San Diego County Greenhouse Gas Inventory

An Analysis of Regional Emissions and Strategies to Achieve AB 32 Targets

Natural Gas End-use Report

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For an electronic copy of this report and the full documentation of the San Diego Greenhouse Gas Inventory project, go to www.sandiego.edu/epic/ghginventory.

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1. Introduction

Natural gas consumption other than that used for electricity production is a significant source of greenhouse gas emissions (GHG).[1] In San Diego County, emissions from natural gas end uses, such as space and water heating, account for about 9% of regional GHG emissions. This report, a component of the San Diego County Greenhouse Gas Inventory project, provides an estimate of historical GHG emissions associated with natural gas end uses from 1990 to 2006 and future emissions to 2020 for San Diego County. Using emissions reduction targets codified in California's Global Warming Solutions Act of 2006 (AB 32) as a guide, this report also establishes emissions reductions targets for the region's electricity sector. Although AB 32 does not require individual sectors or jurisdictions (e.g., cities and counties) to reduce emissions by a specific amount, the project team calculated the theoretical emissions reductions necessary in each emissions category (e.g., transportation, electricity, etc.) for San Diego County to reduce emissions to 1990 levels by 2020 – the statewide statutory target under AB 32. Finally, the report identifies and quantifies potential emissions reduction strategies to determine the feasibility of reducing electricity-related emissions to 1990 levels by 2020.

This report, which is intended as an overview of the findings from research and analysis conducted for the natural gas end-use category, includes the following sections.

- Section 2 provides an overview of GHG emissions for natural gas end-use in San Diego County, including total emissions, a breakdown of emissions by subcategory (residential, commercial, etc.), a summary of the highest emitting commercial building types and activities, projections to 2020, and reduction targets.

- Section 3 discusses the strategies necessary to reduce natural gas end-use related emissions to 1990 levels by 2020.

- Section 4 provides a detailed discussion of the method used to estimate emissions for this category.

1.1. Key Findings for the Natural Gas End Uses Sector

The key findings of the report are summarized below.

- In 2006, greenhouse gas (GHG) emissions from natural gas end-use consumption were 3 MMT CO_2E, slightly lower than 1990 levels. This is due mainly to a significant decline in industrial consumption and basically flat residential consumption during this period.

- On the basis of a business-as-usual projection, emissions from natural gas end-use consumption are expected to increase by 0.6 MMT CO_2E (22%) between 2006 and 2020.

- To meet AB 32 reduction targets (1990 levels by 2020), emissions from natural gas end-uses will have to be reduced by 0.6 MMT CO_2E (16%) below projected 2020 levels.

- On average between 1990 and 2006, the residential sector accounted for 60% of total natural gas end-use consumption.

- It appears that it will be difficult to reduce emissions from natural gas consumption to 1990 levels by 2020 to reach AB 32 targets, though significant reductions are possible.

2. Emissions from Natural Gas End Uses

Combustion of natural gas results in release of greenhouse gases (GHG) into the atmosphere. Natural gas consumption for purposes other than electricity production is a relatively small, but still significant contributor to greenhouse gas emissions in San Diego County. In the county, natural gas end uses, including commercial, industrial, and residential consumption, represent 9% of total GHG emissions.[2] This sector ranks third in total regional emissions. Figure 1 shows the relative contributions of all categories to the region's GHG emissions.

Greenhouse gas emissions from natural gas end-use consumption were nearly 3 MMT CO_2E in 2006, essentially equal to consumption levels in 1990. This flat trend is due in part to a significant reduction and then leveling off of natural gas consumption in the industrial sector as well as limited growth in residential consumption. On the basis of available data, GHG emissions from natural gas end uses exceeded 1990 levels for the first time in 2007 and are expected to reach 4 MMT CO_2E by 2020, an increase of 22% above 2006 levels. Figure 2 presents historical and future projected trends in GHG emissions from the natural gas end-use category.

Figure 3 presents a comparison of population and emissions from natural gas, indexing both to 1990 levels. The data show that natural gas consumption has remained basically flat on average as regional population has increased by 18% since 1990.

