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STAFF REVISED FORECAST

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Abstract

The *California Energy Demand 2010-2020 Staff Revised Forecast* presents 2010-2020 electricity, peak demand, and natural gas demand forecasts for each utility planning area in California and for the state as a whole. The report supports the *2007 Integrated Energy Policy Report* and the *2008 Integrated Energy Policy Report Update* analysis and recommendations. In particular, this document addresses staff progress in the measuring and attributing energy efficiency program impacts within the forecast.

The report's energy consumption and peak forecasts are lower than the 2008-2018 forecasts previously produced for the *2007 Integrated Energy Policy Report*, primarily because of worsening economic conditions. Compared to the previous forecast, projected electricity consumption is down by almost 6 percent, and peak demand is down by around 4.5 percent in 2018. Electricity consumption is expected to increase by 1.1 percent per year from 2010-2018, versus the 1.2 percent per year projected for the *2007 Integrated Energy Policy Report.* Peak demand is expected to grow an average of 1.2 percent annually over the same period, compared to 1.3 percent in the 2007 forecast.

Keywords: Demand, consumption, weather-adjusted, peak, natural gas, self-generation, conservation, energy efficiency, California Solar Initiative, economic scenario

Executive Summary

Introduction

The *California Energy Demand 2010-2020 Staff Revised Forecast* (*CED 2009 Revised*) is an Energy Commission staff report presenting forecasts of electricity and end-user natural gas consumption and peak electricity demand for California as a whole and for each major utility planning area within the state for 2010-2020. *CED 2009 Revised* supports the analysis and recommendations in the *2007 Integrated Energy Policy Report (2007 IEPR)* and *2008 Integrated Energy Policy Report Update (2008 IEPR Update)*, including electricity and natural gas system assessments, and the analysis of progress toward increased energy efficiency. As a result of a major staff effort to improve the measurement and attribution of efficiency impacts within the energy demand forecast, *CED 2009 Revised* provides more detail on the impacts of energy efficiency programs and standards than in the past.

Summary of Changes to Forecast

The long-run forecast used in the 2007 IEPR cycle, the *California Energy Demand 2008-2018 Staff Revised Forecast*[1] (*CED 2007*), was based on 2006 peak demand and energy. For the current electricity and end-user natural gas consumption forecasts, staff added 2007 and 2008 energy consumption data to the historical series used for forecasting, while the peak demand forecast incorporates recent analysis of 2008 temperatures and peak demand at the planning area level.

As in the *California Energy Demand 2010-2020 Staff Draft Forecast*[2] (*CED 2009 Draft* or *Draft Forecast*), residential lighting was broken out as a separate end use in the *CED 2009 Draft* to better capture the impacts of residential lighting efficiency programs. For self-generation, staff refined its methods to track various technologies and individual programs.

CED 2007 assumed constant electricity rates throughout the forecast period and increasing (by around 30 percent) natural gas rates. *CED 2009 Revised* assumes rates for electricity and natural gas increase by 15 and 10 percent, respectively, between 2010 and 2020. This corresponds to the "mid-rate" scenario forecast in *CED 2009 Draft*.

The increased effort to capture the effects of energy efficiency programs, along with including the expected effects of 2009-2011 investor-owned utility (IOU) programs, results in reduced forecasted energy demand in California relative to *CED 2007*. *CED 2009 Revised*

[1] California Energy Commission, *California Energy Demand 2008–2018 Staff Revised Forecast,* November 2007, CEC-200-2007-015-SF2.

[2] California Energy Commission, *California Energy Demand 2010–2020 Staff Draft Forecast,* June 2009, CEC-200-2009-012-SD.

provides details on staff work related to efficiency program measurement and attribution for this forecast.

Electricity Forecast Results

Table 1 compares *CED 2007* with *CED 2009 Revised* and *CED 2009 Draft* forecasts for select years. For the draft forecast, the table shows results for the mid-rate case scenario, the same set of rates used in the *CED 2009 Revised*. *CED 2007* assumed constant rates throughout the forecast period. Both the energy consumption and peak forecasts are lower for *CED 2009 Revised* than in *CED 2007* over the entire forecast period, primarily due to worsening economic conditions. Electricity consumption in *CED 2009 Revised* is down by almost 6 percent and peak demand by around 4.5 percent by 2018 compared to *CED 2007*. However, consumption and peak demand are projected to be higher in the *CED 2009 Revised* than in the draft, since predictions for economic growth are slightly more optimistic compared to a few months ago. Electricity consumption is projected to grow at a rate of 1.1 percent per year from 2010-2018, versus 1.2 percent per year in *CED 2007* and 0.7 percent per year in the draft forecast. Peak demand grows an average of more than 1.2 percent annually over the same period, compared to 1.3 percent in *CED 2007* and 1.0 percent in the draft forecast.

The revised statewide forecast of electricity consumption, shown in **Figure 1**, is lower than in *CED 2007* over the entire forecast period, beginning with a dip in 2009, and thereafter increasing at a lower rate than in the previous forecast. By 2018, projected consumption is almost 6 percent lower than the 2007 forecast. This difference reflects current economic conditions along with a slightly lower rate of economic growth in the longer term. Economic conditions affect the forecast through lower personal income growth, lower employment, lower industrial output, and fewer additions to commercial floor space. Most of the remaining difference between *CED 2009 Revised* and *CED 2007* comes from increased efficiency program impacts assumed in this forecast. Slightly more optimistic economic projections compared to those used in *CED 2009 Draft* lead to projected consumption by 2018 more than 4 percent higher in the *CED 2009 Revised* than in the draft.

Figure 2 compares *CED 2009 Draft* and *CED 2009 Revised* forecasts of statewide non-coincident[3] peak demand with *CED 2007*. As with electricity consumption, current economic conditions have a major effect in the short-term in both the draft and revised forecasts. Both of these forecasts show a significant reduction in peak relative to the 2007 forecast for 2010. In the longer term, beyond 2010, the growth rate in the *CED 2009 Revised* is close to that in *CED 2007*, but levels remain around 4.5 percent lower by 2018. More optimistic recent economic projections push the *CED 2009 Revised* forecast peak 1.1 percent higher than in the draft by the end of the forecast period. **Figure 2** also shows the load factor for the state as a whole.

[3] Non-coincident peak refers to the sum of the individual peak demands for each sector in an electrical system. These individual peaks often occur at different hours of the day.

Table 1: Comparison of *CED 2007*, *CED 2009 Draft*, and *CED 2009 Revised* Statewide Electricity Forecasts

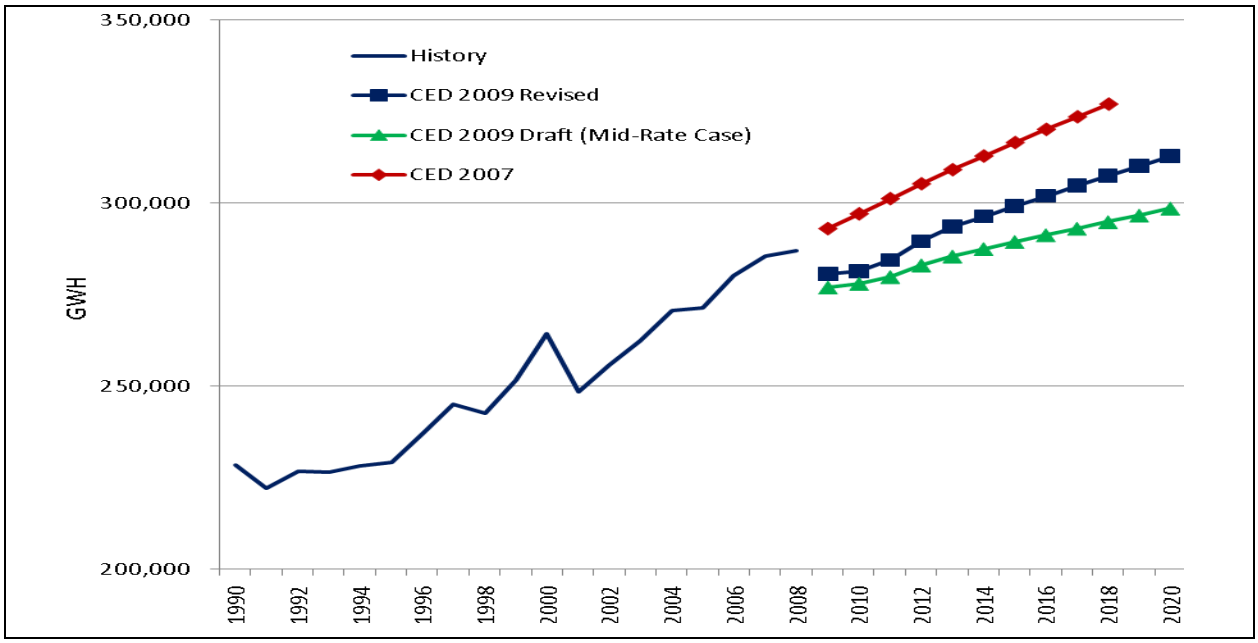
Consumption (GWH)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* Mid-Rate Case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Difference, *CED 2009 Revised* and *CED 2007*	Difference, *CED 2009 Revised* and *CED 2009 Draft*
1990	229,868	228,473	228,473	-0.61%	0.00%
2000	265,769	264,233	264,233	-0.58%	0.00%
2008	288,976	280,184	286,952	-0.70%	2.42%
2010	297,062	278,043	281,408	-5.27%	1.21%
2015	316,575	289,493	299,223	-5.48%	3.36%
2018	327,085	294,895	307,529	-5.98%	4.28%
Average Annual Growth Rates					
1990-2000	1.46%	1.46%	1.46%		
2000-2008	1.01%	0.94%	1.11%		
2008-2010	1.39%	-0.38%	-0.97%		
2010-2018	1.21%	0.74%	1.12%		
Peak (MW)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* Mid-Rate Case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Difference, *CED 2009* and *CED 2007*	Difference, *CED 2009 Revised* and *CED 2009 Draft*
1990	47,308	47,241	47,530	0.47%	0.61%
2000	53,669	53,708	53,709	0.08%	0.00%
2008	62,946	62,948	61,497	-2.30%	-2.30%
2010	64,760	62,520	62,241	-3.89%	-0.45%
2015	69,302	65,968	66,366	-4.24%	0.60%
2018	71,889	67,873	68,634	-4.53%	1.12%
Average Annual Growth Rates					
1990-2000	1.27%	1.29%	1.23%		
2000-2008	2.01%	2.00%	1.71%		
2008-2010	1.43%	-0.34%	0.44%		
2010-2018	1.31%	1.03%	1.23%		
Historical values are shaded					
GWH = gigawatt hour					
MW = megawatt					

Source: California Energy Commission, 2009

The load factor represents the relationship between average energy demand and peak: the smaller the load factor, the greater the difference between peak and average hourly demand. The load factor varies with temperature; in extremely hot years (for example, 1998 and 2006) demand is *peakier*. The general decline in the load factor over the last 20 years indicates a greater proportion of homes and businesses with central air conditioning. This trend is projected to continue over the forecast period. Energy efficiency measures, such as more

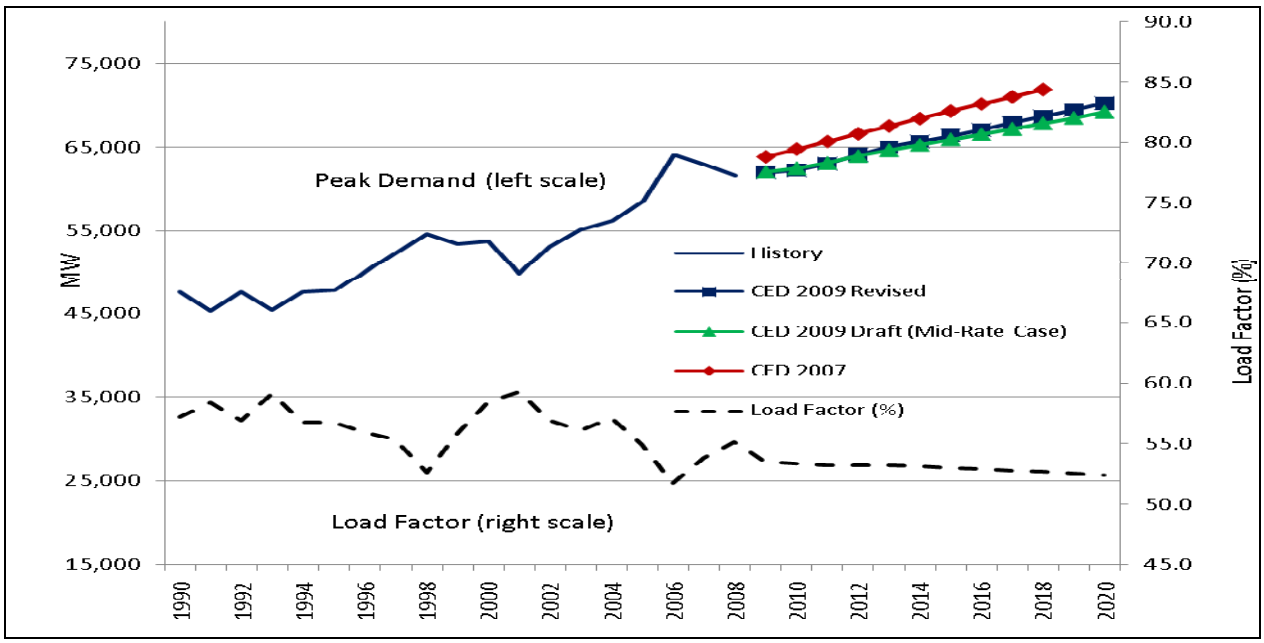
efficient lighting, can also contribute to the declining load factor by reducing overall energy use while having an insignificant effect on peak demand.

Figure 1: Statewide Electricity Consumption



Source: California Energy Commission, 2009

Figure 2: Statewide Non-Coincident Peak Demand



Source: California Energy Commission, 2009

End-User Natural Gas Forecast Results

CED 2009 Revised and *CED 2009 Draft* natural gas forecasts are compared with *CED 2007* for selected years (**Table 2**). These forecasts do not include natural gas used for generating electricity. As in the case of electricity, the set of rates used in the *CED 2009 Revised* forecast corresponds to the mid-rate scenario in the draft forecast; thus the comparison is made to the draft mid-rate case. *CED 2007* used slightly higher rates, roughly equivalent to those in the draft high-rate scenario.

Reported 2008 natural gas consumption for the *CED 2009 Revised* forecast is below that predicted in the draft forecast and *CED 2007*. This difference, along with a projected consumption reduction from 2008-2010 in the industrial and mining sectors, leads to a lower forecast through 2020. However, as the economy recovers beyond 2010, the growth rate exceeds those of the two previous forecasts.

Table 2: Statewide End-User Natural Gas Consumption

End-User Consumption (MM Therms)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* Mid-Rate Case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Difference, *CED 2009 Revised* and *CED 2007*	Difference, *CED 2009 Revised* and *CED 2009 Draft*
1990	12,893	12,893	12,893	0.00%	0.00%
2000	13,913	13,913	13,913	0.00%	0.00%
2008	13,445	12,941	12,494	-7.07%	-3.46%
2010	13,616	12,992	12,162	-10.68%	-6.48%
2015	13,932	13,218	12,751	-8.48%	-3.54%
2018	14,058	13,319	12,894	-8.28%	-3.20%
Average Annual Growth Rates					
1990-2000	0.76%	0.76%	0.76%		
2000-2008	-0.55%	-0.73%	-1.11%		
2008-2010	0.63%	0.19%	-1.34%		
2010-2018	0.40%	0.31%	0.73%		
Historical values are shaded					
End-user consumption excludes natural gas used to generate electricity					

Source: California Energy Commission, 2009

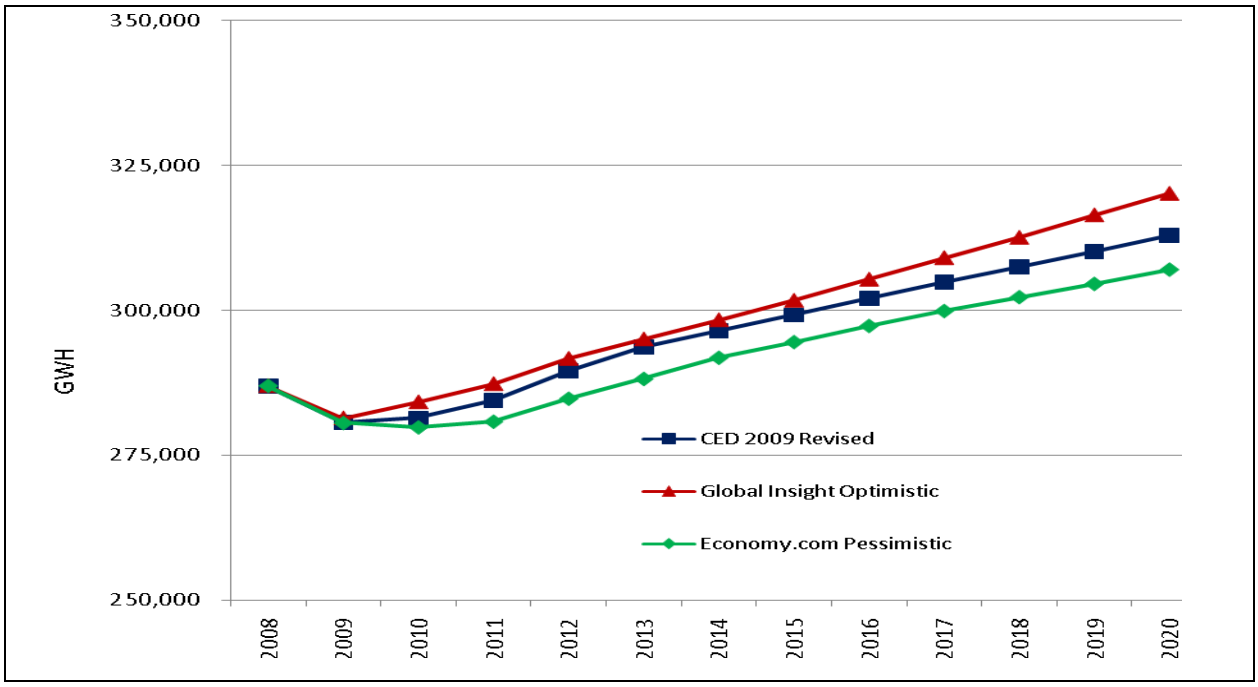
Economic Scenarios

The results presented above rely on economic inputs from a *base case* economic scenario provided by Moody's Economy.com (Economy.com). Staff also examined the effects of two alternative economic scenarios for California electricity demand: an *optimistic* case provided by IHS Global Insight and an Economy.com *pessimistic* case. For this analysis, staff developed econometric models for the three largest sectors (residential, commercial, and

industrial plus mining) at the planning area level, using historical data for electricity consumption, electricity rates, weather, and various economic and demographic variables. Electricity consumption for the remaining sectors was held constant (*CED 2009 Revised* levels) in the alternative scenarios. **Figure 3** shows the projected impacts of the optimistic and pessimistic scenarios on statewide consumption. Peak demand was developed by applying projected load factors from the *CED 2009 Revised* forecast at the planning area and sector level to the consumption results for each scenario. Projected peak impacts are shown in **Figure 4**.

