

California Energy Commission DRAFT STAFF REPORT

ACHIEVING ENERGY SAVINGS IN CALIFORNIA BUILDINGS

Saving Energy in Existing Buildings and
Achieving a Zero-Net-Energy Future



CALIFORNIA
ENERGY COMMISSION

Edmund G. Brown, Governor

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CALIFORNIA ENERGY COMMISSION

Betty Chrisman
Devi Eden
Jenny Wu
Katie Moore
Ken Rider
Martha Brook
Paula David
Peter Strait
Tovah Ealey
Staff Writers

Gabriel D. Taylor, P. E.
Project Manager

Betty LaFranchi
Office Manager
Building Standards Implementation Office

Mike Leason
Office Manager
Appliances and Process Energy Office

Bill Pennington
Office Manager
**High Performance Buildings & Standards
Development Office**

Panama Bartholomy
Deputy Director
Efficiency and Renewable Energy Division

Robert P. Oglesby
Executive Director

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ABSTRACT

Energy efficiency (as opposed to energy conservation) refers to providing the same or improved level of service while using less energy, thus costing less money. Efficiency standards increase California's economic prosperity by protecting consumers from excessive energy costs, and improve the stability of the state energy supply by reducing statewide demand.

This report is the California Energy Commission staff's draft recommendations for achieving zero-net-energy residential buildings by 2020, and zero-net-energy commercial buildings by 2030. Doing so will require enormous efficiency improvements in both building construction and in the ever-increasing number of electric devices they contain.

Staff also provides recommendations regarding the requirements of Assembly Bill 758 (Skinner and Bass, Chapter 470, Statutes of 2009) for the Energy Commission to develop a comprehensive program to achieve greater energy savings in the state's existing buildings.

Staff will hold a public workshop to discuss these recommendations on July 20, 2011, at the Energy Commission headquarters at 1516 9th Street, Sacramento, CA, in Hearing Room A. The workshop will start at 9 a.m.

Keywords: California Energy Commission, energy efficiency, building efficiency, appliance efficiency, building standards, appliance standards, zero-net-energy, ZNE, 2011 IEPR

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EXECUTIVE SUMMARY

Energy efficiency (as opposed to energy conservation) refers to providing the same or improved level of service while using less energy, thus costing less money. Efficiency standards increase California's economic prosperity by protecting consumers from excessive energy costs, and improve the stability of the state energy supply by reducing statewide demand.

This report is the California Energy Commission staff's draft recommendations for achieving zero-net-energy residential buildings by 2020, and zero-net-energy commercial buildings by 2030. Doing so will require enormous efficiency improvements in both building construction, and in the ever-increasing number of electric devices they contain.

Staff also provides recommendations regarding the requirements of Assembly Bill 758 (Skinner and Bass, Chapter 470, Statutes of 2009) for the Energy Commission to develop a comprehensive program to achieve greater energy savings in the state's existing buildings.

Zero-Net-Energy

Zero-net-energy (ZNE) buildings combine energy efficiency and onsite renewable power generation, representing a unique opportunity to manage energy costs and meet greenhouse gas (GHG) reduction goals. A ZNE building is a building in which the societal value of energy consumed over the course of a typical year is less than or equal to the societal value of the on-site renewable energy generated. The societal value of energy is the long-term projected cost of energy, including the peak demand cost (time-dependent valuation [TDV] of energy), the value of associated carbon emissions, and other externalized costs.

Achieving ZNE buildings will require the energy use in buildings to be reduced as much as possible through energy efficiency, to the point where the remaining energy demand of the building can be met through photovoltaic or other renewable systems. Future updates of the building and appliance energy efficiency standards must progressively raise the bar by requiring further energy-saving features in building designs and the equipment.

Efficiency Improvements in Existing Buildings

Enabling new buildings in California to achieve net-energy independence is only part the story. More than half of California's 13 million residential units and over 40 percent of the commercial buildings were built before 1978, when the first building energy efficiency standards were implemented; existing buildings – residential and commercial – make up a huge opportunity for accomplishing California's clean energy and greenhouse gas emission reduction goals. The significance of existing buildings was clearly recognized by Governor Brown when he included improving energy efficiency in existing buildings as a component of his Clean Energy Jobs Plan. The Energy Commission has the legislative authority to develop, adopt, and implement regulations for energy ratings and improvements for existing buildings Assembly Bill 758 (Skinner, Chapter 470, Statutes of 2009). For the first time, a state agency has the authority to take advantage of new efficiency opportunities that were not available at the time of construction.

Staff Recommendations

Public Awareness, Education, and Outreach

The State of California is developing a number of alternative financing products, working to improve methods of verifying energy savings, and advance the understanding of building

sciences. Innovative, honest, and aggressive public outreach and education is necessary to convince an untrusting and risk averse public that investing in energy efficiency is a safe and cost effective priority.

Workforce Development

Future California Public Utilities Commission (CPUC) three-year investor owned utility (IOU) energy efficiency portfolios should contain workforce development plans, targets, and goals that align with the state's energy efficiency and environmental goals. These plans should include on-the-job training and apprenticeship opportunities in the related trades, relevant training for new and incumbent workers, and retraining opportunities to best practice standards.

The commercial contractor sector needs to develop more entry-level classifications and positions so that newly trained workers can successfully enter the field.

Data-Driven Policy and Market Transformation

A strong message is as essential to market transformation as strong policy. Having this message supported by clear, hard, factual efficiency data increases confidence in the core message of efficiency: being able to live better while consuming less.

Being able to show the data and tell the story of efficiency in California makes the proposed actions of state and local authorities transparent and understandable by clearly communicating the context and reasons for the actions taken. In turn, this increases buy-in by stakeholders and general public support for efforts to increase efficiency, reduce waste, avoid costs, and move closer to ZNE. The Energy Commission has the largest repository of appliance energy use data *in the world* and the most comprehensive rating system for homes *in the nation*; California must make greater use of these data resources in establishing policy and educating the public.

Improving Compliance and Enforcement

Enforcement of both Building and Appliance Efficiency Standards would be tremendously more effective if the Energy Commission and local governments obtained the authority to cite and fine noncompliant entities. This authority would ensure a level playing field in the marketplace and protect customers from inefficient appliances and buildings that are excessively expensive to operate.

Reaching Zero-Net-Energy

The definition of ZNE, as defined in this report using the societal value of energy as the metric, should be adopted by all state agencies and their affected industries in the development and implementation of ZNE programs.

The Energy Commission should proactively develop comprehensive reach standards to set voluntary levels of energy efficiency and renewable energy that can be adopted by local governments, incented by public goods efficiency programs, and included in the state's Green Building Standards.

CHAPTER 1:

Policy Framework

The buildings in which people live and work and the many energy consuming devices within them consume 40 percent of the total energy they use, and California has a long history of leading the push to improve the energy efficiency of those buildings. Energy efficiency (as opposed to energy conservation) refers to providing the same or improved level of service to the consumer while using less energy, thus costing less money. California's energy efficiency leadership has been a key contributor toward keeping per capita energy consumption in the state flat over the past 35 years, saving California's consumers and businesses billions of dollars.

Current efforts to attain all cost-effective energy efficiency in the built environment are based on numerous policy initiatives with diverse goals ranging from job creation to economic development to environmental protection. Some of these initiatives, upon which this report draws heavily for guidance, include:

Governor Brown's Clean Energy Jobs Plan

Governor Brown's Clean Energy Jobs Plan (2010)¹ proposes an eight-point action plan to develop renewable energy and energy efficiency technologies and create more than half a million green jobs. With respect to building efficiency, the Governor's plan calls for:

- Adopting stronger appliance standards for lighting, consumer electronics, and other products.
- Creating new efficiency standards for new buildings.
- Increasing public education and enforcement efforts so that the gains promised by California's efficiency standards are, in fact, realized.
- Adopting a plan and timeline for achieving "zero-net-energy" homes and businesses.
- Making existing buildings more efficient, especially the half of California homes that were built before the advent of modern building standards.
- A requirement to disclose building energy consumption prior to building sale.

The Warren-Alquist Act – Appliance Efficiency Standards

The Warren-Alquist Act, Public Resources Code § 25402(c)(1), directs the California Energy Commission to develop, implement, and enforce standards that require either appropriate minimum efficiencies or maximum energy consumption allowances for appliances. Appliance efficiency standards require manufacturers to meet technically feasible energy reductions that do not sacrifice any of the utility or comfort consumers expect from their energy-using devices. These standards increase California's economic prosperity by protecting consumers from excessive energy costs, and improve the stability of the energy supply by reducing statewide demand. Additional benefits of efficiency and reduced energy demand include increased energy security, less energy price volatility, reduced dependence on imported fuels, more stable electric supply during peak demand, and lower cost to consumers. Improved energy efficiency

1. http://www.jerrybrown.org/Clean_Energy

also means reducing the substantial environmental effects of energy production, due to both reduced pollution from existing power generation and reduced need to construct new power plants.

California's Clean Energy Futures Initiative

State energy and environmental agencies have joined forces with the California Independent System Operator (California ISO) to advance carbon-cutting innovation and green job creation. By furthering collaboration on important state energy policies, California's Clean Energy Futures Initiative points the way toward new investments in transmission, energy efficiency, smart grid applications, and increased use of renewable resources. The California Air Resources Board (ARB), California Public Utilities Commission (CPUC), the Energy Commission, and California Environmental Protection Agency (CalEPA) are partnering with the California ISO to ensure California's continued leadership in clean technology over the coming decade.

Global Warming Solutions Act – AB 32

The Global Warming Solutions Act (Assembly Bill 32, Núñez, Chapter 488, Statutes of 2006) has been the foundation of California's efforts over the past five years to reduce greenhouse gas emissions to the state's 1990 level by 2020. Improving the energy efficiency of existing residential and commercial buildings is the single most important activity to reduce greenhouse gas emissions in the electricity and natural gas sectors. Expanding and strengthening existing energy efficiency programs as well as building and appliance standards is a key recommendation of the adopted *AB 32 Scoping Plan*.² In addition, the *2007 Integrated Energy Policy Report (IEPR)* concluded that climate change is the single most important environmental and economic challenge of the century; greenhouse gas emissions are the largest contributors to global warming; and that California's ability to slow the rate of greenhouse gas emissions will depend first on energy efficiency.

2. California Air Resources Board. *Climate Change Scoping Plan: A Framework for Change*. December 2008, page 16.

CHAPTER 2: Stepping Down to Zero-Net-Energy

Zero-net-energy (ZNE) buildings combine energy efficiency and onsite renewable power generation, representing a unique opportunity to manage energy costs and meet greenhouse gas (GHG) reduction goals. A ZNE building is a building in which the societal value of energy consumed over the course of a typical year is less than or equal to the societal value of the onsite renewable energy generated. The societal value of energy is the long-term projected cost of energy, including the peak-demand cost (time-dependent valuation [TDV] of energy), the value of associated carbon emissions, and other externalized costs.

The California Energy Commission, California Air Resources Board (ARB), and the California Public Utilities Commission (CPUC) have adopted the policy goal to achieve ZNE building standards by 2020 for residential buildings and 2030 for commercial buildings through the *2008 Energy Action Plan*, *2007 Integrated Energy Policy Report*, and the *2008 California Long-Term Energy Efficiency Strategic Plan*.

These goals were reinforced when the Energy Commission, the CPUC, ARB, and California Environmental Protection Agency (CalEPA) – the four state agencies responsible for California’s clean-energy policies and mandates – released *California’s Clean Energy Future* strategy, implementation plan, and roadmap in September 2010. *California’s Clean Energy Future* highlights the integration of energy efficiency and rooftop photovoltaic (PV) systems and identifies ZNE buildings as the top priority for addressing California’s energy demand.