Figure 1. San Diego County GHG Emissions by Category (2006)

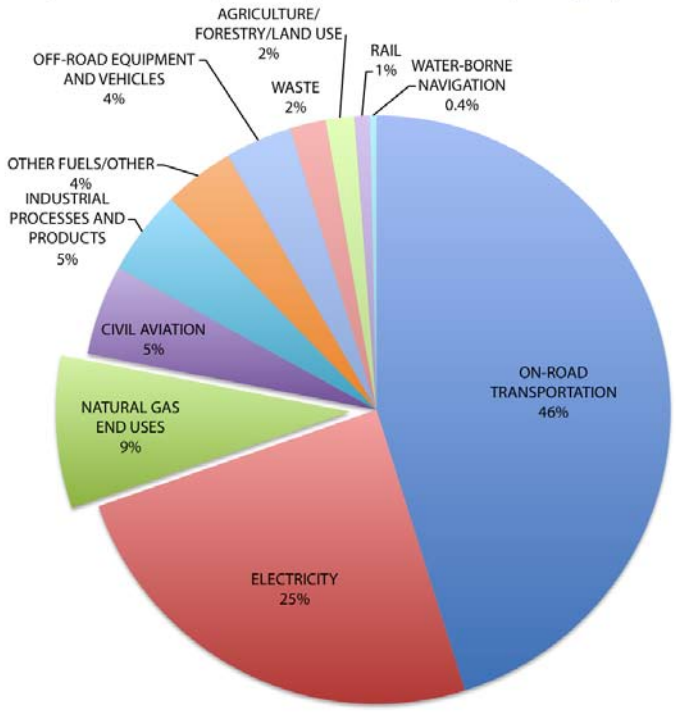


Figure 2. Emissions From Natural Gas End Uses San Diego County

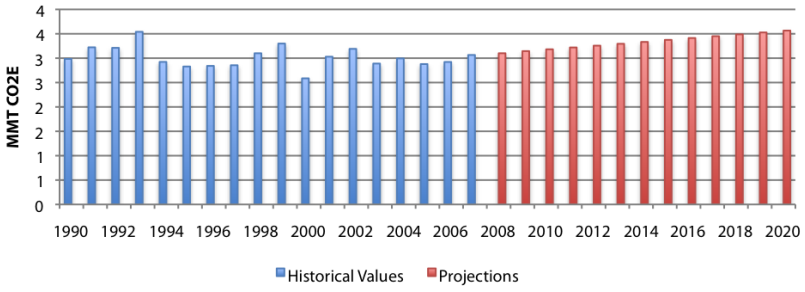
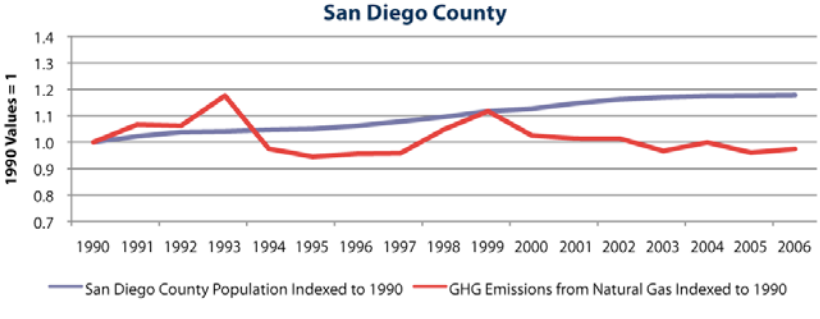
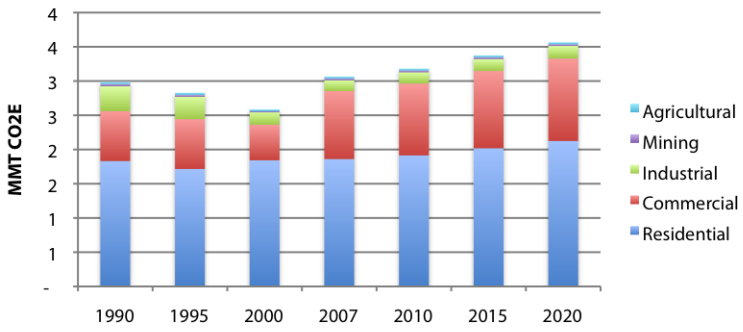


Figure 3. Population and Natural Gas Emissions San Diego County



Emissions from natural gas use correlate to consumption, since emissions estimates are derived directly from fuel use. The residential sector is the largest consumer of natural gas in the region, accounting for about 60% of total consumption and therefore GHG emissions from this category. Within the residential sector the largest uses of natural gas are space heating, water heating, clothes dryers, stoves and ovens, and pool heating.[3] Figure 4 shows historical GHG emissions from natural gas end-use consumption through 2007 and projected consumption through 2020 by sector.[4,5]

Figure 4. GHG Emissions from Natural Gas End Use in San Diego County [6]



Commercial customers account for about 25% of total natural gas consumption and a commensurate level of GHG emissions in the region. Within the commercial sector, buildings consume approximately 30% of total natural gas. Figure 5 shows the natural gas consumption levels for commercial building types in 2006. Industrial end uses account for only about 5% of total natural gas consumption in San Diego County. Figure 6 shows the industrial categories consuming the most natural gas in 2006.

