OPTIONS for

ENERGY EFFICIENCY in EXISTING BUILDINGS

STAFF DRAFT REPORT

SEPTEMBER 2005
CEC-400-2005-039-SD2

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EXECUTIVE SUMMARY

AB 549 (Longville), Chapter 905, Statutes of 2001, directs the California Energy Commission to "investigate options and develop a plan to decrease wasteful peak-load energy consumption in existing residential and nonresidential buildings" and report its findings to the legislature. The Energy Commission's initial response to this legislation was the report, *Assessing the Energy Savings Potential in California's Existing Buildings: An Interim Report to the Legislature in Response to AB 549* (December, 2003 Energy Commission Report #400-03-023F). The following draft report is based upon the interim work, research efforts conducted since that time, and public comment received at two workshops.

Recommended Portfolio of Strategies

After considering many strategies for reducing energy use in existing buildings, eight were selected as the recommended portfolio and are presented in order of decreasing electricity savings within each of two categories. Residential strategies are presented first as workshop participants expressed greatest interest in these options. The second category is labeled "nonresidential and cross-cutting," since one strategy (demand response) applies to both residential and nonresidential markets.

Residential

Information Gateway

This strategy relies on information as a powerful motivator for homeowners to save energy by adjusting behavior and making previously unplanned improvements to their homes. Information provided through a central clearinghouse, or gateway, would refer customers to applicable energy efficiency programs and services, to aid and motivate the homeowner to take action. The gateway functions as an education and referral service directing homeowners and property managers to energy efficient technology information and services, including in-depth online energy audits and referrals to existing energy efficiency programs.

The strategy would target homeowners with higher-than-average utility bills. Customers would receive feedback on their energy consumption, compared to like customers, through utility websites or mailings. Providing homeowners with information on how their

bills compare to others with similar homes, would motivate them to seek more information on the steps they could take to improve the efficiency of their homes. Features of the strategy include enhancing the utilities' existing online energy audit services, providing easy access to financing, and expanding the use of energy efficiency marketing.

Annual energy savings range from 62 to 259 GWh. It would cost approximately $40 million per year and be implemented by each of the utility administrators of the Public Goods Charge (PGC)-funded programs.

Disclosure of Home Energy Information at Time-of-Sale

In California, over 600,000 existing homes are sold each year (triple the number of new homes built) with little consideration for improving the efficiency of these buildings at the time ownership changes. This situation represents a significant lost opportunity for realizing additional energy savings. The condition of the energy-using features of the home and the potential to upgrade them to avoid excessive energy bills are facts that materially affect the value and desirability of a particular property. Therefore, property buyers should be informed of the energy using features of a home and ways to improve its efficiency. [1]

Staff considered several options for addressing the time-of-sale lost opportunity and benefited from advice offered by the realty community and the home energy rating industry. While it is not currently practical to require detailed energy ratings for every home sold in California, staff recommends that steps be taken to prudently move in that direction over time.

A first step is to offer buyers, sellers, brokers, appraisers and the general public a booklet of tips for reducing their electricity and natural gas bills coupled with information on programs and services. The Energy Commission would work with the real estate industry to ensure that brokers and sellers distribute the booklet to potential buyers. Work would proceed with utilities to ensure that processes to disclose seller energy bills to buyers are easily carried out. The next step is for the Energy Commission to complete its proceeding to adopt Phase II of the California Home Energy Rating System Program. A third step is training brokers, sellers, appraisers, and lenders about the rating program. Training of additional home energy raters would also be necessary. An expanded version of the information booklet would recommend that buyers and sellers voluntarily get home energy ratings prior to sale and that appraisers take rating information into account is establishing the market value of the property. A fourth step is

[1] Section 2079.16 of the California Civil Code requires real estate agents to disclose certain information. It says, "Seller's agent or a subagent of that agent has the following affirmative obligations: (c) A duty to disclose all facts known to the agent materially affecting the value or desirability of the property that are not known to, or within the diligent attention and observation of, the parties."

to provide incentives for buyers and sellers to obtain ratings and to implement energy efficiency improvements recommended by the rating.

Staff recommends that this strategy of information, completion of proceedings, training, and incentives be undertaken as a one-year, voluntary pilot project in collaboration with the utilities and the real estate industry to demonstrate the value of the services to brokers, sellers, buyers, purchasers, appraisers and lenders. Based on experience from the pilot project, a two-phase mandatory disclosure program would then be implemented. Phase 1 would require ratings for homes built prior to 1982 and would operate for one year. Older homes offer the most logical starting point for reducing wasteful energy use. Phase two would apply to all homes being sold. Although the rating would be mandatory, it is the buyer's voluntary decision to pursue, or not pursue, energy efficiency upgrades.

The program's annual cost ranges from $4 million in the early one year pilot program to $53.5 million in latter mandatory years. Program costs would be paid for through PGC funds and by property sellers or buyers, depending upon the details negotiated in the home sales agreement. Annual average energy savings range from 175 to 186 GWh and 52 to 55 megawatts (MW), with smaller savings in the first, voluntary year and larger savings in the latter mandatory years.

Residential Whole Building Diagnostic Testing

Whole-building diagnostic testing is a process to systematically detect flaws in building construction or operation, diagnose their causes, and facilitate, enable and verify their correction. A trained contractor performs the diagnostic testing, implements the upgrades, and verifies performance in a systematic process. Occupant comfort, safety, and building energy efficiency are improved in the process, and costs may be reduced because of interactive effects (e.g., a smaller HVAC unit may be needed because of other system corrections made by the contractor).

Due to the comprehensive nature of the whole building approach, it is more costly than efforts focusing on only a single energy efficiency measure. While it was determined to be a cost effective strategy, homeowners needing whole-building testing often find it even more valuable and worth the cost due to the non-energy benefits that are realized. For many of California's 5.6 million older single family homes built prior to 1982, whole building diagnostic testing offers the potential for significant energy and demand savings, in addition to non-energy benefits. These homes would be targeted in this strategy.

One barrier that can be overcome is the lack of qualified contractors to perform the work and, limited training opportunities to prepare them. The California Building Performance Contractors Association currently conducts whole building system training. About 100 contractors have been trained to use the whole building approach so far, but many more would be needed to implement this strategy.

The program's annual cost of $12 million would be paid for by the strategy's customers and PGC funds. These funds are necessary to support contractor training which is a critical strategy element. Annual estimated energy savings range from 45 to 54 GWh. This represents approximately 27,000 homes, with an average savings of 1,650 kilowatt hours per year per home.

Low Income Multifamily Housing

Multifamily apartments and condominiums represent 31 percent of the total housing stock in California, with most of these units occupied by renters. Over half of multifamily occupants earn less than $35,000 per year, making about 17 percent of the total units in the state low income multifamily. The combination of having units occupied by low income tenants and a split incentive situation, where tenants pay the bill so the building owner who must pay for improvements does not receive the reduced bill benefit, makes this group especially hard to reach. This strategy is intended to work within existing policies, procedures and agencies to improve the energy efficiency of these units. While low income multifamily housing was the focus of this strategy, many of the features are applicable to multifamily housing that is not low-income.

These elements form the basis of the multifamily housing strategy:

- Use the subsidized housing tax regulatory process to accomplish energy ratings and energy efficiency upgrades.
- Fund HVAC tune-ups using PGC funding
- Provide technical assistance for multifamily property management
- Use property rehabilitation, operation and maintenance, and time-of-sale as key trigger events
- Develop interagency partnerships between state housing agencies and the Energy Commission to provide technical support services to local housing authorities, non-profit organizations and project developers.
- Provide energy efficiency training to operating and maintenance personnel, property managers and asset managers

The program's annual cost of $27 million would be paid through PGC funding and annual energy savings would range from 16 to 34 GWh. Savings could be significantly higher by applying features of this strategy to multifamily properties other than low income.

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Residential Equipment Tune-Ups

This strategy focuses on increasing the frequency and effectiveness of Heating Ventilation and Air Conditioning (HVAC) system tune-ups and maintenance services for single family and multifamily residential customers. This strategy relies on HVAC service technicians to improve HVAC system efficiency by testing and correcting faulty performance. To succeed, this strategy will require increasing the competency of contractors; educating consumers about HVAC issues and solutions; and providing incentive funding to ensure adequate training resources are available to reduce the cost of HVAC system testing.

This strategy would ensure that technicians properly check and correct airflow, refrigerant charge and duct leakage during equipment replacement or at the time a home is being sold. This strategy would consider adding, in future Building Standards, the checking of proper airflow, as well as refrigerant charge for package air conditioners.

PGC funded programs should encourage HVAC tune up at time-of-sale, when home ownership changes. This supplements the disclosure of home energy information at time-of-sale strategy, which leads to making available a list of cost effective measures that the new owner may consider. The tune up strategy would check air conditioning systems at time-of-sale and correct any performance problems. The strategy is attractive for multifamily applications where the cost per transaction can be even lower than in the single family market.

Annual energy savings ranging from 16 to 19 GWh are estimated. Program costs are estimated at $4.9 million per year.

Nonresidential and Cross-Cutting

Commercial Building Benchmarking

Commercial building benchmarking can motivate building owners to improve the energy efficiency of their building(s). As with the Information Gateway strategy, this plan provides energy consumption information in a form that customers, in this case commercial building owners and operators, can use to compare how their buildings perform against similar buildings. Once a building is benchmarked, further steps are needed, such as a detailed building energy audit, installation of efficiency measures, and retro-commissioning, to ensure that all energy-using equipment is installed and operating properly. AB 549 research also found that benchmarking should have multiple levels of increasing detail so that simple benchmarking could be done and potentially more meaningful comparisons could be made by more closely examining building characteristics and uses.

The proposed benchmarking strategy depends on financing or refinancing as important trigger events. Utilities are the logical delivery mechanism to periodically benchmark all commercial buildings, to refer building owners to auditing and retro-commissioning services, and to inform them of available incentives.

The estimated annual program cost of $2 million would be paid for through PGC funds. Annual energy savings ranging from 26 to 33 GWh are estimated. The rationale for energy savings from benchmarking is that it will lead to energy audits, changes in building energy use patterns and customers having measures installed.

Commercial Building Retro-commissioning

This strategy promotes services that detect and diagnose faults in commercial building systems operations, and corrects them. Retro-commissioning systematically investigates the operation of the building's energy consuming equipment. It is a logical next step after benchmarking, and typically results in both low-cost upgrades to building operations and replacement of failed components. Buildings with lower benchmarking scores would be targeted under this strategy, regardless of the year of construction.

Even though retro-commissioning is considered one of the more cost-effective options by efficiency experts, commercial building owners remain skeptical of its value and can be slow to initiate a retro-commissioning project. Incentives are needed to increase market demand. At the same time, the industry that provides retro-commissioning services will need to be built up. Retro-commissioning will need more providers as incentives for building owners become available. Training commissioning service providers is a key element of this strategy.

The program's annual cost of $25 million would be paid for primarily by property owners. Each of the utility administrators of PGC-funded programs should pursue aggressive incentives programs for training of commissioning agents and retro-commissioning services. Annual energy savings ranging from 52 to 63 GWh are estimated.

Demand Response

Demand response seeks to reduce peak load energy use by changing all customers to a new, default, critical peak pricing rate (with an option to switch back to non-time based tariffs if they choose). It would educate customers about opportunities for automated controls. The term "demand response" refers to customers' actions to cut electricity use as a result of higher prices, usage reduction incentives, supplier signals, or emergency requests when electric system stability is threatened by inadequate power supply. Supplier signals may automatically trigger reductions or be a basis for a customer

choice to reduce usage. One example of a structure to enable demand response is critical peak pricing. This variation on time-of-use pricing provides day-ahead notifications to customers that peak period prices on the following day will be at a pre-established higher level, due to anticipated unusually high demand for power. Such a program can be made more effective when combined with enabling activities such as educating customers about opportunities for automated controls.

