Energy Savings Pup Assignment: 1/7/2011

Energy Economics, Inc. – Consultants to TURN

Indicate what analytical work your organization has performed on California utility efficiency savings and costs. Very briefly state the objective (s) and key result.

Energy Economics, Inc. conducted an analysis to quantify the effect of savings from IOU energy efficiency savings on per capita electricity consumption in California. The analysis also looked at other factors that may have contributed to the apparent stabilization of per capita electricity consumption, such as the price of electricity, demographic variables, and economic structure. Our findings indicated that while it is difficult to identify the specific contribution of savings from energy efficiency programs to per capita consumption trends, there is a very clear association between the price of electricity and consumption (see Attachment 1).

Provide the following information concerning the data used in your analyses:

- *What was the source(s) of your data?*

  We used savings data supplied by the CEC that is consistent with the data in: California Energy Commission. "Implementing California's loading order for electricity resources. CEC-400-2005-043." July, 2005. www.energy.ca.gov/2005publications/CEC-400-2005-043/CEC-400-2005-043.PDF.

  We also used electricity consumption, population, electricity price, and implicit price deflator data from the Energy Information Administration's, State Energy Data System (SEDS). http://www.eia.doe.gov/states/_seds.html

  Additional information came from the US Census Bureau, the National Climatic Data Center, the US Historical Census of Housing Tables, and the 1997 and 2001 Residential Energy Consumption Surveys, and the Bureau of Labor Statistics.

- *What years were covered?*

  1975-2003 – CA Energy Efficiency Savings

  1970-2004 – Electricity Consumption and Electricity Price analysis

  Various years depending on data availability for other variables.

- *What customer sector and programs?*

  Most of the analysis was undertaken on the residential sector.

- *What were other characteristics of the data such as net or gross savings, first year/cumulative, ex ante/ex post?*

  The savings data were based on net, first year, annual savings for the main analysis. The data presented in Figures 1 and 6 of Attachment 1 are cumulative savings.

- *What were the measure life assumptions?*

  EULs for measures included in the savings data from the CEC were determined by the CEC.

- *In what ways did you modify the data (e.g., discounting) for use in your analysis? Why did you do this?*

  We did not modify the data. For some initial regressions, outliers were excluded in an effort to specify the effect of savings from IOU programs on consumption. This did not greatly improve the results.

- *In what ways is your modified data set and analysis different from other uses of this data that you know of?*

  Our analysis sought to directly specify the impact on electricity consumption of savings from EE programs. Other studies have sought to identify the sources of the "gap" between electricity consumption in California and the United States by accounting for as much of the difference between California and the United States as possible given available data and then ascribing the remaining "gap" to energy policy.

- *(Energy Commission) Using the information in the questions above, describe the ways in which the use of efficiency data in the forecast changed over the last 20 years?*

- *How is naturally occurring conservation handled, if at all, by each organizations estimates? Has this changed over time? Is there a specific definition of naturally occurring?*

  Energy Economics, Inc.'s analysis did not address naturally occurring conservation. However, we did find that changes in the price of residential electricity were strongly associated with changes in residential electricity consumption, both at the California level and at the multi-state level. Given that one of the main impetuses for naturally occurring savings is the price effect, our analysis highlights the importance of questions about the magnitude of naturally occurring savings in the forecast and the price elasticity of demand for electricity assumptions that are included in the modeling process. We understand that in their forecasts the IOUs use a short-term price elasticity of about 0.10, indicating that the price elasticity of demand for electricity is highly inelastic. However, many other analyses have indicated that in the long term, the price elasticity of demand for electricity is higher than the short-term 0.10 figure used in utility forecasts of demand.

For example, a recent survey of the literature indicates that long-run elasticities for the residential sector range between -0.7 to -1.4 with a mean of -0.9.[1] This finding is consistent with an earlier survey of 21 studies of residential demand which showed that the long-run price elasticity is between -0.75 and -0.91.[2] The same study estimated aggregate long-run price elasticity of demand to be close to -1.0.[3] Long-run elasticities are clearly more appropriate for estimating responses to the price of electricity because it takes time for consumers to adjust their purchasing practices and behavior to changing electricity prices. The same article also cites a California study which indicates that the price elasticity of demand for electricity varies by household, with some households displaying no price elasticity and other households responding strongly to prices, with price elasticities as high as -1.02.[4]

This is important to the discussion of naturally occurring savings because, to the extent that such savings are prompted by price signals, a low price elasticity of demand for electricity would suggest low levels of naturally occurring savings simply because people do not respond to price when making decisions about electricity consumption.

Understanding the issue of electricity price and its effect on consumption is crucial to accurately estimating naturally occurring savings. If the level of such savings is underestimated, not only is the reliability of forecast demand estimates called into question, but ratepayers may end up paying for IOU energy efficiency programs that generate savings which would have occurred anyway. Furthermore, savings are meant to substitute for supply-side resources; if the predicted savings do not materialize, ratepayers will pay for both the energy efficiency program and the cost of additional supply-side resources.

Additional questions that arise from this issue include:

- How can the discrepancy between Itron's and the CEC's estimates of naturally occurring savings, especially in the residential sector, be

[1] Ahmad Faruqui, Inclining Toward Efficiency: Is electricity price-elastic enough for rate designs to matter? Public Utilities Fortnightly, August 2008, page 24-25: http://www.fortnightly.com/exclusive.cfm?o_id=94

[2] Carol Dahl, A Survey of Energy Demand Elasticities in Support of the Development of the NEMS, 1993, Contract De-AP01-93EI23499, U.S. Department of Energy cited in Ronald Lafferty et al, Demand Responsiveness in Electricty Markets, FERC Office of Markets, Tariffs and Rates, Janaury 15, 2001, page 7: http://www.naseo.org/committees/energyproduction/documents/demand_responsiveness_in_electricity_markets.pdf

[3] *ibid.*

[4] Ahmad Faruqui, Inclining Toward Efficiency: Is electricity price-elastic enough for rate designs to matter? Public Utilities Fortnightly, August 2008, page 25: http://www.fortnightly.com/exclusive.cfm?o_id=94

resolved? This discrepancy is particularly puzzling given that the CEC assumed a substantial price increase in its model while Itron assumed that electricity prices would remain constant.[5]

- To what extent can the forecast model take into account the rebound effect, in which consumers increase their use of an energy efficient technology because it uses less energy? That is, the energy efficient technology does not result in a reduction in consumption because consumers make greater use of the technology, either in the form of using it more or by purchasing additional features.

[5] "[I]n the case of the residential sector, the Energy Commission's estimates of naturally-occurring are well below both Itron's estimates of residential naturally-occurring savings and the free-ridership rates implied in the net-to gross assumptions applied to residential measures." See Incremental Impacts of Energy efficiency Policy Initiatives Relative to the 2009 Integrated Energy policy Report Adopted Demand Forecast, Attachment A: Technical Report, CEC-200-2010-001-ATA,January 2010, discussion page 64-66: http://www.energy.ca.gov/2010publications/CEC-200-2010-001/CEC-200-2010-001-ATA.PDF

Attachment 1

Stabilizing California's Demand

The real reasons behind the state's energy savings.