Figure 5. Natural Gas Consumption by Building Type in San Diego County (2006)

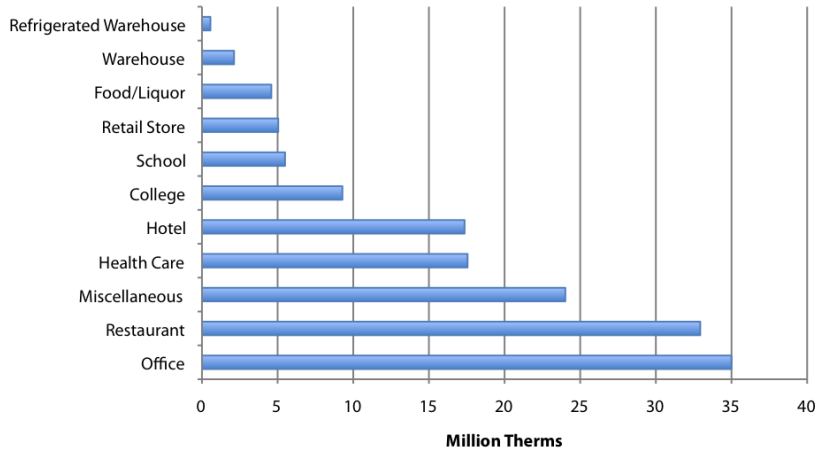
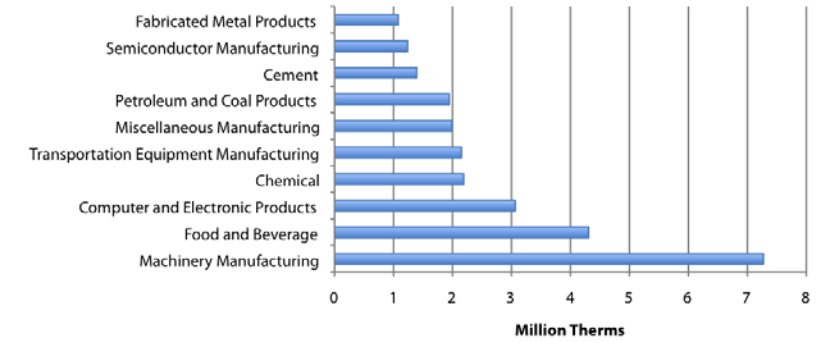


Figure 6. Natural Gas Consumption by Industrial Use in San Diegon County (2006)

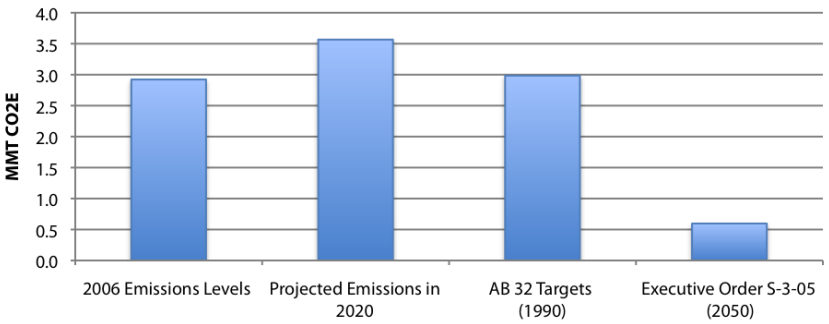


2.1. Emissions Reduction Targets

In 2006, California Governor Arnold Schwarzenegger signed the Global Warming Solutions Act (AB 32), establishing statutory limits on greenhouse gas emissions in California. AB 32 seeks to reduce statewide GHG emissions to 1990 levels by the year 2020. Even though AB 32 does not specify reduction targets for specific emissions categories or jurisdictions, this study team calculated theoretical reductions targets as if the statewide statutory emissions reductions targets applied pro rata to San Diego County. This calculation included the necessary reductions for each emissions category, including natural gas. As demonstrated above, emissions

today are slightly lower than they were in 1990; however, projected growth in natural gas consumption will raise greenhouse emissions rates above 1990 levels. To reach the AB 32 targets, emissions from natural gas end use will have to be decreased by 0.6 MMT CO_2E (16%) below the business-as-usual 2020 projected level of emissions.