Consumers need to identify controls that will not lead to a reduction in service or comfort and will help them understand if they will be better off on the new rate structure. For the rate structure to be effective, consumers must be educated about it and be willing to respond accordingly.

Currently, the Energy Commission and the CPUC are jointly developing demand response rate structures. The vision is for critical peak pricing to become the default rate for residential, small commercial, and large customers, with real time pricing to become the default rate for very large customers. The shift to these rate structures will help to prevent high system costs and outages in the electricity network, but education must take place on the financial benefits before customers accept them.

Large reductions in demand can be achieved with automatically activated technologies, such as Programmable Communicating Thermostats (PCTs), that reduce energy consumption as pricing signals are received. Automated demand response technology would ensure that load shedding occurs during an energy crisis in real-time, and would not be dependent on manual actions. Although there are PCTs to support such programs, this is a new field, and more enabling technologies need to be developed. The Energy Commission plans to use the Building and Appliance Standards as a means to increase system reliability and reduce customers' costs.

Estimates of program costs, annual energy savings and cost effectiveness for demand response were not within the scope of this project, although joint pilot projects of the two Commissions indicate that the potential for energy savings is high. While a mandatory rate structure change would cause 100 percent participation, those interviewed during the AB 549 work suggested that only 50 to 70 percent of consumers would change their electricity use; some consumers do not have such flexibility. Even so, experience in California and other states indicates that energy savings from demand response can be impressive. Despite predictions of 260 hours of rolling blackouts, California experienced only one contingency event throughout the summer of 2001. Major contributing factors were the extensive level of peak demand reduction (on the order of 10 percent) resulting in part from demand response programs.

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Conclusion

While many strategies to reduce the energy use of existing buildings can be pursued, staff concludes that those presented in this report offer the most promise for further cost-effective energy savings. These options could save from 393 to 648 GWh of electricity usage each year without considering additional savings offered by demand response. Program costs of $114 million to $163 million annually would be primarily funded through PGC funds.

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CHAPTER 1: Purpose of the Report

Reducing energy consumption and peak demand through greater energy efficiency is the cornerstone of the state's energy policy. Homes and commercial buildings consume 66 percent of the state's electricity; improving the efficiency with which this energy is used will significantly improve the state's energy future.

This report is a response to AB 549 (Longville), Chapter 905, Statutes of 2001, which calls upon the Energy Commission to investigate options to reduce wasteful peak load energy use in California's existing residential and nonresidential buildings. The legislation directs attention to the energy savings potential of *existing* buildings, in contrast to Title 24 building standards which are promulgated by the Energy Commission to achieve energy efficiency in buildings through measures incorporated during their initial construction or significant remodeling. There are over 11 million homes in California, compared to the approximately 200,000 constructed each year. Since a wide range of utility-sponsored efficiency programs are directed at existing homes and buildings, there is assurance that we are achieving efficiency improvements in this sector.

Residential buildings range from single family homes to high-rise multi-family apartments and commercial buildings from small businesses in strip malls to skyscrapers and warehouses. More than half of existing buildings were built before the first energy efficiency standards were established in 1978, and while many have been upgraded over time, these older buildings represent a large reserve of potential energy and peak demand savings.

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

Report Structure

The remaining report chapters are as follows:

Chapter 2. Current Energy Efficiency Programs
Chapter 3. Energy Savings Potential of Existing Buildings
Chapter 4. AB 549 Research Approach
Chapter 5. Recommended Residential Strategies
Chapter 6. Recommended Commercial Strategies
Chapter 7. Demand Response for Peak Load Savings

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CHAPTER 2: Current Energy Efficiency Programs

Building and Appliance Standards

Statewide Building Standards, which are adopted under Title 24, Part 6, of the California Code of Regulations, apply to both residential and nonresidential buildings. First put into effect in 1978, in response to the Warren-Alquist Act's mandate to reduce California's energy consumption, they are enforced by local building departments. The Building Standards are a critical tool for achieving California's energy efficiency goals.

In addition, the Energy Commission adopts Appliance Standards under Title 20. The Appliance Standards, which apply to a large number of appliances and equipment categories, prohibit the manufacture for sale in California of non-complying appliances. The first Appliance Standards went into effect in 1976. The Building Standards adopt the Appliance Standards by reference and, in some cases, set more stringent efficiency requirements for appliances that are permanently installed in newly constructed or existing buildings.

The Energy Commission stepped-up the intensity of updating both Building and Appliance Standards in response to the 2000-2001 energy crisis and subsequent energy policy direction. In 2000, Assembly Bill 970 (Ducheny), Chapter 329, Statutes of 2000, directed the Energy Commission to adopt emergency updates to both Building Standards and Appliance Standards. In 2001, Senate Bill 5X (Sher), Chapter 7, Statutes of 2001, required the Energy Commission to adopt energy efficiency standards for outdoor lighting, including lighting in unconditioned buildings, such as warehouses. As a result, the Building Standards were substantially updated in 2001 and 2003 and the Appliance Standards, in 2002 and 2004.

The recent Standards updating effort was targeted not only at raising the energy efficiency of newly constructed buildings, but also of renovations and the installation of equipment in existing buildings. This emphasis is partially in response to concerns, as raised in AB 549, about the need to achieve greater efficiency in existing buildings. An example of the new Building Standards emphasis is the requirement to test and seal ducts in existing buildings when central air conditioning equipment is substantially refurbished or replaced.

It is estimated that between 1975 and 2003, California's programs and Building and Appliance Standards have saved close to 40,000 gigawatt hours (GWh) of electricity and nearly 12,000 megawatts (MW) of peak demand, equivalent to more than two dozen 500 MW power plants.[2] The Standards have saved the equivalent of over $56

[2] Source: *Integrated Energy Policy Report Draft,* 2005.

billion in electricity and natural gas costs above the costs of compliance. The Energy Commission expects that the Standards will save an additional $23 billion by 2013.

Utility Energy Efficiency Programs

California has also embarked on a significant expansion of CPUC-authorized, utility-administered energy efficiency programs. Much of the current spending in these programs is already targeted toward achieving savings in existing homes and buildings so the recommended strategies of this report are coordinated with, and reflect, the expanded efficiency base that these programs are expected to achieve.

In the *2003 Energy Report*[3] the Energy Commission recommended the following:

- Increase public funding for cost effective energy efficiency programs above then current levels to reduce peak electricity demand by at least an additional 1,700 MWs and reduce total electricity used by 6,000 GWh by 2008

- Increase funding for natural gas efficiency programs to reduce natural gas use an additional 100 million therms by 2013

- Standardize and increase the evaluation and monitoring of energy efficiency programs to ensure delivery of savings and benefits

- Implement appropriate mandates, incentives, and funding to maximize the energy efficiency potential of existing buildings.

The *2003 Energy Report* concluded that the maximum achievable cumulative savings from energy efficiency programs over the next decade would be 30,000 GWh. In September 2004, the CPUC adopted a set of aggressive energy savings goals designed to reach and exceed this potential. The Energy Commission has been an active partner with the CPUC and the investor-owned utilities in planning and administering these programs.

As shown in Table 2-1, the CPUC goals exceed the recommendations in the Energy Commission's *2003 Energy Report*. If these goals are met, the energy savings could represent as much as 59 percent of the investor-owned utilities' additional electricity needs between 2004 and 2013, and could increase natural gas savings by 116 percent over the next decade. Ensuring that savings from these efficiency programs are achieved is a vital component of the state's *Energy Action Plan*, and a top priority of both agencies.

[3] *2003 Integrated Energy Policy Report*, December 2003, publication no. 100-03-019.

Table 2-1

Electricity and Natural Gas Program Savings Goals (All Investor-Owned Utilities)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total Annual Electricity Savings (GWh/yr)	1,838	1,838	2,032	2,275	2,505	2,538	2,465	2,513	2,547	2,631
Total Cumulative Savings(GWh/yr)	1,838	3,677	5,709	7,984	10,489	13,027	15,492	18,005	20,552	23,183
Total Peak Savings (MW)	379	757	1,199	1,677	2,205	2,740	3,259	3,789	4,328	4,885
Total Annual Natural Gas Savings (MMTh/yr)	21	21	30	37	44	52	54	57	61	67
Total Cumulative Natural Gas Savings (MMTh/yr)	21	42	72	110	154	206	260	316	377	444

Source: CPUC Decision 04-09-060, September 23, 2004, *Interim Opinion: Energy Savings goals for Program Year 2006 and Beyond.*

Green Buildings Initiative

On December 14, 2004, Governor Schwarzenegger issued Executive Order S-20-04, launching the Green Buildings Initiative, which establishes a high priority for energy efficiency in existing nonresidential buildings. The Green Buildings Initiative (the Executive Order and the accompanying Green Building Action Plan) sets a goal to reduce energy use in both state-owned and other nonresidential buildings by 20 percent by 2015, and provides specific direction to accomplish these savings. The CPUC is requested to determine the level of ratepayer-supported energy efficiency and clean power generation funding that should be devoted to achieving the 20 percent goal. The CPUC is also urged to collaborate with the Energy Commission and other organizations to encourage energy efficiency retrofits, benchmarking and building commissioning.

One responsibility placed on the Energy Commission is to aggressively update the Energy Efficiency Standards for nonresidential buildings so that by 2015, the Standards will save 20 percent more energy (the Standards are expected to be updated three times in that period with effective dates of 2008, 2011, and 2014). The Building Standards support the Green Buildings Initiative because these savings will occur not only in newly constructed nonresidential buildings, but also in the large amount of floor

space that annually undergoes renovation (additions and alterations) which fall within the scope of the Standards. The Building Standards are expected to advance the use of building commissioning in California, and special efforts are to be placed on improving compliance. These efforts are to include cooperative initiatives with state license boards. In July 2005, the Energy Commission entered into a Memorandum of Understanding with the Contractors State License Board to launch this effort. Special attention will be placed on achieving contractor compliance with Building Standards requirements for alterations to existing buildings.

The Green Buildings Initiative also directs the Energy Commission to work with the CPUC, utilities, other governmental agencies and the business community to develop a building energy benchmarking system for all commercial buildings and public buildings in the state. The Energy Commission is to prepare a plan and recommendations for how to accomplish benchmarking in all commercial and public buildings, including benchmarking at time of property sale and the disclosure of benchmarking results to tenants, buyers, and lenders. Implementing benchmarking on this scale is a massive undertaking that will necessarily need to be spearheaded by the utilities.

Furthermore, the Energy Commission is directed to develop guidelines and standards for commissioning activities to achieve operational and maintenance efficiency savings in commercial and public buildings. The Green Building Initiative requests that the California Public Employees Retirement System and the State Teachers Retirement System cut energy use in their real estate investment portfolio by 20 percent by 2015 through retro-commissioning and retro-fitting of energy using systems. The Executive Order also established a Real Estate Industry Leadership Council, made up of commercial real estate industry leaders, to help achieve the Green Building Initiative goals in the private sector.

Finally, specific actions for achieving the 20 percent reduction goal include benchmarking of all state-owned buildings, retro-commissioning of all state-owned buildings with over 50,000 square feet of floor space, and cost effective retrofits in all state-owned buildings.

Results of Current Programs

Figure 2-1 shows the estimated cumulative savings in GWh that have been achieved by standards and efficiency programs.

