Docket:	**R.12-03-014**
Witness:	**Bill Powers**
Exhibit No.:	

Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans	R.12-03-014 (Filed March 22, 2012)

SELECTED SOURCES SUPPORTING PREPARED DIRECT TESTIMONY OF BILL POWERS ON BEHALF OF THE CALIFORNIA ENVIRONMENTAL JUSTICE ALLIANCE

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

JULY 25, 2012

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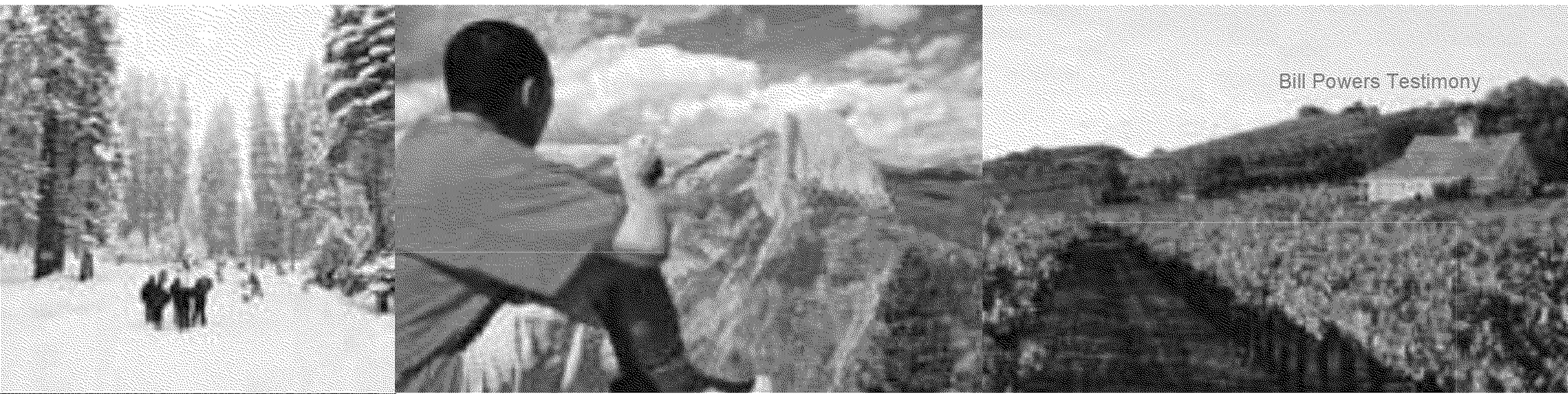

Climate Change Scoping Plan

a framework for change

DECEMBER 2008

Pursuant to AB 32
The California Global Warming Solutions Act of 2006

Prepared by
the California Air Resources Board
for the State of California

Arnold Schwarzenegger
Governor

Linda S. Adams
Secretary, California Environmental Protection Agency

Mary D. Nichols
Chairman, Air Resources Board

James N. Goldstene
Executive Officer, Air Resources Board

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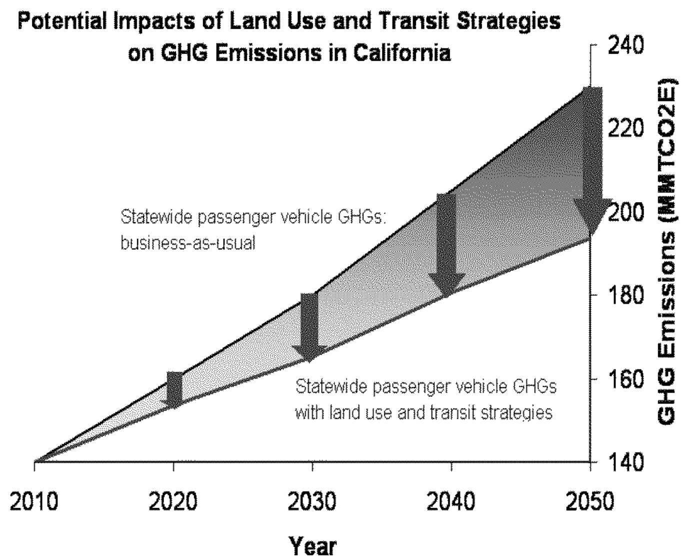

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When I was governor, California was the world leader in renewable energy and it led the nation in efficiency standards. Our programs saved California consumers billions and created nearly 1.5 million jobs.

Until ┐└┘ ╟–◘ ╠♂♂□♫☼╫┘–◘ ├◘●┘┼┘◄–↕◘ energy development in the US occurred in California, which at one time had more than 90% of ┐└┘ ◄‼◘¶♫◄┼¶ energy capacity.

That has changed-- ┬ └┼–╠♫╫‼◄ ╓└┘ ◄‼◘¶♫╓‼┤ ●┘┼┘◄–↕◘ ╟┼┘●↑ ╫●‼¶├→┘●☼┼¶| Texas and Iowa generate more wind power than California.

As we face the devastation to our job market caused by the mortgage meltdown and the Wall Street debacle, we need to find a way to get California working again. Investing in clean energy and increasing efficiency are central elements of rebuilding our economy. It will create hundreds of thousands of jobs, build the businesses of the 21st century, increase energy independence, and protect public health.

Renewable Energy:

Investments in clean energy produce two to three times as many jobs per dollar as gas, oil or coal. And dollars invested in clean energy tend to stay in California, instead of other states or countries. Renewable energy also reduces greenhouse gas emissions and other harmful air pollutants.

Clean energy jobs and businesses have grown much faster than the economy as a whole in the past fifteen years, and have continued to grow even during the economic downturn.

Investment in clean technology is also growing. Clean tech investment in California reached $3.3 billion in 2008 alone and it is on track to exceed that in 2010. California attracts 60% of the clean-tech venture capital in the entire U.S, but with the right policies and incentives, California could attract even more investment and create far more jobs in the coming years. Over the next decade, the global clean energy market is expected to nearly triple to nearly $2 trillion annually in 2020.

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Efficiency:

Energy efficiency is the cheapest, fastest, and most reliable way to create jobs, save consumers money and cut pollution from the power sector. It is by far cheaper than the cheapest source of energy and has no negative impact on the environment.

California has led the nation in efficiency standards and programsfflWhen I was Governor, California adopted the first appliance and building efficiency standards in the U.S. As a result of these policies, California's per capita use has remained virtually flat even while the state's economy grew by 80%. During that same time period, the United States' per capita electricity consumption has increased 50%. These standards have saved California more than $56 billion in electricity and natural gas costs since 1978, equivalent to more than $1,000 per household. Savings from energy efficiency also have a multiplier effect that creates far more jobs than comparable investments in fossil fuels or other energy sources.

ffiffl┘├●◘ |ffl♂□─|□ ♬ |♂☼ffl ┼ffl◘┼◁and programs have triggered innovation and creativity in the market◀ ☼●┼ffl♬♂|ffl↕↕┘|ffl □♂|ffl◘┤ ●☼|only more efficient, but they are cheaper and more versatile than ever. Consider refrigerators, the biggest energy user in our homes. Since California adopted efficiency standards in 1978, refrigerators now use one-fourth the energy, are larger and have more convenient features than models 30 years ago, and are about 1/2 the price. The same story can be told for dishwashers, heaters, air conditioning units and other major appliances.

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Throughout our history, California has led the nation in innovation, whether it was the entertainment industry, biotech, green tech or computers. To get California working again, we need to re-focus our efforts on attracting and retaining these innovative industries.

One such industry is clean energy. We need to lead again. California has tremendous potential in renewable energy. Peak electricity demand in California today is 65,000 megawatts (MW), and California has the ability to produce at least 1.3 million MW of renewable energy◀ concentrating solar, wind, solar photovoltaic (PV), small hydro, geothermal, and biomass◀ roughly twenty two times our current electricity capacity. Below is my plan to get us there. It will produce a half a million new jobs in the next decade.

ffi ffl By 2020, California should produce 20,000 new megawatts (MW) of renewable electricity, and also accelerate the development of energy storage capacity. California can do this by aggressively developing renewables at all levels: small, onsite residential and business systems; intermediate-sized energy systems close to existing consumer loads and transmission lines; and large scale wind, solar and geothermal energy systems. At the same time, California should take bold steps to increase energy efficiency.

ffi [illegible]

[illegible]

- ffi California should develop 12,000 megawatts of localized energy by 2020. Localized energy is onsite or small energy systems located close to where energy is consumed that can be constructed quickly (without new transmission lines) and typically without any environmental impact.

- ffi Solar systems of up to 2 megawatts should be installed on the roofs of warehouses, parking lot structures, schools, and other commercial buildings throughout the state.

- ffi Solar energy projects up to 20 megawatts in size should be built on public and private property throughout the state. For example, we should create the California Solar Highway by placing solar panels along the banks of state highways.

- ffi The California Public Utilities Commission (CPUC) or Legislature should implement a system of carefully calibrated renewable power payments (commonly called feed in tariffs) for distributed generation projects up to 20 megawatts in size. Holding down overall rates must be part of the design.

[illegible]

- ffi The Legislature should codify a requirement that 33% [illegible] be derived from renewable sources. This will create market certainty and drive investment in renewable technologies..

- The California Energy Commission (CEC) should prepare a renewable energy plan by July 1, 2011, that will expedite permitting of the highest priority generation and transmission projects.

- Federal and state agencies should carry out one integrated environmental review.

- [illegible] deliver clean energy to market. The permitting time for these projects--which now can take 6 to 8 years--should be dramatically reduced, and in no case be longer than three years.

- As Governor, I will ensure that all agencies involved work together with a sense of urgency to permit the new transmission lines without delay.

[illegible]

- The reliability of our energy system depends on the ability to meet peak [illegible] just a few hours a year, usually on hot summer afternoons. These plants pollute more and are less efficient than other power plants. We also import out of state coal and pay very high prices on the spot market to satisfy peak demand. Energy storage will help reduce the need for peaker plants and imports of out of state coal.

- Renewable power is often intermittent. Neither wind nor solar energy is available 24 hours a day. As a result, renewable energy can be difficult to integrate into the base load of the overall energy delivery system. Energy storage helps smooth out this variability and makes it less costly to integrate renewables into the grid.

- The California Public Utilities Commission and [illegible] municipal utilities should adopt policies and incentives that promote the development of energy storage.

- As Attorney General, I have sponsored legislation that would direct the PUC to establish policies that will encourage the building of energy storage systems. If utilities procure storage equivalent to 5% of their peak load demand, approximately 8,500 permanent new jobs would be created.

[illegible] [illegible]

- A typical home uses much more energy than it needs to operate economically. New buildings can be designed today to use 1/3 to 1/2 less energy than they use today, with little or no cost increase.

- We should establish a plan and a timeline to make new homes and commercial buildings [illegible] highly efficient structures that use onsite renewable energy for all their electricity and natural gas needs.

[illegible] [illegible]

- [illegible] were adopted. Energy consumption in these homes can be reduced by 40% if the CPUC and municipal utilities provide incentives for retrofits and efficiency upgrades.

- Probably the most significant reason people do not make their homes or businesses more efficient is the high up-front costs of major efficiency upgrades, even though they save money in the long run. To overcome this barrier, the State, local governments, and utilities should make available programs whereby businesses and homeowners could take out loans and pay back the costs of efficiency upgrades (and renewable energy projects) through savings on their property tax or utility bills.

- Another reason that people do not invest in efficiency upgrades is that they lack information about the energy use and energy costs of their homes and businesses. Disclosing information about energy performance can be a powerful motivator to improve efficiency. State law requires that, starting in 2011, commercial owners have to disclose energy use to potential buyers. This same program should be extended so that homebuyers receive [illegible]

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ffi The CEC should adopt stronger appliance standards for lighting, consumer electronics and other products. Federal law should be changed to make it easier for California to adopt standards more stringent than federal standards, as we have authority to do for automobile emission standards. For example, a proposed CEC efficiency rule for clothes washers would save enough water for all of San Diego for a year.

ffi We should also increase public education and enforcement efforts so that the gains promised by our efficiency standards are in fact realized.

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ffi Combined heat and power projects (also known as cogeneration) use the excess heat or electricity generated by power plants or industrial facilities. They are much more efficient than traditional power plants and many industrial plants. California currently produces 9,249 MW of combined heat and power. With the right incentives, we can increase this by 6,500 MW over the next 20 years.

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ffi I will designate one person, directly accountable to the governor, who will be responsible for ensuring that all energy jobs goals and deadlines are met.

California Public Utilities Commission

PUC > Energy > Energy Efficiency > EE Strategic Plan > Energy Efficiency Strategic Plan

Energy Efficiency Strategic Plan

On Sept. 18, 2008, the CPUC adopted California's first Long Term Energy Efficiency Strategic Plan, presenting a single roadmap to achieve maximum energy savings across all major groups and sectors in California. This comprehensive Plan for 2009 to 2020 is the state's first integrated framework of goals and strategies for saving energy, covering government, utility, and private sector actions, and holds energy efficiency to its role as the highest priority resource in meeting California's energy needs.

Plans

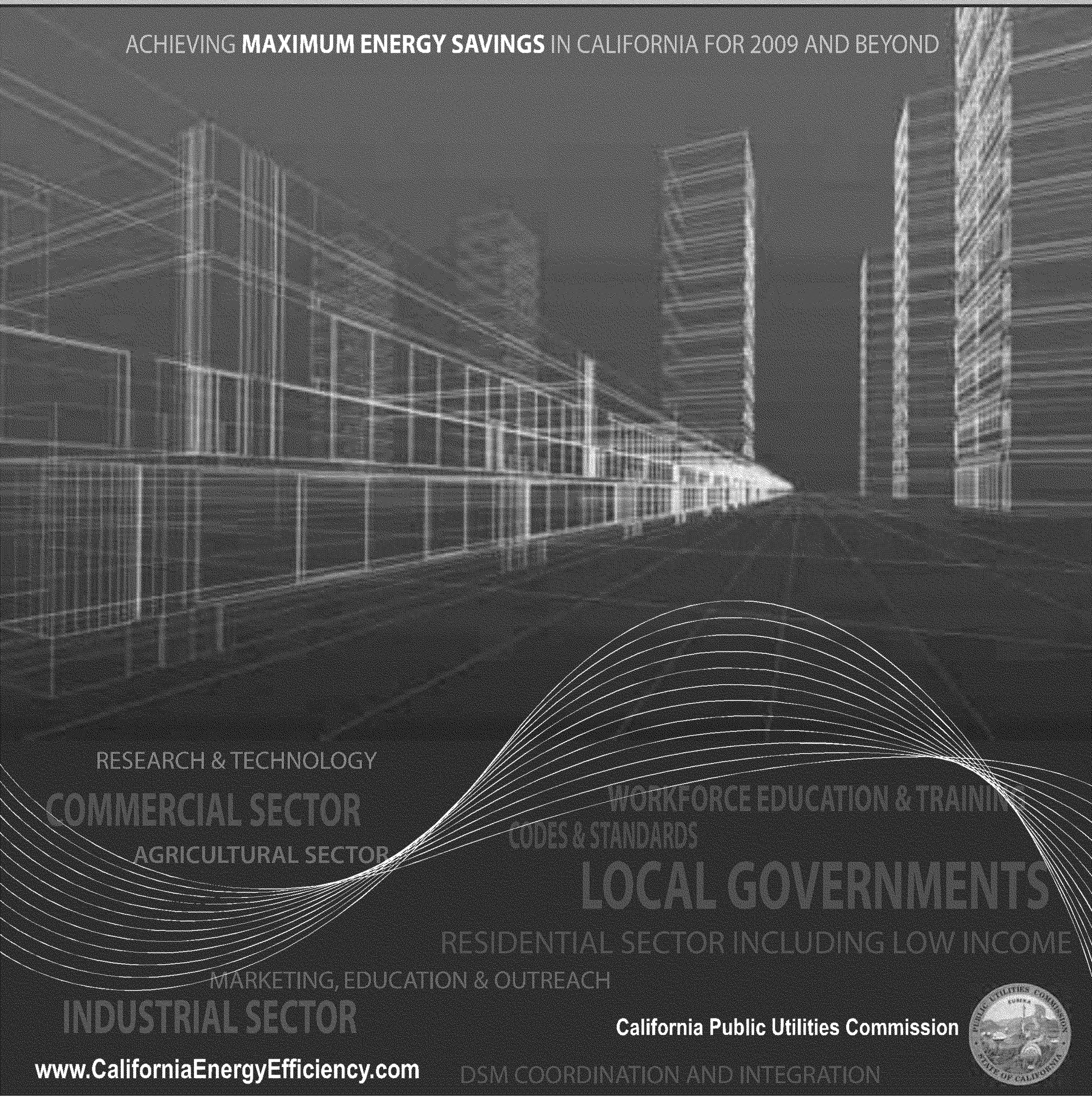
- **Strategic Plan Progress Report - October 2011**
- **Lighting Action Plan:** the near term implementation guide to achieving the goals of the Lighting chapter. Approved in 2010, the chapter includes a target reduction of 60-80% in statewide electrical lighting energy consumption by 2020.
  - Presentation for the June 30, 2011 Meeting
  - Lighting Chapter
- **HVAC Action Plan**
  - Agenda for March 30, 2011 Meeting
  - HVAC Plan Stakeholder Meeting Notes
- **Zero Net Energy Action Plan**
- **Energy Efficiency Strategic Plan - January 2011 Update**
  - Strategic Plan Executive Summary
  - Fact Sheet
- **California's Long Term Energy Efficiency Strategic Plan – September 2008**

Press Releases

- **October 14, 2010:** CPUC Introduces New Statewide Brand and Website to Motivate Consumers to Embrace Clean Energy Solutions as a Way of Life
- **September 23, 2010:** CPUC Adopts Plan to Save 60-80 Percent Lighting Energy Use Statewide
- **September 1, 2010:** CPUC Launches Zero Net Energy Action Plan; Goal of Efficient, Clean Energy Powered Buildings by 2030
- **September 24, 2009:** CPUC establishes energy efficiency programs for 2010 - 2012, making the largest

California long term ENERGY EFFICIENCY STRATEGIC PLAN

ACHIEVING **MAXIMUM ENERGY SAVINGS** IN CALIFORNIA FOR 2009 AND BEYOND



California Public Utilities Commission

www.CaliforniaEnergyEfficiency.com

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In October 2007, the California Public Utilities Commission (CPUC) created a framework to make energy efficiency a way of life in California by refocusing ratepayer-funded energy efficiency programs on achieving long-term savings through structural changes in the way Californians use energy.[1]

The Commission recognized that California's very ambitious energy efficiency and greenhouse gas reduction goals require long-term strategic planning to eliminate persistent market barriers and effect lasting transformation in the market for energy efficiency across the economy. Accordingly, the Commission committed to prepare and adopt a long-term strategic plan for California energy efficiency through 2020 and beyond.

This *Long Term Energy Efficiency Strategic Plan (Plan)* was developed through a collaborative process involving the CPUC's regulated utilities – Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), San Diego Gas & Electric Company (SDG&E) and Southern California Gas Company (SoCalGas) (collectively, "IOUs") – and over 500 individuals and organizations working together over an eleven-month period.[2]

This *Plan* sets forth a roadmap for energy efficiency in California through the year 2020 and beyond. It articulates a long-term vision and goals for each economic sector and identifies specific near-term, mid-term and long-term strategies to assist in achieving those goals.[3]

With broad stakeholder input, the CPUC has continually refined the implementation strategies which are at the heart of this Plan. Every participant in this process recognizes the formidable task that lies ahead. Every participant also recognizes, however, that ever-increasing energy prices and the urgent threat of climate change require that California set the bar high and move forward quickly and purposefully to realize the full extent of efficiency opportunities statewide and achieve deep reductions in energy demand and usage.

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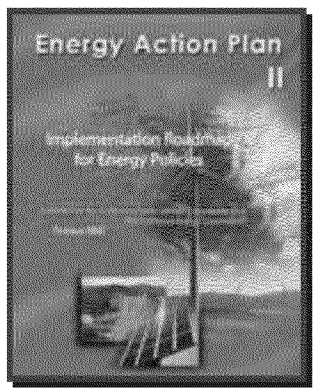
The 2005 CPUC and California Energy Commission's (Energy Commission) Energy Action Plan II,[4] declared:



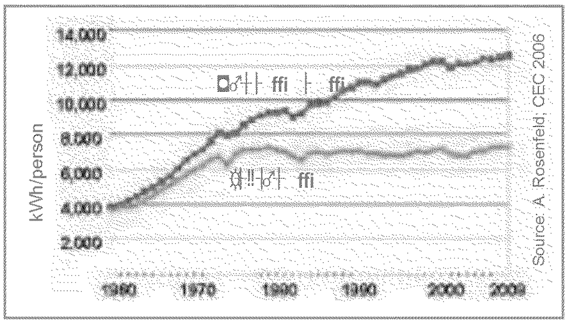
"[The] goal is for California's energy to be adequate, affordable, technologically advanced, and environmentally-sound…[C]ost effective energy efficiency is the resource of first choice for meeting California's energy needs. Energy efficiency is the least cost, most reliable, and most environmentally-sensitive resource, and minimizes our contribution to climate change."

The State's "loading order" – first acknowledged in Energy Action Plan I[5] – identifies energy efficiency as California's top priority resource. Under Public Utilities Code Section 454.5(b)(9)(C) utilities are required to first meet their "unmet resource needs through all available energy efficiency and demand reduction resources that are cost effective, reliable, and feasible."

California has taken this principle to heart and with three decades of leadership and innovation in the public and private sectors, California leads the nation, and perhaps the world, in developing and implementing successful energy efficiency efforts.

As the Energy Commission notes in its 2007 Integrated Energy Policy Report (IEPR)[6]:

"Energy efficiency, which helped to flatten the state's per capita electricity use, will continue to be the keystone of California's energy strategy. California's building and appliance standards have saved consumers more than $56 billion in electricity and natural gas costs since 1978 and averted building 15 large power plants. It is estimated the current standards will save an additional $23 billion by 2013."



Over the years, successive CPUC decisions have created a policy framework to motivate IOUs to develop and continuously expand energy efficiency programs on behalf of their customers. This policy framework is composed of a number of elements including: the State's adopted loading order; aggressive goals set based upon up-to-date potential studies; decoupling of sales from revenues for electric and gas utilities; performance-based incentive mechanisms; and a robust dual funding stream comprised of a public goods charge and procurement funding.

The IOUs' 2006-2008 energy efficiency portfolio marks the single-largest energy efficiency campaign in U.S. history, with a $2 billion investment by California's energy ratepayers. In addition, individual and corporate energy consumers; state and local agencies; and publicly-owned utilities continue to make significant independent investments to increase the efficient use of energy across California.

However, with a growing population, increasing demand for energy, and the pressing need to reduce greenhouse gas (GHG) emissions in a rapid and low-cost manner, there has never been a more important time for energy efficiency in California. California is the second-largest GHG-emitting state in the U.S. and electricity production is the second largest source of carbon emissions in California, accounting for some 32 percent of its total, with gas use in businesses and homes another 9 percent.[7]

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California's success to date has been enabled by a comprehensive policy framework supporting energy efficiency investment. The aggressive scale-up envisioned by this Plan hinges on a steady foundation composed of the following elements:

- ***Clear Policy Direction.*** *The Energy Action Plan* sets forth a bold policy vision establishing efficiency as the California's first priority energy resource. Specific savings goals, tied to supply procurement, implement that policy.
- ***Adequate Financial Incentives and Funding.*** The decoupling of sales from revenues for electric and gas utilities, along-side performance-based incentive mechanisms, address a fundamental bias against efficiency investment. Meanwhile, a public goods charge and procurement funding produce substantial funding resources for such investment.
- ***Robust Program Administration and Oversight.*** In California, efficiency programs are largely administered by utilities utilizing universal contact with homes and businesses throughout the state, while government maintains primary responsibility for program direction and oversight, including program evaluation and the measurement and verification of claimed energy savings.
- ***Firm Ratcheting Standards.*** The establishment of minimum efficiency standards for buildings and appliances that are updated on a regular basis have driven guaranteed progressive energy savings over the past three decades.

Meanwhile California demand for electricity and natural gas continues to grow, with statewide electricity consumption forecast to increase an average of 1.25 percent per year over the next decade.[8] In addition, the State faces rapidly-escalating fuel prices.

The combination of these pressures poses significant economic and social risks to California. As both an emissions-free and low-cost energy resource alternative, energy efficiency is uniquely-poised to play a central role in reconciling the current challenge. This fact is acknowledged in virtually every discussion of GHG abatement opportunities, including McKinsey & Company's comprehensive 2007 review.[9]

Capitalizing on this opportunity in California will require that we make energy efficiency investments an integral part of life and a "business as usual" choice for California market actors.

It will require that we overcome market barriers that have persisted over the course of California's 30-year history with energy efficiency policy, and it will demand the political will to continue making investments during times of economic stress to extend and to capture the full extent of energy efficiency potential obtainable across the State. However, in succeeding, this initiative will bring benefits not only for California but will allow the State to share its energy efficiency leadership, skills and experience in the national and international efforts to combat global warming through energy efficiency.

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The passage of the California Global Warming Solutions Act of 2006 (Assembly Bill 32)[10] has amplified the need for intensive energy efficiency efforts across California. The California Air Resources Board's (CARB) Draft Scoping Plan for Assembly Bill (AB) 32 implementation states that while "California has a long history of success in implementing regulations and programs to encourage energy efficiency… [it] will need to greatly expand those efforts to meet our greenhouse gas emission reduction goals." [11]

The Draft Scoping Plan, which offers preliminary indication of how the State plans to achieve its GHG reduction targets, establishes a statewide energy efficiency target of at least 32,000 gigawatt hours and 800 million therms by 2020.[12] If achieved, emission reductions from these efficiency savings would result in over 25 million metric tons of GHG emissions reductions, making them the second largest component in the State's overall emissions reduction program. The Draft Scoping Plan recognizes this, stating that efficiency provides an emission reduction opportunity for California "on a scale second only to the Pavley regulations."[13]

AB 32 and other pivotal legislation and policy in California — such as the Energy Action Plan II, AB 2021 (establishment of statewide energy efficiency goals), the Low-Income Energy Efficiency statutes, the Governor's Green Building Executive Order[14], and the 2007 IEPR — create an environment where energy efficiency efforts must not only continue to thrive but scale up unprecedented levels.

In July 2008, the CPUC redoubled its own energy savings efforts by establishing new targets for energy savings for the years 2012 through 2020 for its regulated utilities.[15] Within IOU service areas these goals are expected to save over 4,500 megawatts, the equivalent of over 9 major power plants, and over 16,000 GWh of electricity savings and 620 million therms. Combined with recent goal-setting by the State's publicly-owned utilities under AB 2021, these goals provide an aggressive contribution to statewide energy savings targeted under AB 32.

A number of recent policies, such as AB 1109, which requires defined reductions in energy usage for lighting, and the Federal Energy Independence and Security Act of 2007, which contains many provisions for new minimum efficiency standards and research, have dramatically altered the landscape for energy efficiency activities in California.[16] Ensuring the continued effectiveness of public purpose efficiency programs, for instance, will require careful coordination with emerging mandates and market changes.

This *Plan* provides a strategic roadmap for integrating energy efficiency efforts to achieve the aggressive goals the State has set for itself. It aims to bring together key participants beyond the CPUC and the IOUs, including publicly-owned utilities, the financial and building industries, cities and counties, other State agencies, and businesses and consumers, to work together toward common energy efficiency goals. Therefore, the strategies and goals are not restricted by geographical, jurisdictional, regulatory, or political boundaries. To achieve these goals, all actors must work collaboratively over the long-term to fundamentally transform the way Californians use energy at home and at work.

[illegible]

The CPUC's October 2007 decision (D.07-10-032) directed that "a key element of the Strategic Plan would be that it articulates how energy efficiency programs are or will be designed with the goal of transitioning to either the marketplace without ratepayer subsidies, or codes and standards."[17]

The CPUC also stated that the *Plan* would incorporate the market transformation goal described above and "develop milestones to measure progress towards that goal," including the development of a "targeted timeframe for such market transition and the process for tracking progress so that it is clear at what point a program has made a successful transition or conversely, is having problems."[18]

This *Plan* fulfills the Commission's goal by employing market transformation as its unifying objective. The *Plan* seeks to effect substantial and sustained progress towards more efficient technologies and practices in each of the customer end use sectors (e.g., Commercial, Industrial, Residential, Agricultural). Likewise, the *Plan* describes the market transformation efforts necessary in each of the cross-cutting areas discussed (e.g., Codes and Standards, Workforce Education and Training, Marketing Education and Outreach, and Research and Technology)

As early as 1998, the Commission defined market transformation as:

"Long-lasting sustainable changes in the structure or functioning of a market achieved by reducing barriers to the adoption of energy efficiency measures to the point where further publicly-funded intervention is no longer appropriate in that specific market."[19]

In theory, ratepayer-funded efficiency programs over the past thirty years have been designed either to encourage suppliers and manufacturers to sell efficiency products or services to "push" the market, or to encourage consumers to buy these products or services to "pull" the market. Typical utility rebate programs aim to increase the market penetration of energy-efficient products along a continuum until market acceptance reached sufficient levels for the measure to be incorporated into codes and standards or used in the marketplace without ratepayer subsidies.

In practice, however, utility programs in California have naturally tended towards measures which produce readily-quantified, low-cost, near-term savings which offer the opportunity to "buy" load reduction in easy, well-packaged measures with limited market impacts. There has been little incentive for utilities to engage in measures with a longer-term orientation – those very measures which produce meaningful market transformation.

This *Plan* seeks to move utilities, the CPUC, and other stakeholders beyond a focus on short-term energy efficiency activities into a more sustained long-term, market transformation strategic focus.

By re-emphasizing the market transformation goal, we do not discount the benefits of short-term measures for energy savings. Utility portfolios must contain an appropriate mix of short and longer term energy savings. However, short-term programs such as the replacement of incandescent light bulbs with compact fluorescent light bulbs must be accompanied by solutions which focus on multi-year and holistic lighting system strategies, improved conservation actions, and other means of market transformation.

Additionally, the *Plan* recognizes that the process of market transformation cannot and should not be driven by ratepayer-funded utility programs alone. While utilities will play a continued role in stimulating market transformation across sectors, each of the cross-cutting areas described in this *Plan* represents an avenue where non-utility actors may well be better positioned to drive the "push" of new technologies to market, or the "pull" for customers and business to adopt available efficiency technologies or practices.

Transformation is an evolutionary process, as markets for a given end-use are not transformed just once, but continuously. Understanding when a technology promoted in utility programs has become established within the mainstream market or incorporated into codes and standards will help target when new programs are needed to encourage the next generation of energy efficiency technologies. Decision 07-10-032 recognized this in directing the utilities' proposed 2009-2011 portfolios to identify "an 'end game' for each technology or practice that transforms building, purchasing, and the use decisions to become either 'standard practice', or incorporated into minimum codes and standards."[20]

It is necessary to develop appropriate rules, metrics, and guidelines for determining when market-transformation has occurred and publicly-funded intervention is no longer appropriate, so as to define an end-point for strategies and set the course for new programs and goals. A key priority for the first update of this *Plan* will be the development of end-point definitions, rules, and progress metrics. The *Plan*'s content, however, is oriented towards charting a programmatic course that embraces the goals and strategies of market transformation by seeking to achieve significant transformative progress in all sectors by 2020 or earlier.[21]

The CPUC also recognizes its responsibility to examine changes to the policy rules on counting savings from IOU programs to attribute gains from market transformation and long-term strategies resulting from IOU actions. In order to ensure utilities are motivated to devote portfolio dollars towards market transformation measures, associated savings must be fairly accounted for in attribution methodologies.

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The market transformation strategies covered in the Plan are built upon one or more of the following policy tools employed to "push" or "pull" more efficient products or practices to market:

- ***Customer Incentives*** including rebates; innovative or discounted financing; and/or non-financial support to consumers are the "carrots" that help *pull* consumers into choosing the efficient option.
- ***Codes and Standards*** which mandate minimum efficiency thresholds for buildings, appliances and/or equipment, removing the less efficient choices from the marketplace are the "sticks" that *push* builders and manufacturers to provide efficient goods and services.
- ***Education and Information*** through marketing, education and outreach inform market actors about energy efficiency opportunities. These programs often include labeling; benchmarking; internet-based comparisons; professional and trade materials; school curricula; peer-to-peer exchanges; and other resources.
- ***Technical Assistance*** helps to ensure that knowledge barriers on the part of customers, installers or retailers are not unnecessarily hampering the progress of critical efficiency initiatives.
- ***Emerging Technologies*** rely on research, development, demonstration and/or deployment to move energy-efficient products and developments from the laboratory into the commercial marketplace.

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Decision 07-10-032 outlined the key goals, content, and development process for this *Plan*. During November and December 2007 and January 2008, working groups for four "vertical" market sectors — residential, including low-income, commercial, industrial, and agricultural — and seven cross-cutting areas — Heating, Ventilation and Air Conditioning (HVAC) systems; Demand Side Management (DSM) Coordination and Integration; Workforce Education and Training (WET); Marketing Education and Outreach (ME&O); Research and Technology; Codes and Standards; and Local Governments — held 36 public stakeholder workshops.

The objective of these workshops was to facilitate information exchange and develop an action plan for each market sector and each cross-cutting sector. In January 2008, these plans ("Convener Reports") were provided to the IOUs to inform their strategic planning efforts.

Throughout this process, the CPUC acted as a centralized information hub via a specially built webportal, disseminating team updates and reports and providing models for teams to look to in recording their findings.

As required by the CPUC, the IOUs filed a draft *Plan* on February 8, 2008. On March 6, 2008, the IOUs filed a revised draft *Plan*, supplementing the February draft pursuant to Commission direction. Three stakeholder workshops were then held in San Diego, Los Angeles, and San Francisco.[22]

All public comments, workshop transcripts, IOU and CPUC staff materials, and convener reports have been archived and are available on the strategic planning website: www.californiaenergyefficiency.com.

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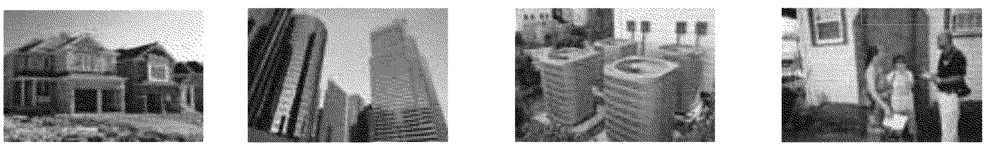

In order to guide market transformation in a number of key sectors, this Plan embraces four specific programmatic goals, known as the "Big Bold Energy Efficiency Strategies," established by the CPUC in D.07-10-032 and D.07-12-051.These goals were selected not only for their potential impact, but also for their easy comprehension and their ability to galvanize market players.

1. All new residential construction in California will be zero net energy by 2020;
2. All new commercial construction in California will be zero net energy by 2030;
3. Heating, Ventilation and Air Conditioning (HVAC) will be transformed to ensure that its energy performance is optimal for California's climate; and
4. All eligible low-income customers will be given the opportunity to participate in the low income energy efficiency program by 2020.

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Two limitations to this 2008 *Plan* should be noted:

- Because it is the initial plan—and due to time and other constraints—this *Plan* has not undergone cost-benefit analysis. However, the efficiency activities envisioned in this *Plan* subject to the Commission's jurisdiction will only be funded by ratepayers as part of cost-effective portfolios. Similarly, the strategies and actions have not been fully evaluated for prioritization or for budget and resource-allocation decisions. Accordingly, the strategies and actions described in this *Plan* will be updated as conditions change and new experience and information is obtained.
- This *Plan* does not specifically address three important elements of energy efficiency. These are the evaluation and measurement and verification of energy savings; transportation; and the water-energy "nexus." The reasons for these exclusions are two-fold: first, there was no specific input provided by the working groups on these topics; and, second, various State agencies are covering these issues in separate processes. Future strategic planning cycles are likely to address these issues.

Many of the strategies in the *Plan* do not require changes in State or Federal law or the regulations of various agencies. Specifically, most of the activities to be implemented in the near term (approximately 2009-2011) are expected to be feasible under current law and the rules of the CPUC and other agencies. However, there are longer term elements of the *Plan* for which changes in law and/or agency rules and policies would be useful—or even essential—to achieve the desired cost-effective energy efficiency over the 2009-2020 period.

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This *Plan* is a dynamic document that will be regularly updated to reflect past successes, failures, and lessons learned and to adjust the visions, goals and strategies accordingly. Given the urgency of the need to achieve the AB 32 goals, it is necessary to quickly and efficiently complete foundational activities such as studies, data collection and pilot programs and to move just as quickly to implement actual programs and deliver real results in the near term.

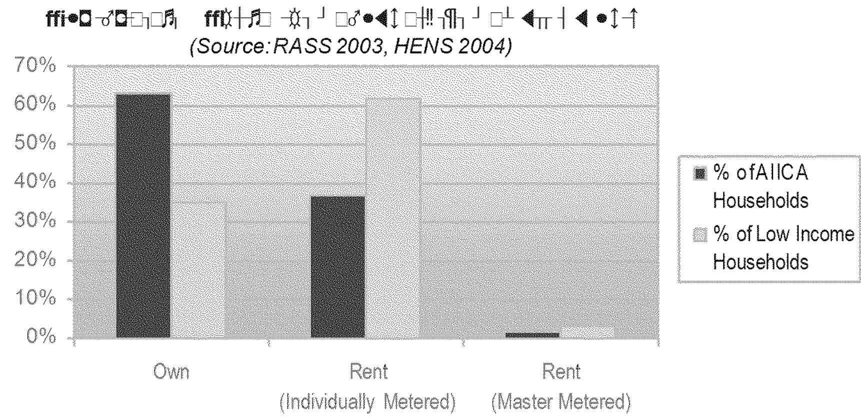
The process that started during the fall of 2007 was a tremendous and highly productive effort by the utilities, CPUC, and the Energy Commission working with a large number of stakeholders from all sectors of the California economy. This process must continue in order to continue the momentum and build the sustained velocity needed to achieve the goals expressed in this *Plan*.

In the short term, this process will be advanced through the establishment of goal and/or strategy-specific task forces, to be coordinated by the CPUC. Over the longer term, there is widespread stakeholder support for coordination at a statewide level by an entity with a membership and mandate better suited to the multi-jurisdictional scope of the strategies articulated in this *Plan*. Such an entity would build on the collaboration initiated by the strategic planning process thus far and allow for enhanced participation by all stakeholders.

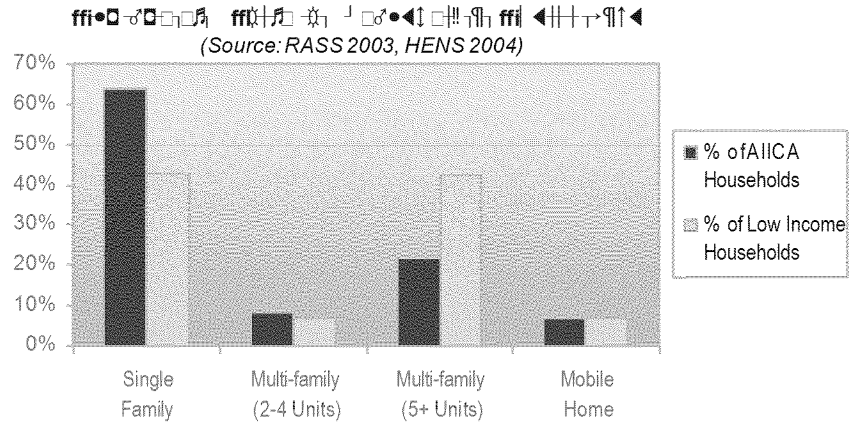
The next planning cycle will include:

- Incorporating data collection efforts, including market assessment and market potential studies, more directly in this and other planning processes, such as the Energy Commission's IEPR and the utilities' long-term procurement planning processes.
- Aligning this planning effort with related statewide long-term resource plans, such as those associated with water, land use, and greenhouse gas mitigation.
- Evaluating performance with respect to the goals and strategies established in the current *Plan*, and market transformation criteria in particular.
- Engaging even more key stakeholders prior to initiating the planning cycle and cooperatively developing roles and a process that increases information exchange and participation of these stakeholders. Conducting more widespread public workshops to enable these stakeholders to provide planning input and to vet planning documents.
- Central to this expanded process will be participation by additional State agencies, which may wish to co-sponsor various task forces—for example, in Workforce Education and Training or the Agricultural Sector -- and obtaining commitments from key participants willing to fund, lead, or implement strategies.

Residential energy use will be transformed to ultra-high levels of energy efficiency resulting in Zero Net Energy new buildings by 2020. All cost-effective potential for energy efficiency, demand response and clean energy production will be routinely realized for all dwellings on a fully integrated, site-specific basis.



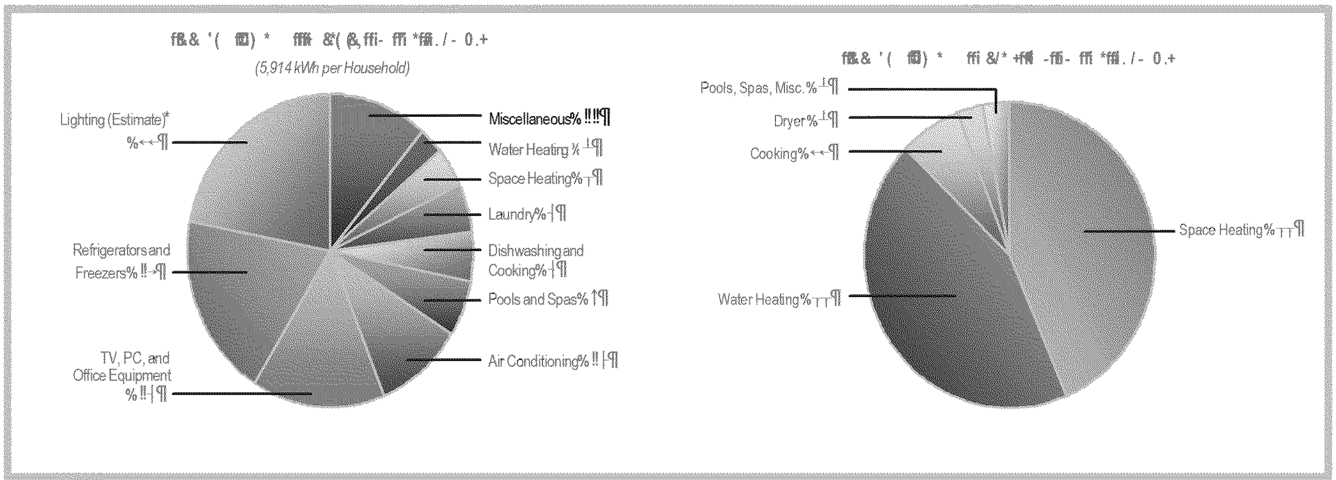
In 2008, energy demand for California's 12.6 million households was over 25,000 MW. The residential sector represents approximately 32% of total state electricity consumption and 36% of its total natural gas consumption. Electricity demand is expected to grow to almost 31,000 MW by 2018.[23]



Approximately one-third of all households live in multi-family structures, and two-thirds in single family homes. The balance of renters to homeowners is about 42% to 58%, respectively. Most or all of these households qualify for utility energy efficiency programs targeting residential customers.[24] About one-third (approximately 4 million) of these households qualify for additional low income energy efficiency (LIEE) programs extended to households with annual incomes less than or equal to 200% of Federal Poverty Guidelines.[25]

Pursuant to a legislative mandate to reduce energy usage in California, the Energy Commission adopted California's Appliance Efficiency Regulations in 1976 (Title 20) and Part 6 of Title 24 of the California Code of Regulations, the Energy Efficiency Standards for Residential and Nonresidential Buildings in 1978, (Title 24).[26] The Title 24 standards are updated triennially to incorporate new energy efficiency technologies and methods. The Title 20 standards are updated more frequently.