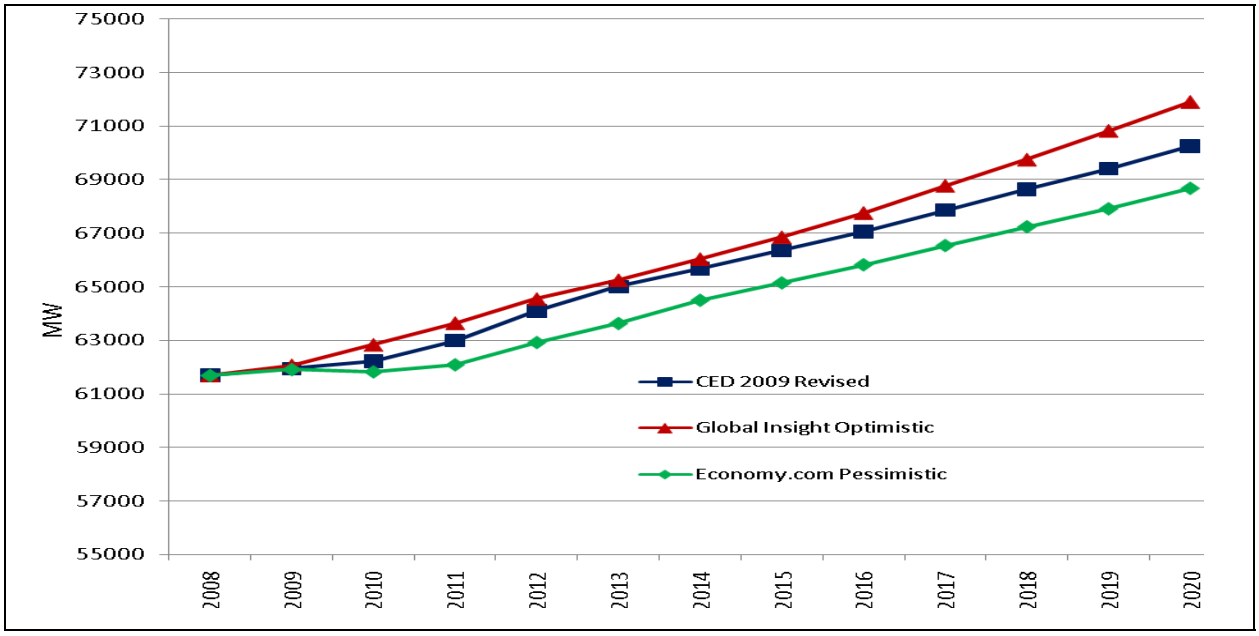
Electricity consumption is projected to be 2.3 percent higher in the optimistic economic case than in the *CED 2009 Revised* forecast by 2020 and 1.9 percent lower in the pessimistic scenario. The peak demand forecast increases by 2.3 percent under the optimistic scenario by 2020 and falls by 2.2 percent in the pessimistic case. The percentage of peak reduction is more than consumption in the pessimistic case because the relative decrease in consumption is projected to be higher for the residential and commercial sectors than for the industrial, which has a higher load factor (is less *peaky*). Annual growth rates from 2010-2020 for electricity consumption and peak demand increase from 1.1 percent and 1.25 percent, respectively, to 1.2 percent and 1.4 percent in the optimistic case, and fall to 0.9 percent and 1.1 percent under the pessimistic scenario.

Figure 3: Projected Statewide Electricity Consumption, *CED 2009 Revised* and Alternative Economic Scenarios



Source: California Energy Commission, 2009

Figure 4: Projected Statewide Peak Demand, *CED 2009 Revised* and Alternative Economic Scenarios



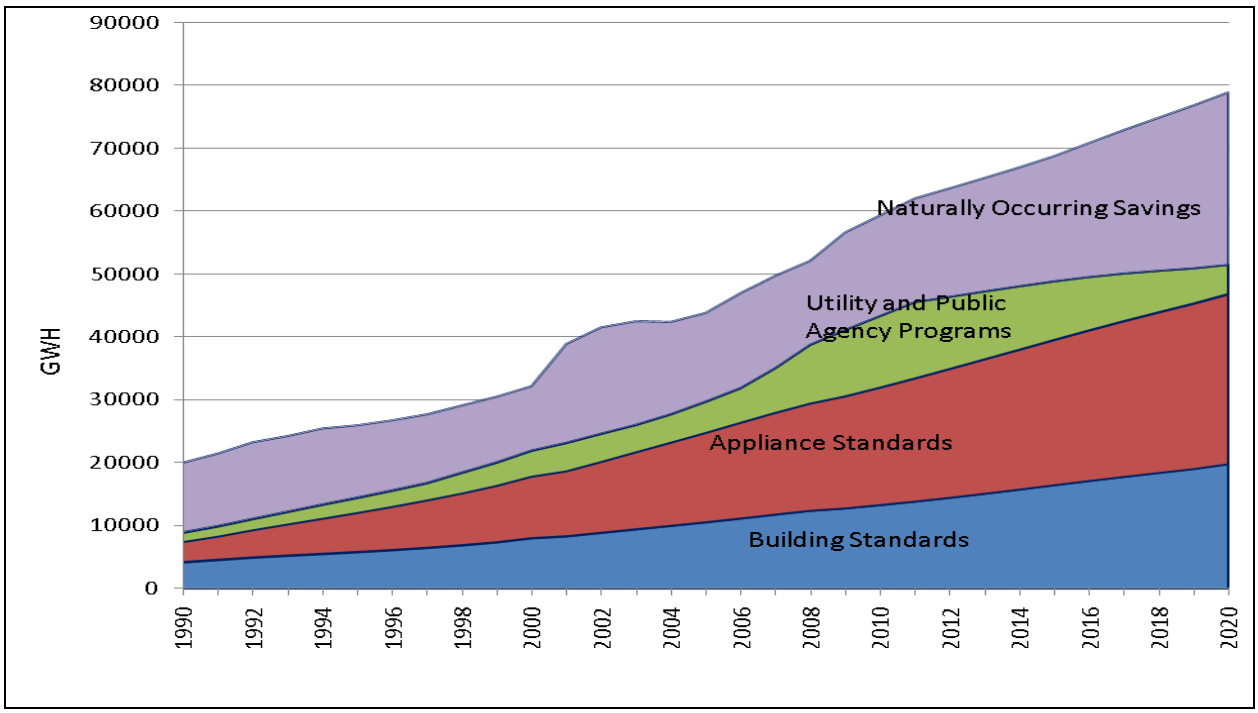
Source: California Energy Commission, 2009

Conservation/Efficiency

With the state's adoption of the first *Energy Action Plan (EAP)* in 2003, energy efficiency became the resource of first choice for meeting the state's future energy needs. Assembly Bill 2021 (Levine, Chapter 734, Statutes of 2006) set a statewide goal of reducing total forecasted electricity consumption by 10 percent over the next 10 years. Under AB 2021, the Energy Commission, in consultation with the California Public Utilities Commission (CPUC), is responsible for setting annual statewide efficiency targets in a public process using the most recent investor-owned and publicly owned utility targets. These targets, combined with California's greenhouse gas emission reduction goals, make it essential for the Energy Commission to properly account for energy efficiency impacts when forecasting future electricity and natural gas demand.

Much time and effort was put into refining the staff's forecasting methods to account for energy efficiency and conservation impacts while preparing this forecast, particularly for utility efficiency programs. **Figure 5** shows electricity consumption savings estimates incorporated in *CED 2009 Revised* for building and appliance standards, utility and public agency programs, and *naturally occurring* savings, or savings associated with rate changes and market trends not directly related to programs or standards.

Figure 5: Efficiency/Conservation Consumption Savings by Source



Source: California Energy Commission, 2009

CHAPTER 1: Statewide Forecast Results and Methods

Introduction

The *California Energy Demand 2010-2020 Staff Revised Forecast* (*CED 2009 Revised*), an Energy Commission staff report, presents forecasts of electricity and end-user natural gas consumption and peak electricity demand for California as a whole and for each major utility planning area within the state for 2010-2020. *CED 2009 Revised* supports the analysis and recommendations in the *2007 Integrated Energy Policy Report (2007 IEPR)* and *2008 Integrated Energy Policy Report Update (2008 IEPR Update)*, including electricity and natural gas system assessments as well as analysis of progress towards increased energy efficiency. As a result of a major staff effort to improve the measurement and attribution of efficiency impacts within the energy demand forecast, this report provides more detail on the effects of energy efficiency programs and standards than in the past.

Energy Commission staff conducted a workshop on June 26, 2009, to receive public comments on the staff draft forecast[4] (*CED 2009 Draft,* or *draft forecast)*. Staff revised the draft forecast to address many of the comments received, as well as direction from the IEPR Committee. The Committee will hold a workshop on September 21, 2009, to receive public comments on *CED 2009 Revised*. After considering these comments, the Energy Commission may adopt this forecast.

CED 2009 Revised will be used in a number of applications, including the California Public Utilities Commission (CPUC) 2010 procurement process. The CPUC has identified the IEPR process as "the appropriate venue for considering issues of load forecasting, resource assessment, and scenario analyses, to determine the appropriate level and ranges of resource needs for load serving entities in California."[5] *CED 2009 Revised* will also be an input to California Independent System Operator (California ISO) controlled grid studies and other transmission planning studies and in the *California Gas Report*[6] and electricity supply-demand assessments.

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[4] California Energy Commission, *California Energy Demand 2010-2020 Staff Draft Forecast*, June 2009, CEC-200-2009-012SD.

[5] California Public Utilities Commission, Assigned Commissioner's Ruling On Interaction Between The CPUC Long-Term Planning Process And The California Energy Commission Integrated Energy Policy Report Process, September 9, 2004 Rulemaking 04-04-003.

[6] The *California Gas Report,* prepared by California electric and gas utilities in compliance with California Public Utilities Commission Decision D.95-01-039.

Summary of Changes to Forecast

The long-run forecast used in the 2007 IEPR cycle, *California Energy Demand 2008-2018 Staff Revised Forecast*[7] (*CED 2007*), was based on 2006 peak demand and energy. For the current electricity and end-user natural gas consumption forecasts, staff added 2007 and 2008 energy consumption data to the historical series used for forecasting. The peak demand forecast incorporates recent analysis of 2008 temperatures and peak demand at the planning area level.

As in *CED 2009 Draft*, residential lighting was broken out as a separate end use in *CED 2009 Revised* to better capture the effects of residential lighting efficiency programs. For self-generation, staff refined its methods to track various technologies and individual programs.

CED 2007 assumed constant electricity rates throughout the forecast period and increasing (by around 30 percent) natural gas rates. *CED 2009 Revised* assumes rates for electricity and natural gas increase by 15 and 10 percent, respectively, between 2010 and 2020. This corresponds to the *mid-rate* scenario forecast in *CED 2009 Draft*.

The increased effort to capture the impacts of energy efficiency programs, along with including the expected effects of 2009-2011 utility programs, helps reduce forecasted energy demand in the investor-owned utility (IOU) service territories relative to *CED 2007*. Chapter 8 provides details on staff work related to efficiency program measurement and attribution for this forecast.

Changes From CED 2009 Draft to CED 2009 Revised

For *CED 2009 Revised*, staff updated the economic projections used in *CED 2009 Draft*. In addition, staff developed alternative economic scenarios for *CED 2009 Revised*. *CED 2009 Revised* incorporates one rather than three sets of electricity and natural gas rates, the mid-rate scenario used in *CED 2009 Draft*.[8]

Commercial floor space, a key input for the Commercial Model, was projected using the method developed for *CED 2007*[9], rather than a more recent model developed for *CED 2009 Draft*. Staff was concerned that application of the newer method may have led to unrealistically low commercial energy output. The newer model does have potential as an

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[7] California Energy Commission, *California Energy Demand 2008–2018 Staff Revised Forecast,* November 2007, CEC-200-2007-015-SF2.

[8] In *CED 2009 Draft*, three price scenarios were developed for electricity and natural gas rates: high rates, low (constant) rates, and a rate scenario in between the two, the "mid-rate" case.

[9] California Energy Commission, *California Energy Demand 2008–2018 Staff Revised Forecast,* November 2007, CEC-200-2007-015-SF2, pp. 21-23.

effective projection tool and staff will attempt to correct the current problems and use the model in the future.

Measured utility efficiency program energy savings in *CED 2009 Revised* include updated estimates for both the publicly owned and investor-owned utilities (IOUs). In *CED 2009 Draft*, staff relied on publicly owned utility estimates made for *CED 2007*. In addition, staff made adjustments to projected 2009-2011 program cycle IOU efficiency savings. The forecast for self-generation energy production was updated to incorporate 2009 installations and pending installations.

Statewide Forecast Results

The following summarizes the results presented in this chapter:

- *CED 2009 Revised* forecasts of statewide electricity consumption and peak demand are lower than *CED 2007* levels because of the economic downturn and increased efficiency impacts but higher than in *CED 2009 Draft*.
- Per capita electricity consumption and peak demand in California are projected to be lower than in *CED 2007* but higher than in *CED 2009 Draft*.
- The largest percentage reductions in electricity consumption and peak demand relative to *CED 2007* occur in the residential and commercial sectors.
- Alternative economic scenarios increase or decrease electricity consumption and peak demand by around 2 percent in 2020.
- Self-generation impacts are projected to be higher than in *CED 2007* and *CED 2009 Draft*, mainly because of increased adoption of photovoltaic systems.

Table 3 compares the revised and draft forecasts for select years with *CED 2007*. For *CED 2009 Draft*, the table shows results for the mid-rate case scenario, the same set of rates used in *CED 2009 Revised*. The 2007 forecast assumed constant rates throughout the forecast period. Both the energy consumption and peak forecasts are lower for *CED 2009 Revised* than in *CED 2007* over the entire forecast period, primarily due to worsening economic conditions. Projected electricity consumption is down by almost 6 percent and peak demand by around 4.5 percent by 2018 compared to *CED 2007.* However, consumption and peak demand are projected to be higher in *CED 2009 Revised* than in the draft forecast since predictions for economic growth are slightly more optimistic compared to a few months ago. Electricity consumption is projected to grow at a rate of 1.1 percent per year from 2010-2018, versus 1.2 percent per year in *CED 2007* and 0.7 percent per year in *CED 2009 Draft*. Peak demand grows an average of over 1.2 percent annually over the same period, compared to 1.3 percent in the 2007 forecast and 1.0 percent in *CED 2009 Draft.*

The historical data used for this forecast differs slightly from *CED 2007* and *CED 2009 Draft* because of revised data submitted by utilities and because a detailed review of self-generation data found some additional consumption from small systems before 2008.