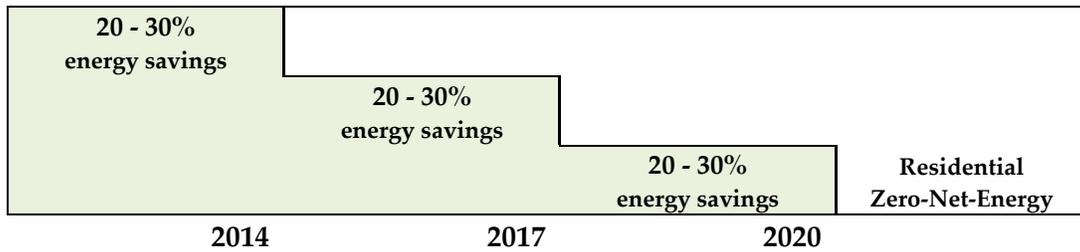
To meet the ZNE goals, Governor Brown, in his Green Energy Jobs Plan, specifically calls for establishing new energy efficiency standards to achieve ZNE for new homes and businesses in California, making building standards a key driver in California’s energy future and GHG reduction.

Achieving ZNE buildings will require the energy use in buildings to be reduced as much as possible through energy efficiency, to the point where the remaining energy demand of the building can be met through photovoltaic or other renewable systems. Future updates of the building and appliance energy efficiency standards must progressively raise the bar by requiring increased energy-saving features in building designs and the equipment.

Getting to ZNE Buildings: Technical Strategies

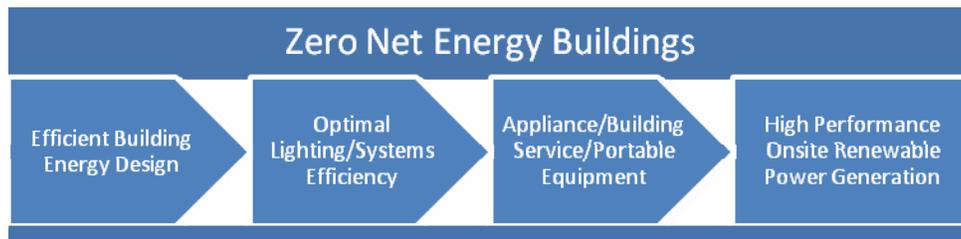
As energy consumption varies across the population and building types, the purpose of Building Energy Efficiency Standards (Title 24) is to cost-effectively minimize building energy costs to consumers as much as technically feasible, not to restrict energy use. The Energy Commission believes that a 50-70 percent improvement in building energy efficiency is achievable through technical strategies, while maintaining or improving the comfort of building occupants. Using building standards as an instrument to transition newly constructed residential and commercial buildings in California to be energy independent by 2020 and 2030 respectively, the Energy Commission aims to achieve a minimum of 20 percent energy savings for each Title 24 update by incorporating cost-effective best practices for building envelope, mechanical systems, appliances, service and portable equipment, and eventually for high-performance onsite renewable systems (Figure 1 and Figure 2).

Figure 1: Stairway to Zero-Net-Energy



Source: California Energy Commission staff, June 2011

Figure 2: The Role of Building Standards in ZNE Buildings



Source: California Energy Commission staff, June 2011

Achieving ZNE begins with an efficient building energy design. A building design that factors in environmental characteristics and building features to maximize passive opportunities to reduce energy needed for heating and cooling is arguably the most cost-effective strategy for improving building performance and a logical first step toward making ZNE building a reality. Design concepts that consider climatic characteristics of a region such as weather and seasonal temperature variations, and site-specific optimization, including orientation, daylight, shade, and prevailing wind, can significantly minimize building energy demand. To encourage climate- and site-specific building designs, Title 24 provides a performance path to compliance. Whereas prescriptive building standards specify the energy efficiency minimum for each building component that the designers must meet, performance-based standards set a desired energy budget for the whole building to allow building designers the flexibility to choose how to cost-effectively satisfy the requirement through design decisions and by incorporating available energy-saving technologies. By allowing for trade-offs between regulated efficiency measures and energy-efficient design concepts not prescriptively regulated by the standards, the performance standards provide builders and designers with greater latitude to introduce low-energy buildings into the market.

Building energy demand can be further reduced by incorporating high-efficacy lighting and high-efficiency mechanical systems into building design; Appliance Efficiency Standards (Title 20) and the Building Energy Efficiency Standards (Title 24) provide the complementary mechanisms for lowering the energy required for operating buildings. By incorporating new energy-efficient technologies such as high-efficiency luminaries for lighting and passive, compressorless systems for heating, cooling, and ventilation into Title 24, buildings can be maintained using less energy without compromising comfort. The 2013 Title 24 update also seeks to generate additional energy savings through energy management technologies that

integrate efficiency with demand response to offer building occupants greater and more precise control over energy use. The 2013 Title 24 update includes enhanced controls, like dimming ballasts, on/off switches for banks of lighting, and demand response communication protocols that enable building occupants to use low-energy systems or equipment only as needed to reduce unnecessary energy expenditure. The update also incorporates energy performance monitoring and fault detection diagnostics software that flag operational faults and efficiency degradation of systems over time. This technology makes energy usage visible to building owners and operators, allowing them to use empirical data to make informed and timely decisions to address issues that affect the energy performance of their buildings.

Energy demand from devices such as appliances and consumer electronics contribute to every building's "plug load" consumption. Plug sockets are installed to give occupants flexibility after a building is constructed. However, as the number and variety of plug loads increase, they play an ever more critical role in defining a building's energy use. The Energy Commission will continue to use appliance efficiency standards to address and limit the growth of energy consumption in plug loads.

Within Title 20 are state and federal regulations for energy consumption that limit the total amount of energy used by the many appliances and electronics commonly found in, on, and around buildings. Over the past 30+ years, the Energy Commission has adopted efficiency standards for thousands of such devices, such as refrigerators, freezers, and televisions. These standards have effectively reduced demand for power statewide. Only the most efficient devices will help achieve ZNE. For this reason, the Energy Commission will continue to set new energy use standards and revise existing standards as efficiency technology continues to improve.

In addition to establishing energy efficiency standards for buildings, the Energy Commission is also developing requirements for high-performance rooftop photovoltaic (PV) systems for possible inclusion in future building standards. The goals for the PV standards are to promote high-quality solar energy systems that result in the highest energy production, deliver optimal system performance during periods of peak demand, and ensure the appropriate level of energy efficiency improvements in the building structure are met before the solar energy system is installed. Specifically, the PV standards will cover components of solar energy systems, installation characteristics requirements, calculation methods for expected system performance, and protocols for third-party installation verification. The PV standards must consider planning issues, including rooftop space constraints and dense urban development, which affect the feasibility of rooftop PV systems as a means to achieve ZNE buildings.

Special considerations would need to be given to data centers, grocery stores, restaurants, offices, laboratories, and other building types that are designed to provide high-energy consuming services. Energy demands in these building types are primarily driven by end uses such as refrigeration in grocery stores and office equipment in commercial buildings, which are challenging to estimate and therefore regulate. Unregulated end use has been climbing over time and presents a significant hurdle to achieving ZNE buildings. Appliance efficiency standards are critical to ensure that original and replacement equipment do not displace gains from efficient building design and renewable installation.

Getting to ZNE Buildings: Market-Driven Strategies

Keeping the message simple but offering a rich mix of resources available for interested consumers to learn about ZNE provides an appealing model for public outreach in the information age. While energy efficiency standards play an instrumental role in leading the building sector toward ZNE development, public support for ZNE policy is equally critical to create real and lasting demand for high performance buildings in the marketplace. In an era when climate change, the cost of energy, and energy independence are common topics in the public discourse, the media is replete with green concepts and information competing for space in the public mindscape. The challenge for ZNE policy implementers is to present a clear vision of ZNE that the public can respond to without burdening consumers with complicated energy metrics.

Empowering Consumers

Perhaps the most direct approach to garner public support is to empower individuals with tools that enable them to improve their bottom line through energy savings. Building energy performance data can serve as useful decision tools to guide investments. Establishing infrastructure within the existing compliance processes for the collection and reporting of building energy performance data makes energy performance information available to building decision makers – from property developers, to building owners, facility managers, tenants, and financial institutions – allowing energy efficiency to become part of the cost-benefit analysis at various transaction points. For example, incorporating California Home Energy Rating System (HERS) Ratings into residential real estate transactions enables perspective homebuyers to factor the energy performance of homes into purchasing decisions, thereby increasing the value of and the demand for energy-efficient homes. Access to energy performance information that can be used as a decision tool helps elevate the role of efficiency and raise consumer expectations of efficient buildings. Similar energy performance ratings are applicable for commercial buildings, providing an effective means to disclose and display building performance information relative to the ZNE goals.

The Energy Commission's Appliance Efficiency database is also a source of efficiency information consumers can use to make purchasing decisions. The database contains information on appliances, electronics, and other products that contribute to building plug load. The database is the most comprehensive source of appliance efficiency information in the world. Appliance manufacturers must submit all regulated appliances that are sold or offered for sale in California to the database, and the Energy Commission plans to update the database to allow the public more user-friendly access to that information. The Energy Commission may also use the database to implement energy usage and efficiency labeling requirements for appliances, further empowering consumers to factor energy concerns into their decisions.

Lead by Doing

Innovators and early adopters are role models who inspire change. Demonstration programs featuring real world implementation of emerging technologies, practices, and designs can help transform ZNE buildings from an abstract concept to viable building examples for others to follow. The CPUC's Savings by Design program for commercial buildings and the proposed California Case Study Buildings design contest are among the efforts to inform, inspire, and encourage demand for sustainable, zero-net, and ultra-low-energy buildings.

Market Partners

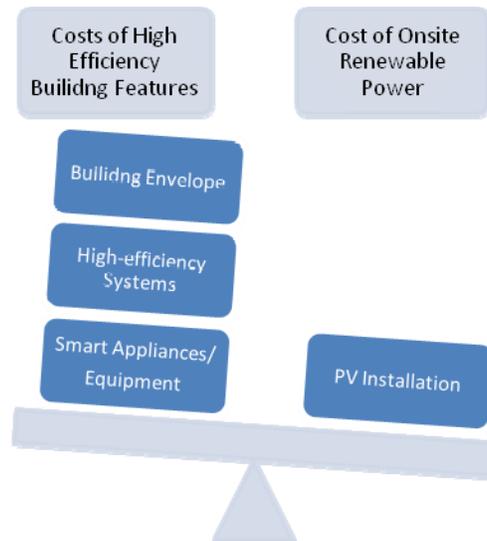
Market transformation toward efficient products and product implementation is a key strategy to meeting the goals of ZNE. Building lasting change requires broad-based support. Stakeholders in both the private and public sectors must be engaged to provide the input and leadership needed to integrate efficiency, demand reduction, and onsite renewable power systems to create ZNE buildings. Partnerships at the local and national levels should also be leveraged to share experience and raise public awareness. For example, to better characterize and investigate the lighting loads, which account for a sizable portion of building energy expenditure, through the Public Interest Energy Research (PIER) Program, the Energy Commission has created the California Lighting and Technology Center, which continually produces lighting research and identifies lighting energy-saving opportunities. A new initiative under PIER will create and develop a plug load center to expand research expertise to understand this significant and growing load. The information gathered from the new center will be critical to developing a strategy for controlling plug loads and reaching the most cost-effective ZNE. These centers also provide a forum and framework to bring researchers, government, manufacturers, and other stakeholders together and encourage the development of partnerships.

From Parts to Whole: Rethinking Efficiency Standards in the ZNE Context

The concept of a ZNE building extends beyond prescription-driven energy savings. While efficiency measures contribute to the overall energy performance of buildings, ZNE buildings compel a holistic approach in which energy performance is evaluated at the building level, rather than by individual component. For example, while replacing an inefficient HVAC system with a new compressorless ENERGY STAR® certified unit is a bona fide energy upgrade, the improvement is unlikely to result in significant savings for the building owner if the building has a leaky duct system. In contrast, the whole-building approach considers all available efficiency measures and the sequencing of improvements to maximize energy savings potential for each building.

