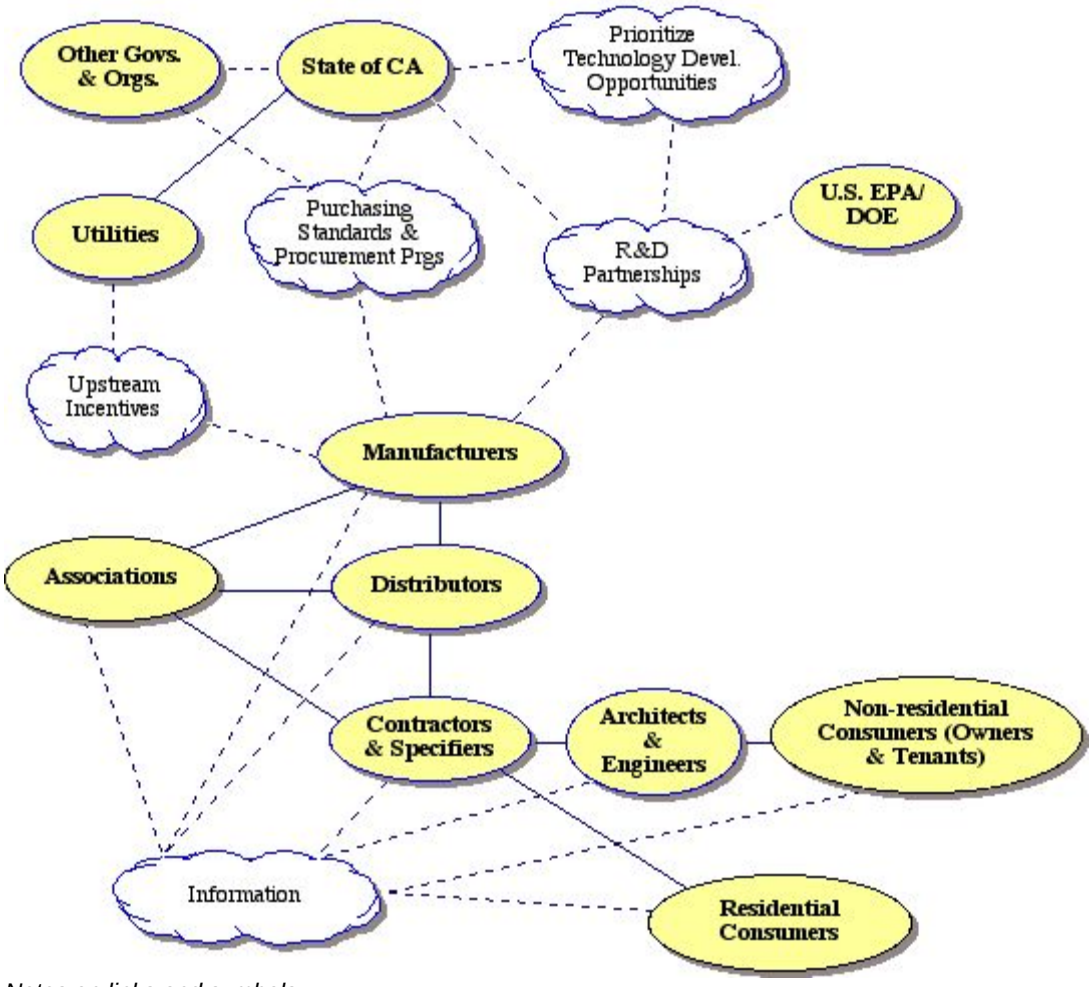
An actor network diagram for this intervention is shown in Figure 16.

Market Conditions

There are a number of issues and market conditions that will affect the success of this initiative. These include:

1. Finding strong manufacturing partners who are willing to work with the state is a considerable concern. Manufacturers are often wary of partnerships with organizations that may not have goals that are congruent with their own. Strong manufacturers with strong product development expertise and extensive distribution infrastructure often feel that they have enough resources and expertise to select product development targets and to finance these developments. Secondary and marginal manufacturers are more likely to be receptive to overtures to engage in cost-shared product development efforts with the state or with other R&D funders. These secondary players however, may not have the market clout to aggressively promote the products that are developed in these partnerships. The ideal situation is to find strong manufacturers seeking to develop energy efficient products to augment their conventional product line who look to the Energy Commission and others not just for money, but for access to the infrastructure inherent with partnering with energy efficiency advocates and the resulting marketing advantages and image enhancements that this will afford. These partnerships will not happen overnight and need to be nurtured by seeking

strong companies and individuals that can effectively develop and promote new energy efficient products and to build trust with these organizations and people that will carry over into win-win situations. An interviewee suggested working with those strong manufacturers that want to work with you so that others will follow as success is achieved.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 16. Actor Network Diagram for Upstream Interventions

Manufacturers may see the state primarily as a regulator and as such may want to keep an arms length distance. Consistent behavior that shows the manufacturer that the state can be trusted to maintain confidentiality agreements and can act as a partner rather than as a regulator or overseer will be needed. Manufacturers need to perceive that working with the state will reduce the risks of energy efficient product development and enhance their opportunity for market success.

2. Timing is important. If manufacturers have just retooled to meet some regulatory hurdle they will be disinclined to retool to make their new product line obsolete. If, on the other hand, the manufacturer was approached before the redesign and retooling the likelihood increases dramatically of interesting the manufacturer in creating an enhanced, more efficient product than would otherwise have been produced.
3. Rebate and incentive infrastructures are geared to the consumer and retail level. To make upstream incentives work smoothly, mechanisms will need to be put in place for the manufacturer to be able to document product sales as they occur. This may require some paperwork to be generated at the retail or consumer level and, if so, could result in higher programmatic cost than would take place for a comparable consumer rebate program.
4. The manufacturer's distribution chain needs to buy into the marketing and sales efforts for the energy efficient products that are developed and promoted. The distributors and dealers need to avail themselves of the ancillary information products provided to them as part of the marketing campaign and use them to overcome the market barriers of those specifiers and customers making product selection choices.
5. As the product becomes successful and sales grow, the distribution chain needs to moderate their natural desire to increase product prices to increase their profits and as such dampen demand and reduce sales momentum.
6. If the initiative is rapidly successful there may be a shortage of the energy efficient technologies and products in the market and an overabundance of inefficient choices, causing a price drop in the inefficient choice, thereby potentially boosting their market demand, causing more of the lower cost items to be placed in the market.
7. As the energy efficient choices become more established in the market, parts and service for the inefficient choice may become a lower priority for stocking practices.
8. A coordinated effort will be required between all interest groups to make these efforts successful.

Key Barriers

There are a number of barriers to deploying manufacturing partnerships and upstream interventions that increase the availability of cost-effective energy efficient products. Some of these were discussed in the previous section and relate to:

- Finding strong manufacturing partners.
- Choosing the correct timing.
- Documenting product sales.
- Buy-in to the marketing and sales efforts by the distribution chain.
- Avoiding price gouging.

- Shortages of the energy efficient technologies and products.

Other barriers are principally related to reducing the risk of specifying and installing new, unfamiliar technology:

- *Lack of an educational system or network.* This barrier is focused on the lack of an educational system or operational structure that can place energy efficient information into the hands of the decision makers. Interviewees point out that "people don't always know what is efficient and what to buy, they need to be educated about the fact that you can buy in a way that is energy efficient and environmentally friendly." Because the level of energy efficiency across different makes and models changes all the time as a normal course of the market operations, there needs to be a way that specifiers are kept up-to-date on what is efficient.
- *Lack of expert advice and information.* This barrier is associated with the inability of specifiers to go to a credible information source and obtain the information they need to make an energy efficient purchasing decision. While there are publications and sources to go to for car mileage information, and there are ENERGY STAR related information sources, for a wide range of other energy consuming technologies, there is no central source of information that can be accessed to obtain the quality information and documentation on energy efficiency that is needed to support purchase decisions.
- *Lack of performance information and assurance of adequate operation.* Most specifiers/consumers are naturally risk averse and will avoid selecting and installing products unless they are reasonably sure they will work.
- *Misinformation or lack of information in catalogs and vendor documentation.* Similar to the previous barrier is the tendency of product suppliers to place their products in the best possible light to gain a competitive advantage and identify a product as being energy efficient. Or, more often, information about a product's efficiency is not included in the product information. This misinformation or lack of information provides a barrier to making the right purchasing choice. For example, new product catalogs may not yet be available.
- *First cost.* Higher efficiency products will likely be more complex and therefore more costly to produce.

Strategies for Overcoming Key Barriers

Strategies to overcome these barriers are listed below:

- Efforts should be made to attract strong manufacturing partners by providing them with incentives to work with Intervention actors to develop lower priced, more efficient products for California.
- Pace product development efforts to coincide with manufacturer product design and development efforts underway to address their cycle of new product development.

- Develop bookkeeping methodologies and procedures for accounting for product sales to determine the distribution of upstream incentives.
- Provide marketing materials to make it as easy as possible for the distribution chain to effectively execute a successful sales and marketing program for energy efficient products.
- Monitor market conditions to assess whether new popular products will be fairly priced and take corrective action to correct anomalies that are found. Use the clout of manufacturing partners to ensure that this effort is effective.
- Anticipate the demand for new products by encouraging stocking of the distribution change. This will be accomplished as part of the aggressive marketing and sales program being addressed in this initiative

Other strategic efforts focus principally on reducing the risk of specifying and installing new unfamiliar technology. These include:

- Provide energy efficiency information and distribute this information through existing manufacturer and trade ally networks.
- Provide a central source of information that can be accessed to obtain the quality information and documentation on energy efficiency that is needed to support purchase decisions.
- Provide case studies documenting successful design, installation and operation, in situations similar to that of the specifier/consumer, to provide the credible performance information needed to overcome the resistance to change.
- New product catalogs and directories need to be developed and distributed with accurate, unbiased information about product operation and efficiency.

This initiative seeks to reduce the cost of manufacturing with R&D partnerships and upstream incentives and rebates to efficiently reduce the cost of new energy efficient technologies. The following programmatic actions are needed to mobilize this effort.

- *Prioritize technology development opportunities.* Look at energy use and demand in California and ongoing efforts to reduce consumption and peak demand. Identify needed products and their desired characteristics. Set product development goals including desired timing based on this assessment. Candidate products for early consideration include low voltage external power supplies for consumer electronics, dimmable electronic ballasts for commercial lighting and daylighting applications and demand responsive thermostats for residential and light commercial applications.
- *Develop manufacturer R&D partnerships.* Investigate the key manufacturing players and their possible roles in participating in this initiative. Focus one-on-one efforts with potential key partners and move forward to cement relationships and initiate these partnerships.
- *Upstream incentives.* Examine existing and past incentive programs and determine which end uses and product types are most amenable to upstream interventions that include rebates and other financial rewards.

- *Market connections.* Mobilize market connection efforts that follow the recommendations of the Information, Case Studies and Demonstrations initiative

Procurement

Sector:	*Trigger Event:*	*Intervention Type:*
Residential and commercial	No specific trigger event	Mandatory for state government agencies

This initiative focuses on governmental purchasing procedures and the systems associated with establishing energy efficient purchasing approaches, and the acquisition standards that are associated with energy efficient product specifications. These will be discussed separately, but are strongly linked. That is, while an energy efficient purchasing approach can be in place to acquire energy efficient technologies, it is the actual purchasing standards and specifications that typically drive the individual, product-associated contract awards. However, because these can be used in the market in different ways that are addressed later and we approach the discussion of these aspects separately.

The procurement and procurement support initiatives should be considered as a potential mandatory initiative in that is should be ordered to be delivered via legislation, preferably, but at the very least by executive order. However, executive orders, without funding, may have little impact in California. As a result, we recommend that this initiative be legislatively required with a funding source allocated to this effort. Participation in the initiative should be mandatory within the state purchasing system to provide clear guidance to purchasing agents; participation of non-profit and local governments that are eligible to buy off of state contracts is voluntary.

There are no specific trigger events associated with this initiative, however, procurement practices typically follow annual cycles within the jurisdictions that need to be considered in the implementation efforts.

Energy Efficient Procurement

This part of the initiative discusses the establishment of a statewide energy efficient procurement system in California. Energy efficient procurement is not new to California. In the late 1970s and early 1980s the State of California began procuring products with attention to the amount of energy they consumed. This effort continues today, but is not aggressively pursued on a statewide basis, nor are there strong promotional efforts that keep attention focused on this aspect. Likewise, there is a lack of expertise within the California purchasing community that allows for constant concentration on acquiring the most cost-effective products.

California is fortunate in that it has already established purchasing regulations that allow state purchasing contracts to be used by all governmental jurisdictions and nonprofit organizations. This condition essentially allows any government or nonprofit organization to obtain products from competitively bid state purchase contracts. What this also means is that the foundation for large-scale energy efficient purchases already exists in California, it only has to be more effectively used to save energy. However, there is also a condition in California, as in most other states, in which the purchasing function is fragmented and distributed across a host of agencies.

There is no strong central purchasing function in California that covers all state agencies and organizations and their associated purchases. We are not suggesting that there should be, as this condition allows substantial freedom for agencies and organizations funded by tax dollars to acquire products they need. However, this fragmented purchasing environment also means that there are a host of state offices all doing the same thing; purchasing the products they need. According to interviewees, even different campuses within the university and college systems have their own purchasing staff that acquires products at the campus level. The same applies across many agencies, boards, and commissions. Likewise, there are thousands of local government agencies in California, most of which have purchasing staff or staff charged with the responsibility of obtaining the products needed to support their operations.

In California, all the market pieces are in place to launch an effective statewide Energy Efficient Procurement initiative. This initiative needs to start by bringing all the purchasing organizations, offices, and staff together into a single focused effort of modifying purchasing procedures to evaluate products and apply energy efficiency credits to the purchase of those technologies that reduce energy demand and save energy. Some offices are already doing this, but many are not because of a number of barriers (discussed below) that inhibit this kind of effort. The effort needs to be adequately structured, funded and placed in operation so that the state can capture the savings available through this approach. We do not suggest a specific design for this effort within this report, but suggest that the Energy Commission focus efforts to obtain initiative funding and design the program to be effective within California's distributed purchasing structure. The Energy Commission should consider the following program design considerations:

1. The program should be mandatory for state purchasing agencies. According to state procurement officials affected by this intervention, well-defined mandatory procedures are desirable and welcome by the purchasing agents to eliminate uncertainty in purchasing procedures.
2. The initiative should have a strong central product assessment office that evaluates the energy efficiency of products that are purchased within the public and nonprofit markets. This can be done within the Energy Commission or contracted out through other organizations that are already established to provide testing services. The responsibilities of this component are to produce bid-defensible product evaluations that are grounded in objective scientific analytical processes. Products that are already being evaluated by other

organizations may not need to be evaluated by this function, but rather the procurement initiative can use the assessment of others if it is certified that the assessment approach is objective and provides reliable results.

3. The staff conducting assessments should be composed of skilled scientific investigators who understand the physics and chemistry associated with the products and their ability to influence energy consumption.
4. The assessment should not be restricted to technologies that are directly connected to electrical or gas supplies, but should include any products that affect energy demand or consumption and for which there are alternative products that provide the same function but save energy in the process. For example, low temperature laundry detergents can save more energy than high-efficiency washing machines. It is important that all products that impact energy consumption be considered.
5. The initiative should have a strong sales force. Without a strong sales force that can bring the product testing results to the thousands of state and local government organizations that could use the information, the likely success of the initiative is questionable. The sales force should be structured to match the ability of the initiative to be formed and begin operations. As a result, the sales force will need to be phased in as procurement recommendations and specifications are developed. The initiative should establish a sales force that allows personnel visits and initiative presentations to at least the top 50 percent of the targeted state and local governments and the top 30 percent of the targeted nonprofit organizations.
6. The initiative should have a statewide communications effort. The initiative will need to maintain communications relative to the changing products and analysis conducted, verified, and disseminated. Different approaches to information dissemination should be explored and multiple approaches used. E-newsletters, purchase alert e-grams, presentations, and workshops should all be considered. Without strong communications across state and local governments and the nonprofit sector, the effort will struggle.
7. Feedback is important. The program should be established to provide feedback to participating organizations so that they know how much energy they are saving by using the coordinated energy efficient purchasing approach.
8. Make it easy to participate. The initiative will need to employ tactics that are compatible with user needs and timelines, and be user friendly. The initiative should make it easy to incorporate purchasing specifications or to support policy decisions with the information developed through the initiative. These materials should be unthreatening from a technical perspective, from a legal bidding and contract award perspective, from an operational or systems perspective and from a political perspective.
9. Publicize success and case studies. The initiative should proclaim its successes within the purchasing community. When organizations save energy they should be recognized for their contributions. Coordinate success stories through the

procurement community and the procurement associations and related support organizations.

10. Learn from others and from the past. The initiative is not new, but newly resurrected. During the design process, learn about others who have done this before in California and in other locations.
11. Obtain the support of the Governor's Office and key allies. Have an opening launch that is publicized with key technical and policy makers on board. Show California as wanting to become the national leader in this area. Obtain the visible support of key procurement professionals in California, such as DGS's Reta Hamilton, Waste Management Board's Mark Leary, Sunne Wright-Peak of Business Transportation and Housing, members of the Energy Commission's Energy Coordination Committee, members of the Green Building Action Plan team, and others key stakeholders and supporters.
12. Coordinate, design, and launch with the cooperation of the U.S. Environmental Protection Agency (EPA) Environmentally Preferable Purchasing Team (EPPT), a federal-wide program that encourages and assists federal agencies in the purchasing of environmentally preferable products and services.
13. Consider placing the implementation branch of the initiative within the procurement offices of the state rather than within the energy offices of the state.

This initiative will need careful planning and coordination and will need to be given a few years to prove itself. However, if this is effectively designed, launched and supported, the savings could be substantial.

Energy Efficient Purchasing Standards and Specifications

This part of the initiative description discusses the establishment of statewide purchasing standards and specifications that allow energy efficiency to be contract-award criteria, either by policy, or through the bid analysis process.

The bid process is a legal contracting process. It is grounded in objective public assessment and bidding supply contracts. Purchasing decisions are subject to challenges from losing bidders and procurement staff must be able to defend awards with solid objective selection criteria. It is not enough to read that something is energy efficient; you have to be able to prove it is efficient enough to justify a bid award. For this reason, it is critical that this initiative be founded on objective accurate product assessments. The assessment process must be transparent and the criteria for assessing energy efficiency must be solid. For this reason, the most important aspects of an energy efficient procurement initiative are the standards and specifications on which the bidding process is based. The initiative must be able to provide procurement standards and purchasing specifications that support bid decisions or policy guidance that points to a specific type and model of equipment or practice. However, if done well, the purchasing standards and product specifications that will come out of this initiative can be of value to any organization making similar purchases. While the initiative can be established by targeting the governmental and

nonprofit sectors, the resulting products of the initiative will likely also be adopted by private sector purchasing officials across the country. The potential “spillover” of savings from this type of program can be as much or more than the impacts captured in the target market.

Affected Groups

As product suppliers begin to see that energy efficiency is important to the award of supply contracts, these suppliers will focus more attention on bringing those products into the bid process rather than a set of products that are most likely to obtain an award if energy is not an assessment criteria. Product suppliers will be more attuned to energy efficiency in selecting the models they carry and service. Pressure will be placed on upstream interest groups to design more efficient products so that their dealers can obtain more awards. As more energy efficient products are placed in the market to fit the changing bid process, suppliers and service contractors will obtain more experience with the energy efficient choices, creating a stronger service sector for the energy efficient choices. These changes will take place in the market, and thereby affect all interest groups and technology consumers. The result will be increased efficiency across the product stream. If successfully launched, there should be few product lines that influence energy use that are not impacted by this initiative. If successful, the impact of this initiative will grow in the market as other states, local governments, nonprofits and even the private sector adapt their purchasing standards and approaches.

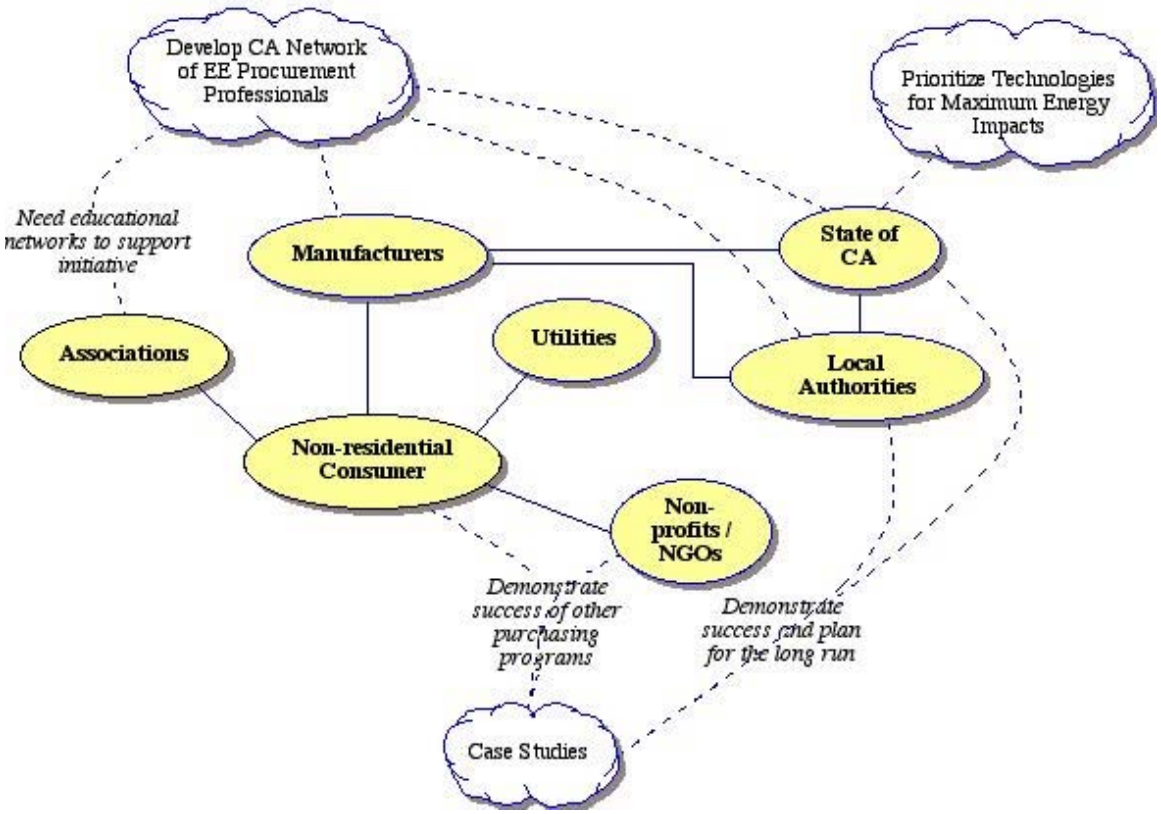
The government procurement network has a strong association called the National Association of State Purchasing Officials (NASPO). This organization has embraced the concept of energy efficient procurement procedures and will most likely continue to do so. This organization also provides or supports training programs for procurement professionals. It may be advantageous for this initiative to team with NASPO to offer workshops at regional and national conferences that focus on this initiative and how to use the standards, specifications and processes developed in California.

Certainly this initiative will impact every purchasing official in the State of California that wishes to take part in the voluntary aspects of the effort. These individuals include the state government purchasing agents and managers, as well as their contracting staff that needs to write supply contracts, bid documents and bid specifications. Likewise, the local governments that elect to join this effort will be impacted; and if adopted by private industry, their purchasing staff will also be impacted. This is the purpose of the initiative; however, this initiative may also complicate the procurement process for those people who are not using energy efficient purchasing approaches, but who elect to move in this direction (see associated barrier on this issue). For those who are using these approaches or for those who want to do a better job at this approach, this initiative should ease their burden by helping support their product analysis needs.

In addition to coordination with the organizations mentioned above, there are a number of groups that have direct or indirect interest in this initiative. These include the following.

- *Associations.* Industry groups and trade associations are already involved in "green" purchasing, including preferential purchasing of higher efficiency energy using equipment. BOMA, facilities managers associations, purchasing managers associations, schools and local government associations are all interested in procurement for a variety of budget and policy reasons.
- *Corporations.* A number of large private-sector companies have strong environmental friendly purchasing programs. Some of these (e.g., prominent home improvement and office supply retailers) are also vendors of higher efficiency products.
- *Manufacturers.* Negotiate special pricing on large-volume sales of goods and equipment to large public and private-sector purchasers. Manufacturers have produced some special high efficiency items in response to volume demands from combined purchasers.
- *Nonresidential customers.* Within government agencies and firms, a number of individuals influence nonresidential product choice and purchasing policies. They range from the individual worker who buys items from local retailers with an organization credit card, to units supervisors who favor certain items or brands because of their non-energy operational characteristics (e.g., easy to replace or repair, commonly available, long-time vendor), to purchasing officers, to purchasing department managers, to higher-level decision-makers in the organization. All can influence the purchasing process (which is generally highly diffused through out the organization and much more flexible than might be imagined). Even lower level individuals can effectively veto green purchasing goals and policies. Innovative purchasing officials and others in organizations have been instrumental in changing practices in a number of cases, however, and they are members of networks of procurement professionals that cross organizational lines and the public/private sector boundary.
- *Residential customers.* Residential customers look to government and others for recommendations on what they should buy and the energy and non-energy impacts associated with their purchase decisions.
- *Utilities.* Utilities are also large purchasers and influence the purchasing of others thorough their energy efficiency programs. Utilities are often logical partners in government and private sector purchasing initiatives. Utilities are considered to be one of the best sources of product and performance information that can inform procurement decisions.

The actor network diagram for this initiative is shown in Figure 17.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 17. Actor Network Diagram for Procurement Initiative

Market Conditions

There are a number of market conditions that will affect the success of this initiative. These include:

1. Procurement staff may not like outside organizations attempting to tell them how to purchase the items that they have been successfully procuring for many years.
2. If the initiative is rapidly successful there may be a shortage of the energy efficient technologies and products in the market and an overabundance of inefficient choices, causing a price drop in the inefficient choice, thereby potentially boosting their market demand, causing more of the lower cost items to be placed in the market.

3. Vendors will need to adjust their product mix to maintain more stock of the energy efficient choice, this will percolate up through the supply change causing manufacturers, dealers, and distributors to change their market mix.
4. As the energy efficient choices become more established in the market, parts and service for the inefficient choice may become a lower priority for stocking practices. (This is what happened in Wisconsin when more than 90 percent of the market went to incentivized high-efficiency furnaces. Dealers reacted by stocking the high-efficiency products and special ordering more of the inefficient products and their associated parts.)
5. There may be a mix in the regional or national distribution of energy consuming product models. Distributors may elect to send the high-efficiency stock to California where it will be more readily sold and send the lower efficiency stock to other states with lower demand, such as Texas.

Key Barriers

There are a number of barriers to having a statewide coordinated open-access energy efficient procurement initiative that the program design will need to address. These include:

- *Lack of an educational system or network.* Interviewees point out that "people don't always know what is efficient and what to buy, they need to be educated about the fact that you can buy in a way that is energy efficient and environmentally friendly." Because the level of energy efficiency across different makes and models changes all the time as a normal course of the market operations, there needs to be a way that purchasing officials are kept up-to-date on what is efficient.
- *Lack of expert advice and information.* This barrier is associated with the inability of purchasing officials to go to a credible information source and obtain the information they need to make a energy efficient purchasing decision. While there are publications and sources to go to for car mileage information, and there are ENERGY STAR related information sources, for a wide range of other energy consuming technologies there is no central source of information that can be accessed to obtain quality information on energy efficiency that is needed to support purchase decisions. The energy efficiency program environment is not structured to advise purchasing officials who need comparative information on which a decision can be based. While AB-495 requires the state to develop an environmentally friendly purchasing manual to inform purchasing decisions, there is no easy way to get the information to support these decisions.
- *Lack of people with expertise.* Energy efficiency assessment is typically not a critical part of the qualifications needed for procurement managers or purchasing agents. Few people within the procurement function have energy efficiency and energy-related technical expertise. There is a need to educate the purchasing professionals about the science and assessment techniques associated with

energy efficient procurement practices. While several procurement professionals within the state, university, and larger city procurement systems are very knowledgeable about energy analysis techniques and the importance of energy efficiency, it is not a standard set of knowledge embedded at all levels of purchasing officials. Likewise, most purchasing offices, including the state, university and larger city procurement offices, do not have staff charged with the responsibility of acquiring energy efficiency information on the technologies they purchase. There is a lack of skilled, trained professionals within the purchasing systems to focus on this issue.

- *Misinformation or lack of information in catalogs and vendor documentation.* Similar to the previous barrier is the tendency of product suppliers to place their products in the best possible light to gain a competitive advantage and identify a product as being energy efficient. Or, more often, information about a product's efficiency is not included in the product information. This misinformation or lack of information provides a barrier to making the right purchasing choice.
- *Efficiency knowledge at the product level.* To make energy efficient purchasing awards, the purchasing official or decision maker must have the information to know how to assess the energy savings for each product being bid. This requires expert knowledge that is capable of withstanding an award challenge. It is one thing to think a product or approach is more efficient, it is another to award a contract based on an undocumented assumption or an opinion. Purchasing decisions need to be based on a foundation of strong documentation that is capable of withstanding a legal challenge. This means that purchasing officials need very high quality energy efficiency information at the specific product and model level. While it is a standard approach to let the vendors submit this data with their bid, this does not mean that the data submitted is accurate. Purchasing officials need to be able to confirm a bidder's claim regarding energy efficiency.
- *Increases the cost and complexity of the acquisition process.* The process of procurement is an organizational support function. Typically, procurement is not a revenue generating operation; however, it does have the ability to lower costs through lower-priced, higher-volume competitive acquisitions. Nevertheless, the purchasing process needs to be fast and efficient. It has to acquire products within the timelines needed by the product users and it cannot add substantial costs to the acquisition process that are not recovered through price savings. Energy efficient procurement adds another relatively complex process to what would otherwise be a standard acquisition process. Adding costs to operational support functions is not something favored by upper management and executives. As a result, the process of establishing energy efficient procurement practices across the state can be challenging. Initiatives must not add costs, but instead add benefits that can be employed to help everyone.
- *Information that is too late to use or too early to be accurate.* Each organization that has a formalized procurement process has procurement schedules, many of which are annual schedules. The information needed to make energy efficient bid evaluations and procurement decisions needs to be in the hands of the users at

the right time, and it needs to be accurate for that bid period. Information that is available after the bid is of little use until the next bid cycle. Information that is available before the bid process can be used for the bid documents, however it must be accurate at the time products are purchased. That means that last year's information on models that are not offered in the following bid cycle is of little value to the procurement process.

- *Adequate supply of product.* When volume pricing is requested for an energy efficient technology that does not mean that the bidders can actually provide the product in the volumes needed. Suppliers of products must be able to obtain enough product through their supplier networks to fill the demand. As volume purchasing increases to obtain a lower price, the bidders must be able to increase their supplies to meet the demand. However, in many cases the bidder is not the product provider, but instead is the retailer who has to go to their providers to obtain the product to meet their bid obligations. If their suppliers cannot meet the demand via their supply chains, or their providers decide not to meet the demand because it would leave other customers without product, the demand can remain unfilled. This forces customers to acquire the product via other, typically more expensive, market channels.
- *Vendor availability.* This barrier is similar to supply availability, but is focused on the vendor population. In some cases there are not enough vendors of the energy efficient technologies to acquire competitive bids that are the key driver for lower costs. Vendor availability is a technology-level consideration. An assessment will need to be made on a product-by-product basis concerning the vendors in the market that are capable of bidding and supplying energy efficient products in a volume bid environment.
- *First cost.* This common barrier was identified in the literature and by the interviewed experts, however, it is not thought to be a significant barrier for many of the purchasing jurisdictions that practiced life-cycle-costing in the late 1970s and early 1980s. While this is a significant barrier for some jurisdictions on some types of items, "…Most jurisdictions are familiar with the concept of life-cycle-costing, in which the smart move is to buy the product that is the least expensive to own over the life of the product." This comment suggests that while some jurisdictions may focus on least first cost for some products that meet quality standards, a statewide initiative will find that most purchasing officials and decision makers will already be familiar with a key component of energy efficient procurement practices, even the ones that now value first cost as the primary purchase criteria. However, some jurisdictions will need to be convinced that the energy efficient approach is better.
- *Cost of higher-level energy efficiency.* This barrier was identified to point out that there are levels of energy efficiency, and that if jurisdictions stay in the high, but not the highest, energy efficiency levels, there will be fewer issues with cost. However, this interviewee pointed out that once you get into the highest efficiency technologies then cost does become an issue.