Table 3: Comparison of CED 2007, CED 2009 Draft, and CED 2009 Revised Statewide Electricity Forecasts

Consumption (GWH)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* Mid-Rate Case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Difference, *CED 2009 Revised* and *CED 2007*	Difference, *CED 2009 Revised* and *CED 2009 Draft*
1990	229,868	228,473	228,473	-0.61%	0.00%
2000	265,769	264,233	264,233	-0.58%	0.00%
2008	288,976	280,184	286,952	-0.70%	2.42%
2010	297,062	278,043	281,408	-5.27%	1.21%
2015	316,575	289,493	299,223	-5.48%	3.36%
2018	327,085	294,895	307,529	-5.98%	4.28%
Average Annual Growth Rates					
1990-2000	1.46%	1.46%	1.46%		
2000-2008	1.01%	0.94%	1.11%		
2008-2010	1.39%	-0.38%	-0.97%		
2010-2018	1.21%	0.74%	1.12%		
Peak (MW)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* Mid-Rate Case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Difference, *CED 2009* and *CED 2007*	Difference, *CED 2009 Revised* and *CED 2009 Draft*
1990	47,308	47,241	47,530	0.47%	0.61%
2000	53,669	53,708	53,709	0.08%	0.00%
2008	62,946	62,948	61,497	-2.30%	-2.30%
2010	64,760	62,520	62,241	-3.89%	-0.45%
2015	69,302	65,968	66,366	-4.24%	0.60%
2018	71,889	67,873	68,634	-4.53%	1.12%
Average Annual Growth Rates					
1990-2000	1.27%	1.29%	1.23%		
2000-2008	2.01%	2.00%	1.71%		
2008-2010	1.43%	-0.34%	0.44%		
2010-2018	1.31%	1.03%	1.23%		
Historical values are shaded					
GWH = gigawatt hour					
MW = megawatt					

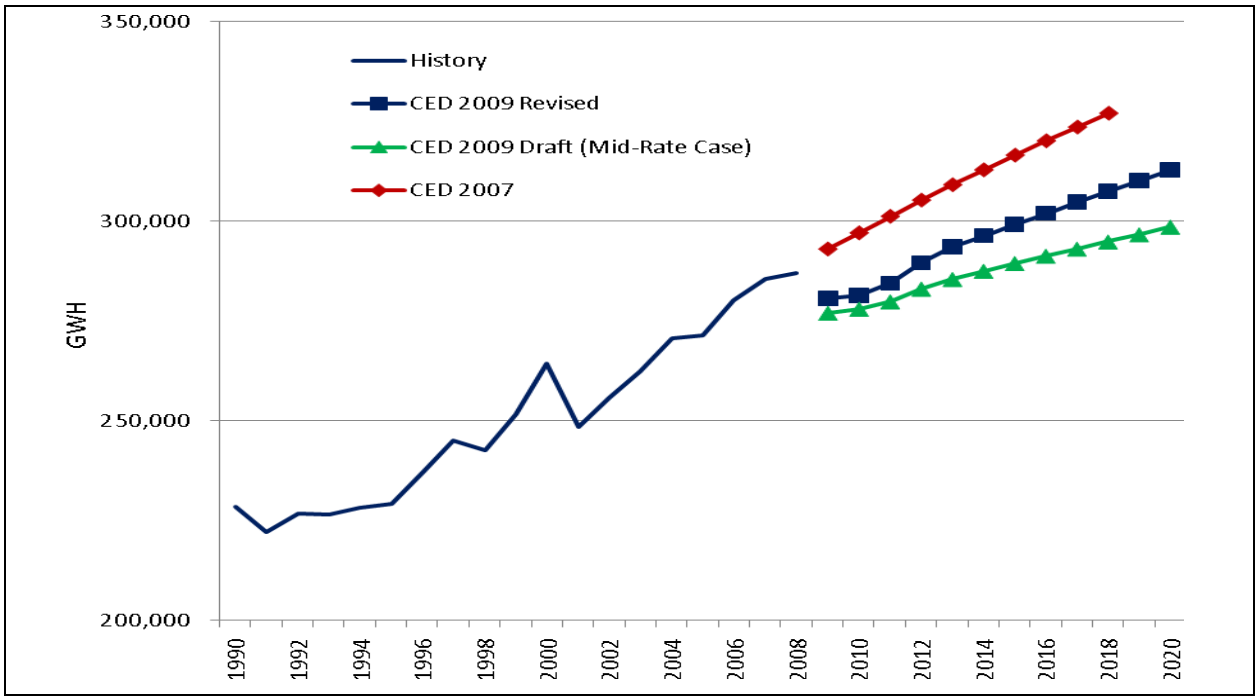
Source: California Energy Commission, 2009

Annual Electricity Consumption

The staff revised statewide forecast of electricity consumption, shown in **Figure 6**, is lower than in *CED 2007* forecast over the entire forecast period, beginning with a dip in 2009, and thereafter increasing at a lower rate. By 2018, projected consumption is almost 6 percent lower than in the 2007 forecast. This difference reflects current economic conditions, along with a slightly lower rate of economic growth in the longer term. Economic conditions affect the forecast through lower personal income growth, lower employment, lower industrial output, and fewer additions to commercial floor space. Economic inputs are discussed later in this chapter. As discussed in Chapter 8, most of the remaining differences between *CED 2009 Revised* and *CED 2007* come from increased efficiency program impacts assumed in this forecast. Slightly more optimistic economic projections, compared to those used in *CED 2009 Draft*, lead to projected consumption more than 4 percent higher by 2018.

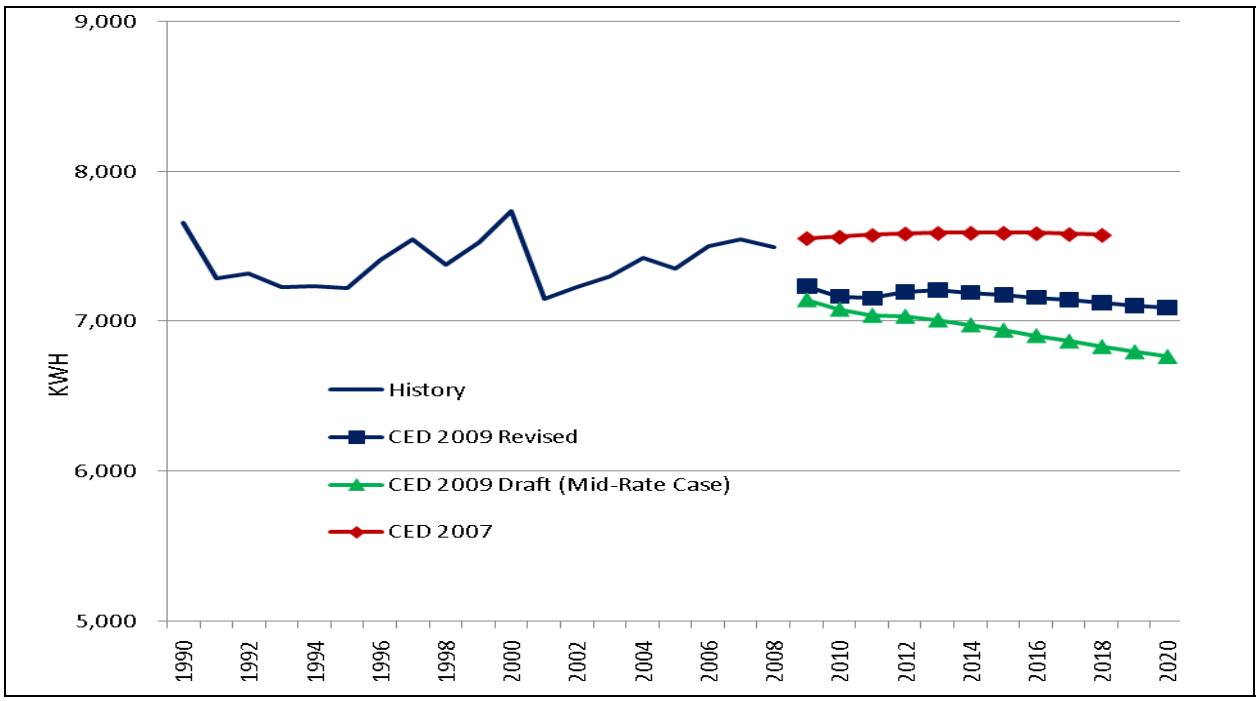
Consistent with lower total consumption compared to *CED 2007*, per capita electricity use is lower in *CED 2009 Revised* throughout the forecast period, as shown in **Figure 7**. Projected per capita consumption is reduced by almost 500 kWh by 2018 compared to the 2007 forecast, but higher by around 300 kWh in 2020 compared to *CED 2009 Draft*.

Figure 6: Statewide Annual Electricity Consumption



Source: California Energy Commission, 2009

Figure 7: Statewide Annual Electricity Use per Capita

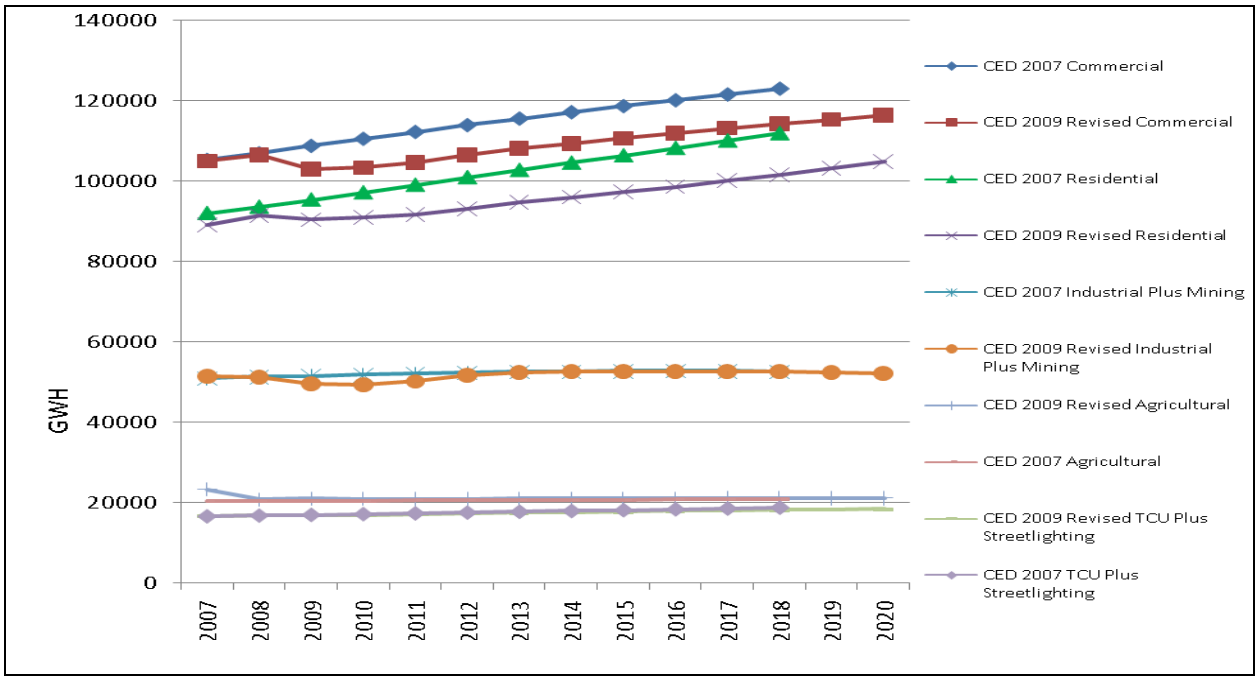


Source: California Energy Commission, 2009

Figure 8 shows projected annual consumption by major economic sector, comparing *CED 2009 Revised* with *CED 2007*. The largest percentage reductions from *CED 2007* occur in the residential sector (-9.3 percent by 2018) and the commercial sector (-7.1 percent by 2018). In the residential case, the main driver for these reductions compared to *CED 2007* is lower personal income per capita. Commercial reductions result from lower projections of floor space based on decreases in projected employment and commercial sector output. Industrial consumption compared to *CED 2007* decreases by a much lower percentage (around 0.1 percent by 2018), reflecting declines in industrial output projected in both forecasts. The only sector with increased consumption compared to *CED 2007* is agricultural/water pumping (up 1 percent in 2018), a result of higher actual consumption in 2008 than projected in *CED 2007*.

Annual electricity consumption is projected to be higher in *CED 2009 Revised* than in the draft throughout the forecast period for every sector except agricultural. By 2020, commercial consumption is forecast to be 4.3 percent higher, residential consumption 4.9 percent higher, industrial consumption 4.0 percent higher, and the transportation, communications, and utility (TCU) and street lighting sectors 1.3 percent higher. Lower agricultural consumption projections result from reduced actual demand in 2008 compared to *CED 2009 Draft* predictions, which used 2007 as the last historical year.

Figure 8: Statewide Electricity Consumption by Sector



Source: California Energy Commission, 2009

To support sub-regional electricity system analysis, staff disaggregates the planning area forecasts to correspond to control areas and congestion zones. **Table 4** shows the forecast of energy required to meet demand by control area and congestion zone. Compared with 2008, demand is projected to be down in all areas in 2010 with the exception of the Imperial Irrigation District (IID) control area. After 2010, demand is expected to grow the fastest in the SMUD and IID control areas, reflecting strong population growth for SMUD and relatively high expected economic growth for IID. The slowest growth occurs in the Los Angeles Department of Water and Power (LADWP) control area because of relatively low projected economic growth in that area. In the California ISO control area, demand is projected to grow slightly faster in Southern California beyond 2010.

Table 4: Control Area Net Energy for Load (GWh)

	North of Path 15	South of Path 15	California ISO Total	SMUD	LADWP	Imperial Irrigation	Turlock Irrigation
2008	109,962	133,290	243,252	17,986	30,604	3,712	2,694
2010	107,693	129,988	237,682	17,368	29,522	3,763	2,592
2015	114,204	137,615	251,819	18,524	31,000	4,245	2,747
2020	119,420	144,275	263,695	19,344	31,936	4,776	2,860
	Annual Growth Rates						
2008-2010	-1.04%	-1.25%	-1.15%	-1.73%	-1.78%	0.68%	-1.92%
2010-2015	1.18%	1.15%	1.16%	1.30%	0.98%	2.44%	1.17%
2010-2020	1.04%	1.05%	1.04%	1.08%	0.79%	2.41%	0.99%

Source: California Energy Commission, 2009

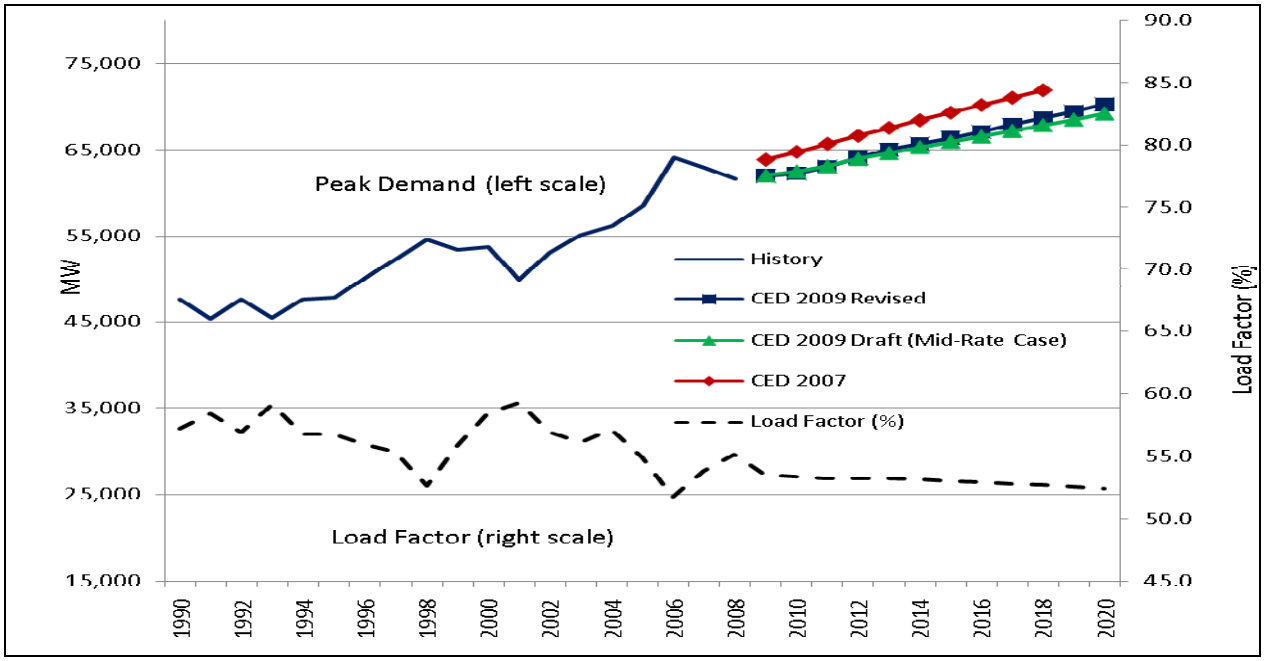
Statewide Peak Demand

Figure 9 compares *CED 2009 Draft* and *CED 2009 Revised* forecasts of statewide non-coincident[10] peak demand with *CED 2007*. As with electricity consumption, current economic conditions have a major impact in the short term in both the draft and revised forecasts. For 2010, both of these forecasts show a significant reduction in peak relative to *CED 2007*. The growth rate in *CED 2009 Revised* is close to that in *CED 2007* in the longer term, beyond 2010, but the level remains around 4.5 percent lower by 2020. However, more optimistic recent economic projections push the *CED 2009 Revised* peak 1.1 percent higher than in the draft by the end of the forecast period.

Figure 9 also shows the load factor for the state as a whole. The load factor represents the relationship between average energy demand and peak: the smaller the load factor, the greater the difference between peak and average hourly demand. The load factor varies with temperature; in extremely hot years (for example, 1998 and 2006) demand is *peakier*. The general decline in the load factor over the last 20 years indicates a greater proportion of homes and businesses with central air conditioning. This trend is projected to continue over the forecast period. Energy efficiency measures, such as more efficient lighting, can also contribute to the declining load factor by reducing overall energy use while having an insignificant effect on peak demand.

[10] Non-coincident peak refers to the sum of the individual peak demands for each sector in an electrical system. These individual peaks often occur at different hours of the day.