The utilities have responded to the diverse needs of California's residential sector by offering a wide range of energy efficiency programs that impact every level of the residential market, including rebates for efficient products, such as lighting, air conditioners, and refrigerators; training and education to architects, engineers, building managers and building inspectors; and work to enhance the Energy Commission's building and appliance codes and standards. The utilities also have introduced a number of innovative whole-house or community-wide programs such as the SCE Sustainable Communities program which targets new residential developments and the Design for Comfort Program that provides efficiency assistance to affordable housing developments that are undergoing renovation.



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Over the past two utility program cycles (2004/2005 and 2006/2008), the utilities have focused heavily on residential lighting, which accounts for the largest electricity end use in the residential sector. As a result, the bulk of residential efficiency savings has come from lighting programs such as measures that encourage the use of compact fluorescent light (CFL) bulbs. In the past few years, the CFL market has undergone a major transformation, as evidenced by the ubiquity of CFL products in the retail market and recent energy measurement and verification studies.

A major transformation of the lighting market will be completed through the passage and implementation of AB 1109, the 2007 California Lighting Efficiency and Toxics Reduction Act.[27] AB 1109 requires a 50% increase in efficiency for residential general service lighting by 2018 through phased increases in the Energy Commission's Title 20 regulations, with the first phase of the standards taking effect by January 1, 2010.[28] These changes in the lighting market provide will allow opportunities to redirect utilities' residential energy efficiency resources towards new lighting technologies and other innovative programs focused on whole-building efficiency measures.

Likewise, the strategies set forth in this *Plan* will create longer-term savings from the built environment with a goal of continual incorporation of advances into codes and standards or the private marketplace. The 2009-2011 IOU program cycle will lay the foundation for aggressive, long-term strategies to change the way residential buildings are constructed, used and maintained.

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1. New construction will reach "zero net energy" (ZNE) performance (including clean, onsite distributed generation) for all new single and multi-family homes by 2020.	***	By 2011, 50% of new homes will surpass 2005 Title 24 standards by 35%; 10% will surpass 2005 Title 24 standards by 55%. By 2015, 90% will surpass 2005 Title 24 standards by 35%. By 2020, all new homes are ZNE.
2. Home buyers, owners and renovators will implement a whole-house approach to energy consumption that will guide their purchase and use of existing and new homes, home equipment (e.g., HVAC systems), household appliances, lighting, and "plug load" amenities.	***	Energy consumption in existing homes will be reduced by 20% by 2015 and 40% by 2020 through universal demand for highly efficient homes and products.
3. Plug loads will be managed by developing consumer electronics and appliances that use less energy and provide tools to enable customers to understand and manage their energy demand.	***	Plug loads will grow at a slower rate and then decline through technological innovation spurred by market transformation and customer demand for energy efficient products.
4. The residential lighting industry will undergo substantial transformation through the deployment of high-efficiency and high-performance lighting technologies, supported by state and national codes and standards.	***	Utilities will begin to phase traditional mass market CFL bulb promotions and giveaways out of program portfolios and shift focus toward new lighting technologies and other innovative programs that focus on lasting energy savings and improved consumer uptake.

Transformation of markets for new multi-family homes can be achieved through strategies targeting the Commercial or Residential sectors or a combination of both, since rental buildings are commercial enterprises as well as dwelling units. In this first *Plan,* with the exception of the approximately 50 percent of LIEE-eligible households living in multi-family housing, there is no specific focus on strategies to upgrade efficiency in existing multi-family dwellings. This is a recognized shortcoming and strategies for this market must be addressed in greater detail in the next iteration of this *Plan*.

The leadership and active participation of many organizations are also necessary to achieve the vision for the residential sector. The Energy Commission must continue to lead the efforts to continually enhance and expand the building and appliance codes with active technical support and expertise from the IOUs, national laboratories, and the building industry.

In addition, the United States Department of Energy (DOE) and the United States Environmental Protection Agency (EPA) play critical roles in residential energy efficiency efforts. Moreover, significant attention must be directed towards manufactured (or "prefabricated") housing, a substantial and growing component within new housing stock, which is built under federal code set by the United States Department of Housing and Urban Development.

Extensive R&D efforts and partnership programs will push the market further. For technological advances in buildings, appliances and plug loads, the IOU's Emerging Technologies program and the Energy Commission's ratepayer-funded Public Interest Energy Research (PIER) program must work cooperatively with the national laboratories and private industry to achieve the advances envisioned in this *Plan*.

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The market transformation envisioned by the residential sector *Vision and Goals* involves changing both the supply chain of products and services and the behaviors that residential energy consumers rely on to use energy efficiently. The four interrelated residential Goals are designed to achieve this transformation through the following themes:

└┐ |←◘– ♂ □–: Drive continual advances in technologies in the building envelope, including building materials and systems, construction methods, distributed generation, advanced metering infrastructure, and building design, and incorporate technology advances into codes and standards.

|┐ ♬ !☼┼☼ "–☼◄ ●– –": Develop, offer and promote comprehensive solutions for single and multi-family buildings, including energy efficiency measures, demand management tools and real-time information, and clean distributed generation options in order to maximize economic decision-making and energy savings.

↕┐ ←" ♬☼!┐‼☼♬ □ ◘: Create high levels of customer demand for progressively more efficient homes through a coordinated statewide public education campaign and targeted incentive programs.

¶┐◄ □☼#◘☼◄ ●– –": Coordinate and collaborate with State agencies and private organizations to advance research and development and to align State efforts on buildings.

┴┐– □ ┤–: Work with the financial community to develop innovative and affordable financing options for energy efficient buildings and retrofits.

↑┐ ◘☼"┐□ ◘◄ □ ◘□!◘": Adopt aggressive and progressive minimum energy codes and standards for buildings and plug loads, effective code compliance and enforcement, and parallel, tiered voluntary energy efficiency standards that pull the market along and set a higher bar for subsequent standards.

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While the overall mission for the residential sector is ambitious, these goals and strategies are interrelated and many of the efforts to reach one goal will contribute to the achievement of a different goal; for example, success in Goal 3 (Plug Load) will contribute to the success of Goal 1 (ZNE Homes) and Goal 2 (Whole House Performance). Improvements in building standards resulting from improvements in technologies (Goal 1) will promote efficiencies from existing home renovations and improvements (Goal 2).

Certain strategies in the residential market (e.g., marketing, education and outreach) are part of larger, cross-cutting strategies. As a consequence, the strategies described below contain a certain amount of repetition and cross-referencing; however, each strategy will require refinements to accomplish the specific goal for target markets. This is consistent with our overall goal of encouraging integrated energy efficiency programs that recognize and leverage the benefits of related projects, while at the same time aligning specific strategies with the requirement of each goal.

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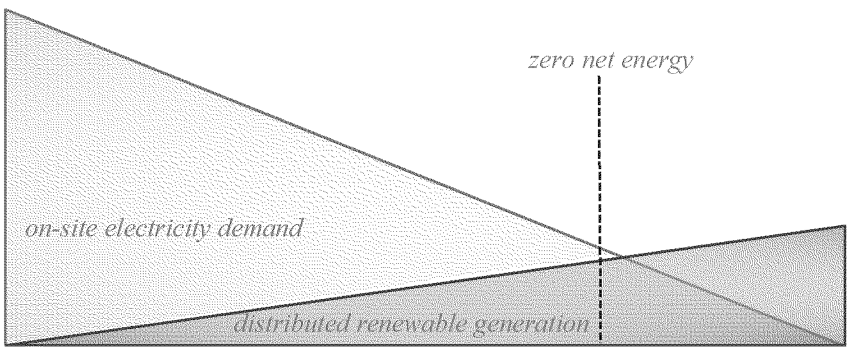
Goal 1 envisions a continual and dramatic increase in the demand for and supply of lower energy homes based on new technologies, new building principles, and policy support to achieve a statewide standard of zero net energy (ZNE) for all new homes built in 2020.

A ZNE home employs a combination of energy efficiency design features, efficient appliances, clean distributed generation, and advanced energy management systems to result in no net purchases of energy from the grid. The CPUC has defined "Zero Net Energy" at the level of a single "project" seeking development entitlements and building code permits in order to enable a wider range of technologies to be considered and deployed, including district heating and cooling systems and/or small-scale renewable energy projects that serve more than one home or business.

A wide range of design features may be considered to achieve zero net energy, including building orientation (relative to the daily and seasonal position of the sun), window and door type and placement, insulation type and values of the building elements, weatherization, the efficiency of heating, cooling, lighting and other equipment, as well as local climate.

Heating and cooling loads are lowered by using high-efficiency equipment, added insulation, high-efficiency windows, in addition to passive solar and other design elements; water heating loads can be alleviated by using heat recovery units and high-efficiency water heating equipment; lighting energy needs are reduced by daylighting and fluorescent and LED fixtures; while plug loads are managed by efficient appliances and minimized standby power.

Zero net energy is a general term applied to a building with a net energy consumption of zero over a typical year. To cope with fluctuations in demand, zero energy buildings are typically envisioned as connected to the grid, exporting electricity to the grid when there is a surplus, and drawing electricity when not enough electricity is being produced.



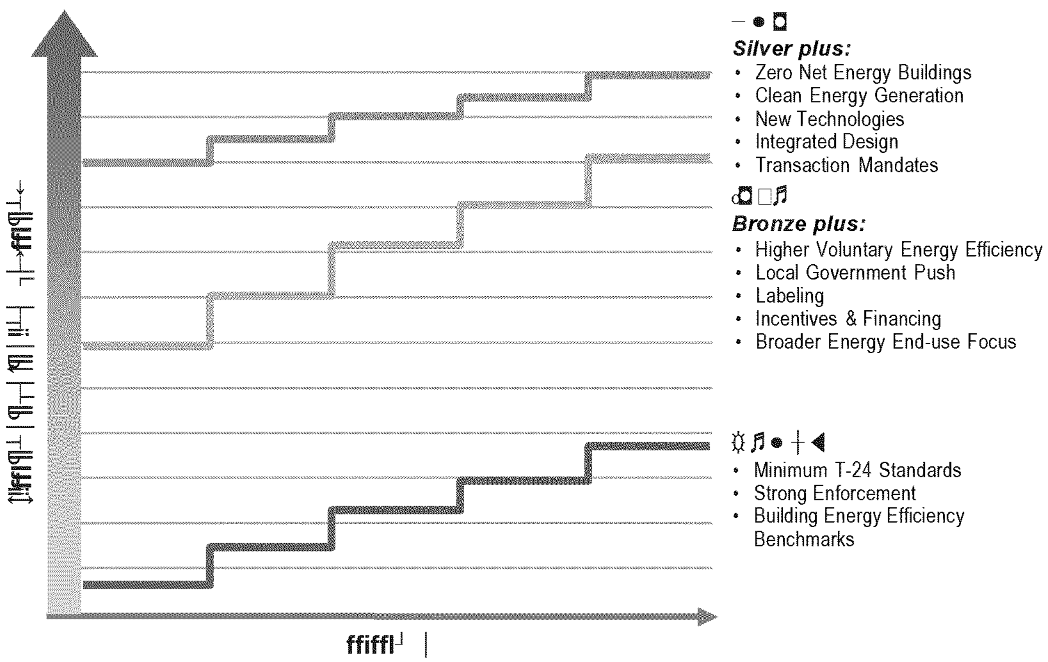
- The amount of energy provided by on-site renewable energy sources is equal to the amount of energy used by the building.
- A ZNE building may also consider embodied energy – the quantity of energy required to manufacture and supply to the point of use, the materials utilized for its building.[29]

Interim milestones for this programmatic goal are that by 2011, 50% of new homes will be 35% more efficient than 2005 Title 24 standards (coincident with the Energy Commission's Tier II standard for incentives under the New Solar Homes Partnership[30]) and 10% will be 55% more efficient; and that by 2015, 90% of homes will surpass 2005 Title 24 standards by 35%.

The "Big / Bold" goal of achieving ZNE for 100% of new residential construction and the supporting interim goals are extremely aggressive. Accordingly, we characterize them in this first *Plan* as "reach" and "programmatic" goals. They are intended to capture the imagination and spark the enthusiasm of all who participate in transforming residential new construction to ultra-high levels of energy efficiency.

As part of this effort, California will establish a "Path to Zero" campaign sponsored by the CPUC, State agencies, utilities, the building industry, and others. This campaign will feature real-world experience and data on emerging technologies, practices, and designs that deliver zero net and ultra-low energy buildings, alongside mechanisms to demonstrate their effectiveness and create demand in the marketplace for high-performance buildings coordinated with marketing tactics and financial incentives. A first step will be convening a task force of key stakeholders committed to zero net energy buildings.

California's Title 24 should continue to be progressively updated and tightened on a triennial basis along a planned trajectory leading to achievement of goals for the year 2020. Mandatory standards of Title 24 should be linked to one or two tiers of voluntary, beyond-code standards such that the single mandatory and one or two voluntary levels comprise a bronze-silver-gold approach to residential efficiency performance. Each Title 24 Code update will achieve a stepped pattern of tightening standards toward what had been the higher voluntary level, dropping the previous minimum mandatory (i.e., 2011's gold becomes 2014's silver and 2017's minimum mandatory). These voluntary silver-gold tiers could be used as reference points for "reach" building policies and programs, local ordinances, and utility incentives.



In July 2008, California's Building Standards Commission (BSC) adopted a first-ever set of Green Building Standards that apply to commercial and residential construction statewide.[31] The standards will take effect on a voluntary basis in 2009, and will likely be adopted as mandatory standards by 2012. In addition, in August, the City and County of San Francisco adopted a Green Building ordinance requiring newly constructed commercial buildings over 5,000 sq ft, residential buildings over 75 feet in height, and renovations on buildings over 25,000 sq ft to meet the United States Green Building Council's Leadership in Energy and Environmental Design standards (LEED) and other green building certifications.[32] Similarly, the City of Los Angeles enacted its own Green Building Ordinance in April 2008, which takes affect later in 2008 and 2009. It establishes a series of requirements and incentives for developers to meet LEED standards and is expected to affect at least 7.5 million square feet each year.[33]

The emergence of sustainable building policies and ordinances are an indication that many local governments desire building practices that go beyond State minimum building codes. As more local governments enact codes that are more stringent than State codes, a patchwork of different and potentially conflicting building requirements is arising. As requirements become more varied across geography, developers and particularly production home builders may have difficulty designing and building major developments consistent with both State and local codes.

Accordingly, Strategy 2 requires coordination of local government building codes and development policies to facilitate common approaches to the adoption and rapid evolution of highly energy efficient technologies and techniques in new construction statewide. Coordination also will advance testing of sustainable building technologies and techniques in different operating environments to provide a stronger basis for progressive increases in the stringency and coverage of energy efficiency standards within State building codes.

The Energy Commission is the logical candidate to lead the codes and standards effort along with the BSC and the Department of Housing and Community Development. Near-term, the Energy Commission could collaborate with these agencies to publish a provisional, performance-based "reach code" reference standard for "beyond code" residential construction in California. This would be advisory and create a reference from which to gauge further improvements.

The process could coordinate with the Energy Commission's Public Interest Energy Research (PIER) and other research organizations (Lawrence Berkeley National Laboratory (LBNL), National Renewable Energy Laboratory (NREL), Building Industry Research Alliance (BIRA) to assess and provide the foundation for recommendations, including monitoring and measurement approaches.

This Goal also requires a major transformation in the construction, design and usage of residences through a combination of mandates and voluntary actions. The technical feasibility of ZNE homes is in early stages of demonstration through the pioneering efforts of the Sacramento Municipal Utility District (SMUD), NREL, and home designers and builders. DOE's Building America effort, for instance, has put ZNE research to work in homes across 34 states. These demonstrations also provide a forum for continual research on optimizing performance of homes with ZNE elements.

Several ZNE residential projects, such as SMUD's project in Roseville, CA, are already underway and others are in the planning or conceptual phase. In the near term, the utilities will aggressively promote additional proof of concept pilots, including affordable housing elements in these pilots.

Significant additional resources will be required to scale these efforts up to for full-scale production and sale at affordable prices. In an effort to marshal private, public, academic, corporate, and entrepreneurial resources towards this objective, a prominent philanthropy organization will soon announce an Energy Free Home Challenge: to achieve net zero energy at net zero cost. Launching in fall 2008, the prize will award $20 million in cash prizes both for enabling technology innovation and whole-home innovation.

California will need new, cost-effective technologies for home building materials and fabrication techniques, and "smarter" home operating systems, such as visual displays of real-time (or near real-time) energy use. In addition, the energy efficiencies of household equipment and appliances must increase. (In this regard, see Strategies 2 and 3 below and the Heating, Ventilation & Air Conditioning Chapter.) These innovations must be accompanied by a strong education, outreach and marketing effort to increase consumer demand for efficient homes, including the use of energy or carbon benchmarks and labels.

Affordability is a key consideration in California, where the cost of housing is a serious, long-term issue.[34] A key element of this Goal is to develop ZNE example homes across the spectrum of housing options, including multi-family affordable housing in urban infill areas with access to public transportation.

Finally, innovative financing solutions, such as loans that remain with the property through owner-occupant turnover and energy efficient mortgages, will be essential in allowing builders and owners to leverage the cost-savings inherent in ZNE buildings into investment costs. Furthermore, finance mechanisms must fully reflect the savings in monthly operating costs from low energy homes. New programs must leverage and build upon financing options available from private markets and other government initiatives. To this end, the CPUC will establish a Finance Task Force for the commercial and residential sectors made up of members of the financial/investment industries; building and developer community; and, State, Federal and local governments to identify existing and additional needed tools, instruments, and information necessary to attract greater participation of capital markets in funding efficiency transactions. The Task Force will identify actors to develop innovative and effective financing tools especially suited for ZNE and ultra low-energy buildings.

[illegible] Zero Net Energy Homes

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[illegible] Drive continual advances in technologies in the building envelope, including building materials and systems, construction methods, distributed generation, and building design.	Energy Commission (PIER) Utilities DOE, national labs Production home builders and building industry organizations	• 50% of new homes exceed 2005 Title 24 standards by 35% • 10% of new homes exceed 2005 Title 24 standards by 55%	• 90% of new homes exceed Title 24 by 35% • 40% of new homes exceed Title 24 by 55%	• 100% of new homes exceed Title 24 by 35% • 90% of new homes exceed Title 24 by 55%
		• Develop and participate in pilot projects in specific climates to prove technologies for next generation of lower and zero energy homes, including affordable housing projects. • Continually monitor performance of pilot projects to provide feedback for next level of design and development of technologies.	• Develop and implement next generation of pilot projects; continually monitor performance of pilots to provide feedback for next level of design and development of technologies.	• Develop and implement next generation of pilot projects; continually monitor performance of pilots to provide feedback for next level of design and development of technologies.

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		ffi Advance technological innovation through collaboration of Energy Commission PIER and Emerging Technologies Programs, LBNL, NREL, Utilities, CBIA, and other appropriate organizations.	ffi Ongoing	ffi Ongoing
		ffi Assess existing technologies and identify areas for strategic involvement in research and development.	ffi Ongoing	ffi Ongoing
Continual coordination and cooperation between the Energy Commission and others to progressively increase Title 24 building standards and Title 20 appliance standards consistent with the interim and long-term goals set forth in this Plan. ff	Energy Commission Utilities Local governments California Building Standards Commission	ffi Map a trajectory for Title 24 mandatory and voluntary standard(s) through 2020. ffi Progressively make energy efficiency advances permanent by raising Title 24 mandatory standards in 2011 consistent with the trajectory. ffi Progressively advance Title 24 voluntary, "beyond code" standard(s) and ratings systems in step with changes to the mandatory standards.	ffi Fine-tune and revise the trajectory based on the changing energy efficiency state-of-the-art. ffi Progressively make energy efficiency advances permanent by raising Title 24 mandatory standards in 2014 consistent with the trajectory. ffi Progressively advance Title 24 voluntary, "beyond code" standard(s) in step with mandatory standards in 2011 and 2014.	ffi Fine-tune and revise the trajectory based on the changing energy efficiency state-of-the-art. ffi Progressively make energy efficiency advances permanent by raising Title 24 mandatory standards in 2017 and to ZNE by 2020 consistent with the trajectory. ffi Progressively advance Title 24 voluntary, "beyond code" standard(s) in step with mandatory standards in 2017 and 2020.
% Coordinate and Support "Reach" Building Standards	Energy Commission Utilities Local governments California Building Standards Commission Building Industry	ffi Identify and resolve conflicts or inconsistencies between Title 24 and local "green" building ordinances or other standards. ffi Establish policies and procedures for statewide coordination of local building standards that are acceptable to local governments. ffi Provide technical support for the development and implementation of reach standards through partnerships with local governments.	ffi Monitor success of coordination and resolve new issues as they arise.	ffi Monitor success of coordination and resolve new issues as they arise.

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Develop innovative financing programs for the construction of energy efficient homes.	Finance Task Force Financial institutions Building Industry Utilities	Convene a task force of financial experts to develop attractive financial products for energy efficiency homes. Implement Options	Ongoing expansion of these options.	Ongoing expansion of these options.
: Encourage local, regional, and statewide leadership groups to support pilots and foster communication among pioneering homeowners and builders.	Local Governments Homeowner groups Leading Builders Utilities	Develop network of building owners (home-owners associations) and builders to help support the dissemination of information and develop peer-to-peer relationships.	Ongoing	Ongoing

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The overall objective of Goal 2 is to reach all existing homes and maximize their energy efficiency potential through delivery of a comprehensive package of cost-effective, whole-house energy efficiency retrofit measures—including building shell upgrades, high-efficiency HVAC units, and emerging deep energy reduction initiatives— with comprehensive audits, installation services and attractive financing. This can be achieved through parallel and coordinated initiatives among utility programs, private market actors, and State and local government policies.

The IOUs currently offer a wide range of energy efficiency programs for existing homes, including audits, efficient appliance rebates, and consumer education. This Plan envisions a refocusing of these programs to move from a "widget" based approach to a "whole house" approach to program delivery to offer comprehensive packages of audits, demand side management options and tools, rebates and financing options, and installation services.

A similar approach must be developed for multi-family housing, both condominiums and rentals. The key to this effort will be defining workable financing mechanisms that allow energy bill savings from improvements occurring in the individual units to offset the up-front capital costs typically paid by building owners and homeowners associations. These mechanisms also must allow repayment of energy improvements from successor occupants so that turnover does not dissuade taking action. With such financing mechanisms, it should be possible for multi-family housing to take fuller advantage of both private energy services and utility programs and incentives. Since many lower-income households live in multi-family housing, they can be served via the strategies targeting low income households discussed later in this Chapter.

It is also essential that market actors, once aware of efficiency opportunities at hand, have access to suitable financing mechanisms for whole-house measures. The Finance Task Force referenced in the ZNE discussion above, will focus on effective financing tools especially suited for whole-house retrofit measures.

While many residential building retrofit measures have unacceptably long customer payback periods based on energy prices alone, they can find market acceptance and leverage private sector investment based on attributes other than energy savings (e.g. comfort and noise reduction). Financing mechanisms for whole-house measures will also improve customer affordability and thus may increase market acceptance. In the future, the increased value of GHG reductions may also improve the economics of such measures. These issues should be considered in updating the methodology for calculating program or portfolio cost-effectiveness.

A key driver for the success of this Goal is to create market demand for efficient homes by increasing awareness of, and information on, energy efficiency. In the near term, the Energy Commission will adopt its Home Energy Rating System (HERS) standards for existing homes by the end of 2008. In cooperation with the Energy Commission, the IOUs will begin voluntary pilot programs to implement the HERS system and to encourage local governments to adopt residential energy conservation ordinances for energy ratings at the time of sale. In the longer-term, additional mechanisms might include community initiatives to reduce the "carbon footprint" of homes or neighborhoods, or promoting inclusion of home energy ratings in real estate sales listing information.

To achieve both widespread and deep levels of energy efficiency throughout the existing housing stock will require local government leadership. Individual local governments can adopt residential energy conservation ordinances (RECOs) for energy ratings and possible improvements at the time of sale. Utility programs can partner with these governments to provide supporting information on ratings systems, cost-effective measures and related implementation issues.

In addition, many actors must work together to ensure building code compliance. Strengthening building codes without improving local on-the-ground compliance leads to illusory progress. Concerns have arisen regarding whether HVAC compliance issues already undermine the effectiveness of Title 24 standards, and increasing the stringency and coverage of State standards is likely to add to these issues. The reasons behind compliance issues vary with jurisdiction and may include conflicts between State and local priorities, local government budget limitations, and market disincentives for contractors to comply.

The CPUC and utilities should coordinate with the Energy Commission and local governments to identify barriers to aggressive enforcement of State building standards and to develop effective plans for overcoming these barriers. An objective of these plans should be to leverage State and local resources to improve compliance. City and county building officials, for instance, are responsible for the vast majority of Title 24 enforcement, and their statewide association, the California Association of Local Building Officials (CALBO) is one key source of perspective on what is and is not working as energy standards become more stringent.

In order to ensure progress in implementing this Goal, a task force of key stakeholders should be convened to refine and oversee the strategies identified here.

[illegible] Existing Homes

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Deploy full-scale Whole-House programs.	Utilities Home improvement industry	Implement pilot home retrofit programs with effective integration and delivery of comprehensive demand-side options including energy efficiency, demand response and renewable energy measures in specific locations to prove technologies for next generation of lower energy homes in various climate zones.	Monitor performance of selected lower energy homes. Design implement, monitor and continuously improve full-scale programs for whole-house energy efficiency and renewable energy retrofits.	By 2020: 25% of existing homes have a 70% decrease in purchased energy from 2008 levels 75% of existing homes have a 30% decrease in purchased energy from 2008 levels 100% of existing multi-family homes have a 40% decrease in purchased energy from 2008 levels

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, ┬, Promote effective decision-making to create widespread demand for energy efficiency measures.	Utilities Home improvement industry Real estate industry assns Local governments	ffi Complete initial market research to determine homeowner "decision triggers" to improving home energy efficiency, including an assessment of the impact of EE or carbon labeling.	ffi Follow-up market research.	ffi Follow-up market research.
		ffi Develop, launch, monitor and continuously improve campaigns to raise demand for lower energy homes, including home energy or carbon labeling programs. ffi Actively support local governments considering RECOs to improve the energy performance of existing homes at time of sale or during major renovations. ffi Develop and implement home rating system pilot projects based on the Energy Commission HERS program.	ffi Continuously improve campaigns to raise demand for lower energy homes, including home labeling programs.	ffi Continuously improve campaigns to raise demand for lower energy homes, including home labeling programs.
, ┬$ Manage research into new/advanced cost-effective innovations to reduce energy use in existing homes	Energy Commission DOE/National labs Utilities	ffi Gather and disseminate information on advanced retrofits. ffiAdvance technological innovation through collaboration of Energy Commission PIER and Emerging Technologies Programs, Utilities and other appropriate organizations. ffi Promote commercialization of home energy management tools including AMI-based monitoring and display tools.	ffi Ongoing	ffi Ongoing
, ┬ [illegible]velop financial products and programs such as on-bill financing to encourage demand for energy efficiency building products, homes systems, and appliances.	Finance Task Force Financial institutions Contractors Local Government Utilities	ffiDevelop partnerships for innovative financing programs, such as performance contracts and City of Berkeley's solar and EE property loans. ffiInvestigate the feasibility of on-bill financing and other lending products. ffiConvene Task force on Financing with attention to issues of multi-family housing and paying for actions with longer-term paybacks.	ffiDesign implement, monitor and continuously improve financial products and programs for whole-house energy efficiency and renewable energy retrofits.	ffiDesign implement, monitor and continuously improve financial products and programs for whole-house energy efficiency and renewable energy retrofits

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Increase Title 24 compliance through specific measures leading to aggressive statewide enforcement.	Energy Commission State Contractor Licensing Board Utilities Local Governments CALBO California BSC	Identify the barriers to compliance and develop a compliance plan to implement remedial measures, including legislation if necessary. Leverage the compliance plan measures to support enforcement of local energy efficiency codes and standards. Identify opportunities for leveraging Title 24 and local codes enforcement. Develop program models that require proof of code compliance as a condition of receiving rebates or financing.	80% of transactions that trigger Title 24 requirements will comply with all applicable requirements. Monitor success or failure of leveraging and pursue additional actions to achieve success as necessary.	Monitor success or failure of leveraging and pursue additional actions to achieve success as necessary.

[illegible]

Plug loads are a complex, rapidly growing driver of electricity consumption, which currently account for at least 10-15% of overall household energy use.[35] The loads range from the ubiquitous energy thief transformers on almost every electronic appliance to home offices and the 1+ kW home entertainment centers growing in popularity. Potential savings from this plug load strategy could be 200 MW by 2011, with larger potential savings in the future.

Reduce plug loads will require changes in consumer purchasing patterns, research to develop smarter products, commercialization support for such products in terms of upstream rebates and incentives, and stimulation of customer demand through informational initiatives including unbiased and ubiquitous labeling. Ultimately, these savings will need to be locked in by raising State and Federal standards.

[illegible] Reduce Plug Loads

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Drive continual advances in residential energy usage, including plug loads, home energy management systems, and appliances.	Energy Commission (PIER) Utilities LBNL Appliance manufacturers Retailers	Work with research organizations to develop smarter products with lower energy requirements. Work with manufacturers to raise product energy efficiency, both when in use and when in standby mode.	10% reduction in plug loads	25% reduction in plug loads

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[illegible] In coordination with Strategy 2-2 above, develop public awareness of and demand for highly efficient products.	Utilities Manufacturers retailers Local Government Consumer information outlets	ffi Complete initial market research including identification of customer decision triggers for choosing highly energy efficient devices. ffi Implement public awareness and information campaign to promote purchase of more efficient products and create behavioral changes in the way products are perceived, used, and managed.	ffiFollow-up market research	ffiFollow-up market research.
[illegible] Create demand for such products through market transformation activities	Utilities Industry partners	ffi Deploy package of rebates, incentives and voluntary industry agreements to bring significant numbers of the best current technologies for managing plug loads (e.g., smart power strips and informative visual displays) to market. ffi Promote unbiased labels and Web sites (*Consumer Reports* approach).	ffi Ongoing	ffi Ongoing
[illegible] Continuously strengthen standards, including the expansion of both Title 24 and 20 to codify advances in plug load management	Energy Commission Utilities	ffi Continuously incorporate gains in efficiency in the appliance standards.	ffi Continuously incorporate gains in efficiency in the appliance standards.	ffi Continuously incorporate gains in efficiency in the appliance standards.

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Lighting programs have composed the majority of savings from the California IOU portfolios for the residential sector over the past several years. Such programs typically represent well over half of the utility efforts in the residential sector. This emphasis is largely due to the widespread conclusion that lighting opportunities are the least expensive and easiest to implement strategies for major, near-term savings in the residential sector.

Over the past year, new legislation has dramatically changed the context for lighting programs in California. As discussed above, AB 1109 and new Federal lighting standards have codified increasingly stringent standards for lighting. California utility lighting programs have coincided with dramatic changes in national and international lighting markets, in addition to recent legislative changes.

While significant savings potential still exists today, as these new standards and market changes come into force, utility programs targeting these same applications will provide little incremental benefit. Ratepayer-funded programs must re-orient towards measures which extend beyond these new standards and measures accepted in the marketplace to usher in the next generation of high-efficiency lighting. Accordingly, there is a need to move quickly beyond current lighting programs and towards solutions which focus on multi-year and holistic lighting system strategies, improved conservation actions, and other means of market transformation.

There is also a need to improve collection and recycling of end-of-life general purpose lighting to ensure the control of toxic materials. AB 1109 requires the Department of Toxic Substances Control (DTSC) to convene a Task Force of industry, government, and interest group stakeholders to make recommendations on safe disposal programs.

Solid-state lighting (SSL) is a pivotal emerging technology which represents one avenue of possibility for the future of high-efficiency lighting. No other lighting technology currently offers so much potential to save energy and enhance the quality of our living environments.

Increasing the market penetration of advanced lighting solutions will require coordinated efforts on a number of interrelated fronts. Research and development will remain a critical aspect of this effort to drive continual advances in lighting technology and cost performance. Critical solid-state lighting R&D is being conducted at the National Labs through DOE's Building Technology Program, particularly in the area of performance testing. In addition, a wide variety of research in lighting technology applications is being conducted at UC Davis's California Lighting Technology Center, as well as the Energy Commission's ratepayer-funded PIER program.[36]

DOE's current L-prize competition represents an innovative approach to market transformation in the area of residential lighting. The competition challenges industry to develop high-performance solid-state lighting products to replace two of today's most widely used and inefficient products: 60W incandescent lamps and PAR 38 halogen lamps. The performance specifications of the competition are very high and will require significant levels of innovation on the part of manufacturers. To match, the reward is alluring: significant cash prizes, opportunities for Federal purchasing agreements and access to utility promotion programs. Each of California's electricity IOUs has been engaged as sponsors of the program.[37]

Emerging lighting technologies will require commercialization support through a well-coordinated market push. On the supply-side, design competitions to engage manufacturers will be necessary to motivate far-reaching innovations to match customer preferences and needs. Technology demonstration projects will engage utilities and their customers, and build buyer confidence in the emerging technologies. Partnerships between large retailers and utilities to jointly negotiate price buy-downs with manufacturers and large-scale retail stocking commitments will ensure the ubiquity of advanced technologies at attractive prices. Finally, continual upgrading of standards for lighting technology and applications (EnergyStar, Title 24) will ensure new technologies are incorporated into business as usual across the state.

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[illegible] High-Performance Residential Lighting

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Drive continual advances in lighting technology through research programs and design competitions.	Energy Commission (PIER) Universities DOE National Labs Manufacturers Utilities Retailers	Work with research organizations to develop lighting products with lower energy requirements and improved spectral performance. Work with Utilities and Retailers to develop public awareness and demand.	Ongoing	Ongoing
Create demand for improved lighting products through demonstration projects, marketing efforts, and utility programs.	Utilities Industry partners	Deploy package of rebates, incentives and voluntary industry agreements to bring significant numbers of the best available lighting technologies (SSL) to market.	Ongoing	Ongoing
Continuously strengthen standards.	Energy Commission DOE EPA Utilities	Continuously incorporate gains in efficiency in the appliance standards.	Continuously incorporate gains in efficiency in the appliance standards.	Continuously incorporate gains in efficiency in the appliance standards.
Coordinated phase out of Utility incentives for purchase of CFLs	Utilities Retailers	Ensure that big box and home improvement retailers such as Wal-Mart and Home Depot are ready to stock Energy Star price discounted CFLs in CA as IOUs phase CFL programs out. Utilities engage in negotiations with manufacturers and retailers to buy-down prices and stock the next generation of high efficiency lighting.	Ongoing	Ongoing
Ensure environmental safety of CFLs and other emerging lighting solutions	CPUC Utilities Retailers DOE / EPA Cal EPA CA Dept. of Toxic Substances Control AB 1109 Lighting Task Force	Establish minimum mercury content requirements on the CFL manufacturers participating in utility programs. Determine cost-effective convenient methods for collection and recycling of any end-of-life light bulbs. Coordinate consumer education and marketing programs to improve disposal habits.	Ongoing	Ongoing

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By 2020, 100 percent of eligible and willing customers will have received all cost-effective Low Income Energy Efficiency measures.

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California's Low Income Energy Efficiency (LIEE) programs provide no-cost energy efficiency and appliance testing and repair measures to qualified low income customers in rental and customer-owned residences. The complementary objectives of the LIEE programs are to provide an energy resource for California and to produce energy savings, while reducing low-income customer bills. Customers qualifying for LIEE programs represent up to 30% of the IOUs' residential customers—or about 3.8 million households. In the past ten years, LIEE programs have provided about 1.6 million low-income households a range of energy-related services including home weatherization, refrigerator replacement, repair and replacement of heating and air conditioning equipment, and CFL distribution.

Although a large number of homes have benefitted from measures under the LIEE programs over the past 10 years, more than 50 percent of low income residences have yet to receive energy efficiency upgrades. The Commission has called upon the IOUs for a fresh look at LIEE programs to provide an expanded role for LIEE programs as a California energy resource, working in concert with other efforts to address climate change and meeting the needs of more low-income customers. In particular, the Commission has adopted a Big/Bold Strategy to provide all eligible and willing low income customers the opportunity to participate in the LIEE programs and to offer cost-effective and quality-of-life improving energy efficiency measures in their residences by 2020.

During the initial years of this *Plan*, the IOUs will focus their efforts on developing a more effective outreach program using segmentation techniques to identify target groups within the low income populations. In order to serve these additional households, the IOUs will design programs to be more administratively and operationally efficient. In the near term, the IOUs will develop partnerships with community organizations and local governments to leverage existing services and tools.

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This *Plan* contains two goals to achieve the LIEE vision:

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1. By 2020, all eligible customers will be given the opportunity to participate in the LIEE program.		Marketing, Education and Outreach programs will be highly successful and the number of eligible households in California receiving LIEE services will increase.
	***	LIEE customers will be educated on the benefits of energy efficiency and conservation behaviors.
		A trained LIEE workforce will accommodate future job demand and educate their communities.
2. The LIEE programs will be an energy resource by delivering increasingly cost-effective and longer-term savings.	***	Other State, Federal and local programs will be leveraged to streamline and improve customer identification and program delivery.
		LIEE programs will be integrated with core energy efficiency programs to achieve economies of scale.
		Participants will receive comprehensive energy efficiency services that produce long-term energy savings for the state, while reducing low-income customers' bills and improving their quality of life.

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The market transformation envisioned for the LIEE sector involves changing both the delivery of products and services and the behaviors that low income energy consumers rely on to use energy efficiently.

The LIEE Goals require leadership from the Low Income Oversight Board and the IOUs working in partnership with community-based organizations, contractors, educational and training institutions, and local, State and Federal agencies that also serve the low income community.

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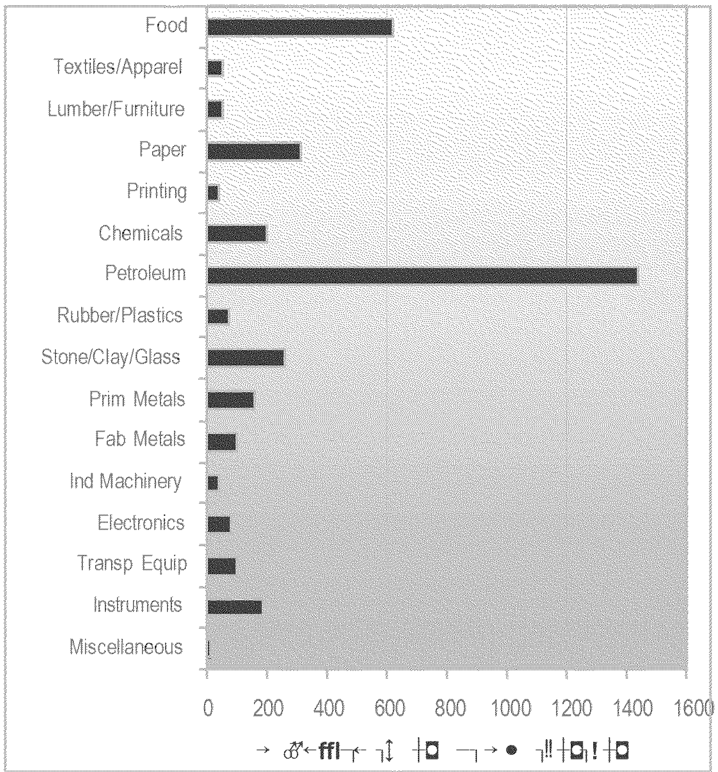
California and the IOUs will approach this Goal through two broad efforts: Marketing, Education, and Outreach (ME&O) and Workforce Education and Training (WE&T). These broader efforts will encompass current activities as a foundation, but will expand to newer, more creative efforts. ME&O efforts will be improved through the statewide collaborative and integrated approach

The largest user of natural gas is petroleum sector, with about half going to feedstocks, followed by food processing.



Source: KEMA 2006, California Industrial Existing Construction Energy Efficiency Potential Study

Several factors unique to the industrial sector require an approach to California's energy efficiency and greenhouse gas (GHG) reduction goals different from that used in the commercial and residential sectors:

- Industry uses a large quantity of energy and other resources via complex and proprietary processes to create and bring products to market. Products, to varying degrees, have embedded energy that traditionally cannot be "zeroed out", although technology is changing (e.g., the developing technologies for "zero energy" cement, dry walls, etc.)
- Industrial facilities in California are increasingly managed by corporations that reside outside of the state or outside of the country and that view these facilities as mobile assets in a competitive global marketplace.
- California industry is highly diverse in type, size, and operation; uniform programs often will not match corporate or facility needs.
- Industries are subject to multiple policies and rules in resource areas (e.g. air quality, water quality, energy efficiency, GHG reductions, solid waste management), where compliance can raise competing objectives and outcomes.