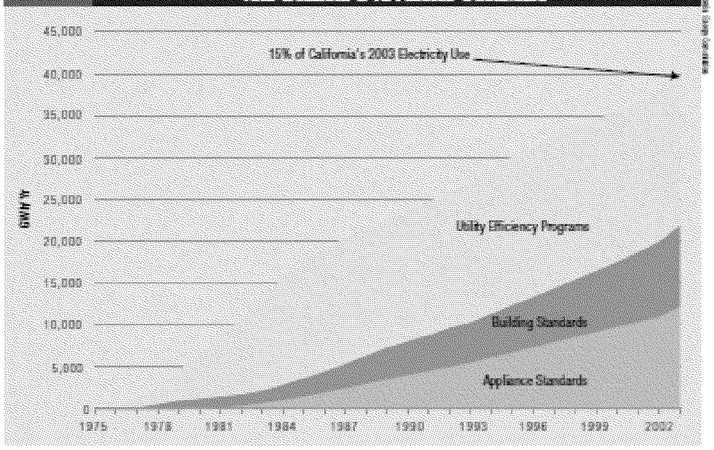
BY CYNTHIA MITCHELL, *ET AL.*

In 2005, California's energy policymakers and regulators established energy efficiency (EE) as California's highest priority resource for meeting future needs in a clean, reliable, and low-cost manner.[1] In 2006, the California legislature and governor positioned energy conservation and efficiency as the cornerstone of the state's Global Warming Solutions Act. The Act mandates a 2020 statewide limit on greenhouse gas (GHG) emissions to 1990 levels. Compliance will be nothing short of Herculean: California will have to reduce per capita energy usage in a manner that accommodates continued brisk population growth and protects the state's economy from economic dislocations and recessionary pressures.

The California Energy Commission (CEC) and California Public Utilities Commission (CPUC) point to California's historical record in saving energy (*see Figure 1*), coupled with its current stable per capita electricity use relative to the balance of the United States (*see Figure 2*), as proof that it is up to this formidable challenge: "Because of its energy efficiency standards and program investments, electricity use per person in California has remained relatively stable over the past 30 years, while nationwide electricity use has increased by almost 50 percent."[2]

The CEC and CPUC take credit for saving, on a cumulative statewide basis from 1975 to 2003, about 40,000 GWh, or the equivalent of 15 percent of annual electricity use, through a combination of utility EE programs and appliance and building standards (*see Figure 2*).[3] Figure 2 illustrates the trend in average per capita total consumption in California and the U.S. between 1960 and 2005.[4] Until the mid-1970s, total electricity use in California and the United States increased at about the same rate. After that, California's usage leveled off, while usage in the United States as a whole continued to increase.[5]

FIG. 1 CALIFORNIA CUMULATIVE GWH SAVINGS: UTILITY EE PROGRAMS AND BUILDING & APPLIANCE STANDARDS



California is Different

California's GHG-reduction policy appears in large part premised on the state already having achieved a strong and direct "cause and effect" between energy savings (utility EE programs and building and appliance standards) and energy consumption. As noted above, several documents highlight the role of EE savings in accounting for the different consumption trends evident in California and the rest of the United States.

When we started this project two years ago, we could find no studies that demonstrated the strength of the relationship between EE savings and consumption in California. Since then, some analyses have been undertaken, but, as yet, there has been no analysis that models consumption in California by looking at the specific contribution of changes in the level of EE savings to changes in consumption via multiple regression. Our own attempts to undertake such an analysis, while preliminary (and the best we felt it worthwhile to do given the limitations of the available data) showed that annual changes in the level of EE savings were not associated highly with changes in per capita electricity consumption. Even when many outliers were excluded, simple linear regression showed that the relationship

Cynthia Mitchell *is a principal with Energy Economics Inc., a utility consultancy providing energy efficiency resource-planning services. Email her at ckmitchell1-@sbcglobal.net.* ***Reuben Deumling*** *and* ***Gill Court*** *are associates with the firm.*

between these two variables was less than 20 percent. In addition, the EE savings variable was not significant within any of the multiple regression models. A major issue we encountered was that on a per capita basis, annual changes in the level of EE savings, were small in relation to the changes in annual electricity consumption. While fully controlling for all other factors that contribute to annual fluctuations in the level of electricity consumption may have allowed us to identify the role of EE savings, we were able to control only for about half of the annual variation in consumption and did not succeed in specifying the role of EE savings.[6]

While we have no doubt that EE programs have contributed to the relatively stable[7] pattern of per capita electricity consumption in California, we were interested to see whether there were other factors that distinguish California from the rest of the country that also should be taken into account when explaining the divergence in consumption. We found that California is different from the rest of the United States in several other aspects (*i.e.*, in addition to the scope of its EE programs) that could help account for some of the difference in consumption trends. These are: the price of residential electricity; climate; household size; housing mix; conservation ethic; and the structure of the economy.

In addition to savings from EE programs, building codes and appliance standards could help account for the different consumption trends evident in California and the rest of the United States over the past 30 years.

Electricity Prices: In California, as elsewhere, there is a predictable relationship between electricity prices and the annual variation in residential per capita electricity consumption. On an annual basis, increases in the price of residential electricity are associated with decreases in consumption (*see Figure 3*). For every one mil increase in the price of residential electricity in California, per capita consumption declines by about 6 kWh per capita.[8] The data points lie relatively well clustered about the line, with price changes explaining about 40 percent of the annual variability in per capita consumption. These findings are in keeping with the national data on residential energy prices and residential per capita consumption that we analyzed: Those states with higher energy prices have lower per capita consumption and vice versa (*see Figure 4*).[9]

Electricity prices in California are higher than those in the United States as a whole, and the difference in price has become more marked over the past thirty-five years. In 1970, the price of residential electricity in California was 0.0809 cents per kWh, only a little higher than the U.S. average of 0.0806 cents/kWh. By 2005, the price had risen by 37 percent in California, to 0.1109 cents/kWh. In the United States as a whole, however, it had risen by just 4 percent, with the 2005 price, at 0.0838 cents/kWh, substantially lower than in California.[10]