The whole-building approach in turn changes how cost-effectiveness is determined for building efficiency standards. Although it is possible to install large PV systems to offset building energy demands, given the capital costs and rooftop space constraints, such strategy may have limited application in achieving ZNE buildings on large scale. Conceptually, the cost-benefit analysis for ZNE buildings weighs the expected energy demand – including electricity loads caused by efficiency measures and plug loads generated by building occupants – against the installation and equipment costs of PV. If PV systems are home runs and efficiency measures singles, combining solar with efficiency measures is like hitting a home run with the bases loaded – it is the most cost-effective and sensible strategy for buildings to become energy independent.

Figure 3: Rethinking Cost-Effectiveness for ZNE Buildings



Source: California Energy Commission staff, June 2011

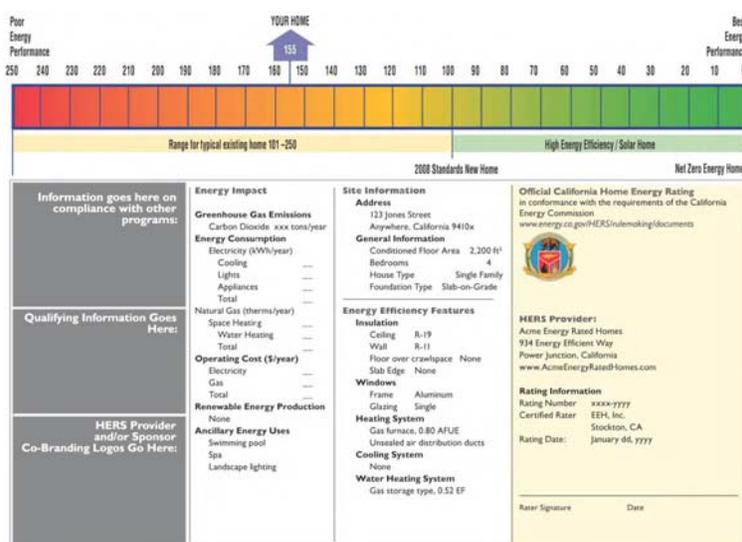
Stairway to Zero: ZNE Through Building Efficiency Standards

Mandatory Approach

The whole-building framework that ZNE building embodies requires thinking beyond the components that are historically regulated by the building standards. Title 24 leads the march toward ZNE by progressively raising the efficiency requirements for building components via the prescriptive path of compliance while encouraging energy-smart designs in the marketplace via the performance path. The performance path allows designers to trade mandatory measures for energy-saving innovations that incorporate the whole-building approach, enabling builders and designers to explore efficiency strategies that are not specified in the standards and creating new opportunities for improved building energy savings.

California's Home Energy Rating System (HERS) Program illustrates one such effort to transform the mindset from a measure-based approach to the building-as-a-system framework. The goal of the HERS program is to provide consistent, accurate, and uniform Whole-House Home Energy Ratings for newly constructed and existing homes based on a single statewide rating scale (Figure 4). A Whole-House Home Energy Rating is a comprehensive evaluation of the efficiency of the entire home akin to the miles-per-gallon rating for vehicles. The rating features a graphic scale ranging from 250 to 0 to reflect the home energy consumption with zero indicating ZNE. The homeowner receives a written report that includes the Whole-House Home Energy Rating certificate and recommendations for improvements that will reduce energy bills and make the home more comfortable. The HERS program aims to empower Californians with a reliable tool to estimate and compare the energy efficiency of homes and prioritize cost-effective energy saving improvements, spurring them to think of home energy use in terms of a whole system and to make evidence-based decisions to improve the energy efficiency of their homes.

Figure 4: California Home Energy Rating System Rating Certificate



Source: California Energy Commission. *HERS Booklet: What Is Your Home Energy Rating?* CEC-400-2009-008-BR-REV1. Page 6.

Paving the Road Through Voluntary Compliance

While Title 24 provides the regulatory impetus to guide the market to meet the ZNE goals, to be effective the market must move in lock-step with the progressively rigorous requirements prescribed in each update. More stringent green building codes, or reach standards, have been developed to ease the transition to ZNE buildings. Reach standards signal to the market how building standards will advance over time, providing an opportunity for manufacturers, developers, and designers to adapt and innovate to meet future requirements. The Energy Commission is developing voluntary energy efficiency codes based on Title 24 for the California Green Building Standards, or CALGreen. Consistent with the reduction targets for future Title 24 updates, CALGreen incorporates three levels of energy efficiency – basic (Title 24), 15 percent energy savings above Title 24, and 30 percent energy savings above Title 24. Local governments are highly encouraged to adopt CALGreen codes as reach standards to provide feedback, share best practices, and serve as pilot cases for future standards implementation. As the success of the ZNE strategy depends on the energy savings targets being met in each cycle, coordination with utilities is critical to ensure IOU incentive programs reward local governments for adopting reach standards that support the energy reduction goals of Title 24.

The 2013 Title 24 update will use reach standards to begin incorporating high-performance PV systems into building standards, starting with newly constructed residential buildings. Consistent with the state’s loading order policy, the reach standard for PV will require buildings to achieve the highest standard of efficiency before PV systems can be implemented for efficiency compliance credit. The reach standards for PV systems will set minimum equipment specifications for modules, inverters, and meters. The standards will provide calculation software based on Time Dependent Valuation (TDV) for determining expected system performance. The update will also address the effect of shading and establish protocols for installation characteristics such as system location, orientation, and distance from shading to

produce higher performing PV systems. Third-party field verification will be implemented to ensure equipment specifications and installation characteristics comply with the standards and to confirm the installed system is performing as expected.

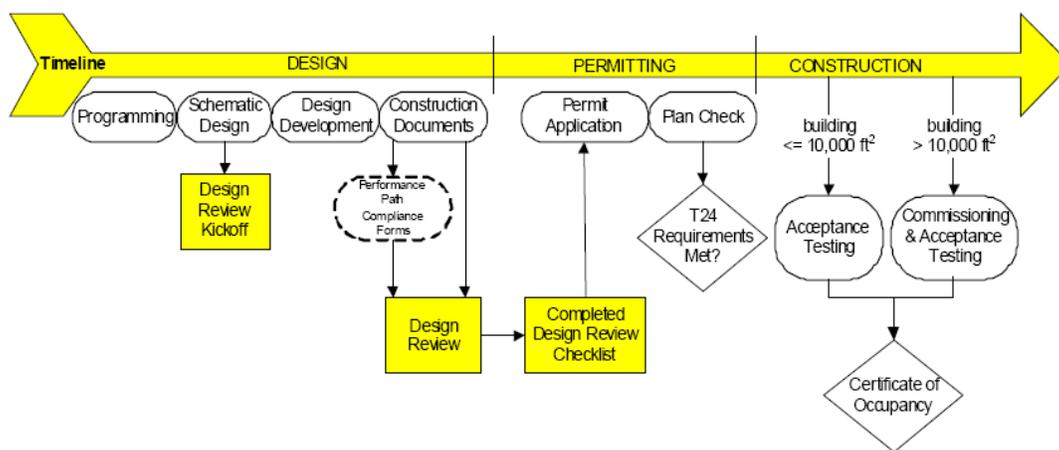
Integrating Building Performance With Compliance

In addition to mandatory and voluntary implementation of technical strategies, including design review and performance data reporting as integral components of the compliance records present additional opportunities for improving building energy performance.

Head Start With Design Review

The Energy Commission is proposing design phase commissioning design review (Figure 5 below) as a part of the permitting requirements for newly constructed commercial buildings in the 2013 Title 24 update. Typically, efficiency compliance occurs after buildings are constructed, making additional energy-saving measures difficult or costly to implement. The proposed design review integrates energy efficiency consideration into the early design decision-making process, providing an opportunity to maximize energy savings. Design-phase commissioning occurs during the design stage of a project and is a key part of the building commission protocol. It confirms that the building design conforms to project requirements; checks that documents are clear, complete, and free from significant errors; and suggests best practice design enhancements. The proposed design review is a secondary review of the construction documents focusing on Title 24 compliance. It confirms that the design conforms to codes and to performance path energy modeling inputs and ensures that CALGreen and Acceptance Testing requirements are reflected in its design documents. Design review integrates Building Energy Efficiency Standards compliance with design phase commissioning, seeking to improve energy savings by increasing compliance with Title 24 requirements while encouraging best practices that achieve more aggressive energy performance goals than those prescribed in Title 24.

Figure 5: Proposed Design Review Requirements



Source: California Utilities Statewide Codes and Standards Team (2013 California Building Energy Efficiency Standards). *Codes and Standards Enhancement Initiative (CASE) Draft Measure Information Template – Design-Phase Commissioning*. March 2011. Page 19, Figure 3.

Closing in on Zero With Energy Ratings

Establishing different energy performance ratings – standard, design, and as-built – provides a set of benchmarks for evaluating building energy performance and improving future efficiency

standards for the next generation of high performance buildings. Standard and design ratings can be included as part of the compliance documentation. A standard rating reflects the expected building energy performance based on a set of standard energy use assumptions by building types. Similar to the fuel efficiency rating for vehicles using miles-per-gallon benchmark, the standard rating provides a point of reference that can be used to assess the expected energy performance of a specific building relative to its peer group under the same conditions. In contrast, a design rating provides an energy performance assessment specific to a building. A design rating indicates how the building is designed to perform; it is generated based on assumptions specific to the building such as building envelope, orientation, day lighting, mechanical systems, and other design components unique to the building. Together, the standard and design ratings provide a functional context for building owners to evaluate the energy savings potential that the buildings can be expected to meet on average and are designed to achieve specifically. Although not part of the compliance documentation, an as-built rating demonstrates the actual energy performance of the building, generated post-construction and immediately after acceptance testing is complete. While as-built ratings do not account for actual operational energy consumption, they serve as the baseline performance data for evaluating building energy use throughout the building life cycle. Systematic reporting and collection of ratings enable a more complete understanding of building energy performance for informing future standards development and improving high-performance building designs to effect buildings that are ZNE by design and in operation.

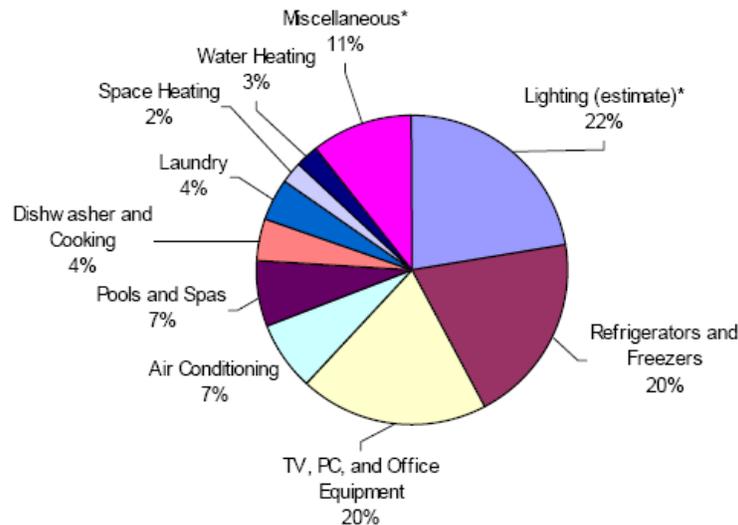
Lights, Plugs, Savings: ZNE Through Appliance Efficiency Standards

Appliance Efficiency Standards pick up where Building Efficiency Standards leave off to enable additional energy savings in buildings. Appliance Standards establish the energy efficiency thresholds for appliances and electronics commonly found in, on, around buildings. Given that appliances and consumer electronics account for nearly all electrical and gas energy in buildings and the amount of energy consumed by electronics is rapidly climbing^{3,4}, Title 20 is uniquely positioned to improve end-use product efficiency. Furthermore, by requiring end use products to be efficient by law, appliance standards are the quickest and most influential way to cause market transformation and critical to achieving ZNE. Efficient innovations tend to reach a market saturation that fails to realize large energy saving opportunities because efficiency is not a major factor in purchasing decisions for some customers. While market incentives and education programs can help further improve market saturation of appliances, the only way to fully realize the opportunity is through appliance standards.