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1. Support California industry's adoption of energy efficiency by integrating energy efficiency savings with achievement of GHG goals and other resource management objectives.	*** By 2012, the goals, program designs and funding of industrial resource management programs are fully coordinated.
2. Build market value of and demand for energy efficiency through branding and certification.	*** Energy efficiency certification and benchmarking will become a standard industrial practice for businesses that are responsible for 80 percent of the sectoral energy usage by 2020. By 2020, Energy intensity (per gross dollar of production value) will be reduced at least 25 percent. There will be a trained workforce in energy management and systems energy efficiency.
3. Provide centralized technical and public policy guidance for resource efficiency and workforce training.	*** Industrial consumers will use this knowledge base to inform energy efficiency actions and manage their energy and resource use by adopting best practices.

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Industry has the capacity to significantly improve its overall energy performance and help meet both private-sector and national goals for energy and the environment. There are a multitude of significant barriers, however, to achieving the full technical or economic potential for energy efficiency in the industrial sector. These barriers are predominantly institutional and behavioral, not technical. They include:

- Lack of awareness of energy efficiency opportunities by industry personnel consultants, and suppliers.
- Difficulty in accessing industry-relevant technical assistance.
- Inadequate availability of qualified personnel and consistent organizational structure oriented towards energy use management.
- Primary business focus on optimizing industrial output, not energy throughput.
- Risk aversion to investing in new technologies and processes which may impact industrial output or quality.
- Resource limitations of both time and capital for assessment and implementation of energy efficiency projects.
- Internal hurdle rates that often limit capital available for energy efficiency projects with paybacks longer than two years.
- Utility program parameters that can be at odds with industry practice (e.g. limitations due to "free-rider shop" rules, lack of recognition of savings from process or operational changes, limits on funding for large projects).

This *Plan* will use the following strategies to address these barriers:

- ffiffl┘|–•◘┘h ♂┘ ffl♬ Provide integrated energy solutions and products through a "one-stop shop" approach.
- ☼ □┼◘┘ ff◘ffl ◄ □┘•|◘┼↕: Provide energy efficiency education and outreach to create awareness of and demand for continuous energy efficiency improvements.
- ¶•◘ffl ffl–◘ffl ┴ |•┘┼◘┘ ffl Promote commonly accepted metrics to document corporate and facility attainment of resource management levels, gaining market recognition, spurring peer competition, and facilitating engagement in market trading mechanisms.
- ↑ •├ •┼|→•◘fflffl–: Leverage existing training initiatives and technical exchange forums so that California industries have access to highly-skilled professionals who are fully knowledgeable in the areas of system energy efficiency and energy management

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Ideally, this Goal will be integrated with the CARB's AB 32 requirements so that industrial facilities use energy efficiency to meet or exceed regulatory requirements for GHG emission reductions (as well as water conservation, waste disposal, and air quality). Properly structured, a coordinated regulatory framework could be coupled with incentives to actively promote and reward measured performance improvements across energy, water, GHG emissions, waste disposal, and air quality.

A major strategy will be to directly engage industry in coordinated interagency planning for the energy efficiency portions of AB 32. This effort will include examining the potential benefits of negotiated, legally binding agreements with the chief operating officers of industrial corporations as a policy mechanism to promote energy efficiency in industry and corresponding reductions in GHG emissions. The United Kingdom, the Netherlands, Sweden, and a number of other countries have negotiated agreements programs in place, and such a strategy may work in California. DOE has begun development of national voluntary agreement programs as well. A multi-stakeholder alliance focused on knowledge sharing and capacity building could further aid in the adoption of changes in industrial operations and processes.

While the CPUC and IOU utilities could potentially develop such a program focused only on energy efficiency savings, a program approach covering all energy resource utilization, including energy efficiency, demand response, energy storage, combined heat and power, distributed generation, renewables and emerging technologies will provide the greatest benefit.

The food processing industry, with the leadership of the California League of Food Processors in partnerships with the Manufacturers Council of the Central Valley, has proposed such a pilot demonstration project that could be initiated in 2009.

This effort will also enable broadening utility program incentives from the current focus on energy efficient projects to include energy efficient processes (defined as documented, measurable evidence of energy management resulting in improved energy efficiency via projects, process, and operational improvements). The focus must move to delivered energy savings, either from hardware installations or documented permanent changes in operational processes. Utility program rules must become more flexible and find ways to work with the reality of industrial decision-making, particularly regarding early replacement of equipment.

"← ff%Integration with Other Resource Strategiesffi

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# %Develop coordinated energy and resource management program for CA's industrial sector, to enhance use of energy efficiency	CARB CEC State Agencies for water, solid waste, and toxic substances Utilities Industry Reps.	ffi Establish CARB AB 32 Industry Team ffi Study feasibility of implementing negotiated agreements ffi Undertake pilot program with food processing sector	ffiAnalyze results of pilot program. ffiIf favorable, negotiate agreements with other key sectors	ffiImplement statewide

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Goal 1 above focused on strategies that will support development of minimum regulatory energy efficiency requirements for either individual company or industrial sub-sectors as a whole, preferably integrated with the State's AB 32 program. Goal 2 is focused on companies that seek to exceed either minimum regulatory requirements or any negotiated bilateral agreement targets for industries as a whole, by actively managing their energy use over time.

In order for industry to make significant gains in energy efficiency, there must be greater awareness and knowledge sharing about programs, resources, and practical methods that can help industrial plants identify, develop, and document energy efficiency improvements and their economic benefits. Technologies common to many industries offer opportunities to increase efficiency. Significant knowledge sharing opportunities exist across firms and industries in the areas of combustion, industrial distributed energy, energy-intensive processes, fuel and feedstock flexibility, materials, sensors and automation, and combined heat and power.

The development of a national standard for industrial energy efficiency is currently under way. The Superior Energy Performance (SEP) partnership is a collaboration of industry, government, and non-profit organizations seeking to improve the energy intensity of U.S. manufacturing through a series of initiatives, most notably, by developing the standardized Plant Certification program.[49] The development of this American National Standards Institute (ANSI) accredited standard will help individual companies certify energy efficiency improvements, independently verify resulting energy savings, receive public recognition for achievements, and "raise the bar" for industrial energy efficiency overall.[50] Building on the ANSI standards, the SEP partnership is also helping to coordinate US participation in the development of an international ISO energy management standard. A representative from PG&E has been selected as the lead on the national ANSI effort, which positions California to play a critical role in the development of this important national and international standard. California's engagement in the partnership would ensure that the elements of the certification program, including the monitoring and verification methodology, are compatible with other California industrial energy efficiency and GHG emission reduction program regulations.

By participating in a recognized national effort to certify industrial facilities for energy efficiency, California will be assisting its industries to:

- More easily reach their GHG emission reductions targets via a supported, structured program based on proven best practices;
- Develop wide market recognition for their efforts through third-party certification, thus increasing global competitiveness

- Ensure corporate attention to a uniform national approach; and
- Provide a tangible way to encourage greater energy efficiency through their supply chain.

Programs such as those offered through DOE's Industrial Technologies Program (DOE/ITP) and EPA could provide substantial cost-share opportunities and in-kind assistance, especially if linked to certification.

To meet the near-term needs for a branding and certification program, California industries must have ready access to highly-skilled professionals who are trained in energy management and systems efficiency. Key areas include training industry professionals (consultants, plant engineers, and equipment suppliers) to provide energy management assistance, in-depth system assessment services, and in later phases, multi-resource utilization assistance, including waste reduction, water efficiency and air quality. California can leverage the workforce training element of the SEPP program to achieve this goal.

[illegible] Certification Program for Continuous Improvement

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[illegible] Participate in DOE/EPA's national Plant Energy Efficiency Certification Program (E²).	DOE/EPA SEPP participants Utilities Industry	• Participate in planning process.		
[illegible] Implement certification	E² Program Utilities Industry	• Plan pilot and recruit host sites (8-10 facilities). • Implement and analyze pilots.	• If successful, launch broader program for priority industry segments.	• Refine and obtain widespread industrial enrollment and certifications.
[illegible] Develop and implement workforce training program (integrated with national training effort).	E² Program WE&T Task Force Utilities Industry Universities	• Adopt the national curriculum for certification. • Consider curriculum enhancements for awareness-level training on integrating energy efficiency into the workplace and developing a new curriculum to fast track for future energy management professionals • Begin pilot courses with key industry segments.	• Expand to wider industry segments.	• Expand to industries statewide • Maintain and update curriculum.
[illegible] Create tracking and scoring systems to measure resource efficiency improvements. (integrate w/ nat'l effort)	Utilities Industry	• Develop systems. • Implement on test basis.	• Modify and roll-out to industry segments on a phased schedule statewide. • Coordinate with ME&O program.	• Maintain and improve systems based on feedback.
[illegible] Implement ME&O program to educate industry and consumers	ME&O Task Force Utilities Industry	• Form industrial collaboration mechanisms. • Develop plan.	• Launch w/ priority industry segments.	• Modify and roll-out statewide on a phased schedule. • Maintain and improve systems based on feedback.

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To achieve the Commission's adopted Programmatic Initiative of transforming the HVAC market and the four specific goals identified above, broad-based and aggressive strategies are needed that involve many stakeholders beyond the Commission and IOUs. An HVAC Advisory Group should be chartered to involve high-level HVAC industry stakeholders—such as manufacturers, distributors, and contractors—to coordinate industry sponsorship of and participation in HVAC strategies. Membership should also include other key players, such as the CPUC, Energy Commission, utilities, local building officials, building owners/managers, consumers, and the Federal government.

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California law requires contractors to obtain a permit for the installation of new HVAC equipment (including replacements of existing equipments) and to perform quality control checks. Yet fewer than 10 percent of contractors obtain such permits, perform quality control checks, or have their work verified by third-party raters. Failure to ensure quality at the time of cooling system installations results in a 20 to 30 percent increase in the peak energy needed by systems.

This problem is exacerbated by Title 24 provisions that allow optional compliance with HVAC quality control requirements; a contractor may install higher efficiency measures in a new building in lieu of the quality installation and control requirements, absent any performance verification. The Air Conditioning Contractors of America (ACCA) recently developed a quality installation (QI) specification for air conditioning equipment that has become an American National Standards Institute (ANSI) standard. It is comprehensive, addressing all aspects of HVAC quality installation, including equipment, installation and ducts. The Energy Commission's June 2008 HVAC report recommended that the Energy Commission consider making the ACCA or similar requirements mandatory for all HVAC installations, in lieu of Title 24's current optional requirement. Energy Commission action to change its optional standards to mandatory quality control provisions is critical.

Changing the status quo will require significant effort, since contractors who comply with HVAC code provisions incur higher costs that are difficult to pass onto customers in a highly competitive market. Such contractors may also experience delays due to local government permit timelines. Local building officials may not have the resources or knowledge to establish streamlined permitting systems to support quality HVAC installations or penalize contractors who do not comply.

Strategies to achieve significantly improved compliance include:

- [illegible] Streamlining local government permitting and State licensing processes, beginning with pilot programs.
- [illegible]. Changing the building code by replacing the current optional quality control requirements with mandatory requirements.
- [illegible]. Improving the current processes for inspecting and verifying compliant system installations, such as tracking the installation of all new and replacement equipment to ensure they are installed in compliance with all applicable State energy codes, or developing lower-cost compliance verification mechanisms.

ffi ffiffi |–◀● ◀ffi Actively enforcing penalties for contractors who do not pull required permits or who operate without the appropriate licenses.

!) !ffi ffiImprove Code Compliance ffi

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. ffiDevelop streamlined local government HVAC permitting systems, including on-line HVAC replacement permitting.	Local Governments CALBO Utilities Distributors Contractors	ffi Convene an industry/local government stakeholder group; develop proposed new system; pilot test with local governments.	ffi Revise pilots and expand to other cities; develop framework for statewide program.	ffi Expand statewide.
.¶ ffiStreamline process for obtaining and overseeing contractor business licenses.	Local Governments CALBO Calif. Contractor State License Board	ffi Pilot test streamlined process with local building departments. ffi Explore possible common business licenses for multiple jurisdictions.	ffi Revise pilot and expand pilot testing to other cities; develop framework for statewide program.	ffi Expand statewide.
.├ ffiReplace Title 24's current optional quality control requirements with mandatory requirements (ACCA/ANSI QI/QM specification).	Energy Commission ACCA/ANSI Utilities Contractors	ffi Adopt ANSI standards into Title 24; integrate into existing utility program designs.	ffi Explore steadily higher QI/QM standards as baseline becomes commonplace.	ffi Ongoing
.← Develop affordable standards and quality compliance solutions.	Utilities Local Governments CALBO Distributors Contractors	ffi Convene stakeholder group; develop details of proposed system and determine whether to proceed. ffi Consider developing an internet-based system that tracks the status of equipment, from the initial sale to final quality check in the field	ffi If recommended for development; pilot test.	ffi Expand statewide if pilot testing is successful.
. ffiEnforce penalties for contractors who do not pull permits or operate without the appropriate license.	Local Governments CA Contractor State License Board Contractors Utilities	ffi Pilot test local government fines in lieu of contractor license suspension; expand SMUD program to IOUs (proof of quality installation req'd for rebate); identify local govn't resources needed for enforcement; establish action plan to phase-in mandatory enforcement.	ffi Expand pilot programs; Continue phase-in of mandatory enforcement activities.	ffi Fully implement mandatory enforcement.

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Quality HVAC installation and maintenance (QI/QM) is currently the exception, not the norm. Achieving this goal will require a major transformation in both markets and behavior. Consumers need education on the value of properly installed and maintained systems in order to demand quality installations, and the service industry needs proper education, training, and certification to then meet consumer demand.

Beyond Strategy 1-3 under Goal 1 above, a logical next step is to develop a label that would be attached to residential or small commercial HVAC installations by a third-party rater.

Even before a change in the Title 24 requirements occurs, a statewide brand program could be developed to benchmark and recognize and/or certify quality installation and maintenance and high levels of HVAC technician competence. This effort could be conducted by California alone, with other southwestern states, or on a national basis. The brand would be used in at least two ways: (1) affixed to equipment to certify the equipment has been installed pursuant to QI/QM requirements and, (2) made available to contractors who voluntarily ensure a high proportion (perhaps 90 percent) of their workers have received high-quality certification from North American Technician Excellence or other industry groups. This branding effort could be tied to utility programs, such that only customers or contractors who use the brand receive incentives.

A consumer marketing and education campaign about the value of HVAC QI/QM can introduce and stimulate the demand for the new brand—communicating that quality work results in increased comfort, improved air quality and higher energy and cost savings. Development and launch of the quality brand should be supported with the appropriate level of behavioral studies to assess the market transformation impacts of the brand and ensure that utility incentives linked to use of a statewide brand are effective in changing consumer and contractor behavior.

A necessary concurrent strategy is the development of adequate workforce education and training for HVAC contractor/owners, service and installation technicians, sales representatives and building officials. This requires a comprehensive needs assessment to identify industry skill gaps and form the basis of an effective action plan to address these gaps. After this assessment is completed, support should be provided to certify new trainers and courses and provide incentives directly to technicians who complete training.

▯◀ !ffi◀Quality HVAC Installation and Maintenanceffi

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$.1 Create a statewide Quality Installation and Maintenance (QI/QM) brand that will be attached to systems/installations/ contractors that meet quality standards.	ME&O Task Force Utilities HVAC industry Retailers	ffi Create and launch statewide quality brand and/or align with national brand. ffi Develop operating and lifecycle data on economic and comfort benefits.	ffi Ongoing	ffi Ongoing
$.$ Launch a consumer marketing and education campaign to support the brand and stimulate market demand	Utilities HVAC industry Retailers Local Governments	ffi Develop and launch campaign.	ffi Conduct ongoing behavioral studies to ensure strategies are effective	ffi Conduct ongoing behavioral studies to ensure strategies are effective

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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] Develop and provide expanded QI/QM training for contractors, technicians and sales agents.	WE&T Task Force Utilities HVAC Industry Educational institutions Labor Unions CSLB NATE	• Conduct comprehensive training needs assessment to indentify industry skill gaps; begin expanded training programs.	• Assess impact of training activities and update needs assessment as required. • Expand training programs statewide, particularly at the vocational/technical and community college levels.	• Ongoing
[illegible]: Develop and implement comprehensive contractor accreditation program	HVAC Industry Energy Commission Labor Unions CSLB WE&T Task Force Educational institutions NATE	• Develop accreditation program requirements; begin implementation.	• Expand program	• Statewide certification program

[illegible]

Both the Residential and Commercial Sector Chapters address the need for "whole building" design and implementation in California, in order to achieve truly aggressive energy efficiency savings. One key goal of this overall effort must be building performance that improves space conditioning, by dramatically reducing cooling and heating loads. Fundamental changes will be needed in current design and building practices.

Specific design and building changes addressing HVAC performance include:

- Placing more emphasis on the whole building as a complete interactive system and improving the thermal integrity of the building shell to reduce heating and cooling loads.
- Moving ducts and equipment off the roof and out of hot attics.
- Incorporating ductless systems, radiant heating and cooling, ground source heat pumps and thermal energy storage technologies with overall higher efficiencies.

The Residential and Commercial Sector Chapters address behavioral change strategies to promote whole building design and implementation. Those strategies must include a focus on the HVAC industry in particular.

! #┤ ffi!ffiWhole-Building Designffi

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├┤ !ffiAggressively promote whole building design concepts that improve the overall thermal integrity of new and existing structures.	CEC HVAC industry Architects Builders and Contractors Utilities Local Governments	ffi Pilot targeted programs. ffi Incorporate radiant cooling, ductless systems, ground source heat pumps, etc. into 5 percent of new and existing construction by 2011. ffi Review priorities of PIER and Emerging Technologies program activities to more fully support newer HVAC technologies and systems.	ffi Include standard program offerings that emphasize HVAC-related elements to whole building approaches. Incorporate radiant cooling, ductless systems, ground source heat pumps, etc. into 25 percent or more of new and existing construction by 2015.	ffi Incorporate radiant cooling, ductless systems, ground source heat pumps, etc. into 50 percent or more of new and existing construction by 2020.
├┤¶!ffiAccelerate activities related to HVAC aspects of whole building industry design standards.	ASHRAE Energy Commission Utilities Manufacturers AHRI	ffi Evaluate and update existing standards to include increased emphasis on HVAC aspects of whole building approaches.	ffi Ongoing	ffi Ongoing
├┤┤!ffiAccelerate HVAC related aspects of whole building design in the educational and professional communities.	Colleges/ Universities Utilities Department of Education	ffi Develop continuing education programs. Begin curriculum use.	ffi Expand statewide. Develop university degree level programs.	ffi Ongoing
├┤←!ffiAccelerate code-based solutions to improving the thermal structural integrity and incorporating alternative cooling methods into building designs.	Energy Commission Local Governments Utilities	ffi Implement optional code improvements necessary to facilitate moves to whole building design approaches	ffi Establish mandatory whole building code-based solutions.	ffi Ongoing
├┤♬Sponsor design competitions to encourage builders to design and build homes with net zero peak demands	Utilities Foundations Industry Builders and Contractors	ffi Conduct first competition in 2010 and annually thereafter.	ffi Annually	ffi Annually

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Goal 4 requires coordinated development and use of new and improved HVAC technologies (equipment *and* controls, including two-way demand response and onboard diagnostics) that are adapted to California's climate zones.

The strategies to achieve this goal include:

- **↕☼¶☼┴ ◘┬☼┤↑ ├◘┴ffiffl ├• ◘ffl├ ffl│♂◘&**: Because advanced technology development and market penetration has a regional impact, it would be advantageous to draw participants from other states experiencing similar increasing air conditioning loads (e.g., Nevada, Arizona, New Mexico and perhaps Texas). The focus would be on working with DOE to develop new cooling systems with technology and designs that reflect California and similar hot/dry climate conditions.
- **♬ ♂☼┼◄↕‼¶◘♂◘┼ ┤↑├**: Past improvements in HVAC energy efficiency have been the result of R&D by the HVAC manufacturers, utilities, government, and academia. There needs to be a new focus on hot dry climate solutions.
- **→┘ │┬☼ ◘ ◘☼│♂┬← ◘ ◘☼│ffl ◄↕‼¶◘ ┘← ◘☼│** Because highly advanced cooling technologies will only penetrate small portions of the total market at a time, incremental improvements in standard HVAC equipment are also necessary, including continued upgrading of codes and standards. Any cost-benefit analysis for State or Federal regulations must include on-peak energy resource values and resulting peak-specific standards.
- **¶ ◘ ♂← '◘ ☼┴! ♂┼ ┼♂◘☼ ffl├ ff&ffl◘ ff** Such systems automatically collect data and alert consumers and/or contractors when a fault or negative performance trend is detected. These diagnostics will result in energy benefits by helping ensure that HVAC systems are maintained and operate within design specifications. While many manufacturers currently offer either "on board" systems or hand-held ones that work with all systems, none are widely used by consumers or contractors. Actions to accelerate the commercialization of such diagnostics include:

1. Prioritizing in-field diagnostic and maintenance approaches based on the anticipated size of savings, cost of repairs, and the frequency of faults occurring
2. Benchmarking of existing diagnostic, repair and maintenance protocols
3. Developing nationwide standards and/or guidelines for onboard diagnostic functionality and specifications for designated sensor mount locations.
4. Aggressive promotion of diagnostic systems as a standard offering on all HVAC equipment.

In addition to technology development, a key strategy to achieve this goal is education of contractors and consumers about the advanced technologies' availability and value, as well as education and training of service technicians, particularly on the use of diagnostic systems.

□☼┤◀ffi‼ffiNew HVAC Technologies and System Diagnostics ffi

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↕ $‼Pursue regional climate optimized equipment standards through DOE rulemaking process.	DOE Utilities Nat'l Labs NBI HVAC industry	ffi Develop recommended standards and present to DOE.	ffi Regional climate optimized standards adopted by DOE.	ffi Ongoing
↕ !ffiUpdate "Total Avoided Cost Model" and Title 24 "Time Dependent Valuation" calculations, including use of peak energy values.	Energy Commission Utilities	ffi Evaluate, revise and update as needed in State and Federal applications.	ffi On-going.	ffi On-going.
↕ * ‼Accelerate market penetration of advanced technologies by HVAC industry promotions and updating/expanding current utility programs to include the new technologies as appropriate.	Utilities Energy Commission	ffi Conduct a comprehensive cost-benefit analysis of leading and prospective advanced technologies, and use to prioritize utility incentive offerings and HVAC industry deployment strategies ffi Establish an incubator program to accelerate commercialization of most promising technologies.	ffi Provide necessary program incentives to ensure that advanced technologies represent 30 percent of the systems sold by 2015.	ffi Continue to provide necessary program incentives to ensure that advanced technologies represent 50 percent of systems sold by 2020.
↕ ↕‼Adopt a progressive set of building codes that support the deployment of peak efficient equipment.	Energy Commission Utilities AHRI ASHRAE ACCA	ffi Enhance and accelerate the deployment of Title 20/24 codes.	ffi Ongoing	ffi Ongoing
↕ (‼Develop nationwide standards and/or guidelines for onboard diagnostic functionality and specifications for designated sensor mount locations.	Manufacturers Utilities Trade Associations AHRI ASHRAE	ffi Establish an industry-wide task force to develop national standard diagnostic protocols. ffi Begin implementation. ffi Incorporate into HVAC industry and utility programs.	ffi Incorporate diagnostic standards into equipment codes.	ffi Ongoing
↕) !ffiPrioritize in-field diagnostic and maintenance approaches based on the anticipated size of savings, cost of repairs, and the frequency of faults occurring.	Manufacturers Utilities Trade Associations AHRI ASHRAE	ffi Benchmark existing diagnostic, repair and maintenance protocols and develop appropriate products.	ffi Commercialize on-board diagnostic systems.	ffi Incorporate mandatory onboard diagnostic systems in California building codes.

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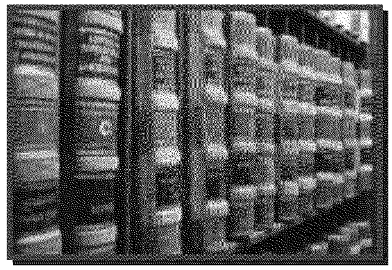
A broad range of aggressive and continually improving minimum and higher voluntary sets of energy codes and standards will be adopted to greatly accelerate the wide-spread deployment of zero-net energy and highly efficient buildings and equipment. The effectiveness of codes and standards will be enhanced by improved code compliance as well as coordinated voluntary efficiency activities.



The ambitious goals of this *Plan* as well as greenhouse gas imperatives place an unprecedented reliance on mandatory codes and standards—both on energy codes for new and renovated buildings and on efficiency standards for appliances and equipment—and pressure for them to perform.

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There is no policy tool more essential for the widespread and persistent transformation of energy performance in California than energy codes and standards. For thirty years, California has aggressively and successfully used its two principal frameworks for regulating minimum energy performance—Title 24 building energy codes and Title 20 appliance standards[58]—to cost-effectively reduce the energy consumption of commercial buildings, homes, and appliances. The effectiveness of energy codes and standards is beyond debate—the Energy Commission's 2007 Integrated Energy Policy Report[59] finds that: "California's building and appliance standards have saved consumers more than $56 billion in electricity and natural gas costs since 1978 and averted building 15 large power plants. It is estimated the current standards will save an additional $23 billion by 2013."

The appeal of codes and standards for promoting energy efficiency is simple: they make better energy performance mandatory, and not just for early adopters or self-selected consumers but for all users of regulated products and structures.

Codes and standards' impact, while enormous, can be enhanced and made even more successful and cost-effective if they are:

- Capturing a wide range of economically viable technologies and building practices, including integrated DSM approaches.
- Coordinated with non-regulatory market transformation efforts, such as utility incentives and rebates, Energy Star and other benchmarking programs, and builder and consumer education efforts that pave the way for successive strengthening of codes and standards.
- Optimized with other regulations, especially Federal efficiency standards, non-California State efficiency standards, AB 32, ambient air quality

rules and local government development policies.

- Applied more comprehensively to end uses, including plug loads and building operations.
- Supported by better enforcement and compliance at local levels.
- Reliant on more sophisticated design principles and analytics regarding whole buildings and measures.
- Encouraging of building industry players to design or manufacture new energy solutions

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1. Continually strengthen and expand building and appliance codes and standards as market experience reveals greater efficiency opportunities and compelling economic benefits.	***	California's codes and standards will support this *Plan's* residential, commercial, and HVAC sector goals.
2. Dramatically improve code compliance and enforcement.	***	Energy savings from codes and standards will be fully realized.

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The Energy Commission re-visits and tightens Title 24 energy efficiency codes on a triennial basis. However, the scale of the goals and challenges at hand—including that of putting all new commercial buildings on a path to zero net energy by 2030, and meeting AB 32's emission reduction targets—prompts an accelerated strategy to make the codes more stringent and cover more end uses and measures.

The strategies described below pursue both sides of the codes and standards coin: they develop enhanced regulations "on paper;" and they improve their real world effectiveness, cost-effectiveness, and compliance. Although the strategies place greater emphasis on building codes than on appliance/equipment standards—as the former are principally regulated at the State level and the latter principally at the Federal level—there is nonetheless a tremendous opportunity for appliance regulation to increase energy savings.

The Energy Commission is a key leader in this effort, along with the California Building Standards Commission. The Federal government, utilities, research organizations (Energy Commission-PIER, national labs), trade and professional licensing/registration agencies, the building/developer/contractor/ manufacturers industry and realtors must work cooperatively to develop common goals and provide the technical support for this effort.

These strategies are intentionally presented at a high level in this Chapter. The Residential, Commercial and HVAC Chapters provide greater detail on codes and standards goals and strategies applicable to those sectors

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There is a de facto symbiotic relationship between more stringent codes and standards and improvements in technology, products and practices (the former prods the latter, while the latter helps allow the former) that will need to strengthen and accelerate in the coming years.

More than most other efficiency policy areas, codes and standards demand coordination with other efforts and parties—from regulators to the regulated—to be optimal. Both the Energy Commission and the IOUs have played a major role in coordination, and must be committed to playing an even larger role in the future to support and/or facilitate future efforts. Such coordination has two major components: one, coordinating with other relevant governmental regulations; and two, coordinating with relevant programs, incentives, market dynamics, research and other non-regulatory initiatives.

Many other governmental entities can impact the effectiveness of California's codes and standards. For example, the Federal government (i.e., DOE) has primary responsibility for appliance/equipment standards. Local governments play an important role, both in the enforcement of Title 24 for building construction and renovation and in the development of local "reach" codes that can serve as pilots for statewide codes. California's newly-adopted Green Building Standards along with San Francisco and Los Angeles' recent Green Building Ordinances, referenced earlier, represent recent "beyond code" efforts. These important efforts serve to continually "raise the bar" for California's statewide standards. Coordination among such "reach" codes and the statewide efforts, as well as among non-governmental building rating and certification systems frequently embraced by local government development policies, is critical.

Coordination with other programs and laws is also critical. Codes and standards are more focused on eliminating inefficient products and practices than on developing or popularizing new highly efficient ones. Accordingly, codes and standards should be coordinated with public and private efficiency programs that develop and commercialize new products and building design solutions.

While efforts to leverage efficiency investments at times of sale and/or major retrofit labeling or other requirements provide important opportunities for efficiency gains, excessive "trigger" requirements can serve as a disincentive to undertaking beneficial investments. Interagency collaboration is needed to identify solutions to such challenges and develop and prioritize action paths towards California's energy and GHG goals.

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ffiffiCode Enhancement and Expansion

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ffi ffiDevelop a phased and accelerated approach to more stringent codes and standards.	ffi Adopt a progressive set of building codes; including one or two voluntary "reach" code tiers for residential and commercial sectors. ffi Lower the renovation threshold at which the code applies to an entire existing structure ffi Identify local code or ordinance opportunities as pilots or where local conditions may support accelerated action.	ffi Develop road map for accelerating Title 20 standards and Title 24 codes in a "top-down" approach ffi Increase use of building commissioning requirements for new buildings and retrofits. ffi Identify analysis, case study, R&D, and other activities necessary to support progressive strengthening of codes and standards.	ffi Develop "reach" codes for buildings as "net producers" of energy (ZNE). ffi Codes and Standards require net zero residential buildings by 2020.	ffi Codes and Standards require net zero commercial buildings by 2030.

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[illegible] Expand Titles 24 and 20 to address all significant energy end uses	ffi Expand Title 20 to cover additional plug loads such as copy machines, printers, battery chargers, televisions. ffi Enhance Title 24 to include whole building approaches including metering and data management; automated diagnostic systems; and sub-metering for tenant-occupied space. ffi Pursue greater alignment of national and localized green building codes with energy codes. ffi Integrate AB 32 standards with energy efficiency goals.	ffi Expand Title 20 and Title 24 to cover additional uses such as server farms, process loads and water use. ffi Develop building standards to better integrate on-site clean distributed generation. ffi Investigate establishing energy and green building codes on a community and/or city level that may include infrastructure issues such as transportation, wastewater treatment, solid waste disposal.	ffi Investigate expansion of Titles 24 and 20 to address all significant energy end uses (manufacturing, agricultural, healthcare, etc.). ffi Evaluate including land development in energy standards and regulations.	ffi Continue to develop and refine approaches from experience.
[illegible] Improve code research and analysis.	ffi Conduct analysis that will help the code move toward a zero-based approach. ffi ffi Analyze approaches for whole buildings, non-covered end uses and measures that are not currently credited by Title 24. ffi Conduct tests and evaluations of potential code change measures. ffi ffi Increase research and analysis regarding how behavior affects use of buildings and code compliance. ffi Evaluate and develop appropriate approaches to include DR standards in C&S. ffi Continue exploration and adoption of improved building energy simulation and compliance tools.	ffi Continue research to improve program impact and processes. ffi Conduct analysis of embedded energy savings with transportation, wastewater, and solid waste options for green building standards. ffi Investigate the balance between mandatory, prescriptive, and beyond-code "reach" standards to achieve more effective codes, greater compliance rates, and more innovation in the marketplace.	ffi Continue research. ffi Conduct research on revising and updating the cost-effectiveness, including the potential for using non-energy benefits as a component of cost effectiveness.	ffi Continue research based on promising next steps.
[illegible] Improve coordination of State energy codes and standards with other state and Federal regulations.	ffi Continue to develop appliance standards to influence the market prior to preemption by DOE. ffi Coordinate Title 24 goals with 1992 Energy Policy Act requirements for meeting/exceeding Federal code. ffi Coordinate development and adoption of California Green Building Standards with Title 20/24 and ASHRAE Standard 189, CHPS.	ffi Coordinate development of related codes and standards such as the California Green Building Standards, ASHRAE 90.1 and 189.1, ICC, CHPS, etc. ffi Coordinate/support implementation of legislation impacting C&S program such as AB 32. ffi Coordinate development of codes and standards with State and voluntary programs such as Energy Star, LEED, Flex Your Power, etc.	ffi Pursue remaining priorities as identified.	ffi Pursue remaining priorities as identified

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┤◘ ffiImprove coordination of energy codes and standards with utility programs.	ffi Develop and implement plan for enhanced coordination and integration of codes and standards with full spectrum of EE market transformation, including Emerging Technologies promotion, deployment, incentives, consumer education, etc.	ffi Investigate ways to integrate C&S with other DSM by offering tiered incentives (financial and other) and technical assistance for more comprehensive and inclusive definitions of codes and standards.	ffi Investigate a greater convergence of the C&S and other DSM through non-code mechanisms and utility program integration.	ffi Investigate the integration of utility infrastructure planning with potential community-based codes.

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Compliance with California's efficiency codes and standards varies enormously, especially with respect to building codes. For example, fewer than 10 percent of HVAC systems installed have permits pulled and 30-50 percent of new central air conditioning systems are not being installed properly. This compliance failure comes at considerable cost to Californians—the HVAC compliance shortcomings have led to an estimated 20-30 percent increase in the peak energy needed on hot summer afternoons.[60] It has been estimated that at least 30 percent of the technical energy savings potential of energy codes is lost due to non-compliance—but in reality there is inadequate understanding of code compliance rates or the resulting degradation in performance.[61]

This strategy will require a strong, coordinated effort among Federal, State and local entities, the utilities, California building officials (and their association, CALBO) and other code compliance organizations, trade and professional licensing/ registration agencies, and building/developer/ contractor/ manufacturers associations.

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ꝏffiImprove code compliance and enforcement.	ffi Conduct research to determine high-priority tactical solutions for code compliance and focus efforts accordingly. ffi Increase training and support for local building code officials. ffi Investigate regulatory tools such as licensing/ registration enforcement. ffi Evaluate proposed changes to the code and compliance approaches to simplify and expedite compliance. ffi Work with local governments to improve code compliance, adopt above code ordinances, and provide training/education.	ffi Continue to conduct further research relating to code compliance. Refocus efforts as needed. ffi Pursue appropriate involvement of HERS raters. ffi Pursue trade associations to improve "self-policing" of membership. ffi Investigate tools, software programs, "incentives", and policies to simplify and streamline permit process. ffi Apply feasible mechanisms to prove code compliance as a pre-requisite for partnership funding or incentives from the IOUs.	ffi Continue to conduct research. ffi Investigate aggressive "stick" and "carrot" programs with monetary penalties and incentives. ffi Investigate greatest opportunities of compliance improvement of appliances (Title 20) in the upstream and midstream markets, including working directly with manufacturers and distributors to improve appliance and equipment compliance.	ffi Continue to conduct research. Investigate and pursue solutions to the perceived and real "penalties" associated with non-compliance. ffi Investigate codes and standards that would regulate the operation of buildings that may include such things as maintenance requirements, regular updates to operating schedules, mandatory monitoring and controls points, system reporting requirements, etc.

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Energy efficiency, energy conservation, demand response, advanced metering, and distributed generation technologies are offered as elements of an integrated solution that supports energy and carbon reduction goals immediately, and eventually water and other resource conservation goals in the future.

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Historically, demand side management (DSM) options for energy consumers have been "siloed" activities within regulatory bodies, utilities, environmental organizations, and among private sector service providers. The programs are focused on mass delivery and promotion of individual products, for example efficient air conditioners, rather than on integrated packages of measures, for example, air conditioner rebates with duct sealing, weather-stripping, programmable thermostats, and advanced meters. This current narrow focus on a single product offering does not maximize energy savings nor minimize the costs of program delivery.

A narrow, single-product approach also results in customer confusion by requiring the customer to seek out information on a wide array of different programs with multiple points of contact in order to acquire a basic understanding of the DSM options available and the various benefits they offer. Most energy users across all economic sectors do not have the time or expertise to seek this information; as a result, many opportunities to accomplish DSM actions are lost.

At the CPUC, a number of individual proceedings relate to DSM, including energy efficiency, demand response, advanced metering, combined heat and power/distributed generation, and the California Solar Initiative (CSI), in addition to an upcoming Smart Grid rulemaking.[62] The CPUC should integrate the DSM programs within its jurisdiction – including the harmonization of cost-effectiveness methodologies and metrics – in order to enable offerings of integrated packages that will maximize savings and efficiencies of utility program overhead.

The development of Smart Grid technologies that enable active, real-time energy management in homes and businesses also will play a critical role in the packaging of integrated DSM services. A recent report by IBM, *Plugging in the Consumer*, demonstrates that we are poised for the uptake of advanced energy management systems.[63] Activities to plan for Smart Grid integration are underway in a number of venues, including on-going R&D at the CEC[64], and the upcoming Smart Grid rulemaking at the CPUC. These efforts will lead to deployment of new grid and metering technologies. These, in turn, will help to optimize energy system performance, and encourage behavioral changes in energy use.

The goal of this *Plan* is to build on successes from initial efforts such as PG&E's Market Integrated DSM Initiative and the SCE and Sempra Sustainable Communities Initiative to offer integrated DSM solutions to maximize energy savings. A related goal is to design policies and programs in research and development, commercialization, deployment, and codes and standards that reinforce each other and use feedback loops to constantly improve energy efficiency programs.

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Deliver integrated DSM options that include efficiency, demand response, energy management and self generation measures, through coordinated marketing and regulatory integration.ffi	*** Customers realize increased energy savings at lower cost through the implementation of a menu of DSM options.ffi

There are three levels of integration for DSM options:

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ffi┬‼ –ffl↕–┘ ┐¶•┴♂◘•–┬┬ffiffl ffl–♬♂ ☼ffl: Combined DSM audits and recommendations across all relevant energy management opportunities will be offered to customers, including advice on energy efficiency, demand response, distributed generation, Permanent Load Shifting (PLS), solar rebates, and other applicable measures.

ffi┬┘•↑◘ ffl┘ffl↕┬♬ ┐┼┬☼┘ ┬ ☼•↕–☼ffl : This includes equipment and information systems that enable achievement of multiple DSM options (energy efficiency, demand response, etc.) and synergies across DSM program types (e.g., addressable electronic ballasts that both save energy and manage demand during utility peak hours).

Integrated packages of DSM solutions are a consistent theme throughout each of the Chapters in this *Plan*. This Chapter describes augmented, not duplicate, strategies described elsewhere.

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This *Plan* contains four overarching strategies for DSM integration:

└┐ ‼♂ffl☼‼ –ffl↕–┘ : The best short-term path to promote integration is to continue successful efforts by the IOUs and pursue an expanded series of pilot projects as part of the IOUs' efficiency and demand response 2009-2011 portfolios. These pilots will (a) be designed to inform future program and policy submissions regarding the value and best methods and targets of integration, (b) offer a bundled product that includes elements of energy efficiency and conservation, consumer generation, demand response, and the best available AMI technology and, (c) offer different forms of delivery (including third-party and local government platforms) and information access.

|┴┐ ├☼◄•◘ffl┘♬•–┐ffiffl ffl–♬♂ ☼ffl: For the longer term, the CPUC will work with key stakeholders to develop and implement a comprehensive, coordinated long-term approach to effective utilization of energy resources while also achieving GHG emissions reductions, water conservation, waste disposal, and air quality requirements.

←┐ • ┐┘•↑◘ ffl┘ffl↕:┬Technology is a fundamental element in achieving the CPUC's Big/ Bold Strategies and maximizing the contribution of energy efficiency in meeting the State's energy and environmental goals. A major effort is needed to develop new technologies and systems that enable multiple DSM options and provide synergy across DSM program types. The CPUC has already approved installation of AMI throughout IOU service areas and will soon initiate a Smart Grid proceeding which will likely spur development of new, integrated DSM technologies.

┤ ┼┼◀fiffl┘│-●ffi ┐│♂□●-ffl┘ :┐Coordinated marketing will be an essential component in achieving greater up-take of integrated DSM programs.┐"Smart meter" systems and associated dynamic pricing tariffs also are important tools for customers to monitor and reduce their energy consumption. The majority of these systems will be deployed statewide during 2009-2011. This present a unique near-term opportunity to promote integrated demand-side management programs. Program administrators should streamline and integrate the marketing of DSM programs in conjunction with smart meter deployment. ┐

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Historically, resource efficiency messages, programs, and initiatives have been promoted as separate and largely independent activities. Energy, air quality, water, and waste regulations are under the jurisdictions of separate agencies and commissions. It is critical to develop a shared vision and process for regulatory coordination in California to support the energy savings benefits of DSM coordination/integration and to ensure consistent and mutually supportive energy, water, air, and GHG policy and regulations. Enhancing utility programs, technology advancement and general education and training objectives depends on coordinated regulation and voluntary efforts across the spectrum of DSM activities. In addition, the implementation of AB 32 will require additional coordination by all agencies to achieve a common goal.

Achieving this vision will require new forms of government agency collaboration, mechanisms to quantify and value multiple resource benefits, and fundamental changes to the standard business and service delivery practices of utilities, energy service companies and building contractors.

┴◀↕!¶ffiIntegrated DSM Programs, Messages, and Technologies

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"♂": Carry out integrated marketing of DSM opportunities across all customer classes.	ffi IOUs adopt marketing integration plans, by sector ffi Streamline and integrate EE, DR, and DG program outreach ffi Coordinate integrated marketing with AMI deployment ffi Offer audits and technical assistance that address combined DSM opportunities	ffi Continue integrated marketing through AMI full deployment ffi Leverage lessons learned to other general marketing materials	ffi Incorporate output of other integration strategies and pilot programs into marketing materials
" ¶ffiConduct integrated DSM delivery *pilots* in the Residential, Commercial, Industrial and Agricultural sectors.	Propose and launch program delivery pilots testing capabilities and effectiveness in the marketplace, including EE, DR, AMI and DG	ffi Apply lessons from pilots to full scale implementation ffi Develop new pilots "smart buildings", building operator training, and solar PV and hot water.	ffi Expand successful activities statewide
"♂'¶ffiDevelop *integrated* DSM programs across resources, including energy, water, and transportation.	ffi Establish on-going working group to develop and implement blueprint for integration.	ffi Implement pilot programs that integrate solutions across resources.	ffi Expand successful approaches.
"♂(¶ffiPromote development and support of new technologies that enable or facilitate DSM Coordination and Integration	ffi Assess the current state of integration-enabling technology and develop a guidance document detailing a technology development path for fuller integration. (2009) ffi Prioritize integration-enabling technologies in RD&D and ET programs based on the technology assessment.	ffi Update biennially.	ffi Update biennially.