- *Turf issues.* Some procurement professionals would interpret a statewide procurement effort as imposing on their purchasing turf, limiting the success of such an effort. However, the number of individuals taking this position would be smaller each year as user networks communicated the success of the approach and the lack of risk when handled objectively. This effort might difficulty in the first few years, but if designed and managed objectively and efficiently, the initiative would gather momentum and support.
- *Mistrust.* This barrier was identified by interviewees as mistrust across governmental jurisdictions that would impede cooperative relationships.

Strategies for Overcoming Key Barriers

There are a number of proven operational approaches for overcoming these barriers and implementing successful intervention strategies. These include:

- Use current professional organizations to leverage and launch the development of a California network of energy efficient procurement professionals or build on one or more of the current organization/associations to establish an educational network specifically supporting this initiative. Most of these organizations are already familiar with the ideas associated with energy efficient procurement and will be receptive to these efforts. Some of these organizations have already established training programs of this nature within their organizations. This educational effort does not need to start from ground zero, but is a matter of organizing and using what is already there and supplementing current structures with initiative-focused structures. Current organizations that would be expected to support this educational and training network include:
    a) The National Association of State Procurement Officials.
    b) California Association of Public Purchasing Officials.
    c) California Association of School Business Officials.
    d) California County Superintendents Educational Services Association.
    e) National Contract Management Association.
    f) National Institute of Governmental Purchasing.
    g) National Association of Counties.
    h) Public Housing Authorities Directors Association.
    i) Government Finance Officers Association.
    j) International Federation of Purchasing and Materials Management.
- Use the educational and training network established above to develop and train purchasing officials. Make the training high quality, inexpensive, and easy to attend. Build on the expertise that is already there. Use current and past programs as examples and provide case studies and clear examples.
- Identify local and national experts to kick off and start the educational and training efforts. Look for people with scientific and analytical assessment skills to guide the effort and support the training with initiative funding.

- Prioritize the technologies to consider so that energy impacts are maximized. Prioritize at the state and local government levels as well as the nonprofit levels, so that the initiative is rapidly effective. Focus on energy savings and improving the environment.
- Use successful approaches that have been tried by others to demonstrate that energy efficient purchasing is not overly risky or technically challenging. Have the initiative provide documents that help new users thorough the bid, assessment and award process. Demonstrate how challenges to awards can be successfully handled. Demonstrate how a routine approach, with information support from the initiative and others, can minimize costs and risks and can build on current knowledge and expertise.
- Team with key organizations and procurement officials to understand bid cycles in California and tailor assessments to these cycles, allowing time for information dissemination and use before the bid cycles.
- Make sure product assessments are grounded on objective, reliable assessment approaches. Have the data that demonstrates energy savings. Make sure product or assessment approaches include reliability assessments of the savings and of the performance of the technologies. Make sure vendors can back up product performance with guarantees.
- Make sure the information about products is based on scientific assessment and not anecdotal or vendor claims. Keep the quality of the technical information strong. Consider using established organizations that can take on this role, or build expertise that is initiative-specific in California. Both approaches have cost and benefit trade-offs.
- Works with initiative participants, industry representatives and others to structure the bidding process so that is does not over-impact the market. Structure the initiative so that demand is not stretched to the point where energy efficient and cost-effective procurements become unavailable because of increasing demand. Works with vendors to make sure they can deliver on promised bids, have them show proof of supply ability and relationships. Move failures into the communication networks so that users know that they may need to back off of a bid for a year until the market catches up. Works with California's energy acquisition, demand reduction and energy procurement programs to not overly stress the market and cause equipment bottlenecks in the portfolio supply chain.
- Do not regard shipment of more energy efficient products to California as a negative effect; instead, view this effect as positive and promote it. Establish this as a goal and let the market react as more states adopt the practice.
- Establish a central assessment office with a procurement operation or such that very close ties are established within the procurement function. Procurement professionals will listen to other procurement professionals more than they will listen to non-procurement professionals.

- Establish an effective sales force that does show-and-tell demonstrations within the target markets to provide technical assistance to purchasing agents throughout the state purchasing system. Publicize accomplished results, and provide awards and recognition to promote the initiative within the state purchasing system. Provide feedback on the amount of energy saved by participants.
- Plan for the long-term and allow the initiative to organize and mature and become established in the market. Allow travel and technology transfer to occur to spread the initiative in California and beyond.

These efforts will substantially reduce the barriers identified above and if effectively implemented will allow the initiative to succeed and grow in its impacts.

Branding

Sector:	*Trigger Event:*	*Intervention Type:*
Residential and Commercial	No specific trigger event	Voluntary

This initiative focuses on the use of energy efficient technology or technology-service branding and its potential to capture additional energy savings in the residential and nonresidential sectors.

There is considerable interest in the use of branding and co-branding to capture additional market share for energy efficiency programs. However current brands may not reflect the most efficient product choices or cover all of the technologies and services needed in California. There is a need for energy efficiency branding initiatives to focus on the more efficient products and services.

One of the drawbacks of the ENERGY STAR brand is that it does not recognize the most efficient products in the market if the program considers the providers of that product to be too small to create effective competition, may be slow to adopt new products under the brand and may not withdraw the brand fast enough when there are more efficient choices available. As a result, the AB-549 research has identified the need to consider a more effective branding approach in California to replace or supplement the ENERGY STAR brand.

Currently organizations and programs are managing these drawbacks to the ENERGY STAR brand via co-branding approaches or through the CEE's two-tier approach, in which ENERGY STAR products are placed in a lower efficiency, tier-one status or a higher efficiency tier-two, depending on their level of performance. NYSERDA is one state authority that has taken a co-branding approach.

There is a recognition that promoting the ENERGY STAR brand may not be the best branding approach if the goal is maximizing energy efficiency. The question becomes: should California move beyond ENERGY STAR and establish its own

brand and have California programs incentivize or market only the new brand, or should California co brand with ENERGY STAR and only co brand the products that are the most energy efficient, essentially maintaining a double-labeled two-tiered approach? Or should California use only the ENERGY STAR brand as currently configured and realize that the brand may not provide the maximum effects?

This decision has national implications. If California, with its massive market pull, moves away from ENERGY STAR, the brand will suffer in the market and its value as a label will be significantly lessened. Yet using the ENERGY STAR brand means that there could be confusion in the market about what ENERGY STAR means if a two tiered co-branding approach is put forward.

If California builds a new brand, then California will have control over the products classified under that brand and can move products under the brand as desired. Likewise, California would be free to create its own approach for providing brand awareness and for setting brand standards. California could move into concepts such as the Energy Commission-certified kitchen, the Energy Commission-certified home or building, and it would be free to have Energy Commission-certified plug load appliances or to set branding relationships with home inspections, building commissioning professionals or other technology-service combinations. California could streamline the process for homes or buildings becoming Energy Commission-Certified, and create partnerships that allow home rater/contractor relationships to move Energy Commission energy-rated homes into the market at a premium to other homes.

The benefits of a California brand are many. However, branding is very expensive and time consuming. Moving a new energy brand into the marketplace will take time and significant funding, draw funding away from other initiatives, and send mixed marketing messages about what the ENERGY STAR brand means and what competing or complementary branding means. California brand awareness to impact customer purchase decisions would need to be built from the ground up. Tens of millions of dollars a year would need to be applied to support product assessment approaches and to building brand awareness across the consumer population. Since it would not be possible to push the ENERGY STAR brand out of the state, a co-branding approach would be the logical default position if a California brand were to be established. If California wanted to incentivize only the most efficient products it would need to incentivize only the California brand or develop a two-tier approach. The two-tier approach would be least expensive compared to establishing a new brand because it builds on the CEE's approach and builds on the ENERGY STAR brand.

Likewise, manufacturers will most likely resist efforts for individual states to move toward multiple branding approaches, as product testing and labeling is expensive. Yet, California makes up one of the largest economies in the United States and changes in California would most likely influence the branding and product purchasing characteristics of at least the western half of the United States. Likewise, if the California brand were seen as more efficient than ENERGY STAR, users of the ENERGY STAR brand would see benefits in moving to the California brand. From this perspective building a new, more energy efficient brand for California has great

appeal. This brand could be used to co brand when it is linked with an ENERGY STAR product, especially a tier-two product, and it could be used to move into new branding areas that ENERGY STAR is slow to adopt.

In essence, a co-branding approach similar to that being used in New York, can provide California with the best of both approaches without harming the ENERGY STAR brand beyond some level of brand confusion within the co-branding market. Essentially, California could establish its own brand and use that brand for identifying products eligible for incentives. This would essentially place the ENERGY STAR brand in a supporting role in California. New York may be interested in having the Energy $mart brand become entrenched in California so that a whole new brand is not established. If the two largest economies in the United States, one in the east and one in the west, were to adopt the same brand, other brands such as ENERGY STAR would need to follow.

A key factor in this choice is the question of where California wants to be in ten years, and if California can work with ENERGY STAR to have ENERGY STAR respond to California's needs for increased energy efficiency from the brand. A long-term perspective should drive this decision, as branding awareness does not happen in a few years, even with large budgets for market connections and publicity. California needs to launch into additional negotiations with the ENERGY STAR brand to see if the brand is willing to work with California and other key states to move the brand into higher efficiency levels and the new uses. We expect that if the states of New York and California and other public benefits states were to begin negotiations about a different brand, this would pressure the ENERGY STAR brand to be responsive to state needs.

Affected Groups

In addition to coordination with organizations, there are a number of groups that would have direct or indirect interest in this initiative. These groups are discussed in the following subsections.

- *Associations.* Industry associations and trade groups provide information on best practices and new products to their members and other industry members. They also represent their members' interests in legislative and regulatory contexts when product standards are under discussion. In these ways they serve as both diffusers and blockers of innovation.
- *Building commissioning agents and system assessment analysts.* Building commissioners and systems assessment analysts need to be able to know what technologies are available to help solve building energy problems and to commission buildings so that they perform well. This group has an interest in staying current in what is and is not brand rated.
- *Building professionals.* Architects and building engineers need to know what equipment to use. Current branding approaches exclude much of the larger energy consuming equipment found in commercial and industrial buildings. This

market also needs simple ways of specifying technologies that meet code and save energy.

- *Code officials and associated code analysts.* Code officials and code assessment support analysts have an interest in staying current on branded technologies. This interest will grow as branding enters more commercial building size equipment.
- *Consumers.* Brands provide consumers with shorthand information about product characteristics and quality. Brands were originally developed as marketing strategies to differentiate otherwise unremarkable commodities (e.g., soap or bacon). Subsequently, brands have come to be associated with innovative products, durable products, high quality products, and products intended for elite consumption styles. In some cases, just the fact that a particular company name (which is often synonymous with the brand) is affixed to a product is taken as an indicator that the product will necessarily have all of the features and qualities one might want. In the energy arena, consumers view the ENERGY STAR brand favorably—30 percent of U.S. households have purchased an ENERGY STAR product, and have been happy with it. One observer noted that, in addition to signaling efficiency, this brand is associated with "doing the right thing for some higher good." In essence, the very idea of efficiency gains credibility from its association with the ENERGY STAR brand.
- *Contractors.* Contractors will recommend and install specific branded products, typically within the lines of the products they carry. Contractors favor certain brands over others, and in some cases are closely connected (e.g., through exclusive commercial relationships, as in HVAC servicing) with particular vendors and their brands. These connections can be legally binding and restrict the contractor to certain brands. Some contractors also act as retailers, buying branded items in bulk and reselling to their residential and commercial customers. It has been noted that the contractor is most often the person who "makes the sale," and this can be a process in which branding plays a significant part.
- *Energy efficiency service providers.* The infrastructure for branded services such as "Home Performance with ENERGY STAR" (whole house diagnostic testing and retrofit) is very limited. Technical training and specialized equipment are required and have yet to be widely adopted by energy auditors and contractors. The situation is very different for branded products such as ENERGY STAR computers or appliances, which are widely available through a variety of distribution channels.
- *Energy inspectors, raters, and auditors.* This group of professionals needs a simple means of determining what is and is not efficient, as well as what changes to recommend in their audits and ratings. These professionals need to provide trusted information to consumers about the efficiency characteristics of branded products.
- *Local authorities.* Local authorities are trusted sources of information and referral. Because of their roles as consumers of energy-using equipment, they are also likely partners in promoting high efficiency brands. They may actually have

greater familiarity with and trust in innovative technology than businesses in local communities.

- *Manufacturers, distributors, and dealers.* The manufacturers, distributors and dealers, in addition to being involved in the development of the branding approach, would need to supply the products under that brand. A number of large manufacturers are already involved with the ENERGY STAR brand and feature that label on their products next to their own brands. They can and do alter product designs and operating characteristics to secure rights to the ENERGY STAR brand and may do so for a California brand. Manufacturers sell through a distributor/dealer network. Brand differentiation makes it easier to sell the branded product. Since the manufacturing and distribution chains make margins on each sale, it is normally in their interest to move whatever is easiest to sell.

  Distributors are often the key link between retail demand and manufacturing, ordering goods, distributing surplus production, and managing cooperative advertising programs. One observer noted that those in the supply channel (distributors and resellers) "… [are] the ones that invest in taking the brand to the consumer at the point of sale." They also noted that many individuals in the distribution system sometimes decide to "take up a brand," although this is probably more likely for a "public brand" such as ENERGY STAR, since many distribution relationships are exclusive, preventing vendors from carrying competing brands. However, when sets of trade allies do decide "…to pick up the brand … they will spend their money to promote the brand … because they are marketing their [own] product."
- *Managers and owners of leased and rented properties.* Managers and owners of leased and rented buildings need to know what equipment to put in their properties, especially when they pay the utility bills.
- *Nonresidential consumers.* Commercial building owners and tenant firms are customers for both high efficiency and customary products. ENERGY STAR office equipment and appliances are commonly purchased by businesses and government agencies for use in commercial settings. There is reason to believe that a number of these consumers, as in the case of residential consumers, "want to do the right thing." A number of building owners have taken advantage of opportunities to benchmark their buildings using the EPA/DOE database to qualify for an ENERGY STAR Commercial Buildings designation as a high-performing facility.
- *Program participants.* Program participants in most of California's programs dealing with a potentially brand-covered technologies and practices need to understand what is and is not brand-rated and how the technology is related to program services and incentive levels.
- *Real estate agents and lenders.* Real estate agents and lenders may need to work with inspectors or certifiers to arrange equipment upgrades before a sale, especially if home or building energy audits become a requirement in California.

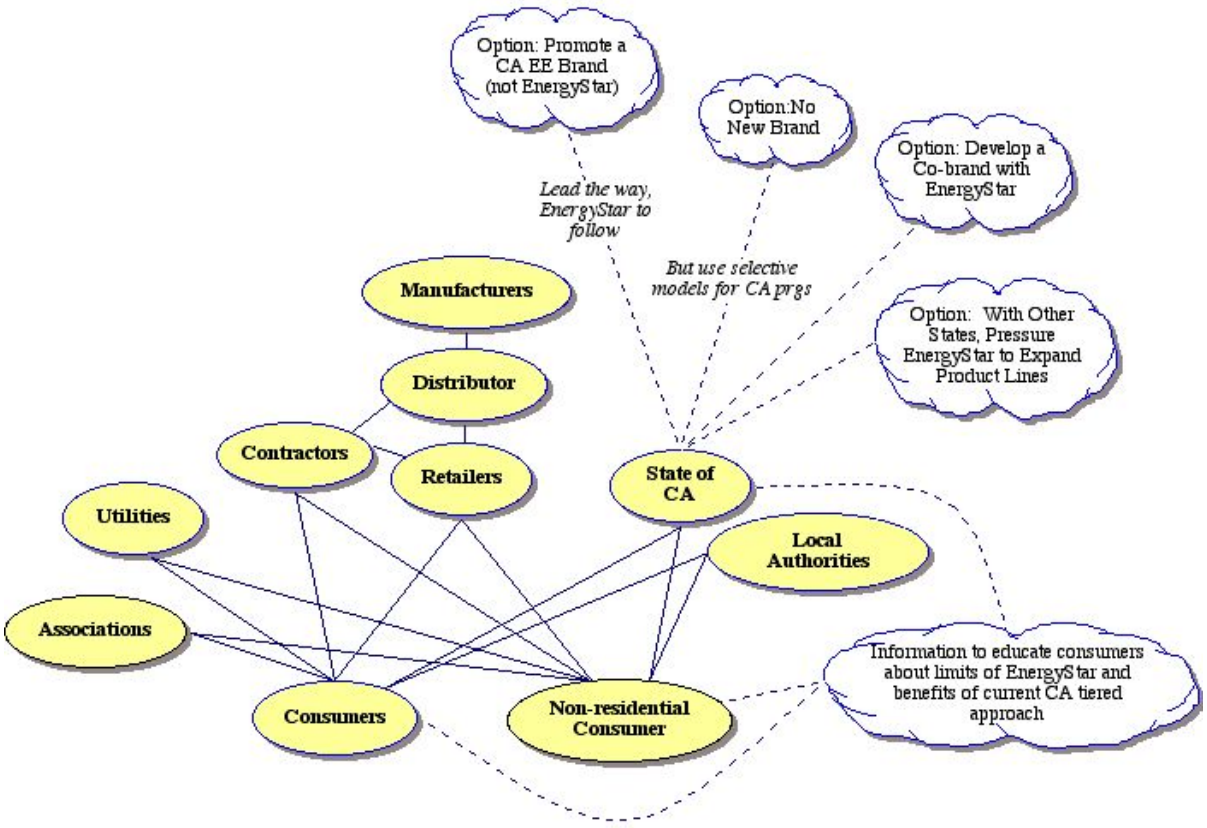
- *Remodeling and renovation designers.* These professionals will typically specify equipment in their designs and specifications and need to know what items are and are not energy savers.
- *Retailers.* Retailers sell the majority of appliances, lighting, and electronics to residential customers and a large share of commercial and government purchasers. Retailers are a primary source of information on branded items and they are often deeply invested in particular brands. Of all of the representatives in this arena, they are the closest to the consumers and they typically "close the deal."
- *State of California.* The state is also a large consumer of branded goods and has supported both ENERGY STAR and California equipment brands through Energy Commission and CPUC programs, including delivery of information and incentives.
- *Utilities and third-party providers.* These groups have promoted ENERGY STAR and other brands in the past, and provide information and recommendations to consumers. Utilities and third-party administrators need to know what to include in their programs.

The actor network diagram for this initiative is shown in Figure 18.

Market Conditions

There are a number of market conditions that will affect the success of this initiative. These include:

1. The approach that California takes in addressing the branding issue and the confusion the approach initiates in the market. It will be important not to send mixed signals in the market, or all energy efficiency branding will be harmed. Consumer confidence in the brand must be kept at a high level. Brand confusion can be generated if not handled well, as there is already an energy brand in the market.
2. The available dollars that can be provided to establishing a new brand, a co brand, or in adjusting the tiered approach to program-qualified products. Establishing a brand is expensive and typically measured in tens or hundreds of millions of dollars. It is not unusual to spend millions of dollars in a single brand recognition event.
3. The ability of California to build brand awareness and overcome lack of knowledge in the purchase decisions by customers, but also the lack of knowledge of all types of market participants that have a direct interest in the brand.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 18. Actor Network Diagram for the Branding Initiative

4. Accessibility of the energy branded products. If the brands are not easily accessible, they may not be adopted. Customers will not wait for brand-associated equipment to become available. It must be in the market before the demand is created.
5. Manufacturer, distributor, dealer and retailer ability to offer branded equipment or to test and certify equipment beyond the current approach. Industry support may be critical, depending on the branding approach taken. Industry must be able to place the products in the market to meet the brand requirements and the products must be promoted by the industry, or the branding initiatives must create enough pull to move the suppliers.
6. The ability of the branding-related initiatives to move decision makers to seek out or specify approved brands.
7. High energy or supply problem prices will drive more customers to branded equipment.

Key Barriers

There are a number of barriers to having a branding initiative that the program design will need to address. These include:

- *The lack of strong support in California for a new brand.* Few people think that having a new energy efficiency brand to compete with the established ENERGY STAR brand is worth the effort.
- *Industry may balk.* Industry may not agree with the notion of placing new branding mechanisms in their path and resist this approach. Without industry cooperation branding initiatives will fail.
- *Market awareness for the ENERGY STAR brand* is high and rising each year during the last several years. New initiatives would need to compete for customer recognition.
- *Cost and confusion of establishing a new brand can be high*. Brand awareness building is expensive and will result in confusion between competing brands.
- *Market channels and coordinated program support* will need to be established for any new brand.
- *New education initiatives* would be required to educate a wide range of organizations and professionals that would be affected by a new brand approach.

Strategies for Overcoming Key Barriers

There are few strategies for mitigating the barriers identified above that could be easily, quickly, and/or inexpensively implemented. That is the nature of creating a new brand. However, there are several strategies for accomplishing the branding needs without establishing a new brand. These include:

- Continue to use the ENERGY STAR brand and continue selecting specific models to include in California's energy programs. Use the tiered approach and continue to try to educate consumers. Unfortunately this will also increase confusion in the market, as many customers will think that if it is ENERGY STAR, it is the most efficient choice, but then it will not qualify for program incentives.
- Limit incentives to only specific ENERGY STAR models or establish a new co brand. Establish an Energy $mart or Energy Commission-certified (or other name) level of efficiency identification process that moves beyond the ENERGY STAR brand but only qualifies the higher level ENERGY STAR products for program inclusion.
- Expand the new co brand into new product lines and service systems so that the newly covered products reflect the co brand. Then, as ENERGY STAR catches up, include the ENERGY STAR brand with the co brand.

- Move into new branding aggressively. Promote branding concepts such as the Energy Commission-certified kitchen, or the Energy Commission Certified Commissioning approach.
- Work with states like New York, Wisconsin, Vermont, and others to build consensus about what products and services should be ENERGY STAR rated. Act as a branding expediter for ENERGY STAR and work with federal legislators to have ENERGY STAR move more quickly into brand development. Consider building multi-state brands that are controlled beyond the ENERGY STAR label.
- Work with ENERGY STAR to develop co-brand names, such as ENERGY STAR-PLUS or BEYOND ENERGY STAR to differentiate products but not fully abandon the ENERGY STAR market recognition.
- Set ENERGY STAR certification as the minimum level of practice for energy efficient, environmentally effective purchasing, but establish co-branding that is considered for resource acquisition and educational efforts to supplement the ENERGY STAR brand.

These efforts will substantially reduce the barriers associated with developing a whole new brand, and if effectively implemented will allow the initiative to succeed and grow in its impacts.

Information, Case Studies, and Demonstrations

Sector:	*Trigger Event:*	*Intervention Type:*
Residential and Commercial	No specific trigger event	Voluntary

This initiative provides technology transfer materials needed to make the market connections to effectively overcome information-related market barriers that would otherwise inhibit the market penetration and use of energy efficient products and services. This initiative supports all the other initiatives in the portfolio. Elements of the initiative include; identifying key market participants; determining related market barriers; designing and developing information products to overcome those barriers; and developing and executing an information dissemination plan to get the information products to the relevant stakeholder. Information products need to be developed and delivered for each initiative recommended in this report and as such will be an integral part of each commercial sector and residential sector intervention.

Information products will include fact sheets and brochures, product directories, and guidelines for design, installation, operation and maintenance. Training materials will be developed that will include manuals, presentations and videos. Walk-through tours of operating installations and connections with industry/association meetings will also contribute to the effort. All of these elements are designed to overcome specific market barriers described later in this initiative.

Other issues addressed in the following sections include the importance and potential of the initiative to affect California's energy supplies, the interest groups that influence and are affected by this initiative, market conditions and key barriers that will affect the success of the initiative, and strategies for overcoming the barriers and maximizing market penetration and participation.

Initiative Elements

The following paragraphs describe the information products, and the case studies and demonstrations needed to overcome barriers to the market penetration of energy efficient products and services.

Information Products

Information products need to be developed and disseminated to help increase the market penetration of energy efficient products. Each of the information products should be designed to overcome market barriers that otherwise impede the adoption of the desired product by market participants. Market participants can be classified by their function and therefore have similar information needs. Each class of market participants has particular needs that must be satisfied if a new technology is to be specified, financed, installed, operated and used. Most technology product attributes are universally required across all of the functions/chains but some are particularly critical to a subset of the market participants. Information products need to focus their contents on the attributes most important to the market participants or chain of market participants they are designed to address.

- Funders, for example, will be interested in cost-effectiveness, particularly first cost, as well as cost/energy savings. Utilities offering rebates or other incentives to new technologies will also want to know how the technologies save energy compared to conventional systems.
- Business owners are concerned with project planning, obtaining funding, selecting the architect and engineering firm(s), approving the project scope, and tracking expenditures and project progress. Managers are concerned with project specifications that can cost-effectively provide an outstanding work environment.
- Specifiers will also be interested in cost-effectiveness, and how well the system performs compared to specifications. Reduced energy use, improved occupant performance and reliable operation will also be of great interest to this market function/chain. The more technically oriented participants in the "specifier" group will need information on how well the technologies performed in terms of delivering their expected advantages. Similarly and perhaps more importantly are how well the perceived disadvantages have been overcome. The information products that are focused on influencing this group, therefore will pay particular attention to documenting proven performance advantages and how perceived disadvantages have been and can be overcome.

- Suppliers need to see demand for their product and/or anticipate product demand. Information products that provide well-accepted performance evaluation, third-party testimonials, delivered through the most effective channels to specifiers and others in the supplier chain, will encourage dealers and distributors to stock the product, and manufacturers to produce it. If utilities can be influenced to provide financial incentives, this would be a major step toward increasing product availability and reducing acquisition cost.
- Installers would be most receptive to receiving application guidelines showing the simplest and most effective techniques for installing the new technologies and for assuring that they are operating correctly.
- Maintenance personnel/operators need checklists of time-phased maintenance procedures as well as operating manuals that could be used to keep the systems working effectively, assuring their continued high performance.
- Users of the technology such as building occupants, home owners and customers will be concerned with ease of operation, safety, indoor air quality, temperature control, and noise. A brochure for users/occupants could help them understand the virtues of the energy efficient systems and will help the occupants to operate them correctly, assuring that the system advantages are consistently received.
- Codes and standards setting bodies need information on the performance of new technologies to ensure that they adhere to existing requirements. If the new technologies do not comply with existing requirements but nevertheless satisfy the objectives of the codes or standards, then this information should be clearly provided. This will enable the language of the regulation to be changed to permit effective usage of the new technologies.

Information products should be developed by the personnel involved with each particular initiative addressing AB 549 recommendations. This initiative should provide oversight and guidance in design and production of the most appropriate information products and in disseminating them in the most effective manner.

Case Studies and Demonstrations

Market participants tend to favor systems and technologies that have performed well for them in the past. As such there often exists a very substantial resistance to change. Performance information needs to be provided to overcome this resistance to change, and to minimize risk, by assuring market participants that energy efficient products will perform as desired. In this regard, the best approach is to provide the market participant with examples that reinforce the desired outcome. Demonstrations that will provide the desired information are recommended. The information to be derived from these demonstrations should be documented in case studies and guidelines that permit the new adopter to replicate the success of the demonstration. Market participants have different roles in the specifying, design, installation, operation, maintenance, supply, and funding of the energy efficient

products and services and as such require different types of information to be derived from these demonstrations. For example, an operator would desire information on reliable performance, and how to operate and control the equipment. A specifier would also desire information on cost-effectiveness, and sizing. (The market actor section of this intervention describes these roles.) Specific market interventions are suggested to address the market barriers influencing the decisions of each decision maker/market participant.

Demonstrations need to be designed to overcome the market participants natural risk aversion and resistance to change. To be most effective the conditions for the demonstration should be as similar as practical to the conditions of the decision/maker trying to decide whether to specify or endorse specification of the new technology. The test protocol needs to be thoroughly designed to obtain all the information needed for the new technology compared to a conventional “control” unit. Careful monitoring needs to be made using state-of-the-art data recording and retrieval to ensure measurement accuracy and real time analysis of the data needs will permit detection of test anomalies in a manner that affords quick correction. Access to the test site should be permitted to ensure parties that conditions are similar to what they are likely to experience. Concise, well written reports should be provided. Demonstration information should be used to prepare fact sheets and brochures, as outlined in the following section.

Information Product Attributes

The types of products to be produced should include the following:

- Fact sheets, brochures, and flyers featuring case study information from demonstrations.
- Journal articles/technical papers.
- Presentations.
- Application guidelines.
- Training materials and training sessions.
- Walk-through tours.
- “Word of mouth” contacts using the materials above.

Fact Sheets

The fact sheet format will likely consist of the following material.

- *A description of the situation.* Describe the problem and the current technology being used.

- *The technology.* Describe the technology, what it looks like, how it works, and how this differs from current practice. Provide a schematic or photo of the technology.
- *Advantages and opportunities.* Clearly outline the advantages of the new technology and situations where it can best be applied.
- *Applications.* Provide examples of effective applications with initial cost, and operating cost clearly stated.
- *Case studies.* Describe the sites in the study, provide a photograph of the building(s), installations(s), describe the problems overcome, benefits, challenges/lessons learned that can help someone avoid a similar problem, and provide testimonials from the specifiers/users.
- *Sources of information.* Provide authoritative references, opportunities to obtain additional information and technical assistance in implementing the new technology.
- *Other issues.* If applicable, present information on ancillary issues, applicable codes and standards, health and human performance improvement; items not covered in the main body of the fact sheet.

Fact sheets will be produced to suit different audiences. While a substantial amount of the fact sheet material will be similar for all audiences, each audience will be provided with more details addressing their areas of concern. For example, demonstrated cost-effectiveness is likely to be more important to funders, specifiers and energy service companies than it would be to teachers. Occupants, on the other hand, would mostly be interested in ease of operation; safety; indoor environment (temperature control, fresh air, and good acoustics) and attractive appearance; factors that influence the work or home environment. Facilities and maintenance personnel will want to see evidence of reliability as well as ease of operation and information on installation and maintenance requirements.

Journal Articles/Technical Papers

Contact appropriate engineering journals and trade publications to place articles drafted by the initiative leads that explain the benefits of the energy efficient products and service.

Presentations

Develop presentation materials for explaining the benefits of energy efficient systems and services. These materials will act to promote understanding of these systems and services among market participants with the goal of including these systems in specifications for retrofit situations.

Application Guidelines

Application guidelines that deal with the maintenance and operation of equipment for facilities and maintenance personnel should be developed.

In addition, guidelines citing the benefits and applications of energy efficient systems and services for decision-makers controlling design and construction of major remodels and retrofits should be created.

Such guidelines will promote understanding among mainstream design professionals of energy efficient system applications and practices in residential and commercial buildings.

The guidelines will contain the following information:

- Description of the technology, including a photo or schematic, indication of applicable space, climate, when to consider the technology in the planning cycle, variations and options.
- Applicability, configuration, building type;
- Applicable codes.
- Integrated design implications.
- Cost-effectiveness.
- Advantages/disadvantages.
- Design tools.
- Design details.
- Operation and maintenance issues.
- Commissioning.
- Attributes of available products.
- References/additional information.

The information provided in the guidelines and the format used will be tailored to suit the audience. For example, guidelines for maintenance and operation of energy efficient systems may be different than those for conventional systems. To provide guidelines useful for facilities and maintenance personnel would necessitate substantial expansion of the operation and maintenance section of the guidelines to include instructions to deal with settings and controls issues; calibration issues; software training issues; automatic and manual overrides; maintenance items and schedules; and other related items. Guidelines useful to specifiers would include material on the specification of available energy efficient products.

Training Materials and Training Sessions

Staff at the five utility sponsored energy centers should organize and promote training sessions for the energy efficient systems and practices identified under this initiative. Energy center staff should coordinate with initiative staff to develop special all-day and half-day training curricula. Information from the fact sheets, application guidelines, technical papers, journal articles and presentation materials in the training materials should be included. The initiative should assist in developing guidelines for energy efficient systems in ongoing training programs such as the CHPS training program. Training sessions and corresponding presentation materials should be developed for equipment specifiers, installers, operators, maintainers and users.

Walk-Through Tours

Walk-through tours at demonstration sites should be arranged and conducted, including provisions for these tours and for onsite meetings in the site agreements

"Word of Mouth" contacts

A "word of mouth" movement should be created by involving opinion leaders in the process of convincing them of the benefits of the systems, services and practices contained in the program initiatives. Initiative technical staff should work closely with a opinion leaders and influential market participants to ensure that the initiative is designed to meet their needs and that the results are accepted by their peers. For example:

- Contacts should be established and relationships facilitated to enable working with legislators and/or the state allocations board to provide incentives for modernization projects that employ energy efficient systems.
- Manufacturers should be consulted to promote awareness of the market need for developing new lines of products, or adapting existing products, to the energy efficient application with the greatest energy and demand saving potential.
- Program staff should attend key meetings to "get the word out" to influential market participants. Program staff should regularly interact with federal and state government personnel in the normal course of their business; HVAC professionals at ASHRAE; business personnel at association meetings; utility personnel and specifiers at training sessions at utility energy centers across the state; and a range of experts and market participant at industry meetings.