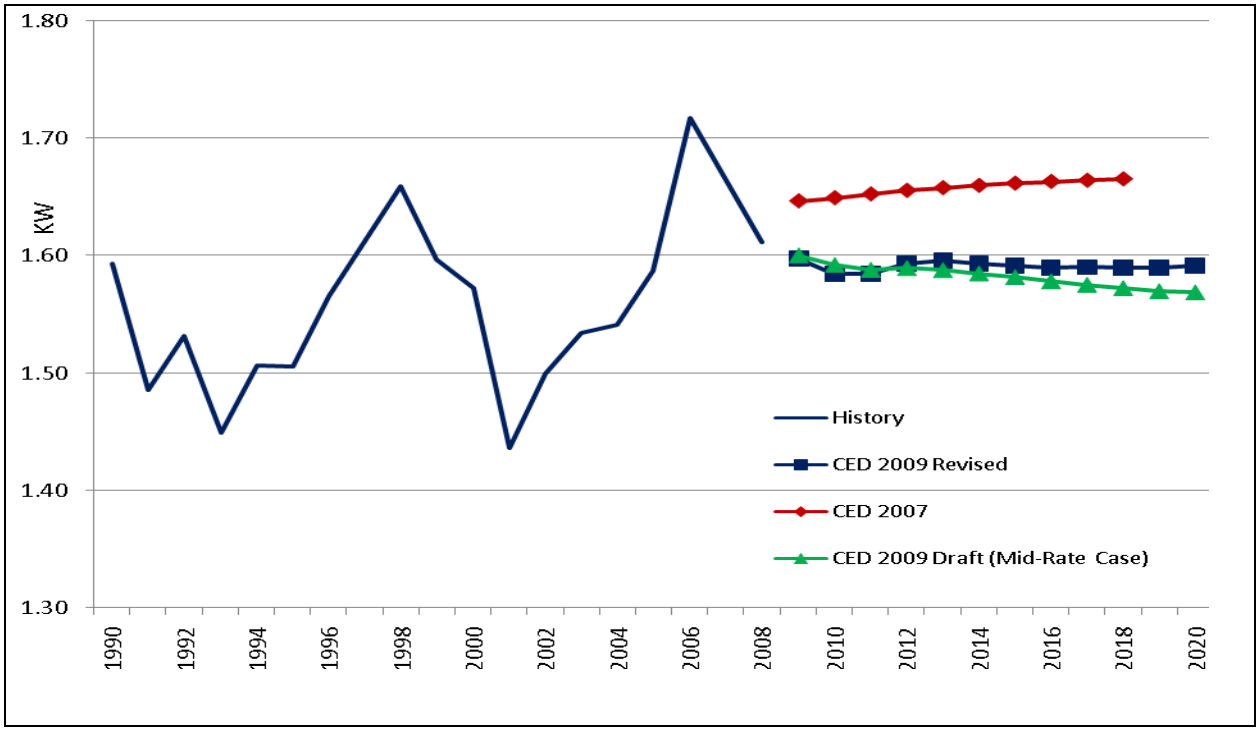
Figure 9: Statewide Non-Coincident Peak Demand



Source: California Energy Commission, 2009

Per capita non-coincident peak, shown in **Figure 10**, is projected to remain flat over the forecast period in *CED 2009 Revised*, unlike the marked decline projected in *CED 2009 Draft*, although it remains well below that projected in *CED 2007*. As in the forecast for per capita consumption, economic conditions and energy efficiency impacts result in a marked reduction in projected per capita use relative to *CED 2007* at the beginning of the forecast period. Thereafter, the difference between the two forecasts becomes slightly more pronounced as per capita peak was projected to rise slightly in the 2007 forecast. By 2018, the per capita peak is almost 5 percent lower in *CED 2009 Revised* than in *CED 2007*, declining from 1.67 kW to 1.59 kW.

Figure 10: Statewide Non-Coincident Peak Demand per Capita

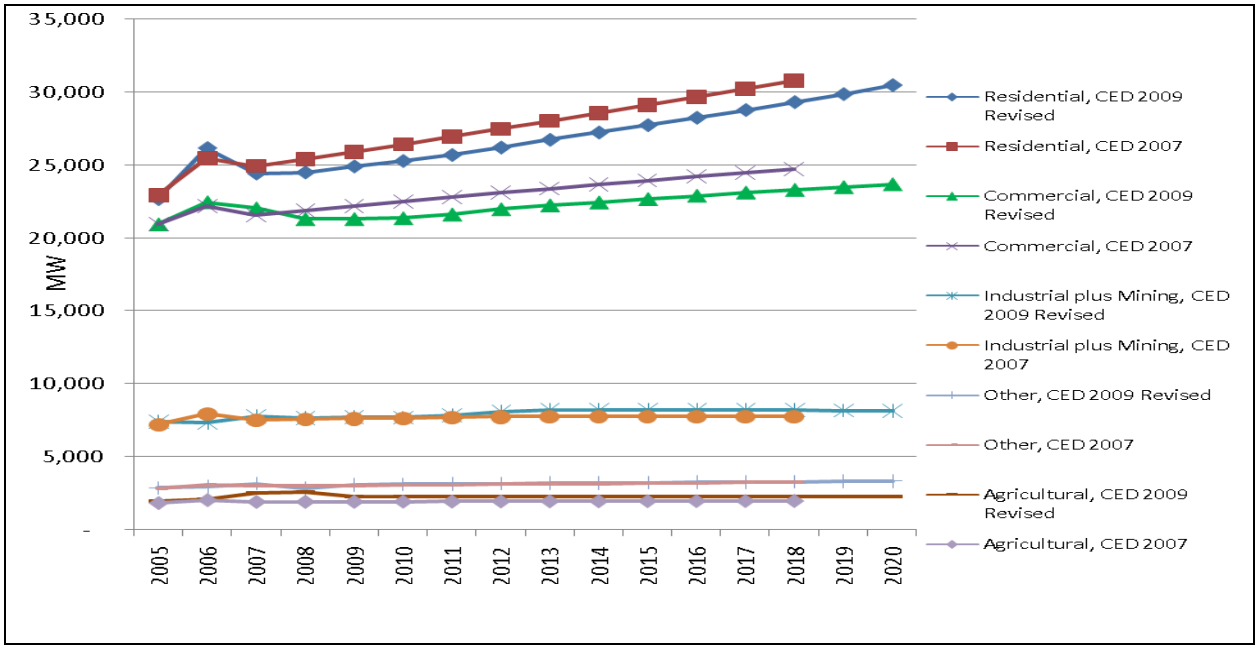


Source: California Energy Commission, 2009

Figure 11 shows projected annual peak demand by the major economic sectors for *CED 2009 Revised* and for *CED 2007*. As in the consumption forecast, the largest percentage reductions compared to *CED 2007* occur in the residential and commercial sectors (-4.8 percent and -5.7 percent by 2018, respectively). In both cases, the decrease in peak is less than the decrease in consumption, a reflection of smaller reductions in cooling relative to other end uses. Projected industrial and agricultural/water pumping peaks are higher (by 5.7 and 15.3 percent by 2018, respectively) because of significantly higher reported actual peaks in the final historical years (2007 and 2008) compared to peaks predicted in the 2007 forecast.

Annual peak demand is projected to be higher in *CED 2009 Revised* than in *CED 2009 Draft* throughout most of the forecast period for every sector except "other" (TCU and street lighting). By 2020, peaks are forecast to be 2.6 percent higher in the commercial sector, 0.9 percent in the residential, 2.1 percent in the industrial, and 5.6 percent in the agricultural. Lower TCU and street lighting peak projections reflect lower recorded consumption in 2008 compared to *CED 2009 Draft* predictions.

Figure 11: Statewide Peak Demand by Sector (MW)



Source: California Energy Commission, 2009

Table 5 shows peak demand by control area. Demand is down in 2010 compared to 2008 in all areas except the Southern California portion of California ISO, which experienced lower than average temperatures in 2008, and IID. As with net energy, demand in the IID control area grows the fastest and LADWP the slowest beyond 2010, for the same reasons. Growth in peak demand is higher than growth for energy beyond 2010 because the trend toward increased air conditioning use is expected to continue.

Table 5: Annual Peak Demand (MW) by Control Area and Congestion Zone

	North of Path 15	South of Path 15	California ISO Coincident* Peak	SMUD	LADWP	Imperial Irrigation	Turlock Irrigation
2008	22,039	26,867	48,905	4,464	6,599	977	599
2010	21,691	27,880	49,571	4,420	6,416	985	583
2015	23,120	29,904	53,024	4,723	6,687	1,112	620
2020	24,511	31,813	56,324	4,968	6,865	1,252	653
	Annual Growth Rates						
2008-2010	-0.79%	1.87%	0.68%	-0.49%	-1.40%	0.40%	-1.35%
2010-2015	1.28%	1.41%	1.36%	1.33%	0.83%	2.46%	1.24%
2010-2020	1.23%	1.33%	1.29%	1.18%	0.68%	2.43%	1.15%

Source: California Energy Commission, 2009
*Staff estimates coincident peak by applying an estimated factor (0. 9761) to non-coincident peak.

End-User Natural Gas Demand Forecast

Table 6 compares *CED 2009 Revised* and *CED 2009 Draft* natural gas forecasts with *CED 2007* for selected years. These forecasts do not include natural gas used for generating electricity. As in the case of electricity, the set of rates used in *CED 2009 Revised* correspond to the mid-rate scenario in *CED 2009 Draft*; thus the comparison is made to the draft mid-rate case. *CED 2007* used slightly higher rates, roughly equivalent to those in the draft forecast high-rate scenario.

Reported 2008 natural gas consumption for *CED 2009 Revised* is well below that predicted in *CED 2009 Draft* and in *CED 2007*. This difference, along with a projected consumption reduction from 2008-2010 in the industrial and mining sectors, leads to a lower forecast through 2020. However, as the economy recovers beyond 2010, the growth rate exceeds that of the two previous forecasts.

Table 6: Statewide End-User Natural Gas Consumption

End-User Consumption (MM Therms)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* Mid-rate Case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Difference, *CED 2009 Revised* and *CED 2007*	Difference, *CED 2009 Revised* and *CED 2009 Draft*
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2010-2018	0.40%	0.31%	0.73%		
Historical values are shaded					
End-user consumption excludes natural gas used to generate electricity					

Source: California Energy Commission, 2009

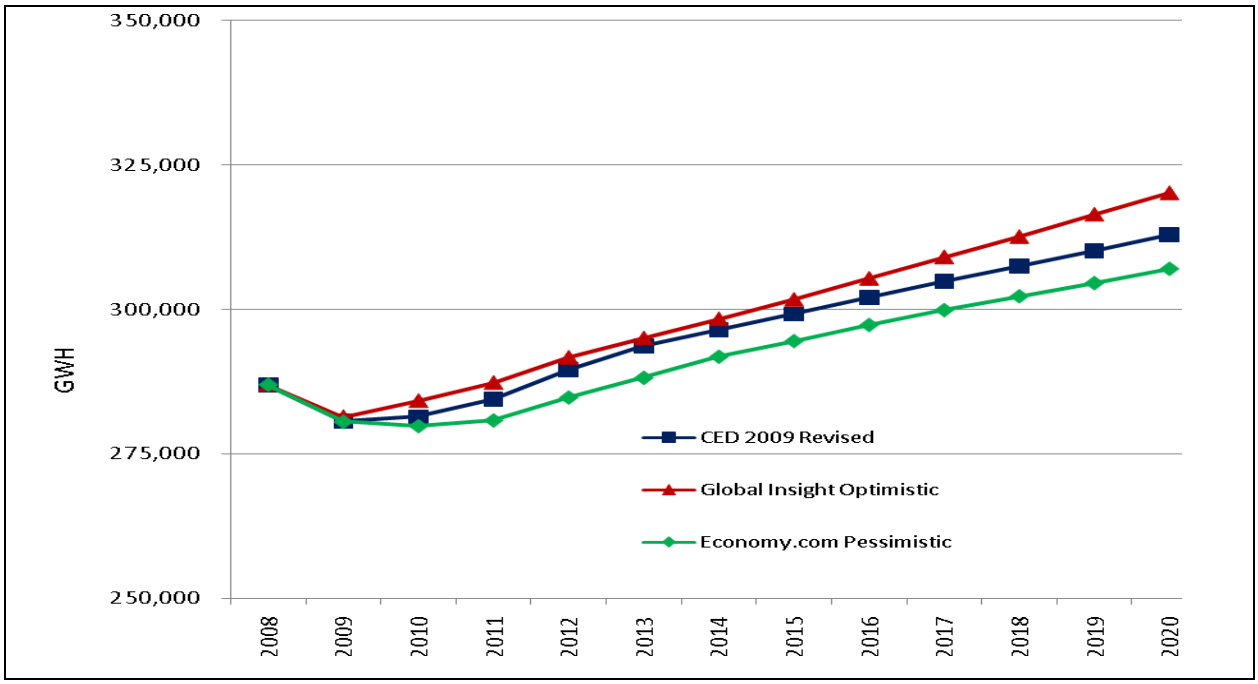
Economic Scenarios

The results in this chapter thus far rely on economic inputs from a *base case* economic scenario provided by Moody's Economy.com (Economy.com). Because of the importance of economic factors to the energy forecast and the uncertainty involved in economic forecasting, staff also examined the impacts of two alternative economic scenarios for California electricity demand: an *optimistic* case provided by IHS Global Insight and an

Economy.com *pessimistic* case. These two cases, in general, project the highest and lowest rates of economic growth of the various scenarios provided by the two companies. For this analysis, staff developed econometric models for the three largest sectors (residential, commercial, and industrial plus mining) at the planning area level, using historical data for electricity consumption, electricity rates, weather, and various economic and demographic variables. Electricity consumption for the remaining sectors was held constant (*CED 2009 Revised* levels) in the alternative scenarios. The Appendix provides details on the scenarios and the econometric models.

The estimated models were run for the two economic scenarios as well as the Economy.com base case.[11] The resulting percentage differences in electricity consumption between the two alternative scenarios and the base case were applied to *CED 2007 Revised* consumption projections. **Figure 12** shows the projected impacts of the optimistic and pessimistic scenarios on statewide consumption. Peak demand was developed by applying projected load factors from *CED 2009 Revised* at the planning area and sector level to the consumption results for each scenario. Projected peak impacts are shown in **Figure 13**.

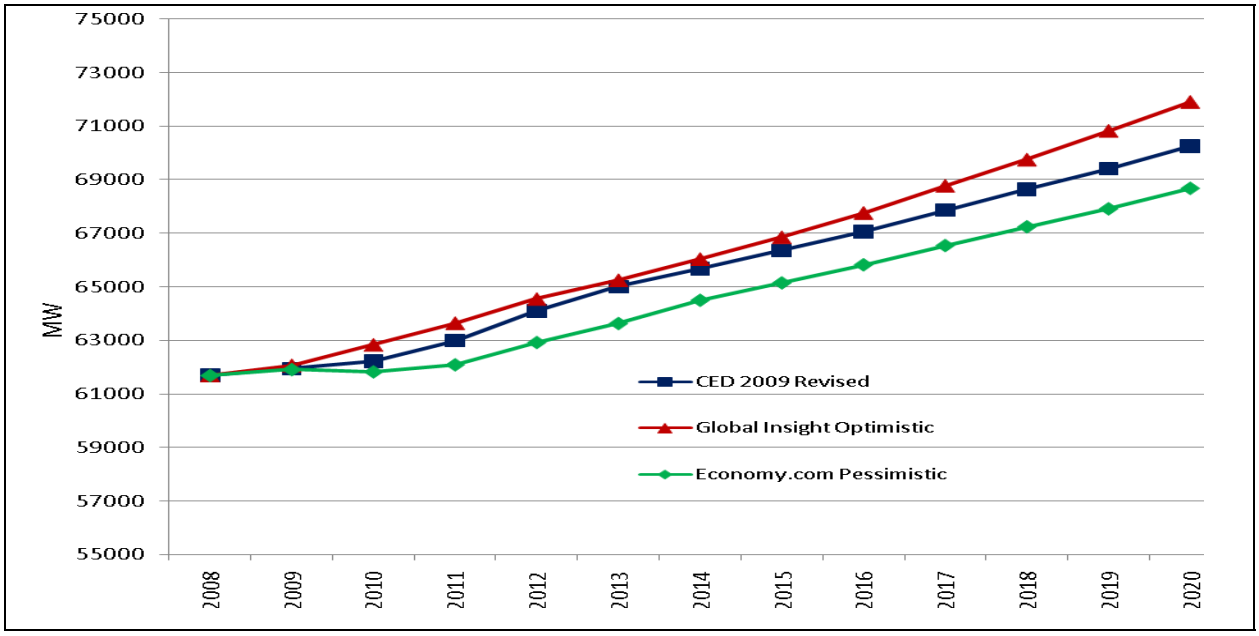
Figure 12: Projected Statewide Electricity Consumption, CED 2009 Revised and Alternative Economic Scenarios



Source: California Energy Commission, 2009

[11] As shown in the Appendix, the results from the econometric models together using Economy.com base case inputs matched *CED 2009 Revised* forecast very closely. In 2020, the difference in projected statewide consumption was less than 0.5 percent.

Figure 13: Projected Statewide Peak Demand, CED 2009 Revised and Alternative Economic Scenarios



Source: California Energy Commission, 2009

Electricity consumption is projected to be 2.3 percent higher (around 7,000 GWH) in the optimistic economic case than in *CED 2009 Revised* by 2020, and 1.9 percent lower (6,000 GWH) in the pessimistic scenario. The peak demand forecast increases by 2.3 percent (1,600 MW) under the optimistic scenario by 2020 and falls by 2.2 percent (1,600 MW) in the pessimistic case. The percentage peak reduction is higher than that of consumption in the pessimistic case because the relative decrease in consumption is projected to be higher for the residential and commercial sectors than for the industrial, which has a higher load factor (is less *peaky*). Annual growth rates from 2010-2020 for electricity consumption and peak demand increase from 1.1 percent and 1.25 percent, respectively, to 1.2 percent and 1.4 percent in the optimistic case, and fall to 0.9 percent and 1.1 percent under the pessimistic scenario.

Changes in consumption and peak demand are small compared to *CED 2009 Revised* totals in percentage terms because of a relatively narrow spread among the three economic scenarios. For example, retail employment is projected to be only 2 percent higher or lower in the alternative scenarios than in the Economy.com base case, and projected industrial output under the pessimistic scenario is almost identical to that of the base case by 2020. This spread reflects a convergence in views of the economic future: neither Global Insight nor Economy.com currently projects a scenario with a complete long-term economic collapse or with a new "bubble" that rapidly increases economic growth.

Overview of Methods and Assumptions

Although the methods to estimate energy efficiency impacts, self-generation, and commercial floor space have been refined and residential lighting is now explicitly modeled, *CED 2009 Draft* uses essentially the same methods as earlier long-term staff demand forecasts. The specific data sources and assumptions used for this forecast and any changes to the methods since *CED 2007* are described here. A more detailed discussion of forecast methods and data sources is available in the *Energy Demand Forecast Methods Report*. [12] The Appendix discusses model performance relative to historical consumption and provides other additional documentation for *CED 2009 Revised*.