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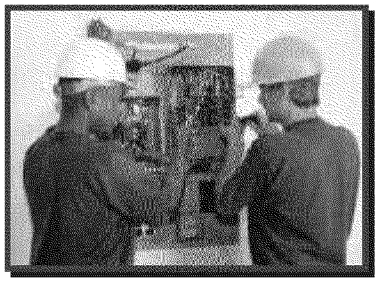
By 2020, California's workforce is trained and fully engaged to provide the human capital necessary to achieve California's economic energy efficiency and demand-side management potential.



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Workforce Education and Training (WE&T) focuses on educating and training people to perform the jobs needed to reach California's clean energy goals. The IOUs currently provide efficiency-specific training and education courses to fulfill needs associated with implementing IOU programs; efficiency-specific course materials; training for third-party program implementers; and energy efficiency and sustainability curricula at K-12 schools.

In order to accommodate the dramatic increase in energy efficiency activities envisioned by this *Plan* and required by AB 32, California must develop a trained workforce, including people qualified in energy-efficiency engineering, construction, maintenance, program design and implementation, and financial analysis. Meeting the goals established in the *Plan* will require at least two categories of personnel development: completely new types of jobs that do not exist today (e.g., corporate emissions manager) and supplemental training for existing positions (e.g., training engineers to enhance energy efficiency).

This cross-cutting sector demands a truly statewide coordination effort that integrates energy efficiency training into a wide range of public and private programs. This effort will include the California Department of Education, the Department of Employment Development, industry and labor associations, educational institutions at all levels, technical and vocational training organizations, community based non-profit organizations, and the business community.

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1. Establish energy efficiency education and training at all levels of California's educational systems.	***	Students develop careers and existing workers develop skills and knowledge that advance DSM businesses, policy, research and development, and education. **ffi**
2. Ensure that minority, low income and disadvantaged communities fully participate in training and education programs at all levels of the DSM and energy efficiency industry.	***	Individuals from the targeted communities take advantage of programs that specialize in energy disciplines at all levels of the educational system and successfully advance themselves into rewarding careers in the energy services fields.

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An effective, comprehensive WE&T program for a new energy efficient economy requires collaborative efforts by many entities. It is not the core mission of utilities to effectuate the level of change needed to create a comprehensive WE&T program, nor can ratepayers fully fund the effort. In addition to the educational institutions themselves, participants in defining and/or providing energy efficiency WE&T resources include:

- ffi ffiff⟅┘|–● ┘–◘┐California Department of Education and the Department of Employment Development, Federal government (e.g., Department of Labor), specialized State agencies (e.g., licensing boards) and local governments (e.g., building departments) to recruit train and prepare workforce candidates for technical and professional careers.
- ffi ♂)◘ffl–☼ ┬◀◘◘)◘ffl–◀ The University of California, the California State University, community colleges, school districts and private colleges, universities, and technical schools.
- ffi ↕ ffl● ●)–♬!¶◀┘♂ ┬♂ ┬ffl–‼ |ffl┬◘ ffl|┤–♬◘ffl–◀ Organizations funded to provide education, career development and workforce training programs (i.e., Greenlining Institute, Apollo Alliance).
- ffi ┼♂)◀◘|*┬♂ ┬☼|ffl|┬ffl|┤–♬◘ffl–◀ Trade unions, the Sheet Metal and Air Conditioning Contractors' National Association, the California Building Performance Contractors Association, home rating organizations, and energy efficiency associations.

Several strategies must be initiated or completed in the near term to more thoroughly define, initiate and drive long-term WE&T development and strategic planning.

↑┐├→← ┐ ┘┘♂◀┐ ◀◀┘◀◀● ┘–◘ An in-depth formal statewide training and education resource inventory and needs assessment is necessary for long-range strategic planning and delivery. The needs assessment and resource inventory will be structured to produce short-, near- and long-term workforce strategies to support each sector defined in the *Plan*. Information in the WE&T Convener Report[65] provides an excellent start for the assessment. The assessment will be completed by a third-party with its process managed by the CPUC and IOUs, in collaboration with the California Department of Education.

┐├→← ┐├┘¶┐ ffl|◘☼ The web portal will include links to various demand-side management (DSM) related training programs and will allow for a single point of communication. The portal will also serve as a repository for all demand-side management and energy efficiency training, educational conferences, and career opportunities. This portal will be created and funded in collaboration with other appropriate entities, and linked to the statewide energy efficiency web portal.

┐─┘├ *┬♬♬–◘ *┐├→← ┬◀! ┐"ffl|◘┘ The Task Force, comprised of energy efficiency program administrators, the CPUC, and educational experts, will fulfill administrative functions including: developing a needs assessment RFP; selecting the third party to conduct the needs assessment; and managing the needs assessment evaluation. The Task Force members will continue to help implement the goals and strategies set forth in this *Plan*.

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CALIFORNIA ENERGY COMMISSION

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INCREMENTAL IMPACTS OF ENERGY EFFICIENCY POLICY INITIATIVES RELATIVE TO THE *2009 INTEGRATED ENERGY POLICY REPORT* ADOPTED DEMAND FORECAST

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COMMITTEE REPORT

May 2010

CEC-200-2010-001-CTF

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Arnold Schwarzenegger, *Governor*

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Table 4: Overview of Energy Efficiency Initiative Scenarios Defined in the *2008 Goals Study*

Category of Initiative	Description	Scenario		
		Low	Mid	High
IOU Programs	Continuation of 2006-2008 program mix through 2020	Partial incentives	Partial incentives	Full incentives
Codes and Standards	Title 24 Building Standards ratcheted multiple times	Residential: 10% ratchet in 2014 only Commercial: 5% ratchet in 2014 only	Residential: 10% ratchet in 2011 and 2014 Commercial: 5% ratchet in 2011 and 2014	Residential: 10% ratchet in 2011, 2014, 2017 Commercial: 5% ratchet in 2011, 2014, 2017
	Federal appliance standards updated according to DOE schedule issued in 2006	Updates to standards for residential clothes washers, dishwashers, central AC and room AC; updates to standards for commercial packaged AC units	Same as Low	Same as Low
Big Bold Initiatives	Zero Net Energy level achieved by 2020 in residential and by 2030 in commercial new construction	Residential 60% Tier 2 25% Tier 3 Commercial 40% Tier 2	Residential 80% Tier 2 60% Tier 3 Commercial 55% Tier 2	Residential 100% Tier 2 90% Tier 3 Commercial 70% Tier 2
	HVAC standards modified to match "hot, dry" conditions	Accelerated penetration of SEER 15 AC units	Accelerated penetration of SEER 15 AC units	Accelerated penetration of SEER 15 AC units
Huffman (AB 1109)	Lighting measure efficiency increased according to adopted Title 20 standard	Low compliance	Mid compliance	Mid compliance

Source: *2008 Goals Study*

Big Bold Initiatives

[illegible]

[illegible]

[illegible]

Lighting Reductions Required by AB 1109

[illegible]

Overview of Qualitative Assessment Results

[illegible]

Treatment of Savings Decay From Committed IOU Programs

[illegible]

2011 IEPR

INTEGRATED ENERGY POLICY REPORT

CALIFORNIA ENERGY COMMISSION
EDMUND G. BROWN JR., GOVERNOR

CEC-100-2011-001-CMF

state's need for conventional transportation fuels. There are two crude oil import infrastructure projects proposed in Southern California that are at early stages of development, Berth 408 at Pier 400 in the Port of Los Angeles, and Berth T126 at Pier Echo in the Port of Long Beach. Based on Energy Commission analysis, the Southern California market should require construction of only one of these crude oil import facilities over the forecast period. However, oil imports at the high end of the range will require expanded capability to receive crude oil imports within the next four to five years to ensure sufficient supplies of conventional transportation fuels.

For alternative transportation fuels, demand for biofuels is expected to grow as a result of the federal Renewable Fuels Standard 2 mandates and the state's Low Carbon Fuel Standard. Certain biofuels (ethanol in low-level blends, biodiesel, renewable diesel, and renewable gasoline) will require only modest fueling infrastructure investment and little to no modifications to motor vehicles to enable greater use. California's infrastructure to receive, distribute, and blend ethanol is robust and adequate to accommodate a continued growth of ethanol use over the next several years. Although California's biodiesel infrastructure is currently inadequate to accommodate widespread blending of biodiesel, with sufficient lead time (12 to 24 months) modifications could be completed that would enable expansion of biodiesel use. An initial $100 million investment from the Energy Commission and private sources should accelerate the development of several biofuel production projects in California by 2017.

Other alternative transportation fuels like electricity, natural gas, and hydrogen will require considerable investment over the next several years in fueling infrastructure and vehicles that run on these fuels. Significant public and private investments are being made in California's electric charging infrastructure, and federal economic stimulus funds matched with Energy Commission program funds and other private and public funds are providing the charging infrastructure to support the deployment of plug-in electric vehicles in California. The Energy Commission has also allocated funds to upgrade and install fueling infrastructure for 20 natural gas stations, 11 hydrogen stations, and 50 E85 (85 percent ethanol) dispenser stations.

California's Clean Energy Goals

In his 2012 State of the State address, Governor Brown stated that "California is leading the nation in creating jobs in renewable energy and the design and construction of more efficient buildings and new technologies." This commitment to clean energy was echoed by President Obama in his 2012 State of the Union remarks calling for Congress to set "a clean energy standard that creates a market for innovation."

California's ambitious energy and environmental policy goals are important strategies to promote energy independence, increase energy reliability and safety, reduce statewide greenhouse gas emissions, and help create clean energy jobs. The *2011 Integrated Energy Policy Report* discusses issues associated with the state's clean energy goals to increase energy efficiency, renewable electricity, distributed generation, combined heat and power, and alternative and renewable transportation fuels. In addition, the report discusses the important roles that interagency coordination, and research and development will play in achieving these goals.

Energy Efficiency

Energy efficiency remains California's top priority for meeting new electricity needs and is a key strategy for increasing jobs and reducing greenhouse gas emissions from the electricity sector. Past and current government energy policies and programs have made California a national leader in energy efficiency. In the last three decades, California's policies, programs, and efficiency standards for buildings and appliances have contributed to keeping California's per capita electricity consumption relatively constant while use in the rest of the United States has increased 40 percent. The Energy Commission staff estimates that standards have also saved customers $66 billion in electricity and natural gas costs (in 2010 dollars) since 1975. President Obama, noting in his 2012 State of the Union address that more efficient use of energy saves money, asked Congress to send him a bill to: "Help manufacturers eliminate energy waste in their factories and give businesses incentives to upgrade their buildings. Their energy bills will be $100 billion lower over the next decade, and Americans will have less pollution, more manufacturing, and more jobs for construction workers who need them."

California's energy efficiency policies include achieving all cost-effective energy efficiency; reducing energy use in existing buildings built before the advent of building and appliance efficiency standards; and making all new residential construction in California "zero net energy" (a combination of greater energy efficiency and on-site clean energy production to reduce building energy use to "net zero") by 2020, and all new commercial construction zero net energy by 2030.

Achieving All Cost-Effective Energy Efficiency

To further California's goal of achieving all cost-effective energy efficiency, Assembly Bill 2021 (Levine, Chapter 734, Statutes of 2006) requires the Energy Commission, in consultation with the California Public Utilities Commission, to develop statewide energy efficiency potential estimates and targets for California's investor-owned and publicly owned utilities and report on their progress toward these targets in the *Integrated Energy Policy Report*. In December 2011, the Energy Commission staff released the *Achieving Cost-Effective Energy Efficiency for California 2011–2020* final report, which summarizes utility progress and recommends improvements for publicly owned utility efficiency efforts. Investor-owned utilities reported 4,607 GWh of annual energy savings and 837 MW of peak savings for 2010, which exceeded the California Public Utilities Commission 2010 savings goals of 2,276 GWh and 502 MW. Reported natural gas savings were 46 million therms, just short of the California Public Utilities Commission's natural gas savings goal for 2010 of 48 million therms. Publicly owned utilities achieved 74 percent of the 2010 energy savings target and provided 523 GWh of electric energy savings, a decrease of 19 percent from 2009, and 94 MW of peak savings, 20 percent less than in 2009.

For future savings potential, the *Achieving Cost-Effective Energy Efficiency for California 2011–2020* report estimates 9,525 GWh of cost-effective savings potential for the publicly owned utilities for 2011–2020. This target, however, only represents about 42 percent of net annual savings from all publicly owned utilities. The two largest publicly owned utilities will be updating their savings potential and targets at a later date.

Forecasted savings from several individual utilities meet the AB 2021 goal of 10 percent savings over 10 years, but the combined publicly owned utility targets achieve only 6.8 percent savings from forecasted 2020 base energy use. For most utilities, market savings potential was calculated using a 50 percent customer measure incentive level. Energy Commission staff analysis indicates that when a 75 percent incentive level is used, nearly all utilities would meet the 10 percent consumption reduction goal contained in AB 2021. This suggests that the publicly owned utilities can meet the consumption reduction goal but may require a higher level of program effort and budget than was factored into their targets. However, the issue of cost-effectiveness is a key factor in setting incentive levels and determining which efficiency measures to include in programs. Increasing incentive levels to 75 percent may not be cost-effective for all utilities.

Reducing Energy Use in Existing Buildings

Existing buildings also provide a tremendous opportunity for low-cost energy savings, reduced greenhouse gas emissions, and job creation. More than half of California's 13 million residential units and more than 40 percent of commercial buildings were built before implementation of the state's building standards. Assembly Bill 758 (Skinner, Chapter 470, Statutes of 2009) directed the Energy Commission to develop, adopt, and implement a comprehensive statewide program to reduce energy consumption in existing buildings and report on that effort in the *Integrated Energy Policy Report*.

Efforts by the Energy Commission, the California Public Utilities Commission, local governments, and utilities to coordinate residential and commercial building retrofit programs under the Energy Upgrade California™ brand are providing the foundation for the AB 758 program. Next steps are to complete needs assessments for both residential and non-residential buildings, identify what must be done in program component areas (including lessons learned from pilot programs), and develop action plans for moving forward with AB 758 program development.

The Energy Commission will also work with the California Public Utilities Commission to emphasize joint efforts to achieve improved compliance with building and appliance standards to ensure that energy efficiency measures and equipment are properly installed and delivering savings. The Energy Commission will also develop regulations to improve compliance with appliance efficiency standards using its authority under Senate Bill 454 (Pavley, Chapter 591, Statutes of 2011), which allows the Energy Commission to adopt an enforcement process for violations of appliance efficiency regulations and impose civil penalties of up to $2,500 for each violation.

Achieving Zero Net Energy Homes and Buildings

The Energy Commission, the California Public Utilities Commission, and the Air Resources Board have adopted a goal of achieving zero net energy building standards by 2020 for residential buildings and 2030 for commercial buildings. According to the California Public Utilities Commission, California has more zero net energy buildings than any other state. To support the state's zero net energy goals, in September 2011 the California Public Utilities Commission released its *2010–2012 Zero Net Energy Action Plan* for the commercial building sector.

The Energy Commission is contributing to zero net energy goals by regularly updating its building efficiency standards to reflect new technologies and strategies with the goal of achieving 20 to 30 percent energy savings in each triennial update, and by updating appliance standards to include electronics and other devices plugged into electrical outlets that represent an increasing portion of California's energy use. In 2010, appliance efficiency standards alone saved an estimated 18,761 gigawatt hours of electricity, representing nearly 7 percent of California's electric load, and saved consumers about $2.6 billion in energy costs.

Governor Brown noted in his 2012 State of the State address: "Our state keeps demanding more efficient cars, machines, and electric devices. We do that because we understand that fossil fuels, particularly foreign oil, create ever rising costs to our economy and our health." To meet the demand for more efficient electric devices, the Energy Commission in early 2012 adopted standards for the estimated 58 million battery chargers sold each year in California that, when implemented, will save state ratepayers an estimated $306 million each year, provide annual electricity savings of more than 2,000 GWh, and eliminate 1 million metric tons of carbon emissions.

Renewable Energy

California has more than 10,000 MW of renewable generating capacity on-line, with estimated technical potential (which does not reflect economic,

California has used renewable energy – energy from natural resources like sunlight, wind, rain, and the Earth's heat –

to help meet its electricity needs for more than a century. Renewable electricity provides many economic and environmental benefits including local jobs in clean technology and construction industries revenues from property and sales taxes; energy independence from using local energy sources and fuels rather than imported natural gas; reduced fossil-fuel generation that has negative impacts on ai and water quality; and reduced greenhouse gas emissions from the electricity sector to help meet state climate change goals. California has been a leader in expanding its consumption of renewable energy since the late 1970s when, under Governor Jerry Brown's first administration, the California Public Utilities Commission ordered utilities to establish standard offers for buying electricity from alternative suppliers ("qualifying facilities") at cost-based rates, with the price equal to the buyer's full avoided cost. By 1991, these standard contracts resulted in more than 11,000 megawatts (MW) of qualifying facilities on-line in California, about half of which use renewable resources.

Now, Governor Brown is putting forth new and expanded targets. In his Clean Energy Jobs Plan, the Governor is emphasizing the importance of investing in renewable energy as a central element of rebuilding California's economy. The Governor directed the Energy Commission to prepare a plan to "expedite permitting of the highest priority [renewable] generation and transmission projects" to support investments in renewable energy that will create new jobs and businesses, increase energy independence, and protect public health. In December 2011, the Energy Commission released the *Renewable Power in California: Status and Issues* report, which describes the current status of renewable development in California and identifies challenges to meeting the state's renewable goals. This chapter summarizes that report and outlines high-level strategies to be included in a comprehensive strategic plan for renewable energy in California that will be developed as part of the *2012 Integrated Energy Policy Report Update*

California's Renewable Electricity Targets and Status

In 2002, the California Legislature established the Renewables Portfolio Standard (RPS) to diversify the electricity system and reduce growing dependence on natural gas. At that time, the target was to increase the amount of renewable electricity in the state's power mix to 20 percent by 2017, which was subsequently accelerated to 2010 by legislation passed in 2006. In 2011, the RPS was further revised and expanded to require that renewable electricity should equal an average of 20 percent of the total electricity sold to retail customers in California during the compliance period ending December 31, 2013, 25 percent by December 31, 2016, and 33 percent by December 31, 2020.[18] To support these RPS targets, Governor Brown's Clean Energy Jobs Plan calls for adding 20,000 MW of new renewable capacity by 2020, including 8,000 MW of large-scale wind, solar, and geothermal as well as 12,000 MW of localized generation close to consumer loads. According to a recent presentation by Michael Picker, Senior Advisor to the Governor for Renewable Facilities, resources included in the 12,000 MW goal are defined as: (1) fuels and technologies accepted as renewable for purposes of the Renewables Portfolio Standard; (2) sized up to 20 MW, and (3) located within the low-voltage distribution grid or supplying power directly to a consumer.[19] Some parties have suggested that this definition be expanded to include other low GHG-emitting resources, such as fuel cells and high-efficiency combined heat and power facilities. The Energy Commission will hold workshops during the *2012 IEPR Update* and *2013 IEPR* proceedings to discuss combined heat and power issues, and welcomes suggestions from parties on how to best ensure that the state's distributed generation and combined heat and power goals are complementary.

California appears to be on track to achieve the 20 percent average by 2013 RPS compliance period, with nearly 16 percent of statewide retail sales coming from

18 The California Public Utilities Commission recently established procurement quantity requirements for interim years of 21.7 percent (2014); 23.3 percent (2015); 27 percent (2017); 29 percent (2018); and 31 percent (2019). Decision 11-12-020, *Decision Setting Procurement Quantity Requirements for Retail Sellers for the Renewables Portfolio Standard Program*, December 1, 2011, docs.cpuc.ca.gov/WORD_PDF/FINAL_DECISION/154695.PDF.

19 Michael Picker, presentation at the December 8, 2011, California Foundation on the Environment and the Economy Energy Roundtable Summit on Distributed Generation, www.cfee.net/_documents/Picker.pdf.

Table 1: In-State Renewable Capacity and Generation (2010)

Renewable Resource	Utility-Scale Capacity (MW)	Wholesale Distributed Generation Capacity (MW)	Distributed Generation Capacity (MW)	Total Capacity (MW)	Total Generation (GWh)
Biomass	1,070	632	25	1,727	5,745
Geothermal	2,521	46	0	2,567	12,740
Small Hydro	315	1,080	0	1,395	4,441
Solar	408	149	1,070[B]	1,627	908
Wind	No data	No data	8[C]	3,027[D]	6,172
Total	4,314	1,907[A]	1,103[E]	10,343	30,005

Source: California Energy Commission

A. Sources of the data Include the Energy Commission's Quarterly Fuels and Energy Report Database and POU RPS database; CPUC's IOU database (www.cpuc.ca.gov/PUC/energy/Renewables/), and CPUC staff update on installed capacity under SB 32.

B. Solar PV systems under SB1 (CPUC staff calculation for CSI, Energy Commission staff calculation for NSHP, and Energy Commission staff calculation as reported by the POUs for their portion), the Self-Generation Incentive Program (energycenter.org/index.php/incentive-programs/self-generation-incentive-program/sgip-documents/sgip-documents), and the Emerging Renewables Program (www.energy.ca.gov/renewables/emerging_renewables/).

C. Wind turbine systems in the Self-Generation Incentive Program (energycenter.org/index.php/incentive-programs/self-generation-incentive-program/sgip-documents/sgip-documents) and the Emerging Renewables Program (www.energy.ca.gov/renewables/emerging_renewables/)

D. Includes 3019 MW of utility scale and wholesale distributed generation wind capacity. California ISO data on wind projects located in the California ISO and the Energy Commission's QFER Database, energyalmanac.ca.gov/electricity/web_qfer/ for wind projects located outside the California ISO.

E. Total updated in 2011.

renewable generation in 2010.[20] In-state renewable generation represented about 75 percent of total renewable generation from more than 10,000 MW of renewable generating capacity (Table 1[21]).

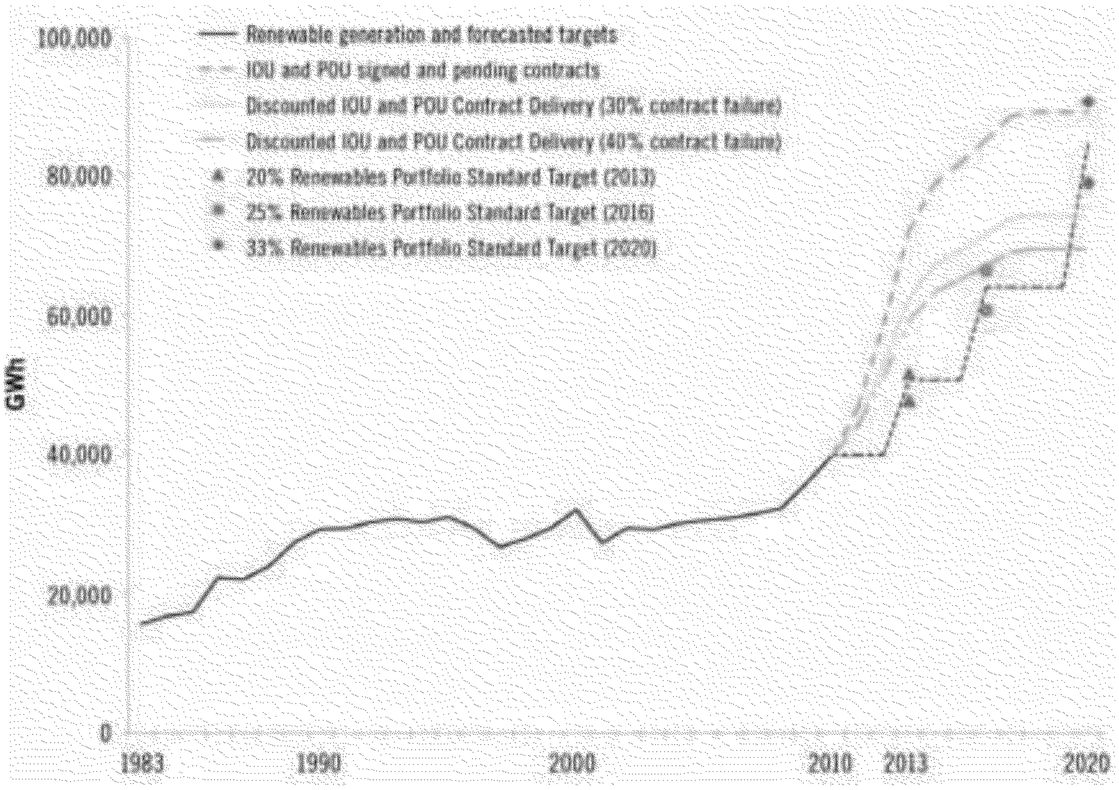
For the 33 percent by 2020 target, Energy Commission staff estimates that the state will need renewable generation in the range of 35,000 gigawatt hours (GWh) to 47,000 GWh in addition to generation expected from existing facilities. Utility contracts signed and pending to date are expected to deliver enough energy to reach the upper bound of this range if most or all of the contracted renewables are built and generating by 2020 (Figure 1).

This estimate includes a number of short-term contracts that may not be renewed, as well as existing facilities that may retire due to age or contract expiration, which could reduce the contribu-

20 Depending on the data source, total renewable generation varies between 15 and 16.5 percent of statewide retail sales from renewable generation in 2010. Procurement and generation sources include: The Power Source Disclosure Program, CPUC RPS Compliance Filings, Energy Commission RPS Tracking, and the Energy Commission's Total System Power.

21 The wholesale DG total in Table 1 was based on project size (20 MW or less) and excluded wind capacity due to lack of reliable data; the total will therefore need further refinement,given the revised definitionof what meets the Governor's 12,000 MW goal, to screen out projects connected at the transmission level and include wholesale DG wind capacity.

Figure 1: Renewable Generation for California and Renewables Portfolio Standard Goals



Source: California Energy Commission, *Renewable Power in California: Status and Issues*, December 2011.

Dashed orange line showing expected renewable generation does not include potential generation from electric service providers, community choice aggregators, or small multi-jurisdictional utilities which are also subject to the RPS. In 2010, renewable generation from these entities represented only about 5 percent of statewide renewable generation.

tion from existing facilities.[22] There is also risk of contract failure; data from the Energy Commission's IOU contract database indicates that since the start of the RPS program, about 30 percent of long-term RPS contracts (10 years or more) approved by the California Public Utilities Commission (CPUC) have been cancelled.

The contract failure rate increases to about 40 percent when also considering contracts that have been delayed, and, at the September 14, 2011, workshop on the draft *Renewable Power in California: Status and Issues* report, two utilities indicated that they currently assume a contract failure rate of 40 percent.[23] This suggests it would be prudent for utilities to contract for renewable generation in the range of 55,000 GWh (contract failure rate of 30 percent) to 85,000 GWh (contract failure rate of 40 percent).[24]

22 According to metrics on the California Clean Energy Future website, contracts for roughly 12,000 GWh of renewable generation will expire before 2020, www.cacleanenergyfuture.org/documents/RenewableEnergy.pdf.

23 Transcript of the September 14, 2011, Integrated Energy Policy Report workshop on the *Draft Renewable Power in California: Status and Issues* report, comments by Valerie Winn, Pacific Gas and Electric Company, (page 72) and Gary Stern, Southern California Edison (page 73), www.energy.ca.gov/2011_energypolicy/documents/2011-09-14_workshop/2011-09-14_transcript.pdf.

24 The Energy Commission acknowledges that historical contract failure rates are not predictive of future rates, which could be lower or higher.

Table 2: Preliminary Regional Targets for 8,000 Megawatts of New Renewable Capacity by 2020

Identified Transmission Line(s)	CREZ Served	Cumulative Renewable Deliverability Potential with New/Upgraded Lines (MW)	2010 Permitted Generating Capacity Associated with New/Upgrades (MW)	Additional Transmission Project Capacity (MW)
Sunrise Powerlink	Imperial North and South, San Diego South	1,700	760	940
Tehachapi and Barren Ridge Renewable Transmission Projects	Tehachapi, Fairmont	5,500	2,810	2,690
Colorado River, West of Devers, and Path 42 Upgrade	Riverside East, Palm Springs, Imperial Valley	4,700	1,825	2,875
Eldorado-Ivanpah, Pisgah-Lugo, and Coolwater-Jasper-Lugo	Mountain Pass, Pisgah, Kramer	2,450	1,470	980
Borden-Gregg	Westlands	800	145	655
South of Contra Costa	Solano	535	155	380
Carrizo-Midway	Carrizo South, Santa Barbara	900	800	100
			TOTAL	8,620

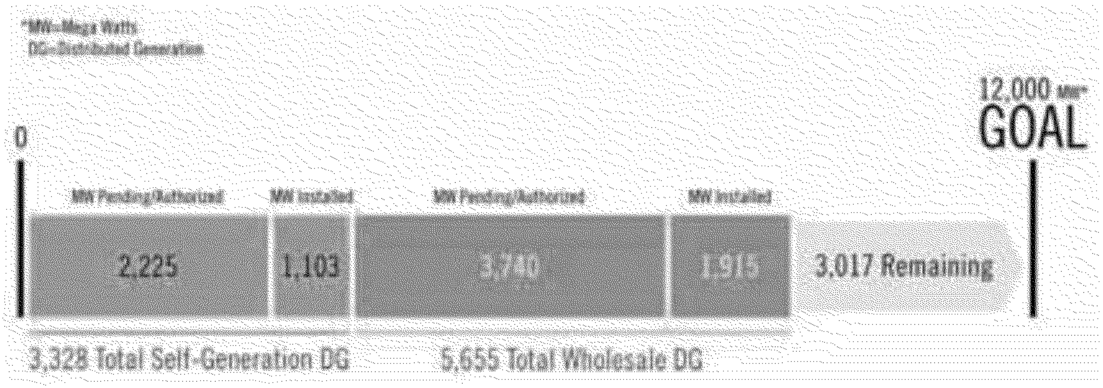
Source: California Energy Commission, *Renewable Power in California: Status and Issues*, December 2011.

As a starting point for measuring progress toward meeting the Governor's 20,000 MW goal, the *Renewable Power in California: Status and Issues* report included preliminary regional targets for both utility-scale and localized renewable generation facilities. For the target of 8,000 MW of utility-scale renewables by 2020, Energy Commission staff identified rough regional targets based on new transmission lines and upgrades that have been identified by the California Independent System Operator (California ISO) for all of California's balancing authorities and potential renewable capacity in Competitive Renewable Energy Zones (CREZ) identified through the 2007–2010 Renewable Energy Transmission Initiative (RETI) that would be served by those lines and upgrades (Table 2).[25]

If these new lines and upgrades are permitted, built, and operating before 2020, they could allow generation from more than 16,000 MW of cumula-

25 RETI was initiated in 2007 as a joint effort among the CPUC, the Energy Commission, the California ISO, utilities, and other stakeholders. Primary goals were to identify transmission projects needed to accommodate California's renewable energy goals; promote designation of corridors for future transmission line development; and make transmission and generation siting and permitting easier. *Renewable Energy Transmission Initiative Phase 2B Final Report*, RETI-1000-2010-002-F, May 2010, www.energy.ca.gov/reti/documents/index.html.

Figure 2: Renewable Distributed Generation Capacity Counted Toward 12,000 MW Goal



Source: California Energy Commission.

"Pending" capacity refers to projects approved under existing programs and in development but not yet completely installed. "Authorized" capacity refers to capacity allocated under existing programs that is not yet approved or installed. Existing programs include the Senate Bill 32 feed-in tariff, the Renewable Auction Mechanism, the Utility Solar Photovoltaic Program, and the California Solar Initiative. The Energy Commission acknowledges that the totals presented in this figure will need further refinement; for example, not all projects deve loped under the Renewable Auction Mechanism may qualify as wholesale DG under the definition of DG presented in this report.

tive renewable capacity to flow across those lines.[26] In 2010, state and local entities issued permits for roughly 9,000 MW of new renewable capacity, about 8,000 MW of which is associated with the new lines and upgrades. This indicates that another 8,000 MW of renewable capacity could be sited in the CREZ associated with these lines in the future.

For the 12,000 MW distributed generation (DG) target, Energy Commission staff developed preliminary regional targets for localized generation (Table 3), defined for purposes of the analysis at that time as renewable DG projects 20 MW and smaller interconnected to the distribution or transmission grid. The analysis was technology neutral and included solar, biomass, geothermal, wind, fuel cells using renewable fuel, and small hydropower. The analysis also assumed that renewable DG capacity installed would count toward meeting the 12,000 MW goal. California has roughly 3,000 MW of renewable DG capacity installed and, if existing state programs to support renewable DG are fully successful, the state could add about 6,200 MW of capacity in the next five to eight years (Figure 2). More information is needed to assess the legitimacy of the targets and the targets should be periodically updated. Given the trend of declining costs for solar photovoltaic (PV) technologies, the Energy Commission believes the focus should be on developing the "low-hanging fruit" in the next few years. Meanwhile, the state should focus on reforming permitting and interconnection processes so that subsequent development of renewable DG installations can take advantage of cost reductions and improved regulatory structures in later years.

26 Written comments by Kern County and Critical Path Transmission on the draft 2011 IEPR suggested a transmission line which, if built, could potentially open up the West Mojave Desert to renewable energy development. The West Mojave Desert has been identified as an area of high solar insolation and the Energy Commission and other members of California's Renewable Energy Action Team have encouraged development there. That area also has lands with high conservation value, particularly for the Mohave ground squirrel and desert tortoise, and the Desert Renewable Energy Conservation Plan provides a forum for balancing energy and conservation needs in the area. Toward this end, the Energy Commission supports efforts by independent transmission advocates to improve access to the West Mojave and will work with agencies and stakeholders involved in the Desert Renewable Energy Conservation Plan to address development and resource conservation options.

Table 3: Proposed Preliminary Regional DG Targets by 2020

Region	Behind the Meter (all technologies) (MW)	Wholesale (MW)	Undefined(mix of behind the meter and wholesale) (MW)	Total (MW)
Central Coast	280	90	0	370
Central Valley	830	1590	0	2,420
East Bay	420	30	0	450
Imperial	50	90	0	140
Inland Empire	480	430	0	910
Los Angeles (city and county)	970	860	2170	4,000
North Bay	220	0	0	220
North Valley	120	50	0	170
Sacramento Region	410	170	220	800
San Diego	500	50	630	1,180
SF Peninsula	480	10	310	800
Sierras	30	40	0	70
Orange	420	10	40	470
Total	5,210	3,420	3,370	12,000

Source: California Energy Commission, *Renewable Power in California: Status and Issues* December 2011.

Post-2020, additional investments in renewable generation may be needed to replace generation expected to decline over the course of the next decade, such as generation from expiring coal contracts. Generation from a number of these contracts, which currently represents about 10 percent of total generation serving California, is expected to decline by 61 percent between 2010 and 2020 due to constraints imposed by the Emission Performance Standard.[27] Remaining coal contracts are expected to expire between 2027 and 2030, which will require replacement power from a mix of renewable and thermal generation with storage to satisfy electricity needs while still meeting greenhouse gas emission reduction goals.

When signing the 2011 RPS legislation, Governor Brown indicated that the 33 percent by 2020 RPS target should be considered a floor rather than a ceiling. This is consistent with the need for additional renewable generation and other zero-carbon electricity resources to meet the state's long-term (2050) GHG emission reduction goals. Back-of-the-envelope estimates by Energy Commission staff indicate that if new renewables alone provided the zero-emission generation needed to meet electricity needs in 2050,

27 The Emission Performance Standard prohibits California utilities from renegotiating or signing new contracts for baseload generation that exceeds 1,100 lbs of carbon dioxide equivalent (CO_2e) emission per MWh. A number of contracts with coal generation facilities that exceed the Emission Performance Standard will expire within the decade and cannot be renewed with another long-term contract.

Table 4: California's Renewable Energy Potential

Technology	Technical Potential (MW)
Biomass	3,820
Geothermal	4,825
Small Hydro	2,158
Solar – Concentrating Solar Power	1,061,362
Solar – PV	17,000,000
Wave and Tidal	32,763
Wind – Onshore	34,000
Wind – Offshore	75,400
TOTAL TECHNICAL POTENTIAL	18,214,328

Source: California Energy Commission, *Renewable Power in California: Status and Issues*, December 2011.

renewable generation could represent from 67 to 79 percent of total electricity sales in 2050.[28]

California's estimated renewable technical potential is 18 million MW (Table 4).[29] Although this figure does not reflect economic or environmental constraints, development of even one-tenth of 1 percent of this potential would nearly meet the Governor's 20,000 MW renewable goal. Achieving this potential will depend on the ability of project developers to secure financing, permits, transmission, interconnection, local community acceptance, and power purchase agreements.

Despite these challenges, recent trends indicate increasing market interest in renewable development. The 2009 RPS solicitation by the investor-owned utilities (IOUs) drew bids from developers offering to supply enough renewable generation to meet half of the IOUs' total electrical load in 2020, and IOUs currently have signed contracts for roughly 14,000 MW of new renewable capacity. In 2010, state and local entities issued permits for 9,435 MW of renewable capacity, and another 28,000 MW is being tracked in various

28 The 67 percent estimate assumes that electricity demand, the number of self-generation projects, and energy efficiency programs continue to grow at current rates; increased penetration of electric vehicles; and continued operation of existing renewables, nuclear, and hydroelectric generation at the same levels in 2050 as today. The 79 percent estimate uses the same assumptions with the exception of nuclear and assumes that existing nuclear plants are not relicensed. These estimates do not consider the additional need for integration of intermittent renewables, which may require additional flexible capacity toward which fossil fuels, energy storage, and demand response could play a part. Estimates are presented for illustration only and not intended to be used for planning purposes.

29 *Technical potential* refers to the amount of generating capacity theoretically possible given resource availability, geographical restrictions, and technical limitations like energy conversion efficiencies and does not reflect economic potential (how much could be developed at cost levels considered competitive) or market potential (how much could be implemented in the market after accounting for energy demand, competing technologies, costs and subsidies, and barriers).

permitting processes.[30] The California ISO's Interconnection Queue includes about 57,000 MW of renewable capacity, and there are 450 active interconnection requests for DG systems in the Wholesale Distribution Access Tariff queue totaling about 5,200 MW.

Issues Affecting Future Renewable Development in California

The *Renewable Power in California: Status and Issues* report identified a variety of issues that will affect the amount of renewable capacity ultimately developed, including environmental, planning, and permitting; transmission; grid- and distribution-level integration; investment and financing cost; research and development (R&D); environmental justice; local government coordination; and workforce development. The report also discussed past and current efforts to address these challenges, which must be overcome to achieve California's renewable energy targets and goals.

Planning and Permitting Issues

For utility-scale renewable plants, the primary planning and permitting challenges are environmental/land use issues and fragmented and overlapping permitting processes. Renewable facilities can have a variety of environmental and land-use impacts depending on location and technology. Because the majority of new renewable development is proposed in the California desert, the *Renewable Power in California: Status and Issues* report focused on desert environmental impacts. These include impacts on sensitive plant and animal species, water supplies and waterways, and cultural resources like areas of historical or ethnographic importance. There are also land-use concerns because the majority of desert lands in California are owned by the federal government and managed for multiple uses, including recreation, wildlife habitat, livestock grazing, and open space.

In terms of the permitting process, a variety of federal, state, and local agencies have licensing authority for different types of utility-scale renewable projects. This can lead to inconsistent environmental reviews and standards and variation in the extent of environmental evaluation, interpretation of results, and mitigation requirements. The result is that developers may have to satisfy more than one set of conditions, submit duplicate information, or face delays while agencies resolve their differences.

For renewable DG facilities, widely varying codes, standards, and fees among local governments with jurisdiction over these projects are a challenge for developers trying to meet permitting requirements. In addition, developers must get permit approvals from multiple local entities like fire departments, building and electric code officials, and local air districts, which can lead to duplication and inefficiency in the permitting process. Also, many local jurisdictions do not have energy elements in their general plan or zoning ordinances to guide renewable development and may have environmental screening and review processes in place only for large-scale renewables, not DG projects.

The state's Renewable Energy Action Team (REAT) is developing the Desert Renewable Energy Conservation Plan (DRECP) to help minimize environmental impacts of renewable generation and transmission

30 California Energy Commission, see: www.energy.ca.gov/33by2020/documents/renewable_projects/REAT_Generation_Tracking_Projects_Report.pdf.

projects in the desert.[31] The DRECP's role is to identify areas in the Mojave and Colorado Desert regions suitable for renewable generation and transmission project development and areas that will contribute to the conservation of sensitive species and natural communities. The DRECP encompasses roughly 22 million acres in Kern, Inyo, Los Angeles, San Bernardino, Riverside, San Diego, and Imperial counties (Figure 3). It will promote development of solar thermal, utility-scale solar PV, wind, and other forms of renewable energy as well as associated infrastructure such as transmission lines.

Other efforts to improve permitting for utility-scale and DG renewable projects include:

*** The REAT published the multidisciplinary *Best Management Practices and Guidance Manual: Desert Renewable Energy Projects* in December 2010, which helps project developers design projects that minimize environmental impacts.[32]

*** The Energy Commission's Public Interest Energy Research (PIER) Program is funding research to help reduce the environmental impacts of renewable energy facilities, including strategies to diminish the effects of desert solar and wind projects on sensitive species. For more information about the role of the PIER Program, please see Chapter 12.

*** The Energy Commission initiated an Order Instituting Informational Proceeding in December 2010 to evaluate lessons learned during the licensing of large-scale renewable facilities in 2010 with the goal of identifying innovative approaches to future planning and permitting (see Chapter 6).

*** The U.S. Department of Energy's (U.S. DOE) Solar America Cities Program provided funding for cities that promote solar power and streamline interaction between local government and residents.

*** The U.S. DOE's SunShot Initiative provides funding to encourage cities and counties to streamline and digitize permitting processes and to develop innovative information technology systems, local zoning and building codes, and regulations.

*** California's Assembly Bill X1 13 (V. Manuel Pérez, Bradford, and Skinner, Chapter 10, Statutes of 2011), passed in 2011, requires the Energy Commission to, upon appropriation, provide $7 million in grants to qualified counties for developing or revising rules and policies (including general plan elements, zoning ordinances, and a natural community conservation plan) to promote the development of eligible renewable energy resources.