What is needed is a technology transfer/market connection effort that extends well beyond the completion of any research, development, and demonstration (RD&D) advocated in other initiatives in this program. Such an effort should extend perhaps two years or more after the completion of RD&D to ensure that the energy efficient products get a chance to mature before they are overwhelmed by cheaper, easier to

sell, and/or less efficient products. Manufacturers will sell whatever is easiest to sell. It's up to the energy efficiency advocates to provide the information and the infrastructure support to make efficiency an easy sell.

Barriers to the sales of energy efficient equipment can include:

- A lack of familiarity with the equipment.
- Uncertainty as to how the equipment will perform.
- Lack of knowledge of product or service availability.
- Lack of understanding of installation, operating and maintenance issues.
- Transaction costs.
- Resistance to change.

The technology transfer products should be designed to overcome these market barriers with well designed and presented product directories, case studies, and guidelines for specifying, buying, installing, operating, monitoring, maintaining, and servicing the energy efficient products developed in this upstream initiative.

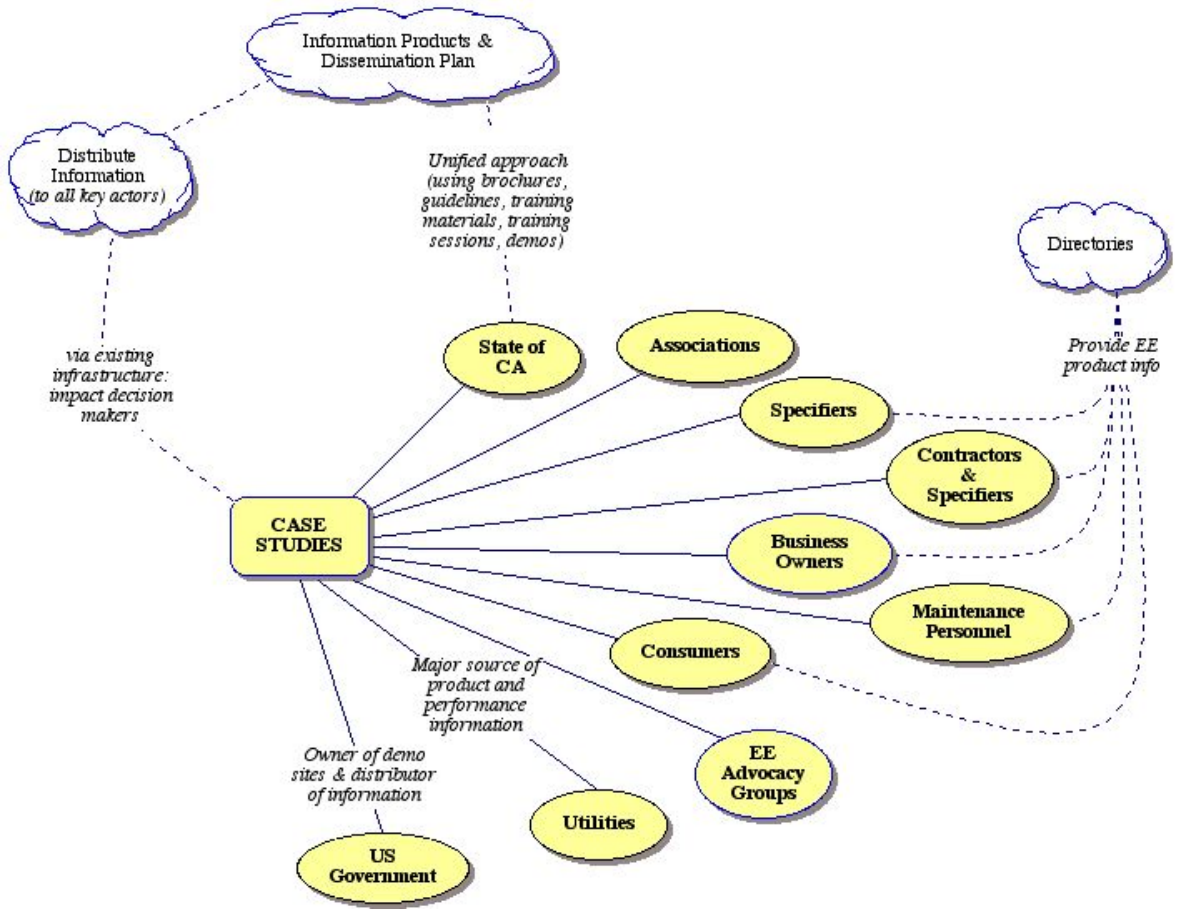
Affected Groups

The following tabulation identifies the key interest groups that are affected by this initiative and influence this initiative. Since this initiative supports all the initiatives in the program, all interest groups in their respective sectors need to be considered.

- *Associations.* Industry groups and trade associations will need to support the technology transfer marketing efforts to encourage market penetration, and to encourage training of their constituents to adequately deploy new technologies.
- *Building owners.* The largest private and institutional owners "…are the most important players in general." They serve as role models to other property owners and building managers. As one observer put it "If you could get the big owners to demonstrate–the smaller guys may see it and think 'I could do that too.'" Another suggested that "The large owners also hold the largest market share, and they may inspire smaller owners to improve their own buildings."
- *Consumers.* Can provide useful models (sources of ideas) for consumers and can be a first stop in research for those who are "… in the habit of researching an improvement to their home." Can also demonstrate a complete working solution (i.e., "I don't have to look into whatever the idea was, because someone else already did the work, what a relief."). At the same time, other consumers may not be persuaded by demonstrations, choosing to rely on trusted vendors, brands, contractors' advice, et cetera (e.g., "I don't care, I just want a Whirlpool.").
- *Contractors and specifiers.* Contractors often select the product to be installed in a retrofit, major remodel situation and as such will be users of the information provided to assist in product selection and use.
- *Distributors.* The distributors of energy efficient products can use technology transfer and promotional materials and activities to make it easier to sell these products.

- *Lenders.* This includes other groups in lending/real estate networks, including real estate agencies, appraisers, and secondary mortgage brokers. They are likely to be eager recipients of any documentation of building performance that allows them to assess a prospective building owner's operating costs and therefore their ability to repay a loan.
- *Manufacturers.* Manufacturers will be the focal point for distributing the technology transfer materials developed to overcome the adoption barriers of market participants.
- *Nonresidential customers.* Nonresidential customers will benefit from increased availability of energy efficient products and the information needed to make informed market decision and to use the product effectively.
- *Residential customers.* Residential customers will benefit from increased availability of energy efficient products and the information needed to make informed market decisions and to use the product effectively.
- *State of California, Energy Commission (PIER).* The Energy Commission (in partnership perhaps with DOE, ASERTTI and other R&D funders) organizations could provide funding for the technology transfer and market connection activities advocated in this initiative.
- *State of California.* The state is a very large owner and tenant of commercial real estate, providing sites of previous and potential future demonstrations. The state has distribution channels that could be used to disseminate relevant information to their constituents.
- *U. S. Government.* The federal government is another very large owner and tenant of commercial real estate, providing sites of previous and potential future demonstrations. It would be a consumer of demonstration information. The U.S. government has distribution channels that could be used to disseminate relevant information to their constituents.
- *Utilities.* Utilities should be one of the best sources of product and performance information that can help promote energy efficient products and services. Utility energy centers can be a focal point for training and for distribution of information products. They have been a previous sponsor of demonstrations.

The actor network diagram for this initiative is shown in Figure 19.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 19. Actor Network Diagram for Information, Demonstrations and Case Studies

This initiative, if successfully implemented, will have an effect across the market. Product manufacturers will be stimulated to produce and promote lower-cost, energy efficient products. Associations of manufacturers, such as ARI (Air-conditioning and Refrigeration Institute, CRMA (Commercial Refrigeration Manufacturer's Association), AHAM (Association of Home Appliance Manufacturers) and GAMA (Gas Appliance Manufacturer's Association) and others will be encouraged to develop test procedures, training materials, courses and ratings for the energy efficient products. The initiative will make it easier for distributors and dealers to sell high efficiency products by reducing their cost and providing ancillary materials and support to facilitate sales. Consumers and specifiers will be provided with cost-effective, higher efficiency products and the information needed to select, install and operate this equipment. Organizations such as ASHRAE (American Society of Heating, Refrigerating and Air-conditioning Engineers), and ACCA (Air Conditioning Contractors of America) that represent these market participants will play key roles

in providing this information and monitoring its utilization. Utilities such as PG&E, SCE, SMUD, SCG and SDG&E that maintain energy centers will be provided with information materials for distribution to their customers and for running training sessions to educate key market participants. Utilities will be able to satisfy their demand-side management objectives more readily of cost-effective, energy efficient products become more readily available as a consequence of this initiative. As more energy efficient products are placed in the market, suppliers and service contractors will obtain more experience with the energy efficient choices, creating a stronger service sector for the energy efficient choices. These changes should take place in the entire market, and thereby affect all interest groups and technology consumers. The result will be increased efficiency across the product stream. If successfully launched, many product lines should be impacted by this initiative. If successful, the impact of this initiative will grow in the market as other R&D organizations partner with the Energy Commission to further leverage this initiative.

Market Conditions

There are a number of issues and market conditions that will affect the success of this initiative. These include:

- *Finding funding* to support this initiative will be the first hurdle to overcome. Funding could come from utilities, from the Energy Commission, including the PIER program and from partnerships with manufacturers, other R&D and energy efficiency advocacy organizations and other market participants.
- *Coordination with other initiatives* will be a key to optimizing the cost-effectiveness of all initiatives in this Program by providing well-designed and well-executed market connections, and information dissemination efforts. A coordinated effort will be required between all interest groups to make these efforts successful.
- *The manufacturer's distribution chain needs to buy into the marketing and sales efforts* for the energy efficient products that are developed and promoted. The distributors and dealers need to avail themselves of the ancillary information products provided to them as part of the marketing campaign and use them to overcome the market barriers of those specifiers and customers making product selection choices.
- *Prevent price gouging*. As the product becomes successful and sales grow, the distribution chain needs to moderate their natural desire to increase product prices to increase their profits and as such dampen demand and reduce sales momentum.
- *Energy efficient product shortages may occur.* If the initiative is rapidly successful there may be a shortage of the energy efficient technologies and products in the market and an overabundance of inefficient choices, causing a price drop in the inefficient choice, thereby potentially boosting their market demand, causing more of the lower cost items to be placed in the market.

- *Familiarity can breed acceptance.* As the energy efficient choices become more established in the market, parts and service for the inefficient choice may become a lower priority for stocking practices.

Key Barriers

The barriers associated with this initiative are principally the market barriers inhibiting the selection, installation and use of energy efficient products and services. An educational system or operational structure is needed that can place energy efficient information into the hands of the decision makers. Interviewees point out that “people don’t always know what is efficient and what to buy, they need to be educated about the fact that you can buy in a way that is energy efficient and environmentally friendly.” Because the level of energy efficiency across different makes and models changes all the time as a normal course of the market operations, there needs to be a way that specifiers are kept up-to-date on what is efficient. Specific barriers include:

- Performance uncertainties exist that inhibit selection of energy efficient products and services. Market participants need to experience the performance of energy efficient technology as it is affected by their own unique operating conditions, practices or preferences.
- Asymmetric information and opportunism exists wherein sellers of equipment and services know more than buyers. Obtaining equivalent information may be costly or impossible for the buyer.
- Hidden costs occurring because of unexpected operation, monitoring, servicing or maintenance costs can be minimized by providing operating, monitoring, servicing and maintenance guidelines for facilities and maintenance personnel.
- Rules of thumb and standard selection practices often limit consideration of new technology options. There is a bureaucratic tendency to be risk averse. Misplaced or split incentives exist with institutional relationships where the person charged with deciding on adopting a new technology is not the person who benefits from the technology.
- New products may not be readily available because of stocking practices of the dealer networks.
- It may not be clear if a technology can be deployed in retrofit situations and the means to do so may not be clear.
- Existing codes and standards may not properly account for attributes of new technologies making it difficult to favorably deploy the technologies in their most suitable applications.

Strategies for Overcoming Key Barriers

Existing infrastructure should be used as much as possible to place energy efficient information into the hands of the decision makers. This could include utility networks, trade association and industry publications and distribution channels. Specific strategies recommended include:

- Specifiers and installers need a directory that provides the characteristics and performance of available energy efficient products and practices and where to obtain them.
- To overcome resistance or change and related performance uncertainties, market participants need case studies based on well-documented performance demonstrations and testimonials from their colleagues with similar requirements.
- Information on ownership costs, energy, and performance from a reputable third-party, is needed to assist the buyer/specifier in making a selection/purchase decision. Associated training and technical assistance would be helpful.
- The cost of acquiring energy efficient products, i.e. transaction costs, can be minimized by providing guidelines, training and technical assistance for specifying, buying and installing a product.
- Hidden costs occurring because of unexpected operation, monitoring, servicing or maintenance costs can be minimized by providing operating, monitoring, servicing and maintenance guidelines for facilities and maintenance personnel.
- Case studies documenting cost-effectiveness and other performance advantages are needed to overcome rules of thumb that might otherwise inhibit consideration. Case studies focused on economic, and other benefits can help overcome the bureaucratic tendency to be risk averse. Both case studies require strong messages that clearly show benefits.
- Case study information to help the manager/specifier understand the energy, health and productivity benefits of the new technologies should help overcome the problem of split incentives and encourage consideration of organizationally beneficial technologies.
- To ensure that new products are readily available, aggressive publicity for the product should be employed to increase awareness of the need for increasing inventories to keep up with demand.
- If retrofits are possible, make it clear that this is so and also provide clear instructions on how to modify the building for these retrofits and how to install the product.
- To ensure that existing codes and standards properly account for attributes of new technologies, the performance of the new technology should be documented, providing evidence that a waiver or alteration is required in the

existing codes and standards. The information should then be prepared, packaged and presented to influential individuals and organizations to affect the desired changes.

The following programmatic actions would help mobilize this effort.

- *Identify information dissemination opportunities.* Look at all other initiatives in this Program to identify market barriers and corresponding information product opportunities for overcoming these barriers.
- *Design information products.* Prepare a plan for developing information products to overcome market barriers that includes fact sheets, brochures, guidelines, training materials and training sessions, presentations, papers, and walk-through tours. This will include design and execution of demonstrations to provide documented, credible case study information.
- *Develop information dissemination plan*. Prepare a plan for distributing information products to overcome market barriers that includes fact sheets, brochures, guidelines, training materials and training sessions, presentations, papers, and walk-through tours. Utilize utilities and their energy centers, government organizations and their clearinghouses, manufacturers and their distribution chains, industry trade associations and their channels to reach building owners, specifiers, facility managers, users, and energy efficiency and environmental advocacy groups, to effectively disseminate information to their constituents.
- *Develop and disseminate information products.* Execute the information products design plan and the information dissemination plan to develop and deliver information products to support all the initiatives in this Program.

Technical Training and Certification

Sector:	*Trigger Event:*	*Intervention Type:*
Residential and Commercial	No specific trigger event	Voluntary (Certification could be Mandatory)

This initiative focuses on training and certification for expanding building-level energy efficiency assessment skills in the market. In addition, the initiative also includes a certification component to guarantee that technicians and building assessors providing energy services are sufficiently trained to provide these complex, interactive assessments and services. It is anticipated that certifying experts will help to influence the quality of the professionals providing these services to ensure that a high quality assessment product is provided. This will help establish market confidence in the related high efficiency products and services leading to expanded market demand for high efficiency. Several experts, who were interviewed in this study, or who served on one of the expert panels, expressed a need for a

training program that can be supported by energy efficiency funds to improve the skills of practitioners and build market demand. However, it was noted that the training and certification initiative must be implemented in close coordination with market development initiatives aimed at building market value and stimulating customer demand by demonstrating the ability of skilled professionals to provide valued services that result in energy savings and improved internal and external environmental conditions.

The training and certification initiative discussed in this section focuses on training two types of individuals. On type is the energy assessor who can diagnose a building's energy related performance problems and make recommendations to solve the problem ultimately by making the building more energy efficient. There also are needs for a training and certification programs for builders of energy efficient structures and installers of energy efficient equipment. These market actors are capable of building structures and deploying energy efficient equipment to achieve maximum energy efficiency at the building performance level and maintain satisfied occupants. The training efforts may need to be segregated into efforts focused on construction practices, operational practices, installation practices, and approaches to improve energy performance in existing buildings. The different course content needed for these functions should be considered further as the training development process is developed.

The trigger events associated with this initiative are the educational processes that are used by people entering, or wanting to enter, the energy technologies and technology services field. Continued educational needs for those already in the field present another opportunity. While these are not the only possible trigger events, they are the events in which a training and certification initiative will capture the most interest.

Energy Efficient Technical Training and Certification

One of the key market barriers to expanding energy assessments as an approach to capturing more savings is the number of people entering the energy assessment field in specific, and the energy equipment performance field in general. Several interviewees and experts indicated that a lack of highly skilled, trained and certified individuals (especially at the whole building level) could stand in the way of initiatives designed to expand the number of assessments that can be conducted in California to achieve energy savings. There was general support across the interviewees and the experts taking part in the panel sessions that California needed to launch a program that moves more individuals into the assessment field to respond to increased demand for these services as influenced by California's energy efficiency programs. However, these experts also indicate that training must integrate technology issues into a whole building assessment approach. The training must be well developed so that it provides people with needed skills, provides a method for certifying who has these skills, and is linked to initiatives that build service demand.

Experts also indicated that the market for these individuals is tight and barriers exist that will need to be overcome regarding the educational system's financial ability to

provide training and the time constraints on people who will need to obtain the training and certification. Likewise, experts warn that the training must be linked with demand-building initiatives so that trained and certified individuals can readily find positions in the markets in which their skills can be applied. Other initiatives presented in this report will build this demand for skilled professionals. Experts suggested that training institutions will need financial help in establishing and providing the programs to produce trained and certified experts. This jump start is needed, at least in the short-term, until the training programs become well established and provide clear value to the students.

Interviewees suggested that technical training and certification should focus on building commissioning to ensure that trained understand how to discern whether the systems in the buildings work together to achieve savings instead of working against each other. Interviewees and expert panel members agree that the people typically responsible for building operations and maintenance do not have the skills to understand buildings from a systems approach. These people work on the systems one technology at a time, and building decision makers often use outside contractors for these services. The outside contractors are often operating a “low-cost” mode and have to get in and get out quickly to make a profit. As a result they work on the building’s issues one technology at a time. It was also noted that building owners and operators often do not know that they have systems that are not well maintained, not working together or are working against each other. It was suggested that there is a need to educate building decision makers that buildings can have systems that work against each other and that this has an impact on comfort and costs if not properly addressed. The initiative would need to focus on educating building owners, managers and operators about energy and non-energy effects of poor performing buildings to enhance market pull for energy efficient buildings and practices.

Training at the residential level is suggested to focus on increasing the supply of building auditors so they have the skills to assess technology level problems, but also to assess building-level problems that affect energy efficiency. This effort would also need to move ahead on several fronts, increasing market knowledge, demand and skills simultaneously.

Interviewees, as well as expert panel members stressed the importance of energy efficiency, occupant comfort and establishing a safe internal environment. These people also think that when people purchase a home or building they should be advised of the energy efficiency and environmental conditions of the structures they are buying. As a result, there is support for establishing a requirement that all buildings receive a detailed whole building energy assessment during the property inspection process prior to a change in ownership. There is also general agreement that this will require a significant increase in the number of skilled professionals to fill this need. If California is to move ahead with making energy inspections part of the real-estate-purchase process, more professionals will be needed to provide these services. The auditing and assessment industry will both need help in meeting the demand for skilled professionals that is placed on the system.

In addition to mandatory energy efficiency inspections required as part of the real-estate transactions, several interviewees and panel members indicated that if decision makers know that their buildings can be significantly more energy efficient, more comfortable and safer, there would be increased demand for professionals to do energy efficiency inspections. However, if demand was increased through an educational approach, training support would be required to produce the needed assessors. As part of this AB 549 research, several individuals suggested that these assessors will need to be certified so that there is confidence in the services they provide, but more importantly so that the assessment is done professionally and that the quality standard for the assessment process is kept high enough to maintain service demand, strong energy savings and acquired benefits from implementing assessment recommendations.

Technical Training Grants

One way to initiate an education and certification effort, which was supported by several interviewees and expert panel members, is by establishing training curricula within the technical and community colleges. This training would thus be incorporated into the college's building trades and technologies curricula creating a professional development course within the currently established trade's development courses. This would, of course, require planning, materials development, and equipment acquisition, linked with strong training oversight and monitoring. Unfortunately, in the last 30 years schools have moved away from these types of training efforts because of the high cost of the training and correspondingly lower training budgets. It is much cheaper to have a room filled with desks and teach math than it is to train people in a laboratory on a range of equipment and equipment interactions and operational characteristics. As a result, technical and community colleges have been reluctant to provide energy assessment training unless that training is underwritten through a reliable funding source. Policy makers should consider providing training initiative resources to the technical and community colleges through the current funding sources available for California's energy efficiency efforts.

Panel experts suggested that the real estate profession is not fully aware of the benefits of energy assessments or the value of an energy efficient home and are interested only in moving the home as quickly as possible. These concepts may not be mutually exclusive.

Interviewees suggested that a statewide education and training initiative could be developed for about $20 million dollars a year and could be implemented and begin producing skilled professionals with advanced skills in about a year. Experts suggested the following training options:

- *Focus on a building systems approach.* When developing training efforts, they should fit within a systems approach to energy efficient construction practices and assessment techniques. Trainees will thus be made aware of how construction and specifying practices affect the efficiency of the buildings, not just

the efficiency of parts of the building or of the technologies. This approach can be an integrated approach where the overall goal is system knowledge, with individual training components focusing on key technologies and practices and both their stand-alone and integrated performance. Interviewees suggested a systematic buildings program that covers all the basic parts, but ties the results together so that a gain in one place is not lost in another place.

- *Provide both residential and nonresidential course components.* Small-residential and residential-sized structures behave differently than larger buildings such as commercial and large residential structures. They have different technology needs and different performance characteristics. Training and experience in residential structure assessment and construction does not equate to providing adequate skills for larger structure assessments or construction.
- *Training should be tied to achieving certification.* Interviewees suggested that there needs to be a strong certification program in which contractors that obtain training, or can demonstrate knowledge and skills, can be certified as an energy efficiency professional capable of assessing or installing/building the most highly efficient equipment and structures. There may need to be a Master Energy Certificates for Assessors, Installers, and Builders.

Experts agreed that the educational system, as it is currently configured and funded, may not be able to adjust to providing these services without some support in the form of grants or other financial support. The financial support should be linked to a performance assessment effort that monitors how the funds are spent, to ensure that the training is of high quality and meets the needs of the developing field.

Certification Process

Interviewees and panel members suggested that there needs to be a certification process in place to make sure that people in the field who are doing the assessments (especially if required as part of a real estate transaction) installation and construction efforts are properly skilled. Panel members noted that there are many openings in the energy equipment maintenance and operations field and that the construction field can be somewhat transitory, resulting in many unskilled people being involved in both of these fields. There is a need to make sure that people doing energy assessments are trained and skilled in these area, and to make sure that building professionals doing ENERGY STAR or branded buildings know what they are doing.

Panel members and interviewees also noted that energy auditors and assessors need to be highly skilled and understand not only equipment performance issues and approaches but also need to understand how equipment systems and buildings interact and how to look for and find improvements. This also applies to construction professionals. Experts noted that there are certification organizations that can take responsibility for the training task if supported to do so. Experts noted that NATE already does certifications and can expand to upgrade the process in California. NATE is now getting ready to launch an advanced certification process for HVAC

systems that could be applied to California. And energy efficient construction practices should be incorporated into current construction trades programs.

Other expert panel participants suggested that HVAC systems are going in without proper setup procedures and suggested that the State establish certification procedures for installers so that installations are done properly. It was noted that many systems are installed or tuned improperly and that effective training and certification was needed to correct these deficiencies.

Expand Audit Training to Whole Building Systems Approach

Several experts noted that auditors need to be trained in whole building assessment techniques. They suggested that it is not enough to inspect the key components of a structure without an assessment of the interrelated performance of the building components. Examples include: duct systems that work against heating or cooling requirements; lighting and other systems that overload space-conditioning equipment; lack of use or effective use of untreated or outside air; lost opportunities to use heat recovery when parts of a building need cooling while other parts need heating; technology selections that work, but are the wrong technology for the building's configuration or use; improperly sized equipment requiring adjustments to compensate, which increase energy use; poor circulation or moisture control that reduces insulation performance or causes health problems, et cetera.

Experts agree that the auditing training needs to not just focus on individual technologies, but also focus on the interaction of the technologies and the performance of the building.

Affected Groups

The organizations that are participating in this initiative and will be affected by the initiative are outlined as follows:

- *Oversight organization.* A central authority will be needed to handle the development of this initiative, to focus on course needs and to work with stakeholders to design and launch the initiatives and to oversee and monitor performance. An organization such as the Energy Commission or an independent private sector or nonprofit organization skilled in these approaches will need to carry the ball and champion the effort. They will need a strong background in energy efficiency, energy auditing, installation practices, assessment skills and understanding of energy efficient design and construction techniques. They should also have skilled people who have extensive experience in the construction and trades industries and understand how educational systems are integrated into these trade industries.
- *Technical and community colleges.* These are typically the best institutions in which to place trade and trade associated training efforts. There is a generally recognized need within this arena to provide skills development training. This

initiative is consistent with this recognized need. If financial support can be provided, the technical and community colleges should be receptive to expanded skill development efforts for the energy efficiency assessment, contracting and construction industry.

- *Certifying organizations.* Certification of knowledge and skill levels will need to be incorporated into the training efforts. These can be considered for implementation via the colleges that provide the training, via state agencies that handle licensing or via nonprofit organizations that specialize in certification programs, such as NATE (North American Technical Excellence).
- *Utility companies.* Many customers look to their energy providers to help them with energy issues. The utilities companies would need to be supportive and provide guidance to owners who wanted or needed this type of service. As a result, customers would consult their utility companies for guidance and recommendations about this service and the benefits. Utilities will need to be "on board" and be able to recommend the service to their customers. As a result, the utilities should be involved in the development of the education and training efforts to have confidence that the service can provide customer value. Utility energy centers might serve as training sites for selected courses.
- *Real estate industry.* If energy inspections were to become required at the time-of-sale the real estate industry would have to be supportive and actively incorporate the initiative into their processes (see audit and assessment initiative). As a result, it would be appropriate to include the real estate industry in the development of the training and certification initiatives. Assessors would need to be well educated in the real estate transfer process and the timelines required of that process. It would be critical for the energy assessment process not to slow down the transfer process in any way and assessors will need to be knowledgeable about these processes. This would be a critical part of the education and certification initiative.
- *Equipment suppliers.* The training will need to cover a wide range of equipment that is found in commercial buildings and in homes. As such it may be appropriate to involve equipment suppliers in the training development coordination efforts. They may be able to help guide some of the training curricula development with respects to their equipment and operational characteristics.

Other interest groups connected to this initiative include:

- *Associations.* Industry associations play a variety of roles in certification of products, programs, processes and personnel. Some associations actually construct certification standards, deliver training, administer tests, and award certifications. Some offer certain services (e.g., testing and certification) and leave the others (e.g., training) to other entities. Trade groups promote certification and refer prospective customers to certified dealers or contractors. Some professions (e.g., home inspectors) may be able to use certification of products and processes as sources of information about system design and quality. For example, having an ENERGY STAR air conditioner, refrigerator or

performance-tested house may be a marker of quality and formally noted on inspection reports. To the degree that individual professionals are not in a position to establish standards and benchmarks, the certification process at the industry association level serves that purpose for them.

- Industry associations are seen as particularly important actors in this area. They include trade groups for general contractors, remediless, HVAC and specialty contractors, labor unions, and energy services professionals. One observer noted that their role is particularly important because "…they are reaching individual contractors directly and are already part of the infrastructure." Organizations include North American Technical Excellence (NATE) and the Air Conditioner Contractors of America (ACCA) among others.
- *Building owners and managers.* Some observers noted a perceived value to some owners to secure ENERGY STAR status for their homes or buildings. ENERGY STAR and other certifications also provide confidence of product/process quality and performance that reduces search costs and time required when making efficiency choices, which is important given the variable level of sophistication of building owners, property managers, and building operators. Others noted the advertising value of ENERGY STAR building recognition.
- *Consumers.* Homeowners, and to some degree renters, have a stake in making good decisions related to the energy-using characteristics of their appliances and homes. Consumers are familiar with certification in a number of market contexts. For example, they understand UL listing, J.D. Powers ratings, Good Housekeeping seals of approval, USDA organic standards, AAA approval, et cetera. They understand that some third-party has something at stake in issuing an evaluation of the product, process or professional being certified. If the certifier is a trusted agent, then the fact of certification can be taken as evidence that objective standards were applied and met to earn the certification. This stands then as a concise source of information for decision making in cases of complex choices with limited information. It allows the consumer to "cut through the noise" and make a responsible choice with a minimal amount of effort (and transaction cost).

  Residential energy consumers are seen by multiple observers as a potent source of support for energy efficiency products and services. This is because they are perceived to care about their personal impact on the environment, to be concerned about dependence on foreign sources of oil, and to be generally motivated to "do the right thing." They are also perceived to have an affective "concern for maintaining the home," as well as a financial stake, since "…people are not able to move because of tight housing markets; they just need to stay put, and will invest in the house that they have." Certification allows them to make good choices in their home improvement and maintenance investments. Consumers expect technically competent and well-trained designers, contractors and technicians to be working on or assessing their homes. Systems of product warrantees and service guarantees support those expectations.

- *Contractors.* Observers note, however, that contractors and their employees chronically lack expertise in energy efficiency. They cite a lack of training, employee turnover, poor supply of trained workers, need to complete jobs quickly, lack of regulatory oversight, lack of professional standards and peer pressures, and a host of other causes. These problems are identified in large firms as well as small ones. In addition, the limited success of some trained contractor's efforts to develop whole house diagnosis and retrofit businesses have been traced to lack of basic business skills. Innovation and change among contractors is driven by code changes, requirements imposed by suppliers (e.g., HVAC equipment manufacturers), and observed changes being made by competitors. As one observer put it: "everyone else is doing it"—i.e., a fear of "being left behind" or need to stay current, works in motivating the market. It is important to note that contractors cultivate a customer base and many consumers enjoy long-term relationships of trust with particular contractors (regardless of whether the energy advice provided is as good as it could be).
- *Energy Efficiency Service Providers.* These include specialized property managers, consulting engineers, ESCOs, manufacturer's representatives, commissioning agents, retailers, et cetera. A newly emerging group is the "systems integrators"—specialists that can look at buildings from the system perspective. They may perform the testing, provide recommendations and implement changes, or just parts of that continuum of services.
- *Higher education.* This includes technical schools and community colleges offering specialized training in HVAC, energy auditing, energy management, building operations, et cetera. These institutions are primarily responsible for providing training to new people entering the market as technicians and contractors. They have been adversely affected by budget cuts and have moved away from the trades focusing more on four-year college prep course work. There now are relatively few schools offering comprehensive training in any of the areas of interest to this initiative. Also there is an existing adult education infrastructure that offers some level of ongoing and introductory training.
- *Local authorities.* In addition to schools, city and county level economic development programs can provide training in basic business development and management needed for successful contracting businesses. Also, cities and counties have credibility related to buildings, licensing, and in some cases energy, which allows them to offer at least incidental advice in response to consumer requests for information about trained contractors for energy improvement.
- *Manufacturers.* Some manufacturers currently require certification of technicians who work for the contractors to which they supply products (e.g., in HVAC contracting firms to which a manufacturer is a major suppliers of product and support). Manufacturers provide training for retailers, distributors, installers, and technicians in operations and repair of HVAC, appliances, and production equipment. Manufacturers might be participate in this initiative by donating equipment to the training programs and providing corresponding installation and maintenance manuals and materials.