Models for the major economic sectors produce forecasts of annual energy consumption in each utility planning area. After adjusting for historical weather and usage, the annual consumption forecast is used to forecast annual peak demand.

The commercial, residential, and industrial sector energy models are structural models that attempt to explain how energy is used by process and end use. Structural models are critical to enable forecasts to account for the impacts of mandatory energy efficiency standards and other energy efficiency programs that seek to force or encourage adoption of more efficient technologies by end users. The forecasts of agricultural and water pumping energy consumption are made using econometric methods, while projections for the street lighting and the transportation, communications, and utility sectors rely on trend analyses.

Economic and Demographic Assumptions

Population growth is a key driver for residential and commercial energy demand and for water pumping and other services. As in past forecasts, staff used the California Department of Finance's (DOF) most recent long-term population forecast, which has not been updated since *CED 2007*.[13] **Figure 14** shows the historical (through 2008) and forecasted population growth used in *CED 2009 Revised*. Population is projected to grow at about 1.2 percent annually during the forecast period. For comparison, statewide population grew an average of 1.4 percent annually from 1990 to 2008. The declining growth rates over the forecast horizon reflect lower rates of fertility and immigration as the population of California and other regions age. Older age cohorts have a lower tendency to migrate.[14]

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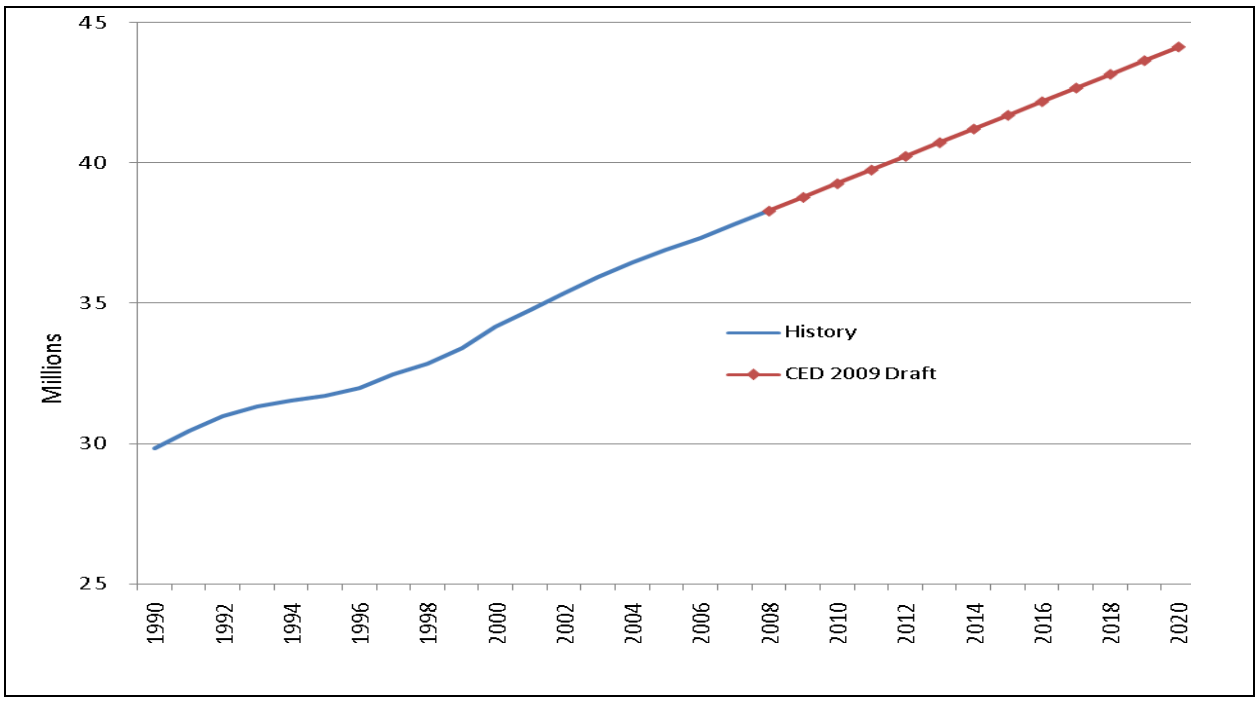
[12] California Energy Commission, *Energy Demand Forecast Methods Report*, CEC-400-2005-036, June, 2005.

[13] Economy.com also provides a population forecast, based on projections from the U.S. Department of Census. Population estimates are lower for recent historical years in the Economy.com forecast, but projected rates of growth (more relevant to Energy Commission energy demand forecasts) for 2010- 2020 are almost identical: 1.16 percent per year for Economy.com and 1.18 percent per year in the DOF forecast.

[14] A "cohort" is a generational group as defined in demographics or statistics.

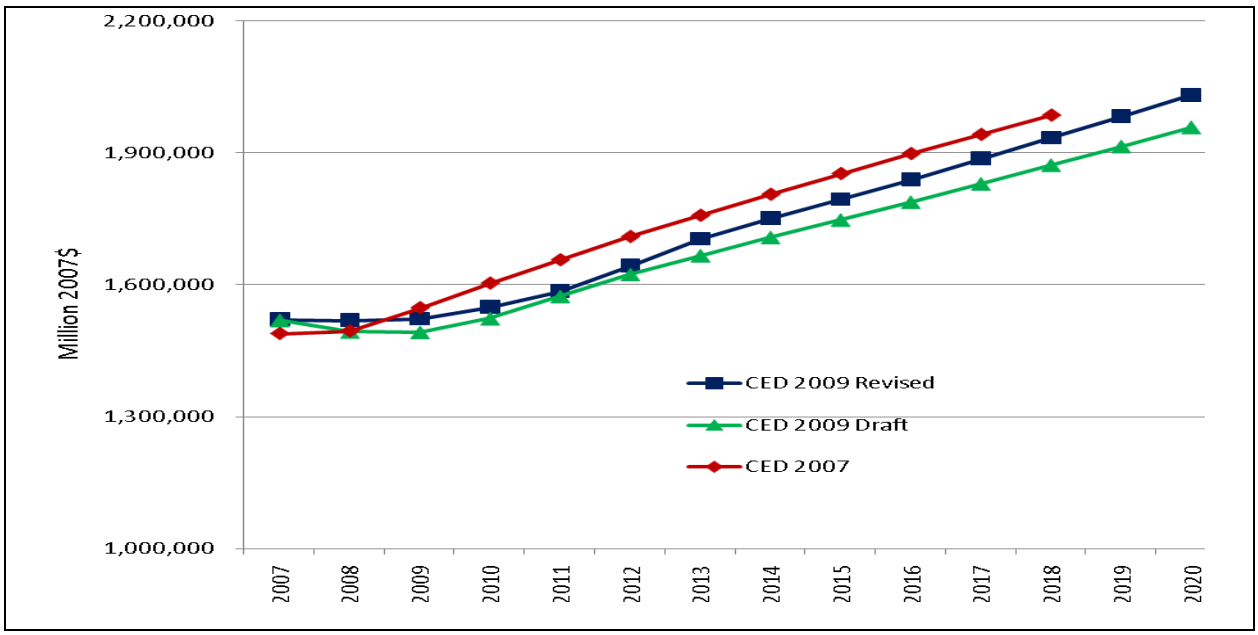
Figure 14: Historical and Projected Total Statewide Population



Source: California Department of Finance, 2009

Most of the difference in energy peak demand and consumption projections compared to *CED 2007* comes from the *base* economic outlook provided by Economy.com. The economic forecast particularly reflects short-term impacts from the current recession. These effects are indicated in **Figure 15**, which compares projected statewide real personal income incorporated in the draft and revised forecasts with that used in *CED 2007*. In the longer term, as the economy is projected to recover, the *CED 2009 Revised* growth rate for personal income return to levels similar to those projected for *CED 2007*. Economic projections were updated in *CED 2009 Revised* using a June 2009 release, compared to December 2008 for *CED 2009 Draft*. The more recent projections show a more optimistic outlook in the longer term, and growth rates are higher in *CED 2009 Revised* than in the draft for personal income and other important economic drivers. Projections for key economic variables are listed in the forms posted with this report on the Energy Commission's website.

Figure 15: Statewide Personal Income ($2007)



Source: Moody's Economy.com, 2009

Electricity and Natural Gas Rate Projections

CED 2009 Revised assumes a slight increase in rates for electricity (15 percent) and natural gas (10 percent) between 2010 and 2020 for each planning area.[15] These projections correspond to the mid-rate scenario used in *CED 2009 Draft*. **Table 7** shows the increase in rates assumed over the first five and last five years of the forecast. Electricity rate projections assumed that most of the increase would occur in the last five years.

Table 7: Percentage Growth in Rates by Scenario and Fuel Type

Time Period	Electricity	Natural Gas
2010-2015	5. 0%	4. 9%
2015-2020	9. 5%	4. 9%

Source: California Energy Commission, 2009

Residential Lighting

Residential lighting was broken out as a separate end use to better capture the effects of residential lighting efficiency programs. Functionally, this meant separating lighting from

[15] If utilities provided a rate forecast for 2009 and 2010 in the *Forms and Instructions* filed with the Energy Commission in March 2009, these were used; otherwise rates were kept constant from 2008-2010.

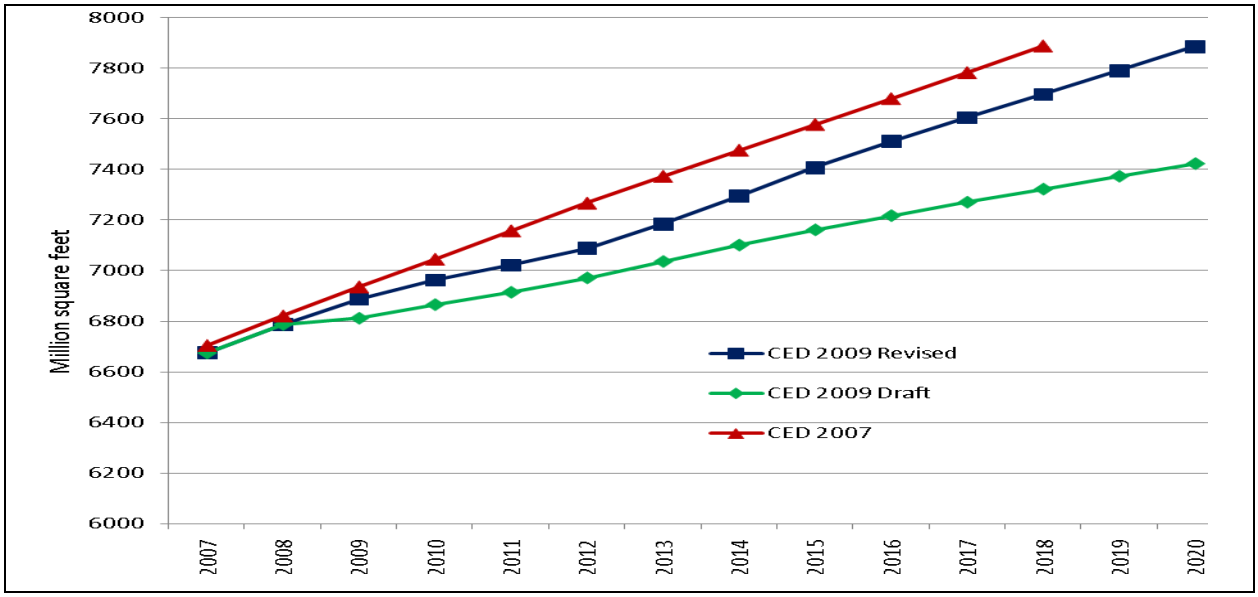
the *miscellaneous* end use in the Residential Model, estimating historical use of lighting per household and projecting the use through 2020.

Historical estimates of lighting use per household through 2004 are based on values supplied by the consulting firm Itron along with various lighting studies. For the investor-owned utility (IOU) planning areas, reported energy savings and efficiency program plans were used to provide reductions to average lighting use relative to the 2004 estimates for 2005 – 2011. Details about average lighting input assumptions and the impact of residential lighting programs are provided in the Appendix.

Floor Space Forecast

Energy use in the commercial sector is modeled in terms of energy use per square foot for each of twelve different building types. A forecast of floor space in each county serves as the economic driver of demand trends. For *CED 2009 Revised*, staff applied the econometric model for forecasting growth in floor space developed for *CED 2007*. A new model was estimated for *CED 2009 Draft*, but staff was concerned that the newer methods may have been producing unrealistically low commercial energy output. The difference in models, along with a more optimistic economic outlook, gives a higher projected growth rate for floor space in *CED 2009 Revised* than in the draft forecast, although projections remain below CED 2007 levels through 2018. **Figure 16** shows projected floor space for the three forecasts.

Figure 16: Comparison of CED 2007, CED 2009 Draft, and CED 2009 Revised Statewide Commercial Floor Space Projections



Source: California Energy Commission, 2009

Conservation/Efficiency Impacts

Energy Commission demand forecasts seek to account for all conservation that is *reasonably expected to occur*. Since the 1985 *Electricity Report*, reasonably expected to occur conservation programs have been split into two types: committed and uncommitted. *CED 2009 Revised* continues that distinction. Committed programs are defined as programs that have been implemented or for which funding has been approved and include some form of program plan. While conservation reasonably expected to occur includes both committed and uncommitted programs, only the effects of committed programs are included in the demand forecast. However, the Energy Commission models include naturally occurring or market-driven energy efficiency. Therefore, the forecasts include some impacts associated with the historical and ongoing levels of programs to the extent they represent impacts associated with replacement of aging building stock and equipment, or installation of new stock and equipment at efficiency levels that comply with current building and appliance standards. Uncommitted effects are thus defined as the incremental impacts of the level of future programs (for example, savings associated with new equipment that exceeds current standards or early replacement of existing stock), impacts of new programs, and impacts from expansion of current programs.

Chapter 8 gives details regarding the committed energy efficiency impacts projected for *CED 2009 Revised*. Staff will also provide a forecast of the impacts of uncommitted programs on energy demand later this year.

Demand Response

The term *demand response* encompasses a variety of programs, including traditional direct control (interruptible) programs and new price-responsive demand programs. A key distinction is whether the program is dispatchable. Dispatchable programs, such as direct control, interruptible tariffs, or demand bidding programs, have triggering conditions that are not under the control of, and cannot be anticipated by, the customer. Energy or peak load saved from dispatchable programs is treated as a resource and is therefore not accounted for in the demand forecast. Non-dispatchable programs are not activated using a predetermined threshold condition but allow the customer to make the economic choice whether to modify usage in response to ongoing price signals. Impacts from committed non-dispatchable programs should be included in the demand forecast.

At this time, all of the existing demand response programs have some form of triggering condition. Although the utility or California ISO may not have direct control, only the customer has the opportunity to participate in the program when the program operator has called an event, either because of high market prices or resource scarcity. Therefore, in this forecast, no demand response impacts are counted on the demand side.

Self-Generation

CED 2009 Revised accounts for all the major programs designed to promote self-generation, building up from sales of individual systems. Incentive programs include:

- Emerging Renewables Program (ERP)—managed by the Energy Commission
- California Solar Initiative (CSI)–managed by the CPUC
- Self-Generation Incentive Program (SGIP)–managed by the CPUC
- New Solar Homes Partnership (NSHP)—managed by the Energy Commission
- Incentives administered by public utilities such as SMUD, LADWP, Burbank Water and Power, City of Glendale, City of Pasadena, and IID

The forecast also accounts for power plants that report information to the Energy Commission. The principal source of that information is Form CEC-1304, which must be submitted to the Energy Commission by owners of electric power plants located in California or within a control area serving end users inside California. Staff included only power plants that were explicitly listed as operating under cogeneration or self-generation mode in the forecast.

The general strategy of the ERP, CSI, SGIP, and NSHP programs is to encourage demand for self-generation technologies with financial incentives until the size of the market increases to the point where economies of scale are achieved and capital costs decline. The extent to which consumers see real price declines will depend on the interplay of supplier expectations, the future level of incentives, and resulting overall demand.

The ERP and SGIP programs currently fund small wind turbines and fuel cells. Based on the availability of historical data, either a simple trend or the average rate of installations reflected in the historical data was used to project future capacity additions. For the CSI and NSHP programs, added future photovoltaic (PV) capacity was projected by taking the average annual capacity installed and pending for 2008 and 2009 for the IOUs, and the capacity installed in 2008 for the publicly owned utilities, where 2009 data was not yet available. These values are carried forward until 2016, when both the CSI and NSHP programs are scheduled to end. Capacity additions between 2017 and 2020 are derived by allowing the cumulative installed capacity to grow at the historical rate of electricity consumption for each sector. The difference in cumulative capacity between successive years is assumed to reflect new additions once the programs have ended.

Capacity additions for programs administered by the public utilities were assumed to increase at the same rate as electricity growth by sector. For the large generators reporting under CEC-1304, cumulative capacity was assumed to remain constant at 2008 levels throughout the forecast period. Inspection of historical data revealed no trend upward or downward in installations. Since many of these plants sell electricity back to the grid, the effective plant generating capacity for projecting future onsite generation was derived by

weighting overall plant capacity by the ratio of historical total electricity consumed by the plant to the overall electricity generated.