If there is a planetary imperative to

FIG. 2 PER CAPITA ELECTRICITY USE IN THE UNITED STATES AND CALIFORNIA: 1960-2005

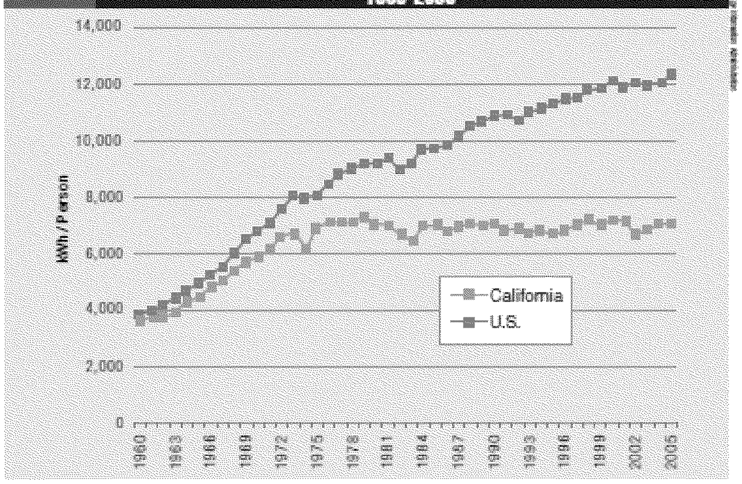
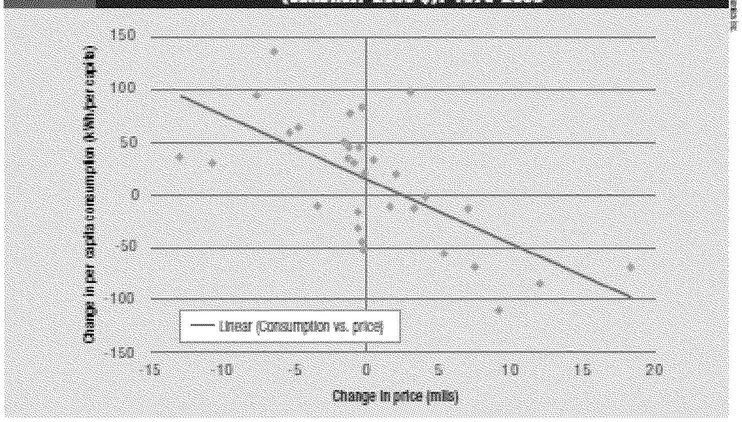


FIG. 3 CHANGE IN CALIFORNIA PER CAPITA RESIDENTIAL ELECTRICITY CONSUMPTION VS. CHANGE IN CALIFORNIA PRICE OF RESIDENTIAL ELECTRICITY (CONSTANT 2000 $): 1970-2005



6

SB_GT&S_0801845

reduce overall energy consumption, and California's marked departure in historical per capita consumption trend in relation to the balance of the United States is in large part, energy price induced, one might ask, why not just raise energy prices further? California energy policymakers and regulators discuss EE as the one component of the state's aggressive GHG-emissions reduction policy that will keep money in state and local economies, while all of the other GHG-reduction strategies will be expensive. In other words, California needs moderate energy prices to help keep the economy going.[11]

■ **Climate:** Not surprisingly, the weather also is a strong driver of per capita electricity use. We conducted an analysis of the relationship between the number of cooling degree days (CDDs) in California against per capita residential electricity consumption.[12] This analysis showed that years with higher numbers of CDDs, are associated with higher levels of per capita electricity consumption (*see Figure 5.*). This is in large part due to the electricity demands of air conditioners in years with warm summers.

> Changes in energy-efficiency savings were small compared to changes in California's electricity consumption.

FIG. 4 PER CAPITA RESIDENTIAL ELECTRICITY CONSUMPTION AND PRICE OF RESIDENTIAL ELECTRICITY: 2004 BY STATE

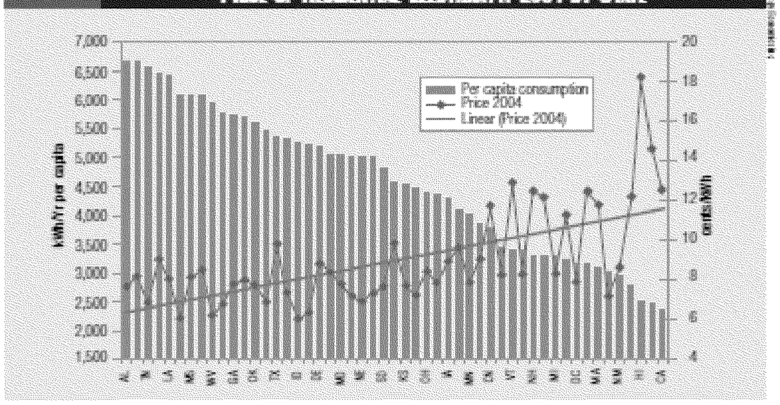
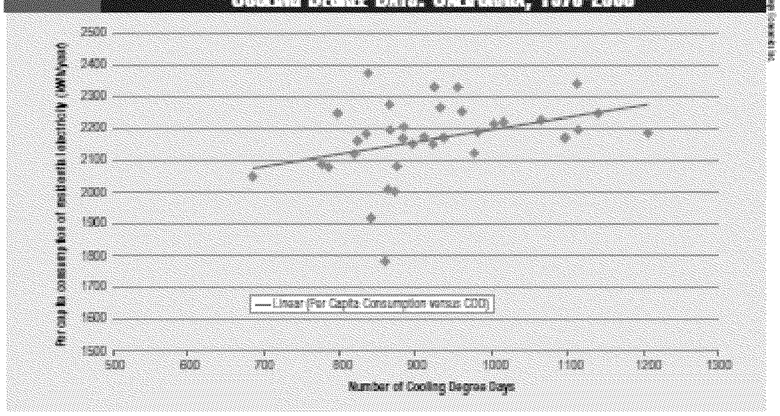


FIG. 5 PER CAPITA RESIDENTIAL ELECTRICITY USE VS. NUMBER OF COOLING DEGREE DAYS: CALIFORNIA, 1970-2005



We also found that California tends to experience fewer CDDs than the United States as a whole. The state's relatively moderate climate greatly affects the amount of residential electricity that is used for space cooling in the summer. Heating is less of an issue because of the dominance of gas heating in the state. A good summary measure of the difference between California and the United States as regards climate is the annual number of CDDs each experience. For the period between 1975 and 2005, California had an average of 932 CDDs annually. This is substantially less than the U.S. average of 1,274 CDDs, and represents an average difference of 342 CDDs, or 27 percent fewer.[13] While there is limited evidence of a divergence between California and the United States in terms of the number of CDDs over the past 30 years, it is likely that part of the reason for California's relatively low per capita residential electricity consumption is due to the state's lower average number of CDDs. California's relatively mild climate means that the demand for air conditioning is likely to have increased less than in the United States as a whole, despite the rising income levels in the state.

■ **Household Size:** In explaining the overall trend in consumption, we need to assess the impact of variables such as household size and housing mix. In California, use per household has increased more than electricity use per capita since the introduction of EE programs. California households are larger than average for the United States: In 2006, they contained an average of 2.93 persons compared to 2.61 persons in the United States as a whole.[14]

Household size is important because while each additional person in a household adds to household consumption, they do so by a declining amount.[15] Furthermore, in California, household size has increased since 1980, when there was an average of 2.68 persons per »

SB_GT&S_0801846

household. This is in contrast to the pattern in the United States as a whole, which has seen household size decline over the same period: In 1980 the average U.S. household size was 2.75, a little higher than for California, whereas by 2006 this figure had fallen to 2.61. Given that larger households consume less electricity per person than do smaller households, these trends in household size may have contributed to the divergence between California and the United States in terms of residential electricity consumption.[16]

California has become more highly urbanized with multi-family and attached housing accounting for 39 percent of total units.

■ **Housing Mix:** California has become more highly urbanized with multi-family and attached housing accounting for 39 percent of total units in 2000, compared to an average of 31 percent in the rest of the United States.[17] In addition, the state has diverged from the rest of the United States in this respect: Since 1970 the proportion of total units accounted for by multi-family and attached housing has increased in California (from 33 percent to 39 percent) whereas in the rest of the country it has remained stable. Housing mix is important to understanding per capita consumption of electricity because multi-family and attached housing units generally use less energy than detached structures due to the insulating effects of multiple units.