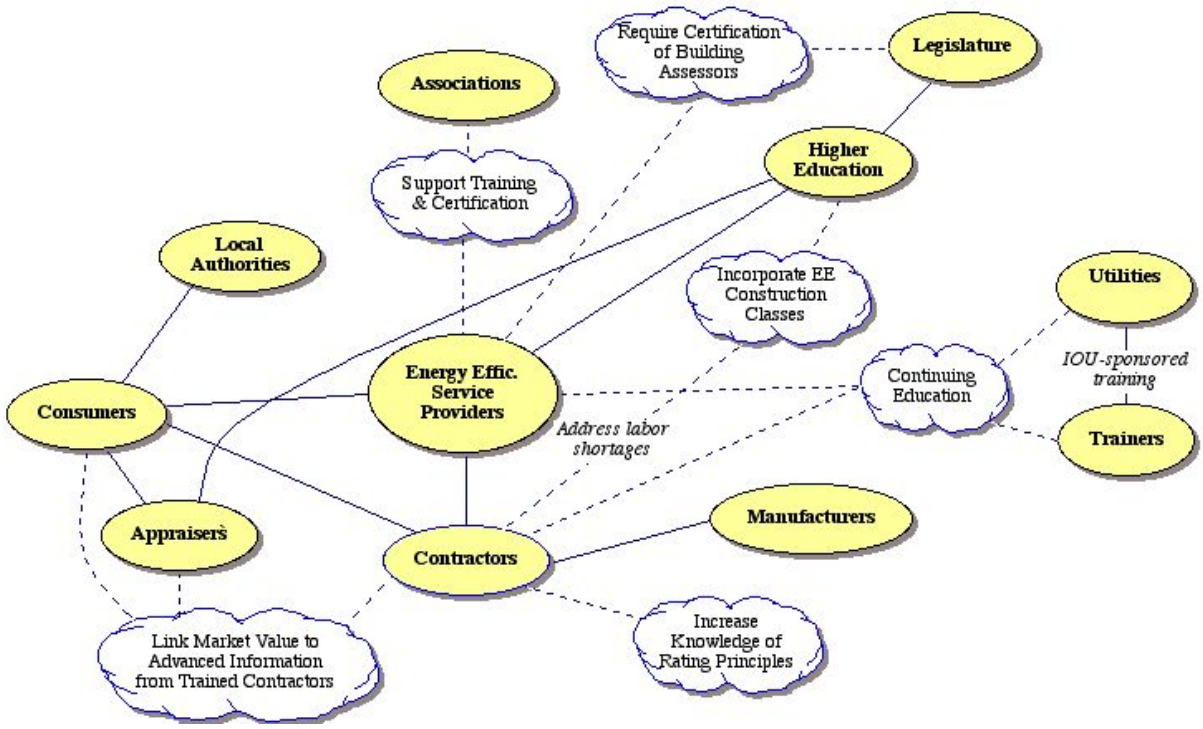
- *Service providers.* Energy raters, renewable energy installers, green building specialists, architects, et cetera tend to seek training and to be interested in advancing the state of the art.
- *Trainers.* A number of trainers are operating in the state. Several observers noted the need for high quality training regardless of the source (e.g., utility, public institutions, private sector trade associations, unions, et cetera).
- *Utilities.* Directly offer extensive training and design assistance. They are aware of training resources. Can (if allowed by company policy) refer consumers to trained contractors. Utilities represent a fairly widely trusted source of consumer energy information. Several observers noted an important utility role in this area, particularly as a referral agent to certified products and services. One noted that "[utilities are the] prime actor because they are unbiased. They are not promoting any particular product and they are trusted."

The actor network diagram for this initiative is shown in Figure 20.

Market Conditions

There are a number of market conditions that were identified during the research effort that affect the success of this initiative. These include:

- *Community and technical colleges have networks that can be used.* Interviewees suggested that California has a significant number of community and technical colleges that train students in trade industries and are in a good position to incorporate energy efficient construction techniques into their programs. As such they could be a valuable player in certification programs. However, there has also been a national movement of community colleges to serve more as two-year colleges focusing on getting students ready for a four-year college or university program and colleges have moved away from the more expensive trades curriculums. However, community and technical colleges that have strong trades programs may be well positioned to train students and to certify people for more advanced services where certification is an issue.
- *Trade associations can be allies.* According to interviewees, California has a number of trade associations and industry allies that can be recruited to help grow a training and certification industry. Many programs have worked with these trade associations in the past and have established favorable contacts that can be used to help grow an initiative.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 20. Actor Network Diagram for Technical Training and Certification

- *The current training programs can grow to meet need.* California has a number of training efforts in operation. These have been provided by the utility companies for years and have effective approaches. Interviewees suggest that because of these past efforts, new more comprehensive efforts can be scaled up and implemented in a very short time. Interviewees suggested that training and certification programs can be developed, deployed and start showing results in just a couple of years. However, these same interviewees suggested that policy makers will need to understand the period of time it takes between training and applied skills in the market. It was suggested that about half of the trained individuals will apply that training in the market during the following years.
- *Current professionals are an incubator for advanced skills.* It was noted by interviewees and panel members that the current auditing and assessment industry is ready to grow if demand exists. The basic skills are already present in the auditing and assessment community, and these skills can be developed through add-on initiatives that increase skill levels.
- *Contractors are looking for ways to differentiate themselves.* According to some interviewees, contractors are looking for ways to differentiate their services in the

market and give customers a reason for using their firms. The more market savvy contractors will see the energy efficient training and certification initiatives as a way to move above the pack, and attract more or higher-end customers.

- *Insurance industry may be supportive.* There is some opinion that the building trades insurance industry may be supportive of a stronger trades training and certification initiative that focuses on building techniques that are safe and effective, which lowers risk for insuring individuals involved in providing these services.
- *Link to environmental issues can grow the market.* It was suggested that training and certification initiatives need to be linked to environmental sentiments. Interviewees suggested that strong marketing efforts that creates demand using positive environmental messages will help the initiative.
- *Build confidence in ability to achieve impacts.* There may be a lack of confidence on the part of building owners and operators who are skeptical of the level of expertise and potential impact to make whole building assessment approaches worth while. It was suggested that a strong training and certification program will build market confidence.

Key Barriers

There are a number of market barriers and conditions that will affect the success of this initiative. These include:

- *Available funding.* This initiative will not support itself in the short term and may need support until the consumer demand is strong.
- *Value of the skill.* In the short term especially, there may be a condition in the market in which potential users of the training will need to be convinced that the training provides enough benefit that it is worth obtaining. This means that the value of the skill demanded will need to be evident before a decision is made to obtain the skills. Training will not be sought until there is a strong benefit that can be captured immediately upon graduation or certification.
- *Low level of importance.* While California has gone through a number of energy crisis conditions that have elevated the importance of energy efficiency, and the price of energy in California is among the highest in the United States, there is still a large portion of the building owner/manager community who do not consider energy costs to be a primary driver in making operational/facility decisions. This will affect the demand for these skills . However, more and more owners and managers are setting energy costs as a higher priority, potentially increasing demand for energy efficiency assessment and construction skills.
- *People interested in trades professions.* There is a question if there are or will be enough people who are interested in the trades professions who will enter the energy efficiency assessment, installation and construction fields. Expert panel

members indicated that there is a significant shortage of trades/skill-associated people moving into the trades industry. This will need to be examined.

- *Receptiveness of colleges.* There is some question if the technical and community colleges are interested in developing expensive trade associated training programs without reliable “outside” financial help.
- *Weak mentoring systems.* It was suggested that there are not enough mentors in the energy efficient construction and assessment field willing to take people under their wing and help them obtain the construction or assessment skills. It was suggested that training should also focus on how to spread skills across the firms and industry and how to build interest in assessments and construction approaches.
- *Book-based training is not as effective as hands-on training.* Interviewees suggested that training within the building trades industry is more effective when hands-on instruction is provided. Students need to experience and practice the skills needed to design, construct and assess energy efficient building systems. However, hands-on training is more expensive to offer compared with book-based training such as math or history. Interviewees noted that training and certification efforts need to understand that visual and hands-on experience are effective training tools for this market even through those tools can be more expensive.
- *Established trades people may be reluctant to change practices.* There is some concern in the market about the receptivity that the established trades industry (been in business for several years) will have to new training and certification initiatives unless they see a direct route to using the training and certification initiatives to their market advantage. It will be necessary to grow the market demand at the same time as the professional skills are being developed. Developing skills without a market demand for those skills will be a “nonstarter” for the initiative.
- *Lack of confidence that a building approach is better.* While there seems to be agreement that customers understand that specific equipment can help save energy and lower bills, there is some suggestion that customers of homes and small commercial type structures may not believe there is enough potential to make the building-level assessments worth the effort. A training and certification program may help build consumer confidence. However, some panel members were skeptical about whether a training program will affect consumer confidence, and suggested that consumer confidence would need to be addressed beyond training and certification efforts.
- *Lack of qualified professionals.* There is general agreement among the interviewees and panel members that the trades industry has a significant lack of professionals who fully understand whole building assessment approaches and fewer still who know what to do to improve building-level performance. A training and certification program would be expected to increase the number of qualified professionals able to provide this service, especially in the nonresidential area.

- *Cost of services may be greater than market value.* It was noted that for residential structures the cost of providing whole house energy efficiency assessments is, for many customers, too expensive for the anticipated benefit. This was also noted for nonresidential customers. Training and certification efforts must be linked with market value efforts that educate owners about the potential benefits.
- *Shortage of skilled labor.* Expert panel members indicated that there is a shortage of skilled labor in the equipment maintenance and energy equipment trades fields from which assessors might come, and suggested that training may help that shortage. They noted that people in this field are overbooked much of the year and are concerned with getting each job done as quickly as possible, potentially limiting the amount of effort that can be placed in an assessment without additional people in the field. Panel members noted that there are a significant number of untrained people working in the field and that training on energy systems is needed. A larger question, however, is whether firms will place their employees into the training efforts in this initiative.
- *Lack of knowledge of how to promote or sell energy efficient structures.* Several interviewees suggested that the people who are in charge of building and selling energy efficient structures do not have the skill sets associated with placing energy efficient structures in the market, developing a market message and positioning that message in the market, or dealing with the issues around the selling of these structures. While there are skilled people who can specify and build these structures, very few of these same people know how to position and sell the energy efficient structure. Experts suggested that training is needed on how to position and sell these structures and how to build market demand for energy efficient construction techniques.
- *Lack of rating knowledge for homebuilders.* Interviewees suggested that many of the contractors building homes do not understand the rating principles and approaches. They are therefore less skilled at constructing a home that is specifically designed to acquire the highest energy ratings appropriate for the building and within the available budget. Training needs to help contractors understand the rating approach so that they can build to achieve the highest ratings.
- *Lack of time and money inhibit technical training potential.* New builders entering the construction market are not skilled in the approaches for building energy efficient structures. Interviewees noted that when construction is strong contactors do not have time for training, and when construction is slow they do not have the resources to obtain training. Interviewees noted that training needs to be applied when the market is slow and it needs to be easy and inexpensive to obtain. However, some interviewees suggested that training needs to be onsite in the environments in which the contractors work to be effective. If this is the case, training when conditions are slow may not be the right approach unless it can be conducted at a construction site.

Strategies for Overcoming Key Barriers

Establishing, expanding, or creating a new training effort for whole building energy assessments and energy efficient construction practices is not a simple task. It will require a strong steady funding stream to keep pace with the level of interest in entering the field and the needs of the field for trained professionals. Because the field may be somewhat transitory without strong profit margins, there may be an ongoing need for skill training unless profits are enough to keep people in the field. Unless the assessment and construction skills can provide a living for the students it will be rapidly abandoned and fail in the market. As a result, it will have to be coordinated with initiatives that build demand, so that there is demand for the training and it can be immediately applied. As a result, the initiative is challenging. It is essentially focused on trying to simultaneously strengthen skill levels and create demand for those skills to grow an industry focused on using less energy. There are organizations ready to help with training and certification efforts and there is a growing need for these skill sets as building energy efficiency requirements grow. In addition there is an indication that community colleges are ready to move back into the trades skills or strengthen their current trades programs.

Should there be related initiatives that make assessment mandatory, similar to the current approach for building sales inspections, the assessment industry will grow rapidly and there will be a shortage of people with the needed skill sets. As a result, it will be necessary to coordinate skill needs with the ability to obtain skills training.

Risk Protection

Sector:	*Trigger Event:*	*Intervention Type:*
Residential and Commercial	No specific trigger event	Voluntary

When interest groups are confronted with a choice concerning a selection of technologies that meet their needs, there is often a perceived risk of doing things differently than the ways that have worked in the past. This perception can be reinforced when individuals have to make changes to operational practices that have ended in unwanted results or results that did not meet expectations. When this occurs, individuals network the effects of the decision within their communication channels, building more market resistance to change. This initiative removes much of the perceived risk associated with the perception of making a poor decision by going with the energy efficient option. This initiative covers the cost of making a wrong energy efficient decision through the development of an optional risk protection component that can be added to technology incentive programs.

This initiative focuses on addressing three key participant barriers and two key product barriers that when combined, make up one of the most important barrier

combinations in the market, limiting the adoption of energy efficient technology decisions. The five barriers include the participant barriers of risk avoidance, skepticism about benefits, and institutionalized procedures. The product barriers are reliability uncertainty and the barrier of performance uncertainty. These barriers build on each other and reinforce themselves and limit market movement toward the energy efficient choice. This combination of barriers is among the most powerful influences in the market and significantly outweighs price considerations or payback periods, yet very few programs address these critical barriers independently and no programs address them as a combined effect. Yet, this barrier combination is real, it is strong, and it limits the energy efficiency of the economy. It is a missed opportunity.

One of the reasons why it is missed is a reluctance of energy professionals to want to enter into the risk assessment and risk protection arena. It is, in some ways, considered a part of the insurance industry or the product guarantee and liability field. These are areas in which energy efficient program managers feel uncomfortable and into which some policy makers and regulators feel that energy programs should not go. As a result, the market is less efficient, and energy efficient decisions are abandoned for the comfort of doing things the way they have done things in the past.

The initiative consists of following elements:

1. *The formation of a risk assessment function* that examines the operations of the market relative to the adoption of California incentives for energy efficient technologies. This risk assessment function examines the technology mix covered by the program offerings and determines per-participant-proportional cost of reducing the influence of this barrier combination on the available choice decision. This assessment will identify the financial risk associated with an energy efficient technology choice that does not perform to customer expectations. The initiative will need to determine what expectations are included and design the initiative around those characteristics. The expectations that have the greatest customer concern should be included.

   Research shows that reliability is of great concern, as is the amount of down time experienced, and the effect on operations. Concerns about performance are critical: Is the product filling the purpose for which it was purchased or is the performance less than needed or expected? Some participants are concerned about energy cost savings, if they are in fact being realized. The assessment can examine the costs associated with the removal or repair of the technology and the cost of purchasing and installing the technology that would have been installed without the incentive program. This effort will also assess the risk of a product dissatisfaction decision in which the participant would want the new energy efficient equipment prepared to perform as intended, or removed and the alternative equipment placed in operation.

2. *Once the risk factors are known or reasonably estimated, the initiative will identify a set of programs that can benefit from the risk reduction initiative*. This assessment will examine the technologies covered in the program and the

environments and use conditions in which those technologies will be placed. The initiative will then construct a set of technology- and program-specific risk cost estimates that allow for coverage of the cost to correct a poor technology choice made through program participation.

3. *Next, the program will develop a set of cost tables* that will be used to drive program design decisions regarding how much of the risk cost should be carried by the initiative and how much should be carried by the participant. Options range from 100 percent of the cost of coverage by the initiative via public goods or procurement funds (or other funding option), to 100 percent coverage by the participant. This determination should be made only after steps one and two above are completed. If the costs are low, such that the programs can bear the cost and remain cost-effective, program designers should consider having most or all of the cost covered by the initiative. If the costs are such that cost-effectiveness is significantly harmed, the initiative can offer the risk protection as a customer-financed or partially financed option.
4. *The initiative would then enter the design stage* in which energy program designers and risk protection experts would determine the details of the designs for a pilot program. The pilot program would need to address operational issues as well as period of coverage issues and how costs will be covered or distributed across the various design options. The initiative will need to consider the following considerations:
    a) Arrangements with manufacturers, distributors, and dealers concerning decision criteria when the manufacturer's technology is at fault and when the participant's decision process or operating environment is at fault. Arrangements need to be made with these interest groups so that the initiative does not end up paying for technology problems that should be covered by the manufacturer, distributor or dealer.
    b) Decision criteria for when the energy acquisition program is, in part, at fault for offering incentives for poorly designed or manufactured technologies that should not be covered by the program or that are not designed to provide service in the customer's use or environmental conditions.
    c) The length of time the risk protection will be provided and the period of the time covered by the initiative. The initiative may need to cover one year via the program, then 50 percent the second year with coverage ending at the start of the third year. The initiative design process will need to work out coverage options and costs.
    d) A pilot program area will need to be defined. The area should be smaller than the state, but large enough to test the concept.
    e) Be open to help. There may be other collaborators that would like to join California in designing and testing this new initiative. California should be open to having design and pilot test partners from Wisconsin's Focus on Energy initiatives, from New York State Energy Research and

Development Authority's (NYSERDA) public benefits program managers, and from Vermont's Energy Efficiency Utility. California may be able to share the program pilot costs to enable others to learn from the effort.

f) Consider teaming with industry stakeholders who are already in the business or providing product guarantees and liability coverage. Or consider teaming with a new organization that is willing to take on this risk and develop this initiative to pilot in California.

5. *Once the cost determination and allocation approach is determined, the initiative will design the appropriate materials and enrollment forms and processes* to be used. The processes may need to offer the risk protection initiative as an option provided with the standard resource acquisition program offerings.
6. *Appropriate marketing and information dissemination materials* will need to be developed and incorporated into resource acquisition program delivery mechanisms. The initiative offering should also be included in with appropriate information and education programs so that the option is known in the market place beyond the program offerings with incentives.

The authors are sure that there are other aspects that will need to be addressed in the consideration and design development process. In addition, there will be issues that come up that may need to be addressed that are unknown at this time. Within the scope of this effort, we bring this significant barrier combination and initiative to the attention of California's policy makers for their consideration.

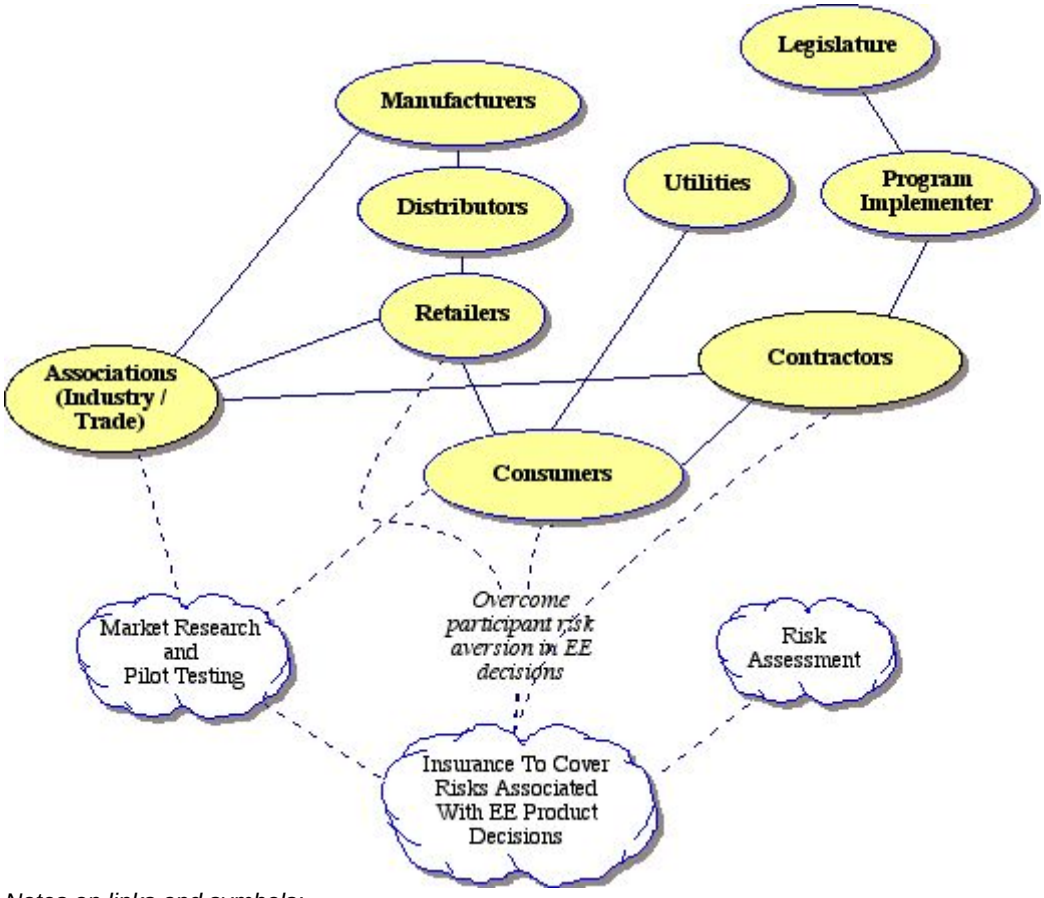
Affected Groups

As customers understand that they are not alone in the risks associated with their decisions, they will begin to minimize the risk associated with the barrier combinations addressed by this program.

- Policy makers may need to change policy provisions so that such a service can be allowed under the current program design and approval structures.
- Lawmakers may need to be consulted to determine how the initiative fits into current product liability and performance laws and support systems.
- Utility companies and third-party providers who would need to be consulted to arrange for the initiative to be incorporated into the program designs. This may also involve legal staff that would need to be comfortable with the liabilities associated with the effort.
- Manufacturers, distributors, dealers and retailers whose product guarantees and/or liability coverage may be affected and need to be incorporated into the program design and coverage aspects.

- Contractors, dealers and retailers who would be expected to be the key delivery mechanism by which the remedies could be provided when a participant is negatively impacted by the decision.
- Industry associations or trade associations who are already involved in industry product support services that may have an interest in this initiative.
- Other energy program policy and design professionals in other states who may wish to join in the pilot development and testing of the initiative.

The actor network diagram for this initiative is shown in Figure 21.



Notes on links and symbols:

- *Circles represent key actors, clouds represent market interventions*
- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 21. Actor Network Diagram for Risk Protection Initiative

Market Conditions

There are a number of market conditions that will affect the success of this initiative. These include:

1. The ability of risk assessment professionals to accurately assess the risk involved and therefore set accurate initiative costs.
2. The ability of the initiative to convince potential participants that this initiative is able to overcome their risk aversions.
3. The ability of the initiative to work with stakeholders to create an initiative niche so that manufacturers, dealers, distributors, retailers, and contractors are comfortable with the initiative.
4. The ability of the initiative to establish clear operational and coverage guidelines and decision criteria so that the program operates efficiently and participants understand the protection provided.
5. The ability of the initiative to be adequately field-tested so that reliable decisions can be made on the future of the initiative.
6. The ability of the State of California decision makers to support an initiative that is not a standard program component. It may be difficult for some state decision makers to support this concept for a number of reasons. This initiative is innovative and is may be considered too innovative or too risky for some.

Key Barriers

There are a number of barriers to having a statewide, coordinated, energy efficient risk protection initiative that the program design will need to address. These include:

1. *Market acceptance.* There may be a market acceptance issue at first, that may or may not change over time. With this being a new initiative, this aspect will need to be monitored as the initiative is tested. If market acceptance is low and does not grow, this may limit the potential for the initiative.
2. *Unknown participation-associated cost of the initiative.* The cost of this initiative is not clear. While some similar initiatives have been placed in the market to cover guarantees of energy savings, they have focused on covering the cost of energy savings promised but not achieved, and have not focused on the ancillary costs associated with non-attainment of expected benefits beyond energy savings.
3. *Unknown management and administrative costs.* The amount of time this initiative will take from an internal operational perspective is not known. This initiative is likely to be more costly during the developing and testing phase and then move to more routine costs as the initiative matures.

4. *Unknown market reaction.* The reaction of the market stakeholders is another unknown. Like any new initiative, the initiative design and expected results are speculative during the discussion and concept sharing stage. How stakeholders will react to this initiative is not known at this time.

Strategies for Overcoming Key Barriers

Reading the barriers listed above, they may seem too significant and leave the success of the initiative in doubt. This is a reasonable reaction to any new initiative. However, it should also be understood that these barriers are consistent with most new initiatives before they are developed and placed in the market. Some initiatives succeed and move the market toward higher energy efficiency. Other initiatives fail to reach a workable design or fail in the market when introduced. For this initiative, additional research is required before decisions on its likely success can be made. For example:

1. This initiative should be presented and discussed in fee-based rider participant and non-participant focus groups and tested in customer surveys and interviews to identify the demand that this initiative is expected to receive. These efforts should also collect program design and fielding concepts from the target markets.
2. If the market research indicates a positive response, the initiative should be discussed within industry stakeholder groups to gauge industry acceptance of the initiative. The results from the customer research should be shared with key stakeholders.
3. If industry support appears likely, the concept should enter the design stage where the cost assessments are conducted and the coverage areas and coverage conditions identified.
4. The initiative should then be pilot tested in a geographical area large enough to obtain and evaluate the results of the test initiatives. The pilot initiative should be modified during the test period to evolve the initiative to a near market read condition.
5. If the pilot program indicates market success can be expected, the initiative should be expanded to a larger region for full-scale implementation and testing. If this step is satisfactory it should be considered for statewide implementation.

These efforts will substantially reduce the risks associated with the barriers identified above, and if effectively developed and tested, may result in an initiative that expands the ability of resource acquisition programs to capture savings.

Interagency Program Coordination

This section discusses the potential to establish a statewide initiative within the current mix of programs focusing on the issue of interagency or cross-organizational

program coordination and referrals. California's energy efficiency, demand reduction, and procurement programs have evolved into a fragmented mixture of services that are not consistent across the state and are now operating in a way that does not support strong cross-program coordination or referral mechanisms. It is highly possible and probable that program participants are not provided with information about other programs or energy-related services in which they are eligible to participant. These are lost opportunities.

At the current time there are several types of energy saving program administrative and implementation structures operating in California. Each of these types of structures is actively providing programs to the people of California. First there are the statewide energy efficiency programs. These programs offer services statewide and represent the backbone of the energy efficiency programs offered in California. Next, there are utility service territory programs that offer additional program services within each of the investor-owned service territories. Then there is the more localized set of third-party programs that offer services within a single service territory or, more likely, within a small section of a service territory. Mixed in with this three-tiered approach are additional procurement and demand reduction efforts that can be implemented within one of the existing programs or as a stand-alone program. There seems to be reasonably good coordination across the statewide programs, and there seems to be reasonably good coordination between the utility territory programs and the statewide programs. However, there is limited coordination between the third-party programs, the utility service territory, and the statewide programs. It is highly possible for participants in the third-party programs to take advantage of a specific program's offerings without being advised of the statewide, utility or other third-party efforts that may be of interest to the participant. Likewise, there seems to be little coordination between the private sector initiatives that receive no energy efficiency funding, and the programs that are being offered in the state or local areas. There seems to be little or no formal system in place to capture program participation within the markets that have an interest in making their homes or buildings more energy efficient, especially across the private-public sector or between the third-party programs and other initiatives.

Behavior research indicates that one of the best predictors of future participation is previous participation. That is, when a customer is pre disposed to seek help with their energy needs in one program, that same behavior applies to other services. If energy programs are not well coordinated with shared promotional materials and presentations of opportunities provided, substantial opportunities are missed. This condition should not be considered a sector-specific event. Participants in nonresidential (commercial/industrial/agricultural) programs are themselves residential customers. Every time a nonresidential program obtains a participant, they are obtaining the participation of a set of residential customers who, at the time of enrollment, are acting on behalf of their employer. Yet these people are seldom provided with information that applies to them as individual customers. Likewise, the residential program participant may be employed within a nonresidential sector business, but the residential customer is seldom provided with information that they can take to their employer for consideration.

These are obvious missed opportunities. However, there are even more serious missed opportunities. Participants in third-party programs are often not provided with the materials and presentation tools that allow them to inform their participant of the other third-party, utility, or statewide programs that are available to them. As one interviewee put it, “there is competition between the utilities and the third-party programs, the system was established that way.” This is in fact the case; the way in which program funding is allocated into the programs sets up a competitive environment that works against the goals of the funded initiatives. There is no formal way for programs to obtain funding for coordination, there is no formal way for programs to receive credit for referrals and there is no formal way for programs to receive energy impact credits for participants who are successfully referred to other services. The current approach actually harms the programs if they provide referral services or coordinate their services with other programs, unless the referral benefits the referring organization, or unless the referral is made by an information or education program that has no need for demonstrated energy impacts. However, even for the information and education programs, if program resources are consumed in the referral process, those dollars are not available for the function of the information and education program, unless that is the function of the program. The structure and operation of the evaluation effort actually compounds the problem. That is, the evaluation efforts are designed to give impact credit to the program and not to the way in which program participation is achieved. At this time, there are no evaluation efforts that look at what part of the program-induced impacts result from referrals or from cross-program coordination efforts. Evaluation budgets are low enough that many programs do not have the resources to provide reliable savings estimates, let alone segregate estimates into what outreach, education or enrollment efforts are responsible for the impacts. Likewise, there is little structure in place for cross-administrator tracking system integration or information sharing. Participant databases are typically held by the program administrators or implementers and these organizations have little or no resources allocated to database sharing or participant information sharing across the services that are available.

In California, lost opportunities are a result of the way in which programs are structured, funded and administered, and the way in which program goals and goal accomplishments are counted and credited. Lost opportunities are designed into the system by default. However, with this said, we must also point out that some interviewees suggested that there are enough websites and retail providers in the market that some coordination is already successful. Likewise, interviewees suggest that the CPUC is responsible for administrative coordination and that administrative coordination needs to be considered when developing a participant-based coordination initiative.

Interagency Program Coordination

This initiative focuses on establishing a system that recognizes and rewards information sharing and gives energy credits for that purpose. We suggest that no program implementation plan be accepted or approved for funding without a

program information and coordination component. We also suggest that the responsibility for this initiative be assigned to an organization that is responsible for making sure energy supplies meet customer needs, that energy policy goals are met, determines who has the authority to approve program implementation plans and program funding streams, and determines who has responsibility for the evaluation planning and approval processes.

The initiative needs to focus on establishing processes, procedures, materials, and implementation and evaluation strategies and mechanisms that allow every participating nonresidential customer to be informed of the other programs and services that are available to them or to their employer. The participant is then free to distribute the materials to their employees or to not accept the offer of information. Likewise, every residential program needs to offer the participant information on the nonresidential services that are available to their employers. Residential customers can then decline the information if they do not want or need it.

The initiative should include an effort to guide the evaluation planning effort to identify how customers come into programs, and to give a portion of the energy savings credits to the efforts that caused that participation to take place. This is not to say that the energy acquisition, procurement or demand reduction programs should have savings taken away from them, as that would discount the importance of how the savings are achieved. However, this data is needed to drive the portfolio planning efforts. The evaluations should provide a distribution of impact credits across the efforts that caused the impacts to take place. An approach will need to be structured to accomplish this goal, but it could be accomplished by including questions in the customer contact efforts (surveys, interviews, et cetera) across all evaluation efforts that ask people how they heard about the programs and asks about involvement in other initiatives. Then the ratings can be structured to give credit to the efforts that drove participation consistent with the participant's accounts of the importance of those initiatives. Once designed, this would be easily and inexpensively incorporated into all impact evaluation efforts.

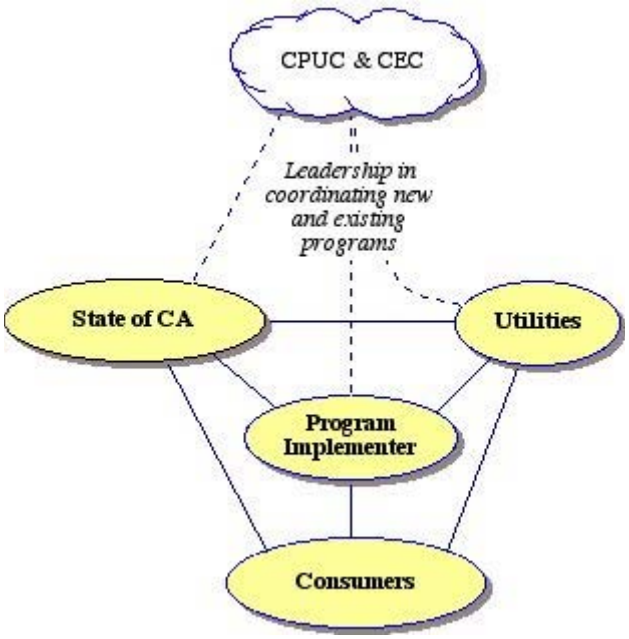
The CPUC should also adopt a policy that a fragmented, uncoordinated approach is unacceptable in California and require that programs receiving public goods or procurement funds must have a coordination component that accomplishes these goals. Another approach would be to have a single entity design the coordination materials and systems and have all impact programs use those systems. We do not attempt to design such a system in this research, but do bring this need to the attention of the Energy Commission, and emphasize the lost opportunities associated with the current program design, operational and evaluation structures.