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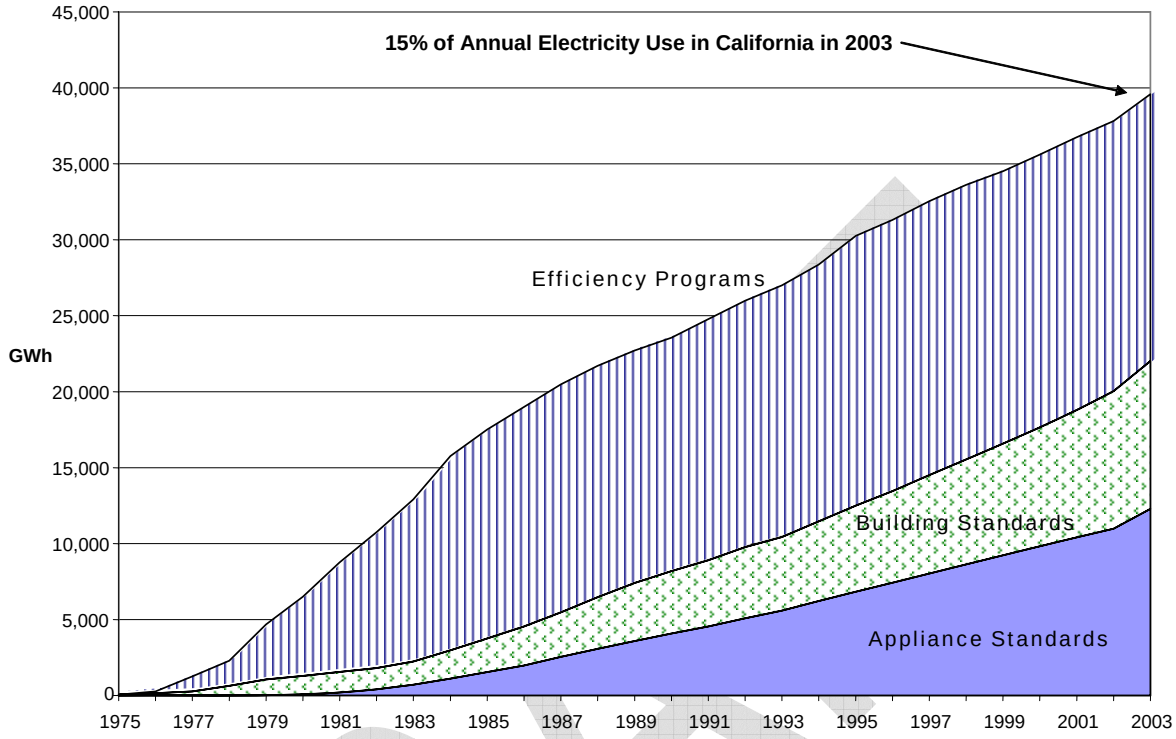
Figure 2-1



These programs have improved the efficiency of energy use in existing buildings through actions such as the following:

- Between 1976 and 2004 the utilities spent more than $5.6 billion on energy efficiency programs, and, in any given year, the utilities focused more than 50 percent of their programs on the achievement of cost-effective retrofits in existing buildings. In the last five years, expenditures that are clearly targeted at new construction programs, aiming to increase the efficiency of new buildings beyond the standards in place, amounted to about 15 percent of total expenditures.

- Over half of the energy savings attributed to the Appliance Standards are from the installation of new appliances in existing buildings. Over time, as existing homes and buildings replace their energy-using equipment, the Appliance Standards increase the efficiency of energy use in those homes and buildings.

- While the Building Standards are usually seen as improving energy efficiency in newly constructed buildings, they also apply to all additions and many alterations made to existing buildings and have affected many vintages of existing buildings constructed since they were first enacted in the late 1970s.

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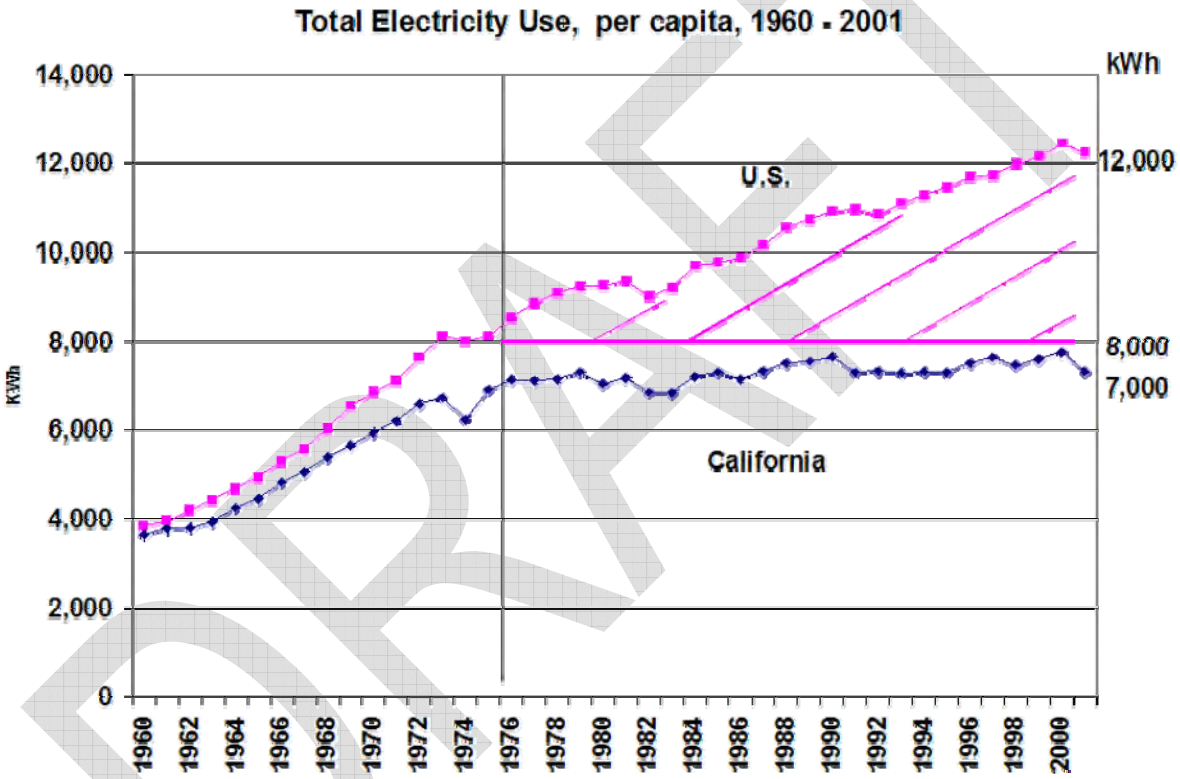
Figure 2-2 indicates that while average per capita electricity consumption has continued to increase for the nation as a whole, Californian's began leveling off their use in the mid to late 1970s. While contributing to this trend, energy efficient new buildings can not explain the entire pattern. A significant influence has to be from improvements to existing buildings.

The strategies recommended in the chapters that follow are intended to coordinate with these existing efforts and to fill in the gaps identified for additional savings.

Figure 2-2



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CHAPTER 3: Energy Savings Potential of Existing Buildings

Characteristics of California's Residential Building Stock

As shown in Table 3-1, the residential building stock is primarily single-family units occupied by the owner. About 72 percent of these homes were built prior to the 1982 version (second generation) Building Standards. Multifamily homes represent the balance of the residential stock; about 73 percent of those units were built prior to the 1982 Standards. Likely candidates for efficiency improvements, based solely on year of construction in relation to the 1982 Building Standards, would then exceed 8 million homes.

Table 3-1
Residential Building Stock by Year

	Single Family Units	Multifamily Units	Total
1982	5,554,290	2,723,422	8,277,712
1991	6,634,644	3,334,322	9,968,966
2000	7,355,358	3,551,042	10,906,400
2004	7,682,759	3,718,122	11,400,881

Source: *California Energy Commission, 2005 Forecast Data for Residential Buildings.*

Survey data indicates that single-family homes in California use about 7,000 kWh of electricity per year, on average. Multifamily units are smaller and average about 4,000 kWh per year. These averages vary significantly by location, or climate zone, and by size and income level of the occupants. They also vary by the age of the home. Older homes tend to use less energy because they are smaller and have a lower saturation of installed central air-conditioning systems. On average, homes built prior to 1996 use less than 6,000 kWh per year, while homes built after 1996 use 20 percent more electricity, or over 7,000 kWh per year. Table 3-2 summarizes the differences between the electricity use of older and newer homes in California.

Table 3-2 provides some indication of where energy savings can be found in existing homes. Newer homes tend to have more insulation, better windows, and more energy efficient equipment, such as compact fluorescent lamps and efficient clothes washers, than older homes. Older homes that have central air conditioning are likely to have significantly less efficient equipment.

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Table 3-2
Comparison of Newer and Older Dwellings

	Newer Dwellings (Built after 1996)	Older Dwellings	Percent Difference
Annual Electric Household Consumption (kWh)	7,159	5,960	20
Annual Gas Household Consumption (therms)	468	459	2
Dwelling Size (square feet)	2,039	1,434	42
Number of Residents	3.14	2.93	7
Average Annual Income	$86,276	$58,082	49
Percent Single Family	74%	58%	28
Owner Occupied	83%	62%	35
Saturation of Central AC	78%	41%	93
Cooling Degree Days	962	900	7
Cooling Degree Days (those with central AC)	1,119	1,279	-13
Programmable Cooling Thermostat	85%	47%	83
Swimming Pool Saturation	13%	8%	59
Average Number of Computers per Home	1.21	0.93	30
Natural Gas Primary Heating	86%	83%	5
Heating Degree Days	2,050	2,023	1
Exterior Wall Insulation Throughout	91%	51%	77
Attic Insulation	91%	66%	38
Double Pane Windows Throughout	79%	31%	157
Low Flow Showerheads Throughout	71%	54%	32
Average Number of CFLs per Home	2.29	1.74	32
Horizontal Access Washers	13%	9%	43

Source: *California Statewide Residential Appliance Saturation Study Final Report, Executive Summary*, June 2004, publication no. 400-004-009.

The average annual energy use per home also varies significantly by climate zone within California, ranging from about 5,000 kilowatt hours (kWh) in the cooler zones to 8,000 kWh or more in hotter zones. In addition, the type of dwelling unit affects energy use. Single family units tend to be larger and have more energy using equipment than multifamily units.

It is worth noting that with energy efficiency gains in new home construction over the years, overall average electricity use has remained relatively unchanged. Since newer

homes are generally larger and in hotter climate zones than older homes, without these gains, average electricity use would have undoubtedly increased.

Characteristics of Nonresidential Building Stock

California's nonresidential building stock is much more diverse than the residential stock and is usually expressed in millions of square feet of floor area. Table 3-3 shows that about 46 percent of nonresidential buildings were built before the 1978 Building Standards. Large offices, retail and non-refrigerated warehouses represent approximately half of the total nonresidential building stock. These data indicate that over 5 million square feet of nonresidential buildings may benefit from efficiency upgrades amounting to significant further savings.

Table 3-3

Percent of Nonresidential Floor Stock Area Built Prior to 1978 (Millions of Square Feet)

Year	Pre-1978 Stock	Current Total Stock	Percent of Pre-1978 Stock to Current Total Stock
Small Office	264.6	646.3	41
Restaurant	143.9	316.8	45
Retail	799.0	1,824.4	44
Food Store	220.4	476.7	46
Non Refrigerated Warehouse	611.6	1,480.5	41
Refrigerated Warehouse	39.3	95.0	41
School	581.2	872.6	67
University	321.7	547.7	59
Hospital	239.3	538.2	44
Hotel	219.9	526.7	41
Other	974.3	2,039.1	48
Large Office	833.7	2,035.7	41
Total	**5,248.9**	**11,399.7**	**46**

Source: California Energy Commission*, 2005 Forecast Data for Nonresidential Buildings.*

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Estimated Potential Savings for Existing Buildings

Table 3-4

Energy and Demand Savings Potentials

Category	GWh	MW	Million Therms
Total Statewide Consumption	**280,000**	**55,000**	**14,344**
Residential	70,595	15,700	5,000
Commercial	80,000	16,500	2,100
Efficiency Technical Potential[4]	**37,498**	**9,316**	**3,365**
Residential	19,710	5,643	2,148
Commercial	14,721	3,673	751
Efficiency Economic Potential[5]	**24,129**	**5,482**	Not Reported
Residential	11,593	2,906	
Nonresidential	12,536	2,576	

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[4] These values were assembled from four efficiency potential studies authored by F. Coito and M. Rufo of Xenergy, Inc., prepared for Pacific Gas and Electric Company, 2003 and 2001. The reports are available at [www.calmac.org].