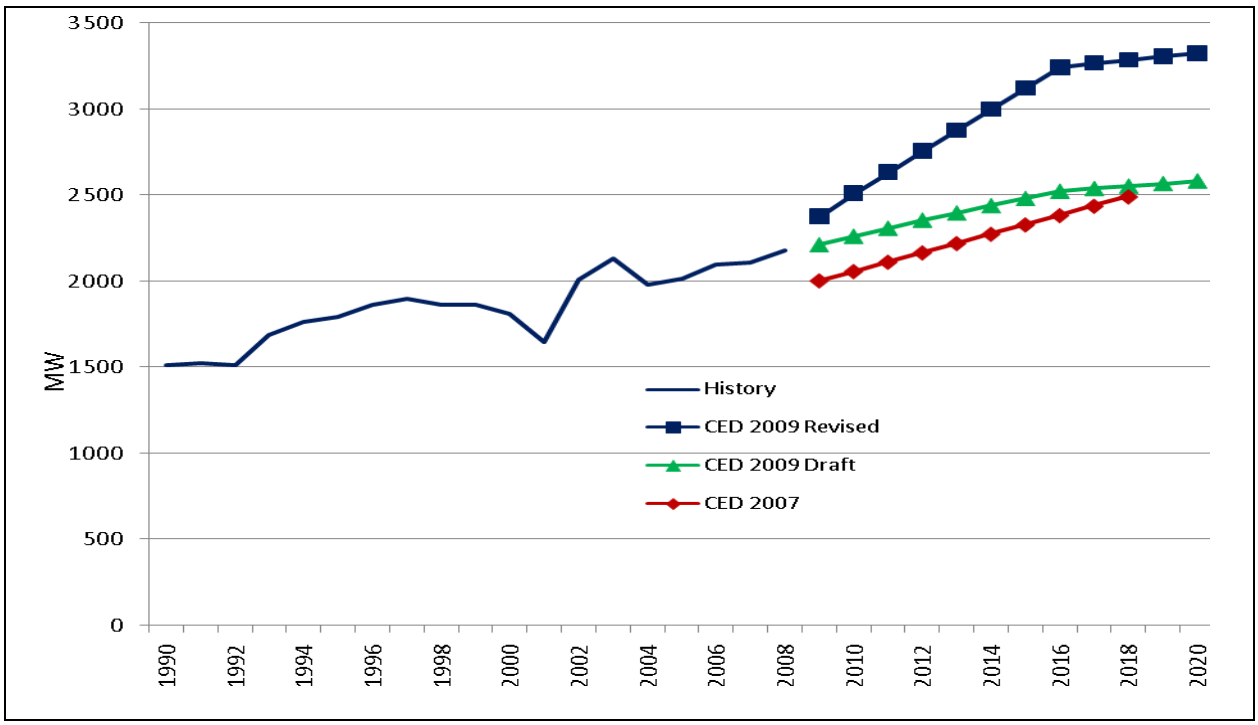
To translate self-generation capacity into effects on system peak demand requires assumptions about load shape, the coincidence of self-generation peak with system peak, and the extent to which self-generation units are operating during peak hours. Staff used four annual evaluation studies of the SGIP program for these assumptions.[16] For example, the 2004 study found that the load impact at the time of the 2004 California ISO peak was 58 MW out of 103 MW of installed capacity. Staff averaged the results of these studies to develop a peak factor for *CED 2009 Revised*. *CED 2009 Draft* relied on the 2004 study only.

Figure 17 shows the cumulative impacts of self-generation of all types on peak demand for the three forecasts. In *CED 2009 Revised*, self-generation is projected to reduce peak load by more than 3,300 MW, significantly more than in the two previous forecasts. This difference comes mainly from higher projections for PV system adoption, shown in **Figure 18**, a result of incorporating 2009 adoptions and pending adoptions. By 2018, PV is projected to reduce peak demand by slightly less than 1,300 MW, 600 MW higher than in *CED 2009 Draft* and 850 MW higher than in *CED 2007*. Staff used a peak factor of 0.5, which means that projected installed capacity is twice as high as the impacts shown in **Figure 18**. Both figures show a reduced rate of increase for self-generation impacts in the draft and revised forecasts beyond 2016, reflecting the end of the solar programs. Self-generation is projected to reduce electricity sales by around 15,500 GWH in 2018, around 2,000 GWH higher than *CED 2007* and 3,000 GWH higher than in *CED 2009 Draft*.

These projections are consistent with current demand but may prove to be conservative. Staff is developing predictive models for some of the self-generation technologies based on estimated payback periods and cost-effectiveness, determined by upfront costs, energy rates, and incentive levels. The first model, near completion, is designed to project residential demand for PV systems. This model is based on one used by the Energy Information Administration as part of its National Energy Modeling System. Details of the model are provided in the Appendix.

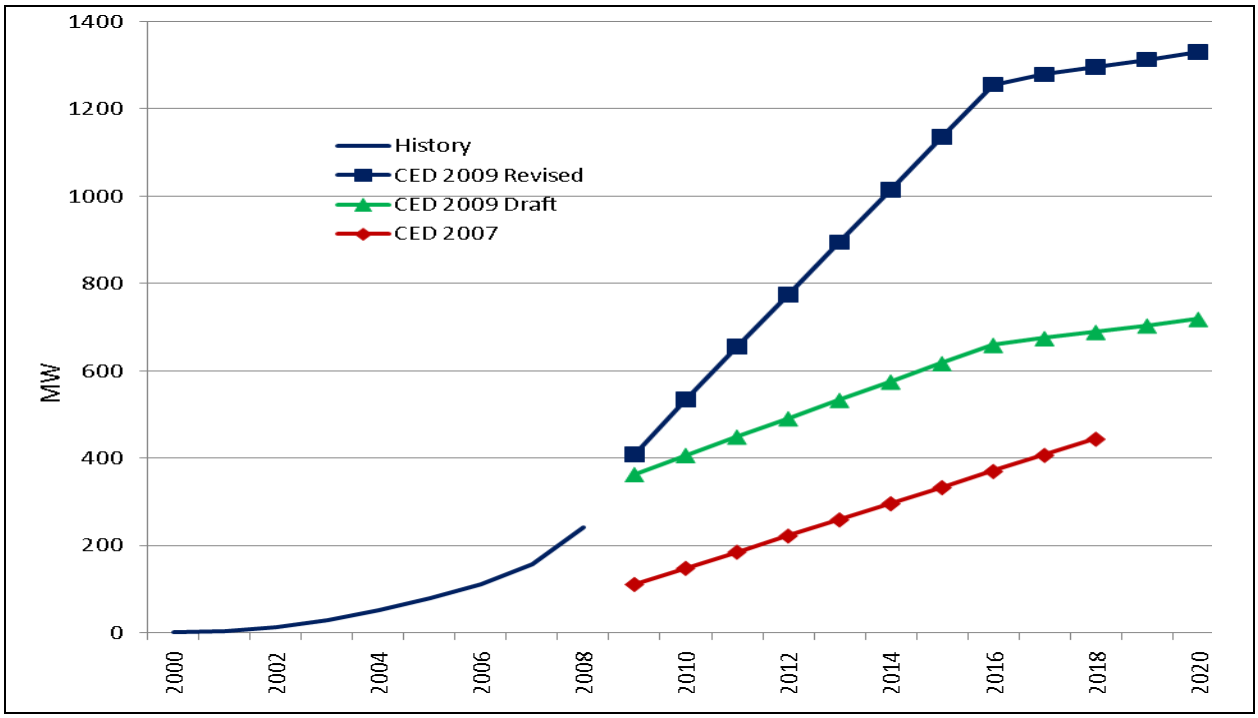
[16] *CPUC Self-Generation Incentive Program Impact Report*, 2004-2007.

Figure 17: Statewide Cumulative Peak Impacts of Self-Generation



Source: California Energy Commission, 2009

Figure 18: Statewide Cumulative Peak Impacts of PV Self-Generation



Source: California Energy Commission, 2009

Historical Electricity Consumption Estimates

Energy Commission forecasting models are organized by sector according to economic activity: commercial, industrial, agricultural, and so on. Each of these models develops a forecast based on sub-activities within the sector (for example, commercial building type or industrial activity). Under the Energy Commission's Quarterly Fuel and Reporting (QFER) regulations, each load-serving entity (LSE) is required to file monthly and annual reports that document energy consumption by activity group.

The quality of the QFER data continues to be undermined by LSE data coding errors, lack of adherence to regulations by some LSEs, and failure to provide economic classification for some of the data. However, unclassified consumption has declined significantly in recent years. From a high of almost 20,000 GWh in 2003, unclassified energy use dropped to less than 8,000 GWh in 2008 as economic classification is now provided for direct access customers, per current reporting requirements. Staff allocated unclassified consumption to economic sectors using professional judgment, relying on such factors as apparently unrealistic changes in historical consumption in a given sector.

Demand Forecast Disaggregation

Many uses for demand forecasts require more disaggregation than the planning area forecasts presented in the following chapters. For example, electricity system analysis requires identification of load by congestion zone or load pocket; evaluation of progress toward renewable energy goals requires sales data by individual LSEs; development of energy efficiency goals requires projections of per capita sales by LSEs; and controlled grid studies require forecasts for each LSE, sometimes with geographic subdivisions. The statewide tables accompanying this report include forecast disaggregations developed by staff to support some of these applications.

Structure of Report

Chapters 2-6 provide *CED 2009* electricity forecasts for the following planning areas: Pacific Gas and Electric, Southern California Edison, San Diego Gas & Electric, SMUD, and LADWP, in that order. All of the planning areas included in this forecast are described in **Table 8**. Chapter 7 provides statewide results from the end-user natural gas forecast, along with results for the Pacific Gas and Electric, Southern California Gas, and San Diego Gas & Electric distribution areas. Chapter 8 describes staff work focused on refining and improving methods to incorporate energy efficiency and conservation savings within the forecast and presents staff estimates of the impacts resulting from utility efficiency programs, building and appliance standards, and other conservation-related factors. The Appendix provides information about the economic scenarios, the impact of climate change on peak demand, model performance, residential lighting, self-generation, utility efficiency program impacts,

and ongoing evaluation of staff modeling methodologies and alternative forecasting approaches.

Table 8: Utilities Within Forecasting Areas

Planning Area	Utilities Included	
Electric Areas		
Pacific Gas and Electric (PG&E)	PG&E Alameda Biggs Calaveras Gridley Healdsburg Lassen MUD Lodi Lompoc Merced Modesto Palo Alto	Plumas – Sierra Port of Stockton PWRPA Redding Roseville San Francisco Shasta Silicon Valley Tuolumne Turlock Irrigation District Ukiah USBR-CVP
Sacramento Municipal Utility District (SMUD)	SMUD	
Southern California Edison (SCE)	Anaheim Anza Azusa Banning Bear Valley Colton MWD	Ranch Cucamonga Riverside Southern California Edison USBR-Parker Davis Valley Electric Vernon Victorville
Los Angeles Department of Water and Power (LADWP)	LADWP	
San Diego Gas & Electric (SDG&E)	SDG&E	
Cities of Burbank and Glendale (BUGL)	Burbank,Glendale	
Pasadena (PASD)	Pasadena	
Imperial (IID)	Imperial Irrigation District	
Department of Water Resources (DWR)	DWR	
Natural Gas Distribution Areas		
PG&E	PG&E Electric Planning Area, SMUD	
SDG&E	SDG&E	
Southern California Gas Company (SCG)	SCG, Long Beach	
OTHER	Avista Energy, Southwest Gas Corporation	

Source: California Energy Commission, 2009

CHAPTER 2: Pacific Gas and Electric Planning Area

The Pacific Gas and Electric (PG&E) planning area includes:

- PG&E bundled retail customers.
- Customers served by energy service providers (ESPs) using the PG&E distribution system to deliver electricity to end users.
- Customers of publicly owned utilities and irrigation districts in PG&E's transmission system, with the exception of the Sacramento Municipal Utility District (SMUD). SMUD is treated as its own planning area and is discussed in a later chapter.

For purposes of this chapter, the PG&E planning area forecast includes the members of the SMUD control area, Roseville, Redding, and the Western Area Power Administration (WAPA). To support electricity and transmission system analysis, staff uses historical consumption and load data to develop individual forecasts for all medium and large utilities in the planning area. Those results are presented in Forms 1.5a through 1.5c following Chapter 1. The results in this chapter are for the entire PG&E transmission planning area.

This chapter is organized as follows. First, forecasted consumption and peak loads for the PG&E planning area are discussed; both total and per capita values are presented. *CED 2009 Draft* values are compared to adopted *CED 2007* values, with differences between the two forecasts explained. The forecasted load factor, jointly determined by the consumption and peak load estimates, is also discussed. Second, the chapter presents sector consumption and peak load forecasts. The residential, commercial, industrial, and "other" sector forecasts are compared to those in *CED 2007*, and differences between the two are discussed. Third, the chapter discusses the forecasts self-generation and effects of conservation and efficiency programs.

For *CED 2009 Draft*, three price scenarios were developed for electricity rates: high-rates, low (constant) rates, and a mid-rate scenario in between the two. The high rate case assumed approximately 30 percent higher rates by 2020 relative to 2010, while the mid-rate case assumed 15 percent higher rates over the same period. In the low-rate case, rates remained at 2010 levels through 2020 as was done in *CED 2007*. In *CED 2009 Revised,* the mid-rate price forecast is used, and all comparisons to *CED 2009 Draft* are made to the mid-rate scenario. Chapter 1 provides more details on price assumptions.

Forecast Results

The following summarizes the results presented in this chapter:

- *CED 2009 Revised* forecasts of PG&E planning area electricity consumption and peak demand are lower than *CED 2007* levels because of the economic downturn and increased efficiency impacts, but higher than in *CED 2009 Draft*.
- Per capita electricity consumption and peak demand are also projected to be lower than in *CED 2007* but higher than in *CED 2009 Draft*.
- The largest percentage reduction in electricity consumption and peak demand relative to *CED 2007* occurs in the residential sector.
- Alternative economic scenarios increase or decrease electricity consumption and peak demand by around 2.3 percent in 2020.
- Self-generation impacts are projected to be higher than in *CED 2007* and *CED 2009 Draft*, mainly because of increased adoption of photovoltaic systems.

Table 9 presents a comparison of the planning area electricity consumption and peak demand forecasts for selected years. *CED 2009 Revised* compares both *CED 2009 Draft* mid rate and *CED 2007*. The revised electricity consumption forecast is higher than *CED 2009 Draft* by more than 4 percent at the end of the forecast period. This is caused mainly by higher economic forecast values provided in June Moody's Economy.com forecast.

The revised consumption forecast is still about 2 percent lower than *CED 2007* at the end of the period. The revised peak forecast is now slightly higher (1 percent) than *CED 2009 Draft* by the end of the forecast period. This is still more than 5 percent lower than *CED 2007*. The smaller increase in the revised peak forecast, relative to changes in the consumption forecast, is caused by increased self-generation assumptions. This reduces net system peak but does not reduce total electricity consumption. Long-term growth rates of both *CED 2009 Revised* consumption and peak forecasts are now just slightly below the growth rates of *CED 2007*.

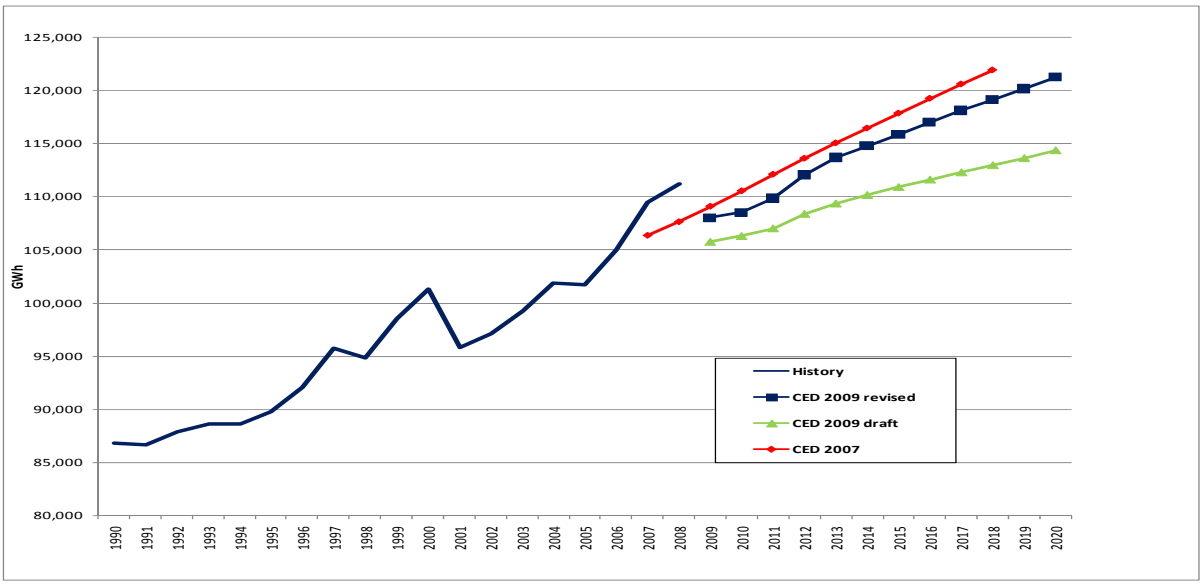
Table 9: PG&E Planning Area Forecast Comparison

Consumption (GWH)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* mid-rate case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Percentage Difference *CED 2009 Revised /CED 2007*	Percentage Difference *CED 2009 Revised / CED 2009 Draft*
1990	86,803	86,803	86,803	0.00%	0.00%
2000	101,331	101,331	101,333	0.00%	0.00%
2008	107,591	106,753	111,205	3.36%	4.17%
2010	110,503	106,240	108,526	-1.79%	2.15%
2015	117,806	110,878	115,860	-1.65%	4.49%
2018	121,873	112,959	119,123	-2.26%	5.46%
Average Annual Growth Rates					
1990-2000	1.56%	1.56%	1.56%		
2000-2008	0.75%	0.65%	1.17%		
2008-2010	1.34%	-0.24%	-1.21%		
2010-2018	1.23%	0.77%	1.17%		
Peak (MW)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* mid-rate case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Percentage Difference *CED 2009 Revised /CED 2007*	Percentage Difference *CED 2009 Revised / CED 2009 Draft*
1990	17,055	17,013	17,250	-0.25%	1.39%
2000	20,716	20,665	20,628	-0.25%	-0.18%
2008	23,413	23,405	23,727	-0.03%	1.38%
2010	24,050	23,240	23,321	-3.37%	0.35%
2015	25,760	24,606	24,874	-4.48%	1.09%
2018	26,754	25,341	25,742	-5.28%	1.58%
Average Annual Growth Rates					
1990-2000	1.96%	1.96%	1.80%		
2000-2008	1.54%	1.57%	1.76%		
2008-2010	1.35%	-0.35%	-0.86%		
2010-2018	1.34%	1.09%	1.24%		
Historical values are shaded					

Source: California Energy Commission, 2009

As shown in **Figure 19**, the *CED 2009 Revised* consumption forecast is about 5 percent higher than *CED 2009 Draft* values by the end of the forecast period but is still below the *CED 2007* projection throughout the forecast period. The dip in the early years of *CED 2009 Revised* is caused by both the revised economic projections and by elevated assumptions about increased energy efficiency program savings.