In planning the coordination initiative the Energy Commission should consider both a dispatched coordination system in which all programs provide information and referrals and a system in which there is one central referral office with supporting databases and web structured systems and contact tracking systems. It may be possible to have all programs provide general referral information to customers and participants that focus not only on the participants, but their employers and neighbors, and then channel people into a central toll-free call center or Internet site with tracking software attached to the referral service.

Affected Groups

This initiative primarily affects the organizations directly associated with the development and delivery of energy services in California. These organizations are discussed above. This initiative involves few other organizations and is primarily an initiative that is internal to the program environment.

The actor network diagram for this initiative is shown in Figure 22.



Notes on links and symbols:

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- *Linkages between actors are represented by solid lines; linkages between actors and interventions are represented by dotted lines.*

Figure 22. Actor Network Diagram for Interagency Coordination

Market Conditions

There are few market conditions that will affect the success of this initiative. These include:

1. The program implementation and administration organizations will need to embrace the concept behind the initiative and support the intent and methods developed for the delivery of the effort. If the implementers and administrators do not embrace and follow through with the efforts in a way that successfully implements the strategies, the effort will only partially succeed.

2. The CPUC and the Energy Commission will need to actively and visibly support the initiative to send a clear message that these efforts will be a successful part of the California portfolio.
3. Program vendors and stakeholders will be affected in that they will find their program-related services in stronger demand than without the initiative. However, the demand will not be strong across all programs. Those program services that lend themselves to referral services will be most affected.

Key Barriers

There are a number of barriers to having a statewide program coordination initiative that will need to be addressed. These include:

1. *Short planning period does not allow for coordination planning.* Interviewees suggested that administrators are asked to put their programs together in a very short period of time, requiring them to forgo complicated or unnecessary program design efforts that do not fit within the available timeline.
2. *Budgets are negotiated down during review.* During the program review and approval process, budgets are not increased to allow elective tasks, but rather are negotiated down, asking administrators to get rid of tasks that are considered not essential to the specific program being planned. As such there is only limited funding for best-practice, inessential approaches such as inter-program coordination.
3. *Not a valued item in current process.* Interviewees report that coordination is not seen as a valued item in the current design and approval process. While many policy staff members and administrators have discussed its importance, it is not seen as a critical path item.
4. *No incentive for cooperation.* There is currently no way for administrators to be rewarded for coordination efforts. It detracts from the tasks that are required to obtain participant impacts. Without an incentive making coordination an income-stream item, there is little incentive to devote resources to this effort.
5. *Energy savings not credited.* Interviewees report that not only is coordination not valued, programs that do provide effective coordination are not given energy credits for the results of their efforts. If you cannot count energy savings that result from coordination efforts, and the rewards go to another organization, there is little perceived benefit.
6. *Information system and materials lacking.* Programs, program referral information, and referral materials are not set up in the fragmented program approach that is currently employed. There is currently no information system that supports a geographical, sector, or participant based coordination approach. Information systems will need to be established and maintained and the appropriate referral materials will need to be designed, developed and fielded in a way that allows easy, error-free, referral services to be provided. The system

will need to be structured so that participants that are only eligible for one program are not referred to another. Likewise, the system must allow referrals when participants are eligible for additional services. In addition, climate zones may require that coordination be filtered through a climate zone check to make sure that eligible customers are referred to programs that have services that apply to the climate zone in which they live.

7. *May be more expensive than benefits suggest.* Interviewees suggested that the benefits from a strong coordination effort may not be worth the additional energy savings that could be achieved. It would have to be somewhat inexpensive to provide. The benefit cost ratio of the coordination effort would have to be carefully studied before the effort was seriously considered. However, interviewees also suggested that if customers heard a clear and consistent message across all the programs and program providers, the customer is more likely to be convinced to take actions and that the need is real.
8. *Conflicting program cycles.* Interviewees suggested that the CPUC's program cycle conflicts with administrator planning cycles and that the various planning cycles need to be coordinated to achieve a participant-based coordination effort. When programs are planned at different times, the coordination initiative needs to be sensitive to these timelines.
9. *Competitive nature of funding access.* Interviewees indicated that under the current administrative approach, organizations are placed in a competitive environment for limited funds. Organizations must compete for funding in a way that requires administrators to prove that their programs are better than others. This builds competition among the program providers and acts to limit cooperation. When administrators are asked to coordinate across programs and providers they interpret this request as providing information that would aid their competitors.
10. *Some administrators may resist.* Competition for funding may not be the only barrier that pits administrators against one another. There may be some administrators that will resist a strong participant-based referral system that routes customers into organizations that they would prefer their customers/participants not to go. This may be especially important in view that program administrators must compete with other potential providers for service image, seeing a need to make other providers look bad or themselves look good. In competitive environments there is often the view that "all our services are the best there is in the market because we are the best provider in the market." Or there may be the perspective that, "our customers should come to us for their energy needs, that's what we do, we are not in the business of showing our customer the front door of other organizations." Some may view this as feeding the enemy.

Strategies for Overcoming Key Barriers

While these barriers seem significant, they may not be substantial from an implementation perspective if there can be general agreement on the need for and the structure of a referral system. There are ways that should be considered that could, for example, employ central referral mechanisms that also act as central information clearing houses making the effort simple and manageable.

These barriers may also be addressed via CPUC orders pertaining to how program proposals should be provided, specifying a referral approach that needs to be included in program proposals. However, the barrier about the energy savings not being worth the cost needs to be more aggressively assessed. This assessment should examine the program mix and the delivery areas in which a coordinated referral system can refer the right people to the right program. Likewise, the CPUC and the Energy Commission should assess the potential to improve energy savings by specifying the type of programs that should be solicited within specific geographic areas to maximize referral potential within the portfolio without damaging program-specific savings. The Energy Commission and the CPUC should not rely on proposals to determine what programs to offer, but set program offering requirements and have vendors bid to those requirements, including referral requirements. The key will be to establish a system that is not threatening to the users, does not cost the users significant time or effort, can sort through customers and participants by location and link location and customer type to program offerings, and do so in a way that tracks referrals. Likewise, the evaluation effort will need to be structured to plan referral assessments of impact to give credit where credit is due. These efforts will substantially reduce the barriers identified above and if effectively implemented will allow the initiative to succeed and grow in its impacts.

Intervention Portfolio

The interventions described in this chapter were chosen based their ability to address important trigger events, fill gaps in existing program offerings, reduce adoption barriers and build infrastructure to support widespread implementation energy efficiency programs throughout California. The interventions should be viewed as a set of mutually supportive activities, rather than as isolated interventions. This section describes the role of each intervention in the overall portfolio and the relationships and synergies between the interventions.

Residential Sector Interventions

The key trigger events in the residential sector and the interventions initiated at each trigger event are shown in Figure 23.

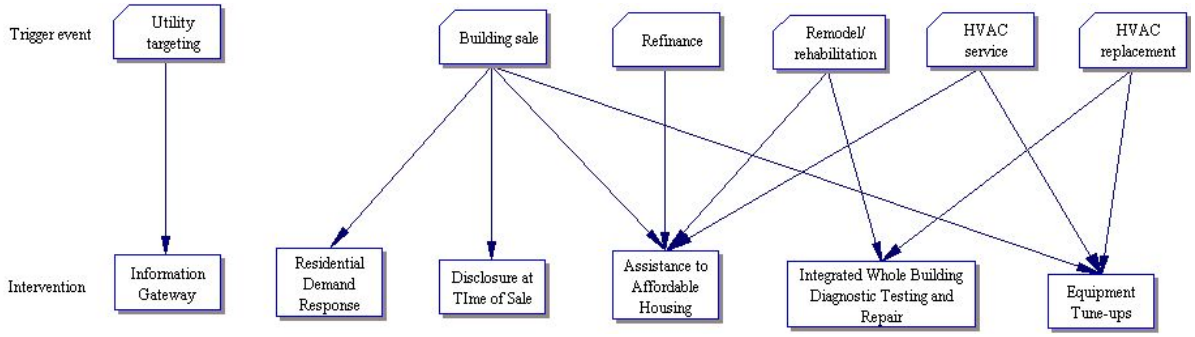

Figure 23. Residential Sector Trigger Events and Interventions

The role of each residential sector intervention within portfolio and the relationships and synergies between the interventions are described as follows:

Information Gateway

This intervention serves as an entry point or "information portal" for residential customers, providing homeowners and property managers with energy efficiency information, energy audits and program referrals. The intervention will be targeted at buildings with higher than average energy bills, geographic areas known to contain inefficient housing stock, low income households and homes in areas of transmission/distribution system congestion. Although customers will be targeted under this intervention, the information portal will be open and available to all customers. This intervention is designed to coordinate with other interventions within the overall portfolio, as described below:

- *Integrated Whole Building Diagnostic Testing and Repair*. Once the decision has been made to improve the efficiency of the home, a contractor may be hired to make the upgrades. Upgrades made from a whole building perspective will likely result in greater energy savings along with other non-energy-related benefits such as improved comfort and a healthier indoor environment.
- *Demand Response.* Audits and efficiency upgrades will likely affect the peak demand of the house. The option of a demand responsive rate structure should be presented to the homeowner as part of an ongoing communication. Improvements undertaken to increase efficiency and reduce peak demand (such as a demand responsive thermostat) may make this an attractive offer.
- *Equipment Tune-ups.* The information gateway will serve as a point of referral to the equipment tune-up intervention. Coordination between the information gateway and the Equipment tune-up intervention will be required to ensure that the customer interest generated from the gateway is smoothly transferred.

Time of Sale Information Disclosure

This intervention provides key information at the time-of-sale trigger event, giving homebuyers timely information needed to make voluntary efficiency upgrade and financing decisions. This intervention will work in conjunction with several other interventions proposed in the project.

- *Integrated Whole Building Diagnostic Testing and Repair.* Once the decision has been made to improve the efficiency of the home, a contractor would be hired to make the upgrades. Upgrades made from a whole building perspective will likely result in greater energy savings along with other non-energy-related benefits such as improved comfort and a healthier indoor environment.
- *Demand Response.* Change of home ownership generally involves initiating a new utility account, which can be coordinated with program services that offer other efficiency upgrades affecting the peak demand of the house. The option of a demand responsive electric rate structure should be disclosed to the homebuyer both during the sales process and also offered to the customer when a new account is initiated.
- *Equipment Tune-ups.* The energy ratings offered under this intervention may recommend equipment tune-ups as a cost-effective efficiency strategy. Coordination between this intervention and the Equipment Tune-up intervention will be required to ensure that the customer interest generated is smoothly transferred.

Equipment Tune-ups

This intervention addresses a key program gap and energy efficiency opportunity at several important trigger events, including building sale, HVAC system service and HVAC system replacement. This intervention will work in conjunction with several other interventions proposed in the project.

- *Information Gateway.* Educating consumers is essential in generating support for this service. Consumers assume that their equipment is operating efficiently if it meets their comfort expectations. Without knowledge of what is included in a quality installation, homeowners and multifamily property owners are content to accept current performance as adequate. Utilities, as a respected entity for homeowners, can play a central role in customer education.
- *Time of Sale Information Disclosure.* Single family home audits and energy ratings completed at the time-of-sale represent an initial screen on determining what type of equipment is installed in a house, as well as the vintage and nameplate efficiency. A simple audit procedure completed at time-of-sale could serve as a flag for pursuing an equipment tune-up or a more rigorous approach such as whole house diagnostic testing and remediation.
- *Technical Training and Certification.* Developing a trained work force to implement this intervention is critical. Currently there are only about 600 NATE-

certified HVAC technicians in California. By building a market-pull approach, contractors would see increased demand for skilled services in the field.

- *Information, Case Studies and Demonstrations.* Case studies of successful tune-up efforts are an important part of the Information Gateway intervention. Documenting the before and after impact of a neighborhood or locality-wide tune-up effort could be effective at conveying to the public the broader effect of this intervention.
- *Demand Response.* Demand response initiatives can play a synergistic role with this initiative. Time-of-use or real-time pricing coupled with a tuned-up air conditioner improves the ability of programs to use smart thermostat technology or cycling programs while better maintaining homeowner comfort.
- *Branding.* Branding can play an important role in promoting the intervention by tying the initiative with a known commodity. ENERGY STAR co-branding would be an effective means of communicating the value of a certified HVAC tune-up or equipment replacement to the consumer.

Integrated Whole Building Diagnostic Testing and Repair

This intervention addresses a key program gap and an energy efficiency opportunity at several important trigger events, including building remodeling and HVAC system replacement. Whole building diagnostic testing is a potentially important intervention that needs the support of other initiatives to achieve its full potential. Specific initiatives include:

- *Information Gateway.* Educating consumers is essential in generating support for this service. Utilities, as a respected entity for homeowners, can play a central role in customer education.
- *Branding.* Branding has the potential for being an effective means for promoting whole building diagnostic testing and repair. Whole house diagnostic-based remediation completed by a certified contractor can be tied to a visible existing brand such as ENERGY STAR[5] or Flex-Your-Power. High consumer recognition with these brands inspires consumer confidence and could prove vital in the early stages of this intervention strategy.
- *Time of Sale Information Disclosure.* Energy ratings completed at the time-of-sale represent an initial screen on the potential for whole house diagnostic testing and remediation. Audit procedures conducted as part of the energy rating should be designed to identify homes that are candidates for more rigorous whole building assessment procedures.

[5] The California Building Performance Contractor's Association was the first program in the Western United States to be recognized as fulfilling the requirements of the new "Home Performance with ENERGYSTAR" process.

- *Technical Training and Certification.* Building the contractor infrastructure is essential in making whole building services available in the marketplace. Technical training, such as the California Building Performance Contractors Association (CBPCA), is absolutely necessary in promoting this intervention. A strong field-training component is needed to complement classroom training. If this intervention is to be pushed through, additional initiatives and coordination efforts will be needed to train professionals that have whole building assessment skills.
- *Information, Case Studies and Demonstrations.* Case studies of successful whole house interventions would be an effective means for conveying the benefits of this intervention strategy. Local media as well as utility bill supplements could take this abstract concept and transform it into something tangible that the customer can relate to. The case studies and demonstrations will need to be promoted and coordinated with related events, such as home shows, parade of homes displays, and so on.

Assistance to Affordable Housing

This intervention addresses a key program gap and energy efficiency opportunity, targeted at traditionally underserved populations. The intervention is applied at several key trigger events, including HVAC service and maintenance, building sale, building refinance and building renovation. Activities promoted through this intervention need to work closely with other interventions considered in this report:

- *Commercial Benchmarking.* Although affordable multifamily properties are in the residential sector, they are often owned and managed much like a commercial building. The commercial benchmarking initiative can provide the comparative energy consumption information and utility bill tracking for multiple properties under management by a single agency or nonprofit organization.
- *Integrated Whole Building Diagnostic Testing and Repair.* Once the decision has been made to improve the efficiency of the property, a contractor can be hired to make the upgrades. Upgrades made from a whole building perspective will likely result in greater energy savings along with other non-energy-related benefits such as improved comfort and a healthier indoor environment.
- *Demand Response.* Efficiency upgrades will likely affect the peak demand of the building. The option of a demand responsive rate structure should be presented to the building owner. Retrofits undertaken to improve efficiency and reduce peak demand, linked with a demand response rate can make the retrofits less expensive over the long run. Metering costs for master-metered properties may be lower for multifamily properties on a per unit basis.
- *Technical Training and Certification.* Training of property managers, asset managers, nonprofit organizations and housing developers on energy efficiency options is needed in order for these individuals to understand, initiate and manage efficiency projects.

- *Equipment Tune-ups.* Equipment tune-ups are an important component of this intervention. Multifamily projects offer the potential for significantly reduced implementation costs relative to single family properties.

Demand Response

This intervention is designed to address key program participation barriers and inform customers of demand response rate structure and technology options at the time of sale trigger event, when a new utility service account is initiated. This initiative should be coordinated with the following interventions:

- *Information Gateway*. The Information Gateway intervention will play a key role in the success of a residential demand response intervention strategy, providing residential customers with the information they need to understand the implications of this initiative.
- *Integrated Whole Building Diagnostics and Repair*. Buildings treated under this initiative will likely be better candidates for demand response technology and rate structures due to reduced energy requirements and improved ability to maintain comfort during peak period interruptions.
- *Equipment Tune-ups*. Buildings treated under this initiative will likely be better candidates for demand response technology and rate structures due to reduced peak demand and/or improved system capacity resulting from the system tune-up. HVAC service and tune-up services provide an opportunity to install a demand-responsive thermostat as a component of the intervention.
- *Upstream Interventions/Manufacturer Partnerships*. Upstream Interventions/ Manufacturer Partnerships are a critical piece in maximizing the success of a demand response initiative. These arrangements may be required to bring the necessary demand response technology such as meters, thermostats and other HVAC system controls into the market.
- *Technical Training and Certification*. Training programs may need to be developed to ensure that new products developed for this initiative are well understood and can be readily specified, installed, operated and maintained.
- *Interagency Coordination*. Interagency coordination is essential in providing a smooth transition to a marketplace where demand response has a prominent presence. The Energy Commission, CPUC, California ISO, and utilities must work together to successfully implement a demand response initiative.

Commercial Sector Interventions

The key trigger events in the commercial sector and the interventions initiated at each trigger event are shown in Figure 24.

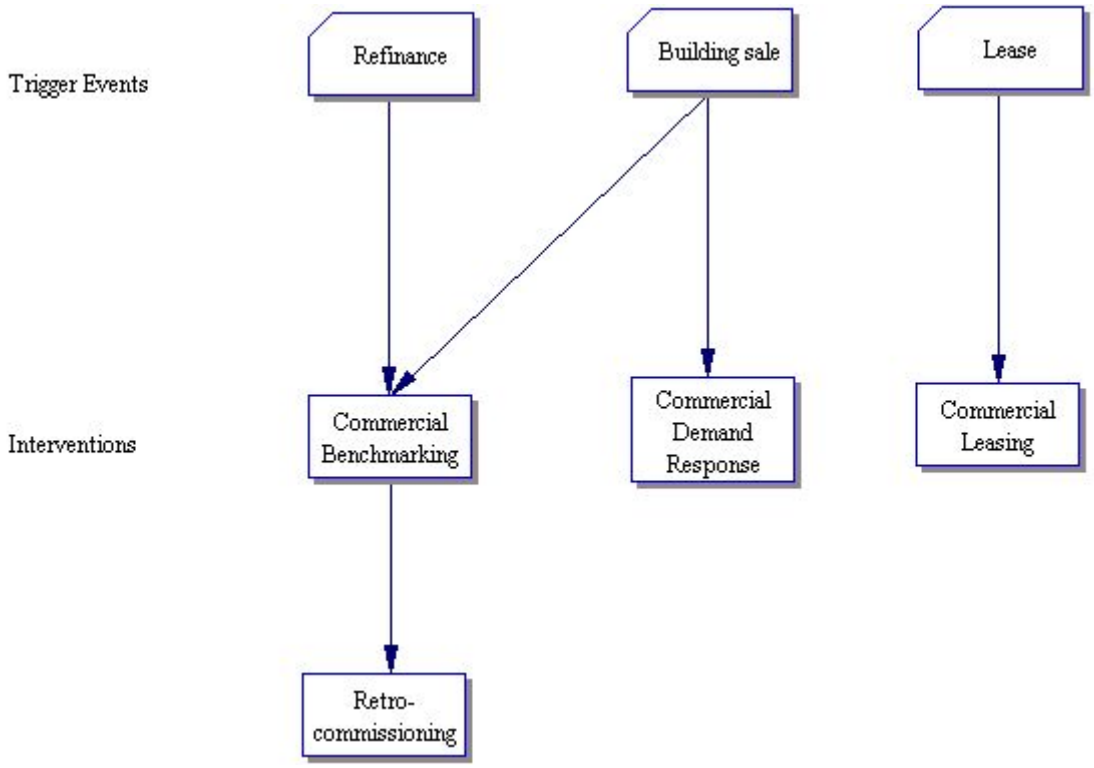

Figure 24. Commercial Sector Trigger Events and Interventions

The role of each commercial sector intervention within portfolio and the relationships and synergies between the interventions are described below.

Commercial Benchmarking

This intervention serves as an entry point or "information portal" for the commercial sector, providing commercial building decision makers with information on building performance, energy audits and program referrals. Key trigger events addressed by this intervention include building sale and refinancing. Although this intervention is designed around these trigger events, general access to commercial benchmarking and the underlying services are included. This intervention should be coordinated with the following interventions and activities:

- *Retro-commissioning.* Retro-commissioning is seen as the primary intervention directed from the benchmarking system.
- *Commercial Leasing.* Energy efficient leasing arrangements may include a clause that requires benchmarking the building.
- *Information, Case Studies and Demonstrations.* This intervention needs to be integrated into the Benchmarking initiative to satisfy the information needs of commercial building decision makers.

- *Assistance to Affordable Housing.* Benchmarking of multifamily properties and comparison of a set of buildings within an agency portfolio is a component of the multifamily intervention.
- *Branding.* Work on benchmarking systems for California should be done with the cooperation (and co-branding) of the EPA ENERGY STAR system.

Retro-commissioning

This intervention addresses a key program gap and energy efficiency opportunity. Although this intervention is not connected to any specific trigger event, the commercial benchmarking intervention will screen and refer qualified customers to the retro-commissioning intervention. This initiative will need to be coordinated with the following interventions and activities:

- *Commercial Benchmarking.* Benchmarking is seen as the "portal" for commercial building owners to access information about the performance of their building and services, including retro-commissioning.
- *Technical Training and Certification.* Increasing capacity in the retro-commissioning service provider network will require technical training and education. Certification of service providers will increase consumer confidence in the intervention. Building operators and maintenance personnel will also require training on how to continue to operate and maintain their buildings once the retro-commissioning work have been completed.
- *Information, Case studies and Demonstration.* Retro-commissioning represents a major opportunity for energy efficiency in commercial buildings in California. This message needs to be delivered to decision makers throughout the state. Case studies and demonstration projects highlighting the energy efficiency and risk management benefits of retro-commissioning should be developed.

Commercial Leasing

This intervention addresses a key trigger event in the commercial real estate industry, and addresses an important market barrier inhibiting the adoption of efficiency technology in commercial buildings. This initiative should be coordinated with the following interventions:

- *Commercial Benchmarking.* A benchmarking requirement is one potential element of this initiative. Audits directed from the benchmarking system play a key role in determining the nature of efficiency upgrades once the issue of split incentives is addressed
- *Retro-commissioning.* The split incentive may be one barrier to building owners to have their buildings retro-commissioned. Retro-commissioning projects may be directed through the commercial benchmarking system.

- *Technical Training and Certification.* Education and training of real estate agents, property managers, building owners, and real estate lawyers on structuring lease arrangements that favor energy efficiency projects is needed to promote this intervention.

Demand Response

This intervention is designed to address key program participation barriers and inform customers of demand response rate structure and technology options at the time of sale trigger event, when a new utility service account is initiated. This initiative should be coordinated with the following interventions:

- *Commercial Benchmarking*. As the primary commercial customer information portal, the Commercial Benchmarking intervention will play a key role in the success of a commercial demand response intervention strategy, providing commercial customers with the information they need to understand the various rate structure options and energy cost implications of this initiative.
- *Upstream Interventions/Manufacturer Partnerships*. Upstream Interventions/ Manufacturer Partnerships are a critical piece in maximizing the success of a demand response initiative. These arrangements may be required to bring the necessary demand response technology such as meters, thermostats and other HVAC system controls into the market.
- *Technical Training and Certification*. Training programs may need to be developed to ensure that new products developed for this initiative are well understood and can be readily specified, installed, operated and maintained.
- *Interagency Coordination*. Interagency coordination is essential in providing a smooth transition to a marketplace where demand response has a prominent presence. The Energy Commission, CPUC, California ISO, and utilities must work together to successfully implement a demand response initiative.

Supporting Interventions

The following interventions were designed to address market barriers to energy efficient product adoption in both residential and commercial buildings through a combination of upstream, information and education, and overarching policy initiatives.

Upstream Interventions/Manufacturer Partnerships

This intervention addresses a key program gap and energy efficiency opportunity. The intervention does not address a specific trigger event, but is designed to support a broad range of programs and interventions. This initiative should be coordinated with several other initiatives. These include:

- Initiatives that measure building performance, such as Integrated Whole Building Diagnostic Testing and Repair, Retro-commissioning, and Equipment Tune-ups will likely uncover deficiencies in technology and practice that may provide targets for upstream interventions to create new, cost-effective products to fill these unsatisfied needs.
- *Demand Response*. The Demand Response initiative is likely to uncover unmet development and commercialization needs that can best be met with this initiative.
- *Technical Training and Certification*. Training programs may need to be developed to ensure that new products developed for this initiative are well understood and can be readily specified, installed, operated and maintained.

Procurement

This intervention is designed to build market demand and efficiency industry capacity. The intervention does not address a specific trigger event, but is designed to support a broad range of programs and interventions by increasing the availability and lowering costs of energy efficient products. The procurement initiative should be coordinated with the following interventions:

- *Branding.* Efficiency levels set for procurement practices should be coordinated with the Branding initiative.
- *Existing efficiency programs*. The intervention should be coordinated with other efficiency programs to make sure that the intervention has the latest information on the performance of the preferred technologies.

Branding

This intervention is designed to lend support to many existing programs and improve the energy savings attained by those programs. The Branding initiative should be coordinated with interventions recommended within this project, existing efficiency programs, and state and national efficiency organizations, including:

- *Interagency Coordination*. The intervention should coordinate with the Energy Commission and CPUC staff who must make the policy decisions on branding and who must provide and oversee funding for efficiency programs that rely on branding as a component of program design.
- *Upstream Interventions/Manufacturer Partnerships*. The intervention should be coordinated with any upstream or manufacturer partnership when setting efficiency targets.
- *Other National and State Organizations*. U.S. EPA ENERGY STAR program managers and CEE administrators and managers would likely prefer partnerships with California rather than deal with the creation of a new competing

brand. NYSERDA and other state efficiency programs that might want to cooperate on an enhanced branding strategy.

Information, Case Studies and Demonstrations

This intervention is designed to address key barriers to energy efficiency technology adoption. This initiative supports many of the initiatives in this program and as such needs to be coordinated with each of them by providing oversight and guidance in identifying information barriers impeding their success and designing and disseminating corresponding products to overcome those barriers. Examples include:

- *Information Gateway.* As the primary residential information portal, case studies and demonstrations of the products and services promoted by the information gateway should be identified.
- *Time of Sale Information Disclosure*. Case studies and demonstrations of the products and services recommended by home energy ratings should be identified and promoted, including energy improvement mortgages.
- *Integrated Whole Building Diagnostics and Repair.* Given the costliness of the service, case studies and demonstrations of the effectiveness of this service should be included to improve consumer confidence in this intervention.
- *Equipment Tune-ups*. Case studies and demonstrations of the benefits of enhanced HVAC tune-ups should be included to reduce consumer resistance to the cost premium of this service.
- *Assistance to Affordable Housing*. Case studies and demonstrations of the benefits and economic viability of comprehensive energy efficiency upgrades during building renovation are needed for housing authority staff and affordable housing developers.
- *Commercial Benchmarking*. As the primary commercial building information portal, case studies and demonstrations of the products and services promoted by the commercial benchmarking system should be identified.
- *Retro-commissioning.* Case studies and demonstrations of the energy cost and risk mitigation benefits of retro-commissioning should be developed.
- *Commercial Leasing*. Case studies and demonstrations of the financial benefits of energy-efficient leasing strategies for all parties involved should be developed.
- *Demand Response.* Case studies and demonstrations of the benefits of demand response technologies should be included to reduce consumer resistance resulting from energy bill uncertainty associated with demand response programs.

Technical Training and Certification

This intervention is designed to address key barriers and build efficiency industry capacity. The intervention does not address a specific trigger event, but is designed to support a broad range of programs and interventions by increasing the skill level of technicians and improving market confidence in the services provided. The Technical Training and Certification initiative should be coordinated with the following interventions:

- *Time of Sale Information Disclosure.* Training and certification of additional HERS raters will be required to meet the goals set out for this intervention.
- *Retro-commissioning.* Training and certification of additional commissioning agents will be required to meet the goals set out for this intervention.
- *Integrated Whole Building Diagnostic Testing*. Training and certification of additional whole-building performance contractors will be required to meet the goals set out for this intervention.
- *Equipment Tune-ups*. Training and certification of additional HVAC service technicians will be required to meet the goals set out for this intervention.
- *Assistance to Affordable Housing*. Training services are needed for housing authority staff and affordable housing developers.
- *Commercial Leasing*. Training services are needed for leasing agents, real estate agents, and others involved in writing and negotiating lease agreements.

Risk Protection

This intervention is designed to address key barriers to energy efficiency technology adoption. The intervention does not address a specific trigger event, but is designed to support a broad range of programs and interventions by increasing the market confidence in energy efficiency equipment and services. The risk protection initiative should be coordinated with several interventions. These include:

- *Information Gateway.* As the primary residential information portal, the existence of the Risk Protection intervention and the products and services covered under the intervention should be identified and promoted.
- *Time of Sale Information Disclosure*. The existence of the Risk Protection intervention and the coverage of products and services recommended by home energy ratings should be identified and promoted.
- *Integrated Whole Building Diagnostics and Repair.* Given the costliness of the service, risk protection in the form of energy bill guarantees may improve consumer acceptance of this intervention.
- *Equipment Tune-ups*. Risk protection in the form of energy bill guarantees may reduce consumer resistance to the cost premium associated with enhanced HVAC tune-up services.

- *Demand Response.* Risk protection in the form of energy bill guarantees may reduce consumer resistance to the energy bill uncertainty associated with demand response rate structures and technologies.
- *Information, Case Studies and Demonstrations*. This initiative should promote the existence of the risk protection option as another means of reducing market barriers.
- *Interagency Coordination*. The Risk Protection intervention is designed to benefit all energy efficiency programs, to the extent that the technologies addressed by the programs are covered and the program design makes use of the service. Coordination of measure identification, pilot testing and roll-out of this intervention with the Energy Commission, the CPUC, the IOUs and non-IOU program administrators will be required.

Interagency Coordination

This intervention is designed to support existing programs and improve their overall effectiveness in the market. By its very nature, the intervention requires coordination with a variety of entities:

- The CPUC, who must oversee and order the implementation of this initiative, including both the program coordination and the evaluation and tracking efforts;
- The Energy Commission, which has expertise that can inform the initiative design efforts and perhaps help develop the operational designs of the initiative;
- The program administrators who are responsible for program design, development and implementation;
- The statewide and utility energy efficiency programs that will likely benefit from the effort through referrals, but who also must refer participants to other programs;
- The third-party program administrators that will refer participants to other programs, but who will also experience referrals; and
- The evaluation contractors who must modify program-based evaluations to recognize the contributions of other programs, referral systems and information providers.

As is evident from the above discussions, the relationships and synergies between the interventions forms a complex and interdependent network of activities. A summary of the important relationships of between each intervention in the portfolio is shown in Figure 25.

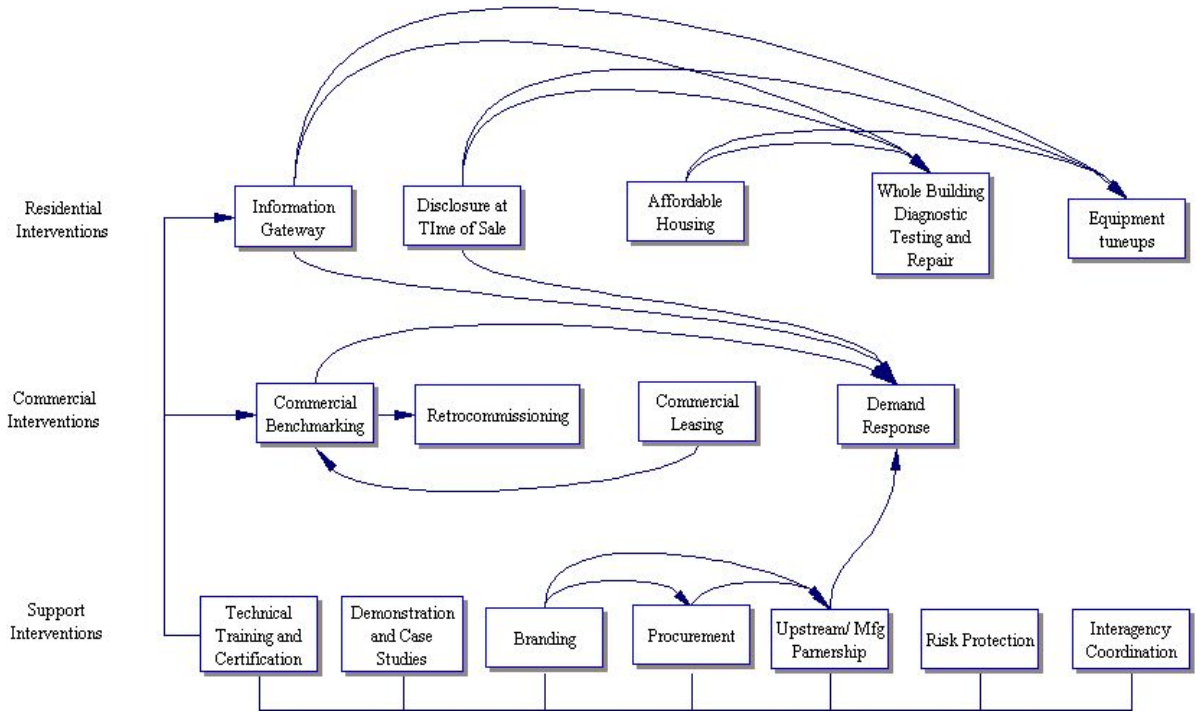

Figure 25. Relationships Between Interventions in Overall Portfolio

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5. ENERGY SAVINGS AND ECONOMIC ANALYSIS

The electricity, natural gas, and peak demand savings potential of the interventions considered in the project are calculated from a combination of the technical potential of a particular technology to save energy and the role of the intervention in improving the adoption of the technology. The technical potential calculations consider the building type, existing building stock, the energy savings potential of a set of technologies targeted under the intervention, the saturation of equipment types in the general population and the frequency with which the target population comes in contact with a particular intervention. The adoption model considers the ability of the intervention to address barriers that influence the technology adoption process. The overall process is shown in Figure 26.