[5] Source: Derived from the Energy Commission's Staff Report *Proposed Energy Savings Goals for Energy Efficiency Programs in California*, publication no. 100-03-021, prepared in support of the *2003 Integrated Energy Policy Report*.

CHAPTER 4: AB 549 Research Approach

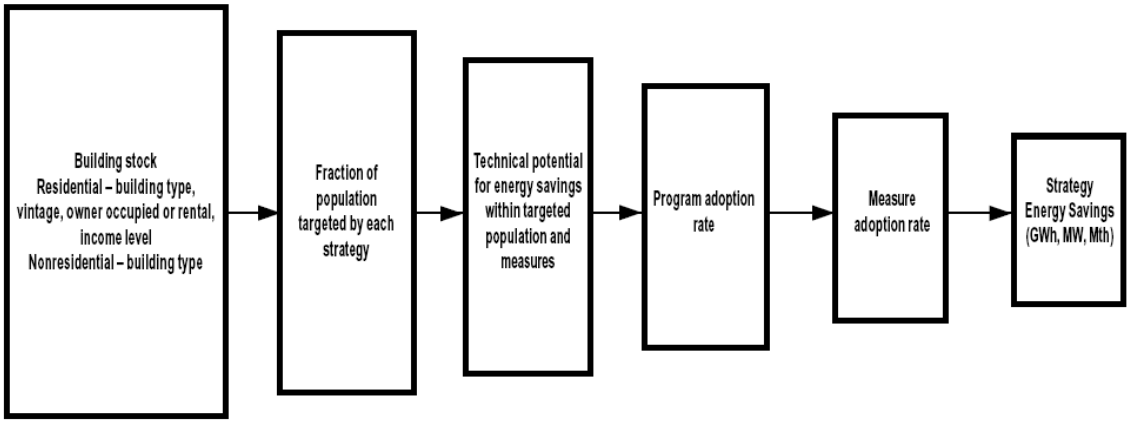
In compiling this report on potential energy savings from existing buildings, the Energy Commission, through its technical consultants, conducted literature searches, program manager surveys, key participant interviews, and expert panel discussions; solicited public comment; and analyzed consumer-opinion survey and appliance saturation survey data. Market barriers to adopting energy efficient technologies were explored, as well as research into consumer behavior and other market participant motivations. The Energy Commission's Energy Efficiency Committee held two public workshops to gain input from the stakeholders and the public about possible strategies to improve the energy efficiency of buildings.[6]

From these discussions and research, 16 possible strategies were identified and ranked according to their potential for energy savings. The energy savings calculations were adapted from a model used by Energy Commission consultants, Xenergy, Inc., in 2002 for a series of studies conducted for existing residential and commercial buildings. The technical potential of a strategy (defined as the energy savings resulting from complete penetration of all measures in applications where they are deemed technically feasible) considered the existing building stock (segmented by vintage, income, ownership and/or building type), the fraction of building stock targeted by a particular strategy, the saturation of equipment types in each market segment that are candidates for upgrades, and the energy savings potential of the technologies promoted by the strategy. The strategy's energy savings were calculated from the technical potential, the program adoption rate, (defined as the fraction of the population targeted by the strategy that choose to participate) and the measure adoption rate (defined as the rate of acceptance of individual measures by program participants). This process is diagramed in Figure 4-1. [7]

[6] To help guide this study, a Project Advisory Committee (PAC) was formed comprised of members of the California Measurement Advisory Council (CALMAC), which includes representatives from the investor owned utilities, the CPUC and the Energy Commission. The Project Advisory Committee provided guidance to the contractor, staff and the Committee and was involved in the review of products developed over the course of the effort. In addition, four public workshops were held to receive input as the report was being developed. Transcripts of workshops, presentations at workshops, and interim reports can be found on the AB 549 web page: [www.energy.ca.gov/ab549/index.html]

[7] Public Goods Charge (PGC) funds of $300,000 were used for this portion of the AB 549 work as well as $80,000 from the Energy Commission's Energy Resources Program Account. The technical support aspect of this project was led by Architectural Energy Corporation (AEC) under Contract Agreement No.: 400-04-001. Subcontractors assisting in this effort were TecMarket Works, Lutzenhiser Associates, RLW Analytics, Morton Blatt and the Davis Energy Group.

Figure 4-1



For example, the low range of the "Information Gateway" strategy targets 10 percent of the pre-standards owner-occupied residential buildings. The technical potential of all technically feasible measures in the targeted population is 1,195 GWh, 686 MW and 145 million therms (MMth). An estimated 19 percent of the targeted population participates in the offering, and the participants adopt measures representing an average of 27 percent of the savings potential in each building. Under these conditions, the strategy is estimated to save 62 GWh, 18 MW and 6 MMth.

More detailed discussions of the approach used and the feedback received can be found in two supporting consultant reports:

- *Technical Assistance in Determining Options for Energy Efficiency in Existing Buildings* (publication number CEC-400-2005-011-F)
- *Technical Assistance in Determining Options for Energy Efficiency in Existing Buildings, Appendices* (publication number CEC-400-2005-011-F-AP)

The cost effectiveness analysis considered two broad measures. The first is participant cost effectiveness which includes energy cost savings, incentives paid to the customer and the customer's out-of-pocket cost for the measure. Total Resource Cost (TRC) is the second indicator and includes the above costs as well as program administration and advertising costs. In addition, the net present value of the utility avoided costs over the life of the measures is calculated in determining TRC. The avoided cost calculations take into account the time-dependent nature of avoided costs, meaning that summer peak savings are valued more highly than off peak savings, and also consider generation, transmission, distribution and environmental costs.

Resulting benefit-to-cost ratios of greater than one indicate that the strategy is cost effective. However, these results are not precise since they depend upon many assumptions and are being applied to very broad strategies. The cost effectiveness analysis is useful in indicating relative cost effectiveness with the understanding that the

benefit-to-cost ratios for one strategy could certainly be higher or lower depending upon the assumptions used.

One of the more subjective elements of evaluating strategies has to do with market and policy readiness. Several criteria were used to qualitatively assess the likelihood of each strategy's success, including:

- Need for, or existence of, regulatory authority
- Degree of policy maker support
- Degree of market participant support
- Ability to pay, and
- Ease of implementation, or moving from a voluntary to mandatory approach

As with any study, it is important to recognize that the results presented here are estimates and subject to variation for many reasons. For example, actual energy savings depend upon how customers respond to proposed strategies. Furthermore, many assumptions must be made in deriving estimated energy savings effects. Despite these analytical limitations, great effort has been invested in maintaining a realistic perspective when formulating these assumptions. The detailed assumptions for each strategy and measures within a strategy can be found in Appendix F of the consultant report.

Staff concludes that the strategies presented in this document will cost effectively save from 393 GWh to 648 GWh of electricity usage each year.

Of the 16 strategies formulated by the consultant team, eight are recommended for implementation. These eight are described in subsequent chapters.

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CHAPTER 5: Recommended Residential Strategies

In 1992, the Energy Commission was directed by SB 1207 (Hart), Chapter 769, Statute of 1992, to establish a statewide home energy rating program which would have the following elements:

- Consistent, accurate, and uniform utility ratings based on a single statewide rating scale
- Reasonable estimates of potential utility bill savings, and reliable recommendations on cost-effective measures to improve energy efficiency
- Training and certification procedures for home raters and quality assurance procedures to promote accurate ratings and to protect consumers
- Procedures to establish a uniform reporting system for information on residential dwellings
- Labeling procedures that will meet the needs of home buyers, homeowners, renters, the real estate industry, and mortgage lenders

Once a California Home Energy Rating System (HERS) program was established, the Energy Commission was to develop and publish an informational booklet to inform homeowners, rental property owners, renters, sellers, brokers and the general public about the program. Real estate sellers and brokers were to be responsible for disclosing the program and furnishing home purchasers with the information.

Phase I of the HERS program was accomplished in 1999. That phase set up the basic operating framework of the program, including training and certification procedures for raters, and quality assurance procedures, and data collecting and reporting requirements. The Phase I regulations, adopted by the Energy Commission, established the role of the HERS provider, an entity to:

- Train, certify and monitor home energy raters
- Conduct complaint investigations
- Collect data and report on services that raters provide

Through this process, the services of HERS providers and raters are made available to the market. Infrastructure costs are included in the cost of the services, and are reimbursed by those benefiting from the services. Under Phase I, raters were able to provide third-party diagnostic testing and field verification services to ensure quality construction and installation of efficiency features that are prone to construction defects in new homes.

Phase II, which was delayed due to the 2000 electricity crisis, will put in place the remaining elements needed to provide oversight for energy ratings of existing residences.

Given that a HERS system is not yet fully developed, staff considered five other strategies for reducing peak load energy use in existing residential buildings. These strategies were evaluated based on their ability to respond to important trigger events, close gaps in existing programs, reduce known barriers, build supporting infrastructure, and achieve significant energy savings cost effectively. They are summarized in Table 5-7 at the end of this chapter.

In developing the strategies, we reviewed the energy efficiency program portfolio for the state's four IOUs' 2004-2005 program cycle which consists of close to 100 programs offered by a combination of the IOUs, partnerships between the IOUs and local governments, and non-utility program implementers. Most programs offer some education, training or information component. Audits, rebates, direct installation of measures, and design assistance are examples of the portfolio's offerings.

Attention was given to identifying known and potential market or regulatory barriers to implementing the strategies and the actions needed to overcome them. Market barriers, for example, may include high first cost, life-cycle cost, payback period, hidden or unexpected costs, uncertain reliability and performance, design limitations, and product options. Regulatory barriers may occur through unintentional conflicting regulatory interests. One example brought to our attention dealt with replacing less efficient refrigerators with new Energy Star® models in multifamily housing. After replacement it was learned that the door handle locations did not comply with the Americans with Disabilities Act requirements. Further discussion of barriers is provided in the consultant report *Technical Assistance in Determining Options for Energy Efficiency in Existing Buildings*.

Staff also considered the interaction among stakeholders in adopting energy efficiency improvements. For example, the homeowner's selection of a contractor is based on a large number of factors. And, decisions are influenced by elements such as technology choices, building codes, or contractor certifications.

Finally, market conditions, strategy costs and energy savings are also key elements to consider in measuring the value of a proposed strategy. While objective and quantitative analytical methods are preferred, many subjective judgments had to be relied upon in accounting for these elements.

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Table 5-1 shows the estimated energy savings, costs, and cost effectiveness of each residential strategy.

Table 5-1

Residential Annual Energy Savings Potential, Costs, and Cost-Effectiveness

Strategy	Gigawatt hours	Megawatts	Million therms	Program Cost ($million)	Participant Benefit Cost Ratio	Total Resource Cost Benefit Cost Ratio
Disclosure of Home Energy Information at Time-of-Sale	175 - 186	52 -55	9 – 10	4 - 53	2.34 – 2.90	1.17 – 1.29
Information Gateway	62 - 259	18 - 75	6 - 27	39.4	2.57	1.07
Residential Whole Building Diagnostic Testing	45 – 54	40 - 48	2	11.9	1.65	1.09
Low Income Multifamily Housing	16 – 34	27 - 56	2 – 5	26.6	3.01	1.27
Residential Equipment Tune-up	16 – 19	21 - 25	4	4.9	1.98	1.11
Total	314 - 552	158 - 259	23 - 48	86.8 – 135.8		

The recommended residential strategies are as follows:

1. Disclosure of Home Energy Information at Time-of-Sale

In California, over 600,000 existing homes are sold each year, triple the number of new homes built, with no requirement for improving the efficiency of these buildings at the time ownership changes. Current energy efficiency programs do not systematically target time-of-sale opportunities. Some sellers may provide the potential buyer with past utility bills, a step in the right direction, but hardly a routine occurrence. Further, utility bills can vary significantly based on occupant behaviors and, therefore, are not necessarily the best indicator of home energy efficiency. Home energy ratings would offer the customer more information, including cost effective options for improving energy efficiency, but add to the cost and complexity of the sales transaction and would require an increase in the number of qualified home energy raters.