Figure 7. Hypothetical Emissions Reduction Targets for Natural Gas End Use in San Diego County



In 2005, Governor Schwarzenegger signed Executive Order S-3-05, which establishes long-term targets for GHG emissions reductions. It seeks to reduce emissions levels 80% below 1990 levels by 2050. While this reduction target is not law, it is generally accepted as the long-term target toward which California regulations are aiming. Emissions will have to be reduced by 3 MMT CO_2E (83%) below projected 2020 levels. Figure 7 depicts the theoretical emissions reduction targets for natural gas end-use consumption.

2.2. Emissions Reduction Strategies for Natural Gas End Uses (Wedges)

California has been a leader in energy efficiency since the 1970s. California's building and appliance standards are among the most aggressive in the nation, and historically the state has had effective energy efficiency programs funded by a public benefits charge paid by all utility customers. Per-capita energy consumption in California has remained relatively flat over the past three decades owing in large part to these standards and programs. Reducing overall consumption and demand for electricity is a key component in the state's overall energy infrastructure planning, policy contained in the Energy Action Plan's loading order, which emphasizes energy efficiency as preferential resource.[7] Similarly, efficiency is also a preferential method to reduce greenhouse gases.

Unlike other sectors, the only driver of emissions for the natural gas end-use sector is total consumption; therefore, the only method to reduce emissions is to reduce overall consumption. To meet the theoretical AB 32 targets by 2020 for this category, a 0.6 MMT CO_2E (16%) reduction in total end use consumption is needed. Determining the amount of natural gas consumption that can be reduced by 2020 is complex, and no single policy exists to achieve such a goal; rather, a combination of existing rules and regulations are evolving to contribute to significant reductions statewide. It is also possible that future legislation will initiate regulatory changes to accelerate efficiency. The project team considered these factors when determining the possibilities for reasonable natural gas reductions by 2020.

Energy efficiency programs funded by the customers of electric and natural gas utilities are a significant factor. The California Public Utilities Commission (CPUC) has regulatory jurisdiction over investor-owned utility expenditures for energy efficiency.[8] An ongoing proceeding is considering the potential for long-term savings from these so-called public goods charge energy efficiency programs. Itron, Inc., has conducted a detailed analysis of this potential for this proceeding.[9] Initial results for the SDG&E service area suggest a potential for natural gas reductions ranging from a base case of approximately 3% to a midrange case of 8% of projected total energy supply by 2020.[10] Itron's base-case estimate assumes that future incentive levels are exactly what they were in 2006. Their midrange estimate assumes that incentives are set halfway between 2006 levels and the full incremental cost of an efficiency measure. Itron also included a high-range estimate, which assumes that the incentive level will be equal to the full incremental cost. Because this level of incentive is not likely to occur, the high-range scenario was not considered here.

The natural gas reduction estimates in the Itron study include savings from energy efficiency programs and from naturally occurring savings, those that would have occurred even without incentives, rebates, and other program activities. The estimate does not include savings from large industrial customers, of which the San Diego region has few, or new appliance and building standards, both of which would have a significant impact on energy use. Table 1 shows Itron's estimated natural gas savings potential for the SDG&E service territory.[11] The table includes the percentage of natural gas end use consumption the potential savings represent. For the purposes of this study, 2020 is the most relevant year, since that is the year AB 32 emissions reduction targets must be met.

Table 1. Natural Gas End Use Efficiency Potential (Million Therms)

Year	Base Estimate	Base Estimate As % of Total Consumption	Mid-Range Estimate	Mid-Range Estimate As % of Total Consumption
2007	2.0	0.4%	3.0	0.5%
2008	3.0	0.5%	7.0	1.2%
2009	5.0	0.9%	11.0	1.9%
2010	6.0	1.0%	15.0	2.6%
2011	8.0	1.3%	19.0	3.2%
2012	10.0	1.7%	23.0	3.8%
2013	12.0	2.0%	27.0	4.4%
2014	14.0	2.3%	32.0	5.2%
2015	16.0	2.6%	36.0	5.8%
2016	17.0	2.7%	40.0	6.3%
2017	18.4	2.9%	43.2	6.8%
2018	19.8	3.1%	46.4	7.2%
2019	21.2	3.3%	49.6	7.6%
2020	22.6	3.4%	52.8	8.0%