■ **California's Conservation Ethic:** While we found that annual changes in savings from EE programs do not well predict changes in per capita consumption of electricity in California, the state's focus on EE and conservation issues, along with the impact of price differentials, may have helped to create a "conservation ethic." Data from the 2001 Residential Energy Consumption Survey (RECS) show that California households are more likely than those in the United States overall to report that they lower their winter temperature settings when no one is at home or during sleeping hours. For example, almost 60 percent of California households reported lowering their winter temperature settings when no one is at home or during sleeping hours, compared to less than 45 percent of all U.S. households.[18] While this does not contribute significantly to reduced electricity usage, it is in keeping with other data that support the idea of a California "conservation ethic." For example, in California a smaller proportion of households report using electricity for heating water and cooking, and fewer households have electric dryers for clothing and a freezer separate from their refrigerator, than is the case nationally.[19] These findings likely reflect the state's efforts with regard to EE and the promotion of energy conservation.

Fig. 6 Re-ordered California Cumulative Energy GWh Savings: Utility EE Programs and Standards

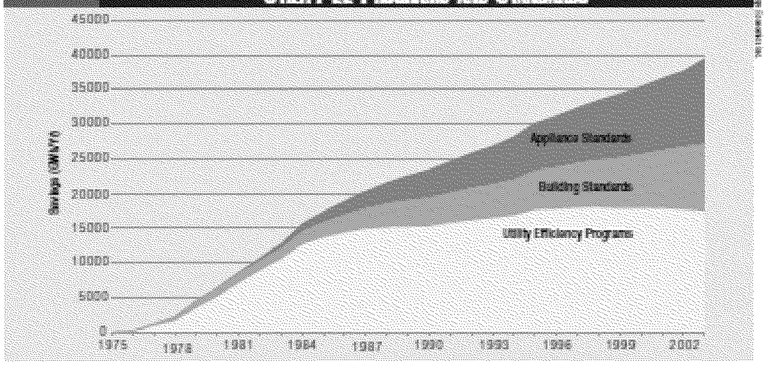
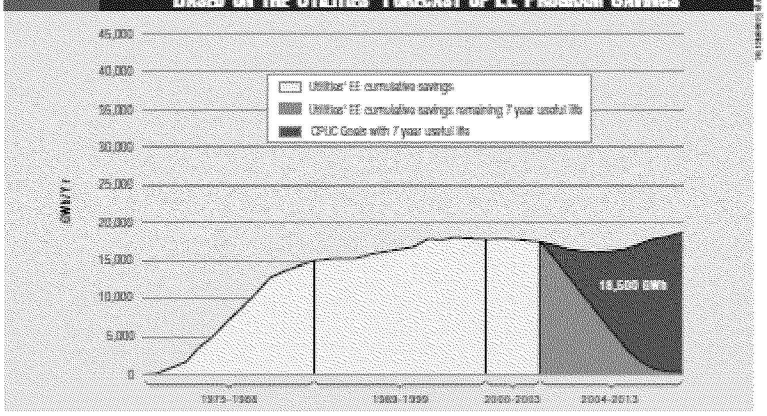


Fig. 7 Forecast of California Cumulative GWh Savings 2004-2013 Based on the Utilities' Forecast of EE Program Savings



Industrial Shift

One of the factors that can influence a state's consumption of energy is the type of industries that dominate the economy. The manufacturing sector is second only to transportation in terms of its share of total energy consumed nationally, and so can heavily influence » overall consumption levels. Thus, the mix of industries in California is likely to be a contributing factor to the state's relatively stable electricity consumption trend. Our analysis indicates that the manufacturing sector has contributed both to the relatively low levels of per capita consumption of electricity in California, and the divergence between trends in consumption in the state and those in the rest of the United States. The California manufacturing economy is more heavily dominated by non-energy-intensive industries than is the case nationally, and between 1990 and 2005, employment in energy-intensive industries declined more in California than was the case for the rest of the United States.

In California, energy-intensive manufacturing industries[20] accounted for about 20 percent of total manufacturing employment in 2005 compared to 26 percent in the rest of the United States.[21] In terms of trends over time, in California, energy-intensive manufacturing industries have shown greater reductions in employment than is the case for the rest of the United States. Between 1990 and 2005, employment in the groups of industries characterized by high energy use fell by 20 percent in California compared to 16 percent in the rest of the United States. This helps explain the divergence between California and the rest of the country in terms of overall energy consumption per capita. Trends within the primary metal industries provided additional evidence to suggest that employment in the specific industries that are particularly energy intensive declined to a greater extent in California than nationally. In California, the number of employees in the energy-intensive aluminum industry declined by 40 percent compared to 31 percent in the rest of the United States. Conversely, employment in the less energy-intensive pharmaceutical industry (a sub-industry within the chemicals group) grew more rapidly in California than nationally (by 81 percent compared to 34 percent). In addition, the energy intensity of one of California's most important industries, computer and electronic product manufacturing (which accounts for over one-fifth of both manufacturing employment and manufacturing value added in the state, compared to 10 percent nationally), has declined substantially over the past 20 years. Not only is this industry a relatively low user of energy, but its use of energy per $ value added also has declined.[22]

Energy-intensive industries in California have shown greater reductions in employment than in the rest of the United States.

This analysis indicates that the manufacturing sector has contributed both to the relatively low levels of per capita consumption of electricity in California and the divergence between trends in consumption in the state and those in the rest of the United States. The California manufacturing economy is more heavily dominated by non-energy intensive industries than is the case nationally, and between 1990 and 2005 employment in energy-intensive industries declined more in California than was the case for the rest of the United States.

Energy-Efficiency Savings

Interestingly, our per capita analysis provides additional insight to our earlier separate analysis concerning the utility EE program savings portion of California's cumulative energy savings (*see Figure 2*).[23] If utility program EE savings are most likely less robust than historically characterized, then it makes sense that California's historical EE savings (*see Figure 1*) cannot fully account for California's per capita consumption (*see Figure 2*).

Since the late 1980s, California's utility EE programs have contributed to only a modest growth in new or incremental savings;[24] building and appliance standards apparently register the lion's share of continued EE savings growth.[25] This is illustrated per Figure 6, which reorders or restacks the CEC's estimate of California's historical cumulative EE savings shown in Figure 1, so that the utility EE program savings are layered in first, followed by building and appliance standard savings.[26]

This is in part because the utilities have relied on EE measures that are short-lived, such as compact fluorescent lamps, (or CFLs). In essence what this means is the California utilities are treading water when it comes to growing cumulative long-term EE savings.[27]

The historical California utility EE program savings data used by the CEC in its DSM forecasting model is as reported by the utilities on an *ex ante* basis—or prior to measurement and verification. Recent preliminary independent analysis of the California utilities' 2006 and 2007 reported EE accomplishments indicate the utilities' claimed savings to be off or high by a significant amount.[28]

Not until 1989 were utility-reported savings adjusted for free ridership or net-to-gross (NTG) ratios. In response to the possible argument that via spillover (or "free drivers"), the California utilities have caused much greater levels of EE than reflected in Figure 1, it is important to note two important facts: The current NTG ratios were in fact derived by the California utilities; and the current NTG values include the effects of free ridership and both participant » and nonparticipant spillover.[29]

From 1989 through 1999, some billing analysis also was used to adjust reported savings on an *ex post* basis. Since that time, the EE savings data has reverted to utility-reported *ex ante* savings. Also, for the first decade of run-up in claimed EE savings from zero to close to 15,000 GWh, the utility EE programs largely were home audits and education and information programs, with the first cash rebate given in 1982. Thus, to represent those EE savings as equivalent "steel in the ground" supply-side resources is extremely far-fetched. Further, about 10 percent of the generation and capacity savings are ascribed to utility T&D conservation voltage reduction implemented from 1975 through 1980. Such utility-system efficiency savings, while beneficial, are not generally classified as consumer EE.