The condition of the energy-using features of the home and the potential to upgrade them may affect the value and desirability of a particular property and, therefore, property buyers should have access to the relevant information. [8]

[8] Section 2079.16 of the California Civil Code requires real estate agents to disclose certain information. It says, "Seller's agent or a subagent of that agent has the following affirmative obligations: (c) A duty to disclose all facts known to the agent materially affecting the value or desirability of the property that are not known to, or within the diligent attention and observation of, the parties."

Staff considered several options for addressing the time of sale information availability. We benefited from advice offered by the real estate community and the home energy rating industry. While it is not currently practical to require detailed energy ratings for every home sold in California, staff recommends that steps be taken to prudently move in that direction over time.

A first step would be to offer buyers, sellers, brokers, and appraisers targeted information, through a brochure and other media, about energy use, utility bills, available energy efficiency programs, home energy rating services, and energy efficiency financing. The Energy Commission would work with the real estate industry to ensure that brokers and sellers distribute this information to potential buyers. The Commission would work with the utilities to ensure that requests for disclosure of the sellers' energy bills to buyers are fulfilled. The second step would be to conclude the Energy Commission's California Home Energy Rating, Phase II proceeding. A third step would involve training about energy use and the rating program for brokers, sellers, appraisers, and lenders. Training of additional home energy raters is also necessary. A fourth action is to use existing utility incentives to offset the costs of the rating and the indicated improvement measures.

Staff recommends a one-year, voluntary pilot program during which the necessary material and processes can be developed. The real estate industry, the utilities, and the public will gain experience with the additional information disclosure. Meanwhile, the Energy Commission will undertake to complete the Home Energy Rating proceeding and will work with the rating industry to increase the number of trained raters. By the end of the pilot we should be prepared to assess the value and practicality of a mandatory program.

If justified based on experience from the pilot, a program of mandatory disclosures of energy ratings could be implemented, beginning with homes built prior to 1982. Although a home of any age may have room for efficiency improvements, older homes offer the most logical starting point for reducing wasteful energy use. The majority of all existing homes in California fall into this category (72 percent, or over 8 million homes). About 136 GWh of electricity would be saved each year if these homes were able to reduce their use by 5 percent. This figure climbs to 189 GWh if all homes sold each year could reduce electricity use by 5 percent through efficiency upgrades.

Home energy ratings are no guarantee of action on the part of the buyer and the proposed strategy, even at later mandatory phases, does not require buyers to retrofit their homes with more efficient products. However, the home energy rating is superior to utility bills which give some indication of energy use, but do not adequately reflect efficiency since bills are highly influenced by occupant behavior. A home energy rating provides a comparable rating to other homes, an assessment of cost effective measures to improve the energy efficiency of the home, information about financing options to make these improvements, and information about utility and non-utility

incentives available to the buyer. The rating report therefore can be a significant motivator to accomplish some level of improvement.

The program's cost of $4 million to $53 million annually could be paid for through some combination of utilities' energy efficiency programs and the property sellers and buyers. If the buyer incurs the cost and decides to pursue efficiency upgrades, the portion of the energy rating and efficiency measure expenses not covered through incentives could be included in an Energy Efficient Mortgage. Energy Efficient Mortgages allow a lender to increase underwriting qualification ratios for borrowers whose property meets minimum energy efficiency standards. The borrower qualifies for a larger loan amount, but the higher payment is offset by reduced energy bills.

Annual average energy savings range from 87 to 164 GWh and 7 to 38 megawatts (MW) are estimated for this strategy, with smaller savings in the first, voluntary years and larger savings in the latter mandatory years.

Staff recommends the following:

- The Energy Commission, utilities, the California Association of Realtors®, the Department of Real Estate and HERS providers should work together to develop an informational booklet to offer buyers, sellers, brokers, and appraisers information about energy use and cost. The booklet should primarily motivate prospective buyers information on energy use in homes. The booklet would coach the buyer on what questions about the energy consumption characteristics of the residence under consideration and to suggest the value of reviewing past utility bills or other available information. It should also identify programs and services available to improve energy efficiency including utility information and incentives, home energy rating services, and energy efficiency financing.

- Once the Energy Commission has concluded its HERS proceeding, homes being sold that were built prior to the 1982 Building Energy Efficiency Standards should receive a HERS rating. The rating should be easy to understand and include a description of cost effective upgrades available to the buyer. These potential upgrades should be described in sufficient detail to allow a prospective homebuyer to apply for an Energy Efficient Mortgage.

- The Energy Commission, the Department of Real Estate and the California Association of Realtors® should work together to develop coursework for training real estate agents and other industry professionals on topics related to disclosure of energy efficiency and home energy rating information. This training should be used as a means of enhancing real estate agent customer service.

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- The Department of Real Estate should make disclosure of energy efficiency and home energy rating information part of its real estate agent coursework.

- Current utility programs should be used to provide incentives for buyers and sellers to obtain ratings and to implement energy efficiency improvements recommended by the rating. The incentive should be set, at a minimum, to cover portions of the rating itself and the efficiency measure(s) cost. Utilities should administer the incentives.

Table 5-2

Action Plan for Time-of-Sale Energy Information

Activity	Lead Organization/Support Organizations	Timeframe
Form strategy development group from Energy Commission, industry experts and service implementers	Energy Commission/ Department of Real Estate, Ca Assoc of Realtors®, IOUs, HERS providers	2006
Assess information needs, funding resources, develop informational booklet	Energy Commission/ Ca Assoc of Realtors®, IOUs, HERS providers	2006
Develop incentive and marketing program	Energy Commission/Ca Assoc of Realtors®, IOUs, HERS providers	2006
Design and launch voluntary pilot program	Energy Commission/Ca Assoc of Realtors®, IOUs, HERS providers	2007
Conduct and complete HERS proceeding	Energy Commission	2007
Develop training materials	Energy Commission/HERS providers, Ca Assoc of Realtors®, Department of Real Estate	2007 – 2008
Conduct training	Ca Assoc of Realtors, HERS providers/Department of Real Estate, Energy Commission	2008
Assess pilot program results, design and launch phase 1 mandatory program for pre 1982 homes	Energy Commission/ Ca Assoc of Realtors®, IOUs	2008
Design and launch phase 2 mandatory program	Energy Commission/ Ca Assoc of Realtors®, IOUs	2009
Evaluate program and modify to improve, continue or eliminate	Evaluation Firm	2010 - 2011

2. Information Gateway

Throughout the process of compiling the AB 549 report, staff heard about the importance of comprehensive, reliable energy efficiency information for California households. The Information Gateway strategy functions as an education and referral service, directing homeowners and property managers to information and services, including in-depth online energy audits and referrals to existing energy efficiency

programs. Customers would receive feedback on their energy consumption, compared to similar customers, through utility websites or mailings. It would function continuously and, therefore, does not depend upon on any specific trigger event, meaning that it would not come into play only when equipment needs replacement, when the property is sold, or when some other event creates a natural opportunity for a customer to consider corrective or improvement measures.

Annual energy savings from the Information Gateway strategy range from 62 to 259 GWh. It would cost approximately $40 million per year and be implemented by each of the utilities under the Public Goods Charge (PGC)-funded programs.

Elements of the strategy include:

- Targeting buildings with the greatest potential for energy savings, requiring utilities to compile energy use data to identify those customers meeting specific targeting criteria.
- Providing feedback on customer energy use through utility websites.
- Providing online home energy audit information in a multi-level format that allows the customer to explore their energy use patterns and options for saving energy. Additional levels of energy audits (e.g., over-the-phone, in-person) would be provided to targeted and/or interested customers.
- Connecting customers with opportunities for financing energy efficiency upgrades either through existing programs or through a separate program.
- Providing customers with energy efficiency program marketing materials through bill stuffers, online customer service applications and media campaigns.

This strategy would be undertaken primarily through utility websites where customers would receive feedback on their energy consumption compared to like customers. The feedback would be formatted to motivate customers to delve deeper into understanding their energy use patterns and options for saving energy. While California utilities currently offer online audits, this strategy would represent an enhancement to those services.

At the Committee workshops, participants noted the limitations of current online audits and customer access to online services and the need for much larger media campaigns. Despite these limitations, estimated energy savings range from 62 to 259 GWh, ranking it first among the residential strategies. And, while earlier analysis indicated that the strategy was not cost effective from a total resource cost perspective, the cost effectiveness calculations were revisited and those measures with the lowest benefit/cost ratios were removed. This lowered the energy savings impact by 5 GWh per year, but improved the total resource cost benefit/ cost ratio to greater than 1.0, rendering the strategy cost effective from either participant or total resource cost perspective.

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Advanced metering infrastructure will be building up over the next five years, offering customers more information on their energy usage and other functions such as detailed billing statements, power outage management, and in-home and web-based displays. The energy savings, strategy costs and cost effectiveness calculations did not address the advanced metering infrastructure.

Staff recommends the following:

- Each utility should establish a centrally-administered information gateway for residential energy efficiency information and referrals to efficiency programs and services offered by utilities, non-utility program implementers and the Energy Commission. In providing information, customers with the greatest potential for energy savings and/or the highest energy cost burden should be given priority, regardless of the year of home construction. All residential building types should be included, with the information focused at residents, property owners and/or property managers as appropriate. An advisory group of utilities, third party implementers and industry experts could assist in shaping and coordinating the effort and should be formed in 2006.

- The utilities should offer feedback on customer energy use through their websites. Customers without access to the internet, or those that do not use online billing, should be provided with written communications.

- The home energy audit information should be provided on a multilevel format that allows the customer to explore their energy use patterns and options for saving energy to as much depth as necessary to motivate action. Utilities should collect building description information and deliver audit results online, over the phone, through the mail or in person as necessary to reach targeted customers. Local governments and community-based organizations could help reach targeted customers.

- The audit report should include marketing materials and referrals that are tailored to the customer's needs and that provide linkages to existing programs and services available for the customer to take action on the audit findings.

- Easy access to financing assistance should be offered, through either existing programs or a separate initiative, to motivate customers to make efficiency upgrades.

- A media campaign should be used to advertise and promote the Information Gateway strategy.

- The CPUC and utilities should investigate utility resources necessary to upgrade utility billing information systems to offer customers more interactive energy efficiency information.

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- The CPUC should encourage utilities to determine and claim credit for energy savings that can be linked to information programs.

- Procedures should be developed to protect the confidentiality of customer billing data while allowing non-utility implementers to work with high energy use customers.