3. Barley C.D., C. Haley, R. Anderson, and L. Pratsch. November 2008. *Building America System Research Plan for Reduction of Miscellaneous Electrical Loads in Zero Energy Homes*. National Renewable Energy Laboratory and U.S. Department of Energy. NREL/TP-550-43718. Pg. 5.

4. U.S. Energy Information Administration. March 28, 2011. *Share of Energy Used by Appliances and Consumer Electronics Increases in U.S. Homes*.
<http://www.eia.gov/consumption/residential/reports/electronics.cfm>

**Figure 6: Statewide Electricity Consumption per Household
(6,296 kWh per household)**



The pie chart illustrates the statewide electric energy consumption per household; with lighting, all residential refrigerators/freezers, and laundry use approximately 70 percent while consumer electronics and miscellaneous plug-loads consume 30 percent. With the numbers rapidly climbing, improving end-use product efficiency is critical to achieving ZNE goals.

Note: An estimate of 1,200 kWh per household (20 percent of the total consumption) has been designated as interior lighting and was shifted from the miscellaneous category to the Lighting category where it is combined with exterior lighting consumption. This number comes from other lighting studies that are better able to pinpoint this estimate than a conditional demand model was used for the RASS.

Source: 2010 California Residential Appliance Saturation Survey

AB 1109: It's All About Energy-Efficient Lighting

Lighting is the largest electrical load in both homes and businesses. Thirty-five percent of commercial electricity use and 22 percent of residential use are attributable to lighting. In late 2007, Assembly Bill 1109 (Huffman, Chapter 534, Statutes of 2007) was signed into law to focus the state's efficiency efforts on this significant segment of total energy consumption. Several of the bill's requirements apply directly to the California Energy Commission:

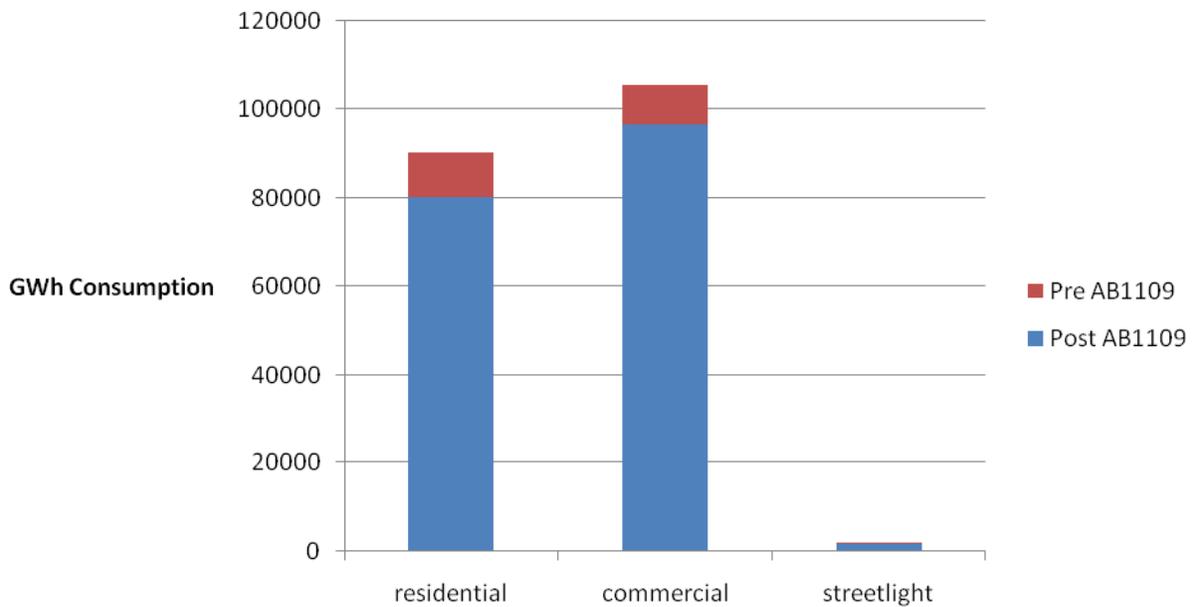
- AB 1109 first requires that the Energy Commission pass new regulations for general purpose lights by December 31, 2008. In response, the Energy Commission adopted standards for general service lamps, portable luminaires, and metal halide luminaires on December 3, 2008.
- AB 1109 also requires the Department of General Services (DGS) coordinate with the Energy Commission to cease all state purchasing of lighting that does not meet the standards adopted in 2008. In accordance with this requirement, appliance efficiency staff met several times with DGS lamp contract managers to ensure that the contract specifications complied with the new regulations.
- Lastly, AB 1109 requires the Energy Commission, through the 2008 rulemaking along with future rulemakings, programs, and other activities, to reduce the lighting-related

energy consumption of residential buildings by 50 percent, of commercial buildings by 25 percent, and of outdoor installations by 25 percent of 2007 levels by 2018.

To accomplish this broader legislative mandate, the Energy Commission must develop a roadmap for further lighting-related programs and activities and implement strategies to meet the goals of AB 1109. The success of these strategies must then be assessed and adjustments made to ensure that the goals are met. Additionally, the Energy Commission will need to develop a 2018 baseline to determine compliance with the bill and to recommend to the Governor and the Legislature how to continue reductions in electrical consumption for lighting beyond 2018.

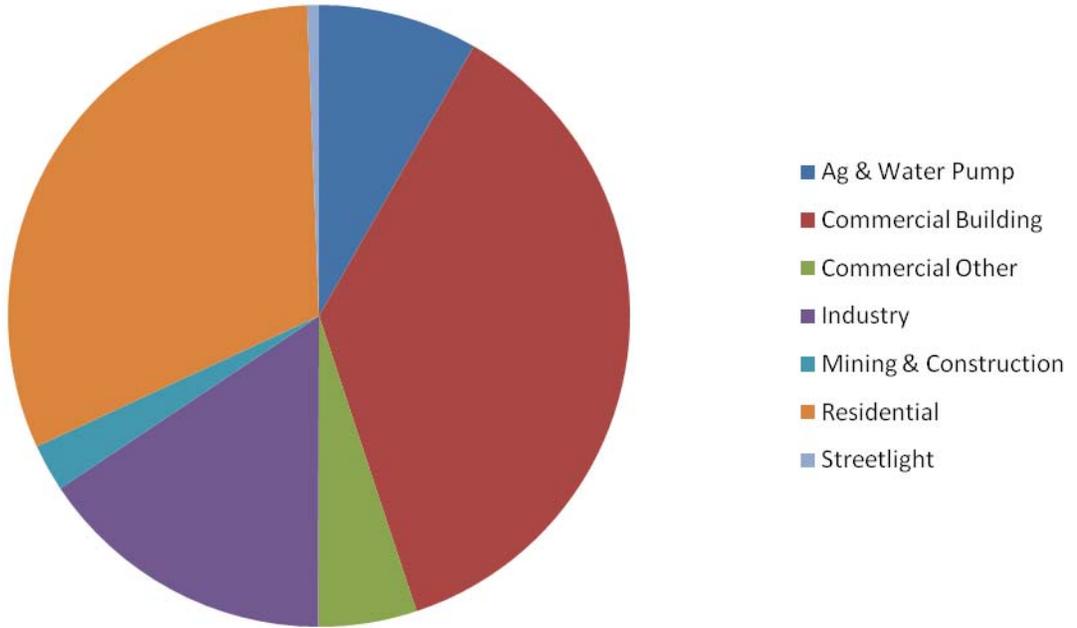
AB 1109 goals, if achieved, will have a significant effect on statewide electrical consumption. The reductions mandated by AB 1109 will translate to a decrease in total electricity consumption of 11 percent in residential buildings and 8.6 percent in commercial buildings. Overall statewide electric consumption, inclusive of all sectors, would decrease by 6.75 percent. Figure 7 demonstrates the displacement of residential, commercial, and streetlight electricity consumption with mandated AB 1109 efficiency savings.

Figure 7: AB 1109 Goals for Lighting Sector Energy Consumption Reduction



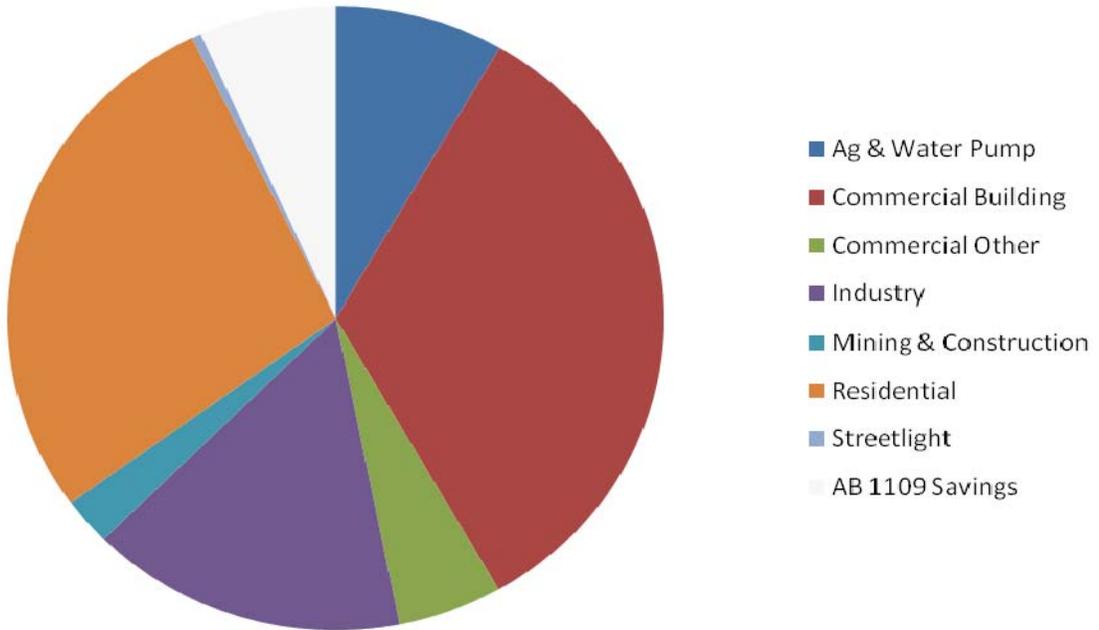
Source: California Energy Commission staff, June 2011

**Figure 8: California Electricity Consumption in 2007
Without AB 1109 Savings**



Source: California Energy Commission Energy Consumption Data Management System, June 2011
(<http://www.ecdms.energy.ca.gov/elecbyutil.aspx>)

**Figure 9: California Electricity Consumption in 2007
With AB 1109 Savings**



Source: California Energy Commission Energy Consumption Data Management System, June 2011
(<http://www.ecdms.energy.ca.gov/elecbyutil.aspx>)

The Energy Commission has taken several steps toward achieving these goals. Since the passage of the bill, the Energy Commission has adopted new standards for screw-based general service lamps, metal halide luminaires, and portable luminaires. Simultaneously DOE has passed and implemented new standards for CFLs, general service fluorescent lamps, and incandescent reflector lamps. In addition, 2008 and future building codes will make significant progress toward meeting AB 1109 as regulatory requirements translate into stock turnover and market transformation.

Initial staff estimates suggest that the Energy Commission will need to aggressively address lighting efficiency to meet the AB 1109 mandated reduction targets. The Commission's best tool for achieving this is stringent building and appliance standards. Outreach, education, and enforcement will also play a critical role in achieving AB 1109 goals. In addition, the Energy Commission will need to advocate for lighting improvements through federal processes at the DOE and U.S. Environmental Protection Agency (EPA) as California is preempted from adopting new regulations for many of the major lighting products.