If the current trend continues (from 2006 through 2008) in utility EE savings as forecasted by the utilities, there will be little if any new or incremental utility EE savings towards the CPUC's aggressive EE saving targets. That trend can be seen in the forecast of California's cumulative utility EE program savings from 2004 to 2013, based on PG&E, SCE, and SDG&E's forecast of 2006 through 2008 EE portfolio savings (*see Figure 7*).[30] To develop this forecast, a weighted average EE measure (energy useful life) EUL of 7.1 years was used, calculated from the IOUs' forecasts of the mix of EE measures in their 2006 through 2008 EE portfolios. By 2013 there will be little if any gains in new or incremental GWh savings.[31] *(See Fig. 7)*

Restarting Growth

Over the past 20 years, there has been a strong divergence between California and the United States with regard to per capita electricity consumption. This divergence has been attributed to California's ambitious and far-reaching EE programs and standards. However, this school of thought fails to address the fact that California is different from the rest of the United States in multiple respects—many of which influence electricity consumption. To isolate one particular difference between California and the United States (EE savings) and attribute the divergence in per capita use to this one factor, is likely to overstate the impact or import of that variable. While EE programs and standards undoubtedly have contributed to the relatively stable pattern of per capita electricity consumption in California, our analysis found a relatively weak association between California's EE savings and per capita consumption. Rather, these savings have been achieved within a specific socioeconomic context that also acted on electricity consumption trends.

A number of factors distinguish California from the rest of the United States, and may have contributed to keeping the state's electricity consumption relatively stable. Understanding the role of these factors, as well as savings from EE programs and standards, will allow for a better assessment of the extent to which the California model successfully can be transplanted to other states, regions, or countries. Although the California model may offer lessons for other states or countries, its applicability to meeting global warming targets is limited at best, since what's necessary are sustained absolute reductions in energy consumption, something not observed in the state of California as a whole or anywhere else.

Slow growth in California's per capita electricity consumption over the past several decades combined with population growth equals significant (~2 percent p.a.) growth in total electricity consumption for the state. This is the variable that must be tracked—and reversed. ◼

Endnotes

1. California's Energy Action Plan II adopted in 2005 by the California Public Utilities Commission (CPUC) and California Energy Commission (CEC) established a "loading order" of preferred resources—placing EE as the state's top priority procurement resource—and set aggressive long-term goals for EE. See CPUC and CEC, *Energy Action Plan II, October, 2005.* Available at: *http://docs.cpuc.ca.gov/word_pdf/REPORT/51604.pdf.*
2. CPUC and CEC, *Energy Efficiency: California's Highest Priority Resource - Lowering Energy Costs, Promoting Growth, and Protecting the Environment,* August 2006. Available at: *www.epa.gov/cleanenergy/documents/calif_cleanenergy.pdf.* See also the CEC's 2007 Integrated Energy Policy Report (IEPR), Executive Summary, p. 2:

   "Largely as a result of these [energy efficiency] policies, California has the lowest electricity use per person in the nation. While the United States has increased by nearly 50 percent over the past 30 years, California's per capita electricity use remained almost flat, demonstrating the success of a variety of cutting-edge energy efficiency programs and cost-effective building and appliance efficiency standards." (emphasis added).

   CEC, *Integrated Energy Policy Report,* CEC-100-2007-008-CMF-ES, December, 2007. Available at:*http://www.energy.ca.gov/2007publications/CEC-100-2007-008/CEC-100-2007-008-CMF-ES.PDF.* Further, see CPUC and CEC, *Energy Action Plan: 2008 Update,* February, 2008, Available at: *http://www.cpuc.ca.gov/NR/rdonlyres/58ADCD6A-7FE6-4B32-8C70-7C85CB31EBE7/0/2008_EAP_UPDATE.PDF,* February 2008.

   "Below we have included one of California's famous graphics of success in energy efficiency. As Figure 3 indicates *(U.S. v. California Per Capita Electricity Sales),* electricity use per person in California has remained relatively stable over the past 30 years, while nationwide electricity use has increased by about 50 percent.

   While this stabilization of per capita electricity use is something we are proud of, it is not nearly enough to meet our AB 32 goals. To address this emissions reduction challenge for electricity, we will need to bend this curve downward, because, among other reasons, the population of California continues to grow rapidly, causing overall electricity use in the state to continue to rise by between one and two percent every year." (emphasis added) p.7.
3. Data supplied by CEC.
4. See Figure 1 in CPUC and CEC, *Energy Efficiency: California's Highest Priority Resource - Lowering Energy Costs, Promoting Growth, and Protecting the Environment,* August 2006. Available at: *www.epa.gov/cleanenergy/documents/calif_cleanenergy.pdf.*
5. Figure 2 reflects total per capita consumption, which includes, or has embedded in it, economic structural changes over time. To isolate this effect on per capita consumption from EE savings, in our statistical analysis to the extent data was available ,we utilized residential per capita »

consumption and residential savings.