Technical Potential

The technical potential calculations consider the building type, existing building stock, the energy savings potential of a set of technologies targeted under the intervention, and the saturation of equipment types in the general population. The technical potential calculations follow the model used by Xenergy (Coito and Rufo, 2003; Rufo and Coito, 2002) for a series of potential studies conducted for existing residential and commercial buildings. Technical potential is defined as the energy savings resulting from complete penetration of all measures in applications where they are deemed technically feasible from an engineering perspective.

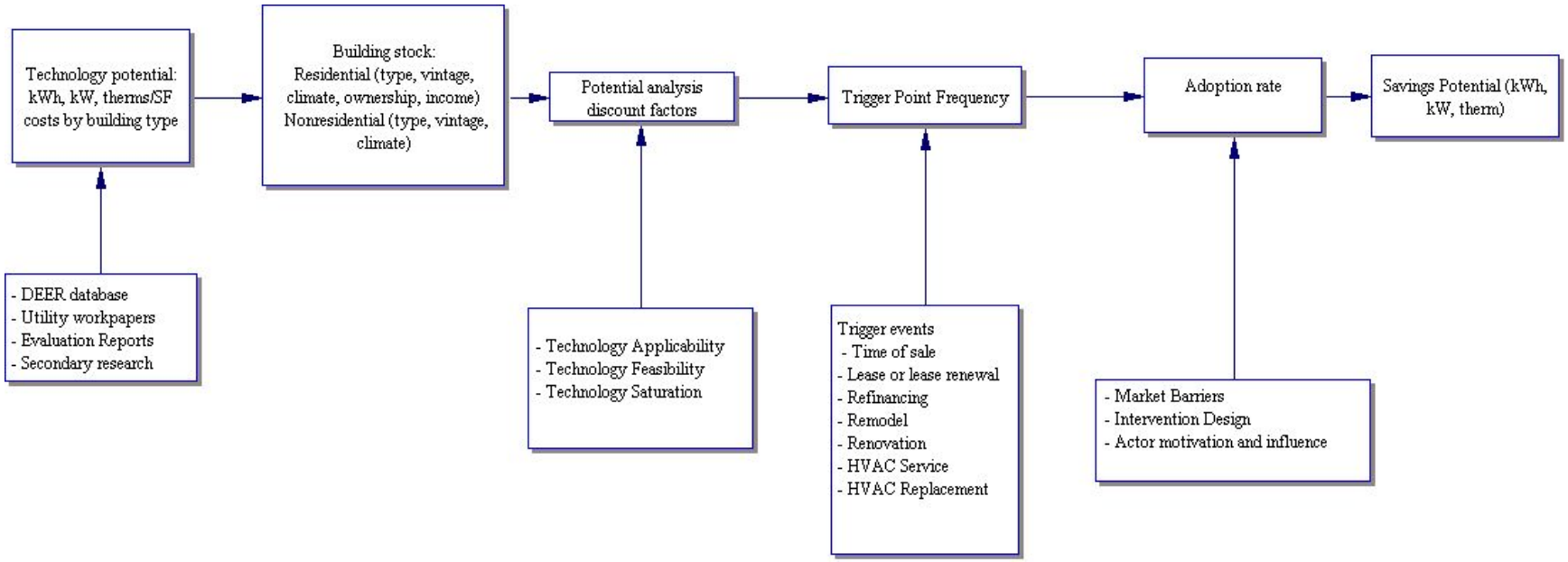

Figure 26. Energy Savings Potential Process

The data for the residential sector analysis come primarily from the California Statewide Residential Sector Energy Efficiency Potential Study (Coito and Rufo, 2003), the California Statewide Residential Appliance Saturation Study (RASS) (KEMA-Xenergy, 2004) and additional secondary research conducted for this project by the consultant team[6]. Basic data on existing building housing stock and the energy savings potential of common energy efficiency measures were taken from the statewide residential potential study. Updated values on appliance unit energy consumption (UEC) and appliance saturations were taken from the RASS. The RASS data were also used to segment the residential building stock into sub-segments by income and ownership type to better understand energy savings potential of the interventions strategies within each segment.

The efficiency potential study segments the building stock into buildings built prior to the Building Efficiency Standards and those built after the Standards. The residential building stock for each of these vintages was divided into segments representing owners and renters in three income groups (< $35,000 per year, $35,000 - $75,000 per year, and > $75,000 per year household income) according to the fraction of the total population represented by each segment. The multifamily data were further segmented into town homes, 2-4 unit buildings, and 5+ unit buildings. The building stock data from the statewide residential potential study are broken out by climate zone, but since the income and ownership segments are defined at a statewide level, these fractions were applied uniformly across each climate zone. UEC data from RASS study by building type were applied to the segmented population data. Since the UEC data in the RASS are also statewide, the UEC distributions by climate zone from the statewide residential potential study were used to assign UECs by building type and climate zone.

Commercial sector data on existing building stock floor area, end-use intensity, the saturation of equipment types within each building type and the energy savings potential of the technologies promoted by the intervention were taken primarily from the California Statewide Commercial Sector Energy Efficiency Potential Studies (Rufo and Coito, 2002, Coito and Rufo, 2003), with additional secondary research conducted for this project by the consultant team. The overall commercial building stock was divided into segments representing two vintages (pre-Building Efficiency Standards and post-Building Efficiency Standards), ten commercial building types, the three electric IOUs (PG&E, SCE and SDG&E) and the three gas IOUs (PG&E, SCG and SDG&E). The building types defined for this study are offices, restaurants, retail, grocery, warehouse, school, college, hospital, lodging and other.

A listing of the data used in the analysis is shown in Appendix F.

[6] See the Appendices to this report for more information.

Adoption Rates

The adoption model considers the ability of the intervention to address barriers that influence the technology adoption process. The measure adoption rate, defined as the fraction of the participants that will adopt a particular measure was estimated to account for the fact that certain measures (for example, compact fluorescent lamps) are more likely to be adopted than replacement windows or new high-efficiency air conditioning systems within a particular intervention strategy. The measure adoption rates were estimated from evaluation studies of similar programs conducted during the 2002-2003 program cycle. The program adoption rate, defined as the estimate of the population targeted by the intervention that will participate in the program offering was also estimated. An "*expert opinion*" approach was used to estimate the program adoption rate for the interventions recommended by this project. This approach relies on the current knowledge of a group identified industry experts to provide their best estimates of program adoption for specific initiatives deployed under different levels of program design and promotional efforts[7].

The expert opinion approach consisted of two levels of program adoption assessments that were merged into the final estimate. In the first level the Energy Commission staff, the Energy Commission -selected technical advisors and the consultant team identified a set of "initiative experts" who are in some way involved in the industry in which each initiative would operate. Interviews were conducted with these experts to gain their opinions on the need for the initiative, their opinions on key operational and design characteristics that would be important to consider in constructing and fielding the initiative, and their estimate of the program adoption rate the initiative would experience if designed an operated consistent with what the experts considered to be good operational practices. This effort resulted in a range of estimated program adoption levels for the initiatives considered.

The second estimation level consisted of the creation of program adoption estimates from the consultant research team. This team consists of experts in the evaluation of energy initiative designs, operations and market strategies, experts in human adoption behavior and behavior response to offered energy initiatives, and experts on the amount of energy that can be saved through the installation and use of energy efficiency technologies. In this "second level" effort the estimates and notes from the expert interviews were examined to help identify range estimates for the various program initiatives. The initiatives were broken down into different design components that would be expected to influence customer demand and participation rates. Following the generation of the design components a series of expert-opinion-estimated program adoption rates based on the initiative design characteristics was established. A range of expected program adoption rates for each design characteristic within each initiative was identified along with an average overall expected program adoption rate for the initiatives. Program adoption rates were

[7] More accurate penetration estimates can be provided by developing specific concept initiatives and conducting primary market research (surveys, focus groups and so on) within the target markets to measure expected demand. This research approach was beyond the scope of the AB549 project.

developed for a set of progressively aggressive designs so that each increase in the aggressiveness of the design was linked to an increase in projected program adoption levels.

The estimates presented in this assessment assume that the initiatives would operate in a non-supply emergency environment most all of the time, with some isolated short-duration periods of limited supply constraints during peak periods in June, July, August and September and stability pricing of electrical and natural gas prices. The initiatives would be expected to experience added program adoption in restricted supply environments or in a situation in which energy costs increase substantially above the rate of inflation. As in all projections of program adoption presented in the AB549 research effort, there is the implied assumption that program design and implementation resources would be provided to support high-quality professionally-developed program designs and operational strategies that would be expertly and effectively employed within the targeted market. Like all initiatives, the success of the initiative lies less with the general nature of the initiative than in the details nested in the development, design and implementation approaches. A list of the intervention strategies and estimated program adoption rates as a function of key intervention activities is shown in Table 1.

Table 1. Estimated Intervention Adoption Rates

Intervention	Incremental Adoption Rate (Percent of applicable market to adopt*)
Information Gateway	• General information with targeted distribution: 2% - 6% • General information widely distributed plus targeted distribution: 6% - 10% • General information widely distributed plus targeted distribution and linkages to programs: 10% - 15% • General information widely distributed with targeted distribution and linkages to programs that have sector-based one-stop customer solutions: 12% - 25% • General information widely distributed plus targeted distribution and pending energy crisis: 15% – 35% • General information widely distributed plus targeted distribution and linkages to programs that have sector-based one-stop solutions with pending energy crisis: 40% - 70% • General information widely distributed plus targeted distribution and linkages to programs that have sector-based one-stop solutions during and shortly after crisis: 60% - 80%
Time of Sale Information Disclosure	• With utility promotion: 10% - 15% • With owner or buyer incentives: 12% - 15% • With rater incentives: 15% - 20% • With real estate agent promotion: 17% - 25% • With owner or buyer, rater and real estate agent/broker incentives and promotion: 50% - 75% • Only code required after 5 years: 80% - 90%
Equipment Tune-ups	• Promotion and education: 5% - 10% • Promotion and education with incentivized service provider training: 12% - 20% • Promotion and education with incentivized service provider training and continued more rapid rise in energy costs: 12% - 25% • Mandatory at time-of-sale and replacement: 40% - 60%
Integrated Whole Building Diagnostic Testing and Repair	• With general promotion: 2% - 5% • With general promotion and education: 3% - 7% • With general promotion and education and decrease in insurance rates for actions: 6% - 10% • With general promotions and education plus targeted promotions and easy, fast, one-step process: 8% - 12%
Assistance to Affordable Housing	• General promotion and education: 5% - 10% • One-on-one promotions linked to targeted and flexible program services: 10% - 20% • One-on-one promotions linked to targeted and flexible program services that make actions cost neutral: 17% - 30% • One-on-one promotions linked to targeted and flexible program services that make actions cost neutral linked with State and Federal support and market push: 25% - 60% • One-on-one promotions linked to targeted and flexible program services that make actions cost neutral linked with State and Federal support and market push with rapid approval and payments/credits: 50% - 75% • One-on-one promotions linked to targeted and flexible program services and that make actions cost neutral linked with State and Federal support and market push with rapid approval and payments/credits and owner incentives: 65% - 90%
Benchmarking	• Promotion and education with benchmarking information program: 3% - 8% • Promotion and education with automated benchmarking on monthly bill and coordinated retrofit program services: 8% - 15% • Promotion and education with automated benchmarking on monthly bill and one-on-one out-reach that links to attractive program services and incentive programs: 15% - 25%
Retro-commissioning	• Promotion and education with information program: 3% - 5% • Promotion and education with information programs linked with real demonstrations and case studies: 5% - 10% • Promotion and education with information programs linked with real demonstrations and case studies and targeted benchmarking services: 10% – 20% • Promotion and education with information programs linked with real demonstrations and case studies and targeted benchmarking services, with trade ally training and incentives: 20% - 30%

Intervention	Incremental Adoption Rate (Percent of applicable market to adopt*)
Commercial Leasing	• Promotional and information efforts: 2% - 4% • Promotional and information efforts with LEED coordination, support and public recognition: 4% - 8% • Promotional and information efforts with LEED coordination, support and public recognition with tax exemption: 10% - 20% • Promotional and information efforts with LEED coordination, support and public recognition with aggressive tax exemption: 20% - 35%
Upstream Interventions/ Manufacturer Partnerships	• Establish more partnerships with manufacturers to encourage production of more efficient products: 2% - 5% • Establish more partnerships with manufacturers to encourage production of more efficient products linked with longer term promotional efforts for the products produced: 15% - 25% • Establish more partnerships with manufacturers to encourage production of more efficient products linked with longer term promotional efforts and national recognition of achievements in the market place: 25% - 35% • Establish more partnerships with manufacturers to encourage production of more efficient products linked with longer term promotional efforts for the product lines produced with national recognition of achievements in the market place and financial incentives for production: 35% - 50% • Establish national, multi-state, multi-organizational partnerships with manufacturers to encourage production of more efficient products linked with longer term promotional efforts for the efficient products produced with national recognition of achievements in the market place and financial incentives for production: 65% - 80%
Branding	• Continued use of ENERGY STAR branding (note: already doing this): 0% • Continued use of ENERGY STAR Brand when most efficient, with CEE tier 2 when available: 2% - 4% • Establish co-brand that improves on ENERGY STAR for ENERGY STAR covered technologies, use co-brand on higher efficiency technologies: 4% - 8% • Build an Energy Commission or California Brand that goes beyond ENERGY STAR and covers wide range of ENERGY STAR and non- ENERGY STAR covered products: 8% - 10% • Build a new National Brand in partnership with other states and organizations that goes beyond ENERGY STAR and covers wide range of ENERGY STAR and non- ENERGY STAR covered products, use ENERGY STAR only when it is not covered by new National Brand: 10% - 15%

**Based on acquired expert opinions as of May 2005. Assumes statewide market development efforts with continued multi-year multi-program cycle efforts, consistent funding, consistent service offerings with clear and focused market messages and interventions. Note: Market interventions have interactive effects, that is, markets are affected by multiple events and conditions; adoption estimates are not additive within a market. Market conditions significantly affect estimates. Adoption projections are for efforts started in 2006 running through 2013 to be consistent with CPUC Public-Goods Charge long-term program objectives.*

Energy and Demand Savings

A simplified engineering approach was used to calculate the energy and demand savings of selected interventions, based on the methodology described above. The impact of a particular intervention is estimated from the following equations:

Intervention kWh or therm savings =

$$\left[\sum^{buildingtypes} Building\ stock \times F_{target} \times \sum^{enduses} EUI \times F_{applicability} \times \sum^{measures} F_{savings} \times F_{feasibility} \times F_{not\ complete} \times F_{adopt,meas}\right] \times F_{adopt,prog}$$

Intervention kW savings =

$$\left[\sum^{buildingtypes} Building\ stock \times F_{target} \times \sum^{enduses} EUI \times F_{applicability} \times \frac{F_{demand}}{1000} \times \sum^{measures} F_{savings} \times F_{feasibility} \times F_{not\ complete} \times F_{adopt,meas}\right] \times F_{adopt,prog}$$

where:

Building stock	=	*existing building stock by building type. These data are expressed in terms of number of homes for residential buildings or building floor area for commercial buildings.*
EUI	=	*energy use intensity for the building type and end-use affected by the efficient technology, defined with units consistent with the building stock data (e.g. kWh/home or therm/home for residential buildings; kWh/SF or therm/SF for commercial buildings)).*
$F_{applicability}$	=	*applicability factor, which is the saturation of a particular baseline technology within each building type. For example, the applicability factor for an efficient air conditioner would be equal to the fraction of the floor space that is served by air conditioning.*
$F_{savings}$	=	*savings factor, which is the end-use savings fraction associated with the efficient technology.*
$F_{feasibility}$	=	*feasibility factor, which is the fraction of the floor space where it is technically feasible to convert from standard to efficient technology. This factor varies by measure.*
$F_{not\ complete}$	=	*not complete factor, which is the fraction of the floor space that has not been converted to the efficient technology. This factor also varies by measure.*
F_{demand}	=	*coincident demand factor, which is and estimate of the coincident peak demand (W) per kWh of energy savings. This factor varies by end-use*
F_{target}	=	*fraction of the market segment targeted by the intervention*
$F_{adopt,prog}$	=	*fraction of the market segment targeted by the intervention that participates in the program*
$F_{adopt,meas}$	=	*rate at which program participants adopt the various measures offered by the program*

Energy and Demand Savings Calculation Example

Estimate the energy and demand impact of an intervention promoting the installation of 14 SEER split system air conditioners at time of replacement in Pre-1979 single family owner-occupied homes with homeowner income levels between $35-$75k in climate zone 3. Equipment replacements are assumed to be 5% of total installed units. The program adoption rate is assumed to be 30%, and the measure adoption rate is assumed to be 100%. The data required for the calculation are summarized in Table 2.

Table 2. Data for Energy and Demand Savings Example

Data Element	Value
Building stock	109,437
EUI	3380
$F_{applicability}$	0.71
$F_{savings}$	0.27
$F_{feasibility}$	1.0
$F_{not\ complete}$	0.98
F_{demand}	0.90
F_{target}	5%
$F_{adopt,prog}$	30%
$F_{adopt,meas}$	100%

Electricity savings are calculated as follows:

$$kWh = 109{,}437 \times 0.05 \times 3380 \times 0.71 \times 0.27 \times 1.0 \times 0.98 \times 1.0 \times 0.30$$

$$= 1{,}042{,}366$$

Peak demand savings are calculated as follows:

$$kW = 109{,}437 \times 0.05 \times 3380 \times 0.71 \times \frac{0.90}{1000} \times 0.27 \times 1.0 \times 0.98 \times 1.0 \times 0.30$$

$$= 938$$

Economic Analysis

The economic analysis of the intervention strategies was calculated considering the value of the expected energy savings resulting from the intervention and the costs associated with achieving those savings. The energy savings were calculated from

the technical energy savings potential for the measures introduced by each intervention and the ability of the intervention to improve the adoption of the measures. Energy cost savings was calculated as the net present value[8] of the energy savings over the life of the measures encouraged by the intervention. Costs to achieve those savings result from the purchase of the new technology, any administrative costs associated with bringing the intervention into the market and any incentives paid to market participants to help reduce market barriers. Cost-effectiveness was considered from two perspectives: participant cost-effectiveness and total resource cost-effectiveness.

Participant Cost-effectiveness

The cost-effectiveness of the intervention is calculated from the perspective of the customer. The participant cost-effectiveness considers energy cost savings resulting from the efficient technology, any incentives paid to the customer to induce the efficient technology purchase, and the out-of-pocket expenses associated with the purchase. It is generally assumed that customers will act in their best economic interest when considering adoption of efficient technology, although behavioral research suggests that the decision is complex and involves many uncertainties and non-energy considerations. The participant cost-effectiveness test is included as a measure of the economic rationale for improving building efficiency due to the intervention. Any intervention with a participant benefit cost ratio of greater than one is deemed cost-effective from the standpoint of the participant.

$$BCR_{part} = \frac{PV\ LCS_{part} + Incentives}{Measure\ costs - PV\ (O\ \&\ M + NEBs)}$$

where:

BCR_{part}	= participant benefit cost ratio
$PV\ LCS_{oart}$	= present value of life cycle participant energy cost savings
$Incentives$	= incentive payments received in year 1
$Measure\ costs$	= costs to install measures incurred by participants
$PV\ (O\&M + NEBs)$	= present value of operations and maintenance savings and non-energy benefits

The measure costs are calculated from:

[8] Net present value was calculated at a real discount rate of three percent per annum.

Measure costs =

$$\left[\sum^{building\ types} Building\ stock \times F_{target} \times \sum^{measures} \frac{measure\ cost}{unit} \times \frac{unit}{building} \times F_{applicability} \times F_{feasibility} \times F_{not\ complete} \times F_{adopt,meas}\right] \times F_{adopt,prog}$$

Measure cost assumptions are shown in a series of tables in Appendix F. The customer avoided costs for the participant cost-effectiveness test were calculated using average utility costs by utility and customer class from the CPUC Energy Efficiency Policy Manual (CPUC, 2003). The residential customer costs represent the 20 year average cost by IOU service territory. The commercial customer cost represents a weighted average across commercial customer classes by IOU service territory to obtain a representative average cost for commercial customers.

Total Resource Cost-effectiveness

The total resource cost-effectiveness evaluates the costs of implementing an intervention as an energy supply resource option. The total resource cost test includes participant out of pocket costs, advertising and administrative costs, and the net present value of the utility avoided costs over the life of the measures addressed by the intervention. The total resource cost-effectiveness is expressed as a ratio of the benefits to the costs. Any intervention with a total resource benefit cost ratio of greater than one is deemed cost-effective on a total resource basis.

$$BCR_{total\ resource} = \frac{PV\ LCS_{util}}{Program\ costs + Measure\ costs - PV\ (O\ \&\ M + NEBs)}$$

where:

$BCR_{total\ resource}$	= total resource benefit cost ratio
$PV\ LCS_{util}$	= present value of life cycle utility avoided costs
Program costs	= Program admin costs not including incentives
Measure costs	= Costs to install measures incurred by participants
PV (O&M + NEBs)	= present value of operations and maintenance savings and non-energy benefits

Energy costs used to calculate the customer energy costs savings and the utility avoided costs are shown in Table 3 and Table 4. The customer avoided costs were calculated from participant avoided cost data contained within the CPUC efficiency program proposal workbooks. The residential customer costs represent the 20 year average cost from the CPUC workbooks by IOU service territory. The commercial cost represents a weighted average across commercial customer classes by IOU service territory to obtain a representative average cost for commercial customers.

Utility avoided costs were taken from the CPUC Avoided Cost Study (Energy and Environmental Economics, 2005).

Table 3. Residential Customer Energy Costs and Utility Avoided Costs

Climate Zone	Customer Electricity Cost ($/kWh)	Avoided Electricity Cost – HVAC Measures ($/kWh)	Avoided Electricity Cost Lighting and Appliance Measures ($/kWh)	Customer Gas Cost ($/therm)	Avoided Gas Cost ($/therm)
CZ1	$0.16	$0.13	$0.08	$1.13	$0.72
CZ2	$0.16	$0.13	$0.08	$1.13	$0.72
CZ3	$0.16	$0.13	$0.08	$1.13	$0.72
CZ4	$0.16	$0.13	$0.08	$1.13	$0.72
CZ5	$0.16	$0.13	$0.08	$1.13	$0.72
CZ7	$0.18	$0.13	$0.08	$1.36	$0.72
CZ8	$0.18	$0.13	$0.08	$1.36	$0.72
CZ9	$0.18	$0.13	$0.08	$1.36	$0.72
CZ10	$0.18	$0.13	$0.08	$1.36	$0.72
CZ13	$0.20	$0.13	$0.08	$1.66	$0.72

Table 4. Commercial Electric and Gas Customer and Avoided Costs

	Electric Customer Cost ($/kWh)	HVAC Avoided Cost ($/kWh)	Lighting, Refrigeration, Misc. Avoided Cost ($/kWh)	Exterior Lighting Avoided Cost ($/kWh)	Gas Customer Cost ($/therm)	Gas Avoided Cost ($/therm)
PG&E	0.20	0.13	0.08	0.06	0.95	0.72
SCE	0.194	0.13	0.08	0.06	0.96	0.72
SDG&E	0.17	0.13	0.08	0.06	1	0.72

Economic Analysis Example

Calculate the cost-effectiveness of the example intervention described in the previous section. The interventions promotes the installation of 14 SEER split system air conditioners at time of replacement in Pre-1979 single family owner-occupied homes with homeowner income levels between $35-$75k in climate zone 3. Equipment replacements are assumed to be 5% of total installed units. The program adoption rate is assumed to be 30%, and the measure adoption rate is assumed to be 100%. The program offers a rebate equal to 30% of the incremental cost of the high-efficiency unit. The program administrative costs are $500,000.

Assume 3% real discount rate for present value calculations. The data required for the calculation are summarized in Table 5.

Table 5. Data for Economic Analysis Example

Data Element	Value
Building stock	109,437
Measure unit cost	$1,623 per unit incremental cost
Units per house	1
$F_{applicability}$	0.71
$F_{feasibility}$	1.0
$F_{not\ complete}$	0.98
F_{target}	5%
$F_{adopt,prog}$	30%
$F_{adopt,meas}$	100%
Energy savings	1,042,366 kWh
Participant energy cost	$0.16 / kWh
Measure life	18 yr.
Utility avoided cost	$0.13 / kWh
Discount rate	0.03
Incentives	0.3
Present value factor 18 yr, 0.03 discount rate	17.48
Program costs	$500,000

Measure costs =

$$\left[\sum^{building\ types} Building\ stock \times F_{target} \times \sum^{measures} \frac{measure\ cost}{unit} \times \frac{unit}{building} \times F_{applicability} \times F_{feasibility} \times F_{not\ complete} \times F_{adopt,meas}\right] \times F_{adopt,prog}$$

$$= 109{,}437 \times 0.05 \times \$1{,}623 \times 1.0 \times 0.71 \times 1.0 \times 0.98 \times 1.0 \times 0.30$$

$$= \$1{,}853{,}781$$

$$Incentives = 0.30 \times \$1{,}853{,}781$$

$$= \$556{,}134$$

$$PV\ LCS_{part} = PV(d,t) \times C_{part} \times \Delta kWh$$

$$= 17.48 \times \$0.16 \times 1{,}042{,}366$$

$$= \$2{,}915{,}279$$

$$BCR_{part} = (\$2{,}915{,}279 + 556{,}134) / (\$1{,}853{,}781)$$

$$= 1.87$$

$$PV\ LCS_{util} = PV(d,t) \times C_{util} \times \Delta kWh$$

$$= 17.48 \times \$0.13 \times 1{,}042{,}366$$

$$= \$2{,}368{,}672$$

$$BCR_{total\ resource} = \$2{,}368{,}672 / (\$500{,}000 + \$1{,}853{,}781)$$

$$= 1.0$$

Cost-effectiveness of Information Initiatives

Some of the initiatives proposed in this project are designed to stimulate the market by providing information, marketing and education services. These programs serve an important role of reducing information-based barriers intended to increase participation in other hardware-based programs. It is difficult to assess the energy savings and cost-effectiveness associated with these types of programs. The Statewide Evaluation Framework a study conducted for the California Investor Owned Utilities on principles and techniques for conduct energy efficiency program evaluation studies states that "if the program has been created primarily as a conduit that leads participants into other programs or services, or it provides training and education on energy efficiency options to customers and other market actors, then the program should not be expected to meet the same cost-effectiveness requirements as programs that are offered expressly as a way of acquiring energy resources." (TecMarket Works, 2004). Thus, an analysis of the energy impacts and cost-effectiveness of some the information only interventions was not attempted.

Intervention Energy Savings and Economic Analysis

The energy savings, costs and cost-effectiveness of each of the interventions expected to provide direct energy savings were estimated using the methodology described in this chapter[9]. The principal assumptions used in the analysis and results of the calculations are summarized below.

Information Gateway

The information gateway strategy targets single family homes and multi-family homes built prior to the Building Efficiency Standards, representing approximately 6.2 million units. Based on discussions with the residential working group and the

[9] Energy and demand impacts are expected from the Procurement and Demand Response interventions, but were not calculated due to limitations in the available data.

expert panel representing program implementers from the IOUs and other stakeholders, an annual target of 10 percent of the total eligible population was selected, representing approximately 624,000 units.

Program Adoption

The program adoption rate was estimated at 19% of the targeted participants. In this initiative the expert opinion consultants considered seven different initiative designs with projected penetration levels ranging from 2% to 80% of the market depending on the aggressiveness of the initiative design, the implementation characteristics and the energy supply conditions. For this initiative, the team settled on the development of a program design that focuses distributing information to targeted utility customers, working in coordination with an aggressive set of resource acquisition support programs (such as the PGC programs for 2006-2008) and repetitive message generation vial multiple contact approaches. The team consensus is that an aggressive, well-designed and well-coordinated information initiative can influence an additional 19% of the market to install one or more of the measures promoted by the program.

Measure Adoption

The analysis assumes measures adopted by homebuyers in the same frequency as those reported in the evaluation of the SCE Residential Audit program (Ridge Associates, 2004). Based on the measure adoption rates observed in this program, approximately 58% of a selected set of HVAC measures, 63% of lighting measures, and 40% of water heater measures were assumed to be adopted by participants. The measures selected and their respective adoption rates are shown in Table 6:

Table 6. Information Gateway Measure Adoptions

End-Use	Measures Included	Measure Adoption ratio
	Ceiling insulation Floor insulation Infiltration reduction Wall insulation	0.58
HVAC	High efficiency central air conditioner High efficiency room air conditioner Programmable thermostat HVAC diagnostic testing and repair Duct repair Condensing furnace	0.58
Lighting	CFLs, interior fluorescent lighting	0.63
Appliances	ENERGY STAR refrigerator ENERGY STAR freezer ENERGY STAR clothes washer ENERGY STAR dishwasher	0.40

Based on these measure installation rates, the average energy savings per participant is 619 kWh, 0.16 kW and 56 therms per year.

The total energy savings estimated for this intervention are summarized in Table 7:

Table 7. Information Gateway Energy and Demand Savings

Homes targeted	624,000
Program adoption rates (probable to high)	0.19 – 0.80
Number of participants	118,600 – 499,200
Savings per home	619 kWh/yr 0.16 kW 56 therm/yr
Gigawatt hours	73 - 307
Megawatts	19 - 80
Million therms	6.6 – 27.8

Economic Analysis

The program administrative costs were estimated at $45 per survey, based on average costs from the PG&E Home Energy Efficiency Survey program proposal for the 2004-2005 program cycle (PG&E, 2003). Measure costs for the measures adopted by the participants were taken from the statewide residential efficiency potential study. Measure incentives are assumed to be provided by referrals to

existing programs, and are not included in the budget. Program costs and cost-effectiveness at probable and high program adoption rates are shown in Table 8.

Table 8. Information Gateway Program Cost and Cost-effectiveness

	Costs ($million) and Benefit/Cost Ratio	
	Probable adoption	High adoption
Program Administrative Cost	$28.0	$117.9
Participant Incentive Cost	$0.0	$0.0
Total Program Cost	$28.0	$117.9
Participant Benefits	$243.6	$1,025.8
Participant Costs	$127.0	$534.7
Participant Benefit/Cost Ratio	1.9	1.9
Total Resource Benefits	$122.1	$514.3
Total Resource Costs	$117.5	$494.7
Total Resource Benefit/Cost Ratio	1.0	1.0

Time-of-Sale Information Disclosure

The time-of-sale information disclosure strategy applies to all residential homes. According to the prior research conducted for the AB 549 project (Heshong-Mahone Group, 2003), single family homes and condominiums were sold in 2002 at the rate of 5.5 percent and 6.3 percent respectively. Assuming a total population of approximately 9.6 million residential housing units, this represents approximately 552,000 resale transactions in these market sectors annually.

Program Adoption

The intervention is designed to be implemented in several phases, starting with a voluntary pilot program, phase 1 mandatory disclosures of energy ratings for pre-Building Efficiency Standards homes, and phase 2 mandatory disclosures of energy ratings for all homes regardless of vintage. The program adoption rate for phase 2 initiative was estimated at 85 percent to 90 percent of eligible participants, based largely by the expected enforcement level of the program.