*** Many jurisdictions are supporting renewable DG by identifying permitting barriers, developing expedited permitting processes, offering online permits for solar PV systems, and offering permit fee waivers for solar and wind projects. The California County Planning Directors Association is also coordinating a multi-stakeholder effort to draft a model ordinance for solar electric facilities for cities and counties across the state.

*** The Ocean Protection Council recently passed a resolution recommending that "the Energy Commission should adopt an ocean renewable energy policy that guides the state's goals for the development of

31 Executive Order S-14-08, November 2008, directs state agencies to create comprehensive plans to prioritize regional renewable projects based on renewable resource potential and protection of plant and animal habitat. The Energy Commission and the California Department of Fish and Game signed a memorandum of understanding formalizing a Renewable Energy Action Team to implement and track progress of this effort. See Desert Renewable Energy Conservation Plan website at www.drecp.org.

32 Renewable Energy Action Team, *Best Management Practices and Guidance Manual: Desert Renewable Energy Projects*, December 2010, www.drecp.org/documents/index.html.

In 2005, Senate Bill 1037 (Kehoe, Chapter 366, Statutes of 2005) made energy efficiency a priority strategy for electric utilities to meet their resource needs. SB 1037 requires the California Public Utilities Commission (CPUC) and the Energy Commission to identify potentially achievable cost-effective electric and natural gas energy efficiency savings and set goals for investor-owned utilities (IOUs) to achieve this potential.[63] Both agencies must review the procurement plans to ensure the consideration of energy efficiency and other cost-effective supply options. In addition, SB 1037 requires all publicly owned utilities, regardless of size, to report annually to their customers and to the Energy Commission on investments in energy efficiency programs.

Assembly Bill 2021 (Levine, Chapter 734, Statutes of 2006) added more specific legal directions for increasing California's energy efficiency programs. AB 2021 requires each publicly owned utility to:

*** Beginning in 2007 and every three years thereafter, identify all potentially achievable cost-effective electricity energy savings. Using the efficiency potential estimates, establish annual targets for energy efficiency savings for the next 10-year period.

*** Report on program cost-effectiveness and third-party energy evaluation, measurement, and verification (EM&V) of program savings.

AB 2021 directs the Energy Commission to:

*** Include a summary of the publicly owned utilities' savings and evaluation, measurement, and verification (EM&V) studies in the *Integrated Energy Policy Report (IEPR)*.

63 The terms for energy efficiency "targets" and "goals" are used interchangeably. There is an established convention (at least since 2004) that the CPUC and IOUs use the term "goals." Publicly owned utilities have adopted the term "targets" since that is the term used in AB 2021.

*** In consultation with the CPUC as the regulator of IOUs' energy efficiency programs, provide a triennial statewide estimate of energy efficiency potential and targets for a 10-year period.

*** Provide recommendations to publicly owned utilities, Legislature, and the Governor of possible improvements by the publicly owned utilities.

In response to AB 2021, the Energy Commission released the fifth annual final staff report *Achieving Cost-Effective Energy Efficiency for California 2011–2020 (2011 AB 2021 Progress Report)* on December 21, 2011. The following section provides an overall summary of the utilities' progress on energy efficiency program savings, EM&V reporting, and a more detailed description of setting energy efficiency targets, followed by recommendations for improvement of these efforts.

Staff Assessment of Utilities' Progress

Investor-Owned Utilities' Progress

The IOUs administer efficiency programs under the CPUC's Decision 09-09-047, which approved the IOUs' efficiency program portfolios for 2010–2012 with a total budget of $3.1 billion. The combined IOUs reported 4,607 gigawatt hours (GWh) of annual energy savings, 837 megawatts (MW) of peak savings, and 46 million therms of natural gas savings in 2010, which exceeded their 2010 CPUC-mandated goals. The 2010 natural gas savings fell just a bit short of the CPUC's natural gas goals for 2010.

The 2010 IOU savings numbers are still *ex ante* savings, that is, self-reported savings that have not

Table 5: IOUs' and Publicly Owned Utilities' 2009 and 2010 Savings and Expenditures

	Investor-Owned Utilities		Publicly Owned Utilities	
	2009	2010	2009	2010
Gigawatt hours	3,770	4,610	644	523
Megawatt hours	700	839	117	94
Therms	54	46	-	-
Expenditures ($ Millions)	$722	$755	$146	$123

All savings data for both IOUs and publicly owned utilities are self-reported and have not been verified by third-party evaluators.

Source: Data obtained from the IOUs' Annual Reports for 2009 and 2010 (eega.cpuc.ca.gov), and CMUA, *Energy Efficiency in California's Public Power Sector: A Status Report*, March 2010 and March 2011 (cmua.org).

been verified by third-party evaluators. Beginning with the 2006–2008 program implementation cycle, the CPUC instituted a more comprehensive process for capturing, retaining, and reporting *ex post* evaluation results. The CPUC's 2006–2008 EM&V results show a significant difference between reported and evaluated savings for that period. While the IOUs reported surpassing their energy savings goals, the evaluation report indicated that the utilities achieved between 37 percent and 71 percent of their goals for that period. However, the CPUC's *2009 Energy Efficiency Evaluation Report for the 2009 Bridge Funding Period* verified that the IOUs achieved 141 percent of the GWh goal and 104 percent of the MW goal.[64]

A new CPUC *Potential and Goals Study* for efficiency is underway and expected to be completed in late summer 2012. The results of this study will be incorporated into the next AB 2021 report to be released in 2014.

64 California Public Utilities Commission, *Energy Efficiency Evaluation Report for the 2009 Bridge Funding Period*, January 2011, www.cpuc.ca.gov/NR/rdonlyres/D66CCF63-5786-49C7-B250-00675D91953C/0/EEEvaluationReportforthe2009BFPeriod.pdf, p. 23.

Publicly Owned Utilities' Progress

In 2010, all publicly owned utilities combined spent a total of $123 million on energy efficiency programs, a 15 percent decrease from 2009 and the first drop in energy efficiency program spending since 2006 (Table 5). Likewise, both energy and peak savings declined for the publicly owned utilities for the first time since 2006. In 2010, the 39 reporting publicly owned utilities provided 523 GWh of electric energy savings, a decrease of 19 percent from 2009. The publicly owned utilities achieved 74 percent of their 2010 energy savings target set in 2007. The decline in the 2010 numbers, however, is largely due to the completion of a large contracted lighting program at Los Angeles Department of Water and Power (LADWP).[65] Despite 2010's lackluster economic conditions, mid-sized

65 In its December 23, 2011, written comments on the draft *2011 IEPR*, LADWP noted that it is "evaluating an updated version of the lighting program, which will be targeted to capture additional energy savings from the small business market that are historically difficult to reach with efficiency programs." (www.energy.ca.gov/2011_energypolicy/documents/comments_draft_iepr/index.php).

and small utilities performed reasonably well in both efficiencyspending and savings.

This report contains metrics that measure the progress made by the publicly owned utilities in their energy efficiency programs: trends in reported energy efficiencyexpenditures, energy efficiencyspending as a percentage of revenue, energy savings relative to adopted targets, energy savings as a percentage of total utility sales, and the cost-effectiveness of efficiency programs.

Energy Commission staff has requested information from the publicly owned utilities that would help to interpret data on efficiencyprogress. Their response to information requests has improved since 2008, but the Energy Commission is still not receiving some significantmaterial. As staff learns their specificobjections to data sharing, the Energy Commission and the publicly owned utilities can develop resolutions.

Evaluation and Verification of Publicly Owned Utilities' Efficiency Savings

The publicly owned utilities' savings reported in this document have not been modifiedas a result of independent verificationstudies. Unlike the IOUs, for which the CPUC can report evaluated savings, most publicly owned utilities do not yet have consistent evaluation methods. Since the passage of AB 2021 in 2006, nearly half of the publicly owned utilities have filedat least one EM&V impact study for program years 2007–2009. The Energy Commission developed EM&V guidelines in 2010 but learned in 2011 workshops that, for many publicly owned utilities, EM&V can impose costs without equal benefitsNot all publicly owned utilities provide earmarked funding for EM&V in their budgets so there can be tradeoffs between paying for third-party evaluation and providing program services. Other publicly owned utilities had difficultymeeting the Energy Commission's draft guidelines because diversity in size, resources, customer types, and program delivery approaches makes it difficultto meet "one-size-fits-all"prescriptive guidelines for EM&V activities. Some utilities, however, did indicate benefits received from EM&V studies, including using study recommendations to improve data tracking systems and program delivery.

Status of Statewide Estimate of Energy Efficiency Potential and Targets for 2011–2020

AB 2021 requires publicly owned utilities to develop estimates of energy efficiencypotential and targets on a triennial basis. Due to the unavailability of certain data, the Energy Commission could not set the statewide efficiencyestimates for all utilities with the method directed in AB 2021. After the passage of AB 2021, the Energy Commission coordinated 10-year savings targets in December 2007 for both the IOUs and publicly owned utilities. In 2007, all the utilities had a recent potential study and set of approved targets and goals from which to develop the statewide savings potential estimate. In 2010–2011, however, the IOUs did not have revised potential estimates and goals available, Sacramento Municipal Utility District committed to putting advanced state energy codes into effect (such as the Energy Commission's 2008 and subsequent Building Energy Efficiency Standards) and developing approaches to achieve high levels of compliance with those standards.

AB 758 directed the Energy Commission and the CPUC to collaborate on how to best deliver financing and design utility programs for upcoming funding cycles to advance the comprehensive AB 758 program.

Efficiency Improvements in Appliances

The Appliance Efficiency Standards (Appliance Standards) are another strategy for reducing energy use in newly constructed and existing buildings. While permanently installed equipment and appliances are a substantial part of the building's energy use,[81] electronics and other devices plugged into outlets make up a growing portion of California's energy use. Unfortunately, the energy use (and thus the true cost) of appliances and electronic devices is often invisible to the consumer, and manufacturers lack the direct incentive (of having to pay for the energy their products consume) to design products that use energy efficiently.

The Energy Commission's Appliance Standards can address this issue by setting cost-effective minimum efficiency requirements for appliances, electronics, and other devices. These efficiency standards set the bar at a level that affects only the least efficient products. Since 1976, the Energy Commission has adopted standards covering a wide range of appliances, including all major household appliances, air conditioners, furnaces, and water heaters. In many instances, California standards have subsequently been adopted as national standards by the United States Department of Energy (U.S. DOE).

Historically, California's energy efficiency standards have resulted in significant reductions in energy consumption. The Energy Commission estimates that appliance efficiency standards adopted between 1976 through 2005 saved 18,761 gigawatt hours (GWh) in 2010.[82] This represents 6.7 percent of California's electric load and is roughly the amount of energy produced by California's two largest power plants. At an average rate of 14 cents per kilowatt hour, appliance efficiency regulations saved California consumers about $2.68 billion in 2010.

Despite the success of appliance efficiency standards, the amount of energy consumed by devices plugged in by building occupants ("plug load") has been climbing rapidly.[83,84] To address these growing plug loads, the Energy Commission has initiated and completed several rulemakings covering products

81 The breakdown of 2009 annual household electricity consumption by end use is: lighting, 22 percent; refrigerators and freezers, 20 percent; television, computer, and office equipment, 20 percent; air conditioning, 7 percent; pools and spas, 7 percent; dishwasher and cooking, 4 percent; laundry, 4 percent; space heating, 2 percent; water heating, 3 percent; and miscellaneous, 11 percent. California Energy Commission, *2009 California Residential Appliance Saturation Study*, October 2010, page 3, www.energy.ca.gov/2010publications/CEC-200-2010-004/CEC-200-2010-004-ES.PDF.

82 Savings from California's appliance efficiency standards are forecasted to grow to 27,116 GWh a year by 2020. This would represent 8.6 percent of projected load in 2020. At the current rate of 14¢ per kilowatt hour, this would save the state about $3.8 billion for 2020, see: www.energy.ca.gov/2009_energypolicy/index.html.

83 C.D. Barley, 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, page 5, www.nrel.gov/docs/fy09osti/43718.pdf.

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

such as televisions, external power supplies (EPS), DVD players, and compact audio devices. These regulations provide minimum efficiency or maximum power use 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 GWh per year,[85] 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. The battery charger standards will improve the efficiency of a wide range of plug loads, such as laptop computers, power tools, electric toothbrushes, cell phones, mp3 players, and golf carts.

The Energy Commission is developing a new scoping order to identify the appliance types that should be included in new standards and to upgrade levels of existing standards. Stakeholder proposals have identified up to 8,000 GWh in potential savings from new standards. Proposals include computers and computer servers, set top boxes, linear fluorescent fixtures, and outdoor lighting as key opportunities for new Appliance Standards.

Improvements to Lighting Efficiency

Lighting is the largest electrical load in both homes and businesses, accounting for 35 percent of commercial annual electricity use and 22 percent of residential annual use. Assembly Bill 1109 (Huffman, Chapter 534, Statutes of 2007) requires an 11 percent reduction in electricity consumption from residential lighting and an 8.6 percent reduction from commercial lighting. Achieving these goals would reduce California's total electricity use by more than 6 percent.

Since the passage of AB 1109, the U.S. DOE has adopted new federal standards for general service fluorescent lamps and incandescent reflector lamps. California has exercised its discretion to implement the federal standards one year ahead of the federal schedule. The Energy Commission has also gone beyond the scope of the federal standards by adopting new standards for metal halide and portable luminaires, updated lighting efficiency and design and use standards in the 2008 Building Energy Efficiency Standards, and will further address lighting efficiency in upcoming triennial updates. The above initiatives will advance the state's progress in meeting the AB 1109 residential lighting mandates. However, the challenge of meeting commercial lighting and outdoor lighting mandates must be addressed through additional standards and voluntary programs developed in collaboration with the lighting industry, consumers, the CPUC, and the state's utilities.

Light-emitting diode (LED) lamps are a promising example for advancing beyond current mandatory lighting standards. LEDs have enormous energy savings potential given their inherent efficiency at converting electricity to light. However, a number of challenges regarding cost, quality, and efficacy must be addressed. Rapid advancements in LED technology have led to a proliferation of products in a growing range of applications at lower prices. Research at the California Lighting Technology Center (CLTC) has revealed large variations in quality across a number of performance parameters, including light quality and longevity, which could reduce consumer acceptance of the technology. As with early efforts to bring compact fluorescent lamps to market, when similar performance quality issues severely dampened

85 Future savings estimated to be achieved in one year after the entire stock of appliances that are covered by the standards meet the requirements of the standards. This would happen in a future year after all such appliances that were manufactured prior to the effective date of the standards are no longer in use because they have reached the end of their useful lives.

consumer demand, there is a risk that barriers to wide acceptance of LEDs could result if California consumers have negative experiences with low-performing products. To address this risk, the Energy Commission is working with CLTC engineers, industry, the state's utilities, and the CPUC to develop product quality specifications for LEDs that could serve as a basis for future utility incentive programs.

Achieving Better Compliance With Standards

Compliance with Building Standards is much better for new construction than for alterations to existing buildings, primarily because alterations are frequently made without the required permits. Without the oversight of local building officials, energy efficiency codes are rarely followed. For example, less than 10 percent of contractors pull building permits and abide by legal requirements for change outs of furnaces and air conditioners. In general, local building departments have limited resources for enforcing building codes, especially those beyond minimum health and safety requirements. The lack of compliance with standards can result in defective construction and installation, including improper installation of wall and duct insulation, HVAC systems, and other efficiency measures, all of which can drive up energy costs for home and building owners.

Widespread noncompliance with appliance regulations also has been brought to light through complaint filings by competing manufacturers and retailers as well as energy efficiency advocates and others. Recent market surveys reveal high rates of noncompliance with the Appliance Standards, finding large numbers of ineligible products being offered for sale in stores, through catalogs, and over the Internet. Addressing the issue of noncompliance has been extremely difficult because the Energy Commission has had limited authority to take enforcement actions against noncompliant manufacturers, distributors, and retailers. If an appliance was found to be noncompliant with a standard, the Energy Commission could conduct an administrative hearing to remove it from the database (if it were improperly certified). However, the Energy Commission was required to petition the Attorney General to seek injunctive or other relief from a court to forbid the sale of an appliance. This administrative process could take up to 190 days, and court actions can take many months or years.

On October 8, 2011, Governor Brown signed Senate Bill 454 (Pavley, Chapter 591, Statutes of 2011) into law, which will help address the challenge with widespread noncompliance by manufacturers and retailers. The legislation allows the Energy Commission to adopt an enforcement process for violations of appliance efficiency regulations and impose civil penalties of up to $2,500 for each violation. The bill establishes the Appliance Efficiency Enforcement Subaccount within the Energy Resources Program Account, where civil penalty funds will be deposited that can then be spent upon appropriation by the Legislature for public education and enforcement of the appliance efficiency standards.

The Energy Commission will use the following criteria in assessing a civil penalty:

***The nature and seriousness of the violation

***The number of violations

***The persistence of the violation

***The length of time over which the violation occurred

***The willfulness of the violation

***The violator's assets, liabilities, and net worth

***The harm to consumers and to the state from the amount of energy wasted because of the violation

Following these criteria will ensure that the Energy Commission imposes only appropriate penalties against violators based on specific circumstances. By providing this authority to the Energy Commission, the Legislature has helped ensure a level playing field for all regulated manufacturers.

Recommendations

Newly Constructed Buildings

***The Energy Commission and CPUC should work jointly on developing a definition of ZNE that incorporates the societal value of energy (consistent with the time dependent energy valuation approach used for California's Building Energy Efficiency Standards).

***The Energy Commission should adopt triennial building standards updates that increase the energy efficiency of newly constructed buildings by 20–30 percent in every triennial update to achieve ZNE standards for newly constructed homes by 2020.

***The Energy Commission should adopt reach standards for newly constructed buildings that provide best practices energy efficiency levels for the marketplace to strive for and serve as a means to pull the industry rapidly to the level needed to achieve ZNE goals.

***The Energy Commission, CPUC, local governments, the state's utilities, and builders should collaborate to encourage the building industry to reach these advanced energy efficiency levels in a substantial segment of the market through industry-specific training and financial incentives.

***The Energy Commission and CPUC should coordinate future investor-owned utility "new construction-related" programs with the Energy Commission's efforts to meet the ZNE goals through triennial updates of mandatory and reach standards. By offering incentives for achieving reach standards, providing technology demonstration and development, and conducting pilot programs for demonstrating ZNE solutions, new technologies and building practices will be integrated into upcoming triennial updates of the Building Standards quicker and with more success.

***The Energy Commission, CPUC, builders, and other stakeholders should collaborate to accomplish workforce development programs to impart the skills necessary to change building practices to accomplish ZNE in newly constructed buildings.

Existing Buildings

***The Energy Commission and CPUC should coordinate future investor-owned utility energy efficiency portfolios with the programs and rules developed in the Energy Commission's AB 758 proceeding. The Energy Commission, in collaboration with stakeholders, should develop an asset rating system for nonresidential buildings that can be used to rate the energy efficiency of commercial properties and provide owners and potential buyers with information about the energy efficiency of the buildings they own or are considering for lease or purchase. This will help drive market demand for efficiency. The Energy Commission also should consider how the cost-effectiveness of options to achieve greater energy efficiency in those buildings can be addressed in conjunction with building asset ratings. The Energy Commission, utilities, the CPUC, and other stakeholders should collaborate to pilot the implementation of the rating system through education and financial incentives.

***The Energy Commission should review ARRA pilot programs to identify lessons learned and opportunities for improvements in rating systems, financial products, workforce development, consumer education, and program coordination.

***The CPUC, the Energy Commission, the State Treasurer, and other agencies should collaborate with local governments, the financial industry, and other stakeholders to promote the availability of financing products for the upgrade of all building sub-sectors.

***The Energy Commission should focus significant resources during the next Building Standards update on efficiency improvements in building additions and alterations.

Appliance Efficiency Standards

***The Energy Commission should adopt appliance standards that focus on reducing plug loads to enable California's ZNE goals to be achieved.

***The Energy Commission should continue to adopt standards for appliances that represent the most significant statewide energy savings potential.

***The Energy Commission and CPUC should collaborate on research to identify the most cost-effective opportunities for new appliance standards and to reevaluate existing standards to identify the most cost-effective opportunities for updates to achieve greater energy savings.

***The Energy Commission and CPUC, in collaboration with utilities and other stakeholders, should jointly develop a roadmap to meet the lighting energy savings mandated by AB 1109, including new appliance and building efficiency standards and market transformation programs to achieve higher levels of energy efficiency than required by standards.

***The Energy Commission should collaborate with industry to develop reach standards for appliances that set higher expectations in California for the quality and performance of key appliances.

***The Energy Commission and CPUC should collaborate to develop voluntary LED quality performance standards.

***The Energy Commission should engage in DOE proceedings that are developing federal test methods and appliance standards.

Compliance With Standards

***The Energy Commission should immediately begin developing regulations to implement the enforcement authorities provided by SB 454 to increase compliance with the Appliance Standards.

***The Energy Commission and CPUC should emphasize joint efforts to achieve improved compliance with the Building Energy Efficiency and Appliance Standards.

This chapter reports on the status of the California's Clean Energy Future (CCEF) joint agency collaborative effort.

Recognizing the growing interdependencies among the state's energy and environmental agencies, the California Air Resources Board (ARB), California Environmental Protection Agency (Cal/EPA), California Energy Commission, California Public Utilities Commission (CPUC), and California Independent System Operator (California ISO) developed a vision, implementation plan, and roadmap to achieve a clean energy future for California.[86] Launched in 2010, the planning effort focuses on 2020, with consideration of the goal to reduce greenhouse gas (GHG) emissions to 80 percent below 1990 levels by 2050.[87]

86 These documents are available at: www.cacleanenergyfuture.org.

87 Executive Order S-03-05, gov.ca.gov/news.php?id=1861.

The purpose of the CCEF effort is to:

*** Compile existing policy goals to support inter-agency planning and management.

*** Identify policy interdependencies, key milestones, and delivery risks to improve communications and cooperation.

*** Use adaptive management practices "to identify policy overlaps, conflicts, unanticipated or unintended consequences, and to make necessary trade-offs and course corrections."[88]

The *California's Clean Energy Future: Overview (Overview)* outlines the agencies' vision for 2020. The agencies released the planning document in September 2010, but it has not yet been updated to reflect the goals of the Brown Administration. The agencies plan to refresh their planning efforts to reflect significant developments since its release, such as the passage of legislation to enact the 33 percent Renewables Portfolio Standard (RPS). Future planning efforts will also reflect findings coming from the Governor's July 2011 Conference on Local Renewable Energy Resources, the Energy Commission's report on *Renewable Power in California: Status and Issues*, and the Energy Commission's *IEPR* and *Renewable Strategic Plan* that will be developed in 2012.

The *Overview* focuses on four elements for achieving the state's 2020 electricity and natural gas goals, with the first being energy demand. As currently drafted, the agencies target reductions of 5,000 to 8,100 MW on peak by 2020 with advancements in efficiency and demand response. This is in addition to the 2,300 MW (on-peak) committed energy efficiency savings already included in the 2009 demand forecast. The current version also calls for installing 5,000 MW of distributed generation (DG) by 2020, although the agencies recognize Governor Brown calls for 12,000 MW of localized renewable generation by 2020.

The second element is energy supply. The *Overview* envisions achieving a 33 percent RPS while maintaining reliability needs and meeting environmental goals, such as phasing out once-though cooling in power plants. The agencies put forward a goal of developing at least one utility-scale carbon capture and storage facility in California by 2020.

The third element is transmission, distribution, and operations. The agencies envision a coordinated effort for planning and permitting to ensure that sufficient transmission and distribution-level infrastructure will be available to meet renewable goals and GHG reduction targets. Investments in advanced metering and smart grid will empower customers to use energy more efficiently. Through agency-supported pilot studies, the agencies are targeting 1,000 MW of additional storage capacity by 2020 to promote renewable integration.

The fourth element is additional supporting processes, including cap and trade, to provide opportunities for lower-cost GHG reductions and advancements in emerging technologies. The *Overview* also recognizes that alternative fuel vehicles, and electrification of the transportation sector in particular, will be a central component to energy security and reduced GHG emissions. The *Overview* calls for California to "develop the infrastructure and operational capabilities necessary to absorb a targeted 1,000,000 fully electric and plug-in hybrid-electric vehicles (PHEV) by 2020." In addition to efforts to reduce GHG emissions, California will need to plan for and adapt to actual changes in climate, such as temperature and precipitation changes and other impacts affecting energy supply and demand. Finally, the plan calls for engaging California's institutions and residents as partners in achieving these goals.

88 *California's Clean Energy Future, 2010, Overview* page 2, see: www.cacleanenergyfuture.org/2821/282190a82f940.pdf.

CCEF Updates and Metrics

On July 6, 2011, the Energy Commission held an IEPR workshop jointly with the ARB, Cal/EPA, California ISO, and CPUC to discuss updates to the *California's Clean Energy Future* planning document. Updates provide an opportunity for incorporating new policy developments and identifying any areas that need course correction. The agencies anticipate the planning updates to include:

*** 33 percent Renewables Portfolio Standard (RPS) legislation Senate Bill (SB) x1 2 (Simitian, Chapter 1, Statutes of 2011–12 First Extraordinary Session).

*** The goals in the Governor's Clean Energy Jobs Plan, including:

- *** 12,000 MW of localized energy by 2020.
- *** 8,000 MW of large-scale renewable and associated transmission lines.
- *** Develop 6,500 MW of combined heat and power (CHP) over the next 20 years.

*** Metrics and data references to indicate progress toward achieving California's clean energy goals and indicate opportunities for the CCEF agencies to propose course corrections.

At the workshop, the IEPR Committee requested comments from stakeholders and the public on draft metrics and received 21 sets of comments. While the agencies could not reflect all the comments, the discussion below highlights the changes made to the metrics in response to stakeholder input. Below is a discussion of the metrics and how they were updated from the workshop.[89]

The agencies publicly posted the revised metrics on the CCEF website[90] on December 22, 2011. The agencies will be updating the metrics periodically to reflect new information.

GHG Emissions

The metric presented at the workshop shows historical and forecasted GHG emissions from 2000 to 2020. Emission forecasts provide a reference for assessing the effect of GHG reduction measures. In response to stakeholder comments, staff revised this metric to include information on GHG intensity, such as GHG emissions per capita and per gross state product, as suggested by Sempra. Other revisions include: adding a business-as-usual projection (per Environmental Defense Fund) and providing a graphic showing progress of GHG emission reductions for all sectors included in Assembly Bill 32 (Núñez, Chapter 488, Statutes of 2006) (per Natural Resources Defense Council [NRDC] and Southern California Edison [SCE]).

Energy Efficiency

The metric presented at the workshop shows California investor-owned utilities' (IOUs) and publicly owned utilities' energy savings from 2006 to 2010. The metric also shows the IOUs' annual energy savings, peak savings, and natural gas savings in comparison with the goals set by the CPUC. For the publicly owned utilities, the metric shows net annual energy savings

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89 At the workshop, staff presented seven metrics and four "data references" that were intended to provide supporting information to the metrics. The CCEF agencies ultimately chose to abandon the distinction between data references and metrics, and refer instead to all as "metrics."

90 See: www.cacleanenergyfuture.org.

and net peak savings as reported by the utilities in comparison with efficiency goals set by the Energy Commission. Stakeholder comments on this metric included NRDC's suggestion to show indicators of net benefits of energy efficiency programs and energy efficiency codes and standards. Sempra suggested adding an indication of the energy intensity of existing and new buildings. Bevilacqua-Knight Inc. supports adding the savings expected from zero net energy strategies included in the *California Energy Efficiency Strategic Plan*[91] Staff revised the metric to provide indicators of cost effectiveness for utility energy efficiency portfolios, the energy intensity standards for California homes constructed after 2001, progress toward zero net energy homes, and energy savings from building codes and standards.

Demand Response

Demand response generally refers to a reduction in customers' electricity consumption over a given time interval in response to a price signal, other financial incentives, or a reliability signal. The demand response metric provides a historical view of the estimated levels of demand response for the IOUs from 2009 through 2011, and a projection to 2020, which assumes broad deployment of advanced metering infrastructure. Staff plans to modify this metric as more information becomes available through the CPUC's Smart Grid Rulemaking.

Renewable Energy

The metric presented at the workshop shows the amount of renewable generation for California, excluding large hydro, from 1983–2009 and estimates of the amount of renewable generation needed to meet the 2013, 2016, and 2020 RPS targets. Data are also provided showing historical generation by fuel type. Since the RPS calls for a specified percentage of retail sales served with renewable energy, the metric shows a range for the amount of renewable energy needed to meet the RPS target based on factors that can affect retail sales, including energy efficiency, self-generation, CHP, and economic and population growth.

Comments from stakeholders included a suggestion by the Sierra Club to add information on project failure by procurement program (SB 32, California Solar Initiative, Renewable Auction Mechanism, feed-in tariff). Pacific Gas and Electric (PG&E) suggested adding indicators related to the CCEF goal that "a significant fraction of renewables will be dispatchable." SCE asked staff to clarify the impact of recontracting on progress toward RPS goals. In response to comments, staff added information on progress for each procurement mechanism and information to track dispatchable renewable resources. Also, staff revised the information on approved and pending RPS contracts to show only contracts for new resources. Finally, a graphic showing the development progress of new renewable projects under contract with the IOUs was revised to show estimated project feasibility based on the CPUC's analysis.[92]

Installed Capacity

This metric presented at the workshop shows on-line, nameplate capacity for all electricity generation resources in California by technology from 2001 to 2010.[93] If all contracts for new large-scale renewable energy facilities in California succeed, they will add more than 8,000 MW. In response to Independent Energy Producers' (IEP) suggestion to show growth rates,

91 California Energy Commission, July 6, 2011, workshop, comments available at: www.energy.ca.gov/2011_energypolicy/documents/2011-07-06_workshop/comments/.

92 www.cpuc.ca.gov/NR/rdonlyres/2A2D457A-CD21-46B3-A2D7-757A36CA20B3/0/Q3RPSReporttotheLegislatureFINAL.pdf.

93 Nameplate capacity is the maximum possible output from a generation facility under specific conditions as designated by the manufacturer.

staff revised the metric to show that contracts for large renewable resources in California are scheduled to come on-line at an average annual growth rate of 18 percent per year from 2010–2016.

The CCEF includes a goal to add 1,000 MW of energy storage by 2020. In response to comments calling for more information about storage, staff shows that about 2,800 MW of pumped hydropower were on-line in 2010 in California. Nine additional projects in California with a combined capacity of 4,900 MW have received licenses from the Federal Energy Regulatory Commission. The goal to add 1,000 MW of new storage would be met if about 20 percent of the licensed capacity completes environmental permitting and comes on-line by 2020. Several hundred megawatts of distributed electricity storage facilities may come on-line by 2020 as well, depending on various factors. For example, one factor is the outcome of the CPUC's Assembly Bill 2514 proceeding (OIR R.10-12-007), which will determine whether and how the CPUC should further encourage storage. Other examples include the eligibility of storage for incentives, the results of utility storage demonstration projects, the cost of storage, and rate structure developments that could make storage more attractive.

Staff revised the metric to show estimates of CHP potential and a goal of adding about 6,500 MW of CHP by 2032. To achieve the goal, staff estimates that CHP would need to grow about 4.7 percent per year from 2012–2022.

Sempra stated that even if the energy efficiency goals are met, the goals for new electricity facilities cannot be met because supply would exceed demand for electricity.[94] In response to this comment, staff expanded the discussion of the interaction of goals for high levels of energy efficiency and the Governor's goals for renewable energy and CHP.[95]

Transmission Expansion

Twelve transmission projects are underway in the California ISO's footprint that will provide sufficient capacity for the state to achieve

94 www.energy.ca.gov/2011_energypolicy/documents/2011-07-06_workshop/comments/Sempra_Energy_Utilities_Companies_Comments_on_Joint_A_2011-07-20_TN-61463.pdf.

95 If existing renewable energy facilities 20 MW and smaller (about 3,000 MW of wholesale and customer-side DG) are counted toward the 12,000 MW goal for localized renewable energy resources, the Governor's goals would add about 17,300 MW of new renewable energy facilities by 2020 and 1,000 MW of new energy storage. Using CPUC input assumptions, the California ISO study on 33 percent RPS modeled "base load case" scenarios, adding about 17,500 MW to 20,800 MW of new renewable facilities by 2020. The scenarios assumed a large amount of energy efficiency (more than 18,000 GWh) was achieved by 2020 beyond the levels included in the 2009 energy demand forecast. (https://www.pge.com/regulation/LongTermProcure2010-OIR/Testimony/CAISO/2011/LongTermProcure2010-OIR_Test_CAISO_20110701_212930.pdf, Exhibit 3, Table 6.) The CHP goal extends to 2032; depending on the renewable resource mix, the amount of energy efficiency achieved, and replacement of gas-fired power plants in California that use OTC, achievement of the CHP goal may not begin in earnest until after 2020. "Post 2020, additional investments in renewable generation may be needed to replace generation expected to decline over the course of the next decade, such as generation from expiring coal contracts. Generation from a number of these contracts, which currently represents about 10 percent of total generation serving California, is expected to decline by 61 percent between 2010 and 2020 due to constraints imposed by the Emission Performance Standard. Remaining coal contracts are expected to expire between 2027 and 2030, which will require replacement with a mix of renewable and thermal generation with storage to satisfy electricity needs while still meeting greenhouse gas emission reduction goals." www.energy.ca.gov/2011publications/CEC-150-2011-002/CEC-150-2011-002-LCF-REV1.pdf.

the 33 percent RPS.[96] The metric tracks the approval status, capacity, and expected on-line date of these projects.

Electric Vehicle (EV)

The metric presented at the workshop shows actual sales-to-date of EVs in California, a scenario of anticipated sales under the Zero Emission Vehicle program, and the potential sale of 1 million EVs consistent with the CCEF goal. For the Zero Emission Vehicle program, the metric reflects anticipated cumulative sales for both battery EVs and PHEVs. In response to stakeholder comments, staff plans to add information on efforts underway to advance deployment of infrastructure needed for the expanded use of plug in electric vehicles in California.

Energy Demand

The metric on energy demand shows statewide electricity and natural gas consumption from 1990 to 2008 by end-use sector and shows electricity consumption by county. Staff also provided data on noncoincident statewide net peak[97] demand for 1990 to 2009, reflecting a combination of peaks that often occur at different times in different planning areas. In addition, staff provided data on coincident statewide peak demand, which is the peak demand for California at the same point in time.

96 The number of transmission projects (12) differs from the 13 projects identified in Chapter 2 because this metric includes only projects within the California ISO balancing authority area.

97 Net peak is total electricity demand at peak on the customer side, plus utility transmission and distribution losses, minus peak demand met by self-generation.

Reserve Margin

A reserve margin is a measure of the amount of electricity imports and in-state generation capacity available over average peak demand conditions. The metric shows available reserve margins in comparison to California's 15 to 17 percent planning reserve target. The planning reserve margin target is intended to assure sufficient electricity supplies can meet real-time operating reserve requirements and ensure that outages occur no more frequently than one-day-in-ten-years.

System Average Rate

The system average rate is calculated by dividing the annual revenue requirement of the IOUs by their annual retail sales. This metric provides a normalized basis for assessing trends in utility costs over time, but it does not necessarily reflect actual rates or trends in those rates experienced by different customer classes.

Once-Through Cooling Phase Out

This metric provides information to track compliance with regulations to phase out once-through cooling (OTC) at 19 power plants in California. Of these, 16 plants totaling roughly 17,500 MW are in the California ISO Balancing Area Authority, and 3 are in the Los Angeles Department of Water and Power Balancing Area Authority. Compliance dates for the power plants range from 2010 to 2024. Staff added a description of the technologies and strategies that were part of the submitted OTC implementation plans in response to comments from NRDC.

The use of natural gas as a transportation fuel in compressed natural gas vehicles, and as a feedstock to make methanol additives for cleaner-burning gasoline, may give natural gas a "bridging" role in attaining California Clean Energy Future (CCEF) goals. However, the penetration of natural gas in the transportation sector is also uncertain. Due to its thermal efficiency, wide-scale delivery infrastructure, end-user familiarity and relatively clean combustion, natural gas will continue as a significant energy supply source for residential, commercial, and industrial end uses such as cooking, space heating, and to fuel boilers and process heaters. In the longer term, the role of natural gas in these sectors may diminish as energy efficiency and conservation, renewable substitutes such as solar thermal or biogas applications, and electrification become more cost-effective or play a larger role in meeting the state's climate change goals. While natural gas serves as a feedstock to manufacture plastics, fertilizers, antifreeze, pharmaceuticals, and fabrics, additional factors besides energy and environmental policies will determine future demand for these end uses.

Natural Gas Uncertainties

Whether by choice or necessity, natural gas will play a significant role in California's energy future. This conclusion prompts the following basic questions:

***To what extent will California's future energy supply include natural gas – what might be the demand for natural gas?

***What will be the cost to California of this demand for natural gas – at what price might it be available?

***What can be done to understand and to manage the risks associated with this role of natural gas in California's energy supply?

Most experts agree that it is not feasible to make single-point forecasts of future gas prices and other market activities, and that it may not be particularly useful. This is a necessary consequence of the gas market's complexity, large menu of competing options for actions, and deep uncertainties about future underlying conditions that are beyond anyone's control.

The Energy Commission has concluded that single-point forecasts of future natural gas prices are not only inaccurate, but not useful in focusing proper attention on the gas market's complexity and range of potential outcomes. Instead, the Energy Commission has, in this *IEPR*, focused on a range of plausible underlying conditions to develop conditional estimates of prices that could occur. This approach can decrease the chance of being unpleasantly surprised by a future not considered and the negative consequences resulting from actions taken under conditions that did not materialize.

Despite the inability of anyone to accurately predict future gas market outcomes, many people – including California's public policy makers – need to make decisions based on an expectation of what those outcomes might be. For example, the California policy to "implement all cost-effective energy efficiency" requires a cost-effectiveness analysis of potential energy efficiency measures and programs. So, having *some expectation* of future gas prices (and other effects of gas extraction, transportation, and use) is a requirement of this analysis and decision-making.

Staff is improving the analytical process on an ongoing basis and has committed to using its models to develop insights rather than simply quantitative results; comparing results of staff model runs to other relevant studies; evaluating alternative scenarios or futures using different sets of assumptions; explaining both what is known and unknown; and making every attempt to present the results fully and clearly.

Exploring California's Potential Gas Price Vulnerability

Natural gas is a heavily traded commodity in a market characterized by price volatility. Over the last decade, daily spot market prices for natural gas traded at Louisiana's benchmark Henry Hub have spiked several times. Figure 4 shows the prices over the past decade, in current year or nominal dollars. The winter periods of 2000–2001 and 2003–2004 saw prices spike to $10.00 per million British thermal units (MMBTU) and $18.00/MMBTU, respectively. Cold weather, which increased demand and put upward pressure on prices, triggered these increases. In September 2005, hurricanes Katrina and Rita caused natural gas production wells in the Gulf Coast to be shut in, which lowered available supply and caused prices to spike to over $15.00/MMBTU.

Since late 2008, daily spot market prices have trended lower (in the $4.50 to $5.00 range) and only once did prices increase above $6.00 (in 2009). The lower prices following the 2008 price spike can be explained by two factors. The late-2008 economic recession reduced overall demand for natural gas, especially in the industrial and power generation sectors. This lower natural gas demand had a negative effect on prices. Secondly, large amounts of shale gas are now becoming technically and economically recoverable at relatively low costs. This injection of shale gas into the market increased the supply of gas available to consumers and thus helped to lower the price. Over the last year (April 2010-April 2011), Henry Hub daily spot prices have averaged $4.15/MMBTU.

The Energy Commission's *2011 Natural Gas Market Assessment: Outlook* explored how a plausible range of assumptions about underlying United States natural gas supply and demand conditions might affect the long-term annual average market price of natural gas.[106] Staff's analysis is based on the well-recognized global gas market expertise of consultant Dr. Kenneth Medlock III.[107] Dr. Medlock used the MarketBuilder platform to construct the Rice World Gas Trade Model (RWGTM). For this analysis, Dr. Medlock and staff worked closely together to modify the RWGTM for use in the *2011 IEPR* proceeding. Staff's analysis contains the following four cases that focus on potential future national natural gas market prices:

*** **Reference Case:** assumes a "business as usual" starting point case

*** **High Gas Price Case:** assumes higher gas demand and more constrained, higher cost gas resources

*** **Low Gas Price Case:** assumes lower gas demand and less constrained, lower cost gas resources

*** **Constrained Shale Gas Case:** assumes higher gas operations and maintenance costs to ensure that development is environmentally acceptable

In addition to the four cases outlined above, two additional cases were added to the analysis in response to stakeholder input suggesting that the estimated natural gas price range was too narrow as a result of keeping the cost of discovery constant across all cases. The two additional cases are:

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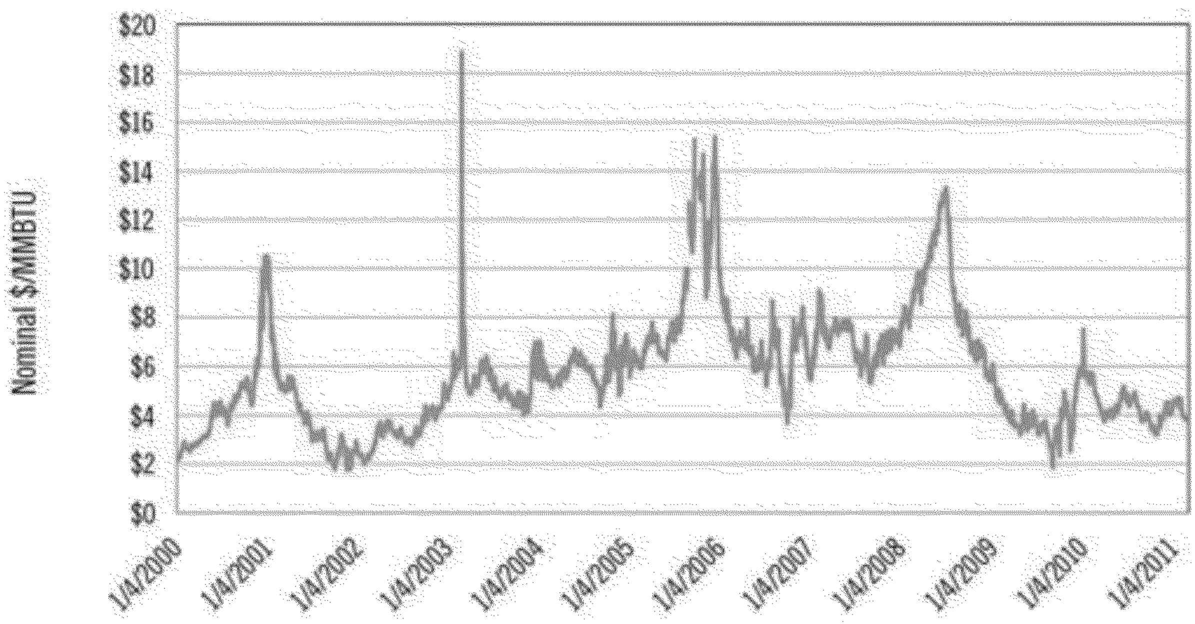
106 Brathwaite, Leon D., Paul Deaver, Robert Kennedy, Ross Miller, Peter Puglia, William Wood, *2011 Natural Gas Market Assessment: Outlook*, California Energy Commission, Electricity Supply Analysis Division, Publication Number: CEC-200-2011-012-SD. Final report expected March 2011.