6. See Mitchell, Cynthia, Reuben Deumling and Gill Court, "Is Energy Efficiency Enough? An Exploration of California Per Capita Electricity Consumption Trends," presented at ACEEE Summer Study on Energy Efficiency in Buildings, August 17-22, 2008, *http://www.aceee.org/conf.*
7. It is important to note that a relatively stable pattern of per capita electricity consumption in this case translates into a moderate but still exponential growth in total residential electricity consumption of an average 2.1 percent per year between 1985 and 2007 (residential account data for PG&E, SCE, and SDGE supplied by the CEC). Such observed growth, though it may be slower than in the majority of other states, is nevertheless antithetical to the state's global warming goals.
8. Energy Information Administration, *State Energy Consumption, Price and Expenditure Estimates*, various years, available at: *http://www.eia.doe.gov/emeu/states/_seds.html*; Energy Information Administration, *State Energy Data 2004*, Appendix C: Resident Population, Tables C1-C5; and Energy Information Administration, *Annual Energy Review*, Appendix D1: Population, U.S. Gross Domestic Product, and Implicit Price Deflator, available at: *http://www.eia.doe.gov/emeu/aer/append_d.html.*
9. *Id.* A simple linear regression of 2004 per capita residential electricity consumption against the 2004 price of residential electricity by state indicated that 45 percent of the variability in consumption could be accounted for by the price variable.
10. All prices in constant 2000 $.
11. See page 3, heading "Supports Economic Development and Creates Jobs in California," in CPUC and CEC, *Energy Efficiency: California's Highest Priority Resource - Lowering Energy Costs, Promoting Growth, and Protecting the Environment*, supra note 2.
12. Energy Information Administration, *Electricity Consumption Estimates by Sector*, various years; Energy Information Administration, *State Energy Data 2004*, Appendix C: Resident Population, Tables C1-C5 Source; and National Climatic Data Center. A cooling degree day (CDD) indicates how heavy the air conditioning needs are under certain weather conditions. One CDD is accumulated for each degree the average temperature for a day is over 65 degrees F (see *http://www.energy.ca.gov/glossary/glossary-c.html and http://www.weather2000.com/dd_glossary.html*). A simple linear regression of California per capita consumption of residential electricity against the number of CDDs for the years 1970-2005 showed that the CDD variable "explained" almost 15 percent of the variability in the per capita consumption variable.
13. Data from the National Climatic Data Center.
14. 1970 data supplied by Reuben Deumling, Energy & Resources Group, UC Berkeley; 2006 data from U.S. Census Bureau, American Community Survey, 2006.
15. See William B. Marcus, Gregory Ruszovan, and Jeffrey A. Nahigian, *Economic and Demographic Factors Affecting California's Residential Energy Use*, (West Sacramento, Calif.: JBS Energy, Inc., 2002), Figure 3.
16. This is not simply because larger households have larger houses. A recent study has found that larger houses have higher energy consumption not because there are more people in them but because the people in them consume proportionately more energy than people living in smaller houses. That is, electricity use per household member increases with the size of the house. See Mithra Moezzi and Rick Diamond. *Is Efficiency Enough? Towards a New Framework for Carbon Savings in the California Residential Sector*. CEC, PIER Energy-Related Environmental Research. CEC-500-2005-162.
17. U.S. Historical Census of Housing Tables – Units in Structure, available at: *http://www.census.gov/hhes/www/housing/census/historic/units.html.*
18. Energy Information Administration, *Residential Energy Consumption Survey, Table HC6-7a: Usage Indicators by Four Most Populated States, 2001*. Available at: *http://www.eia.doe.gov/emeu/recs/recs2001/hc_pdf/usage/hc6-7a_4popstates 2001.pdf.*
19. Energy Information Administration, *Residential Energy Consumption Survey 1997, Table HC5-7a: Appliances by Four Most Populated States*. Available at: *ftp://ftp.eia.doe.gov/pub/consumption/residential/four_states/appl_4states.pdf*; Energy Information Administration; *Residential Energy Consumption Survey 2001, Table CE4-7c: Water-Heating Energy Consumption in U.S. Households by Four Most Populated States. http://www.eia.doe.gov/emeu/recs/recs2001_ce/ce4-7c_4popstates2001.html.*
20. These include the following industries: nonmetallic minerals, primary metals, food, paper, petroleum and coal, and chemicals. See Energy Information Administration, *Annual Energy Outlook 2007*.
21. *Current Employment Statistics Survey* – various years, Bureau of Labor Statistics. Available at *http://data.bls.gov*. These data exclude the pharmaceutical industry, which in contrast to "bulk chemical" manufacturing, is not energy intensive. Pharmaceuticals dominate in California, accounting for over 50 percent of employment in the chemical industry in 2005 compared to 31 percent in the rest of the United States.
22. U.S. Department of Energy, *Indicators of Energy Intensity in the U.S.: Industrial Sector Data*. Available at: *http://intensityindicators.pnl.gov/trend_data.stm.*
23. Work of Energy Economics Inc. as consultant to TURN in R.06-04-010 during 2[nd] and 3[rd] quarters 2007. *http://www.cpuc.ca.gov/Published/proceedings/R0604010_doc.htm*. Energy Economics Inc. per capita analysis separate and apart from the TURN work.
24. It is important to point out that "a modest growth in [energy] savings" is not the same thing as "an absolute reduction in energy consumption," although this often is implied. The only outcome commensurate with California's global warming policies is unambiguous and sustained declines in total energy/electricity consumption. Slight variations in the positive rate of growth are still movement in the opposite direction of that now mandated.
25. The characterization of California's historical building and appliance standard EE savings is an entirely separate matter worthy of additional detailed analysis, given the fact that the savings are highly dependent on assumed levels of compliance rates. The CEC DSM Forecast assumes relatively high levels of building and appliance standards compliance. The May 2007 "Statewide Codes and Standards Market Adoption and Noncompliance Rates," *Final Report*, CPUC Program No. 1134-04 SCE0224.01 by Quantec Consulting found very high noncompliance rates for residential building measures updated per California's Title 24 standard. *http://www.calmac.org/*. Appliance standard compliance rates are easier to estimate because: (1) appliance standards set dates for changes in appliance manufacturing and stocking; and (2) appliance turnover rates can be tracked through retail sales data (with additional consideration needed on whether the replaced appliance enters a secondary market).
26. Data supplied by CEC.
27. *http://docs.cpuc.ca.gov/Published/proceedings/R060410.htm, Decision 07-10-032*, Oct. 18, 2007, Commission Discussion, page 21: "TURN [The Utility Reform Network] correctly notes that an emphasis on measures with savings that decay quickly creates a 'treading water effect' whereby the measures are replaced in the next portfolio cycle with little development towards sustainability programs that do not require continual reinvestments of ratepayer funds."
28. *http://www.cpuc.ca.gov/PUC/energy/electric/Energy+Efficiency/EM+and+V/081117_Verification+Report.htm*, CPUC EE 2006-2007, Verification Report Review Draft prepared by Energy Division Feb. 5, 2009. The California utilities (Pacific Gas & Electric, Southern California Edison, San Diego Gas and Electric, and Southern California Gas) reported 2006 and 2007 EE accomplishments that collectively the utilities had achieved almost 130 percent of the CPUC's electric goal and over 110 percent of the CPUC's gas goal. In contrast, the CPUC's Energy Division Staff has reached a significantly different conclusion on California IOUs' 2006 and 2007 EE accomplishments. Per the CPUC's utility incentive mechanism based on a sharing between ratepayers and shareholders of the net benefits, the California IOUs claimed they were due a shareholder incentive of $236 million. Per the Energy Division's February 5, 2009 *Interim Claim Report*, the California IOUs are collectively at only 78% percent of the CPUC's combined electric and natural ››

gas goals. On an individual basis, the thee electrics are entitled to zero shareholder incentives, with SoCalGas entitled to $2.89 million. *www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/EM+and+V/081117_Verification+Report.htm*. CPUC *Decision 08-12-059* dated Dec. 18, 2008 authorized interim payments based on utility submitted performance reports subject to a 65 percent holdback pending the results of Energy Division's ex post measurement and verification results. *http://docs.cpuc.ca.gov/Published/proceedings/R0604010.htm*.

29. See Program Elements Attachment A: PG&E, SCE, SDG&E, SCG, Sept. 22, 2000; and CALMAC Public Workshops on PY 2001 EE Programs: Day 1 & 2, Sept. 12 and 13, 2000, Day 3 & 4, Sept. 19 and 20, 2000. California Measurement Advisory Council (CALMAC) Workshop Report 9/25/2000 Proposed NTG Ratios for PY2001. *http://www.calmac.org*.

30. Analysis of savings data supplied by the CEC and savings goals data in CPUC, *Interim Opinion: Energy Savings Goals for Program Year 2006 and Beyond, Decision 04-09-060*, Sept. 29, 2004, Table 1E. Available at: *http://docs.cpuc.ca.gov/WORD_PDF/FINAL_DECISION/40212.PDF*

31. The utilities forecast of savings as shown in Figure 7 is more robust than the CPUC's Energy Division Staff November 2008 *Interim Claim Report* noted above in endnote 27.