Table 5-3

Action Plan for Information Gateway

Activity	Lead Organization/Support Organizations	Timeframe
Form strategy development group from Energy Commission, industry experts and service implementers	Energy Commission	2006
Conduct market demand and participation analysis	Energy Commission/Contractor	2007
Conduct detailed review of feasibility, desirability and potential benefits, barriers and approaches	Energy Commission	2007
Examine current homeowner identification systems and contact approaches and assess their applicability	Energy Commission	2007
Review designs and approaches for baselining homes and identifying priority participants	Energy Commission	2007
Develop a coordinated information delivery program that reaches all homeowners, provides covered services and include design strategies	Energy Commission	2007
Assess detailed program cost and cost/benefit potentials for developing strategy under various delivery approaches	Energy Commission	2007
Identify best approaches for information delivery and incorporate into delivery system strategy or devise new system that uses current utility or other means	Energy Commission	2007
Conduct strategy go/no-go decision criteria and make decision based on criteria and available funding	Energy Commission	2008
Form delivery development team to design and test pilot program consistent with funding capability	Energy Commission/IOU	2008
Establish financing programs, potentially link to On-Bill-Financing Programs	Energy Commission/Selected Implementer	2008
Benchmark residential buildings with the IOUs, using SDG&E's 2007 Home Energy Consumption Tool benchmarking efforts as a potential model	IOU/Energy Commission/Selected Implementer	2009
Target customers	IOUs and Selected Implementer	2009
Market services	Selected implementer, linked with Flex-Your-Power and other outreach and strategy-focused marketing efforts	2009
Implement program	IOUs and/or non-utility program implementers	2009
Evaluate program and modify to improve, continue or eliminate	Evaluation Firm	2009 - 2011

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3. Residential Equipment Tune-up

The residential equipment tune-up focuses on increasing the frequency and effectiveness of Heating Ventilation and Air Conditioning (HVAC) system tune-ups and maintenance services for residential customers. Home owners would be required to have HVAC technicians test and, if indicated, correct airflow requirements, refrigerant charge, and duct leakage during equipment replacement. Currently, the Building Standards mandate proper refrigerant charge and duct sealing or the installation of a thermostatic expansion valve (TXV) when equipment is replaced. We would consider adding, in future Standards, the checking of proper airflow, as well as refrigerant charge, for package air conditioners. In addition, mechanisms should be considered to encourage these measures at time-of-sale when home ownership changes. The strategy would require increasing numbers and the training and certification level of HVAC contractors.

Once installed, HVAC systems are typically ignored until they fail. Homeowners do not have experience in determining if a system is operating properly and lack confidence in the industry to remedy problems. The HVAC industry largely relies on rules of thumb when replacing or servicing these systems and, because of strong seasonal demand, technicians are often pressed for time when servicing a unit which can lead to later HVAC performance problems.

Approximately 65 percent of California's 12.2 million households have central air conditioning and would therefore be candidates for this strategy. The estimated energy savings range from 16 to 19 GWh. This strategy was determined to be cost effective with favorable participant and the total resource cost/benefit ratios. Tune-ups in multifamily applications are particularly appealing since the cost per transaction is lower than in the more diffuse single family market.

Staff recommends the following:

- Training organizations, trade associations and the Energy Commission should develop technical training for certification of HVAC technicians.

- Funding should be earmarked for community and vocational schools with HVAC technology programs or starting HVAC programs so that training opportunities are increased to meet the need for additional qualified technicians.

- A media campaign should advertise and promote HVAC performance information to educate consumers and promote industry certifications.

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Table 5-4

Action Plan for Residential HVAC Tune-up

Activity	Lead Organization/Support Organizations	Timeframe
Review evaluation and technical reports; conduct assessment and further refine potential savings	Energy Commission	2006
Conduct program market demand and participation analysis	Energy Commission	2006-2007
Develop program design and funding requirements	Energy Commission	2007
Conduct strategy go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission	2007
Develop stakeholder group with strong legislative influence that can support effort over a reasonable timeline	Energy Commission	2007
Design pilot program development and implementation strategies consistent with funding	Energy Commission	2007-2008
Develop technical training approach for pilot area	Energy Commission/North American Technician Excellence	2008
Design marketing and roll-out approach	Energy Commission/Marketing Firm	2008
Implement technician training and stage the marketing rollout	Energy Commission	2009
Certify technicians	NATE	2009
Rollout initiative in pilot area	Energy Commission/Implementer	2009
Inform and educate consumers	Flex-Your-Power/IOUs	2009
Evaluate program and modify to improve, continue or eliminate	Evaluation Firm	2009 - 2010
Phase in mandatory requirements	Energy Commission	2011

4. Whole Building Diagnostic Testing

The whole building diagnostic testing strategy involves evaluating house performance as an integrated system rather than as a number of unrelated parts. Climate, building materials, building assembly, occupant interaction, and mechanical equipment design and installation all affect the “house as a system” performance. Under this strategy technicians would identify flaws in construction or operation, use the diagnostic tools to guide repairs, and verify improved performance.

A detailed diagnostic evaluation allows a technician to understand building performance issues and implement measures that improve building comfort, health and safety, and energy efficiency. At the time of remodeling, synergistic benefits are likely to be realized. For example, when coupled with an air conditioning retrofit, other energy efficiency improvements may contribute to reduced equipment size of the replacement, saving the homeowner additional money. The whole building diagnostic approach represents a more comprehensive way of addressing household energy issues and

more thorough testing and remediation than the residential air conditioning tune-up strategy.

The energy implications of whole building diagnostic testing services are important, but may be secondary to issues of comfort, health and safety. Significant non-energy benefits provide leverage in implementing energy efficiency, since homeowners highly value comfort, health and safety enhancements.

For many of California's 5.6 million homes built prior to 1982, whole building diagnostic testing offers the potential for significant energy and demand savings in addition to non-energy benefits. Due to the comprehensive nature of the whole building approach, it is a more costly approach than efforts that focus on a single energy efficiency measure. The higher cost of the whole building approach may not be cost effective through reduced energy bills except for high energy users. However, homeowners using whole-building testing often find it very valuable and worth the cost due to the non-energy benefits that are realized. Non-energy benefits should be valued in cost effectiveness calculations and efforts to engage the insurance industry in exploring the risk reduction benefits of whole building diagnostic testing services would be pursued.

The whole building strategy could potentially be tailored to target:

- sub-regions where peak demand is straining the local transmission and distribution system infrastructure.
- situations where a standard home energy rating has identified problems that need to be addressed through a more rigorous approach.
- homes that have been shown to have higher than normal energy consumption that suggests an energy related problem may exist.

Barriers to whole building diagnostic testing include a lack of qualified contractors to perform the work, undervaluing the non-energy benefits such as comfort and indoor air quality, and the extra expense associated with diagnostic testing and whole building retrofits.

Regarding qualified contractors, the California Building Performance Contractors Association currently conducts whole building system training which involves four days of classroom education and two days of field work. About 100 contractors have been trained to use the whole building approach so far, but many more would be needed to implement this strategy if consumers began to request the service in large numbers.

Staff received supportive comments from the public on this strategy. The estimated energy savings range from 45 to 54 GWh. This strategy was determined to be cost effective for participants, but not clearly cost effective from a total resource cost perspective.

Staff recommends the following:

- The Energy Commission and the California Building Performance Contractors Association should work together to evaluate the training approach.

- The Energy Commission should permit qualified contractors to self-verify HVAC performance based on documented testing protocols.

- The CPUC should investigate methods of valuing non-energy benefits in cost effectiveness calculations.

- The Energy Commission should engage the insurance industry in exploring the risk reduction benefits of whole building diagnostic testing services.

- A media campaign should advertise and promote the use of whole building diagnostic testing and qualified contractors.

The Energy Commission should focus the whole building strategy to target sub-regions where peak demand is straining the local transmission and distribution system infrastructure, in situations where a standard home assessment has identified problems that need to be addressed through a more rigorous approach, and for homes that have been shown to have higher than normal energy consumption.

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Table 5-5

Action Plan for Whole Building Diagnostic Testing

Activity	Lead Organization/Support Organizations	Timeframe
Review evaluation and technical reports, conduct assessment and further refine potential savings	Energy Commission	2006
Conduct program market demand and participation analysis	Energy Commission/Market research firm	2006-2007
Develop program design and funding requirements	Energy Commission	2007
Conduct strategy go/no-go decision criteria and make decision based on criteria and available funding.	Energy Commission	2007
Design program development and implementation strategies consistent with funding	Energy Commission	2007
Review and revise technical training approach	Energy Commission/ California Building Performance Contractors Association (CBPCA).	2007
Investigate valuation of non-energy benefits	CPUC	2007
Engage insurance industry	Energy Commission	2007
Design targeting and marketing approach	Energy Commission/Marketing expert	2008
Train contractors in target area	CBPCA	2008
Market and roll-out program in target area	Energy Commission with Flex-Your-Power and other outreach efforts	2008
Evaluate program and modify to improve, continue or eliminate	Evaluation Firm	2008 - 2009

5. Assistance to Affordable Housing

Multifamily apartments and condominiums represent 31 percent of the total housing stock in California, with 83 percent of these units occupied by renters. About 56 percent of multifamily occupants earn less than $35,000 per year, so about 17 percent of the total units in the state can be characterized as affordable multifamily housing. The combination of having units occupied by low income tenants and the “split incentive” situation, in which tenants pay the bill and the building owners who must pay for improvements do not receive the benefit of reduced utility bills, makes this group especially hard to reach.

The financing options to implement energy efficiency improvements in affordable housing differ from those available to standard property owners. The owner or manager of an affordable housing unit may apply for financial support to the California

Department of Housing and Community Development (HCD), the California Tax Credit Allocation Committee (CTCAC), the California Housing and Finance Agency (Cal HFA), a local funding source, a private bank, and possibly other sources for project financing. Resources include tax-exempt bonds of which Cal HFA is one of the main providers, the CTCAC, and the multifamily housing program that is administered by HCD. Nearly every type of affordable housing is associated with one if not multiple agencies. In most cases developers use both the tax-exempt bonds from the California Debt Limit Allocation Committee (CDLAC) and tax credit financing to preserve the project as affordable. In affordable housing projects, tax credits are involved in nearly 80 percent of the projects.

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

- Offer technical assistance

  Provide information, training and technical support services to housing property and asset managers, including energy audits and technical assistance to implement cost-effective upgrade projects. State housing agencies, local housing authorities and non-profit agencies generally do not have the expertise to properly evaluate and manage energy efficiency improvement projects. Provision of utility bill tracking software to the property managers and training on its use would help highlight problems.

- Encourage HVAC tune-up opportunities

  Provide new funding for HVAC system tune-ups, retro-commissioning and operations and maintenance activities. Housing authorities generally lack the funds for HVAC tune-ups and retro-commissioning projects.

- Use the subsidized housing tax regulatory process as a lever

  Developers that participate in subsidized housing programs generally receive tax credits and other financial incentives for their investments in low-income housing. Energy ratings and energy efficiency upgrades should be required as a condition of participation in these programs. California should not be subsidizing lower efficiency construction practices when better practices are cost-effectively available that help lower tenant costs.

- Use property rehabilitation as a key trigger event

  Housing rehabilitation projects are frequently invasive to the point where tenants are relocated during renovation, providing the opportunity to upgrade major building systems such as windows, insulation, common area lighting, HVAC and water heating. At this trigger point, diagnostics and measure verification can be completed, reducing “per unit” costs.

- Develop interagency partnerships between state housing agencies and the Energy Commission to provide technical support services to local housing authorities, non-profit organizations and project developers.

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During public comment on the draft consultant report staff was encouraged to offer technical support services regarding energy efficiency to Cal HFA, HUD, CTCAC and SDLAC similar to the current technical assistance program for public facilities.

- Implement energy ratings

  Use existing state funding sources or PGC funding to cover the cost of the energy rating and whole-building energy audits. Cal HFA has a predevelopment loan program, which covers both preconstruction and/or pre-acquisition expenditures. Energy ratings and audits would be an eligible cost under this program; or audit costs would be a reimbursable item for successful projects. When a loan is closed with Cal HFA the costs would be folded into the financing package without requiring a separate application for predevelopment. Require energy ratings as a condition for receiving the energy efficiency funding.

- Revise housing authority utility allowances to reflect energy efficiency.

  By lowering the utility allowance for these properties to reflect efficiency improvements, property owners would be permitted to charge higher rents since tenant utility bills would be lower. Property owners that invest in energy efficiency upgrades are currently penalized in the sense that utility allowances for more efficient properties are the same as for conventional properties so that owners are not able to charge these higher rents.

- Offer on-going energy efficiency training to operating and maintenance personnel, property managers and asset managers.

  Property managers do not typically have expertise or resources to carry out an energy audit and implement its findings. In addition, high turnover rates among operations and maintenance staff mean that training in energy efficiency must be consistent and continual. Training would be developed in partnership with HCD and housing management associations

The estimated energy savings range from 16 to 34 GWh. This strategy was determined to be cost effective with favorable participant and the total resource cost/benefit ratios. Savings could be significantly higher by applying features of this strategy to multifamily properties other than low income.