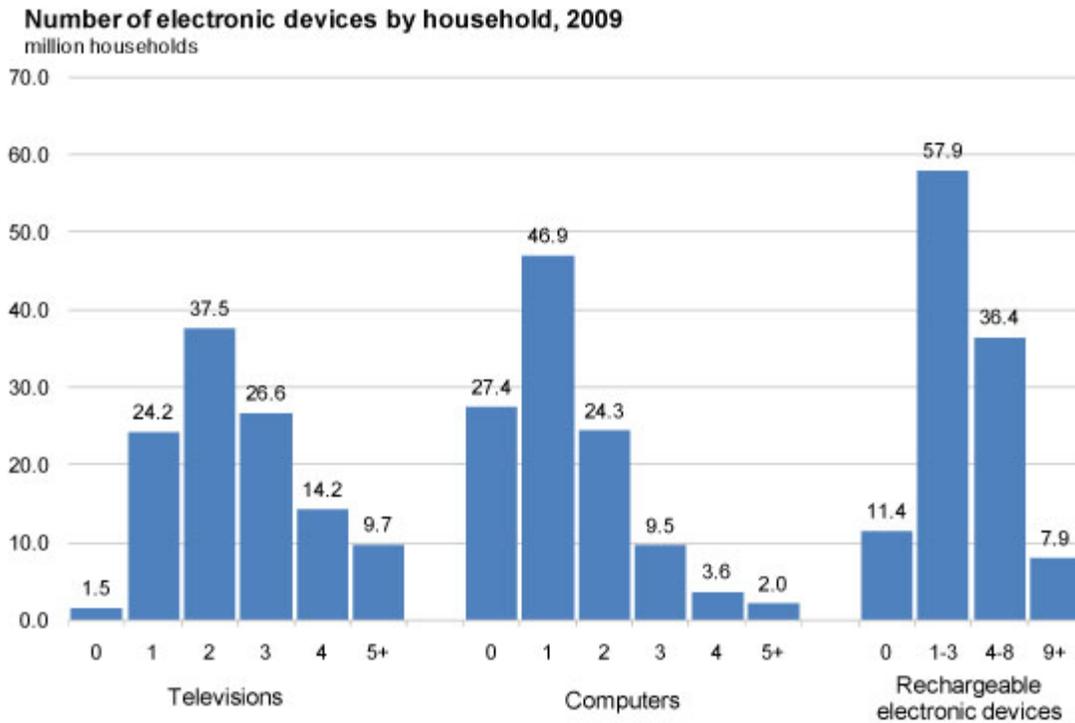
Small Gadgets, Big Impact

As mentioned above the Energy Commission must leverage the research efforts occurring abroad and push for new research efforts to understand the market and to identify opportunities for standards. Current research and analysis by PIER, the Natural Resources Defense Council (NRDC), and California's IOUs have identified set-top boxes, computers, and battery chargers as opportunities for standards. The national saturation figures below demonstrate the large saturation of multiple instances of plug loads per home.

In addition the *2010 California Residential Appliance Saturation Survey* shows computers and home entertainment not only to be a significant load, but also that they have almost universal saturation (meaning every home contains these loads).

To address these significant loads the Energy Commission has initiated and completed several rulemakings for products such as televisions, external power supplies, DVD players, and compact audio devices. These regulations provide minimum efficiency requirements for more than 26 million unit sales per year (TV: 4 million 2010, EPS: 20.6 million 2005, DVD: 1.5 million, compact audio: 1.1 million). The Energy Commission is also developing standards for the estimated 58 million battery chargers sold (2009) in California per year. The estimated energy savings for battery charger standards is 2,000 gigawatt hours (GWh) per year, of which 1,600 GWh will be attributable to reduced residential plug load energy demand and 400 GWh toward reduced commercial plug load energy demand. This standard will improve the efficiency of a wide variety of miscellaneous plug loads such as laptop computers, power tools, electric toothbrushes, cell phones, and mp3 players.

Figure 10: National Saturation Figures of Electronics



Source: U.S. Energy Information Administration, 2009 Residential Energy Consumption Survey

PIER, NRDC, and IOU research has also identified computers and set-top boxes as products with significant energy savings potential. The IOUs estimate efficiency standards for computers could reduce statewide energy demand by 2,900 GWh per year. These potential savings would address one of the largest commercial and residential plug loads. Set-top boxes represent a major plug load savings opportunity for the residential sector. A recent study commissioned by the NRDC estimates that the energy efficiency opportunity could be as high as 300 kilowatt hours (kWh) per year for a typical home.

Because plug load energy consumption is not well-characterized as a whole, it is difficult to estimate how far adopted and proposed standards will take California in addressing its growing plug load consumption. Further plug load research would be useful in identifying progress and further opportunities.

To advance efforts to address plug-loads and lighting loads, the Energy Commission needs a new scoping order that provides a clear policy statement about the commitment to reducing set-top box, computer, and product energy consumption.

Beyond the Standards

The State can also execute appliance efficiency opportunities outside of state mandatory requirements. More specifically the State can pursue product labeling, consumer education, manufacturer education, retailer education, enforcement, and advocacy in federal agencies to achieve further savings.

The Energy Commission has authority to prescribe product labeling under the Warren-Alquist Act. Labeling can take advantage of natural market forces by driving demand for efficiency and

associating life cycle rather than first costs to appliances. The Energy Commission can provide leadership for these labels that can easily be adopted nationwide by the Federal Trade Commission (FTC). The Energy Commission can look to add labeling with each new appliance standard using the test method, market data, and efficiency data to develop sensible labeling requirements to aid consumer choice and achieve savings beyond the adopted standards.

CHAPTER 3:

Efficiency Improvements in Existing Buildings

Enabling new buildings in California to achieve net-energy independence is only part the story. More than half of California's 13 million residential units and more than 40 percent of the commercial buildings were built before 1978, when the first building energy efficiency standards were implemented; existing buildings – residential and commercial – make up a huge opportunity for accomplishing California's clean energy and greenhouse gas emission reduction goals. The significance of existing buildings was clearly recognized by Governor Jerry Brown when he included improving energy efficiency in existing buildings as a component of his Clean Energy Jobs Plan. The Energy Commission has the legislative authority to develop, adopt, and implement regulations for energy ratings and improvements for existing buildings under Assembly Bill 758 (Skinner, Chapter 470, Statutes of 2009). For the first time, a state agency has the authority to more effectively take advantage of efficiency opportunities that were missed in the past.

AB 758: A New Law for Old Buildings

AB 758 is the culmination of a long-standing state priority to develop and implement a comprehensive program to achieve greater energy savings in the state's existing buildings. The AB 758 Program, through regulatory and nonregulatory initiatives, aims to improve the energy efficiency of existing residential and commercial structures that fall significantly below the efficiency set by the current Standards. The AB 758 program is envisioned to develop over three distinct and overlapping phases. These phases include development of the workforce and industry infrastructure and the AB 758 Implementation Plan (2010 - 2012); transformation of the energy assessment, retrofit, and finance markets (2012 - 2014); and development of the requirements for energy ratings and upgrades (2014 - 2015 and beyond). AB 758 calls for the Energy Commission to develop and implement the Program in collaboration with stakeholders, including the CPUC and representatives of local governments, those in the construction, utility, finance, and real estate industries, as well as those working in workforce development and small businesses owners. AB 758 also requires the Energy Commission to update the program and adopt revisions to refine the program over time.

The comprehensive program will provide multiple implementation strategies to overcome the barriers to building energy upgrades, or retrofits. The proposed strategies include public outreach and education, workforce training, public and private sector energy efficiency financing, energy assessments, building benchmarking, building energy use ratings and labels, and cost-effective energy efficiency improvements.

Public Awareness Efforts

While most people agree improving building energy efficiency is a great idea and the right thing to do, energy efficiency and how best to achieve it do not present a clear image in the public's mind. The lack actionable information that would support energy upgrades in existing buildings, ranging from home energy performance contractors to financing, continues to be a major barrier to full and effective implementation of energy efficiency programs. The AB 758 Program aims to educate the public on the benefits and value of building energy efficiency through creative public education, marketing, and outreach to ensure that the programs achieve

the maximum potential benefits in terms of energy savings, greenhouse gas reductions, programmatic momentum, and sustainability into the future.

Workforce Development

Promoting the development and growth of a qualified workforce to provide deep building retrofits is critical to achieving greater energy savings in existing buildings. Contractors who work in the residential sector have historically worked under a low-bid contractor model, where the lowest bidder is typically awarded the contract. The Program aims to change this model by emphasizing contractors' qualifications over their price. It will improve the quality of energy assessors and contractors and promote the whole-building approach to building retrofits through professional training and certification programs, such as Building Performance Institute (BPI)⁵. The Home Performance with ENERGY STAR (HPwES) designed by the U.S. Environmental Protection Agency provides a model for linking consumers with qualified contractors who can offer comprehensive packages of building efficiency improvements as well as financing, thereby removing two common barriers to retrofits.

Integration with utility energy efficiency incentive programs to require consistent and reliable energy assessments and provide rebates based on performance improvements resulting from retrofit work performed by qualified building professionals serve as another mechanism to precipitate market transformation. Currently the IOU whole-house rebate programs require BPI certification of their participating contractors.

Innovative Financing Programs

High levels of penetration of energy efficiency retrofits and the expansion of onsite renewable energy will not be possible without availability of effective financing to homeowners and commercial building owners. The high first costs of some efficiency improvements, long payback period, and/or limited access to capital are among the financing barriers preventing building owners from making efficiency improvements. The Energy Commission is working with stakeholders and identifying public and private programs to make attractive financing options for improving building efficiency available to Californians. These options include Federal Housing Administration (FHA) PowerSaver loans, which offer homeowners up to \$25,000 to make energy-efficient improvements including the installation of insulation, duct sealing, HVAC systems, water heaters, solar panels, and geothermal systems. The Energy Commission continues to support Property-Assessed Clean Energy (PACE) financing that allows property owners to payback the costs of building efficiency improvements as a special assessment on their property tax bills.

Building Energy Use Assessment, Rating, and Labeling Programs

Building energy assessment, rating, and labeling provide a mechanism for informing consumers and comparing building energy performance. This information can be used to guide investments decisions affecting building energy use. In designing and integrating the required program components, the Energy Commission will look critically at lessons learned and best practices from existing programs that assess, rate and label building energy usage in the United

5. BPI is a national standards development and credentialing organization that offers professional certification examinations on the assessment and upgrade of single family and multifamily residential buildings, and quality assurance programs that ensure that the work adheres to BPI's nationwide technical standards.

States and abroad. For example, the Energy Commission will assess the European Union's Energy Performance of Buildings Directive and other certification models, while developing operational and asset rating tools specially designed for California buildings. The Energy Commission will also analyze the results from the Home Energy Score (HES), a simple home energy label developed by the U.S. Department of Energy (DOE), to determine its appropriateness as a prescreening tool for the future AB 758 building energy use assessment and energy upgrade requirements. The Energy Commission will draw from lessons learned in the Energy Performance Score (EPS) program developed by the Energy Trust of Oregon to identify accurate and cost-effective methods and metrics for evaluating, calculating, and scoring the energy use and carbon emissions of new and existing homes.

Additionally, the Energy Commission will determine how the California Home Energy Rating System (HERS), the state's residential home energy labeling program, should be used to support the goals of AB 758, using the American Recovery and Reinvestment Act (ARRA) funded Comprehensive Residential Retrofit programs and other voluntary programs in both the investor and publicly owned utility service territories, as test cases. The Energy Commission is also, as part of some of its ARRA programs, developing and piloting the use of a specialized HERS II multifamily module, which includes protocols and assessment methods for multifamily low-rise and high-rise structures.

The development of a commercial building counterpart to the HERS program fulfills the AB 758 requirement for development of a system of energy assessments, ratings, and building labeling for nonresidential buildings, and is part of the Phase 1 program delivery. Commercial Building Energy Asset Rating System (BEARS) will need to address the diversity and complexity of the commercial building sector. This effort will build upon recent collaboration between the Energy Commission and national experts to develop nonresidential rating and building labeling tools and programs, and will include both operational ratings/building benchmarking (energy consumption as compared to similar buildings) and asset ratings (the energy efficiency of physical characteristics, or assets, of the building).