107 Dr. Medlock is the James A. Baker III and Susan G. Baker, Fellow in Energy and Resource Economics and Deputy Director of the Energy Forum of James A. Baker III Institute for Public Policy at Rice University in Houston, Texas.

Figure 4: Henry Hub Daily Spot Market Natural Gas Prices



Source: intelligencepress.com.

*** **High Finding and Development Cost Case:** assumes that only a small amount of gas beyond what is currently proved will be added to the current stock due to high costs of findingand development, driving market prices higher. This case uses the High Gas Price Case as a starting point and changes only the discovery costs.

*** **Low Finding and Development Cost Case:** assumes that a larger than average amount of gas beyond what is currently proved will be added to the current stock due to low costs of findingand development, driving market prices lower. This case uses the Low Gas Price Case as a starting point and changes only the discovery costs.

Key input assumptions for the Reference Case, highlighting those assumptions that change in at least one of the changed cases, include the following:

*** Average annual growth rate in U.S. gross domestic product is 2.6 percent.

*** The marginal cost curve for gas supplies reflects year 2011 vintage state of knowledge about the underlying gas resource base and production technologies.

*** Average annual rate of "learning" improvement in gas technology is 1 percent.[108]

*** Shale gas development in New York is constrained per current moratorium.

*** Iran, Iraq, and Venezuela do not enter the market until 2020.

108 "Learning improvement" means increased productivity achieved through practice, self-perfection, and minor innovations.

Measuring California's energy use is the essence of a much broader analysis conducted every two years as part of the

Integrated Energy Policy Report (IEPR) This chapter summarizes the Energy Commission staff's *Preliminary California Energy Demand Forecast 2012–2022* (*CED 2011 Preliminary*).[119] The report's analysis characterizes the effects of economic and demographic trends, human behavior, emerging technologies, state and federal policies, and California's diverse climatic and geographic landscape on current and future energy needs. The chief product of this work is the California Energy Demand (CED) forecast of electricity and natural gas consumption over the next 10 years. Staff will release a revised forecast in mid-February and expects to adopt a final version in early spring 2012.

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119 Kavalec, Chris, Tom Gorin, Mark Ciminelli, Nicholas Fugate, Asish Gautum, and Glen Sharp, *Preliminary California Energy Demand Forecast, 2012–2022* 2011, CEC-200-2011-011SD, available at: www.energy.ca.gov/2011publications/CEC-200-2011-011/CEC-200-2011-011-SD.pdf.

Californians consumed around 272,300 giga watt hours (GWh) of electricity in 2010. Natural gas consumption, excluding fuel for electricity generation, reached almost 12,700 million therms that same year. Forecasts of expected growth in energy demand underlie California's efforts to develop effective policy, conserve natural resources, protect the environment, and promote public health and safety while ensuring adequate energy supplies and economic growth. To that end, the Energy Commission's long-term forecast appears in many venues: as the foundation for policy recommendations to the Governor and Legislature through the *IEPR*; as a yardstick by which to measure the utilities' need for new generation resources in the California Public Utilities Commission's (CPUC) Long-Term Procurement Planning proceeding; as a reference point in the Air Resources Board's *AB 32 Scoping Plan*; as a benchmark for assessing the state's progress toward meeting its Renewables Portfolio Standard (RPS); as a baseline for estimating energy efficiency savings potential; and as input into the Energy Commission's infrastructure needs assessment.

The forecast is also used by the CPUC and the California ISO in annual resource adequacy proceedings addressing capacity needs, which depend on projected peak demand. Demand for electricity varies over time with daily, weekly, and seasonal cycles and fluctuates even within a given hour. It is generally lower at night and on weekends and holidays, with the maximum usually occurring on hot summer weekday afternoons. Expected peak demand is a critical factor in electricity and transmission planning, since it determines generation and transmission capacity requirements.

Such an analysis cannot be conducted in isolation. The Energy Commission augments its own expertise with input from other government agencies, utilities, advocacy groups, and consultants. Regular meetings of the Demand Analysis Working Group, formed by the Energy Commission in 2008, provide stakeholders the opportunity to share information, data, ideas, and methods, and to suggest changes in the existing process.

In the most recent forecast and accompanying report, *CED 2011 Preliminary* staff incorporated stakeholder feedback on a number of important issues, including the uncertainty surrounding near-term economic conditions (which are difficult to predict) and the relative impacts of various efficiency efforts (which are difficult to measure). Staff devoted public workshops to consider all stakeholder opinions on these two issues, as they carry sufficient consequence.

Demand Forecast Results

The *CED 2011 Preliminary* forecast includes three demand scenarios: high, mid, and low. The high demand case incorporates relatively high economic/demographic growth, low electricity and natural gas rates, and low efficiency program and self-generation impacts. The low demand case includes lower economic/demographic growth, higher assumed rates, and higher efficiency program and self-generation impacts. The mid-case uses input assumptions at levels between the high and low cases.

Table 8 compares projected electricity consumption and noncoincident[120] peak demand under the three forecast scenarios. Historical and forecasted values from the previous IEPR forecast (2009) provide points of reference.

Figure 8 compares projected consumption under the three scenarios alongside *California Energy Demand 2010–2020: Adopted Forecast (CED 2009)*. Consumption grows at a faster average annual rate from 2010 to 2020 in the mid- and high-energy

120 A region's coincident peak is the actual peak for the region, while the noncoincident peak is the sum of actual peaks for subregions, which may occur at different times.

Table 8: Statewide Electricity Demand Forecast Comparison

Consumption (GWh)				
	CED 2009 (December 2009)	CED 2011 Preliminary High (August 2011)	CED 2011 Preliminary Mid (August 2011)	CED 2011 Preliminary Low (August 2011)
1990	228,473	227,586	227,586	227,586
2000	264,230	260,408	260,408	260,408
2010	280,843	272,342	272,342	272,342
2015	299,471	296,821	292,286	286,100
2020	316,280	321,268	310,462	305,932
2022	—	332,514	318,396	313,493
Average Annual Growth Rates				
1990-2000	1.46%	1.36%	1.36%	1.36%
2000-2010	0.61%	0.45%	0.45%	0.45%
2010-2015	1.29%	1.74%	1.42%	0.99%
2010-2020	1.20%	1.67%	1.32%	1.17%
2010-2022	—	1.68%	1.31%	1.18%
Noncoincident Peak (MW)				
	CED 2009 (December 2009)	CED 2011 Preliminary High (August 2011)	CED 2011 Preliminary Mid (August 2011)	CED 2011 Preliminary Low (August 2011)
1990	47,521	47,520	47,520	47,520
2000	53,703	53,703	53,703	53,703
2010*	62,459	60,455	60,455	60,455
2015	66,868	66,569	65,701	64,246
2020	71,152	72,006	69,818	68,498
2022	—	74,220	71,280	69,738
Average Annual Growth Rates				
1990-2000	1.23%	1.23%	1.23%	1.23%
2000-2010	1.52%	1.19%	1.19%	1.19%
2010-2015	1.37%	1.95%	1.68%	1.22%
2010-2020	1.31%	1.76%	1.45%	1.26%
2010-2022	—	1.72%	1.38%	1.20%

Historical values are shaded blue.

Source: California Energy Commission

*The 2011 forecasts use 2010 weather-normalized peak rather than actual to estimate growth.

Figure 8: Statewide Annual Electricity Consumption

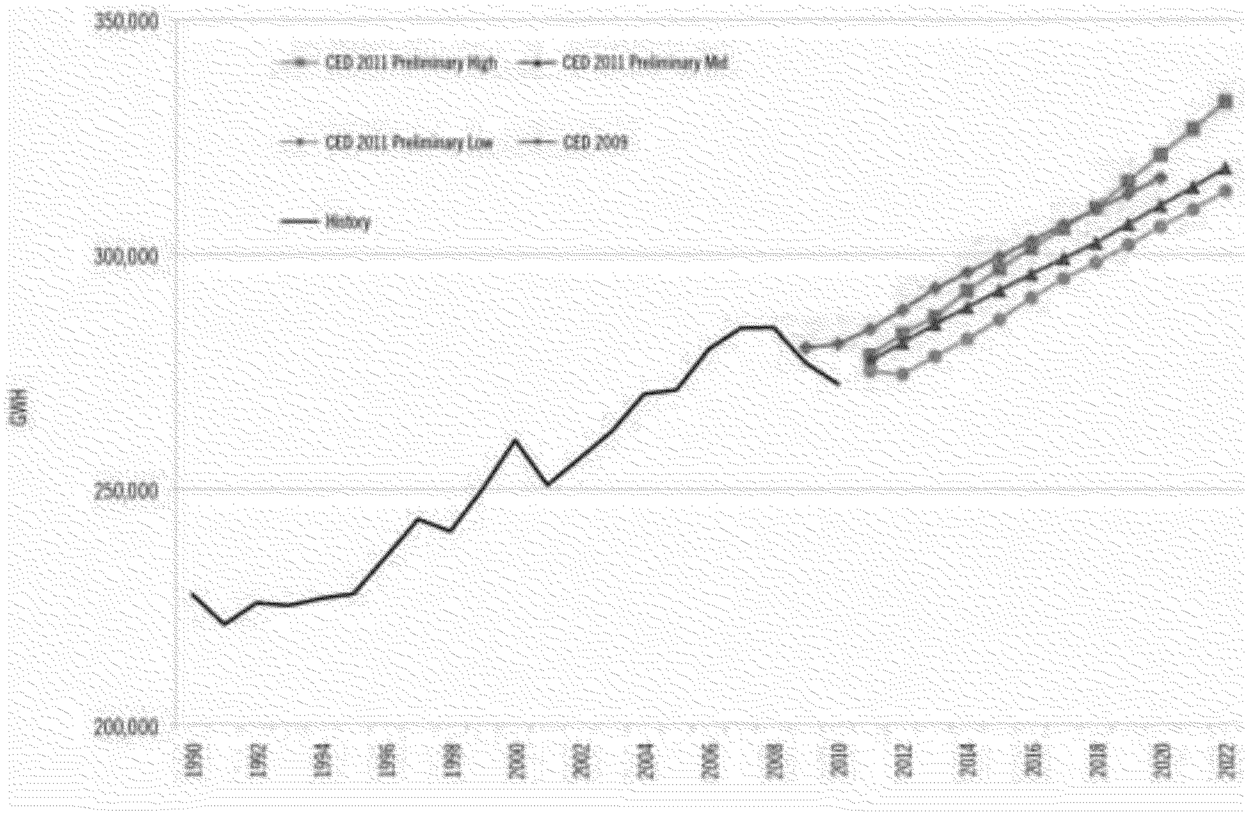
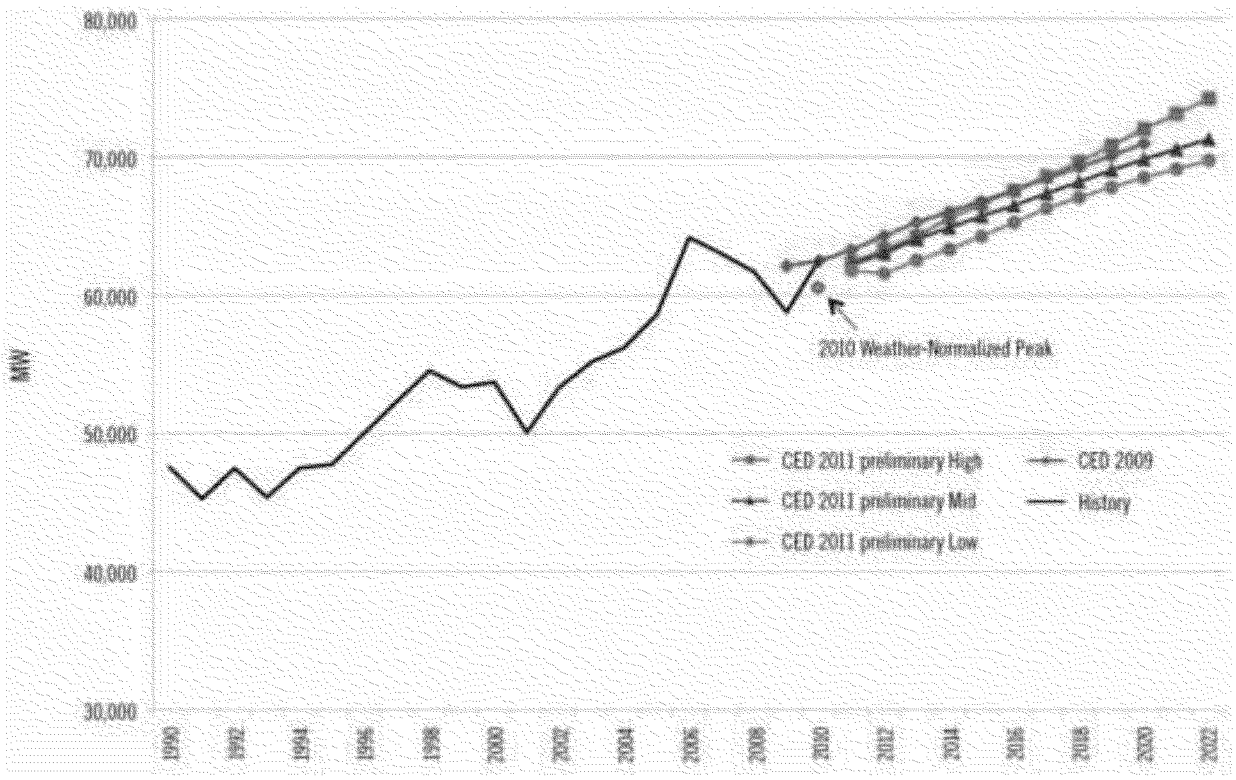


Figure 9: Statewide Annual Noncoincident Peak Demand



Source: California Energy Commission

demand cases (1.32 and 1.67 percent, respectively) compared to *CED 2009* (1.20 percent). In the low demand scenario, annual growth is higher than in *CED 2009* after 2012. Higher projected growth rates in the 2011 forecast reflect a deeper recession in 2009 than assumed as well as a very mild weather year in 2010 and therefore faster growth in reverting to expected long-term weather and economic trends. Forecast consumption reaches *CED 2009* projected levels by 2018 in the high-demand scenario and surpasses the 2020 *CED 2009* projection in the mid-case by 2022. By the end of the forecast period, California's electricity consumption is expected to reach between 313,000 and 333,000 GWh.

Consumption is the main driver for peak demand projections, so the depiction in Figure 9 of the preliminary peak forecast scenarios looks much like Figure 8. Growth in peak demand from 2010–2020, relative to a weather-normalized 2010, is faster in the high and mid cases (1.76 percent and 1.45 percent, respectively) than in *CED 2009* (1.31 percent). Statewide peak demand is projected to reach the *CED 2009* level by 2017 in the high-demand scenario and to surpass the 2020 *CED 2009* projection in the mid-case by 2022. Average annual growth rates from 2010–2020 relative to actual peak in 2010 are projected to be 1.41 percent, 1.10 percent, and 0.91 percent, respectively, in the high-, mid-, and low-demand scenarios. By 2022, peak demand is expected to reach between 69,700 and 74,200 MW.

The *CED 2011 Preliminary* natural gas forecast parallels the electricity consumption forecast. Historical data is incorporated up through 2010, and the same models are used to produce three scenarios (high-, mid-, and low-demand) under the same economic/demographic assumptions developed for the electricity forecast. Historical consumption in 2010 is higher than the value projected by *CED 2009*. Projected growth rates are higher, too, such that all three demand scenarios project greater consumption in 2020 than previously expected. By 2022, consumption is expected to reach between 13,773 million and 14,175 million therms. Table 9 compares projected natural gas consumption under the three scenarios.

Modifications to Forecast Method

Additional consumption data became available after publication of the *2009 Integrated Energy Policy Report*. The *CED 2011 Preliminary* adjusted the timeline so that 2010 is the historical base year and the forecast horizon extends to 2022, compared to 2020 in *CED 2009*. Beyond this routine adjustment, staff made several significant modifications to the *2011 IEPR* demand forecast method.

For one, staff developed the major economic sectors – residential, commercial, and industrial – by combining the Energy Commission's traditional end-use models and a new econometric approach (created by staff in 2011). Additionally, staff developed peak projections using its Hourly Electricity Load Model and a new econometric model. Staff made adjustments to results from existing models based on the econometric estimations. For example, price elasticities estimated in the residential and industrial econometric models replaced previous end-use elasticities. Recommendations from a recent evaluation of the demand model method motivated staff to develop a robust, multi-resolution modeling approach to demand forecasting.

Staff forecasted residential adoption of photovoltaic (PV) systems and solar water heaters using a predictive model rather than a trend analysis (as in previous forecasts). The new method is based on estimated payback periods and cost-effectiveness determined by upfront costs, energy rates, and various incentive levels. Staff developed scenarios using varied assumptions about electricity rates and new home construction.

Finally, *CED 2011 Preliminary* incorporates potential global climate change impacts more comprehensively. The Energy Commission demand forecasting process typically models these impacts by adjusting

Table 9: Statewide End-User Natural Gas Forecast Comparison

Historical values are shaded blue.

Consumption (MM Therms)	CED 2009 (December 2009)	CED 2011 Preliminary High (August 2011)	CED 2011 Preliminary Mid (August 2011)	CED 2011 Preliminary Low (August 2011)
1990	12,893	12,893	12,893	12,893
2000	13,913	13,914	13,914	13,914
2010	12,162	12,665	12,665	12,665
2015	12,751	13,372	13,338	12,891
2020	12,997	13,832	13,789	13,552
2022	—	14,175	13,992	13,773
Average Annual Growth Rates				
1990-2000	0.76%	0.76%	0.76%	0.76%
2000-2010	-1.34%	-0.94%	-0.94%	-0.94%
2010-2015	0.95%	1.09%	1.04%	0.36%
2010-2020	0.67%	0.89%	0.85%	0.68%
2010-2022	—	0.94%	0.83%	0.70%

Source: California Energy Commission

upward the number of cooling and heating degree days in the forecast period, based on the historical ratio of degree days in the last 12 years to that of the last 30 years. The result of this adjustment is an increase in the projected amount of cooling and a decrease in heating relative to the historical period. This correction attempts to account for the likelihood of a general warming trend.

However, temperatures assumed in the peak forecast (an average of daily temperatures over a 30-year period) are not affected by the adjustment, so the forecast may not fully capture the impact on peak demand of possibly more frequent heat storm weather events, in the form of higher maximum temperatures in a given year. Therefore, using climate change scenarios for maximum temperatures developed by the Scripps Institute, staff applied these to the peak econometric model (which includes a coefficient for maximum temperature) and used the projected climate change impacts to adjust the existing end-use peak model results.

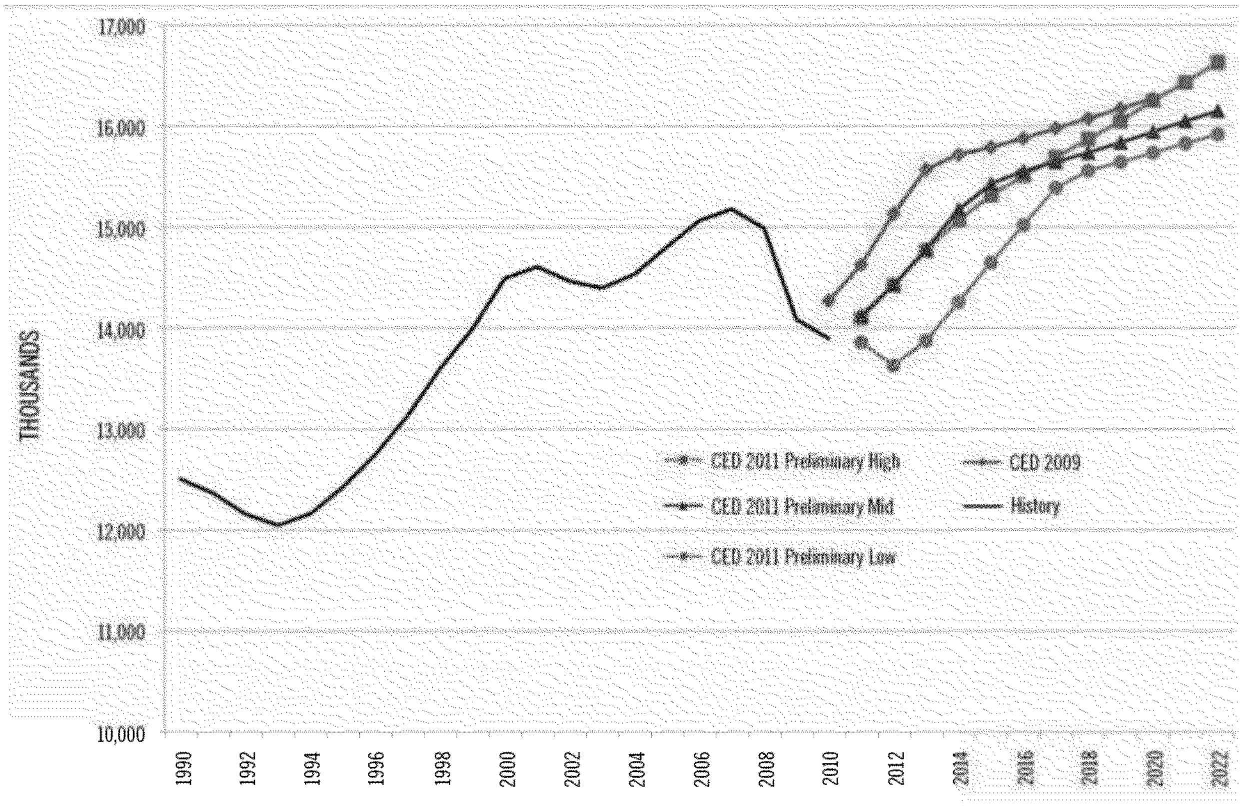
The *CED 2011 Preliminary* describes these changes, along with forecast results and modeling methodologies, in much greater detail.[121]

Energy and the Economy

Economic projections are one of the key inputs to the demand forecast. For the *CED 2011 Preliminary* forecast, staff examined multiple economic and demographic scenarios. The intent was to quantify the impacts from a reasonable range of assumptions

121 Kavalec, Chris, Tom Gorin, Mark Ciminelli, Nicholas Fugate, Asish Gautum, and Glen Sharp, 2011, op. cit.

Figure 10: Statewide Employment Projections



Source: California Energy Commission

on electricity demand. Staff selected three sets of economic projections from Moody's Economy.com and IHS Global Insight. Staff chose scenarios that captured the highest and lowest projected levels of economic growth.

Figure 10 shows historical and projected levels for nonagricultural employment, a key economic driver of the commercial and industrial forecasts. A comparison of the projections illustrates consistent expectations about the future of California's economy. Each case assumes California will experience a period of rapid growth as the economy begins to recover from the 2008 crisis, followed by a return to modest long-term growth at rates similar to those seen in recent history.

The most significant discrepancy between these economic projections lies in the duration of the recession and in the timing and rate of the recovery. Energy consumption trends with employment and other economic indicators, so these transitions are important factors, particularly in characterizing energy use over the next few years. Despite a great deal of economic uncertainty surrounding the current recession (for example, when and how California will recover), the alternative scenarios show a relatively narrow band by the end of the forecast period. This narrowing tends to reduce the differences among the forecast energy scenarios later in the forecast period, all else being equal.

Traditional indicators such as employment, personal income, and population are important, but are not the only economic factors that could affect the forecast. On January 19, 2011, the Energy Commission hosted a public workshop where several expert economists, researchers, policy makers, and business owners discussed ways in which the future of California's economy may deviate from its historical pattern. Staff considered some key points made during the discussion:

***The substantial drop in housing prices may affect migration patterns, specificallyincreasing in-migration. It is likely that California will not experience the same pattern of depressed population growth as seen in previous recessions.

***Changes to average home size and location may have a significanteffect on demographic drivers.

***Over the coming decade, climate change may introduce constraints on water supplies.

***Alternative indicators, such as personal debt, may become more valuable at providing insight into energy consumption patterns.

As California's economy recovers and changes, it is critically important that the Energy Commission adapts its demand forecasting models appropriately. Staff will consider incorporating such factors in future IEPR forecasts while continuing to engage with a variety of economic and demographic experts.

Self-Generation Impacts

The *CED 2011 Preliminary* forecast includes the impacts of on-site distributed generation (DG) used in large-scale facilities and of the major incentive programs designed to promote self-generation. The forecast uses a trend analysis to project self-generation, except in the case of residential PVs and solar water heaters, where it uses a new predictive model. The incentive programs include:

***Emerging Renewables Program (ERP): This program is managed by the Energy Commission.

***California Solar Initiative (CSI): This program is managed by the CPUC.

***Self-Generation Incentive Program (SGIP): This program is managed by the CPUC.

***New Solar Homes Partnership (NSHP): This program is managed by the Energy Commission.

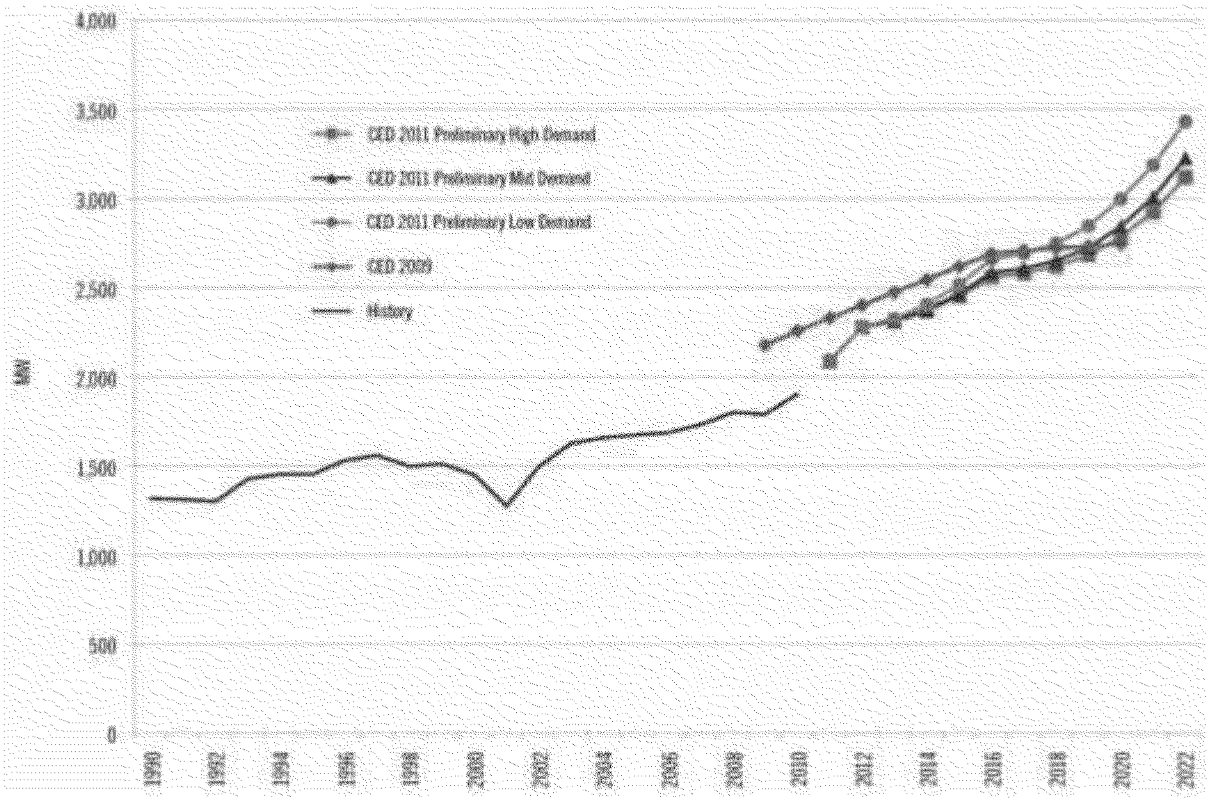
***Utility Incentives: Administered by publicly owned utilities such as Sacramento Municipal Utility District (SMUD), LADWP, Imperial Irrigation District, Burbank Water and Power, City of Glendale, and City of Pasadena.

The general strategy of the ERP, CSI, SGIP, and NSHP programs is to encourage demand for self-generation technologies, such as PV systems, with financialincentives until the market increases and achieves economies of scale and decreases the capital costs. The extent to which consumers see real price declines will depend on the interplay of supplier expectations, the future level of incentives, and demand as manifested by the number of states or countries offering subsidies.

Figure 11 shows historical and expected peak impacts of self-generation, which are projected to reduce peak load by more than 3,000 MW by 2022. Historical impacts were revised downward because some self-generation data was found to be misclassified,so *CED 2009* projections begin well above estimates of historical impacts. Higher projections for PV peak impacts in both the residential and commercial sectors drive total self-generation peak above *CED 2009* levels by 2020 in all three scenarios. The temporary flatteningof the curves after 2016 corresponds to expiration of the CSI program.

Table 10 shows historical and projected statewide electricity consumption from self-generation, and is broken out into PV and non-PV applications. For traditional combined heat and power (CHP) technologies, self-generation is assumed constant, so that

Figure 11: Statewide Peak Impacts of Self-Generation



Source: California Energy Commission

Table 10: Electricity Consumption From Self-Generation (GWh)

	1990	2000	2010	2015	2020	2022
Non-Photovoltaic Self-Generation	8,242	9,179	9,651	10,366	10,852	11,065
Photovoltaic, Low Demand	3	10	1,110	3,063	4,691	6,060
Photovoltaic, Mid Demand	3	10	1,110	2,874	4,118	5,290
Photovoltaic, High Demand	3	10	1,110	2,817	3,894	4,896
Total Self-Generation, Low Demand	8,245	9,189	10,761	13,429	15,543	17,125
Total Self-Generation, Mid Demand	8,245	9,189	10,761	13,488	14,945	16,329
Total Self-Generation, High Demand	8,245	9,189	10,761	13,429	14,716	15,924

Source: California Energy Commission

retired CHP plants are replaced with new ones with no net change in generation in the current forecast. Given the Governor's policy goals for CHP and DG and the recent qualifying facility settlement to CHP, in future *IEPRs* there will be a more comprehensive assessment of the status of CHP in California. As part of this effort, the staff will be developing scenarios for this technology for the revised forecast. Growth in non-PV self-generation comes mainly from recent increases in the application of fuel cells and other low emissions technology, projected forward.

Energy Efficiency Impacts

California's energy policy identifies energy efficiency as the "resource of first choice" for meeting California's future energy needs. As such, efficiency codes and standards, programs, and other policies play a central role in California's energy procurement and transmission plans and are a strategic element in the state's greenhouse gas emission reduction goals. Unlike other resources that are deployed to meet demand, energy efficiency reduces consumption and is therefore considered in the demand forecast, either embedded directly within the forecasting models or as an incremental effect subtracted from the model output. In both cases, staff is ensuring that the demand forecast reflects reasonable levels of efficiency from a comprehensive set of efforts expected to occur.

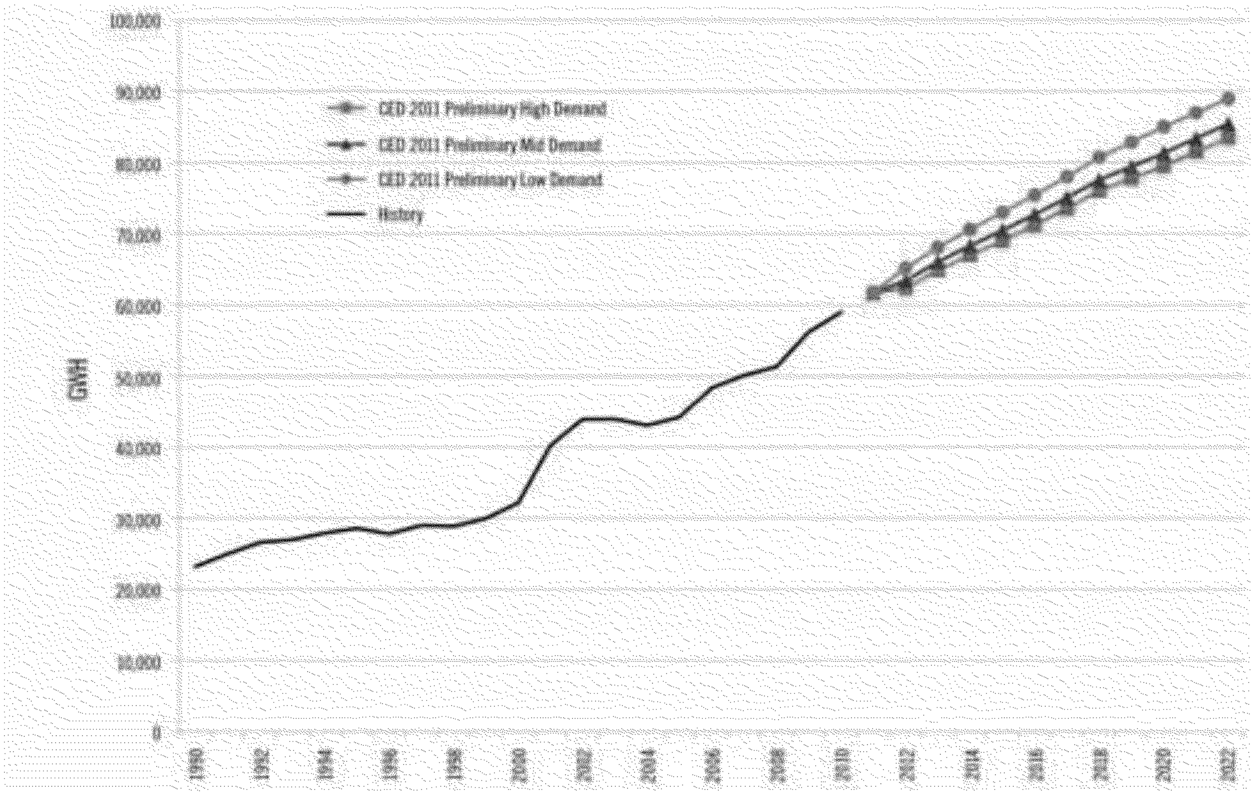
The *CED 2011 Preliminary* forecast continues the long-standing practice of distinguishing between two types of "reasonably-expected-to-occur" savings – committed and uncommitted. Committed efforts to reduce demand include authorized utility programs, finalized building and appliance standards, and other policy initiatives that have implementation plans, firm funding, and a design that can be technically assessed to determine probable future impacts. Committed savings also include price and market effects, which represent savings from rate increases and other market effects not related directly to standards and programs. These savings are incorporated directly into the forecast. Uncommitted savings – which, while plausible, have a great deal of uncertainty surrounding the method, timing, and relative impact of their implementation – are considered separately within the *CED 2011 Preliminary* analysis.

The Energy Commission developed the demand forecasting models in a way that promotes the inclusion of building and appliance efficiency standards. The models distinguish among vintages of floorspace, housing, and equipment. As a new building or piece of equipment is added, the model assumes its energy use characteristics meet – at a minimum – the applicable standards. Following the effective implementation date, standards gradually affect an increasingly larger proportion of the total building and appliance stock. Each cycle of progressively tightened standards can be evaluated to determine the additional energy savings contributed from each vintage of standards by comparing model outputs.

Measuring the effects of utility programs poses a greater challenge, as customer participation is voluntary and is motivated by a complex set of interactive effects. Also, customers may replace appliances well before the end of their usefulness, and while data may be available on the efficiency of new appliances, the reference level of efficiency is often unknown for the replaced appliances.

To better measure program impacts, staff leveraged the CPUC's most recent efforts to measure utility program savings. The CPUC Energy Division's evaluation-based estimates of program savings from the 2006–2008 program cycle, as well as additional evaluation for 2009 programs, represent the most thorough and comprehensive effort to date. This unprecedented level of detailed evaluation data, however, applies only to programs implemented within the last four years. Therefore, staff modeled the uncertainty surrounding the performance of future programs using scenario analysis.

Figure 12: Statewide Committed Consumption Efficiency and Conservation Impacts



Source: California Energy Commission

Because a clear, consistent record of evaluated efficiency program achievements is not readily available,[122] there is a great deal of uncertainty around any estimate of historical program impacts. This uncertainty, along with uncertainty around attribution of savings among standards, programs, and price effects, has been the subject of debate in recent Demand Analysis Working Group meetings. Some parties have insisted that Energy Commission demand forecasts incorporate historical program impacts that are vastly underestimated and/or credit too much savings to standards and price effects, especially before 1998. A recent staff paper summarizes the positions of various parties.[123]

Staff believes that the forecasting process yields reasonable estimates of total savings but acknowledges and shares concerns voiced by stakeholders about savings attribution. Therefore, the *CED 2011 Preliminary* provides no attribution among the three sources (programs, codes and standards, and price and market effects) except for estimates of standards impacts. In other words, it provides no specific esti-

122 See discussion of EM&V requirements over time in Kavalec, Chris and Don Schultz, May 2011, *Efficiency Programs: Incorporating Historical Activities Into Energy Commission Demand Forecasts*, draft staff paper, California Energy Commission, Electricity Supply Analysis Division, CEC-200-2011-005-SD, available at: www.energy.ca.gov/2011publications/CEC-200-2011-005/CEC-200-2011-005-SD.pdf.

123 California Energy Commission, Electricity Supply Analysis Division, Chris Kavalec, *Energy Efficiency Program Characterization in Energy Commission Demand Forecasts: Stakeholder Perspectives and Staff Recommendations: Draft Staff Paper*, August 2011, CEC-200-2011-010-SD, available at: www.energy.ca.gov/2011publications/CEC-200-2011-010/CEC-200-2011-010-SD.pdf.

mates of program and price effects. Staff will continue to work with stakeholders on these issues, with the goal of showing attribution for at least some years in future reports. Figure 12 shows total historical and projected committed efficiency savings from the three sources starting in 1990. Annual totals are relative to conditions in 1975, before the state implemented the first efficiency standards.

Beyond these committed impacts, the CPUC, Energy Commission, California Air Resources Board, and the Legislature have set efficiency goals without approval of specific program designs or authorization of actual program funding levels. Staff must consider long-term utility savings goals, future updates to Title 20 and Title 24 codes and standards, and statewide policy initiatives in determining incremental uncommitted energy efficiency impacts – impacts that are in addition those already included in the baseline forecast.

During the *2009 IEPR* cycle, at the request of the CPUC, staff began to assess the effects of incremental uncommitted energy efficiency policy initiatives. Staff included policy initiatives in the analysis similar to those originally evaluated by Itron and adopted by the CPUC in the *2008 Energy Efficiency Goals Update Report* (*2008 Goals Study*).[124] The incremental uncommitted analysis for *CED 2011 Preliminary* also relies on the *2008 Goals Study* but is updated to account for the passage of time. Therefore, some initiatives considered uncommitted in 2009 are now incorporated in the committed forecast. (Figure 12 includes estimated savings.) The newly committed initiatives include Assembly Bill 1109 (Huffman, Chapter 534, Statutes of 2007) and the 2010 Title 24 Building Code Revisions. In addition, the *CED 2011 Preliminary* extends uncommitted analysis to publicly owned utilities. The uncommitted efficiency initiatives in *CED 2011 Preliminary* include:

124 Itron, Inc. *Assistance in Updating the Energy Efficiency Savings Goals for 2012 and Beyond*, adopted by CPUC in March 2007, www.cpuc.ca.gov/NR/rdonlyres/D72B6523-FC10-4964-AFE3-A4B83009E8AB/0/GoalsUpdateReport.pdf.

***Utility programs beyond 2012, including residential, commercial, and industrial.

***Further updates to state Title 20 and 24 standards along with updated federal appliance standards.

***The CPUC's Big Bold Energy Efficiency Initiatives.

As in the *2008 Goals Study*, *CED 2011 Preliminary* assumed various levels of commitment to these policies to create three scenarios of uncommitted efficiency savings – high, medium, and low. By 2022, consumption in the mid-demand case would be reduced 3.3 percent if adjusted by the low savings scenario and 6.2 percent using high incremental uncommitted savings. For peak, the reductions range from 4.8 percent to 9.5 percent, higher than consumption because the end uses targeted by these initiatives tend to have higher-than-average peak-to-energy-consumption ratios.

Combining the high demand case with the low incremental uncommitted efficiency scenario and the low-demand case with the high efficiency scenario gives a range of "managed" forecasts. Statewide, adjusted consumption ranges from around 294,000 GWh to 322,000 GWh, compared to 313,000 GWh to 332,000 GWh for unadjusted consumption. For peak demand, the adjusted range is 63,000 MW to 71,000 MW, compared to the unadjusted range of 70,000 MW to 74,000 MW. In these adjusted mid- and low-demand cases, peak demand begins to drop slightly by the end of the forecast period. Peak demand in the low case drops slightly below the actual 2010 statewide (noncoincident) level.

The CPUC's new *Potential and Goals Study* is underway and is expected to be completed in late summer 2012. This schedule does not allow the study to be fully incorporated in the revised or final adopted IEPR demand forecasts, but CPUC staff intends to use interim study results to recommend changes to the incremental uncommitted efficiency impacts developed from the *2008 Goals Study.* Thus, the un-committed results will likely differ in the revised and adopted IEPR forecasts compared to the preliminary.