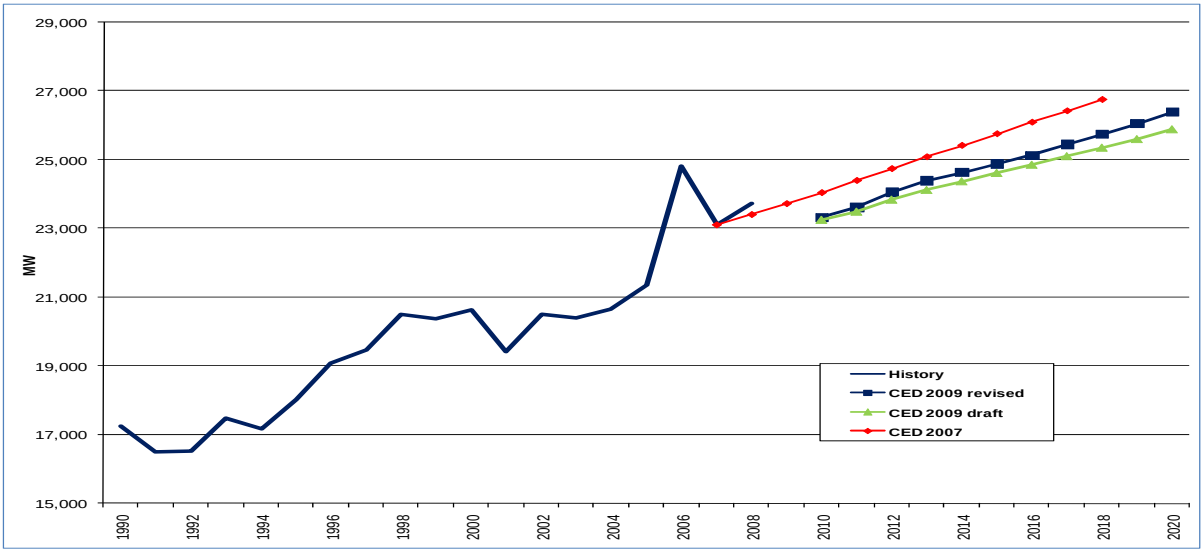
Figure 19: PG&E Planning Area Electricity Forecast



Source: California Energy Commission, 2009

CED 2009 Revised PG&E planning area peak demand (**Figure 20**) is slightly higher than *CED 2009 Draft* by the end of the forecast period. The reason for the smaller difference in peak demand between the forecasts, compared to that in consumption, is a significant increase in photovoltaic self-generation (which has a much larger relative impact on peak than on consumption).

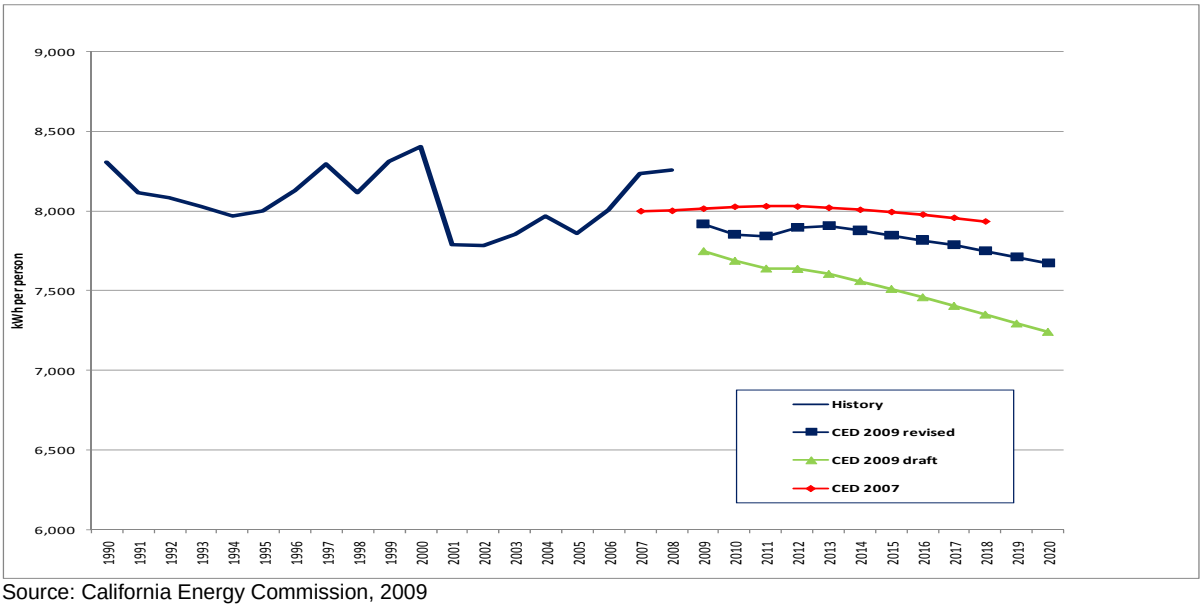
Figure 20: PG&E Planning Area Peak



Source: California Energy Commission, 2009

Figure 21 compares forecasted per capita residential electricity consumption. Per capita consumption in *CED 2009 Revised* is higher than in *CED 2009 Draft*. It is still below the projection of *CED 2007*. The revised projection declines slightly over the forecast period and is lower than recent recorded history. The dip in per capita consumption in the near term is caused by a combination of the aforementioned economic/demographic forecast assumptions and increased savings from energy efficiency programs.

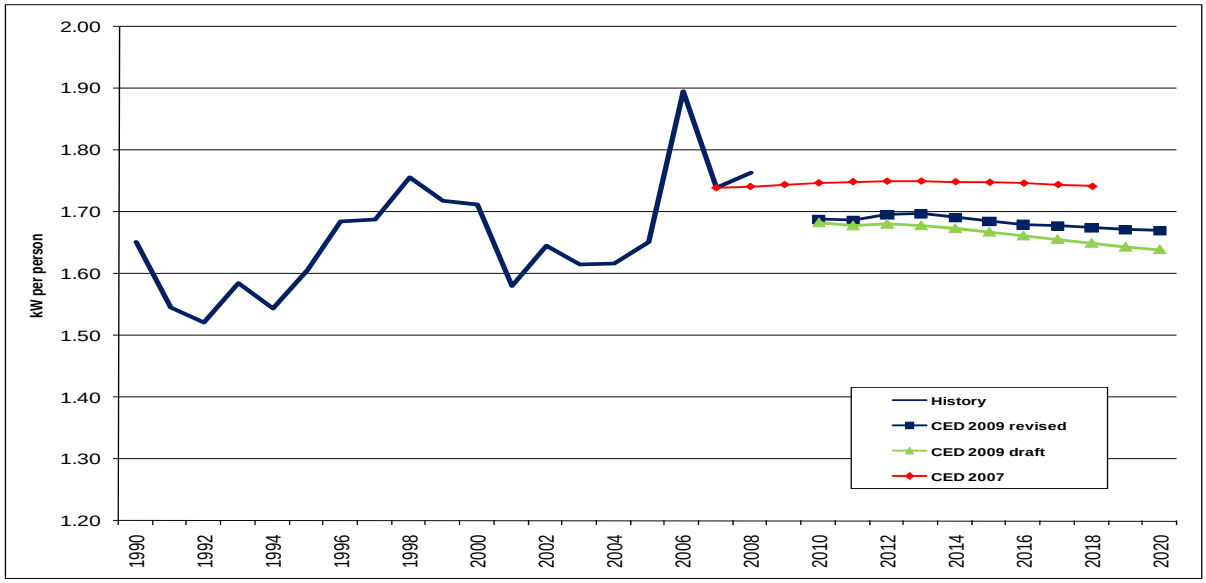
Figure 21: PG&E Planning Area per Capita Electricity Consumption



Source: California Energy Commission, 2009

CED 2009 Revised per capita peak demand, shown in **Figure 22**, is now slightly higher than *CED 2009 Draft* by the end of the forecast period. *CED 2009 Revised* per capita peak demand is lower than recent history because of recent economic events and increases in savings from efficiency programs. The small decline in long-term per capita consumption is a result of continued savings from efficiency programs (both standards and utility programs) as well as from increased self-generation peak reductions.

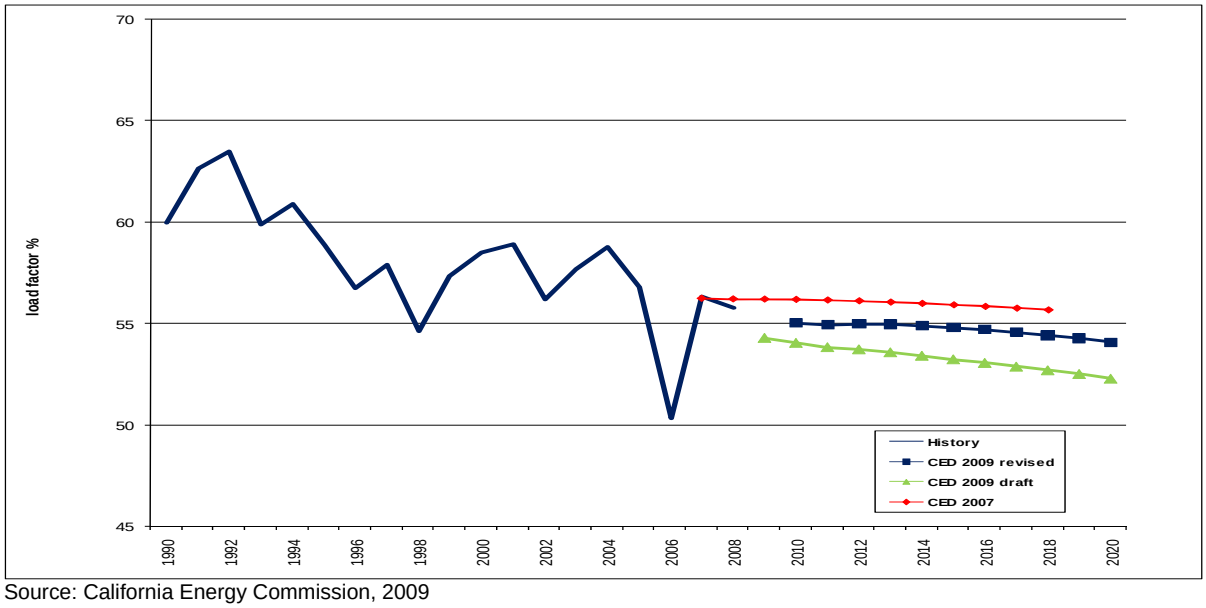
Figure 22: PG&E Planning Area per Capita Peak Demand



Source: California Energy Commission, 2009

Figure 23 compares respective forecast load factors. High load factors observed from 1998-2005 are a product of lower-than-average peak temperatures and reaction to the energy crisis. The projected load factor, based on higher, 1-in-2 peak temperatures and a return to normal air conditioning use patterns, should be lower than these recent values. The *CED 2009 Revised* load factor is higher than *CED 2009 Draft* because of the revised self-generation estimate, which lowers peak relative to consumption peak. As in *CED 2009 Draft*, the *CED 2009 Revised* load factor is projected to decline over the forecast period.

Figure 23: PG&E Planning Area Peak Load Factor



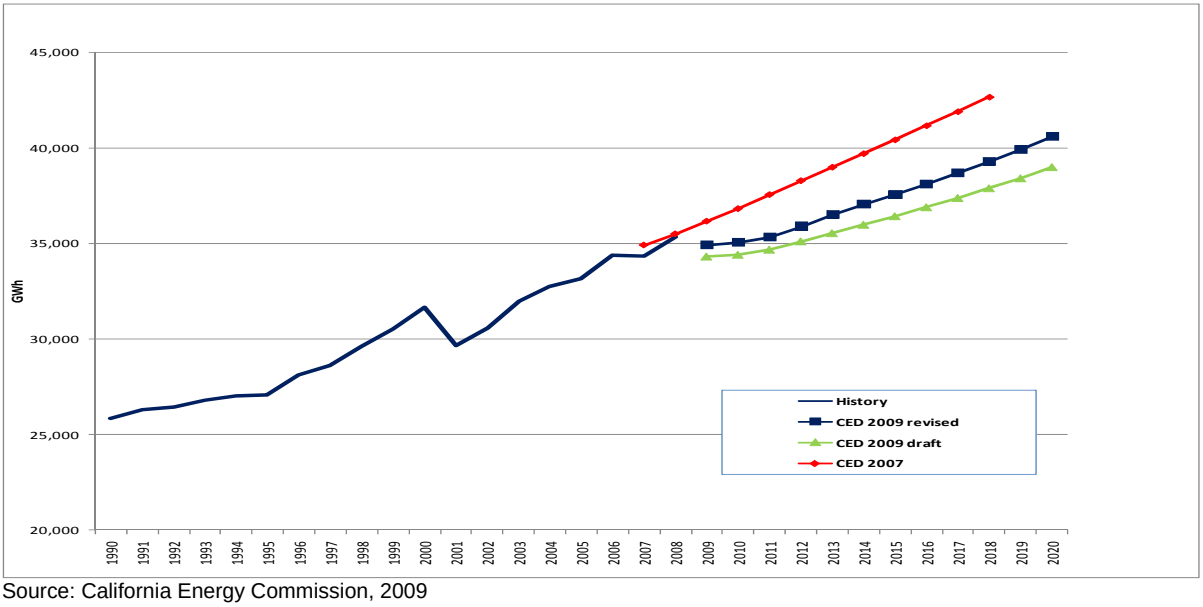
Source: California Energy Commission, 2009

Sector Level Results and Input Assumptions

Residential

Figure 24 compares residential forecasts. *CED 2009 Revised* is higher over the entire forecast period than *CED 2009 Draft* but is still well below the level of *CED 2007*. The increase over *CED 2009 Draft* is caused by increased projections of household income, as well as an increase in the starting value brought about by inclusion of 2008 sales. *CED 2009 Revised* household income projections are still below those projected in *CED 2007*.

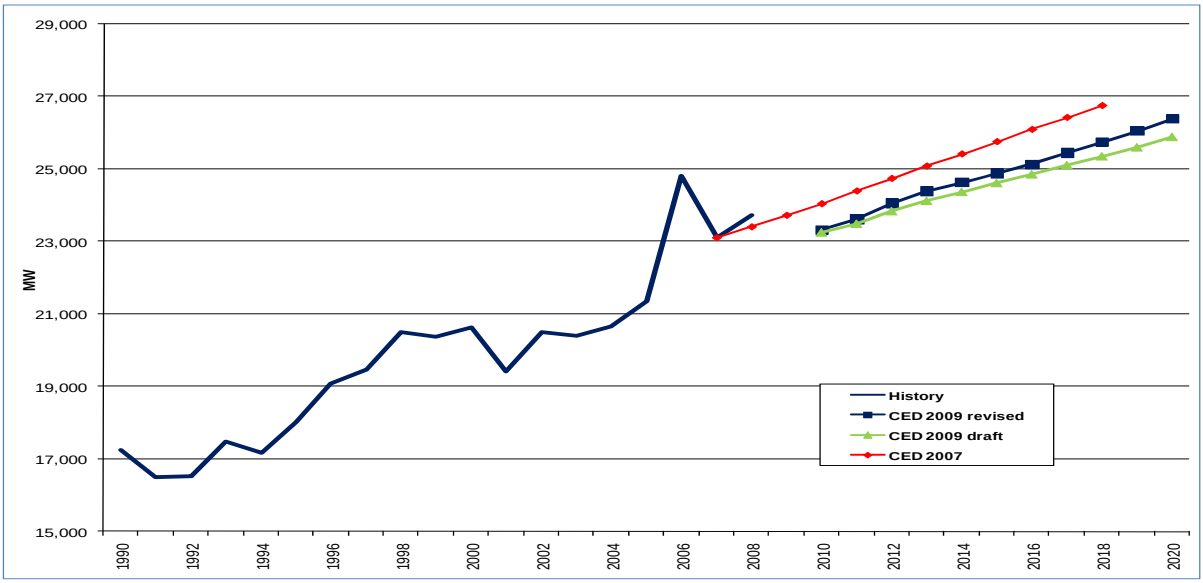
Figure 24: PG&E Planning Area Residential Consumption



Source: California Energy Commission, 2009

Figure 25 compares residential peak demand forecasts. Unlike the consumption forecast, there is only a slight increase in *CED 2009 Revised* over *CED 2009 Draft* residential peak. Almost all of the residential consumption increase is caused by end-use consumption that has little impact on peak.