Measure Adoption

Measure adoption rates for the intervention were taken from the evaluation, measurement and verification (EM&V) study of a voluntary time-of-sale program conducted in the PG&E service territory (Mowris, 2004), as shown in Table 9. Adoptions of energy efficiency measures by homeowners receiving energy efficiency information at time of sale was aided by referrals to existing equipment rebate programs offset first costs.

Table 9. Time of Sale Information Disclosure Measure Adoption Rates

Measure category	Measure description	Adoption rate
Building Shell	Low e window replacement	0.11
	Ceiling Insulation	0.33
	Wall Insulation	0.2
	Infiltration Reduction	0.73
HVAC	High efficiency central AC	0.46
	Programmable Thermostat	0.53
	HVAC Diagnostic Testing And Repair	0.46
	Duct Repair	0.44
	Condensing Furnace	0.44
	High efficiency room air conditioner	0.46
Lighting	CFLs	0.63
	Interior fluorescent lighting	0.39
Appliances	ENERGY STAR Refrigerator	0.31
	High efficiency freezer	0.31
	ENERGY STAR clothes washer	0.1
	ENERGY STAR dishwasher	0.25
Water Heating	High efficiency water heater	0.19
	Low flow showerhead	0.17
	Pipe wrap	0.64
	Faucet aerators	0.8

Based on these measure installation rates, the average energy savings per pre-efficiency standards participant was estimated to be 543 kWh, 0.16 kW and 31 therms per year. Considering all participants, the average energy savings was estimated to be 535 kWh, 0.15 kW and 26 therms.

The total energy savings estimated for this intervention are summarized in **Table 10**.

Table 10. Time-of-Sale Information Disclosure Energy and Demand Savings

Phase	Pilot	Phase 1	Phase 2
Homes targeted	356,000	356,000	552,000
Program adoption rates (probable to high)	.10 - .15	.85 - .90	.85 - .90
Number of participants	35,600 - 53,400	302,600 - 320.400	469,200 - 496,800
Savings per home	543 kWh/yr 0.16 kW 31 therm/yr	543 kWh/yr 0.16 kW 31 therm/yr	535 kWh/yr 0.15 kW 26 therm/yr
Gigawatt hours	19 - 29	164 - 174	251 - 266
Megawatts	6 - 9	49 -52	73 -77
Million therms	1.1 - 1.5	9.3 - 9.9	12.0 - 12.7

Economic Analysis

Cost for this intervention were estimated for each phase. For the pilot phase, the program administrative costs were estimated based on costs for a similar program implemented during the 2002-2003 program cycle (GeoPraxis, 2002). The program costs were normalized per home, resulting in an average cost of $73 per home.[10] Measure costs for the measures adopted by the participants were taken from the statewide residential efficiency potential study. Recommended incentive costs of $30 per home to offset the costs of the energy ratings were taken from the program evaluation report (Mowris, 2004). During Phase 1 implementation, training and incentive costs were removed, resulting in an administrative cost of $50 per home. For Phase 2 and beyond, the program costs are initially set to $25 per home, but will eventually go to zero as the program is taken over by the private sector. Program costs and cost-effectiveness at probable and high adoption rates during each phase of the program are shown in Table 11.

[10] Planned program cost $875,931; planned inspections 12,000. Average cost per inspection: $73.00

Table 11. Time-of-Sale Information Disclosure Program Cost and Cost-effectiveness

	Costs ($million) and Benefit/Cost Ratio					
	Pilot		Phase 1		Phase 2	
	Probable adoption	High adoption	Probable adoption	High adoption	Probable adoption	High adoption
Program Admin Cost	$2.6	$3.9	$15.1	$16.0	$13.8	$14.6
Participant Incentive Cost	$1.1	$1.7	$0.0	$0.0	$0.0	$0.0
Total Program Cost	$3.7	$5.6	$15.1	$16.0	$13.8	$14.6
Participant Benefits	$50.8	$76.2	$432.0	$457.4	$618.3	$654.7
Participant Costs	$24.6	$36.9	$218.0	$230.8	$311.7	$330.0
Participant Benefit/Cost Ratio	2.1	2.1	2.0	2.0	2.0	2.0
Total Resource Benefits	$27.8	$41.7	$236.2	$250.1	$335.1	$354.8
Total Resource Costs	$28.2	$42.4	$233.1	$246.9	$325.5	$344.7
Total Resource Benefit/Cost Ratio	1.0	1.0	1.0	1.0	1.0	1.0

Integrated Whole Building Diagnostic Testing and Repair

This intervention examines whole building diagnostic testing of owner-occupied single family and multifamily homes with central air conditioning built prior to the Building Efficiency Standards. A voluntary program without any particular trigger event was analyzed. Approximately 7% of single family owner-occupied homes in warmer climates are targeted per year, representing 270,000 units.

Program Adoption

The program adoption rate was estimated at 10% of the targeted participants. The participation estimate for the whole building diagnostic testing service ranged from a low of 2% to a high of 12% depending on the initiative's design and the implementation approach. This initiative is not considered to be a high-demand initiative, requiring substantial education and marketing efforts to gain additional market share. The market is currently not substantially aware of this initiative or the range of potential benefits from the service. Expert opinion places added penetration at about 2% to 5% of the market from an initiative that offers only general information and promotional efforts, to as high as 12% of the market from an initiative with general market-sector-level promotion and educational efforts, linked with targeted promotion to high potential customers, offering fast, easy one-step service delivery. The consultant team settled on a 10% increase in penetration as a likely result of a more aggressive initiative linked with participation incentives.

Measure Adoption

Based on research conducted by Lawrence Berkeley National Laboratory (LBNL, 2002), electricity savings for the service are estimated at 50% of the cooling electricity consumption, and gas savings are estimated at 20% of the annual gas consumption for heating. The average energy savings per home in the targeted climate regions are estimated to be 1,650 kWh, 1.5 kW and 68 therms.

The estimated participation, electricity, peak demand and natural gas impacts of the intervention are summarized in Table 12.

Table 12. Integrated Whole Building Diagnostic Testing and Repair Energy and Demand Savings

Homes targeted	272,000
Program adoption rates (probable to high)	0.10 – 0.12
Number of participants	27,000 – 33,000
Savings per home	1,650 kWh/yr 1.5 kW 68 therm/yr
Gigawatt hours	45 - 54
Megawatts	40 - 48
Million therms	1.9 – 2.2

Economic Analysis

Program administrative costs were estimated at $185 per home treated, based on average costs from a similar program implemented during the 2004-2005 program cycle (CBPCA, 2003). The administrative costs include contractor training and program marketing. Participant costs were estimated at $2500 per home. Incentives provided for the service were estimated at 10% of the participant costs. Program costs and cost-effectiveness at probable and high adoption rates are shown in Table 13.

Table 13. Integrated Whole Building Diagnostic Testing and Repair Program Cost and Cost-effectiveness

	Costs ($million) and Benefit/Cost Ratio	
	Probable adoption	High adoption
Program Admin Cost	$5.0	$6.1
Participant Incentive Cost	$6.8	$8.2
Total Program Cost	$11.9	$14.3
Participant Benefits	$112.3	$134.7
Participant Costs	$68.1	$81.7
Participant Benefit/Cost Ratio	1.7	1.7
Total Resource Benefits	$79.8	$95.8
Total Resource Costs	$73.2	$87.8
Total Resource Benefit/Cost Ratio	1.1	1.1

Assistance to Affordable Housing

This strategy considers the impact of annual HVAC tune-ups of affordable multi-family housing units combined with comprehensive shell, and HVAC upgrades of units undergoing major renovations. Based on housing stock data from the residential potential study and income distributions from the RASS analysis, the number of multi-family units is estimated at approximately 700,000 units. The analysis calculates the impacts of tune-ups applied to units with central air conditioning systems and comprehensive retrofits to all renovated buildings regardless of HVAC system type. Buildings built prior to implementation of Building Efficiency Standards are considered. Rehabilitation events are assumed to occur every 20 years, giving an effective rate of comprehensive rehabilitation of 5 percent per year. Considering the saturation of central air conditioning in multi-family units and the number of expected rehabilitations per year, a potential participation of 142,000 units per year was assumed.

Program Adoption

The program adoption rate was estimated at 43% of the targeted participants. This initiative was one that was identified by the consultant team as having significant penetration potential if designed and administered effectively. The penetration projections ranged from a low of 5% of the market to almost the entire market, depending on the design and implementation strategies employed. The experts suggest that a general information program can be successful at capturing about 5%

of the affordable housing market if structured to gain attention at key decision points. This level is suggested because of the cost barriers for energy efficiency and the split-incentive issues associated with the benefits. However, in addition, the current bureaucracies and entrenched operational approaches of this market can and do effectively constrain interest and participation in programs that promote energy efficiency. In the opinion of the experts interviewed for the project, if the initiative uses aggressive time-sensitive one-on-one promotional efforts, linked to targeted and participant-flexible program services that make the changes cost neutral, incorporating State and Federal support and strong market push participant encouragement, the initiative can be expected to gain as much as 90% of the market over time. The consultant team settled on an average increased penetration over time of about 43% if the initiative is developed to be synchronized with the needs and timing of the low-income housing sector.

Measure Adoption

The analysis assumes comprehensive upgrades to building shell and HVAC systems during rehabilitation, and annual AC tune-ups for all units with central air conditioning. Comprehensive rehabilitation projects are assumed to install high efficiency air conditioners and furnaces, low-e glazing, added attic and wall insulation, air leakage sealing, and high efficiency water heaters or water heating boilers. Average annual savings per unit are estimated to be 271 kWh, 0.44 kW and 72 therms.

The estimated participation, electricity, peak demand and natural gas impacts of the intervention are summarized in Table 14.

Table 14. Assistance to Affordable Housing Energy and Demand Savings

Homes targeted	142,000
Program adoption rates (probable to high)	0.43 - 0.90
Number of participants	61,000 - 128,000
Savings per home	271 kWh/yr 0.44 kW 72 therm/yr
Gigawatt hours	17 - 35
Megawatts	27 - 56
Million therms	4.4 - 9.2

Economic Analysis

The program administrative costs were estimated for the two components of the program. For the tune-up component, an administrative cost of $60 per unit was assumed. For the major rehabilitation component, an administrative cost of $250 per unit was used, based on average costs from low income multi-family programs operating during the 2004-2005 program cycle. Measure costs for the measures adopted by the participants were taken from the statewide residential efficiency potential study. Measure incentives equal to 100 percent of the installed cost are included in the analysis. Program costs and cost-effectiveness at probable and high adoption rates are shown in Table 15.

Table 15. Assistance to Affordable Housing Program Cost and Cost-effectiveness

	Costs ($million) and Benefit/Cost Ratio	
	Probable adoption	High adoption
Program Admin Cost	$12.3	$25.7
Participant Incentive Cost	$32.2	$67.5
Total Program Cost	$44.5	$93.1
Participant Benefits	$133.9	$280.3
Participant Costs	$39.0	$81.7
Participant Benefit/Cost Ratio	3.6	3.6
Total Resource Benefits	$59.0	$123.4
Total Resource Costs	$51.3	$107.4
Total Resource Benefit/Cost Ratio	1.1	1.1

Equipment Tune-Up

This strategy examines voluntary tune-ups at time-of-sale and mandatory tune-ups at time of replacement. The analysis of residential equipment tune-up and O&M services calculated impacts of the strategy applied to all single family and multi-family homes built prior to the Building Efficiency Standards. Homes are targeted at time-of-sale and when equipment is replaced, with an assumed equipment life of 20 years. The combined trigger event frequency from resale and/or equipment replacement is 10.2 percent for single family and 11 percent for town homes, representing approximately 532,000 units. Central air conditioning saturations vary from 16 percent to 72 percent across the building, ownership and income strata considered in the analysis, for an average saturation of 36 percent. The residential efficiency potential study further assumes that 50 percent of the units have not been tuned-up[11], giving a potential participation of 97,000 homes.

Program Adoption

The program adoption rate was estimated at 46 percent of the voluntary time-of-sale participants and 50 percent of the replacement participants. The replacement strategy can be expected to attain a 50 to 60 percent penetration based on prior experience with Building Energy Efficiency Standards relating to HVAC replacements applied to existing buildings.

Measure Adoption

The analysis assumes refrigerant charge, airflow and duct leakage repairs on all homes with central air conditioning systems and/or furnaces, assuming 50 percent of the homes have not already had a tune-up. The estimated energy savings across all building types and climate zones is 328 kWh, 0.42 kW and 74 therms per home.

The estimated electricity, peak demand and natural gas impacts of the intervention are listed in Table 16.

[11] The “incomplete factor,” or the fraction of the market that has not installed the measure estimated from is the residential potential study is 0.50 for the air conditioning tune-up measure.

Table 16. Equipment Tune-up Energy and Demand Savings

Resale or replacement events	532,000
Homes requiring a tune-up	97,000
Program adoption rates (probable to high)	0.48 – 0.57
Number of participants	46,600 – 55,300
Savings per home	328 kWh/yr 0.42 kW 74 therm/yr
Gigawatt hours	15 - 18
Megawatts	20 - 24
Million therms	3.6 - 4.4

Economic Analysis

Program administrative costs were estimated at $130 per system including a $70 per system upstream incentive paid to the contractor. These costs were based on average costs from a similar program implemented during the 2004-2005 program cycle (Mowris, 2003). The participant costs for the tune-ups were taken from the statewide residential potential study. Program costs and cost-effectiveness at probable and high adoption rates are shown in Table 17.

Table 17. Equipment Tune-Up Cost and Cost-effectiveness

	Costs ($million) and Benefit/Cost Ratio	
	Probable adoption	High adoption
Program Admin Cost	$4.7	$5.6
Participant Incentive Cost	$0.0	$0.0
Total Program Cost	$4.7	$5.6
Participant Benefits	$74.8	$89.8
Participant Costs	$35.6	$42.7
Participant Benefit/Cost Ratio	2.0	2.0
Total Resource Benefits	$47.3	$56.8
Total Resource Costs	$40.2	$48.3
Total Resource Benefit/Cost Ratio	1.1	1.1

Commercial Building Benchmarking

The benchmarking analysis calculated impacts of the strategy applied to commercial buildings built prior to the Building Efficiency Standards, representing approximately

5 billion square feet of floor space. The analysis assumes that 20 percent of the total population is targeted, based on a mandatory benchmarking requirement during building refinancing, and a refinancing interval of 5 years, for a total potential participation of 1 billion square feet.

Program Adoption

Of the 20% of the buildings targeted, 20% of those elected to have energy audits conducted as a component of the benchmarking service. The estimates for increased penetration of benchmarking derived savings ranged from a low of 3% to a high of 29% depending on the initiative design and implementation strategies. If the initiative was designed to provide only general distribution and limited targeted information efforts, the expected penetration level is placed in the 3% to 8% range depending on the design of the efforts. If the initiative includes an aggressive educational effort, linked to monthly on-bill benchmarking and one-on-one out-reach promotional efforts provided via a program design that is considered attractive to the key target actors incorporating participation and installation incentives, the initiative is expected to move about 25% of the target market into some form of participation and follow-up actions.

Measure Adoption

The analysis assumes that measures are adopted by commercial building owners in the same frequency as was observed through the evaluation of Statewide Commercial Audit program operated by the IOUs (Quantum Consulting, 2004). Unlike residential buildings, where audits triggered measure adoption rates on the order of 50%, commercial building audits are typically less effective by themselves in increasing measure adoptions. Typical measure adoption rates were 7.6% for lighting measures, 1.8% for lighting controls, 0.4% for exterior lighting, 1.8% for central HVAC plant measures such as high-efficiency chillers, VSD chilled water pumps and energy management systems, 4% for packaged HVAC system measures such as high efficiency rooftop units, HVAC system tune-ups and programmable thermostats, and 0.6% for motor measures and VSDs. Based on these measure adoption rates, the average savings across all building types and climates are estimated at 0.13 kWh/square foot, 0.03 W/square foot and 0.002 therms/square foot.

The estimated electricity, peak demand and natural gas impacts of the intervention are shown in Table 18.

Table 18. Commercial Building Benchmarking Energy and Demand Savings

Targeted floor area	1,000 million square feet
Program adoption rates (probable to high)	0.20 – 0.25
Participating floor area	200 – 250 million square feet
Average savings per square foot	0.13 kWh/square foot 0.03 W/square foot 0.002 therm/square foot
Gigawatt hours	26 - 33
Megawatts	6 - 8
Million therms	0.4 - 0.5

Economic Analysis

Program costs were estimated at $0.01/SF, based on average costs for commercial building mail in and online surveys from the PG&E commercial audit program.[12] Measures are assumed to be financed by the program participants. Participant measure costs were taken from the statewide commercial potential study. Program costs and cost-effectiveness at probable and high adoption rates are shown in Table 19.

Table 19. Commercial Building Benchmarking Program Cost and Cost-effectiveness

	Costs ($million) and Benefit/Cost Ratio	
	Probable adoption	High adoption
Program Admin Cost	$2.0	$2.5
Participant Incentive Cost	$0.0	$0.0
Total Program Cost	$2.0	$2.5
Participant Benefits	$60.2	$75.3
Participant Costs	$24.0	$30.0
Participant Benefit/Cost Ratio	2.5	2.5
Total Resource Benefits	$27.4	$34.3
Total Resource Costs	$26.0	$32.5
Total Resource Benefit/Cost Ratio	1.1	1.1

[12] Based on the program implementation plan filed with the CPUC, a total of 26,359 audits were planned under a total program cost of $1,400,000. Average cost per audit was $53. Assuming an average audited floor space of 5000 square feet per audit, the average cost is $0.011 per square foot.

Retro-commissioning

The retro-commissioning analysis calculated impacts of the intervention applied to commercial buildings built prior to the Building Efficiency Standards, representing approximately 5,000 million square feet of floor space. The analysis assumes that 10% of the total conditioned floor space per year is targeted for the intervention, representing a total of 470 million square feet of floor space.

Program Adoption

Of the 10% of the buildings targeted, 25% of those elected to have their buildings retro-commissioned. The estimate of the added penetration for the retro-commissioning initiative ranges from a low of 3% to a high of 30%. The low range of the projection includes the development of an information program targeting potential key customers. The information initiative would be designed to effectively present the benefits of the initiative to key decision makers. No incentives would be offered in the low estimate. The high penetration estimate assumes a range of effective coordinated design components. If the initiative includes effectively targeted customer information and educational strategies, linked with real-building demonstrations and publicized case studies, and the initiative is offered with effective trade ally training and incentives to lower costs, the penetration is expected to be as high as 30% of the market over several years. The consultant team settled on a projected penetration of about 25% if the latter range of services are effectively designed and implemented in a market made friendly via information and educational services, case studies and demonstrations and trade ally training and incentives.

Measure Adoption

Average unit energy savings and retro-commissioning costs from several retro-commissioning programs offered during the 2004-2005 program cycle were used. The average energy savings from retro-commissioning are estimated to be 1.3 kWh/square foot and 0.065 therm/square foot[13].

The estimated participation, electricity, peak demand and natural gas impacts of the intervention are shown in Table 20.

[13] These data are conservative relative to national average savings of 1.7 kWh/SF, 0.065 therm/SF from a study conducted by Lawrence Berkeley National Laboratory. See LBNL (2004).

Table 20. Retro-commissioning Energy and Demand Savings

Targeted floor area	470 million square feet
Program adoption rates (probable to high)	0.25 – 0.30
Participating floor area	117 – 140 million square feet
Average savings per square foot	1.3 kWh/square foot 0.7 W/square foot 0.065 therm/square foot
Gigawatt hours	152 - 182
Megawatts	77 - 92
Million therms	7.6 – 9.1

Economic Analysis

Program administrative costs were estimated at $0.10/SF, based on program administrative costs submitted to the CPUC from a retro-commissioning program implementer (PECI, 2003). The participant costs were estimated at $0.68/SF, based on average costs for all retro-commissioning programs filed with the CPUC for the 2003-2004 program cycle[14]. Incentives are assumed to be provided at 30% of the retro-commissioning cost. Program costs and cost-effectiveness at probable and high adoption rates are shown in Table 21.

[14] The participant cost assumptions are conservative relative to a recent study conducted by Lawrence Berkeley National Laboratory, were the average retro-commissioning costs were reported at $0.27 per square foot. See LBNL (2004).

Table 21. Retro-commissioning Program Cost and Cost-effectiveness

	Costs ($million) and Benefit/Cost Ratio	
	Probable adoption	High adoption
Program Admin Cost	$11.7	$14.0
Incentive Cost	$29.3	$35.2
Total Program Cost	$41.0	$49.2
Participant Benefits	$253.7	$304.4
Participant Costs	$79.5	$95.4
Participant Benefit/Cost Ratio	3.2	3.2
Total Resource Benefits	$153.5	$184.2
Total Resource Costs	$91.2	$109.5
Total Resource Benefit/Cost Ratio	1.7	1.7

Upstream Interventions/Manufacturer Partnerships

The upstream manufacturer partnership analysis calculates the potential energy and demand savings from upstream interventions targeted at computer power supplies, external power supplies for low-voltage appliances and dimmable electronic ballasts.

Energy savings estimates for improved computer power supplies were taken from the “80+” program (Ecos Consulting, 2004). These data apply to the full installed base of personal computers. Assuming a computer replacement interval of 5 years, the electrical energy and peak demand savings calculations are shown in Table 22.

Table 22. Energy and Demand Savings Potential from Improved Computer Power Supplies

Sector	Energy Savings Potential (kWh/unit)	Demand Savings Potential (W/unit)	Installed Base	Replacement Frequency	Annual Energy Savings (GWh)	Demand Savings (MW)
Residential	75	22	6,435,000	0.2	96.5	28.3
Commercial	88	16	19,305,000	0.2	339.8	61.8
Total					436.3	90.1

Lifetime energy savings potential from replacing all external power supplies in answering machines, cordless phones, internet boxes, video cameras and cordless tools with high efficiency units is on the order of 564 GWh (Caldwell, et al., 2002). Assuming an average lifetime of 5 years, the annual energy and demand savings potential is shown in Table 23.

Table 23. Energy and Demand Savings Potential from Improved External Power Supplies

Lifetime savings (GWh)	Estimated lifetime (yr)	Energy Savings per year (GWh)	Demand Savings (MW)	Replacement frequency	Annual Energy Savings (GWh)	Demand Savings (MW)
564	5	112.8	12.9	0.2	22.6	2.6

Energy and demand savings potential for dimming electronic ballasts in California were estimated by ACEEE (Sachs, et al., 2004a). Assuming a lighting fixture replacement interval of 10 years due to space "churn," the energy and demand savings potential for this measure is shown in Table 24.

Table 24. Energy and Demand Savings Potential from Dimming Electronic Ballasts

Application	Total Energy Savings Potential (GWh/yr)	Total Demand Savings Potential (MW)	Churn	Annual Energy Savings (GWh/yr)	Annual Demand Savings (MW)
Task lighting	600	200	0.1	60	20
Daylighting	1700	770	0.1	170	77
Total	2300	970		230	97

The total energy and demand savings estimated for the preceding measures within the Upstream Intervention/Manufacturer Partnerships are shown in Table 25.

Table 25. Upstream Intervention/Manufacturer Partnerships Energy and Demand Savings

Measure	Annual Energy Savings Potential (GWh/yr)	Annual Demand Savings Potential (MW)
Computer power supplies	436	90
External power supplies	23	3
Dimming ballasts	230	97
Total	**689**	**190**
Fraction of potential captured (probable to max)	0.30 – 0.80	
Estimated Savings	**207 - 551**	**57 - 152**

Leasing

The commercial leasing analysis calculated impacts of the intervention applied to commercial buildings built prior to 1979 at lease renewal events assumed to occur every 5 years. According to the HMG AB-549 Markets and Potentials report (HMG, 2003) total of 23% of commercial floor space is assumed to be leased. An estimated 50% of this space is assumed to have a ”net” lease arrangement.

Program Adoption

An estimated 6% of eligible floor space elects to have a lighting retrofit done due to the program.

Measure Adoption

All applicable and feasible T-8 linear fluorescent, CFL, and occupancy sensor measures are assumed to be adopted by participants.

The energy and demand savings estimates for the Commercial Leasing intervention are shown in Table 26.

Table 26. Commercial Leasing Energy and Demand Savings

Targeted floor area	114 million square feet
Program adoption rates (probable to high)	.06 - .36
Participating floor area	6.9 – 41 million square feet
Average savings per square foot	0.58 kWh/square foot 0.12 W/square foot
Gigawatt hours	4 - 24
Megawatts	1 - 5

Economic Analysis

Program administrative costs were estimated at $0.10/SF to cover the costs of lighting audits of the leased space. The estimated program cost and cost-effectiveness is shown in Table 27.

Table 27. Commercial Leasing Program Cost and

	Costs ($million) and Benefit/Cost Ratio	
	Probable adoption	High adoption
Program Admin Cost	$0.69	$4.1
Incentive Cost	$0	$0
Total Program Cost	$0.69	$4.1
Participant Benefits	$7.40	$44.0
Participant Costs	$1.60	$9.5
Participant Benefit/Cost Ratio	4.6	4.6
Total Resource Benefits	$3.05	$18.1
Total Resource Costs	$1.60	$9.5
Total Resource Benefit/Cost Ratio	1.91	1.91

Branding

The branding analysis calculated impacts of increased adoption of ENERGY STAR appliances in general, and improved efficiency levels due to the introduction of higher-tier efficiency levels above the minimum ENERGY STAR efficiency criteria. The analysis addresses refrigerators, dishwashers, clothes washers, programmable thermostats, office equipment and commercial cooking equipment in residential and commercial buildings built prior to 1979.

Program Adoption

An average residential appliance replacement interval of 10 years and a commercial office equipment replacement interval of 5 years is assumed. The intervention is expected to produce an incremental measure adoption rate of 6%. T

Measure Adoption

In residential buildings, all applicable and feasible refrigerator, clothes washer and dishwasher measures are assumed to be adopted by participants. In commercial buildings, all applicable and feasible programmable thermostats, LCD computer monitors, copier, and laser printer are assumed to be adopted by participants. In foodservice establishments, all applicable and feasible griddles and fryers are assumed to be adopted by participants.

The estimated participation, electricity, peak demand and natural gas impacts of the intervention are shown in Table 28.

Table 28. Branding Energy and Demand Savings

Residential	Homes targeted	624,000
	Program adoption rates (probable to high)	0.06 – 0.15
	Number of participants	37,400 – 93,500
	Savings per home	220 kWh/yr 0.03 kW 40 therm/yr
	Gigawatt hours	8 - 21
	Megawatts	1 - 3
	Million therms	1.5 – 3.7
Commercial	Targeted floor area	995 million square feet
	Program adoption rates (probable to high)	0.06 – 0.15
	Participating floor area	60 - 149 million square feet
	Average savings per square foot	0.07 kWh/square foot 0.03 W/square foot 0.014 therm/square foot
	Gigawatt hours	4 - 10
	Megawatts	2 - 5
	Million therms	0.8 – 2.1
Total	Gigawatt hours	12 - 31
	Megawatts	3 - 8
	Million therms	2.3 – 5.8

Energy Savings and Economic Analysis Summary

A summary of the electricity, peak demand, and natural gas savings is shown in Table 29. The interventions are ranked according to the estimated kWh savings at the expected program adoption rate.

Table 29. Energy Savings, Demand Savings and Cost-effectiveness Summary

Intervention Strategy	Electricity Savings (GWh)	Peak Demand Savings (MW)	Natural Gas Savings (MTh)	Cost ($million)	Participant Benefit Cost Ratio	Total Resource Benefit Cost Ratio
Time-of-Sale Information Disclosure Voluntary Pilot Program	19 - 29	6 - 9	1.1 – 1.5	3.7 – 5.6	2.1	1.0
Phase 1 Mandatory Implementation (older homes)	164 - 174	49 - 52	9.3 – 9.9	15.1 - 16	2.0	1.0
Phase 2 Mandatory Implementation (all homes)	251 - 266	73 - 77	12.0 – 12.7	0 – 14.6	2.0	1.0 - 1.1
Upstream Interventions/ Manufacturer Partnerships	207 - 551	57 - 152	0.0	Not estimated	Not estimated	Not estimated
Retro-commissioning	152 - 182	77 -92	7.6 – 9.1	41.0 – 49.2	3.2	1.7
Information Gateway	73 - 307	19 - 80	6.6 – 27.8	28.0 – 117.9	1.9	1.0
Integrated Whole Building Diagnostic Testing and Repair	45 – 54	40 - 48	1.9 – 2.2	11.9 – 14.3	1.7	1.1
Commercial Benchmarking	26 - 33	6 - 8	0.4 -0.5	2.0 – 2.5	2.5	1.1
Assistance to Affordable Housing	17 - 35	27 - 56	4.4 – 9.2	44.5 – 93.1	3.6	1.1
Residential Equipment Tune-up	15 – 18	20 - 24	3.6 – 4.4	4.7 – 5.6	2.0	1.1
Branding	12 - 31	3 - 8	2.3 – 5.8	Not estimated	Not estimated	Not estimated
Commercial Leasing	4 - 24	1 - 5	0.0	0.7 – 4.1	4.6	1.9

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6. POLICY ISSUES AND ACTION PLAN

This section investigates policy issues associated with the proposed intervention strategies. Policy and legislative changes to reduce institutional barriers for the interventions are suggested. An outline of an action plan to develop and implement each intervention is also presented.

Policy and Legal Changes

Successful introduction of this set of interventions will benefit from policy and legal changes at several state agencies and commissions. Policy and legal changes suggested by this research are described in the following subsections.

Existing State Statutes

Section 7195 of the Business and Professions Code governs home inspections. Subparagraph 2 governs energy inspections, and defines what constitutes and energy inspection. Energy inspections are an optional component of a home inspection. Changing this statute to making energy inspections a mandatory component of home inspections is recommended.

New Legislation

New legislation is recommended to address the following needs:

- *Community College and VoTech support.* State funding earmarked for community college, vocational school, or trade union training programs in HVAC is recommended to help supply a trained work force for the industry. The funding should address program development within the institutions as well as tuition support.
- *Procurement.* Legislation should be proposed to establish funding for a coordinated procurement system that includes a product assessment function. Interviewees suggested that past legislation addressing energy efficiency might not be specific enough to have a substantial impact within the purchasing arena.
- *Energy Improvement Mortgages.* Legislation requiring the secondary mortgage market to maintain a certain number of energy improvement mortgages in their portfolio is recommended.

- *Insurance Regulations*. Legislation could be pursued directing the insurance industry to establish a special risk category for homes that have undergone whole building diagnostic testing and remediation. A healthier indoor environment should demonstrate a lower incidence of health risks, and the correction of construction defects through the whole building diagnostic process should reduce property damage risk.
- *Certification of Service Providers.* Legislation should be pursued to establish certification requirements for individuals and businesses involved in improving the efficiency of existing buildings, including home inspectors, whole-building diagnostic and remediation contractors, and retro-commissioning agents. Certification of these key service providers should improve the quality of the services rendered and improve consumer confidence in purchasing these services.
- *Real Estate Regulations.* Regulations regarding real estate transactions should be established to require energy efficiency training as a condition for obtaining and maintaining a real estate license, and require disclosure of energy-related information at time-of-sale of residential and commercial property. Real estate agent training should include modules on energy improvement mortgages, energy-efficient lease arrangements and retro-commissioning. Legislation should be established to require energy ratings of residential properties at time of sale. Energy consumption benchmarking of commercial properties should be required at time of sale and at refinancing. Disclosure of benchmarking results to tenants, buyers and lenders should be required.
- *State Retirement System Real Estate Portfolios.* Require the California State Teachers Retirement System and Public Employees Retirement System to benchmark all buildings in their portfolio and improve the efficiency of the portfolio by at least a 20 percent, consistent with the Governor's Green Building Initiative.
- *State Contractor Licensing Board*. Establish legislation requiring the state contractor licensing board to assist the Energy Commission with improving compliance with the existing building provisions of the Title 24 energy efficiency standards. Require recognition of whole building contracting as a unique discipline under the state contractor licensing system. This will relieve the requirement to obtain multiple contractor licenses to conduct whole building service, and help establish the legitimacy of this approach within the contracting industry.
- *State Housing Agencies*. Develop legislation that requires energy ratings and applies minimum efficiency standards to affordable housing projects receiving state funding. Require all new projects and renovations that use public funds to be energy efficient

Executive Orders

Executive orders are recommended as follows:

- *Procurement.* An executive order requiring offices under the Governor to implement the recommendations of the procurement intervention is recommended.
- *Commissioning Agent Certification.* The Green Building initiative should consider requiring certification of retro-commissioning agents used on state buildings.
- *Benchmarking.* Executive Order S 20-14 directs the Energy Commission to develop a benchmarking system for all commercial and public buildings in California. Further policy requirements to state agencies on implementing the system may be necessary to insure that the system is used. The policy should include a requirement to track and report progress toward meeting the 20% energy savings goal.