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Action Plan: Commercial Building Sector 2010-2012

Developed by ZNE Stakeholders

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This Zero Net Energy (ZNE) Action Plan ╫ |ffiffl┘ ├•ffl|◘i |ffl♂□ |♬♂☼ ┼• |♬ #┘ commercial buildings sector achieve the goals described in the California Long Term Energy Efficiency Strategic Plan ◄◘fl |*↕ ◘♬◘fl─ |‼| ¶♂♬•<| ┼◘fl |*¶♂♬•<┴[1]

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Publicly-noticed workshops were held to revisit the two major goals outlined in the commercial chapter of the Strategic Plan and solicit input and support for the development of this Action Plan. It was through this workshop process that Energy Division began to look for volunteers (later called champions) to step forward and help assist in the implementation leadership of the ZNE Action Plan. This Action Plan reflects the input of Energy Division, Champions, and ZNE workshop participants (Appendix H). Recommendations from workshop participants are located in Appendix A, as well as throughout the document. Following are details on the individual workshops[2] including purpose and outcomes.

1. October 19, 2009 = First workshop, located at the CPUC in San Francisco, focused on Goal 1: New Construction and key strategies for getting to zero in the five key areas of codes, benchmarking, incentives, design community support, and technology transfer/R&D. Key players and chronological sequence of issues were also discussed.
2. December 8, 2009 = Second workshop, located in Irwindale at Southern Californ|♬|╎ ffi|┘ #┘| Customer Technology Application Center, focused on Goal 2: Existing Buildings and how to increase the rate of energy efficiency in key market sectors. Topics included: engaging the broader community and roles of the private industry and state agencies.
3. April 7, 2010 = Third workshop, located at the Pacific Energy Center in San Francisco, focused on key strategies echoed at previous workshops, the selection of near term milestones, mapping of key organizations to specific actions, and identification of priority strategies. The Action Plan process was initiated at this stage, as well as approaches on how to bring this document to life.

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Published in 2008 by the California Public Utilities Commission (CPUC), the Strategic Plan outlines energy goals and efficiency strategies for key market sectors (commercial, residential, etc.) and crosscutting resources (e.g., HVAC).[3] In order to guide long-term changes in the market by reducing barriers to the adoption of energy efficiency measures (to the point where publicly-funded intervention is no longer appropriate) > market transformation > the Plan embraces four specific programmatic goals, ↑• ├•|♬┘ |◘fl |├├├ ♂ffi╡ •ffl┼┤ ☼☼‼ |ffl•‼┤↕ ◘♬◘fl─ |ffl╡ ┼|*→→┤┤↕<|◄ ┬ -10-032).[4] Unlike traditional regulatory approaches, the Plan identifies near-term, mid-term and long-term milestones to move the state towards these BBEES. The Big Bold Energy Efficiency Strategies are:

All new residential construction in California will be zero net energy by 2020

All new commercial construction in California will be zero net energy by 2030

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[1] CPUC, *ffiffl┘├•◘♂□•♬☼┘☼┼◄□•♬┘‼☼¶◘* (Sep 2008): http://www.californiaenergyefficiency.com/docs/EEStrategicPlan.pdf.

[2] http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/EE+Workshops/.

[3] Ibid, Table of Contents.

[4] Ibid, 4.

- Heating, Ventilation and Air Conditioning (HVAC) will be transformed to ensure that its energy [illegible]
- All eligible low-income customers will be given the opportunity to participate in the low income energy efficiency program by 2020.

[illegible] technologies, services and even philosophies in program design are required. Stretching beyond the scope and participation of the existing ratepayer-supported utility programs, achieving the goals in the Strategic Plan requires involvement of stakeholders outside of investor owned utilities (IOUs). While the Plan is a policy-oriented document that sets forth leadership and vision, the ZNE Action Plan is a way to operationalize the zero net energy goals of the Strategic Plan for the commercial sector. Not only does this document help the broader California community proceed step-by-step towards achieving the [illegible] but it also provides meaningful engagement for stakeholders. This document focuses [illegible] ZNE goals for the commercial sector, new construction (Goal 1) and existing buildings (Goal 2). Goal 3 (commercial lighting) has been incorporated in the 2010 Lighting Chapter (added to the Plan in September 2010). The Lighting Action Plan (available by end of 2010) will provide more detail, strategies and milestones for this crucial crosscutting resource.

[illegible]

Engaging industry leaders and influencers, as well as relevant agencies, stakeholders and utilities, is critical for successful implementation of the Plan. To make stakeholder participation in strategic planning activities meaningful and focused on achieving milestones, the ZNE Action Plan is designed to identify the key actions required to achieve Plan milestones, secure leaders for the steps to achieve these actions, and track and report on progress against the Plan. This roadmap is comparatively succinct and graphical in nature, in the hopes of facilitating comprehension and action by the broadest cross section of California players as possible. The ZNE Action Plan is based on a literature review, a series of public workshops (related to both new construction and existing buildings), ongoing outreach to key stakeholders (see Appendix G & H) and participation in both state and national commercial building efforts (see Appendix D).

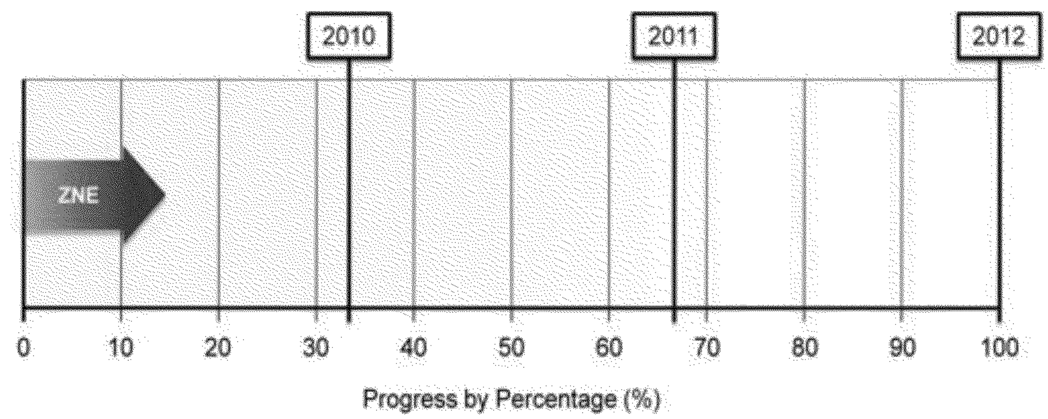
[illegible] The ZNE Action Plan is designed to achieve milestones identified in the Strategic Plan. However, with more than 30 milestones in the commercial sector recommended for implementation in 2010-2012 alone, actions must be prioritized. Moreover, given both the dynamic nature of the energy efficiency (EE) marketplace and concurrent efforts in other sectors, the ZNE Action Plan does not seek to launch all strategies identified in the Plan by 2010, nor does it provide a highly detailed plan for the entire near term (2010-2012) implementation. Instead, the ZNE Action Plan focuses on priority strategies needing immediate attention, and an overview of activities to be launched in 2011 and 2012. These priority strategies were defined and vetted through workshops with the broader stakeholder community.

[illegible] Continued work with the broader stakeholder community is the core focus of this action plan, including manufacturers, contractors, local governments and others. Ongoing coordination is essential to track progress, develop accountability and acknowledge success, as well as generally provide high-level coordination to accelerate progress. The initial approach to the ZNE Action Plan includes identifying champions for each milestone. Via an initial set of workshops (existing buildings, new construction and the joint action plan for both), industry leaders were identified to take on responsibility for the achievement of Strategic Plan goals. Champions include people from relevant state agencies, buildings industry, utilities, and a wide range of trade groups and nonprofit organizations. Many of the champions who have volunteered are already working on some aspect of the action plan in their professional work. In the near-term, the CPUC will serve as a central organizational point for Plan champions, providing both online (www.Enage360.com) and offline facilitation of the [illegible] network, as well as tracking progress towards milestones. Regular updates will be provided on actions and progress indicators via www.Engage360.com. Additional champions from the broader marketplace will be essential to truly institutionalize the Plan in the fabric of the state.

[illegible] For each strategy discussed in this action plan, activities were ordered in a step-wise approach to achieve milestones. While this document serves to create a broadly distributed and easy-to-understand approach to the ZNE Action Plan, additional project management tools are employed to (a) identify groups already working on key issues related to the ZNE Action Plan, (b) identify likely organizations and individuals who would be able to help deliver a milestone, (c) identify champions who can take responsibility for specific tasks, (d) estimate time to achieve a specific action and (e) record any progress.

[illegible] Progress indicators are based on a simple calculation. For each milestone, there [illegible] number of actions complete by the total number of actions. While it may be ideal to develop a weighted approach (as achieving some milestones have a significant ripple effect) or develop a formula that equates a score with activities that are ahead, behind or on schedule, this simple method provides for a gen[illegible] codes) are listed as one-sixth (17 percent) complete as of July 2010, per a total of 12 quarterly progress reports for what the Strategic Plan calls the near-term (2010-2012) implementation cycle. Progress indicators and not provided for strategies which will be launched in 2011 or 2012.

[illegible] In addition to the detail provided in this action plan, a snapshot of general progress [illegible] goals in key sectors is essential to success. To [illegible] indicators would need to ensure that milestones for the 2010-2012 cycle are generally one-third complete at the end of 2010, two-thirds complete at the end of 2011 and 100 percent complete at the end of 2012. Assuming steady progress in each year of the 3-year Strategic Plan cycle, near-term milestones (those included in this action plan), should be approximately 17 percent complete by mid-2010. By averaging the progress of all near-term milestones in the commercial sector (37), the action plan appears basically on track as of July 2010, with approximately 13 percent of necessary activities completed:



[illegible]

[illegible], a joint project of the Urban Land Institute and PricewaterhouseCoopers, characterizes the commercial buildings market as follows:

> [illegible] commercial real estate industry hits bottom in 2010, suffering a surge of painful writedowns, defaults [illegible] more than 40 percent off mid-2007 pricing peaks. These property market reversals likely will be the [illegible][5]

To date, California has more zero net energy buildings (residential and commercial) than any other state in the nation (see Appendix E for details). When reviewing this action plan, it is important to consider the impact of the global recession (2008^2010) on commercial buildings. The market for commercial buildings is in a substantial decline, which will likely continue for several years. This decline will significantly impact development of new projects, as vacancy rates in commercial properties are high and lending is tight. Construction of public buildings has already slowed and will likely continue to lag, as government entities tighten budgets and passage of school bonds may prove difficult. For existing buildings, there will be financial difficulties, but also some opportunities as tenants try to maximize the value of rental dollars and owners look for ways to cut buildings expenses, including the use of energy efficiency. However, with financing and cash both in short supply, the drop in building values may make owners reluctant to invest in their buildings.

Still, with the advent of the Strategic Plan, utility programs have new features that support achieving zero energy commercial buildings. [illegible] energy use (leading to zero energy buildings) and private efforts (including from the architectural, engineering and green building communities) are targeted to fundamentally change energy-use aspects of the built environment. With this unprecedented multi-party effort focused on zero energy buildings, California is on the path to transform how buildings are designed, constructed and operated.

[illegible]

[illegible] California could consider moving beyond quarterly cycles in the private sector, as well as the 3-year policy cycles, in order to create the next generation of buildings that will move [illegible] on.

[illegible] The market includes a wide variety of building owners with divergent perspectives, as well as thousands of manufacturers, services providers and building occupants. Any effort to change the commercial buildings sector must leverage market leaders where change is most possible, while also changing market perceptions. Target markets should be identified as a focus for the next few years. See Appendix C for suggested markets for early adoption.

[illegible] Financial mechanisms that reward, or at least support, depth of energy savings need to be developed, including a cost-effective assembly of best practices in ZNE retrofits. These ZNE best practices must document lessons learned, as well as identify payback periods and provide linkages across multiple program efforts.

[illegible] There is need for a broadly representative group, including a range of public and private sector volunteers, to help coordinate efforts to advance the action plan. Achieving ZNE goals is a complex process requiring actions related to code development, design tool improvements and financial mechanisms. California must create ways to facilitate long-term commitments to the Strategic Plan effort from both public and private institutions.

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[5] Miller, J.D., [illegible] (Oct 2009): 1. http://www.uli.org/ResearchAndPublications/EmergingTrends.

- ffiffiffl┘ ┣┘—●◀ffl◘ ffl▶-● ffl♂ffl◘□□In order to advance ffl┘├◀◘ ♂ |└◘●' ◘ ♬|♂ffl☼◘ffl | └╫♂◀nd successfully create demand for ZNE buildings◀ the ZNE Action Plan must track and report on progress. Ongoing stakeholder engagement will benefit from visible demonstrations of success and how the strategies and milestones are working both independently and collectively to achieve Plan goals.
- ffiffi◘ | ♬ ☼♂╫┘☼◀ ffl↕◘◀ ◘– ●┘–●●| ◀ ◀ ◘ffl | ┼●☼┼ ‼☼¶ ZNE will be helped by the development and market diffusion of new technologies (e.g. LEDs, hybrid lighting, heat pumps, integrated multi-stage units, solar-thin film). The marketplace needs to supply these innovations s and consumers must begin to demand these new products instead of old technologies.

[illegible]

The Zero Net Energy Action Plan includes:

- [illegible] An overview of the strategy and why it is important to focus on these activities now.
- [illegible] A graphical depiction of milestone progress, based on percent complete in the action plan.
- [illegible] identifies the milestones to achieve the strategy and has specific activities, is time bound and is aligned with champions in the industry.
- [illegible] Additional actions that were identified via stakeholders as potential strategies/milestones to include in an update to the Strategic Plan.

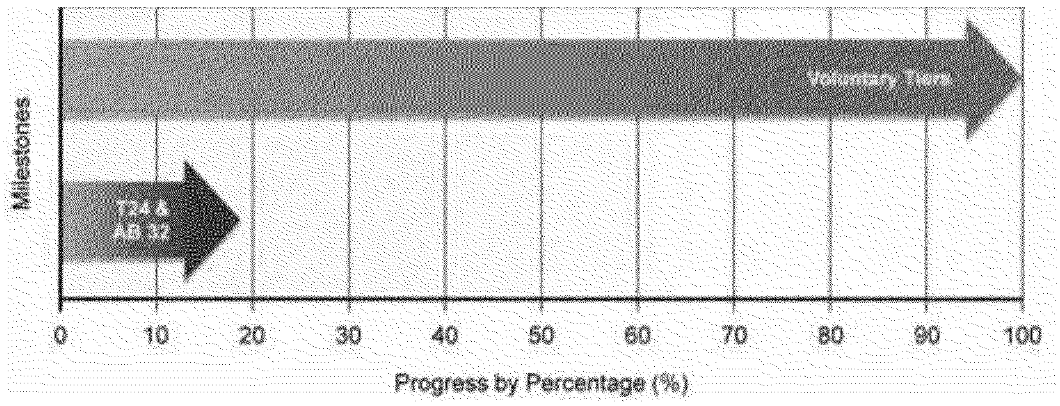
[illegible]

[illegible] construction will increasingly embrace zero net energy performance (including clean and distributed generation), reaching [illegible]

[illegible]

Energy codes are a key policy strategy included in the Strategic Plan to reach zero net energy buildings. To achieve 100 percent zero net energy new construction buildings by 2030, building energy codes need to be a driving policy instrument and ultimately the mechanism by which zero net energy is broadly achieved. No incentive or market-based program can achieve the market penetration routinely achieved by codes. The progressive path [illegible] indicate to the market how codes will advance over the next few years. It is critical to begin to enable these future codes now, given the time-intensive process > and the far-reaching impact > of the 3-year cycles to update codes and standards.

[illegible][6]



While voluntary tiers are established (1-1-1), approximately 17 percent of the action needed to reach the [illegible]-term (2010-2012) milestones to integrate T24 and AB 32 (1-1-2) are complete. For context, here are a few accomplishments on the path to ZNE codes and standards by 2030:

- [illegible] The California Building Standards Commission recently approved and enacted [illegible], updating the 2008 Title 24 (T24) codes, with consensus and adoption from the Department of Housing and Community Development, Division of the State Architect, Office of Statewide Health Planning and Development and the California Energy Commission (CEC). [illegible] incorporates three levels of energy efficiency: a basic level (Title 24), 15 percent over T24 and 30 percent over T24. Cities and counties may adopt one of the three levels as part of their local codes process.[7] These tiers of codes can also be noted as reach codes.
- [illegible] Reach codes are voluntary and are adopted by cities and counties to signal where the market is headed. Several cities and counties are adopting reach codes that are more stringent than statewide standards (Title 24) through local ordinances. These local ordinances will provide lessons and best practices as we move toward progressive code implementation in the state. These cities include: Redwood City, Los Altos, Marin, San Rafael, Union City, Morgan Hill, Richmond, Palo Alto, Chula Vista, Santa Clara, San Jose, Sonoma, Hayward, and San Francisco.[8]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible] Establish one- or two-tiered voluntary EE	Patrick Saxton, CEC	Develop a green building code with multiple voluntary levels; Part 11 of Title 24 (California Green Building Standards Code)	Complete

6 [illegible] ed as one-third complete in 2010, two-thirds in 2011 and three-thirds in 2012. These charts will be updated regularly on www.Engage360.com.

7 California Building Standards Commission, [illegible] (Jan 2010): http://www.documents.dgs.ca.gov/bsc/documents/2010/Draft-2010-CALGreenCode.pdf.

8 CEC, [illegible] (last viewed Aug 2010): http://www.energy.ca.gov/title24/2008standards/ordinances .

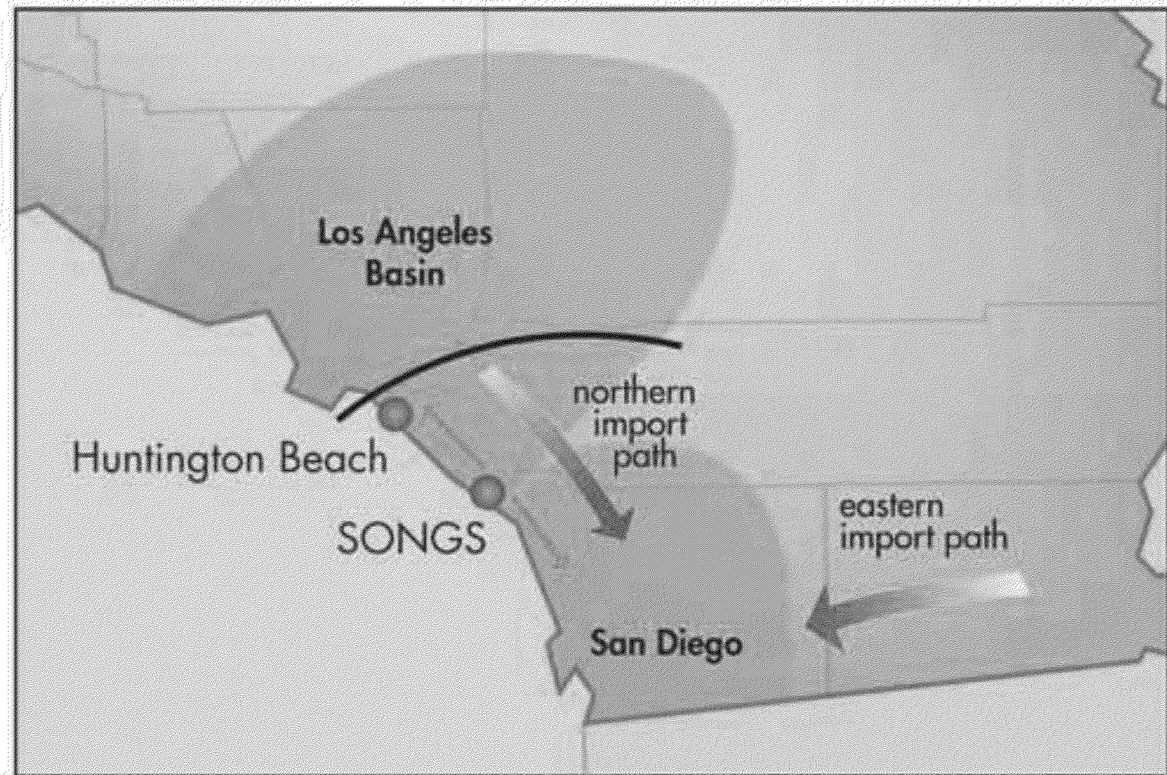
California ISO
Shaping a Renewed Future

Briefing on Summer 2012 Operations Preparedness

Neil Millar
Executive Director, Infrastructure Development

Board of Governors Meeting
General Session
March 22-23, 2012

Without the San Onofre Nuclear Generating Station (SONGS), San Diego and Los Angeles reliability is at risk under heavy load conditions.



San Diego is at risk of outages under heavy load conditions.

Huntington Beach units 3 & 4 increase import capability to San Diego.

Load	Mild Conditions	Heavy Load		Mild Conditions	Heavy Load
	4438	4882		4438	4882
Total gen	3048	3048		3048	3048
Import capability	**2100**	**2100**	➡	**2450**	**2450**
Load can be served	5148	5148		5498	5498
Reserves available	710	266		1060	616
Reserve requirement	603	603		603	603
Reserve margin	107	-337	➡	457	13

Conservation and demand response will provide additional margin.

California ISO

Activating Huntington Beach units 3 & 4 also mitigates the Los Angeles area outage risk that arises under heavy load conditions.

- Without both SONGS units, the Los Angeles area is short approximately 240 MW.
- Huntington Beach units 3 & 4 add 450 MW, thus mitigating the shortage.

These actions mitigate the outage risk.

- Return Huntington Beach 3 & 4 to service
- Accelerate Barre-Ellis transmission upgrade
- Accelerate completion of Sunrise and related outage planning
- Fully fund Flex Alerts and restart CPUC 20/20 program
- Fully utilize available demand response (e.g., as SCE air conditioner cycling)
- Seek additional military and public agency demand response
- Take longer-term steps to increase available demand response system-wide

[illegible]

[illegible]

[illegible]

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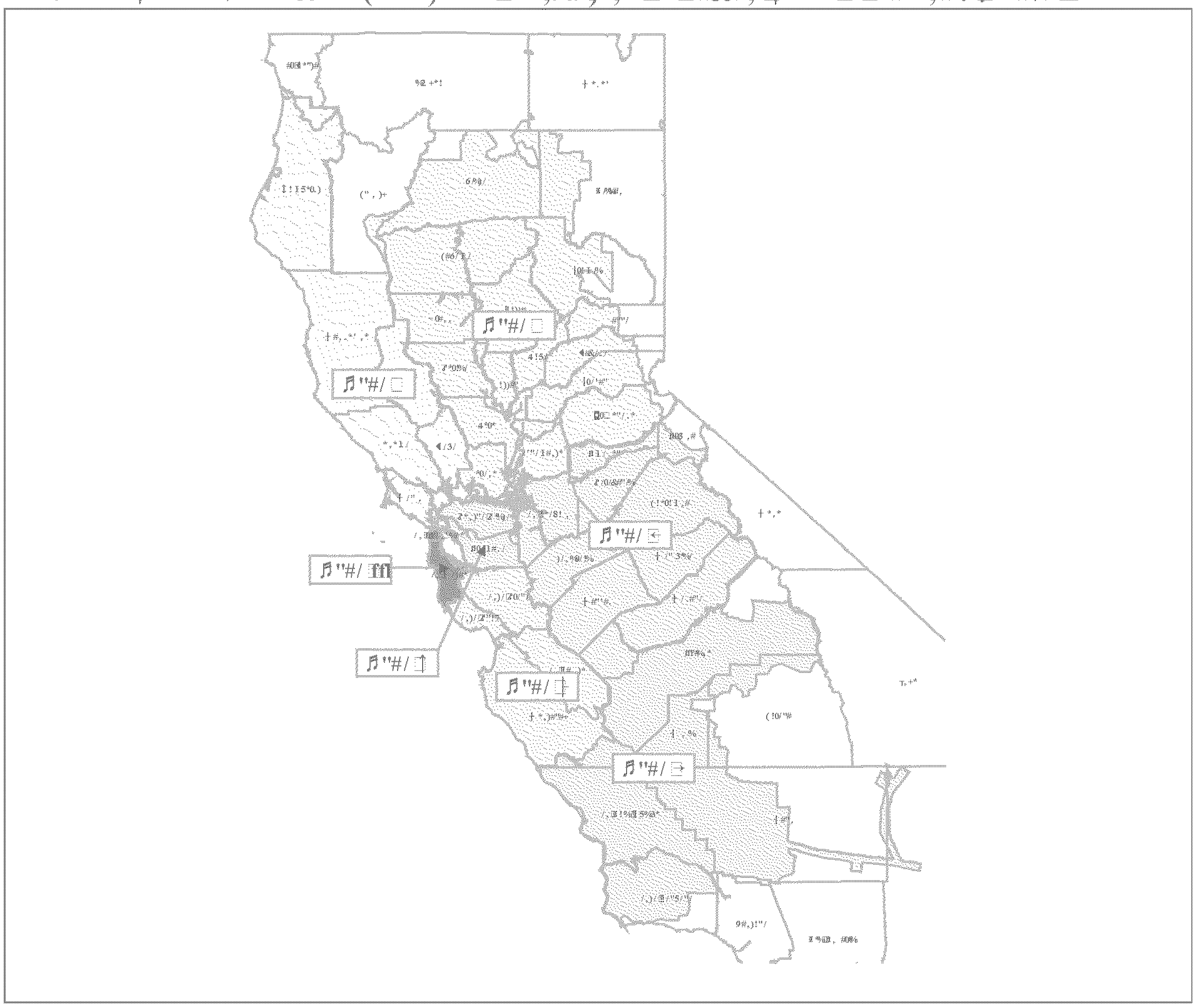

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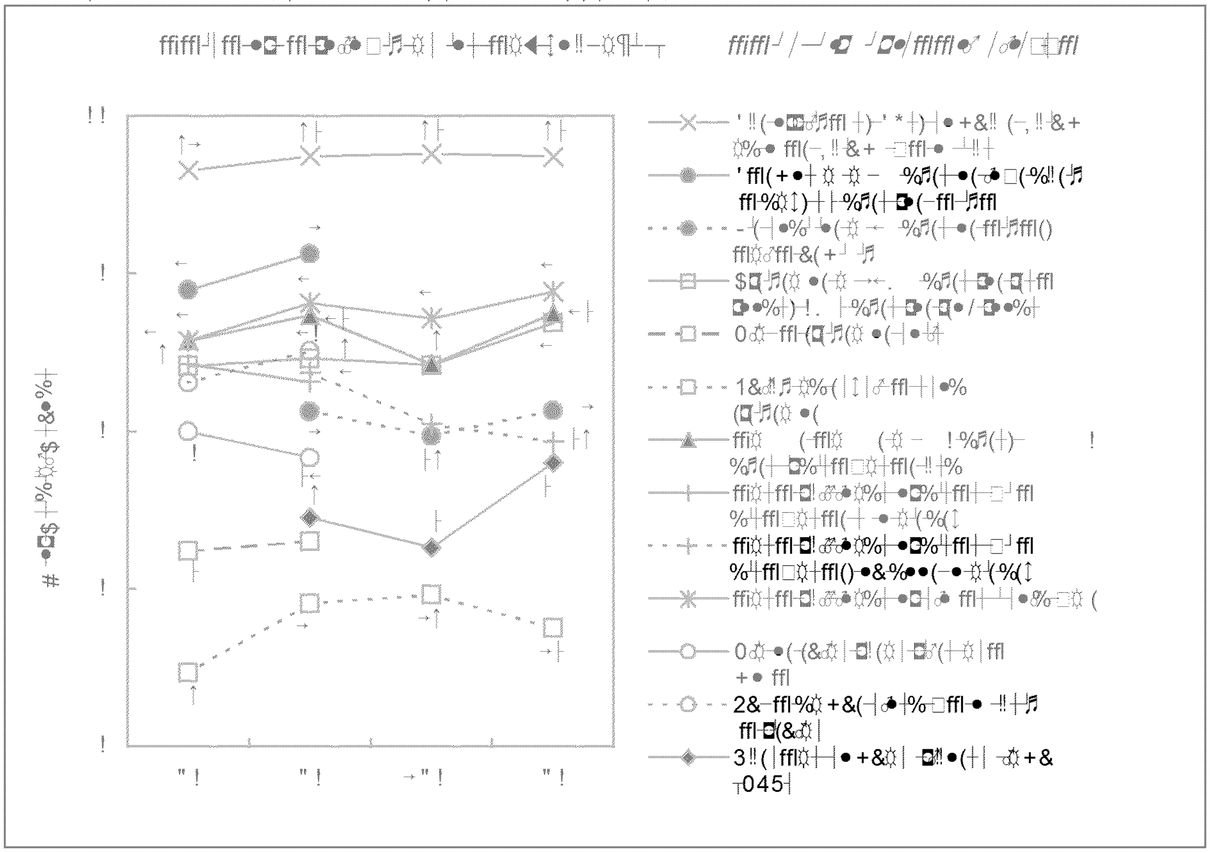

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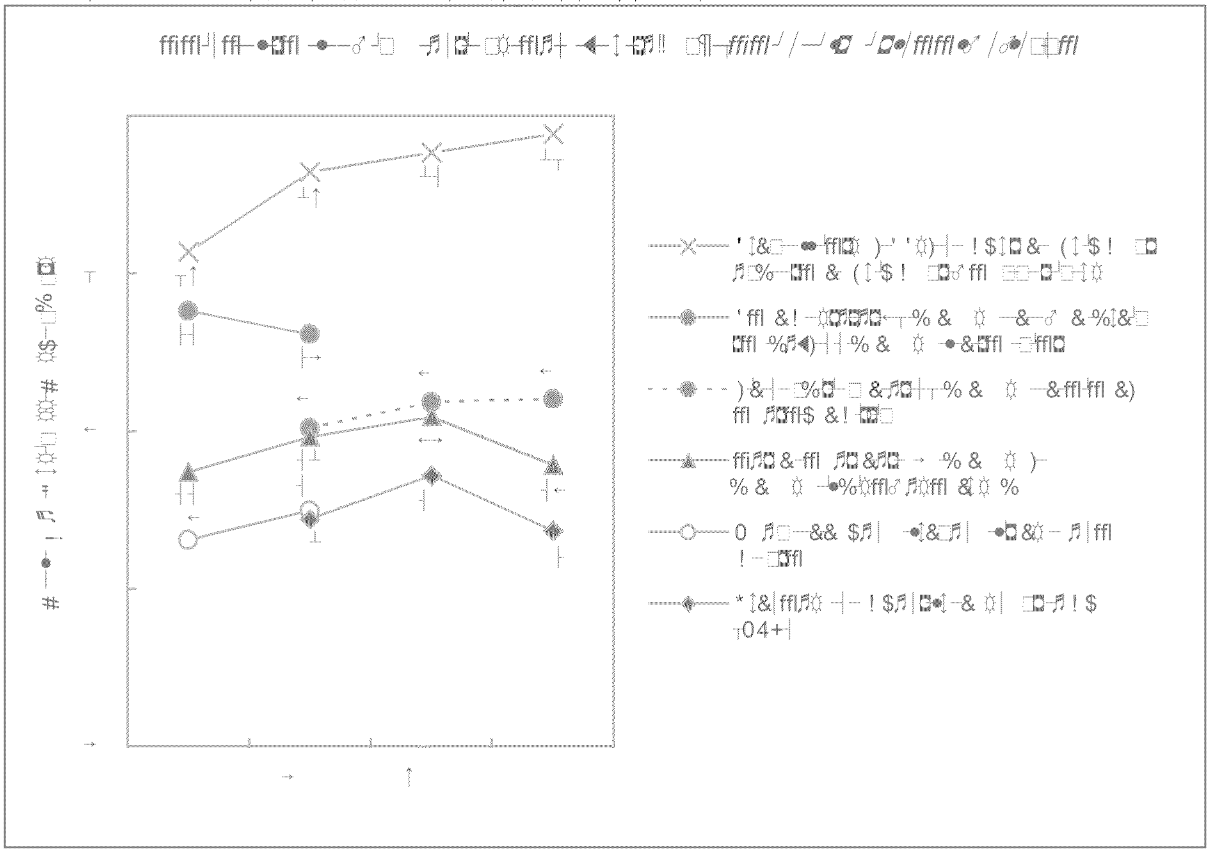

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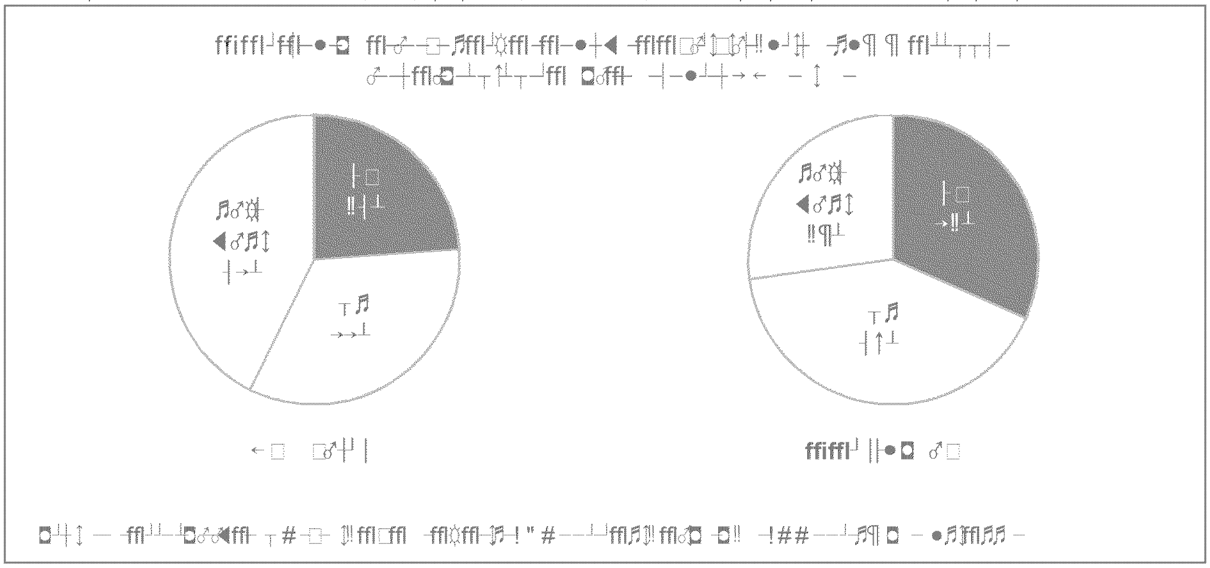

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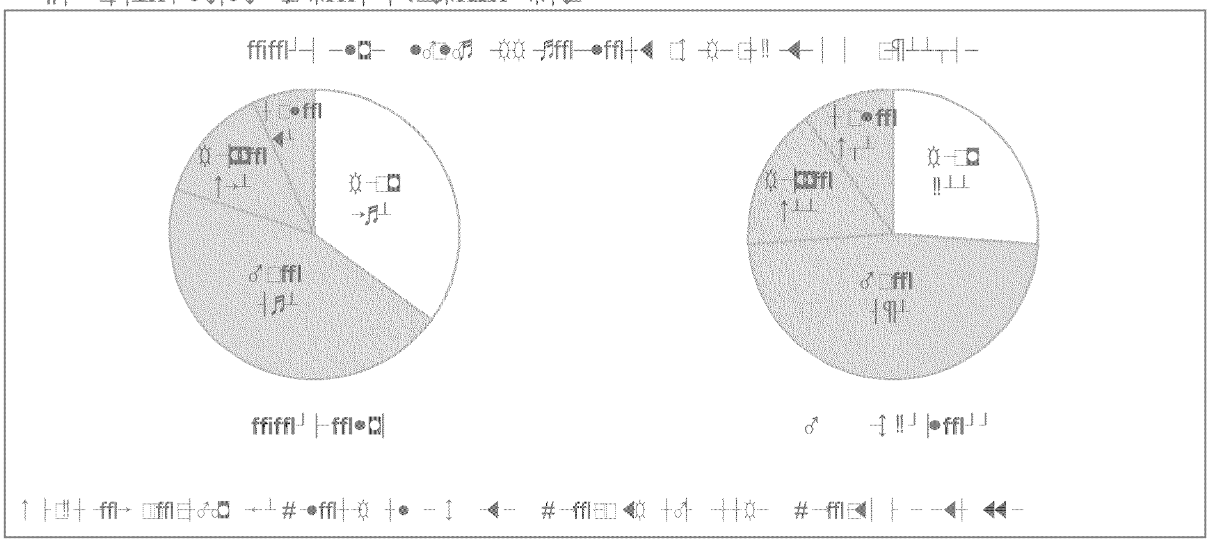

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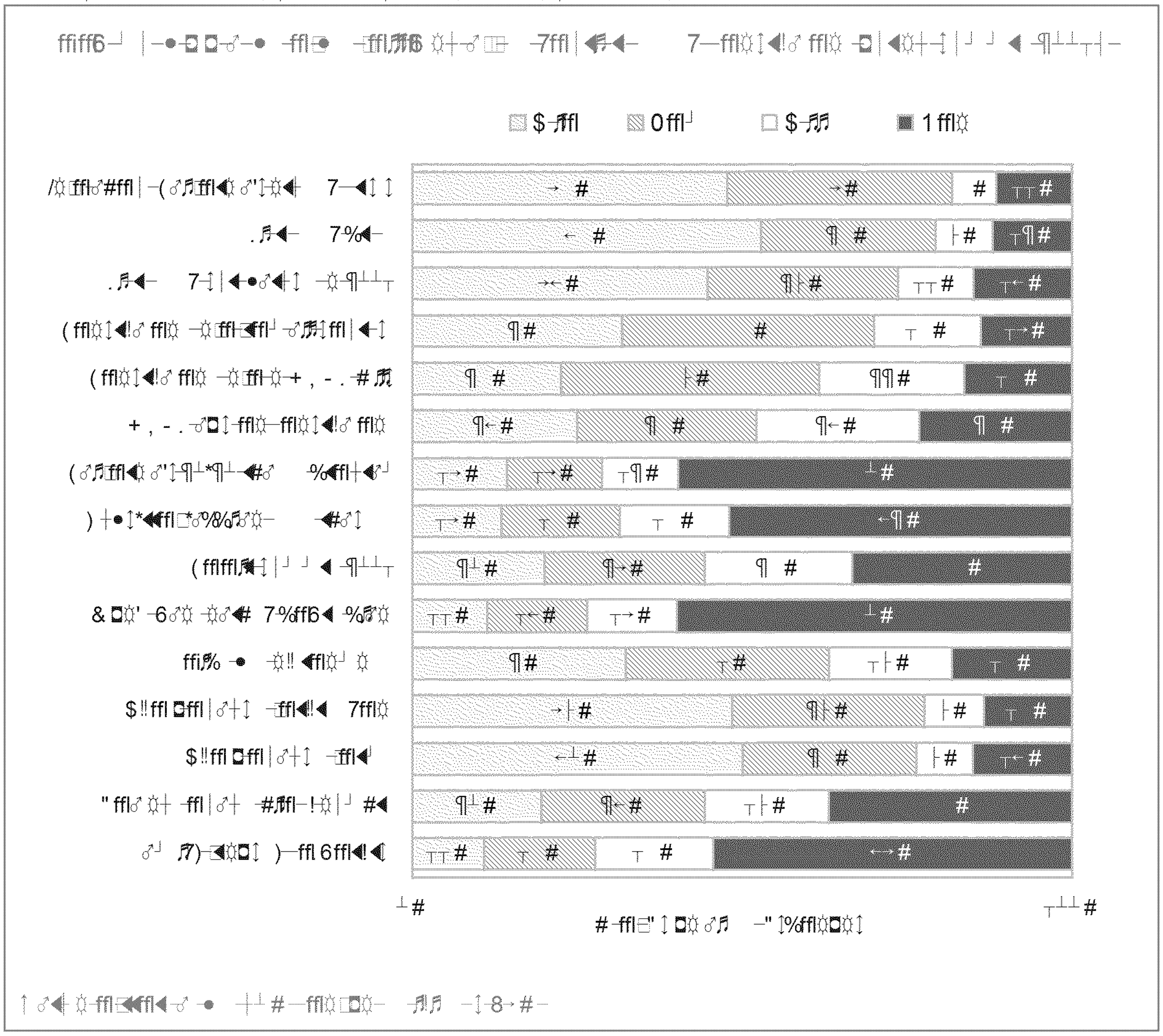

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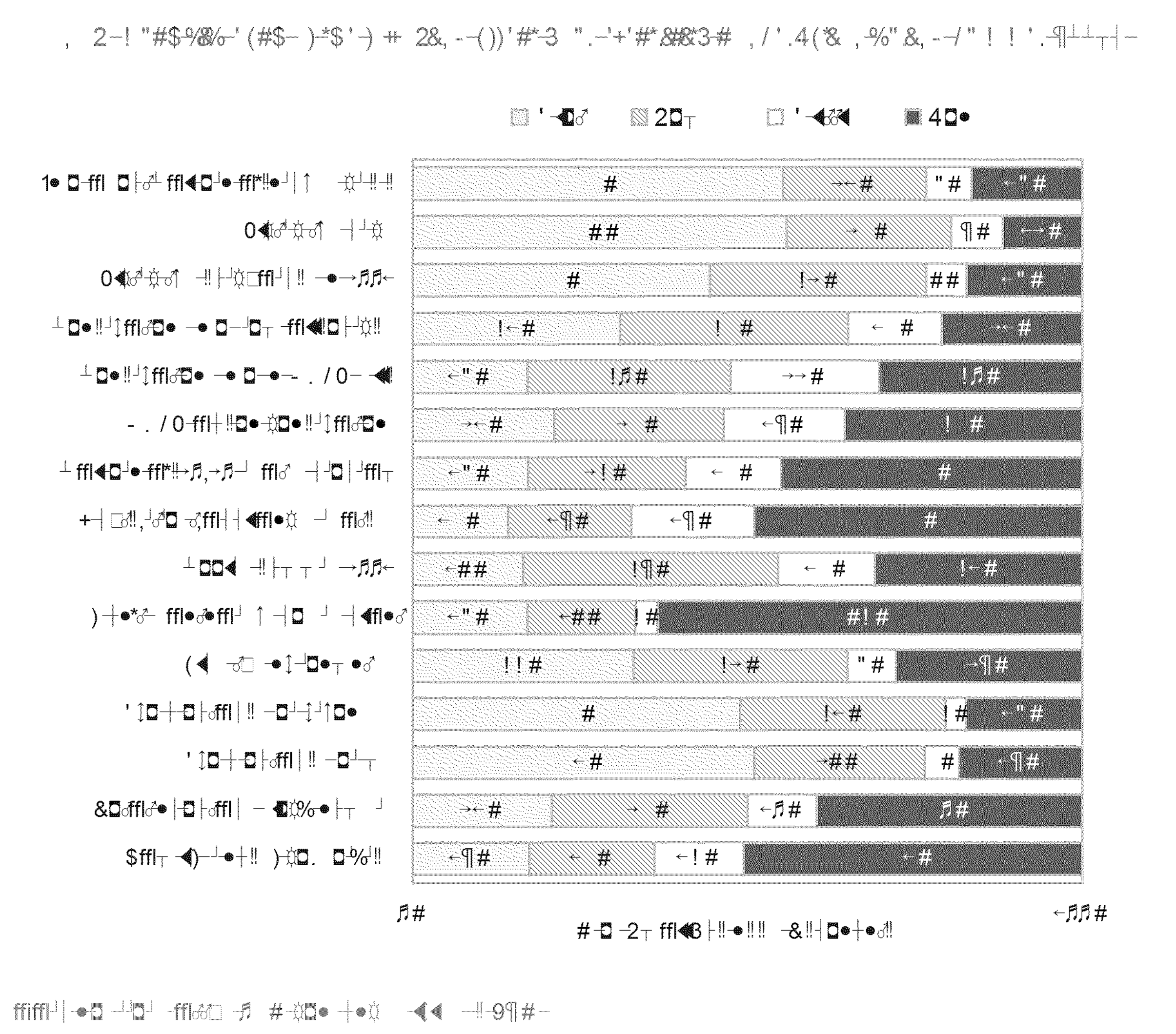