ATTACHMENT 2:

Electricity Consumption Trends: California and the Rest of the U.S.

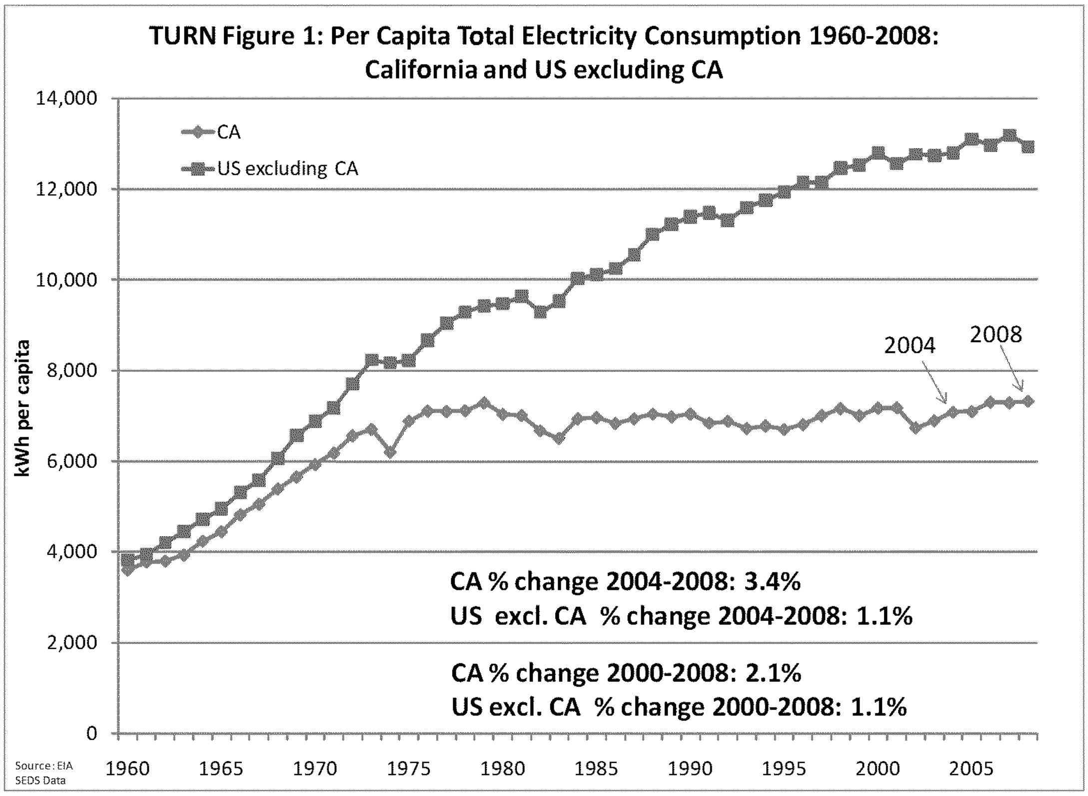
Figures 1 to 4 below show the per capita and absolute change in residential and total electricity consumption between 1960 and 2008 (California and the rest of the U.S.), as well as the reductions in consumption that are consistent with meeting AB32 targets.

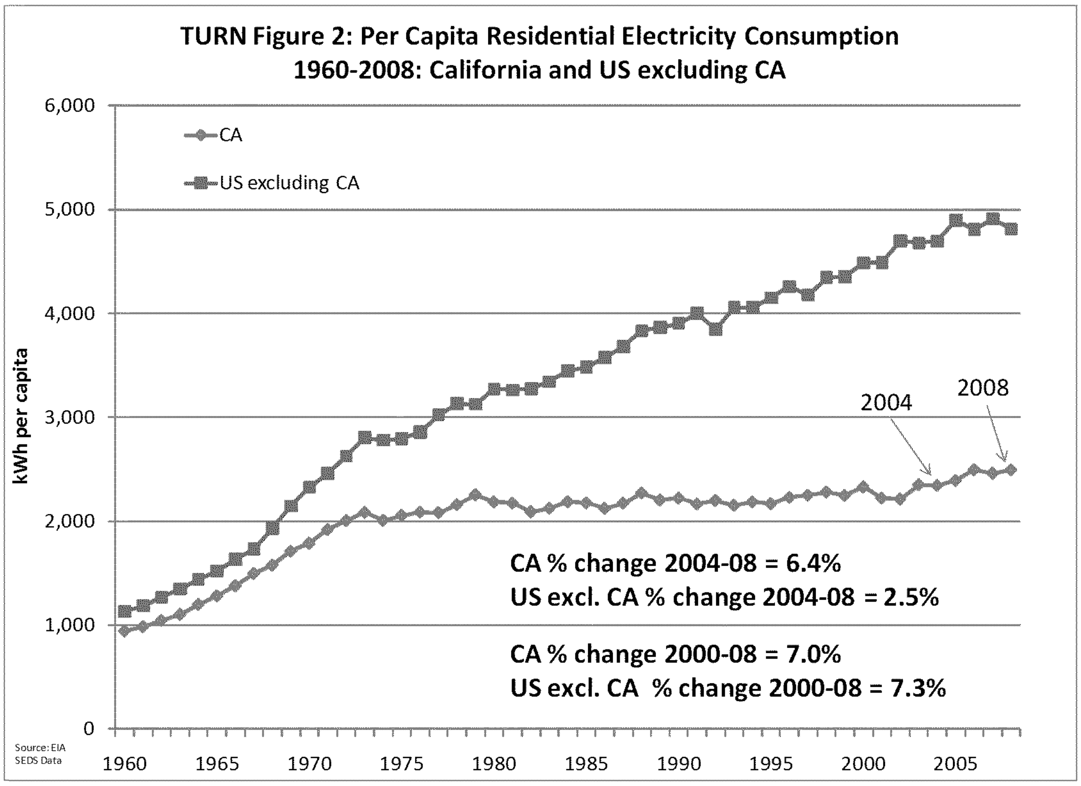
Figure 1 shows total electricity consumption per capita. California and the rest of the U.S. followed divergent paths from the 1970s to the beginning of the twentieth century, with California consumption leveling off while the rest of the U.S. continued to increase its per capita electricity use. More recently, however, the rest of the U.S. has slowed its rate of increase in consumption. A similar pattern is evident in Figure 2, which focuses on trends in the residential sector only. In both cases the rest of the U.S. has actually experienced less of an increase in per capita electricity use over the last several years than California:

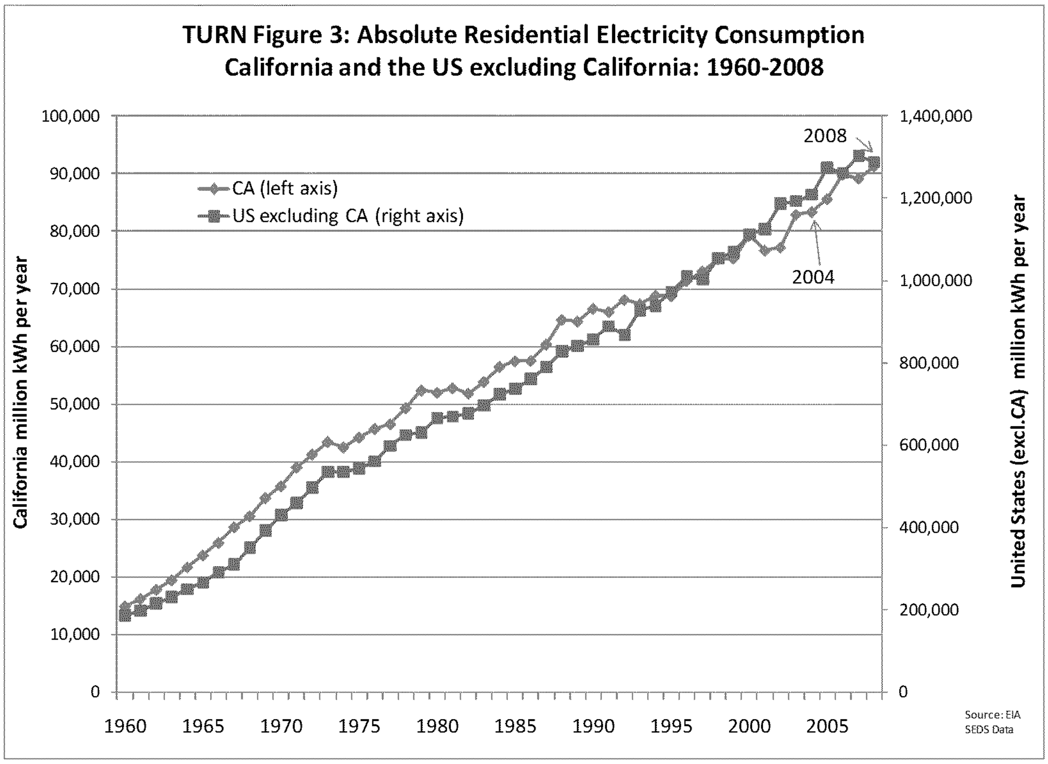
- For total electricity, per capita consumption increased by 3.4 per cent in California between 2004 and 2008, compared with 1.1 per cent in the rest of the U.S. A similar pattern is evident for the 2000-2008 period, during which California recorded an increase of 2.1 per cent compared to 1.1 per cent in the rest of the U.S.
- For the residential sector, per capita consumption grew by 6.4 per cent in California between 2004 and 2008 and 2.5 per cent in the rest of the U.S. Over the longer 2000-2008 period, both California and the rest of the U.S experienced a similar rate of increase (7 per cent).

There has been considerable debate about the causes of California's relatively flat per capita electricity consumption curve in the context of steadily increasing usage in the rest of the U.S. While it is tempting to assume that the difference is due to California's history of energy efficiency, closer inspection reveals a number of other factors that have contributed to the trends in Figures 1 and 2. The issue was addressed in a study conducted by Energy Economics Inc. and published in Public Utilities Fortnightly March 2009, "Stabilizing California's Demand: The Real Reasons Behind the State's Energy Savings". The article illustrates the difficulty of establishing a strong direct "cause and effect" between energy (utility EE programs and building and appliance standards) and energy consumption, and points to a number of other factors that both distinguish California from the rest of the U.S. and which act to reduce the demand for electricity in the state. One of these is the price of electricity; the Energy Economics, Inc. study found a strong correlation between changes in California per capita residential electricity consumption and changes in the price of residential electricity in the state. The study also identified a number of other differences between California and the rest of the U.S. that could help explain the state's history of relatively low per capita electricity use, including climate, the rising share of multi-family housing, increasing household size, behavior suggestive of a "conservation ethic" and, beyond the residential sector, the structure of the economy and trends in energy usage within dominant industries.

Turning now to absolute consumption, rather than usage per capita, Figure 3 shows that both California and the rest of the U.S. have seen steady increases in residential electricity consumption. Although California has kept per capita consumption relatively stable over the past 40 years, population growth has meant that absolute electricity use has continued to rise. Figure 3 also shows that the EE programs of the 2004-2008 period did little to address the steady increase in residential electricity consumption within California. Figure 4 shows that if the state is to meet its AB32 GHG reduction targets, this upward trend will have to reverse direction: California will have to reduce electricity usage in absolute terms and bend down the consumption curve.

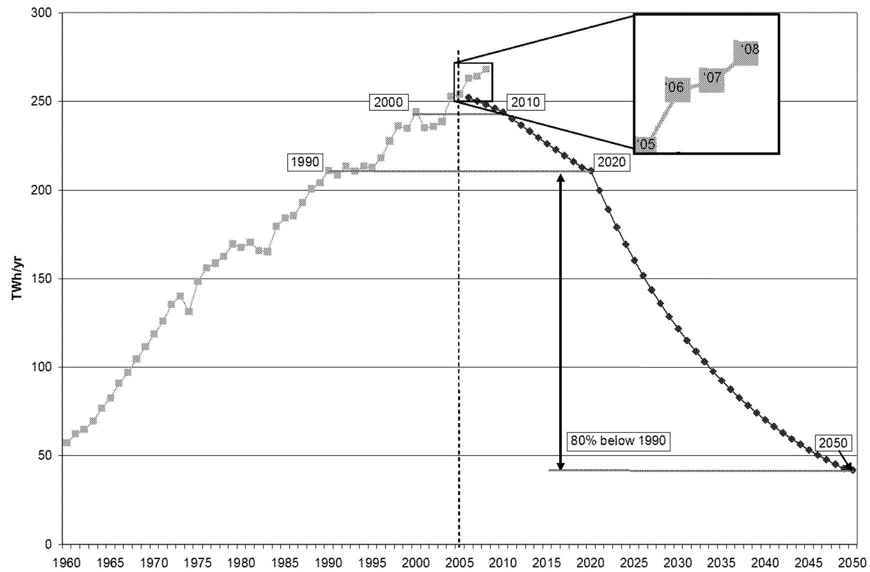

TURN Figure 1: Per Capita Total Electricity Consumption 1960-2008:
California and US excluding CA
CA
US excluding CA
kWh per capita
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2004
2008
CA % change 2004-2008: 3.4%
US excl. CA % change 2004-2008: 1.1%
CA % change 2000-2008: 2.1%
US excl. CA % change 2000-2008: 1.1%
Source: EIA SEDS Data
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005


TURN Figure 2: Per Capita Residential Electricity Consumption
1960-2008: California and US excluding CA
CA
US excluding CA
kWh per capita
6,000
5,000
4,000
3,000
2,000
1,000
0
2004
2008
CA % change 2004-08 = 6.4%
US excl. CA % change 2004-08 = 2.5%
CA % change 2000-08 = 7.0%
US excl. CA % change 2000-08 = 7.3%
Source: EIA SEDS Data
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005



TURN Figure 4

Total CA electricity consumption 1960-2005 & an AB32*-derived trajectory through 2050



Data Source: EIA Electric Power Annual <http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html>

* Executive Order S-03-05 stipulates the 2020 & 2050 targets

Source: Reuben Deumling, Associate Energy Economics Inc. *Separating Means and End: Reorienting Energy Efficiency Programs and Policy Toward Reducing Energy Consumption in California*