The Energy Commission is developing regulations for the commercial building disclosure requirement under Assembly Bill 1103 (Saldaña, Chapter 533, Statutes of 2007). AB 1103 mandated commercial building owners/operators to disclose benchmarking data and ratings to prospective buyers or lessees of the entire building, or to lenders who would finance the entire building using EPA's ENERGY STAR Portfolio Manager (Portfolio Manager), a national benchmarking program. The disclosure of building energy performance information at the time of lease, lending, or sale should become business-as-usual in California. The implementation of these new disclosure requirements must integrate with the activities that occur at the time of these building transactions and should not impede them.

Required Ratings and Improvements

Periodic building ratings updates that reflect changes in building performance over time provide data to support evidence-based energy policy, drive effective efficiency standards development, and guide building efficiency investments.

Several cities have adopted local ordinances that require energy efficiency upgrades to existing buildings at one or more points in their lifetime. Residential Energy Conservation Ordinances (RECO) and Commercial Energy Conservation Ordinances (CECO) require energy and sometimes water upgrades at common trigger points, such as time of sale, transfer, or

renovation. For example, the City of Berkeley's RECO requires residential spaces to comply with the requirements of the ordinance at time of sale, transfer of property, or renovation. The city's CECO requires commercial property owners to install certain energy conservation measures in their buildings upon transfer of property ownership, or when additions or renovations are made. Alternatively, the San Francisco Existing Commercial Buildings Energy Performance Ordinance requires that owners of commercial buildings file an energy efficiency audit confirmation every five years. Building owners also must file an Annual Energy Benchmark Summary report for each building using ENERGY STAR Portfolio Manager. The San Francisco Department of the Environment is mandated to collect summary statistics about the energy performance of commercial buildings and make those statistics available to the public.

The Energy Commission, during the design and delivery of the AB 758 Program, will consider strategies to complete ratings and require disclosures and energy upgrades at significant triggers in the life of buildings.

Energy Upgrade California™ Statewide Program and Pilots

Phase One implementation of AB 758 focuses on development of the infrastructure that is needed to create and advance the tools, protocols, and workforce to conduct best practice building energy assessments and retrofits.

The timing of the American Recovery and Reinvestment Act (ARRA) funding has provided California the opportunity to develop, pilot, jump-start, and test program design and infrastructure development for a successful AB 758 Program. ARRA-funded workforce development and residential and commercial building upgrade programs are being implemented statewide in coordination with IOU upgrade programs under the Energy Upgrade California™ brand. The ARRA-funded pilot programs are designed to be important cornerstones of the AB 758 comprehensive program. The delivery of the ARRA-funded programs will provide valuable information about the viability of whole-building approaches and put California ahead of the traditional low-cost, relatively low-impact, single-measure programs that pay minimal attention to quality installation. These pilot programs will be foundational to the development of the AB 758 Program by building necessary infrastructure and workforce and serving as test beds. The Energy Commission will build the most successful aspects of these programs into the AB 758 comprehensive program, modifying and refining them over time and designing regulatory and market-based programs that will maintain and expand the momentum of these pilot programs. The pilot programs include

- Comprehensive residential retrofit programs
- Commercial/municipal targeted measures retrofit programs
- Financing pilots
- Workforce development pilots

ARRA-Funded Comprehensive Residential Retrofit Pilots

The comprehensive residential retrofit programs have a goal of assessing and upgrading market rate, affordable, and low-income single-family and multifamily housing. Energy assessments, audits and upgrades as well as the HERS II whole-house assessment, rating, and labeling program are being piloted in more than 40 counties in the state. Energy assessments are

expected to identify opportunities for energy savings, prioritized by cost effectiveness, and will be modeled to achieve energy savings of 10 to 35 percent and more over existing conditions.

ARRA-Funded Commercial / Municipal Targeted Measures Retrofit Programs

The Commercial/Municipal Targeted Measures Retrofit programs conduct thousands of energy use assessments in small grocery stores, mini-marts, municipal and commercial buildings, and parking structures across the state, resulting in upgrades of bilevel and advanced lighting technologies and controls, LED refrigeration lighting, energy management system controls, and HVAC controls. These state-of-the-art technologies were tested, demonstrated, and brought to market with the help of Energy Commission PIER research funding.

ARRA-Funded Financing Pilots

Two programs are piloting financing models that target the affordable multifamily and moderate income residential markets. The CHF Residential Energy Retrofit Program is administered by the California Rural Home Mortgage Finance Authority (CRHMFA) Homebuyers Fund, a joint powers authority of the Regional Council of Rural Counties (RCRC). The CHF Residential Energy Retrofit Program administers a revolving loan program that finances whole-house energy efficiency upgrades through no- or low-interest, 15-year loans, and home purchase and refinancing FHA 203(k) loans. The CHF Residential Energy Retrofit Program serves nearly all counties in the state and is expected to create a sustainable, self-replenishing source of loans and grants for comprehensive energy efficiency upgrades targeted at rural Californian homeowners in the low-to-moderate income segments.

The Affordable Multi-family Retrofit Initiative in the City and County of San Francisco, the City of Berkeley, and the City of Oakland is creating a sustainable, self-replenishing source of loans and grants, in the form of a revolving loan fund, that provides capital for comprehensive whole-building energy efficiency and water conservation upgrades for affordable multifamily projects. The program is expected to demonstrate successful techniques for financing and implementing affordable multifamily upgrades of both common spaces and dwelling units, including energy audit procedures and techniques for high-rise residential energy efficiency upgrades that may provide information for future HERS II regulation changes.

The viability of residential and commercial PACE programs is being tested under the Energy Upgrade California™ support contract with the Local Government Commission (LGC). The Residential PACE program, operating in Sonoma County, will investigate secondary market options for PACE products, provide education on PACE assessments, and find options for local government liquidity and long-term program viability. Additionally, Sonoma seeks to educate credit raters on the new PACE bond product to encourage appropriate rating of this product, which should result in lower costs of capital to all jurisdictions. The Commercial PACE program is being piloted by the Community Redevelopment Agency of Los Angeles in collaboration with Los Angeles Department of Water and Power and the Counties of Placer and San Francisco to promote comprehensive energy upgrades and retrocommissioning of commercial property in building projects.

ARRA-Funded Workforce Development Pilots

ARRA funds were used to develop the Clean Energy Workforce Training (CEWT) Program to develop curricula, best practices training programs, and on-the-job training for a variety of jobs in energy efficiency, renewable energy, sustainable building, and other clean energy sectors. Much of the funding will be used to train the workforce necessary to deliver quality

installations of energy efficiency improvements in California's existing residential and nonresidential buildings, as will be required by AB 758 regulations.

In addition, virtually every ARRA-funded residential retrofit pilot program and commercial/municipal retrofit program has a workforce development component, which will leverage ARRA and other funded local and regional workforce development programs and develop appropriate training programs and curricula, on-the-job training, and apprenticeship opportunities. The Energy Commission is creating partnerships statewide with high schools, community colleges, workforce investment boards, and job placement organizations to prepare the workforce necessary for successful implementation of the ARRA-funded programs and to develop the infrastructure necessary for a successful AB 758 Program.

Incentive Programs Beyond ARRA

ARRA provided the Energy Commission the opportunity to explore incentive-based programs and activities. The most successful of these efforts was a program to provide cash rebates for installing highly energy-efficient HVAC and water heater systems to replace older, less efficient, systems. This program offered rebates between \$200 and \$1,000, leveraging every \$1,000 of federal stimulus funds into more than \$8,000 of economic activity.

Two shortcomings of the program were that the program was restricted to residential consumers, ruling out participation by businesses or landlords, and that the rebates were available only until the federal stimulus funds were exhausted. However, the program showed the viability and effect of an incentive-based approach to market transformation and in particular toward promoting building retrofit projects.

Without federal stimulus funds, one way to continue operating a stimulus program that is revenue-neutral is to offer low-cost loans, rather than cash rebates. Consumers would receive a monetary incentive for efficient retrofit projects while the state would recover loaned funds over a reasonable period. Terms could be broadened to include landlords and commercial property owners and tailored to promote the specific types of retrofit projects that produce the greatest overall benefit to the State. In addition, such a program could be expanded to include self-generation projects and small-scale DG. After an initial outlay to establish a revolving fund, such a program could be sustainably managed in perpetuity and would effectively be administered in the fashion of a bank.

Consumer Awareness

ARRA funds were used to establish Energy Upgrade California™ Web portal to provide a single-stop resource to inform Californians of the benefits of retrofits, provide them with information on energy financing options, and help them locate qualified energy raters and contractors to perform building efficiency upgrades and identify applicable rebates and incentive programs.

Consumer awareness efforts such as these help the Energy Commission reach the program goals of achieving the maximum potential benefits in terms of energy savings, greenhouse gas emissions reductions, program uptake, momentum, and sustainability into the future.

CHAPTER 4:

Key Challenges

Although policies and funding have been put in place to achieve significant energy savings in California's newly constructed and existing buildings, many barriers still must be overcome to accomplish the state's ambitious energy efficiency goals. Accurate data on California's buildings and how their occupants' energy use is affected by energy efficiency improvements is often challenging to obtain. The Building and Appliance Efficiency Standards are formulated using such data, and although they provide a set of instructions for making California's buildings more energy-efficient, they will not deliver the energy savings they were intended to unless the state's builders and contractors and appliance manufacturers, distributors, and retailers choose to follow them.

Achieving Compliance With the Building Standards

Achieving compliance with the Energy Efficiency Building Standards (Standards) is challenging. It is estimated that at least 30 percent of the energy savings potential of the Energy Efficiency Building Standards is lost due to noncompliance, including failures to install HVAC systems and seal air ducts properly. California has agreed to develop a plan to achieve a 90 percent compliance rate with its Building Energy Efficiency Standards by 2017 in exchange for stimulus funds. To meet this aggressive goal, the Energy Commission needs to develop a method to determine the level of compliance, enforcement, and quality of installations throughout the industry and use this information as a benchmark against which to determine 90 percent compliance. Without this benchmarking, efforts to increase compliance cannot be effectively targeted or assessed.

The Standards are enforced on the local level by city and county building departments. Building department personnel review plans, inspect work, and have the authority to approve or halt projects through the permitting process. Builders, contractors, and owners are required to obtain a permit to start work and to pass a final inspection when work is complete. To operate legally in California, contractors must be licensed by the Contractors State License Board (CSLB). This agency protects consumers by licensing and regulating California's construction industry. However, the CSLB and building departments often lack the resources and expertise to ensure that energy efficiency equipment and other efficiency measures are installed correctly and therefore provide the most energy savings to building owners.

Due to the lack of effective Standards enforcement along with other factors, improper installation of wall and duct insulation, HVAC systems, and other efficiency measures is a widespread problem that increases energy demand and costs for home and building owners and raises consumer safety concerns. To combat this problem, since 1998 the Standards have required that the proper installation of efficiency measures that are commonly poorly installed be verified by independent, third-party energy inspectors, or HERS Raters. Raters use Energy Commission specified diagnostic testing and field verification protocols to determine the installation quality of efficiency measures and protect consumers by ensuring that the equipment they buy will save them as much energy and money as possible. These raters are trained, certified, and overseen by HERS Providers. HERS Providers are private companies certified by the Energy Commission and are the centerpiece of the HERS program. In addition

to their responsibilities pertaining to raters, they are required to maintain an electronic registry and database for all HERS compliance documentation.

Building Departments

Building departments are a key element in increasing compliance, yet they must overcome significant barriers to enforce the Standards effectively. Many of these barriers are caused by a lack of resources. Building departments are funded by permit fees and therefore do not have excess funds to find and penalize contractors who do not obtain permits. Furthermore, due to the economic downturn and reduced budgets, many cities and counties have downsized their building department staff. The remaining staff have limited time to learn complex energy efficiency Standards and keep up with new requirements when the Standards are updated approximately every three years. Other responsibilities, such as enforcing health and safety codes, may take priority over Standards enforcement. Building departments also usually do not have resources to educate contractors and homeowners who are unfamiliar with the Standards or those who are unmotivated or unwilling to comply with the Standards.