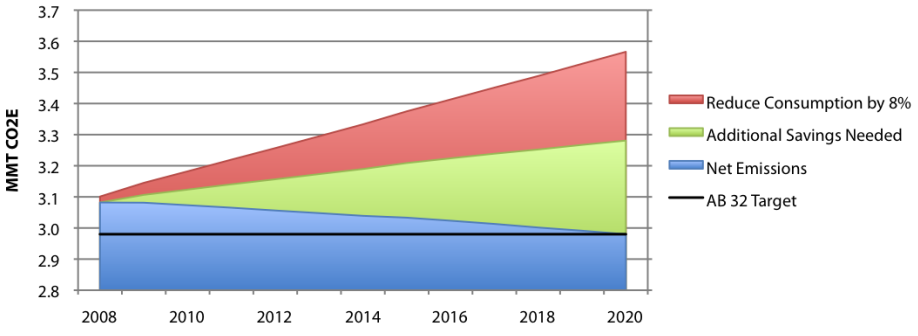
Note: Values for 2018-2020 were interpolated based on Itron study results.

Using the Itron analysis as a base, the project team calculated the GHG emissions associated with a 8% (49 million therms) reduction in natural gas use in the region by 2020, which would result in a 0.3 MMT CO_2E reduction, roughly half of that needed to meet AB 32 targets. Given the uncertainties about how this reduction might be achieved, the project team chose to develop a general reduction wedge. Energy reductions associated with this wedge likely will be achieved through a combination of efficiency programs, appliance and new building standards, and other possible policy and statutory changes, including requirements for zero-energy buildings and efficiency upgrades when an existing building changes ownership.

In Decision 07-10-032, the CPUC established a policy goal for all new residential construction to be zero net energy by 2020 and for all commercial construction to be zero net energy by 2030.[12] Two pending bills in the California legislature seek to establish these zero-energy standards.[13] Also, AB 1470 codified an incentive program for solar water heating, which will also contribute to this goal. Finally, in their Draft Scoping Plan, the California Air Resources Board (CARB) recommended a 5.6% reduction in statewide natural gas usage via energy efficiency. This is less aggressive than the 8% overall reduction projected here.[14]

Figure 8 shows the effect of an 8% reduction in natural gas consumption and the quantity of additional savings needed to reduce emissions to 1990 levels by 2020. If the region could achieve a reduction of 8%, it would then need to reduce emissions by an additional 0.3 MMT CO_2E to meet the hypothetical AB 32 emissions reduction targets by 2020.

Figure 8. Natural Gas Emissions Reduction Strategies
San Diego County



3. Natural Gas End Use Methodology

The method for calculating greenhouse gas emissions from natural gas end use is relatively straightforward. Greenhouse gas emissions correlate directly to consumption, so the team estimated emissions on the basis of historical and projected consumption data provided by the California Energy Commission (CEC).[15] In addition to the aggregated data in the staff forecast, the CEC provided detailed consumption data that allowed the project team to analyze consumption trends for each sector and subsector of the economy.

3.1. Natural Gas GHG Emissions Calculation

The project team calculated total GHG emissions (measured in carbon dioxide equivalent, CO_2E) by aggregating emissions of CH_4, CO_2, and N_2O, according to the following formula:

Greenhouse gas emissions (grams of CO_2E) = (standard cubic feet of natural gas) x (heat content in BTU/scf) x (fuel emissions factor g/BTU) x (global warming potential [GWP] factor)

Each part of the equation is described in more detail below.

Heat Content

The heat content of natural gas is a significant factor in determining emissions. On the basis of actual fuel use data from both the Federal Energy Regulatory Commission (FERC) Form 1 and the Energy Information Administration (EIA), the project team calculated weighted averages of the heat content of the natural gas consumed in the region for electrical generation during the period 1990-2006 (Table 2). By comparison, the heat content used by CARB for 1990, 1995, and 2000 was 1,027 BTU/scf. In 2004, the last year of the statewide inventory, CARB used 1,002 btu/scf.

Table 2 Weighted Average Heat Content for Selected Years (BTU/scf)

Table 2. Weighted Average of Heat Content for Selected Years

	1990	1995	2000	2005	2006
Heat Content (BTU/scf)	1,032	1,019	1,017	1,020	1,020

Fuel Emissions Factors

The project team used the fuel emissions factors for natural gas combustion provided by CARB.