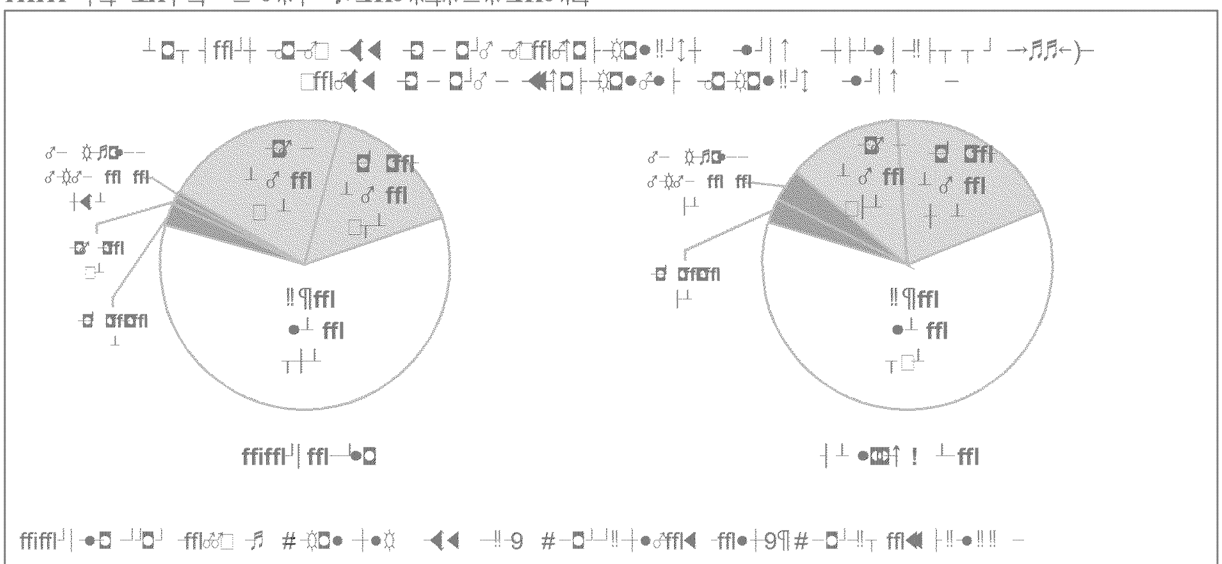

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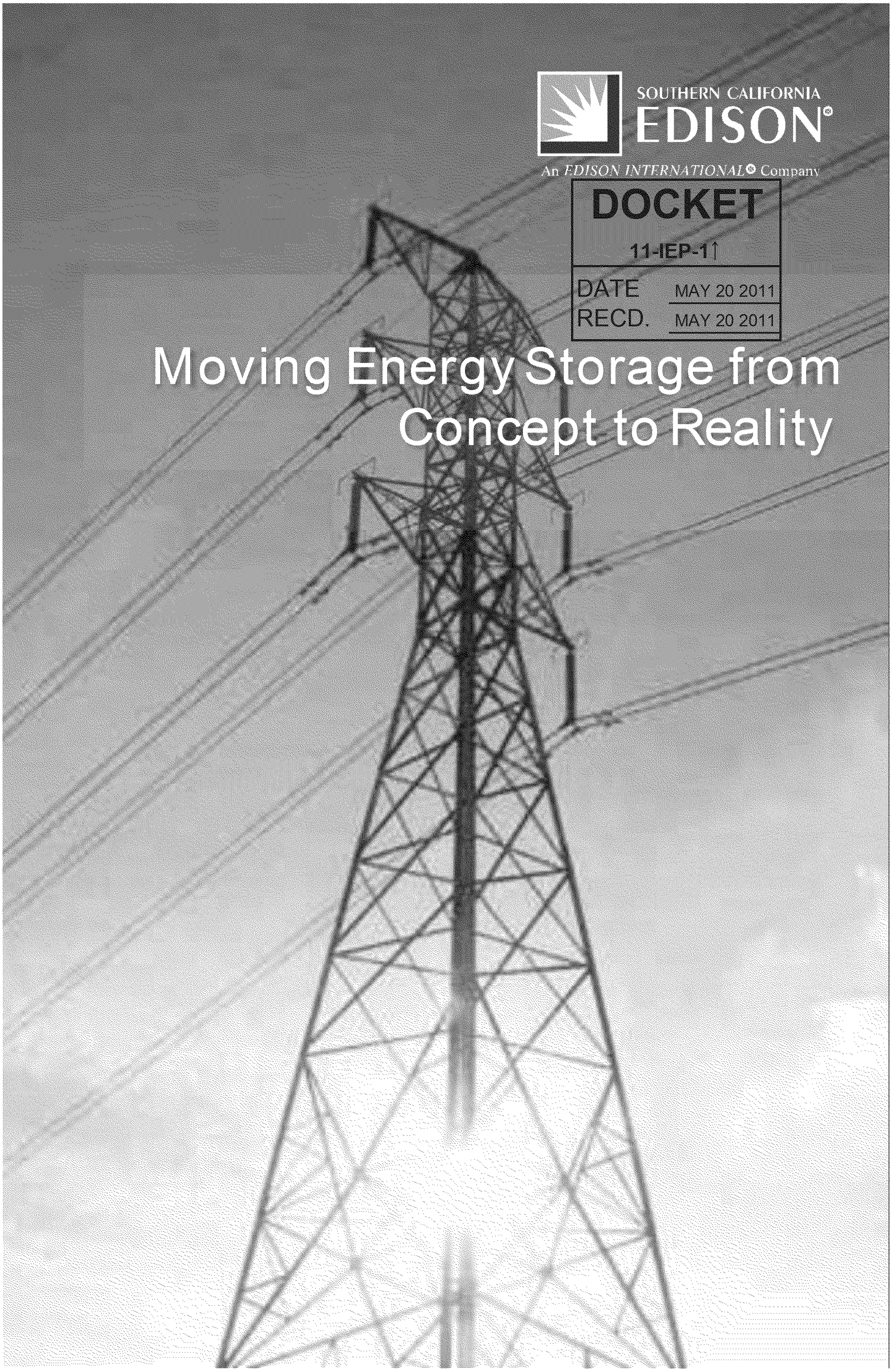

SOUTHERN CALIFORNIA EDISON®
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Moving Energy Storage from Concept to Reality

Southern California Edison's Energy Storage White Paper in Context:

While this white paper is the most recent evidence of Southern California Edison's engagement in the energy storage space, the company's interest spans several decades. In the late 1980s, SCE invested in a pair of energy storage projects. The first was a 200 megawatt (MW) pumped hydro facility christened the Eastwood Power Station, which has been operating since 1987 as part of the larger Big Creek Hydro Project.[5] During the same period, SCE collaborated with the Electric Power Research Institute (EPRI) to bring about the first large-scale battery pilot targeting grid stability. A 10 MW, 4 hour (or 40 MW-hour) lead acid battery was installed at SCE's Chino substation, which operated intermittently from 1988 to 1996.[6] The project proved to be a useful source of data, especially concerning the numerous technical challenges associated with operating over 8,000 cells in 56,000 total square feet of warehouse.[7] The legacy of the Chino battery continues to emerge in today's literature, serving most recently and with some interpretive flexibility as a model for analyses performed by storage industry advocates.[8] In the early-1990s, SCE's Electric Vehicle Test Center (EVTC) began validating battery technologies for both automobile and stationary uses. To date, the center has shepherded an all-electric fleet of nickel metal hydride battery-powered vehicles over 19 million miles, while also testing diverse advanced battery modules in a laboratory recognized with a presidential visit from Barack Obama in March 2009.[9]

In accordance with its historical leadership in the technical arena, SCE launched a dedicated energy storage strategic planning effort in January 2010. A variety of drivers brought about this endeavor. First, advances in science and manufacturing compelled a revisiting of technologies previously confined to research and development activities. Second, federal stimulus funds targeted the "green tech" sector through 2009's American Recovery and Reinvestment Act, totaling $620 million explicitly for energy storage projects with a further $3.5 billion in related smart grid investment.[10] Other nationwide events also addressed storage, including attention from the Federal Energy Regulatory Commission[11] and Congress.[12] Third, California regulatory and legislative bodies have expressed interest in encouraging the nascent industry.[13] Finally, increasing mandates for renewable energy focused attention on potential intermittency and grid stability issues, where storage may provide potential solutions. All told, the time was right for SCE to strategically reassess energy storage.

Others in the industry also formed similar conclusions about the need to re-examine energy storage. In the next section, this paper reviews three notable efforts in more detail.

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[5] See http://www.sce.com/PowerandEnvironment/PowerGeneration/BigCreekHydro/

[6] See *Chino Battery Energy Storage Power Plant: First Year of Operation,* EPRI TR-101786, Dec. 1992 at http://my.epri.com/portal/server.pt?Abstract_id=TR-101786

[7] Ibid, see pps. S-4 through S-5

[8] See the California Energy Storage Alliance June 2010 white paper comparing storage to a gas-fired peaker at http://www.storagealliance.org/presentations/CESA_Peaker_vs_Storage_2010-06-16.pdf
As an additional historical footnote, members of the Chino EPRI-SCE project team went on to found the national Energy Storage Association (ESA).

[9] See http://www.sce.com/Feature/Obama-EV-Tech-Center.htm and http://www.sce.com/PowerandEnvironment/PEV/background-information-tc.htm

[10] See http://www.energy.gov/recovery/smartgrid.htm

[11] See FERC Energy Storage Request for Comments at http://www.ferc.gov/media/headlines/2010/2010-2/06-14-10-notice.pdf

[12] See Storage Technology of Renewable and Green Energy (STORAGE) Act at http://wyden.senate.gov/imo/media/doc/storage.pdf

[13] See California Senate Bill 2514 at http://www.leginfo.ca.gov/pub/09-10/bill/asm/ab_2501-2550/ab_2514_bill_20100929_chaptered.pdf

Selected Literature Review:

Thoroughly reviewing all the relevant literature recently published on energy storage would require a lengthy paper unto itself. However, SCE's team found three studies of particular interest based on their respective approaches, results, and frequent industry references. While SCE independently arrived at its application-based methodology and associated conclusions, a comparison with these reports provides readers with useful context and background on how others in the industry are thinking about storage.

***

Sandia National Laboratories published a weighty examination of energy storage in February 2010.[14] The authors established an ambitious scope, providing a methodology for interested parties to quantify energy storage benefits. Their approach 1) defined the discrete benefits for utilities, 2) estimated the market potential and economic impact of these individual benefits, and 3) identified "synergies" of paired benefit streams which could magnify potential financial returns. It did not, however, assess the combined value of potential synergies beyond a qualitative depiction.[15]

Seventeen discrete uses of energy storage (labeled as applications) were defined and described in the Sandia report. Respective benefits were also calculated at a high level and quoted in dollars per kilowatt. The applications were not mapped to particular technologies, rendering precise benefit-cost analysis infeasible. Instead, the authors highlighted relevant technological considerations. Paired applications formed the proposed synergies, but these were not grouped into larger "bundles" of benefits. Unless explicitly detailed by the application (e.g., end-use), potential synergies also were not associated with a specific physical location on the electric value chain.

Sandia's investigation thus concludes by creating financially attractive "value propositions" using pairings of generic benefits. However, this falls short of a full benefit-cost evaluation which would incorporate more specific technology and project parameters. Each discrete benefit may be used to provide high level cost targets, without further understanding the constraints set by a project's technological costs and physical location. In SCE's opinion, however, such valuations are narrowly applicable in real world situations.

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The California Energy Commission (CEC) commissioned KEMA, Inc. to evaluate the impact of intermittent resources on California's grid with a specific bent towards evaluating energy storage.[16] Resulting analysis provided policy and research options to ensure the optimum use of energy storage associated with increasing amounts of

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[14] Eyer, Jim & Corey, Garth; Sandia National Laboratories, *Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide*, SAND2010-0815, February 2010

[15] ibid, see Table 37, pp. 121

[16] California Energy Commission and KEMA, Inc., *Research Evaluation of Wind Generation, Solar Generation, and Storage Impact on the California Grid*, CEC PIER Final Project Report, CEC-500-2010-010, June 2010

renewable energy. The project further measured the effects of renewable variability on system operation, and then ascertained how energy storage and changes in energy dispatch strategies could improve grid performance. The white paper, therefore, was not intended to provide a holistic assessment of storage, and instead modeled the specific operational impacts associated with pre-defined renewable penetration scenarios.

Major paper conclusions include:

- The CAISO (California Independent Service Operator) control area may require between 3,000 and 5,000 MW of additional regulation/ramping services from fast (5-10 MW per second) resources in 2020. These ramping requirements are driven by longer-duration solar and wind variability.
- The short-duration volatility of renewable resource output will require additional automatic generation control (up to double current levels).
- Fast (defined as 10 MW per second) storage is two to three times more effective than conventional generation in meeting ramping requirements. Consequently, 30-50 MW of storage is equivalent to 100 MW of conventional generation.
- Energy storage may reduce the greenhouse gas emissions associated with committing combustion turbines for regulation, balancing, and ramping duty.

In summary, this report provides an analysis of renewable resource impacts on California's grid operations – particularly the changes in ramping and regulation requirements – and offers storage as a promising mitigation option. While insinuating that storage could be the most cost-effective solution for renewables integration, the authors do not thoroughly demonstrate this through full benefit-cost modeling. Additionally, the analysis is by design bounded in scope and therefore lacks the breadth of potential operational uses necessary to fully evaluate energy storage applications, even those addressing renewable intermittency, across the electric value chain.

***

In late 2009, ***EPRI*** published a report valuing specific energy storage projects and technologies.[17] Like the CEC white paper, it focused on storage's potential to provide solutions for renewables integration issues, specifically those caused by excess wind in the Electric Reliability Council of Texas (ERCOT) region. In contrast, EPRI approached its assessment through the lens of market-based analyses on four broad storage technology options: 1) Compressed Air Energy Storage (CAES), 2) Liquid Air Energy Storage (LAES), 3) bulk batteries, and 4) distributed batteries.

For each technology, the report assessed the rate of return from a potential independent investor's perspective by computing net operating incomes. These were driven primarily by the costs and revenues associated with arbitraged on and off peak energy price spreads and the market rents from offering ancillary services. The authors also assessed a broader societal benefit-cost ratio which included congestion relief and the impact on carbon

[17] Electric Power Research Institute, *Economic and Greenhouse Gas Emission Assessment of Utilizing Energy Storage Systems in ERCOT*, 1017824, Technical Update: November 2009

dioxide emissions (e.g., CAES and LAES make combustion turbines more efficient, and batteries are charged by electricity with off-peak portfolio emissions).

Three high level conclusions emerged from the study. First, the second generation CAES system provided attractive investor rates of return. Second, distributed batteries were the only storage options which provided higher societal benefits than costs, but high capital costs kept rates of return low. Finally, considering Texas' resource portfolio and efficiencies lost during the charge-discharge cycle, all storage devices led to slight increases in CO_2 emissions.

Unlike SCE's approach, EPRI's analysis evaluated energy storage from a technology-driven perspective. Its focus on hypothetical projects in defined locations on the electric system and resulting benefit-cost comparisons also provided noteworthy private return and societal benefit estimates. These assessments, however, failed to account for other potential operational uses and associated value streams (such as avoided T&D cost for distributed batteries) which might accrue to similar applications.

***

While this literature review does not delve into the intricate modeling and analysis assumptions of each report, higher level commentaries on others' methodology and conclusions illuminate SCE's methodology in relative terms:

- Focusing on one bounded use from the outset (e.g., integrating intermittent renewable energy into ISO operations) fails to capture all of the potential uses of energy storage. A complete strategic assessment of storage should ***develop and evaluate applications which reflect all operational uses*** on the electric value chain.
- Commenting on storage's desirability in a particular application is difficult without an understanding of potential cost-effectiveness. Such ***benefit-cost valuations should be undertaken with location-specific application-technology pairs in mind***. Otherwise benefit numbers are too broadly defined and cost numbers often do not exist.
- ***An application-focused valuation approach is optimal***. First, all relevant operational uses (and their resulting benefits) can be captured at the outset during application development. Second, each application is grounded in a physical location and grid context. Third, best-fit technologies can be identified based on an application's operational preferences and other situational constraints. Finally, focusing on applications defines "the problem" before assessing "the solution." Otherwise, valuations appear as specific project or technology justifications instead of broader strategic estimations of the most promising storage uses.

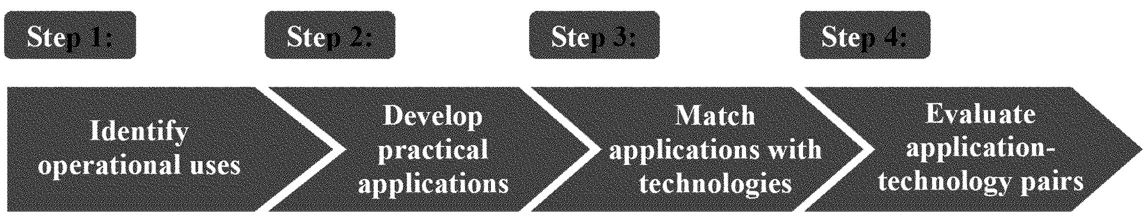
Now that the industry and analytical background have been introduced, readers are positioned to better conceptualize SCE's valuation methodology.

Southern California Edison's Valuation Approach:

The authors and contributors to this paper propose a valuation methodology consisting of four distinct steps (Figure 1):

1. We first identified the discrete *operational uses* where storage could theoretically be deployed across the electric value chain. Each of these uses independently derived value, providing a potential benefit stream.
2. These operational uses were used as "building blocks" by which we developed specific and practical applications. An *application* was defined as a practical combination of potential operational uses of energy storage across the value chain as a function of both physical location and operating profile. Twelve representative applications were developed, each of which prescribed individual requirements and preferences.
3. Using these requirements and preferences, we matched each application with "best fit" technology options. Developing an understanding of the various technology options, including their capabilities, cost projections, and commercial availability timelines was also a necessary task during this phase.
4. We assessed the resultant application-technology pairs from feasibility and economic perspectives, developing a high-level assessment of each.

Figure 1: SCE Valuation Methodology



This methodology has the additional benefit of firmly reflecting SCE's core competencies, which include a deep understanding of electric systems and markets, as well as visibility to the entire grid from central generation to end user. The remainder of this report will expand in detail on these steps, eventually providing strategic conclusions and recommendations.

Step 1: Identifying Operational Uses

A major task of the SCE energy storage effort was to comprehensively identify the operational uses energy storage could potentially fill. *An operational use is a discrete single use for storage that can independently derive value*. These were not based on technological capabilities, but rather all the different functions energy storage (regardless of the technology utilized) might serve on the electric grid from central generation to end user. Once an exhaustive list of operational uses was created, they were bundled into practical applications through a process described later in this report.

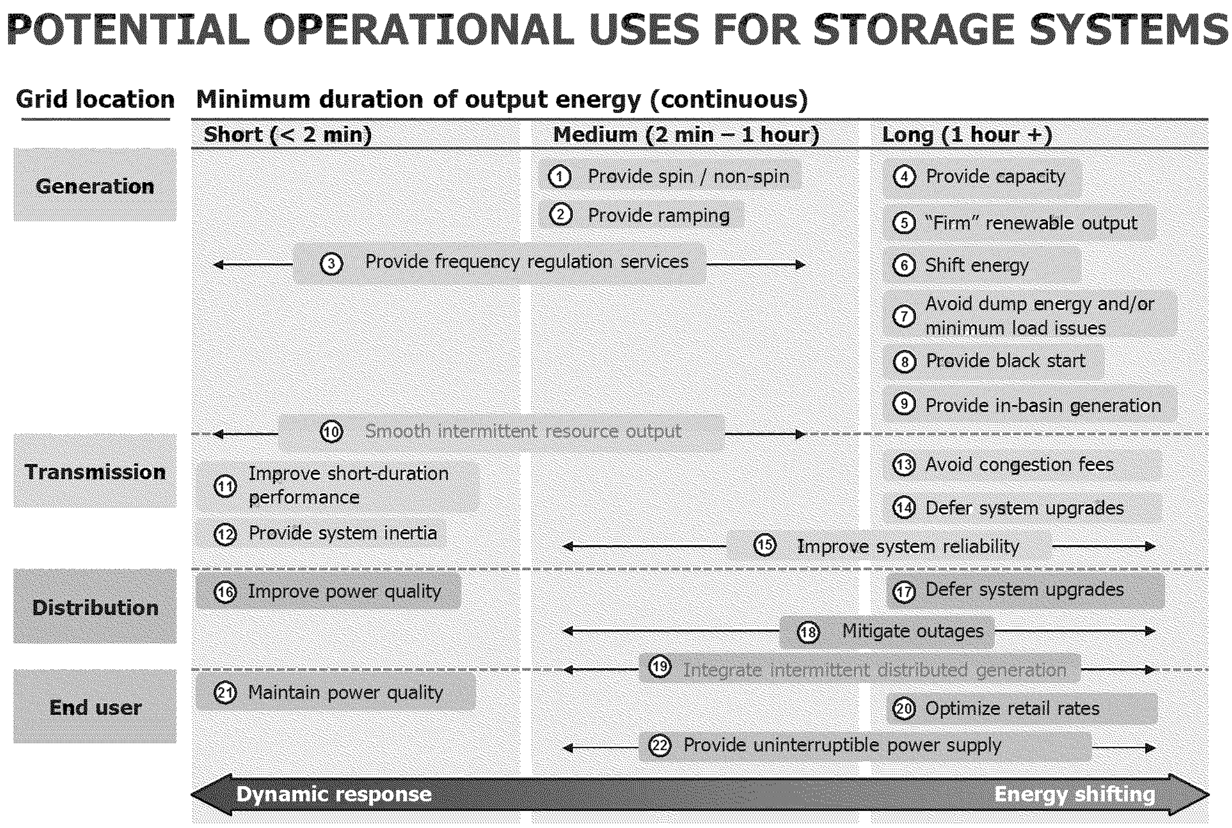
In an attempt to populate an exhaustive list of operational uses, it was necessary to determine:

- what "fills the need" now (e.g., current solutions)
- a clear definition of the use
- potential issues with current solutions
- technical specifications of operational uses (e.g., high/low capacity and/or energy requirements)
- the time frame (duration) of charge/discharge periods required (e.g., seconds, minutes, hours)
- the length of time the solution will be needed (e.g., one season, two years, permanently)
- market considerations (e.g., CAISO regulations and/or product definition)

From this analysis, 22 discrete operational uses were identified and are shown below in Figure 2. Potential operational uses for energy storage systems are categorized by both location on the grid (e.g., generation, transmission, etc.) and the duration of output energy required. The location specified in Figure 2 is the location of the operational use, and not necessarily the location of the energy storage device. For example, the operational use "distribution system upgrade deferral" (#17), is a benefit located at the distribution level. In other words, the avoided cost is that of upgraded or additional distribution conduit or equipment. However, the energy storage device that provides this benefit may be located at one of many locations. For example, the device could replace a capacitor bank or other equipment at a distribution substation. On the other hand, a storage device located at a distributed generation (DG) solar installation (i.e., at the end user) could also avoid or defer a distribution circuit upgrade by limiting backflow from the DG system onto the electric grid. In this way, the storage location is not necessarily where a device is physically sited, but rather where the desired services are provided to the electric system.

The charge/discharge characteristics or requirements of an energy storage device are the other key parameters in defining and understanding potential operational uses. "Discharge duration" defines the period during which a storage device must be able to provide energy and capacity to the electric system. On one end of the spectrum of energy/capacity requirements are *dynamic response* uses, such as "power quality" (voltage support) (#21) and "renewable output smoothing" (#10). Dynamic response applications require quick reactions to a system event or signal. These uses involve short bursts of power to maintain system reliability and consistent operation. They are also more easily compared to quick-response generation, used for ancillary services, or transmission / distribution equipment such as capacitors. On the other end of the spectrum are operational uses associated with *energy shifting*. These can be compared to today's demand response and time-of-use tariff programs that either shape load to lower system peak or lower the need for generation resources like "peaking" natural gas combustion turbines. Even before the full storage applications (groupings of operational uses) are defined, the diversity of potential uses for energy storage is clear. For example, it is not practical to make economic or technical comparisons of a device providing intermittent resource output smoothing (#10) and a device providing distribution system upgrade deferral (#17) in a meaningful way. This difficulty is a major driver for SCE's application-specific approach in which SCE sets up a framework to compare energy storage devices within a specific application.

Figure 2: Operational Use Location and Duration Matrix



A description of each operational use (within SCE's context) is provided below.

1. Spin / non-spin

An energy storage device could provide spin / non-spin products in California Independent Service Operator (CAISO) markets. These "operation reserves" ancillary services require ten minute response time when called, either while already operating (spin) or ready for fast response (non-spin). The CAISO currently procures 7% (split 50-50 between spin and non spin) of any given hour's load in operating reserves, with marginally lower procurement requirements if they are provided by hydro resources. Previously, participation in these separate hourly-bid markets required two hours of energy, although this is being altered to half an hour.

2. Ramping

While "ramping" is not currently a formal CAISO market product, initial research has indicated that it may be a potential service in the future, particularly to help with renewables integration. Ramping would provide a longer duration (15-30 minute) ancillary service to ensure daily ramping capabilities match load profiles.

3. Frequency regulation

Frequency regulation provides four-second Automatic Generation Control (AGC) adjustments to maintain a constant frequency on the grid (60 Hz in the U.S.). In contrast to other regions of the country, in the CAISO, regulation is two distinct services: reg-up and reg-down. While current rules and engineering requirements preclude storage from these markets, the CAISO has opened a stakeholder process to explore allowing for the participation of limited energy resources. As with all ancillary services, it is important to note that regulation markets procure capacity. Energy awards (or repayments) are settled from real-time interval prices as "called" by system dispatchers.

4. Capacity: Resource Adequacy and / or dependable operating

Currently, Resource Adequacy (a regulatory California Public Utilities Commission requirement to ensure generation system reliability) and dependable operating capacity needs are met by various generation resources. System load "super-peaks" (i.e., those requiring dispatch less than 5% of the year) are met today using traditional peak resource options, and in particular Combustion Turbine (CT) peakers and demand response (DR) measures. However, such peaks could also be met using an energy storage device, charged with off-peak energy, and discharged during peak hours.

5. Renewables output firming

Renewable energy sources currently do not provide full capacity to the electric system. As an increasing portion of SCE's energy comes from variable / intermittent renewable generation, "firmed" capacity will become less available and future needs may even require new "dispatchable" generation to be built. Instead, an energy storage device could be paired with a renewable energy supply to provide firm capacity. For example, a large energy storage device could be charged using intermittent wind energy during off peak hours, when wind energy is more often produced in California. The device could then be discharged during peak hours, providing a firmed, dispatchable energy source.

6. Energy shifting

An energy storage device can shift energy demand from peak hours to off-peak periods, or conversely, shift energy supply from off-peak to peak hours. Specifically, a device could be charged using off-peak energy, and discharged to serve load during peak hours, thereby arbitraging between peak and off-peak energy prices. This "arbitrage" might also occur during other periods, such as in Real Time markets between sub-hour intervals.

7. Dump energy / minimum load issues

As must-take resources (particularly those producing energy during off-peak hours such as wind turbines) grow in proportion to other resources in SCE's energy portfolio, dump energy and / or minimum load issues may become a challenge for the system. These problems occur when the system is producing more must-take energy than the load requires. One such example might be during off-peak hours in April when electricity demand is low, yet there are large amounts of must-take hydro and wind generation. In this case, the system may have excess energy. Either the energy will have to be "dumped," (i.e., sold at a negative price) or operational issues may arise on the grid. Energy storage devices could absorb excess energy through charging, making it available to meet system load at another time when it is needed.

8. Black start

Resources such as hydroelectric generators exist today that can start without electric energy input when a system event occurs and the grid goes black. An energy storage device could also fulfill this need. The benefit from this operational use is difficult to monetize, as current resources providing black start are not explicitly compensated for this service in California. The "black start capability" is one of many attributes considered when selecting a generation resource through contractual procurement.

9. "In-basin" (or local) generation

Generation located close to load is required to provide system reliability. In SCE's case, this means a substantial amount of generation must be sited in the Los Angeles basin. As a rule-of-thumb, SCE's system planners and the ISO in real-time ensure that approximately 40% of load is met by in-basin resources, and the remaining 60% of needed energy can be imported. Therefore, the aggregate capacity of in-basin resources must exceed 40% of peak load in order to fulfill this requirement. This poses a particular challenge for SCE, given the stringent air quality requirements in urban areas and difficultly of building new conventional power plants. However, energy storage could serve the same operational use as a "local" generation resource such as a CT. The energy storage device (or many energy storage devices, distributed across the load center) could be charged off-peak, using imported energy, and discharged during peak hours. During the discharge period, the energy provided from the energy storage devices would count as peak period "in-basin" generation.

10. Renewables output smoothing

Many sources of renewable energy provide power intermittently on a minute-to-minute basis. For example, if a cloud overhead shields an array of photovoltaic panels from the sun for 2 minutes, the energy output of that array drops during that time. Once the cloud passes, the array may be back to full production. Such minute-to-minute variability can have negative effects on the system (e.g., transmission and distribution loading and voltage fluctuations, etc.). An energy storage device / system can react to PV output and respond instantaneously to drops in production by discharging its own energy. Similarly, it could soften the increase in energy production after a cloud passes over, by charging the device. Such "smoothing" of these short-duration fluctuations could lessen the potential operational challenges associated with integrating large amounts of intermittent, must-take renewable energy into the electric grid.

11. Transmission system short-duration performance
Energy storage, if installed in large enough quantities, could be used to improve short-duration performance on the transmission system. This includes improving system voltage or providing capacity (fault duty) during system faults. The clearest way in which energy storage could perform this operational use is if it were to replace a device that currently improves transmission system performance (e.g., capacitor banks or Flexible AC Transmission System (FACTS) devices). If a storage device can be shown to provide one or more useful transmission services, the device could be included in a transmission planner's toolkit, and taken into consideration in the transmission planning process. Another way in which a storage device could perform this operational use is by preventing an issue causing problems on the transmission grid. For example, if extremely variable wind production was causing transmission system performance issues, and a large energy storage device firmed or smoothed this energy, it could be simultaneously providing the renewable energy smoothing / firming use while also improving transmission system performance.

12. System inertia
System inertia is provided today by large, conventional generation resources. The "spinning mass" of these devices can provide large amounts of power to the grid instantaneously in the case of a system reliability event. While storage would not do this exactly, the power electronics associated with a device could be designed such that they *simulate* system inertia by quickly discharging power onto the grid, if and when required.

13. Congestion fee avoidance
When a transmission line is congested, higher "fees" are incurred when transmitting energy. Avoiding such congestion would therefore circumvent these costs. Using an energy storage device to time-shift energy demand or supply, by transporting energy during off-peak hours and storing that energy downstream of the transmission line, would avoid such congestion and associated fees.

14. Transmission system upgrade deferral
When a transmission line or component is consistently overloaded, an infrastructure upgrade may be required. An energy storage device could be used to time-shift energy demand / supply (as per use #13, above) to avoid such problematic transmission congestion. The upgrade could be deferred until additional load growth ultimately necessitates the infrastructure improvement or if load requirements for that transmission path remain stable, energy storage could defer the upgrade more permanently.

15. Transmission system reliability
An energy storage device could be used to improve the reliability of the transmission grid in two ways. First, the energy storage device could replace a technology solution that currently improves system reliability (e.g., a Static VAR Compensator). As explained in use #11, if a storage device can be shown to provide one or more useful transmission

services, it could be included as a potential solution in the transmission planning process. Another way in which an energy storage device could improve system reliability is if it were located downstream (on the load side) of a system component outage. For example, if a transmission line had a planned or unplanned outage and a large energy storage device downstream of it were available to discharge its energy during the outage, customers could continue to have electric service during that period. It should be noted that such a use of energy storage would require a device with an extremely large energy capacity. Further, it should be noted that most energy storage systems are not designed for isolated or "islanded" operation, so another tie with the main system would need to be maintained to take advantage of the excess capacity/energy that may be provided.

16. Distribution system power quality
The clearest way in which energy storage could perform this operational use is if it were to replace a device that currently regulates distribution system voltage (e.g., capacitors or voltage regulators). If a storage device can be shown to improve the loading, power factor, and/or voltage profile for a distribution system, the device could be included in the distribution planner's toolkit.

17. Distribution system upgrade deferral
When a distribution circuit is consistently overloaded, an infrastructure upgrade may be required. However, an energy storage device could be used to time-shift energy demand or supply (as per uses #13 and #14, above) in order to avoid these distribution line overloads. If these overloads can be avoided, the upgrade could be deferred until additional load growth necessitates infrastructure improvement or until aging infrastructure requires replacement.

18. Distribution-level outage mitigation
In order to provide outage mitigation at the distribution level, the storage device would have to be located downstream of a system outage. For example, if a distribution line had a planned or unplanned outage, and an energy storage device downstream (on the load side) of that outage were available for discharge, customers could continue to have electric service during the outage if an alternate "tie" can also be maintained with the source system. (Energy storage devices are not currently designed for islanded or isolated operation.) For planned outages, a mobile energy storage device placed in key locations to support the load and mitigate the impacts on customers could fill the need.

19. Distributed Generation (DG) renewable integration
Renewable DG penetrations (in particular solar photovoltaic (PV) generation) are projected to steadily increase across SCE's service territory. SCE has also begun development of 500 MWs of DG solar, an initiative approved by the CPUC in 2009. One of the challenges with non-dispatchable DG, like solar PV, is that it may create "backflow" onto the distribution grid. The grid was designed and built for power to flow in one direction: from the transmission system to the customer. However, in many instances, a DG installation may "push" electricity upstream and away from the customer. While current SCE distribution system planning protocols state that 15% backflow on the distribution grid at any given time may be acceptable, further study is

required to understand the exact limitations of individual circuits beyond this limit. An energy storage device, located adjacent to the DG installation, could minimize potential issues or avoid them altogether. At times when the generation at the site exceeds power consumption, the storage device could be charged using the energy that would have otherwise flowed back onto the grid. When consumption exceeds generation at a later time (e.g., at night when the PV installation is not producing energy), the storage device would be discharged to meet demand. If the DG installation is substantially larger than the site, an energy storage device could be located further upstream in the distribution system. While substantial backflow (and related circuit upgrades) downstream of the device could not be avoided, it would eliminate the need for upgrades upstream of its location.

20. Retail rate optimization

Like many utilities, SCE has several programs that pay customers to turn off their loads during system peaks (e.g. SCE's air-conditioning cycling and industrial demand bidding programs). SCE also has TOU rate structures for certain customers that discourage on-peak energy use with higher prices. While participation in these programs is strong, it is limited by customers' willingness to be inconvenienced by DR / TOU rate program requirements and costs (e.g., customers must agree to not use an air conditioner during a hot summer day with a high system peak). If an energy storage device were located at the customer's home or business, the customer could take advantage of a DR program or TOU rates without changing their behavior. The system would see the load drop off as required, but the customer would in fact be temporarily serving his/her own load, using a charged energy storage device, rather than system generation.

21. Power quality maintenance

Certain electric customers require a level of power quality above and beyond what the system offers (e.g., critical load). In order to meet this need, these customers often invest in their own power conditioning and energy storage systems. Many already have employed energy storage technologies such as batteries and flywheels to fill this need.

22. Uninterruptible power supply

As in use #21, some customers (e.g., advanced manufacturers or technology companies) cannot tolerate interruptions in their power supply. In order to ensure uninterrupted power, these customers often invest in back-up generators (e.g., diesel generators) and quick-response technologies to buffer between a system event and the startup of a back-up generator. Energy storage technologies with integrated battery bank systems and flywheels already fill this need for many customers.

Each operational use provides a quantifiable value that can be used to perform further calculations. For each of the 22 benefits identified, Figure 3 summarizes the value metrics and continuing uncertainties (non-engineering related) that are associated with monetizing those potential benefit streams. For the purposes of further application analyses, many of the uncertainties had to be resolved through assumptions, which are described in further detail as part of Appendix A. The circumstances surrounding these operational uses will also vary by application.

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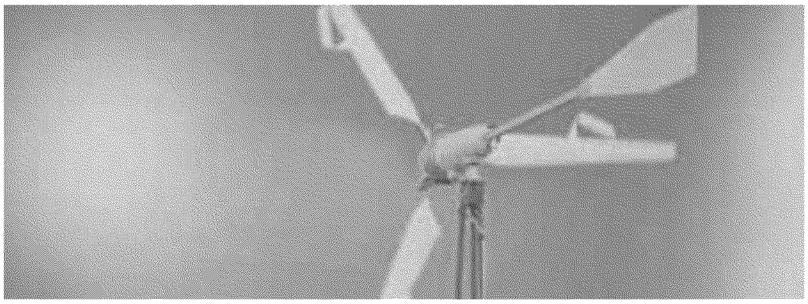
Energy Storage



Energy Storage Is Key To A More Efficient Grid

We are applying decades of know-how in energy storage to solve one of our industry's most pressing challenges: storing intermittent renewable energy.

Advanced storage technology will play an important role in the smart grid. One day, strategically-positioned storage devices will give the grid new flexibility and resiliency. As a result, we and other utilities will be able to rely more on intermittently generated renewable power.

At our Electric Vehicle Technical Center — one of only two**U.S. Department of Energy** (DOE)-approved energy storage technology test sites — we have many years of experience in energy-storage technology. Our research and testing in electric-vehicle batteries has expanded into testing for larger applications, like bulk storage in the electricity grid. Today, our researchers are testing grid-scale storage technologies at generation sites, in transmission hubs, at the distribution level, and at power delivery points.

Utility-Grade Lithium-Ion Batteries

In partnership with the DOE, we are testing the limits of large-scale lithium-ion batteries for storing intermittently-generated wind energy. The project, taking place in California's Tehachapi wind resource area, stores wind energy in utility-scale battery systems. Our partners in the project are battery manufacturer A123 Systems, the California Independent System Operator Corporation, California State Polytechnic University - Pomona, and others.

We believe our work in energy storage will help identify storage systems that can work throughout the industry, and spur production to help bring down the cost for everyone.

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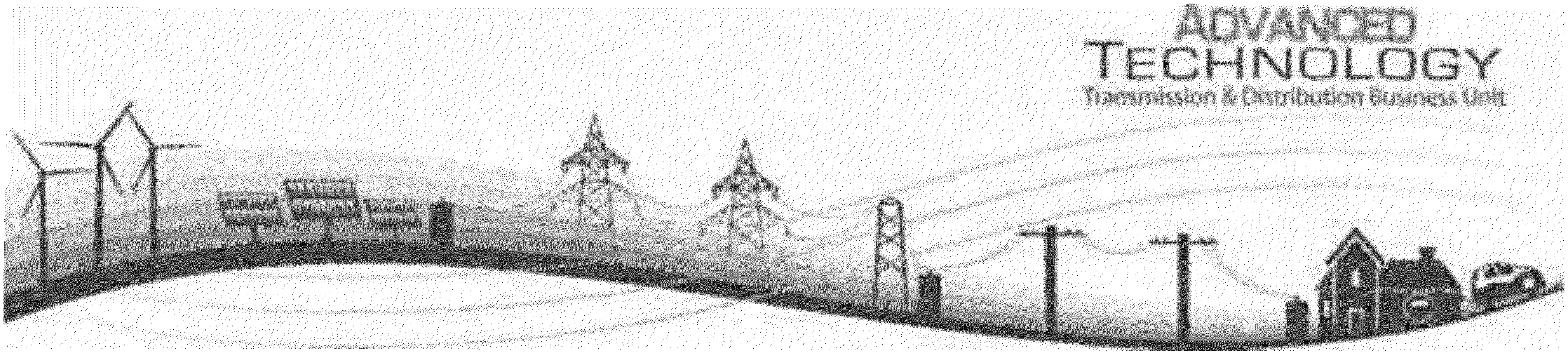
Tehachapi Wind Energy Storage (TSP) Project



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Loïc Gaillac, Naum Pinsky
Southern California Edison
November 3, 2010

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Outline

* Policy Challenges
  – The challenge/opportunity

* Testing a Solution: Tehachapi Storage Project Overview
  – Description of the project & objectives
  – Operational uses
  – Conceptual layout

CA 2020: Energy Policy Initiatives

Highlighting potential areas for storage applications:

* High penetration of Solar and Wind generation
  – Executive order requiring 33% of generated electricity to come from renewable sources by 2020
* Zero Net Energy (ZNE) residential construction standard
  – " ZNE home" Title 24 in 2020
* Plug-in Electric Vehicle (PEV)
  – Up to 54,000 PEV's by 2012 & 1 Million by 2020
* Renewable Portfolio Standard (RPS)
  – Distributed PV (1-2 MW PV rooftop): Up to 250 MW of SCE-owned solar photovoltaic capacity and up to 250 MW owned and maintained by Independent Power Producers (IPP)
  – California Solar Initiative (CSI) - 3,000 MW of customer-side solar photovoltaic capacity by 2017
* SCE's Energy Efficiency Goals
  – Load Control: 1000 MW of Demand Response (DR) by 2017.
  – Conservation: Forecasted 10% of energy consumption reduction using in-home display.

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