The Energy Commission is addressing these issues in a variety of ways:

- Developing audience-specific education and outreach information on the Standards for building departments, consumers, contractors, and others in the building industry, including an online learning center and checklists and guides to assist plan check and inspection.
- Conducting regional outreach at building departments and through International Code Council chapters.
- Providing an energy standards hotline for consumers and building industry professionals to get Standards questions answered.
- Investigating complaints and providing assistance to consumers, enforcement agencies, and other energy professionals.
- Working with the CSLB to enforce and penalize contractors for violating the Standards.

Heating, Ventilating, and Air-Conditioning (HVAC) Installations

Compliance with the Standards is particularly poor for HVAC repairs and changeouts. The CPUC's Long-Term Energy Efficiency Strategic Plan reported that fewer than 10 percent of HVAC systems are installed with the required permits, and the HVAC industry puts the figure even lower, at less than 5 percent. In addition to reducing the energy efficiency of HVAC systems, this puts homeowners at risk by bypassing the health and safety protections associated with permits and reduces revenues that fund local building departments.

However, the problem persists since HVAC contractors have little incentive to obtain the required permits. HVAC changeouts are short-term, low-visibility projects, and therefore the risk of getting caught without a permit is low, while obtaining a permit requires money and time. Furthermore, contractors who engage in unfair business practices by not obtaining permits undercut those who are operating legally. Most consumers do not ensure that contractors they hire obtain permits (either due to lack of knowledge or to save money) and do not have the expertise necessary to determine when contractors incorrectly install their systems.

Though the low compliance rate and barriers to compliance present in the HVAC industry can be daunting, they also represent a substantial opportunity for energy savings. The HVAC industry estimates that 30 to 50 percent of central air-conditioning systems are being installed improperly⁶. These systems cost home and building owners more, decrease occupant comfort, and increase energy use by 20 to 30 percent, largely during times of peak demand in California⁷. This energy loss and peak demand effect can stress the state's electric grid, especially on the hottest summer days.

Ensuring that all HVAC systems are properly installed and operating at their designed efficiency would save considerable energy and reduce pressure on the state's electric grid. Effective enforcement of the permit requirements for HVAC changeouts will also create jobs and generate income for those in the flailing construction industry through increased revenue for building departments and HERS Raters who test HVAC systems.

The CPUC's Energy Efficiency Strategic Plan calls for ensuring compliance on HVAC changeouts through partnerships with the CSLB and the Western HVAC Performance Alliance, which was established in 2009 to provide input from the HVAC community to the IOUs in support of the goals of the California Long Term Energy Efficiency Strategic Plan. The Energy Commission is actively participating in a task force with these groups to increase permitting of HVAC installations.

In addition, the Energy Commission and the CSLB have a memorandum of understanding, signed in 2005 and expanded in 2010, that establishes a collaborative working relationship between the two agencies to educate the building industry, consumers, and contractors and promote common goals through education and enforcement of the Standards. Through this collaboration, the CSLB has planned several enforcement actions, or stings, to catch and hold noncompliant contractors accountable that will take place throughout California in the coming months. The Energy Commission will continue to collaborate with the CSLB and the Western HVAC Performance Alliance to try to accomplish the goal of transforming the residential and small commercial HVAC industry to ensure that technology, equipment, installation, and maintenance are of the highest quality to promote energy efficiency, consumer protection, and peak load reduction.

The Energy Commission is addressing HVAC permitting in the following ways:

- Collaborating with the Attorney General to ensure that incentives offered by utility programs for energy efficiency improvements require permits.
- Working with the Employment Economic Enforcement Coalition (EEEC) to help find and penalize contractors who do not obtain permits. The EEEEC is a partnership of state and federal agencies collaborating to educate business owners and employees on federal and state labor, employment, and licensing laws; conducting vigorous and targeted enforcement against labor law violators; and helping to level the playing field and restore the competitive advantage to law-abiding businesses and their employees.

6. California Public Utilities Commission, California Long Term Energy Efficiency Strategic Plan. September 2008. http://www.cpuc.ca.gov/NR/rdonlyres/A54B59C2-D571-440D-9477-3363726F573A/0/CAEnergyEfficiencyStrategicPlan_Jan2011.pdf

7. Neme C., J. Proctor, and S. Nadel, National Energy Savings Potential from Addressing HVAC Installation Problems (Prepared for the U. S. EPA, February 1999).

Members include the Division of Labor Standards Enforcement, Division of Occupational Safety and Health, Employment Development Department, Contractors State License Board, and the U. S. Department of Labor.

- Requiring contractors to obtain permits when participating in ARRA-funded projects.
- Developing and distributing educational materials for consumers and contractors on the importance of obtaining a permit and complying with the Standards, including information distributed by real estate agents targeted at new property owners
- Creating simplified compliance forms for HVAC change outs

Achieving Compliance With the Appliance Efficiency Standards

The Appliance Efficiency Regulations require manufacturers of numerous types and designs of energy-using appliances to report the performance of those appliances to the Energy Commission to be sold or offered for sale in California. Title 20 includes standards for federally regulated appliances as well, because federal regulations preempt California regulations.

The expected energy savings from new standards are truly achieved when Californians purchase and use only the newest, most efficient products. Therefore, the industry's compliance with appliance efficiency standards is a necessary element of ZNE. However, noncompliance with the Appliance Efficiency Standards is widespread and brought to light through appliance market surveys, self-policing by regulated market participants (primarily manufacturers), Energy Commission investigations, and complaints from energy advocates and others. Most complaints of noncompliance pertain to regulated appliances being sold or offered for sale in California without first being certified to the Energy Commission and listed in the Energy Commission's database as required.

When noncompliance is suspected, Energy Commission staff sends a series of letters to the manufacturer and any known distributors of the noncompliant models, requesting that the models be certified. If the manufacturer fails to respond, staff confers with the program supervisor and program legal counsel to determine if the matter should be referred to an Energy Commission administrative hearing, or be referred to the Attorney General's office or appropriate District Attorney's office for injunctive relief. If the appliance in question has been certified to the Energy Commission, and if the complaint concerns allegations that a regulated appliance model not meet the energy consumption values reported when the model was certified, the model may be tested by the Energy Commission's contracted independent test laboratory for independent confirmation of energy use. Failure of a model, when tested, to meet applicable standards might result in an administrative hearing to have the model removed from the database (thus removing it from sale in California). Enforcement of Title 20 ensures that the state is achieving the energy savings that are anticipated whenever new standards take effect.

Identifying Noncompliance Through Appliance Market Surveys

On January 1, 2010 a new edition of the Appliance Efficiency Regulations took effect, and several additional types and designs of appliances were added. The Energy Commission uses appliance market surveys to determine which Title 20-regulated appliances are being sold or offered for sale in California, and to determine if those appliances appear in the Energy Commission's database of certified appliances. This information, obtained under contract to the

Energy Commission, serves as one basis for initiating the enforcement process mentioned above.

Of the 2,240 regulated appliance models surveyed in the most current appliance market survey, 966 (43 percent) were found to be noncompliant because they were not listed in the Energy Commission's database. The Energy Commission sent letters requesting compliance to 125 manufacturers and 54 retailers. Specifically, manufacturers of regulated but uncertified appliances were asked to certify their models; and retailers of regulated but uncertified appliances were put on notice that they are prohibited from selling or offering them for sale in California until they are certified and appear in the database. As a result, more than 2,400 models were certified to the Energy Commission by manufacturers

The Energy Commission approves appliance market surveys only when contract funds are available. There have been five such surveys conducted in the Appliance Efficiency Program's 30-year existence. None of these surveys captured data on the entire list of the Program's regulated appliances. While these studies clearly demonstrate that there is significant level of noncompliance, the Energy Commission does not have definitive information regarding the rate of overall compliance. Furthermore, the Energy Commission has not conducted a statistically significant study to determine the rate of noncompliance and associated lost energy savings. Therefore, the Program does not have a baseline against which to assess trends in and rates of compliance across all appliance types.

Verifying Energy or Water Use Through Independent Appliance Testing

As funds are available, the Energy Commission contracts for the independent testing of a select number of Title 20-regulated appliance models. The purposes of these tests are: A) to establish independently that the energy efficiency level of the appliance matches that the manufacturer represented at the time the model was certified to the Energy Commission; B) to provide evidence following the receipt of a complaint that a certain appliance either meets or fails to meet an established efficiency standard; or C) to gather efficiency data on regulated appliances for which there is no standard to determine if a standard should be established by the Energy Commission. Finally, the information gathered from independent laboratory testing serves as another basis for enforcement action.

Between April 2009 (the start of the current contract) and June 2011, 31 regulated appliance models were tested. Of the 22 models for which there is an existing standard, 5 failed to meet the standard set forth in Title 20, and 2 were subsequently removed from the database, based on the findings of an informal administrative hearing. The data gained from the testing contract is of immeasurable value because it allows the Energy Commission to verify independently the accuracy of energy consumption reported as a part of the certification process. Further, testing of certified appliances for which there are no standards allows the Energy Commission to collect data to support the creation of new standards at a future date. However, during each of the past testing contracts, only a dozen types of regulated appliances (of the more numerous types and subtypes under regulation) were able to be tested, due to limitations in available contract funding. For example, of the roughly 32 regulated configurations of central air conditioners, only computer room air-cooled air conditioners have been tested in the current contract as of June 2011.

To preserve the integrity of the testing process, and to avoid real or perceived conflicts of interest, the Energy Commission contracts with test laboratories that are not affiliated with

regulated manufacturers. Furthermore, since the appliances to be tested are purchased in California (as a consumer would), the Energy Commission prefers to contract with laboratories that are located within the state. This also prevents contract funding from being spent on shipping appliances out of state for testing. All of these factors narrow the field of available test laboratories to just one lab with whom the Energy Commission may contract.

Limited Enforcement Authority

The Energy Commission's existing enforcement authority is limited to removing noncompliant appliance models from the appliance database⁸ (only appliances listed on the database can be legally sold or offered for sale in the state) and referring manufacturers of noncompliant appliance models to the Attorney General for injunctive relief. The high rate of noncompliant products being sold or offered for sale in the state, as found in the market survey conducted by the Energy Commission's survey contractor, clearly indicates that the Energy Commission's existing enforcement authority is insufficient for ensuring high rates of appliance certification requirements under the Warren-Alquist Act.

Currently, there is no statutory or regulatory mechanism that allows the Energy Commission to impose sanctions against manufacturers, distributors, and retailers who fail to comply with the appliance regulations. Furthermore, current law provides some avenues for investigation of violations and referral of violations to the Attorney General, but no way for the Energy Commission itself to take effective action to compel compliance. This allows noncompliant manufacturers to gain a competitive advantage in the marketplace and to benefit materially from their noncompliance.

In addition, the Energy Commission does not have the statutory authority to enforce Title 20 requirements against products sold or offered for sale in the state over the Internet or through online catalogs. This loophole undermines the effectiveness of the law and costs the state an undetermined amount of lost energy savings. The latest appliance market survey showed that of the 966 noncompliant models identified, 528 models (about 55 percent) were found on manufacturer, retailer, and auction Internet sites. If this trend continues, the lost energy savings from sales of noncompliant appliances through this sales venue could outstrip that of brick-and-mortar retail stores.

Indoor Air Quality and Ventilation: "Seal Tight and Ventilate Right"

Discussion of existing building energy upgrade programs would be remiss without discussing indoor air quality (IAQ). The general assumption is that poor air quality is an outdoor problem caused by industrialization or automobile emissions, and that buildings are reasonably safe. Evidence however, points to a potential for air quality issues originating from within buildings, and it is important to identify any potential IAQ problems that could be compounded by energy upgrades that alter the building envelop or airflow within the building. A successful energy upgrade program must also focus on the health and safety of building occupants, contractors

8. In February 2011, Senator Fran Pavley (Santa Monica) introduced a bill (SB 454) that would give the Energy Commission the authority to cite and fine violators of Title 20. The bill has not yet been chaptered as of the publishing of this report. This report's enforcement section and its discussion do not, and are not intended to, comment on this active legislation.

and other workers, and an awareness of local, state, and federal guidelines and protocols regarding the safe handling of potential sources of potential indoor pollutants.