Staff recommends the following:

- Information, training and technical support services should be offered to affordable housing property and asset managers, including energy audits and technical assistance to implement cost-effective upgrade projects. Utility bill tracking software and appropriate training should be introduced for use by property managers

- The Energy Commission and housing authorities should work together to highlight property rehabilitation as key trigger events for efficiency upgrades. At this time, diagnostics and measure verification can be completed, reducing "per unit" costs.
- The Energy Commission should explore possible funding sources for HVAC system tune-ups, retro-commissioning and operations and maintenance programs targeted at multifamily properties.
- The Legislature should require energy ratings and energy efficiency upgrades for properties that participate in subsidized housing tax credit programs and identify possible funding sources, such as the PGC, to offer incentives to lower the cost of ratings and whole building energy audits. Services should be offered to help developers fill out participation forms, arrange for a rating and determine equipment choices. Energy ratings and audits should be an eligible cost or a reimbursable item for successful projects.
- Interagency partnerships should be developed to provide technical support services to local housing authorities, nonprofit organizations and project developers.

Table 5-6

Action Plan for Affordable Housing

Activity	Lead Organization/Support Organizations	Timeframe
Form strategy development group of experts	Energy Commission	2006
Review research and form consensus on program design	Energy Commission	2006
Obtain funding to support pilot program	Energy Commission	2007
Design pilot program to address rehabs, assessments of existing buildings and HVAC operations and maintenance	Energy Commission	2007
Pass legislation that requires energy ratings and efficiency upgrades for properties participating in tax credit programs	Legislature	2007
Coordinate with state housing authorities and local low income housing organizations	Energy Commission /Strategy Development Group	2007
Identify areas with planned rehab projects and current buildings in need of upgrades and designate pilot program area	Energy Commission/Strategy Development Group	2007
Provide bill tracking software to prioritize efforts for housing authorities	Energy Commission	2007
Revise utility allowances to encourage efficiency	HUD/Energy Commission	2007
Launch educational and outreach efforts at the local level and work with authorities and owners to select projects	Energy Commission/ Strategy Development Group	2007-2008
Provide training and technical education and support to housing authorities	Energy Commission	2008
Provide audits	Energy Commission/Contractor	2008
Provide incentive programs for multifamily projects	IOUs	2009
Implement projects in pilot area	Energy Commission/Strategy Development Group	2008 - 2010
Evaluate program and modify to improve, continue or eliminate	Evaluation Firm	2008 - 2011

Table 5-7
Residential Strategy Summary

Description and Annual Savings	Actions	Lead Role	Timeframe	Funding
1. Time of Sale Information Disclosure (175 to 186 GWh) Energy features of home disclosed to buyer Utility bills disclosed when authorized by seller Information booklet for buyers, brokers, appraisers on energy savings tips and services available Home Energy Rating System process concluded and utility incentives provided to reduce rating cost and offset measure cost Funding made available to train raters, brokers, appraisers and lenders on energy efficiency and energy efficient mortgages Voluntary participation followed by phased in mandatory program for pre 1982 homes, then all homes	Energy Commission concludes that energy features are material facts in the sale of homes Department of Real Estate, Energy Commission, real estate agents and others develop training curriculum on energy efficiency and energy efficient mortgages Department of Real Estate offers home energy rating instruction Energy Commission completes proceeding to adopt regulations establishing home energy rating system for existing homes Energy Commission develops brochure describing home energy rating system as required by law	Department of Real Estate, Energy Commission and real estate agents	2006 for information booklet, partner with realtors 2007 for HERS proceeding 2008 for revised booklet, training, and incentive development 2009 for pilot program to gain experience 2010 for phase I of mandatory program 2011 for fully mandatory program	Public Goods Charge funds Program cost: $4 million annually to $53 million, depending on phase
2. Information Gateway (62 to 259 GWh) Central information gateways established Customers receive feedback on energy use Online energy audits offer multilevel details Online audit provides referrals to energy services Advertising campaign	Utilities establish information gateway providing customers improved online audits and feedback on customers energy use Utilities include referrals for customers to act on Financing assistance offered to encourage customer action Flex Your Power promotes strategy through advertising campaign	IOUs and municipal utilities	2006 assess resources needed, evaluate online audit options and capabilities 2007 finalize program delivery 2008 – 2009 benchmark residential buildings, advertise and implement program	Public Goods Charge funds for IOUs Program cost: $40 million annually
3. Whole Building Diagnostics (45 to 54 GWh) Contractor training on building diagnostic testing Incentives to help fund training and offset the cost of diagnostic services to customers Non-energy benefits considered in cost effectiveness determinations Advertising campaign	Utilities offer incentives for training and for customers choosing diagnostic services California Building Performance Contractors Association conducts additional training Energy Commission and CPUC establish methods to account for non-energy benefits Flex Your Power administers advertising campaign	Energy Commission, Public Utilities Commission, and utilities	2007 develop program, design incentives, and establish non-energy valuation method 2008 train contractors, advertise strategy and implement program	Public Goods Charge funds Program cost: $12 million annually
4. Low Income Multifamily (16 to 34 GWh) Technical services provided Housing authorities trained in energy efficiency (ratings and upgrades) Energy ratings and efficiency upgrades required for housing subsidized by tax credits	Utilities provide technical services to asset managers Housing authorities focus on upgrades during property rehabilitation, maintenance and at time of sale Administrators of tax credit programs ensure energy ratings performed	Utilities and housing agencies	2007 utilities offer technical assistance 2007 – 2008 property manager and housing agency training	Public Goods Charge funds Program cost: $26.6 million annually
5. Equipment Tune Up (16 to 19 GWh) Air conditioners checked at time of property sale for proper operation Building standards are updated to include check of airflow in HVAC systems Utilities support certification of technicians Advertising campaign	Utilities, trade organizations, training organizations, and Energy Commission develop certification training for current and new HVAC professionals Energy Commission updates building standards, check and correction of airflow Flex Your Power conducts advertising campaign to promote certifications	Energy Commission, utilities and trade associations	2007 to begin certification training 2008 to update building standards 2009 to implement strategy	Public Goods Charge funds $4.9 million annually

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CHAPTER 6: Recommended Commercial Strategies

Staff considered several strategies for reducing peak load energy use in existing nonresidential buildings. Three strategies specific to nonresidential buildings were formulated by the Energy Commission's technical consultants, and two of these have been retained in this report. Table 6-1 displays the strategies recommended by staff. Table 6-2 shows the estimated energy savings, cost, and cost effectiveness of each nonresidential strategy.

1. Commercial Building Benchmarking

The Governor's Green Buildings Initiative, Executive Order S-20-04, and its implementing Action Plan endorse benchmarking of all commercial and public buildings in California, calling on the Energy Commission to produce a plan, timetable and recommendations to accomplish this goal.

The benchmarking portion of the Order is a small, but critical, part of the Green Building Action Plan. There are two distinct tasks: 1) the mandatory benchmarking of thousands of state buildings, for which the Department of General Services is responsible, and 2) development of a statewide benchmarking system for voluntary use by the owners and managers of over 1 million private commercial buildings, for which the Energy Commission is responsible.

The Green Building Action Plan directs the Energy Commission to perform the following distinct tasks related to benchmarking:

1. To propose a simple, California-specific energy efficiency benchmarking system for California's commercial buildings, with the input of other governmental agencies, public and private utilities and representatives of the business community.
2. To provide the Governor with a plan, timetable and recommendations to accomplish benchmarking for all commercial and public buildings including benchmarking at the time-of-sale, and a system which discloses benchmarking ratings to tenants and buyers at the time-of-sale.

A simple and accurate benchmarking system will allow building owners and managers to compare their building's energy efficiency performance in two ways: against the performance of similar buildings, and as a baseline to demonstrate changes in building performance over time. Benchmarking alone will not reduce energy use: its purpose is to inform building managers about energy performance and to motivate them to make

Table 6-1

Nonresidential and Cross Cutting Strategy Summary

Description and Annual Savings	Actions	Lead Role	Timeframe	Funding
1. Retro Commissioning (52 to 63 GWh) Retro commissioning guidelines developed as identified in section 2.2.3 of Green Building Initiative action plan Develop infrastructure to provide services through additional training Incentives offered to increase demand for services Best candidate customers identified through benchmarking Promotional efforts to encourage property owners/managers to participate	Energy Commission develops guidelines and standards for commissioning private commercial and public buildings Utilities screen participants using benchmarking information and offer incentives to reduce cost of retro commissioning Energy Commission, utilities and California Commissioning Collaborative develop training materials and cost/benefit information to encourage greater use of retro commissioning Department of General Services, Energy Commission and Flex Your Power develop and distribute marketing messages to engage building owners	IOUs and municipal utilities, Energy Commission and Commissioning Collaborative	2006 utility incentive programs and commissioning guidelines developed 2007 training of providers 2008 program marketing	Public Goods Charge funds for IOUs Program cost: $25 million annually
2. Commercial Building Benchmarking (26 to 33 GWh) Benchmarking tool developed All commercial buildings benchmarked and periodically rechecked Referrals to audit and retrofit improvement services provided Energy efficiency information provided to customers	Energy Commission completes benchmarking methodology (tool) as directed by Green Building Initiative Utilities develop program to benchmark all commercial buildings based on tool Legislature requires benchmarking when building refinanced or refinanced CPUC develops statewide program to promote benchmarking through Flex Your Power as specified in the Green Building Initiative CALSTRS and PERS develop policy to benchmark all buildings in their portfolio and pursue energy efficiency	CPUC, IOUs and municipal utilities, Legislature	2006 complete benchmarking methodology 2006 implement benchmarking	Public Goods Charge funds for IOUs Program cost: $2 million annually
3. Demand Response (savings high, but not quantified) Customer education on benefits Incentives for use of automated technologies Building standards to address demand response technologies Movement toward mandatory time differentiated rates and build up of advanced metering infrastructure	Energy Commission and utilities educate customers on benefits of real time pricing Utilities provide incentives to encourage industry to increase manufacture of demand response equipment Energy Commission adopts requirements for demand response technologies starting with programmable communicating thermostats Public Utilities Commission directs utilities to provide time differentiated rates for all customers	Public Utilities Commission, Energy Commission, and utilities	Timeframe to be set by Public Utilities Commission	Public Goods Charge funds and property owners Program cost: unspecified

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Table 6-2

Nonresidential Annual Energy Savings Potential, Costs, and Cost-Effectiveness

Strategy	Gigawatt hours	Megawatts	Million therms	Program Cost ($million)	Participant Benefit Cost Ratio	Total Resource Cost Benefit Cost Ratio
Benchmarking	26 - 33	6 - 7	0.5	2.0	2.51	1.05
Retro-commissioning	52 - 63	26 - 31	4 - 5	24.9	3.66	1.66
Total	78 - 96	32 - 38	4.5 – 5.5	26.9		

* Potential savings for demand response are high, but not quantified for this report.

their buildings more energy efficient. Benchmarking is also important to help establish investment priorities to take advantage of energy efficiency opportunities.

Prominent commercial building benchmarking systems include the US Environmental Protection Agency's (US EPA) Energy Star® and the Lawrence Berkeley National Laboratory's (LBNL) Cal Arch California Building Energy Reference Tool. Both systems use a web interface to compare the energy consumption data of a particular building to a database of consumption data for a large number of other existing similar buildings. The EPA tool uses the federal Commercial Building Energy Consumption Survey (CBECS) data, while Cal Arch uses data from the Commercial Building End Use Survey (CEUS) that is specific to California buildings. Both databases are updated periodically. A current survey is now being conducted with building data being available for use by Cal Arch in late 2006.