- CH_4 - 1.00E-06 g/BTU
- CO_2 - 0.053 g/BTU
- N_2O - 1.00E-07 g/BTU

Global Warming Potential Factors

To calculate emissions from all greenhouse gases, it is necessary to convert emissions from CH_4 and N_2O into a form equal to the carbon dioxide equivalent. A global warming potential (GWP) factor is used to translate the GWP of a specific gas into the GWP of carbon dioxide. Each gas has its own factor. To calculate the carbon-dioxide-equivalent emissions from natural gas end-use consumption, we used a GWP factor for CH_4 of 21 and N_2O of 310.

3.2. Natural Gas Emissions Projections

Projections in this study are based on the CEC's Energy Demand Forecast for 2008-2018. These data were extended to 2020 via a linear extrapolation. The CEC forecast incorporates the effects of the 2005 building standards and currently funded energy efficiency programs through 2008.[16]

The project team recognized that complex interactions exist among and between categories when considering GHG reduction strategies. For example, increased use of natural gas as a transportation fuel may increase natural gas consumption yet result in an overall greenhouse gas reduction, as natural gas is a cleaner fuel than traditional transportation fuels. To the extent that these interactions are captured in the CEC demand forecast, they are captured here. Modeling the potential interactions among emissions categories is an area for further analysis.

End Notes

1. Emissions from natural gas used to produce electricity are included in the electricity category.
2. These categories are based on the natural gas consumption data provided by the California Energy Commission and may differ from those used by the California Air Resources Board.
3. California Energy Commission (CEC). California Statewide Residential Appliance Saturation Study: Volume 2, Study Results. Final Report. June 2004. Available at the CEC website http://www.energy.ca.gov/reports/400-04-009/2004-08-17_400-04-009VOL2B.PDF.
4. Business-as-usual emissions projections are based on the California Energy Commission's Energy Demand Forecast for 2008-2018. See California Energy Demand 2008-2018 Staff Revised Forecast. November 2007. Available at http://www.energy.ca.gov/2007publications/CEC-200-2007-015/CEC-200-2007-015-SF2.PDF (Last viewed June 17, 2008).
5. The project team recognized that there could be complex interactions among and between categories – such as increased natural gas use to offset traditional transportation fuels, but it did not conduct an analysis to determine the effects of these interactions. To the extent that these are captured by the California Energy Commission, they will be captured in the projections presented here.
6. There appears to be a data inconsistency with year 2000 data from the CEC. The data for commercial consumption are significantly lower than for the preceding and subsequent years.
7. California Energy Commission, Energy Action Plan: 2008 Update, February 2008. Available at http://www.energy.ca.gov/2008publications/CEC-100-2008-001/CEC-100-2008-001.PDF
8. These include SDG&E, the Gas Company, Southern California Edison, and Pacific Gas & Electric. Other municipal utilities, such as Los Angeles Department of Water and Power, also have similar energy programs but are not regulated by the CPUC.
9. Itron, Inc., California Energy Efficiency Potential Study (draft final). Page 4-45 May 12, 2007. Available at http://www.calmac.org/publications/PG&E_EE_FcstModelReport_DraftFinal.pdf (last viewed June 3, 2008). See also http://www.calmac.org/NewPubs.asp.
10. Projected energy supply is based on the CEC forecast, which incorporates the effects of the 2005 building standards and currently funded energy efficiency programs through 2008. See California Energy Demand 2008-2018 Staff Revised Forecast. November 2007. Available at http://www.energy.ca.gov/2007publications/CEC-200-2007-015/CEC-200-2007-015-SF2.PDF (last viewed June 17, 2008).
11. Itron Study, op. cit., p. 4-84
12. See Decision 07-10-032 in Rulemaking R.06-04-010 at http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/74107.pdf.
13. AB 2030 seeks to develop standards for nonresidential buildings. AB 2112 seeks to develop standard for residential buildings.
14. CARB, Climate Change Draft Scoping Plan: A Framework for Change. June 2008.
15. California Energy Demand 2008-2018 Staff Revised Forecast. California Energy Commission (CEC), November 2007. Available at http://www.energy.ca.gov/2007publications/CEC-200-2007-015/CEC-200-2007-015-SF2.PDF (last viewed June 17, 2008).
16. For details on the CEC demand forecast see California Energy Demand 2008-2018 Staff Revised Forecast. November 2007. Available at http://www.energy.ca.gov/2007publications/CEC-200-2007-015/CEC-200-2007-015-SF2.PDF (last viewed June 17, 2008).