Buildings waste enormous amounts of energy when heated or cooled air is lost through imperfect door and window seals, and cracks in the building envelope. Such air movement also compromises the effectiveness of insulation, causing buildings to be drafty and uncomfortable, and leading to the introduction of pollutants from adjoining spaces such as garages, attics, and crawl spaces. Air movement can also introduce moisture into wall systems, resulting in mildew and mold, and over time can compromise the sustainability of the building.

Natural gas or propane appliances inside the building that do not have their own supply of air (such as furnaces, water heaters, and gas ovens and stoves) can introduce combustion by-products into the building during appliance warmup, or if defective or out of calibration. They can also compete with occupants for oxygenated air.

Paints in buildings built before 1978 may contain lead and federal regulations require safe handling of paints being disturbed in homes built prior to 1977. Potentially dangerous volatile organic compounds (VOCs) can be brought into buildings as cleaning products, pet supplies, solvents, insecticides, polishes, or solvents, and if stored in cabinets within the occupied space, in attached garages or sheds, or in basements or crawl spaces, can contribute to poor indoor air quality. Because of air leakage, storage of such compound in unoccupied spaces is often just as unsafe as storage in occupied spaces. Naturally occurring radon exposure is quite rare in California, but there are a few locations of concern that should be taken into consideration when improving the building envelope. Older homes that were designed with steam or hot water heating systems often used asbestos insulation for insulating the boiler and distribution pipes. If asbestos insulation is improperly handled microscopic particles can become airborne and be inhaled by building occupants.

The Energy Commission believes that the best solution to overcome these problems is to thoroughly seal cracks and penetrations in the walls, floor, and ceiling. The Energy Commission strongly supports the development and adoption of best practice combustion and other pollutant testing protocols and guidelines, and strict adherence to relevant local, state, and federal guidelines in conjunction with home energy upgrades.

Chapter 5: Staff Recommendations

Public Awareness, Education, and Outreach Recommendations

Contractors who earn advanced training and certification to learn best practices and the latest in building science want to be appropriately compensated for the higher skill level and better products they deliver. The State of California is developing a number of alternative financing products, working to improve methods of verifying energy savings, and advance the understanding of building sciences. Alternative financing instruments address the high upfront cost of energy upgrades, but will there be takers? Building owners want to be sure they get the energy savings they were promised and to know their investment in energy improvements is appropriately priced when they sell their building. Innovative, honest, and aggressive public outreach and education is necessary to convince an untrusting and risk-averse public that investing in energy upgrades is a safe and cost effective priority.

Workforce Development Recommendations

Future CPUC three-year IOU energy efficiency portfolios should contain workforce development plans, targets, and goals that align with the state's energy efficiency and environmental goals. These plans should develop training programs, apprenticeships, and on-the-job training opportunities. The residential and commercial sectors face different challenges, regarding workforce development and training needs for energy efficiency upgrades. A robust and mature energy upgrade and workforce, for both the residential and commercial markets, will require training programs and curricula that include on-the-job training and apprenticeship opportunities in the related trades, relevant training for new and incumbent workers, and retraining opportunities to best practice standards.

The residential sector operates on a single-measure lowest bid contractor model to complete repairs, retrofits, and energy upgrades. Introduction of the idea of whole-package contractors and contractor certifications, such as BPI, that represent best practices and protocols needs to be accompanied by public demand for higher quality workmanship, commensurate compensation, and guarantees of quality and energy savings.

The commercial contractor sector needs to develop more entry-level classifications and positions, so that those entering the workforce have positions at which to enter the field and learn the skills required to work on complex commercial buildings on the job.

Data-Driven Policy and Market Transformation

Establishing effective policy for achieving energy savings in California starts with the gathering and synthesizing of good raw data. The Energy Commission has the largest repository of appliance energy use data *in the world* in its Appliance Efficiency Database, the most comprehensive rating system for homes in the nation in its HERS Rating program, and by 2013 will have a first-of-its-kind repository for commercial building energy use. This wealth of data has contributed to Energy Commission efforts in the past, yet there exists a much greater opportunity for leveraging this data for identifying energy savings opportunities and formulating effective policy strategies than is currently taken advantage of.

There exists a strong need for energy use baselines, models, and profiles of “typical” single-family homes, multifamily homes, and commercial buildings of varying sectors (retail, food service, office space, and so forth). The data to create these baselines exists in raw form, but serious effort has yet to be given to creating a suite of synthesized, refined statistics for use by policy makers. The value of having a rigorous set of baselines and models is difficult to overstate: It provides state and local policy makers with the tools to act more freely and with more certainty in regards to outcome, while also illuminating where the best opportunities for action lie.

In addition to being essential for formulating policy, the Energy Commission’s efficiency data is able to tell the story of building and appliance efficiency in California to the public. Communicating the story of efficiency, of the transformation of California’s markets and the tangible benefits reaped by California’s citizens, also communicates a very powerful and resounding marketing message about the state’s leadership in energy efficiency. Further, having this narrative supported by hard, factual efficiency data increases the confidence in the message of efficiency, of being able to live better while consuming less. A strong message is as essential to market transformation as strong policy as advocates seek to influence consumer behavior and preference, the supply and inventory decisions of retailers, distributors and contractors, and the design decisions of both builders and manufacturers.

Ultimately, being able to both show the data and tell the story of efficiency in California makes the proposed actions of state and local authorities transparent and understandable by clearly communicating the context and reasons for the actions taken. In turn, this increases buy-in by stakeholders and general public support for further efforts to increase efficiency, reduce waste, avoid costs, and move closer to the goals of ZNE.

Improving Compliance and Enforcement

Effective enforcement for both the Building and Appliance Efficiency Standards is hampered by both the Energy Commission’s and local governments’ lack of authority to penalize those who willfully fail to comply with the Standards. Enforcement of the Building Standards would be more effective if the Energy Commission and local governments obtained the authority and resources to impose fines on builders, contractors, and HERS Providers and Raters for noncompliance with the Standards.

Appliance Efficiency Standards compliance likewise would be improved if the Energy Commission obtained authority to cite and fine noncompliant appliance manufacturers as well as regulate Internet and online catalog sales of Title 20-regulated appliances. This authority would ensure a level playing field in the marketplace and protect customers from inefficient appliances that are excessively expensive to operate.

Recommendations Summary

California must consider innovative approaches for meeting building efficiency goals that go beyond standards development and enforcement. While these activities are the foundation of the T20 and T24 programs, other improvements must be made as well. They include making financing more available for building retrofits, installation of onsite generation, or distributed generation projects; enhancing data collection, processing, and analysis capabilities; providing

more effective enforcement tools; and increasing education and outreach efforts for both consumers and regulated industries.

Building Efficiency Recommendations

Meeting ZNE and Existing Building efficiency goals will require not only standards development and effective enforcement, but also innovative approaches for promulgating aggressive voluntary efficiency standards, valuing the energy performance of buildings, developing and valuing the workforce to deliver high-quality energy upgrades (as opposed to the lowest bid model), and financing these energy efficiency upgrades and renewable energy projects:

- The definition of ZNE, as defined in this report using the societal value of energy as the metric, should be adopted by all state agencies and their affected industries in the development and implementation of ZNE building design and re-design projects, incentives, and Standards.
- The Energy Commission should proactively develop comprehensive reach standards to set voluntary levels of energy efficiency and renewable energy that can be adopted by local governments, incented by public goods efficiency programs, and included in the state's Green Building Standards.
- The Energy Commission should help develop public goods efficiency program plans to integrate workforce development program planning into the efficiency programs, especially on-the-job training and apprenticeship opportunities to promote residential best practice energy upgrades and retrofits and develop entry-level commercial building commissioning and energy upgrade skills and job opportunities.
- The Energy Commission should develop and implement the next three Standards updates to realize significant efficiency improvements (20-30 percent) in each update and on-site renewable energy requirements are included as appropriate to meet the 2020 ZNE goal.
- The Energy Commission should adhere to the AB 758 implementation schedule delineated in this report to first learn from the current ARRA-funded retrofit, workforce development and financing pilots then develop energy performance rating disclosure regulations and eventual efficiency improvement requirements for existing residential and commercial buildings.
 - Trigger, disclosure, and upgrade policies need to be developed with industry stakeholders to determine optimum times in buildings' lives to require disclosure and energy upgrades (that is, at time of sale/refinance vs. on a regular frequency, such as every five years); and what would be disclosed, taking into account occupant confidentiality, and potential negative effect on renting or sales.

Reducing Plug Loads in Buildings Recommendations

To help achieve ZNE and Existing Building Retrofit goals, it is necessary to not only establish efficiency standards for the building envelop, but also to increase the efficiency of appliances used in buildings. To accomplish that the Energy Commission needs to enforce existing

standards more effectively, continue to develop new standards, and more effectively provide technical support to the regulated community.

- The State should grant authority to the Energy Commission to impose fines and other enforcement penalties on entities that willfully fail to comply with the Building or Appliance Efficiency Standards or willfully misreport data.

ACRONYMS

AB 1103	.....Assembly Bill 1103, Saldaña, Chapter 533, Statutes of 2007 . (Energy: commercial buildings: consumption)
AB 1109	.....Assembly Bill 1109, Huffman, Chapter 534, Statutes of 2007. (Energy resources: lighting efficiency: hazardous waste)
AB 32	.....Assembly Bill 32, Núñez, Chapter 488, Statutes of 2006. (The Global Warming Solutions Act)
AB 758	.....Assembly Bill 758, Skinner, Chapter 470, Statutes of 2009. (Energy: energy audit)
AB	.....(California State) Assembly Bill
ARRA	.....American Recovery and Reinvestment Act of 2009
BEARS	.....Building Energy Asset Rating System
BPI	.....Building Performance Institute, Inc. (http://www.bpi.org)
BTU	.....British thermal units
CalEPA	.....California Environmental Protection Agency
CECO	.....Commercial Energy Conservation Ordinances
CEWTP	.....Clean Energy Workforce Training Program
CPUC	.....California Public Utilities Commission
CRHMFA	.....California Rural Home Mortgage Finance Authority
CSLB	.....Contractors State License Board
DOE	.....(United States) Department of Energy (http://www.energy.gov)
EECBG	.....Energy Efficiency and Conservation Block Grant
EPA	.....(United States) Environmental Protection Agency
EPS	.....Energy Performance Score
EU	.....European Union
FHA	.....Federal Housing Administration
GHG	.....Greenhouse gas
GWh	.....Gigawatt hours (one billion watt hours or 3.41 British thermal units)
HERS II	.....Home Energy Rating System’s “Whole House Home Energy Rating” standards
HERS	.....Home Energy Rating System
HES	.....Home Energy Score
HUD	.....(United States Department of) Housing and Urban Development
IAQ	.....Indoor Air Quality
IEPR	.....(Energy Commission’s) Integrated Energy Policy Report
IOU	.....(California’s) Investor Owned Utility
kWh	.....Kilowatt Hour (1 thousand watt hours or 3413.41 British thermal units)
LADWP	.....Los Angeles Department of Water and Power
LBNL	.....Lawrence Berkeley National Lab (http://www.lbl.gov)
MIST	.....Moderate Income Sustainable Training

MPGMiles per gallon (of gasoline)
MW.....Megawatt
NATENorth American Technical Excellence
PACE.....Property Assessed Clean Energy
PVPhotovoltaic (solar electric generation)
RCRCRegional Council of Rural Counties
RECOResidential Energy Conservation Ordinances
RESNETResidential Energy Services Network (<http://www.resnet.us>)
SB 454.....Senate Bill 454, Pavley, Introduced February 16, 2011. (*Energy efficiency standards*)
SB.....(California State) Senate Bill
TDVTime Dependent Valuation