Benchmarking tools typically compare energy consumption per square foot of floor space for comparable classes of buildings or Standard Industrial Code (SIC) designations. To calculate a "first level" benchmark requires only information that should be readily available without requiring energy audits of the building. By considering more detailed information, more insightful comparisons can be drawn. Therefore, the benchmarking tool should be designed to have multiple levels of increasing detail to allow both the simplest benchmarking rating and potentially more meaningful comparisons.

The overall elements of the commercial building benchmarking strategy include:

- Encouragement of benchmarking at the time of financing and refinancing.

  Financing and refinancing are appropriate opportunities to consider the operating costs of the building and ways to reduce them.

- Utility billing information that can be used for benchmarking.

Utilities would make available to building owners sufficient information to allow them to compare their building's energy use to that of other similar buildings. A mechanism would be provided for continuous updating of benchmarking scores with each utility billing cycle, or some other timeframe, to track the effectiveness/impact of changes in building operations or installation of energy efficiency features.

Benchmarking also provides a means for utilities to identify poorly performing buildings for purposes of offering energy audits and energy efficiency information.

- Referral to energy efficiency programs.

  Benchmarking alone leads to limited energy savings. To motivate further investigation into what may be cost-effective for the individual building, referrals to appropriate energy audit programs and opportunities for financial assistance for making improvements would be made.

Staff received supportive comments regarding benchmarking at its public meeting. The estimated energy savings range from 26 to 33 GWh. The strategy was also determined to be cost effective.

Staff recommends the following:

- The Energy Commission's PIER program should continue working with the Lawrence Berkeley National Laboratory and the Oak Ridge National Laboratory to develop a California-specific benchmarking tool since neither the existing Cal Arch or Energy Star® tool adequately meet California's need for a wide-scale, easy to use, and effective tool. In addition, discussions with the US EPA should continue on possible use the Energy Star® brand with California-specific data. Until an improved California-specific system is available, staff recommends that benchmarking be accomplished by using the existing version of Energy Star®.

- Utilities should be required to make available, under appropriate confidentiality considerations, billing information that could be used to benchmark all commercial buildings. A mechanism should be provided for updating benchmarking scores periodically to track the effectiveness of changes in building operations or installation of energy efficiency features.

- Legislation should be considered to require benchmarking during financing and refinancing events. Buildings are financed/refinanced periodically throughout their lives. It is appropriate to consider the operating costs of the building and ways to reduce those operating costs during these events.

- The utilities should provide referrals to retro-commissioning and retrofit services for interested customers who have received benchmarking information on their property.

- Utilities should provide energy audits and retro-commissioning for poorly performing buildings.

- The Energy Commission should work with the Building Owners and Managers Association (BOMA), the International Facilities Management Association (IFMA), and the Real Estate Leadership Industry Council (RELIC) to get benchmarking listed as a best practice for building property management. Enlisting these powerful trade organizations would be very helpful in promoting benchmarking.

Table 6-3

Action Plan for Commercial Building Benchmarking

Activity	Lead Organization/Support Organizations	Timeframe
Form expert panel to guide program development and direction	Energy Commission/DOE/EPA/LBNL	2006
Work with trade organizations and building owners to promote benchmarking as best practice	Energy Commission/BOMA/IFMA/RELIC	2006
Utilities integrate benchmarking into existing energy efficiency programs	Utilities	2006
Require benchmarking of CALSTRS and PERS buildings	Governor	2007
Target poorly performing buildings for audits and retro-commissioning services	Utilities/Energy Commission	2007
Design and Market program	Energy Commission/ Flex-Your-Power	2008
Require utilities to provide referrals for retro-commissioning services for interested customers	CPUC/ Energy Commission	2008
Implement automated benchmarking	Utilities	2008
Require benchmarking of all commercial buildings during financing and refinancing	Governor/Legislature	2009
Evaluate program and modify as needed	Evaluation Firm	2010

2. Retro-commissioning

Retro-commissioning is a process for detecting and diagnosing faults in building operations such that system corrections can be made. It is recognized as a cost-effective strategy, typically involving on-going activities for improvement. Retro-commissioning results in low cost upgrades to building operations and control strategies and replacement of failed components, as well as recommendations for larger capital improvements and equipment replacements.

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Elements of the retro-commissioning strategy include:

- Development of case studies relevant to commercial buildings.

  Current literature about building commissioning relies primarily on information from government and institutional buildings where the operating issues may be different than in commercial buildings. There is, therefore, a need to develop relevant case studies as guidance to commercial building owners and managers.

- Assurance that there are sufficient numbers of skilled technicians.

  Developing infrastructure is an important requirement for any commissioning strategy. Few providers offer high level commissioning services. Developing the skills and expertise of commissioning service providers through training is key.

- Use of incentives and/or tax credits to stimulate demand for retro-commissioning.

  Although the energy savings potential from commissioning is strong, the market demand for these services is weak. Financial incentives, potentially funded trough the utilities' efficiency programs would stimulate market interest.

- Recognition of the risk management attributes of retro-commissioning.

  Casting commissioning as a risk management tool, rather than strictly an energy savings tool may provide greater value to the commercial building owner and manager community. Retro-commissioning of buildings helps control risk from volatile energy costs, as well as loss of tenants due to comfort issues and risks of litigation stemming from indoor air quality problems.

Staff received several comments on this strategy including an ongoing concern that the retro-commissioning industry needs to expand and that continuing training is essential. Some utility experience with retro-commissioning indicated that the services can be difficult to sell even when offered at no cost and that owners can also be slow to have the commissioning agents' recommendations addressed.

The Governor's Green Building Initiative (Executive Order S-20-04) and accompanying Green Building Action Plan require retro-commissioning of all state buildings over 50,000 square feet with re-commissioning every five years. In addition, the CPUC is directed to fund a statewide campaign to inform building owners and operators about building commissioning and ensure that PGC-funded programs include building commissioning. The Energy Commission is directed to develop guidelines and standards for commissioning and that commissioning is incorporated into building standards. The California Public Employees Retirement System (PERS) and the State Teachers Retirement System (STRS) are directed to consider cutting energy use in the

California real estate portfolio through retro-commissioning. Case studies on retro-commissioning that result from the Green Building Initiative would serve as valuable examples for government buildings and businesses as well.

The estimated energy savings from this strategy range from 52 to 63 GWh. It was determined to be clearly cost effective.

Staff recommends the following:

- The Energy Commission and the California Commissioning Collaborative should develop and make available case studies from the commercial building sector. The case studies should emphasize risk management benefits.
- Utilities should identify customers for retro-commissioning potential using benchmarking information.
- Utilities should provide direct energy efficiency program funds to reduce the cost of commissioning services.
- The Energy Commission, utilities and the California Commissioning Collaborative should develop materials for training building operators and commissioning agents to increase awareness and build service capacity in the commissioning industry.
- The Department of General Services and the Energy Commission should develop and distribute marketing messages encouraging building owners and managers to have their buildings audited, upgraded, and retro-commissioned.

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Table 6-4

Action Plan for Retro-commissioning

Activity	Lead Organization/Support Organizations	Timeframe
Form expert panel to guide program development and direction	Energy Commission/ utilities/Commissioning Collaborative	2006
Review evaluation and technical reports, conduct assessment and further refine potential savings	Energy Commission/utilities	2006
Conduct program market demand and participation analysis	Energy Commission/ utilities/Research Firm	2006
Provide incentive programs	Utilities	2006[1]
Develop program design and funding requirements	Energy Commission	2007
Develop case study selection and location criteria	Energy Commission/ utilities/Commissioning Collaborative	2007
Develop case studies	Energy Commission/ utilities / Commissioning Collaborative	2007
Train commissioning service providers	Energy Commission/ utilities/ Commissioning Collaborative	2007
Target customers	Utilities	2007
Market program	Flex-Your-Power, Dept of General Services/ Energy Commission	2008[2]
Evaluate program and modify to improve, continue or eliminate	Evaluation Firm	2008 – 2010

[1] Retro-commissioning is likely to be a component of the 2006-2008 Investor-Owned Utilities program portfolio.
[2] Coordinate with roll out of benchmarking strategy

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CHAPTER 7: Demand Response for Peak Load Savings

In AB549 the Legislature specifically sought strategies to reduce the *peak load* electricity use in existing buildings in California. This policy recognizes the strain and higher costs that increased electrical use at the time of peak demands puts on the electric system. In California, particularly due to air conditioning usage patterns that create "needle peaks" in demand, the state's electrical generation and distribution is constrained during peak periods. Although this condition can be addressed through the addition of new power plants and transmission upgrades, deliberate action by customers to reduce their demand during peak times can forestall the need for infrastructure improvements that must recover all their costs during a very few hours of the year.

Customers' peak loads can be managed in a number of ways-

- Utilities can install equipment to allow the utility dispatchers to "interrupt" customers' power for periods of time when needed. This is typically done for commercial or industrial customers in return for a rate discount.
- Customers can agree to "curtail" their power use or be "interrupted" when called upon by the utility. Typically, these types of rates apply to very large customers who can provide large load reductions on an emergency basis when system reliability is threatened. Because the cost of providing incentives to maintain customer participation is high—as is the cost to the customers of responding—these programs are not the preferred option for system load management.
- Customers can voluntarily respond to public appeals for reductions in electricity use.
- Customers' overall energy use can be reduced through effective energy efficiency programs such as are being proposed in this report, which also affects peak demand.
- Customers can be provided with price signals that more closely reflect the actual cost of delivering electricity during peak time periods than do current "average" rates.
- Customers can be provided with advanced meters, control equipment and information that can be used to help them reduce their peak loads.

These last two items are in the process of being implemented in California, at least among the investor-owned utilities. Proceedings are underway at the CPUC, with Energy Commission collaboration, to enable the IOUs to provide all customers with advance meters that will, in addition to allowing time-differentiated rate designs, offer a wealth of information and communication possibilities. Concurrently, the CPUC is considering "critical peak pricing" tariffs for large customers that will more closely reflect system costs and provide discounts on the underlying rates to participating customers in

exchange for higher critical peak rates that will be dispatched for fewer than the highest cost 100 hours of the year. Extensive experimentation in California and elsewhere has shown that customers will respond to these price signals and that they frequently prefer time-differentiated rate designs.

Besides meters and tariffs, customers can use considerably more information about their consumption patterns and how those patterns affect their bills. While the largest customers have decades of experience with time-varying rates and many larger businesses have at least a couple years experience, the smallest business and residential customers have little, if any, familiarity with how their usage patterns affect costs and how demand reduction strategies can be implemented without major disruption or inconvenience. Customers in all classes would benefit from extensive education about their usage and demand response strategies as well as assistance in implementing those strategies.

A demand response strategy for reducing peak load electricity use would include the following elements:

- "Advanced metering infrastructure" for all electric customers in California.
- "Critical peak pricing" tariffs available to all electric customers.
- An extensive education campaign on the connection between time of electricity use and costs.
- Comprehensive technical assistance services to customers who choose to alter their consumption patterns and improve their equipment stock
- Requirements in the 2008 and subsequent building standards for cost-effective advanced metering and associated technologies.

Staff recommends the following:

- The Energy Commission and the utilities should conduct efforts over the next three years to educate consumers on the rationale for time dependent pricing and the options available to customers to respond to these rates and reduce their bills.
- The Energy Commission should continue to support efforts by the California Public Utilities Commission to shift large customers to a default critical peak pricing tariff.
- California energy policy should support the development and deployment of critical peak pricing rates for residential and small commercial energy customers and the option of a dynamic real-time pricing structure for large (greater than 200 kW) customers.
- The utilities and the Energy Commission should develop programs to encourage the development and deployment of enhanced automation technologies that automatically provide demand reductions in response to price signals.

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- The Energy Commission should consider requiring the installation of demand response technologies through the building and appliance efficiency standards as a means to increase system reliability and reduce customers' costs.
- The Energy Commission should develop case studies showing the use of demand response control systems that successfully reduce peak loads without negatively affecting occupant comfort and productivity.

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