Energy Commission Policy

Energy Commission policy initiatives are recommended in the following areas:

- *HERS Proceeding.* The Energy Commission is encouraged to conclude the Phase 2 proceeding on Home Energy Rating Systems as a component of the Time of Sale energy rating intervention.
- *Title 24.* The Energy Commission should consider further extending the reach of Title 24 into remodeling or renovation activities in existing buildings. Existing provisions of Title 24 that mandate duct leakage sealing during air conditioning system replacement can be extended to include verification of correct refrigerant charge and air flow.
- *Financing Program Development.* The Energy Commission should consider development of financing programs for energy efficiency improvements that meet the special needs of low-income multifamily housing providers.
- *Benchmarking.* Continue development of a California-specific commercial building energy consumption benchmarking tool. Expand the scope of the effort to include components designed to encourage commercial building decision makers to act on the benchmarking results. Aspects of the benchmarking tool that encourage action should include links to existing energy efficiency programs such as commercial building audit and retro-commissioning programs, as described in this report.
- *Appliance Standards.* Incorporate requirements for automated demand response capability into future updates of the Title 20 Appliance Efficiency Standards.

- *Training and Certification.* Develop a central energy efficiency service provider training and certification office within the Energy Commission. Coordinate with community colleges and professional organizations to deliver energy efficiency training services. Build on existing Energy Commission certification infrastructure to expand coverage of certified service providers.
- *PIER.* Continue R&D partnerships with industry under the Public Interest Energy Research (PIER) program. Consider adding incentives based on actual sales of energy efficient products to the partnership agreements. Develop product sales tracking systems to aid in calculation and distribution of these incentives.

CPUC Policy

Changes to CPUC policies regarding energy efficiency program implementation and evaluation are as follows:

- *Non-energy Benefits*. Consumers make energy efficiency-related decisions to optimize both energy and non-energy benefits. Consider allowing the inclusion of non-energy benefits in program cost-effectiveness calculations under certain circumstances.
- *Program Emphasis*. Consider funding programs that support the initiatives recommended by this study, including residential whole building diagnostics, commercial retro-commissioning efforts, upstream manufacturer incentive programs, energy improvement mortgages, and time of sale energy ratings. These programs require stable funding over multiple years to establish their effectiveness. Since the public goods charge funding pool is limited, any new programs implemented here will compete for funding with existing programs. If the CPUC and the IOUs are not willing to fund the initiatives recommended by this study, the legislature should consider appropriating funding specifically for these interventions.
- *Coordination between Programs.* Develop a policy on how to account for energy savings between programs that provide and receive referrals. Establish a mechanism to reward coordination efforts between programs during RFP development and establish incentives for coordination accomplishments in calculating performance incentive awards.
- *Value Self-Verification in EM&V.* Investigate systems that can provide valid verification of installation quality and measure effectiveness by certified service providers, and establish a role for these systems within EM&V policy.
- *Demand Response.* Direct additional resources toward developing and encouraging the use of demand response technologies and strategies. Set metering standards that accommodate the requirements of demand response programs. Establish rates and encourage program designs that provide “shadow billing” for prospective demand response customers.

- *Coordinate Efficiency And Demand Response Initiatives*. Allow the use of PGC funds for both energy efficiency and demand response programs, and encourage program designs that provide an integrated delivery approach.
- *Flex-Your-Power*. Use Flex-Your-Power as a means to promote the initiatives within this study as they are adopted.
- *Utility Billing Systems*. The Information Gateway and Commercial Benchmarking interventions rely on an interface with the utility customer information system to provide billing data, and the utility website to provide program referral information. The willingness of the utilities to restructure their online billing systems will influence the feasibility of these interventions. It may be necessary for the CPUC to order the utilities to upgrade their information systems to support the needs of these interventions.
- *Data Confidentiality.* Policies on customer billing data confidentiality need to be developed that allow access to customer data as required by the interventions.
- *Hard to Reach Funding*. Provide additional funding targeted at affordable housing initiatives. Housing authorities generally do not have the financial or technical resources needed to implement efficiency improvement projects, and may not be able to compete effectively for efficiency program incentive funding. Funding targeted specifically at this underserved population is recommended.
- *Risk Protection*. Establish a policy to investigate the energy savings potential of this intervention and conduct field tests to determine the impact of risk protection offerings on the participation in energy efficiency programs and adoption of energy efficiency measures.

Other Policy Considerations

Policy recommendations for and coordination with other agencies outside of California are as follows:

- *US Environmental Protection Agency (EPA).* The Energy Commission should continue to influence the EPA on changes to ENERGY STAR that benefit California, while formulating a policy on how the brand should be applied. This should be coordinated with programs relying on ENERGY STAR branded products, and with other states considering action on improving efficiency levels of ENERGY STAR branded products, such as New York, Wisconsin, and Vermont.
- *U.S. Department of Housing and Urban Development (HUD)*. The Energy Commission should coordinate with HUD to write separate utility allowance guidelines for energy efficiency projects. The Energy Commission should coordinate the development a partnership program with HUD to promote energy improvement mortgages.

- *U.S. Green Building Council (USGBC)*. The LEED-EB rating system can have an important influence on decisions leading to improving the energy efficiency of existing commercial buildings. The Energy Commission should initiate discussions with the USGBC on including energy-efficient leasing arrangements and retro-commissioning within the LEED-EB rating.
- *CEE*. The Energy Commission should coordinate with the Consortium for Energy Efficiency (CEE) and the National Association for Technical Excellence (NATE) on promoting the CEE Quality Installation program. This program addresses issues relating to proper installation of residential and light commercial air conditioning systems, and could be an important component of the residential air conditioning tune-up intervention.

Action Plan

Successful implementation of the interventions described in this report will require coordinated action by a number of parties involved in the energy efficiency community in California. Assignment and acceptance of roles and responsibilities by key stakeholders will require discussion and negotiation within these groups. As a starting point for these discussions, the key elements associated with each intervention, a candidate organization to take the lead on each element, and the time frame for these activities are listed below:

Information Gateway

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Information Gateway intervention strategy is described in Table 30.

Table 30. Action Plan Outline for Information Gateway Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Form initiative development group from Energy Commission, industry experts and service implementers	Energy Commission	2006
Conduct market demand and participation analysis	Energy Commission/Contractor	2007
Discuss general feasibility, desirability and potential benefits, barriers and approaches	Energy Commission	2007
Examine current homeowner identification systems and contact approaches and assess their applicability	Energy Commission	2007
Review designs and approaches for baselining homes and identifying priority participants	Energy Commission	2007
Research approaches for developing a coordinated information delivery program that reaches all homeowners and provides covered services and identify design strategies	Energy Commission	2007
Research program cost and cost/benefit potentials for developing initiative under various delivery approaches	Energy Commission	2007
Identify best approaches for delivery vehicles and incorporate into delivery system strategy or devise new system that uses current utility or other contact vehicles	Energy Commission	2007
Conduct initiative go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission	2008
Form delivery development team to design and test pilot program consistent with funding capability	Energy Commission/IOU	2008
Establish financing programs, potentially link to On-Bill-Financing Programs	Energy Commission/Selected Implementer	2008
Benchmark residential buildings with the IOUs, using SDG&E's 2007 Home Energy Consumption Tool benchmarking efforts as a potential model.	IOU/Energy Commission/Selected Implementer	2009
Target customers	IOUs and Selected Implementer	2009 on
Market services	Selected Implementer, linked with Flex-your-power and other out reach and initiative-focused marketing efforts	2009
Implement program	IOUs and/or non-utility program implementers	2009
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2009 Impact 2011

Time of Sale Information Disclosure

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Time of Sale Information Disclosure intervention strategy is described in Table 31.

Table 31. Action Plan Outline for Time of Sale Information Disclosure Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Form initiative development group from Energy Commission, industry experts and service implementers	Energy Commission	2006
Conduct market demand and participation analysis; assess baseline practices, market potential and implementation barriers	Energy Commission	2006
Discuss general feasibility, desirability and potential benefits, barriers and approaches	Energy Commission	2007
Develop technical feasibility and market potential assessments for various implementation approaches	Energy Commission/Contractor	2007
Develop program design and funding requirements	Energy Commission	2007
Conduct initiative go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission	2007
Develop stakeholder group with strong legislative influence that can support effort over a reasonable developmental timeline	Energy Commission	2007
Draft supporting legislation and find sponsors to pass bill at the appropriate time when passage can be assured	Energy Commission/Governor	2007-2008
Develop incentive programs	IOUs/Energy Commission	2006-2008[1]
Complete Phase 2 HERS proceeding	Energy Commission	2007
Develop and implement realtor training	Energy Commission/CAR	2007-2008
Investigate feasibility of EIM portfolio standard	Energy Commission	2007
Implement EIM portfolio standard with state agencies	Energy Commission	2008
Develop EIM partnership program with HUD	Energy Commission/IOUs	2006-2008
Phase in mandatory ratings	Energy Commission	2009
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2009 Impact 2011

[1]Assumes voluntary time of sale incentive program offered during 2006-2008 program cycle

[2]Assumes HUD partnership program offered during 2006-2008 program cycle

Equipment Tune-up

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Equipment Tune-up intervention strategy is described in Table 32.

Table 32. Action Plan Outline for Equipment Tune-up Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Review evaluation and technical reports from across the United States; conduct assessment and determine potential savings	Energy Commission	2006
Conduct program market demand and participation analysis	Energy Commission	2006-2007
Develop program design and funding requirements	Energy Commission	2007
Conduct initiative go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission	2007
Develop stakeholder group with strong legislative influence that can support effort over a reasonable developmental timeline	Energy Commission	2007
Draft supporting legislation and find sponsors to pass bill at the appropriate time when passage can be assured	Energy Commission/Governor	2007-2008
Design pilot program development and implementation strategies consistent with funding	Energy Commission	2007-2008
Develop technical training approach for pilot area	Energy Commission/NATE	2008
Design marketing and roll-out approach	Energy Commission/Marketing Firm	2008
Implement technician training and stage the marketing rollout	Energy Commission	2009
Certify technicians	NATE	2009
Rollout initiative in pilot area	Energy Commission/Implementer	2009
Inform and educate consumers	Flex-your-power/IOUs	2009
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2009 Impact 2010
Phase in mandatory requirements	Energy Commission	2011

Integrated Whole Building Diagnostic Testing and Repair

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Integrated Whole Building Diagnostic Testing and Repair intervention strategy is described in Table 33.

Table 33. Action Plan Outline for Integrated Whole Building Diagnostic Testing and Repair Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Review evaluation and technical reports from across the United States; conduct assessment and determine potential savings	Energy Commission	2006
Conduct program market demand and participation analysis	Energy Commission/Market research firm	2006-2007
Develop program design and funding requirements	Energy Commission	2007
Conduct initiative go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission	2007
Design program development and implementation strategies consistent with funding	Energy Commission	2007
Review and revise technical training approach	Energy Commission/ California Building Performance Contractors Assoc (CBPCA).	2007
Investigate valuation of non-energy benefits	CPUC	2007
Engage insurance industry	Energy Commission	2007
Design targeting and marketing approach	Energy Commission/Marketing expert	2008
Train contractors in target area	CBPCA	2008
Market and roll-out program in target area	Energy Commission with Flex-your-power and other out reach efforts	2008
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2008 Impact 2009

Assistance to Affordable Housing

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Assistance to Affordable Housing intervention strategy is described in Table 34.

Table 34. Action Plan Outline for Assistance to Affordable Housing Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Form initiative development group from Energy Commission, industry experts and service implementers	Energy Commission	2006
Review research and form consensus on program design	Energy Commission	2006
Obtain funding to support pilot program	Energy Commission	2007
Design pilot program to address rehabs, assessments of existing buildings and HVAC O&M	Energy Commission	2007
Coordinate with state housing authorities and local low income housing organizations	Energy Commission/Initiative Development Group	2007
Identify areas with planned rehab projects and current buildings in need of upgrades and designate pilot program area	Energy Commission/Initiative Development Group	2007
Launch educational and outreach efforts at the local level and work with authorities and owners to select projects	Energy Commission/Initiative Development Group	2007-2008
Provide training and technical education and support to housing authorities	Energy Commission	2008
Provide audits	Energy Commission Contractor	2008
Provide bill tracking software to prioritize efforts for housing authorities	Energy Commission	2007
Provide incentive programs for multifamily projects	IOUs	2009
Develop financing program to meet special needs of multifamily housing providers	Energy Commission	2008
Revise utility allowances to encourage efficiency	HUD/Energy Commission	2007
Implement projects in pilot area	Energy Commission/Initiative Development Group	2008-2010
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2008 Impact 2011

Commercial Benchmarking

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Commercial Benchmarking intervention strategy is described in Table 35.

Table 35. Action Plan Outline for Commercial Benchmarking Intervention.

Activity	Lead Organization/Support Organizations	Timeframe
Form expert panel to inform program development and direction	Energy Commission	2006
Conduct program market demand and participation analysis	Energy Commission/Research Firm	2006
Develop program design and funding requirements	Energy Commission	2007
Conduct initiative go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission	2007
Work with IOUs to establish benchmarking system for customers using SDG&E's 2007 Home Energy Consumption Tool benchmarking efforts as a potential model.	Energy Commission/Expert Panel	2007
Develop benchmarking tool	Energy Commission/PIER	2007
Target customers	IOUs/Energy Commission	2008
Market program	Flex-your-power and other out reach programs	2008
Implement automated benchmarking	IOUs	2008
Refer participants to IOUs for technology help, incentives and on-bill financing	IOUs	2008
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2008 Impact 2009

Retro-commissioning

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Retro-commissioning intervention strategy is described in Table 36.

Table 36. Action Plan Outline for Retro-commissioning Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Form expert panel to inform program development and direction	Energy Commission	2006
Review evaluation and technical reports from across the United States; conduct assessment and determine potential savings	Energy Commission/IOUs	2006
Conduct program market demand and participation analysis	Energy Commission/ IOUs /Research Firm	2006
Develop program design and funding requirements	Energy Commission	2007
Conduct initiative go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission/IOUs	2007
Develop case study selection and location criteria	Energy Commission/ IOUs	2007
Develop case studies	Energy Commission/ IOUs/California Commissioning Collaborative	2007
Train commissioning service providers	Energy Commission/ IOUs/California Commissioning Collaborative	2007
Provide incentive programs	IOUs	2006[1]
Target customers	IOUs	2007
Market program	Flex-your-power and other outreach programs	2008[2]
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2008 Impact 2010

[1] Retro-commissioning is likely to be a component of the 2006-2008 IOU program portfolio.

[2] Coordinate with roll out of Benchmarking initiative

Commercial Leasing

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Commercial Leasing intervention strategy is described in Table 37.

Table 37. Action Plan Outline for Commercial Leasing Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Form stakeholder panel to inform program development and direction	Energy Commission	2006
Review evaluation and technical reports from across the United States; conduct assessment and determine potential savings	Energy Commission	2006
Conduct program market demand and participation analysis	Energy Commission/Research Firm	2007
Develop program design and funding requirements	Energy Commission	2007
Conduct initiative go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission/Stakeholder Panel	2007
Develop program design and implementation strategies	Energy Commission/Stakeholder Panel	2008
Identify pilot area to test program concepts	Energy Commission/Stakeholder Panel	2008
Develop case studies	Contractor	2008
Market case study across target pilot area to owners and lease occupants	Energy Commission/Stakeholder Panel	2008
Develop training curriculum	BOMA	2008
Train realtors	CAR	2008
Market program	Flex-your-power and other outreach programs	2008
Implement wider program in pilot area	Energy Commission/Stakeholder Panel/Realtors and Lease Holders	2008-2010
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2008 Impact 2010

Demand Response

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Demand Response intervention strategy is described in Table 38.

Table 38. Action Plan Outline for Demand Response Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Form statewide panel of DR experts, CPUC-ED managers, and IOU stakeholders	Energy Commission	2006
Review evaluation and technical reports from across the United States; conduct assessment and determine potential savings	Energy Commission/Panel	2006
Conduct program market demand and participation analysis	Energy Commission/Research Firm	2007
Develop program design and funding requirements	Energy Commission	2007
Conduct initiative go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission/Panel	2007
Implement DR pilot program in selected cities	IOUs	2007
Set metering standards for DR pilot program	CPUC	2007
Develop new pilot program rate structures	IOUs	2007
Develop/identify demand response technologies	Energy Commission/Panel/PIER	2007
Develop incentive programs for enhanced automation	IOUs/Energy Commission	2009[1]
Educate consumers	Energy Commission/IOUs	2008
Launch pilot program in at least 3 cities	IOUs	2008
On going customer satisfaction and use evaluation	Professional Evaluation Firm	2008-2010
Assess success	Energy Commission	2010
Make rates permanent if successful and high customer satisfaction and increasing demand	CPUC	2010
Address demand response capability in appliance standards	Energy Commission	2011
Expand DR locations and sites	IOUs	2011
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2008 Impact 2010 Impact 2012

[1] May be a component of the 2006-2008 IOU program portfolio.

Upstream Interventions / Manufacturer Partnerships

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Upstream/Manufacturer Partnership intervention strategy is described in Table 39.

Table 39. Action Plan Outline for Upstream/Manufacturer Partnerships Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Form team of stakeholder (Program Team) to inform program development and direction	Energy Commission	2006
Review evaluation and technical reports from across the United States; conduct assessment and determine potential savings, especially NEEA and NYSERDA	Energy Commission	2006
Identify funding stream for added initiatives that supplements the IOU's up-stream efforts[1]	Energy Commission/Governor	2007
Develop program design and funding requirements	Energy Commission	2007
Conduct initiative go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission	2007
Design over all implementation strategy and identify funding sources in cooperation with the IOU up-stream initiatives for 2007-2009*.	Energy Commission	2007
Prioritize development opportunities	Energy Commission/Program Team/PIER	2008
Develop manufacturer partnerships	Energy Commission/PIER	2008
Develop incentive programs	IOUs	2009
Develop market connections	Energy Commission/PIER	2009
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2009 Impact 2011

[1] *Note: for 2007-2009 this is a limited budget, limited focus IOU portfolio program, but it needs to be expanded to address market conditions and needs.*

Procurement

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Procurement intervention strategy is described in Table 40.

Table 40. Action Plan Outline for Procurement Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Establish inter-governmental agency working group to set up program concepts	Energy Commission	2006
Conduct program market demand and participation analysis	Energy Commission/Research Firm	2006
Review evaluation and technical reports from across the United States; conduct assessment and determine potential savings	Energy Commission	2006
Develop program design and funding requirements	Energy Commission	2007
Conduct initiative go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission	2007
Design program's general operational structure	Energy Commission/Professional Consultant Support	2007
Develop and implement product assessment function plan	Energy Commission	2007
Develop new procurement procedures, set standards and bid specifications, and documentation trail for all findings	Department of General Services in consultation with participating local governments and non-profits	2008
Develop tracking system that meets the needs of participants	DGS/Energy Commission	2008
Develop communications tools and sales force	Department of General Services	2008
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2008 Impact 2009

Branding

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Branding intervention strategy is described in Table 41.

Table 41. Action Plan Outline for Branding Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Establish national expert panel to advise on branding conditions and environment. Include other states that are implementing Energy Star programs that co-brand and Energy Star managers from the EPA and USDOE	Energy Commission	2006
Assess weakness of Energy Star brand and discuss with Energy Star the need to up-date and modernize procedures, evolve technology coverage, relax competitive policy.	Energy Commission/Panel	2006
Work with Energy Star to modernize procedures and policies. If successful continue to use Energy Star label as key program component in California. If unsuccessful move forward with co-brand assessment….	Energy Commission/Panel/Energy Star	2007
Working with national experts and marketing experts, consider the cost and benefits of developing a co-brand such as NYSERDA's Energy Smart that is controlled and managed by the Energy Commission.	Energy Commission/Panel	2007
If assessment indicates long-term cost-effective, additional energy savings with co-brand, establish co-branding team to chart course	Energy Commission	2007
Establish co-branding working group that expands on the panel and includes appliance and building industry experts.	Energy Commission/Panel	2007
Identify and research potential co-branding opportunities (EnergySmart or a Energy Commission brand, or other brand.	Energy Commission/Panel	2008
Select a co-branding strategy that reflect needs to add measures and strategies under the brand, move rapidly to most reliable cost-effective brands and both encourages and rewards innovation	Energy Commission/Panel/CPUC	2008
Develop branding policy and identify products and technologies to brand	Energy Commission/Panel/CPUC/IOUs	2008
Implement branding strategies in market	Energy Commission/Panel/IOUs/CPUC	2009[1]
Market programs	Flex-your-power/IOUs/Energy Commission	2009
Promote new brand strategy with stakeholders	IOUs/Energy Commission	2009
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2009 Impact 2012

[1] Coordinate with 2009 program cycle offerings

Information, Demonstrations and Case Studies

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Information, Demonstrations and Case Studies intervention strategy is described in Table 42.

Table 42. Action Plan Outline for Information, Demonstrations and Case Studies Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Review marketing, outreach demonstration and case study research to assess potential for market distributed demonstrations and cases studies for energy efficiency measures	Energy Commission/PIER	2006
Assess measures and measure-markets that have significant barriers relating to exposure, familiarity and acceptance	Energy Commission/PIER	2007
Assess the potential for local demonstrations and aggressively distributed and promoted case studies to move the target market	Energy Commission/PIER	2007
Identify measures and market locations in which demonstrations are needed, and identify case study distribution and promotion efforts in target areas	Energy Commission/PIER	2007
Coordinate with all IOUs to gain maximum exposure and integrate into IOU portfolios	Energy Commission/IOUs/CPUC	2007
Develop dissemination plan	Energy Commission/PIER/IOU/CPUC	2007
Where cost-effective launch distributed demonstrations and develop supporting case studies	Energy Commission/PIER	2008
Implement dissemination plan	Energy Commission/PIER	2009
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2008 Impact 2009

Technical Training and Certification

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Technical Training and Certification intervention strategy is described in Table 43.

Table 43. Action Plan Outline for Technical Training and Certification Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Establish stakeholder group with interested parties, including certifying organizations (e.g. NATE, CAR), service industry, educational institutions, state organizations, IOUs, CPUC and others to assess and identify specific needs and funding requirements	Energy Commission	2006
Identify funding source for training efforts	Energy Commission/Governor	2007
Identify where certification is needed to help the industry obtain energy efficiency goals	Energy Commission	2007
Develop central training and certification office	Energy Commission	2007
Interface with existing training service providers	Energy Commission	2007
Develop curriculum development plan	Energy Commission /California Community Colleges Chancellor's Office	2008
Establish grant program to offset program development and participant tuition costs	Energy Commission	2009
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2008 Impact 20010

Risk Protection

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Risk Protection intervention strategy is described in Table 44.

Table 44. Action Plan Outline for Risk Protection Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Identify markets and measures in which performance uncertainty, and reliability are key market barriers	Energy Commission/Research Firm	2006
Conduct program market demand and participation analysis	Energy Commission/Research Firm	2007
Assess cost structure and shared cost arrangements needed to successfully develop and deploy a protection strategy.	Energy Commission/Research Firm	2007
Conduct risk assessment	Energy Commission/Research Firm	2007
Work with manufacturing and guaranteed coverage market to assess feasibility of program	Energy Commission	2007
Develop program design and funding requirements	Energy Commission	2007
Conduct initiative go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission	2007
Identify and prioritize opportunities	Energy Commission/Research Firm	2007
Develop cost tables and pricing structures with incentives to offset additional costs	Energy Commission/IOUs/CPUC	2008
Develop pilot programs	Energy Commission/IOUs/CPUC	2009
If successful, ramp-up and integrate with IOU and other programs	Energy Commission/IOUs	2013
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2009 Impact 2012

Interagency Program Coordination

An outline of an action plan that describes the activities, lead organizations and timeframes to begin the activities suggested for the Interagency Program Coordination intervention strategy is described in Table 45.

Table 45. Action Plan Outline for Interagency Program Coordination Intervention

Activity	Lead Organization/Support Organizations	Timeframe
Establish IOU/CPUC/Energy Commission team to address coordination and customer service coverage issues	Energy Commission/IOU/CPUC	2006
Assess coordination and service delivery issues	Energy Commission/IOU/CPUC	2006
Develop program coordination policy	Energy Commission/IOU/CPUC	2006
Develop central or coordinated program referral system	Energy Commission/IOU/CPUC	2007
Coordinate with other state agencies	Energy Commission	2007
Evaluate program and modify to improve, continue or eliminate	Professional Evaluation Firm	Process 2007

7. REFERENCES

Bijker, Weibe. 1997. *Of Bicycles, Bakelites and Bulbs: Toward a Theory of Sociotechnical Change*. Cambridge, MA: MIT Press.

Bijker, Weibe and John Law, eds. 1994. *Shaping Technology/Building Society: Studies in Sociotechnical Change*. Cambridge, MA: MIT Press.

Bijker, Weibe, Thomas P. Hughes and Trevor Pinch. 1989. *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: MIT Press.

Blumstein, Carl, Loren Lutzenhiser and Seymour Goldstone. 2001. "From Technology Transfer to 'Market Transformation.'" *Proceedings, European Council for an Energy Efficient Economy*. Paris: ECEEE Press.

Calwell, Chris and Reeder, Travis, 2002. "Manufacturer Incentives for Energy Efficient External Power Supplies," Ecos Consulting for the NRDC.

CBPCA. 2003. *California Retrofit Home Performance Program Proposal.* California Building Performance Contracting Association. CPUC ID number 180-02. Available at www.cpuc.ca.gov.

Coito. and Rufo, 2003a. *California Statewide Residential Sector Energy Efficiency Potential Study (volumes 1&2)*, Prepared for Pacific Gas and Electric Company by Xenergy, Inc. Available at www.calmac.org.

Coito and Rufo, 2003b. *California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study*, Prepared for Pacific Gas and Electric Company. Available at www.calmac.org.

CPUC, 2003. *Energy Efficiency Policy Manual, Version 2*. Energy Division, California Public Utility Commission. Available at www.cpuc.ca.gov.

Dosi, Giovanni. 1982. "Technological Paradigms and Technological Trajectories." *Research Policy*. 11:147–162.

Ecos Consulting, 2004. 80+ program for PC power supplies. Available at www.80plus.org.

Energy and Environmental Economics. 2004. *Methodology and Forecast of the Long Term Avoided Costs for the Evaluation of California Energy Efficiency Programs.* Prepared for the California Public Utility Commission. Available at www.ethree.com

Eto, Joseph, Jeff Schlegle and Ralph Prahl. 1996. *A Scoping Study on Energy Efficiency Market Transformation by California Utility DSM Programs*. Berkeley: Lawrence Berkeley National Laboratory.

GeoPraxis. 2001. *Time of Sale Home Inspection Program Proposal*. CPUC ID number 180-02. Available at www.cpuc.ca.gov.

HMG, 2003a. *Markets and Potentials, An AB549 Project Interim Report*, Heschong Mahone Group for Southern California Edison, HMG Project #0304. Available at www.energy.ca.gov/ab549.

HMG, 2003b. *Events and Measures, An AB549 Project Interim Report*, Heschong Mahone Group for Southern California Edison, HMG Project #0304. Available at www.energy.ca.gov/ab549.

Hughes, Thomas P. 1993. *Networks of Power: Electrification in Western Society*, 1880–1930. Baltimore: Johns Hopkins University Press.

Hughes, Thomas P. 1989. “The Evolution of Large Technological Systems.” in W. Bijker, T.P. Hughes and T. Pinch, eds. *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: MIT Press.

KEMA-Xenergy. 2004. *California Statewide Residential Appliance Saturation Study.* California Energy Commission Publication number 400-04-009, 2004.

Kunkle, Richard, Loren Lutzenhiser and Linda Dethman. 2000. “Influencing the Purchase of Energy Efficient Products: It's Not as Easy as It Looks.” *Proceedings, American Council for an Energy Efficient Economy*. Washington, DC: ACEEE Press 8:185–196.

LBNL. 2002. *Potential Benefits of Commissioning California Homes*. Lawrence Berkeley National Laboratory. LBNL-48258.

LBNL. 2004. *The Cost-effectiveness of Commercial-Buildings Commissioning. A Meta-Analysis of Energy and Non-Energy Impacts in Existing Buildings and New Construction in the United States*, Lawrence Berkeley National Laboratory, LBNL-56637.

Lutzenhiser, Loren. 1992. "A Cultural Model of Household Energy Consumption" *Energy–The International Journal*. 17:47–60.

Lutzenhiser, Loren. 1993. "Social and Behavioral Aspects of Energy Use." *Annual Review of Energy and the Environment*. 18:247–89.

Lutzenhiser Associates. 2004. *Social Science Literature Review: AB 549 Intervention-Relevant Work*. Portland, OR.[15]

Lutzenhiser Associates. 2005. *Social Segmentation and the Identification of Market Potential: A Secondary Analysis of the 2004 California Residential Appliance Saturation Survey (RASS)*. Portland, OR.[16]

Lutzenhiser, Loren, Craig Harris and Marvin Olsen. 2001. "Energy, Society and Environment" pp. 222–271 in Riley Dunlap and William Michaelson, eds. *Handbook of Environmental Sociology*. Westport, CT: Greenwood Press.

Mowris. 2003. *Verify RCA Program Proposal.* Robert Mowris & Associates. CPUC program ID 1385-04. Available at www.cpuc.ca.gov.

Mowris. 2004. *The GeoPraxis Time-of-Sale (TOS) Home Inspection Program Evaluation*. Available at www.calmac.org.

Pacey, Arnold. 1991. *Technology and World Civilization: A Thousand-Year History*. Cambridge, MA: MIT Press.

PECI. 2003. *Statewide Retro-commissioning Program Proposal.* Portland Energy Conservation, Inc. CPUC ID number 1381-04. Available at www.cpuc.ca.gov.

[15] Available also in Appendix D of this report.

[16] Available also in Appendix E of this report.

PG&E. 2003. *PG&E Home Energy Efficiency Survey Program Proposal.* Pacific Gas and Electric Company. CPUC ID number 1116-04. Available at www.cpuc.ca.gov.

Quantum Consulting. 2004. *2002 Statewide Nonresidential Audit Program Evaluation.* Available at www.calmac.org.

Ridge. 2004. *Evaluation of the SCE 2002 Residential Audit Program*. Available at www.calmac.org.

Rogers, E. M. 1995. *The Diffusion of Innovations* (4th edition.). New York: The Free Press.

Rogers, E. M. 2003. *The Diffusion of Innovations* (5th edition). New York: Free Press.

Rufo and Coito. 2002. *California Statewide Commercial Sector Energy Efficiency Potential Study*. Xenergy for PG&E, Study ID #SW 039A. Available at www.calmac.org..

Sachs, H. et al., 2004. "Emerging Energy-Saving Technologies and Practices for the Buildings Sector as of 2004" Appendix B: *California-Specific Emerging Technologies and Practices, and Differentiated Screening of Climate-Sensitive Measures*, Report A042, Washington, D.C.: American Council for an Energy Efficient Economy.

Shove, Elizabeth. 1997. "Revealing the Invisible: Sociology, Energy and the Environment." In M.R. Redclift and G.R. Woodgate, eds. *The International Handbook of Environmental Sociology*. Cheltenham, UK: Edward Elgar.

Shove, Elizabeth, Loren Lutzenhiser, Simon Guy, Bruce Hackett, and Harold Wilhite. 1998. "Energy and Social Systems." pp. 201–234 in Steve Rayner and Elizabeth Malon, eds. *Human Choice and Climate Change*. Columbus, OH: Battelle Press.

TecMarket Works. 2004. *The California Evaluation Framework*. Available at www.calmac.org. TecMarket Works. Oregon, WI.

White, Leslie. 1976. *The Concept of Cultural Systems: A Key to Understanding Tribes and Nations*. New York: Columbia University Press.

Wilhite, Harold and Loren Lutzenhiser. 1999. "Social Loading and Sustainable Consumption." *Advances in Consumer Research*. 26:281–287.

Wilhite, Harold, Elizabeth Shove, Loren Lutzenhiser and Willett Kempton. 2001. “The Legacy of Twenty Years of Energy Demand Management: We Know More About Individual Behavior But Next to Nothing About Demand.” pp. 109–126 in Ebarhard Jochem, Jayant Sathaye and Daniel Bouille, eds. *Society, Behaviour and Climate Change Mitigation*. Dordrecht, Netherlands: Kluwer Academic Publishers.

Wilk, Richard. 1996. *Economies and Cultures: Foundations of Economic Anthropology*. Boulder, CO: Westview Press.