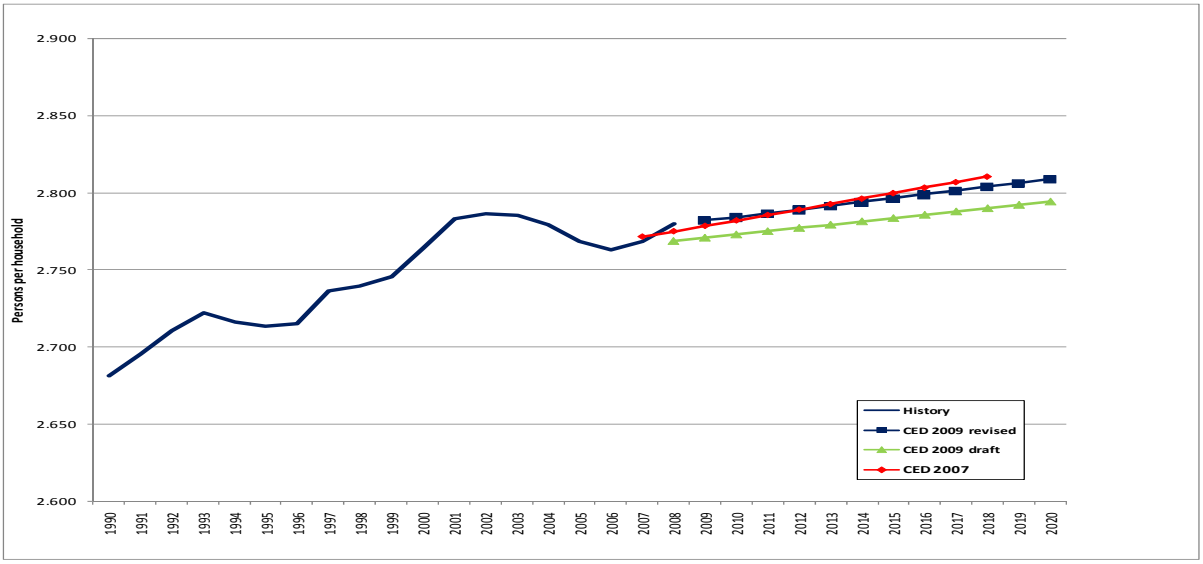
Figure 25: PG&E Planning Area Residential Peak



Source: California Energy Commission, 2009

Figures 26 and **27** compares residential drivers used in the forecasts. **Figure 26** compares persons per household projections. There is slight increase in the forecast of persons per household in *CED 2009 Revised* compared *CED 2009 Draft*. This is primarily caused by inclusion of 2008 person-per-household estimates in *CED 2009 Revised*. The change in *CED 2009 Revised* projections reduces the household forecast by about 28,000 households by the end of the forecast period compared to *CED 2009 Draft* (about 0.5 percent). The new projections are similar to *CED 2007* estimates through the middle of the forecast period.

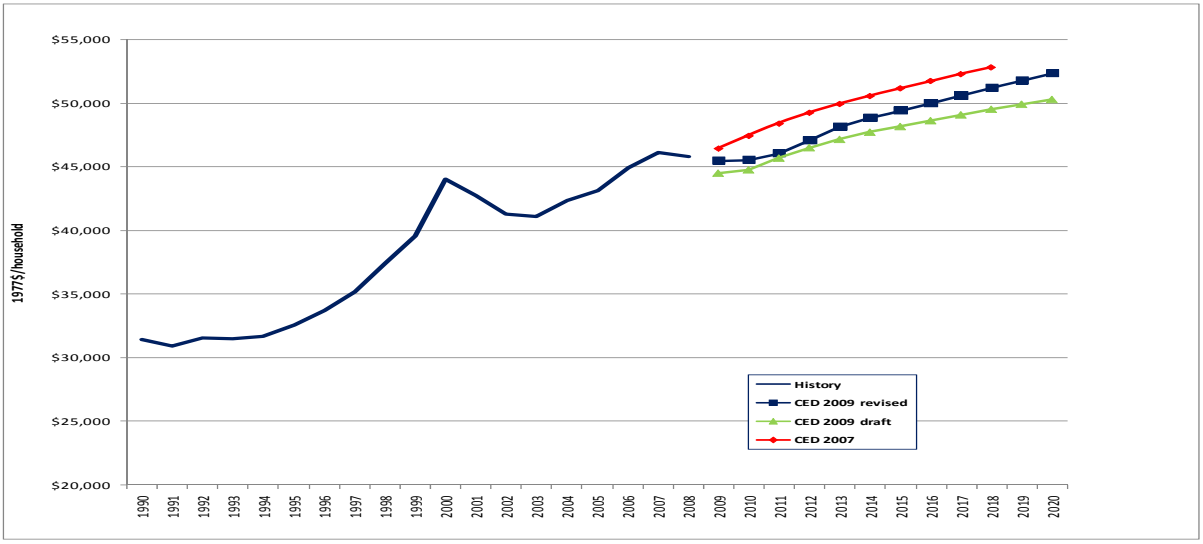
Figure 26: PG&E Planning Area Persons-per-Household Projections



Source: California Energy Commission, 2009

Figure 27 compares household income used in the respective forecasts. *CED 2009 Revised* projection is higher than that used in *CED 2009 Draft* but is still below what was used in *CED 2007*. *CED 2009 Revised* uses the June 2009 projections from Economy.com, while the previous forecasts used earlier vintages of Economy.com projections. The new projections produce long-term growth similar to that used in *CED 2007* coming out of the current economic slump.

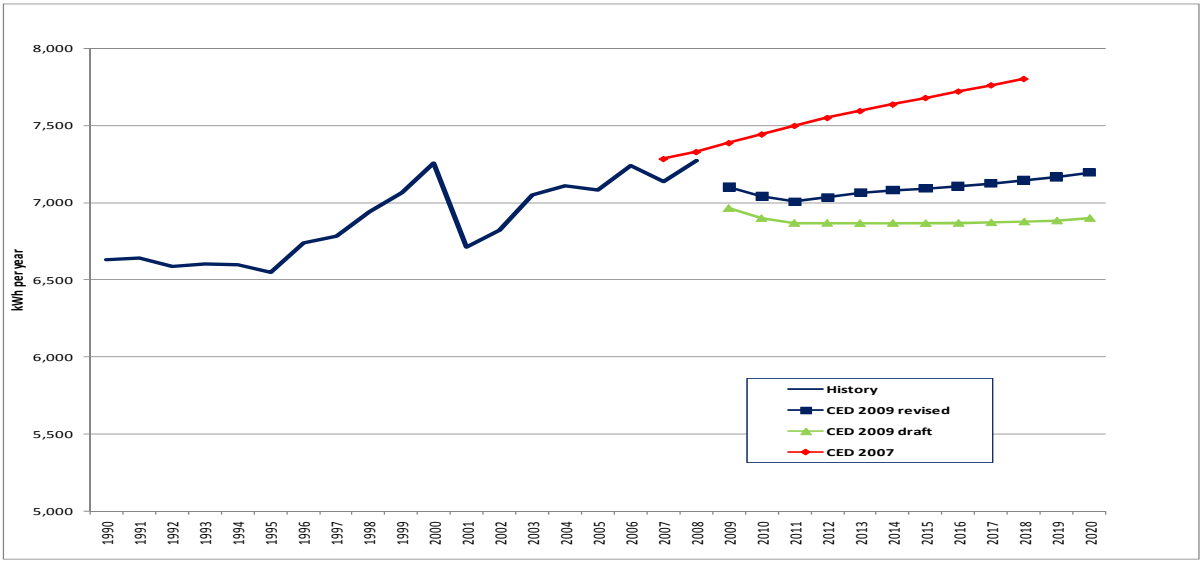
Figure 27: PG&E Planning Area Household Income Projections



Source: California Energy Commission, 2009

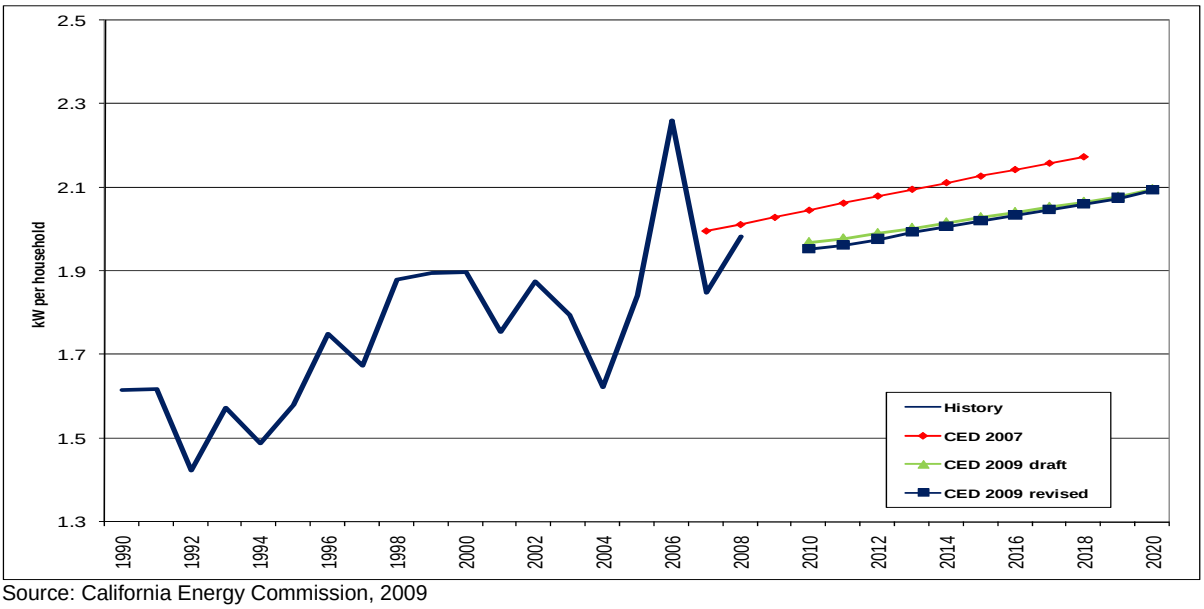
Figures 28 and **29** present comparisons of residential use per household and residential peak use per household, respectively. *CED 2009 Revised* use per household (**Figure 2-10**) is higher than *CED 2009 Draft*. This is partly caused by inclusion of 2008 sales data to adjust the starting point upward, as well as the use of increased household income projections. *CED 2009 Revised* use per household is still well below the level of *CED 2007* projections. In contrast, differences in peak use per household (**Figure 2-11**) are virtually unchanged in *CED 2009 Revised* compared to *CED 2009 Draft* because most of the consumption increases do not directly translate into peak impacts.

Figure 28: PG&E Planning Area Use per Household



Source: California Energy Commission, 2009

Figure 29: PG&E Planning Area Peak Use per Household

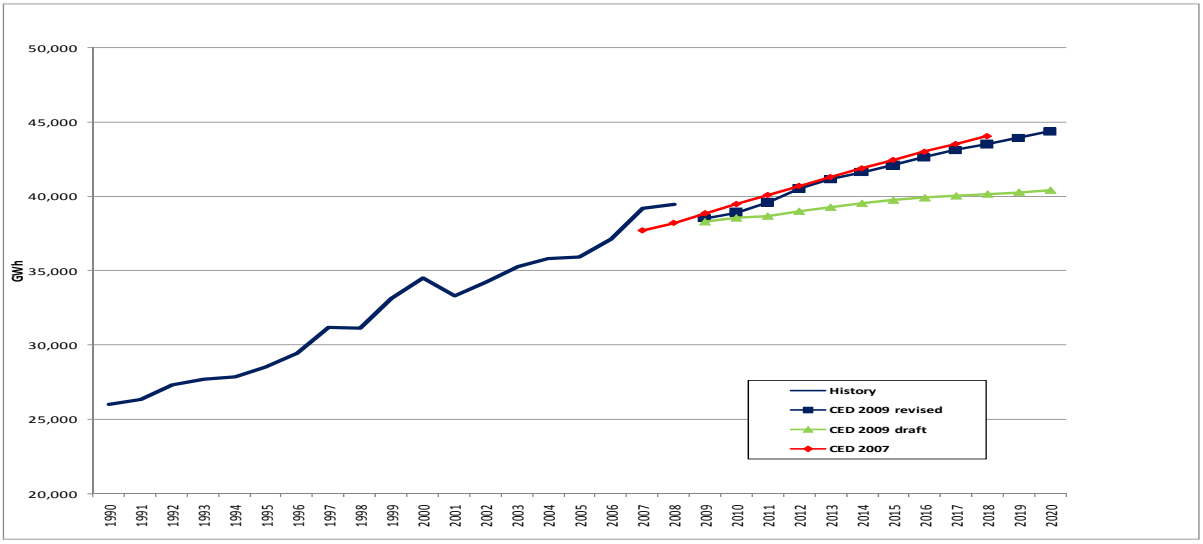


Source: California Energy Commission, 2009

Commercial Building Sector

Figures 30 and **31** compare commercial building sector forecasts. *CED 2009 Revised* is higher than *CED 2009 Draft* because of increased economic growth assumptions, as well as revisions to commercial floor space projections. *CED 2009 Revised* is still below the projections of *CED 2007*.

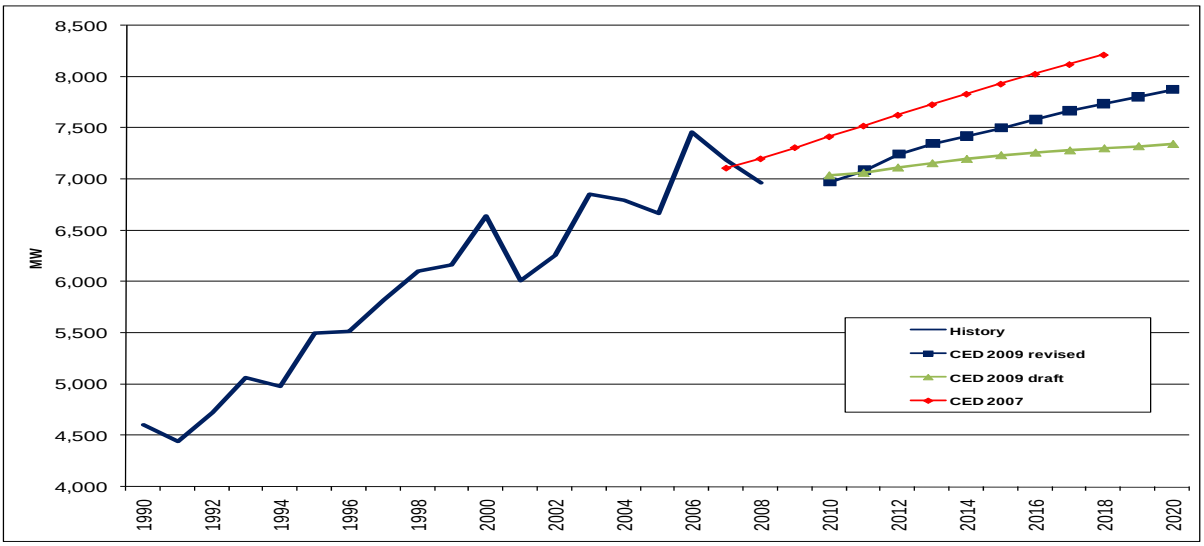
Figure 30: PG&E Planning Area Commercial Consumption



Source: California Energy Commission, 2009

Figure 31 compares commercial building sector peak demand forecasts. Differences in the peak forecasts are smaller than those in the consumption forecast because revised self-generation estimates and increases to end-use consumption have little peak impact.

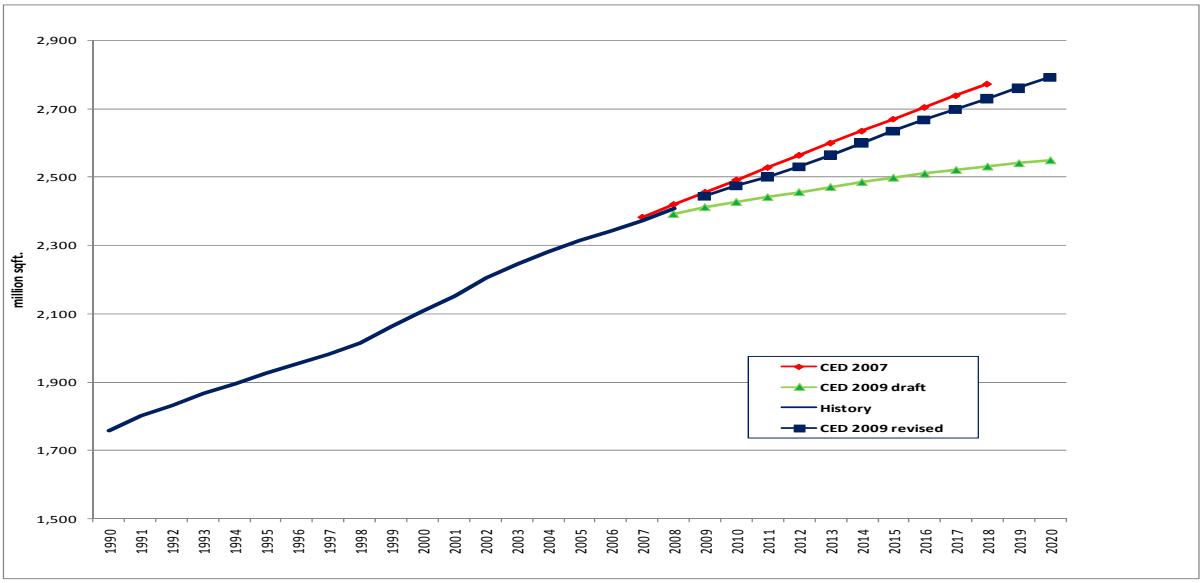
Figure 31: PG&E Planning Area Commercial Sector Peak



Source: California Energy Commission, 2009

In staff's commercial building sector forecasting model, floor space by building type (that is, retail, schools, offices, and so forth) is the key driver of energy use for each specific building type. **Figure 32** compares total commercial floor space projections. The difference between forecasts is caused by differences in economic and demographic drivers, as well as changes to the econometric estimates in the floor space model. *CED 2009 Revised* floor space estimates are higher in total than *CED 2009 Draft* forecast projections, but still below the level projected in *CED 2007*. The new estimate also has a higher value of additions than *CED 2009 Draft*.

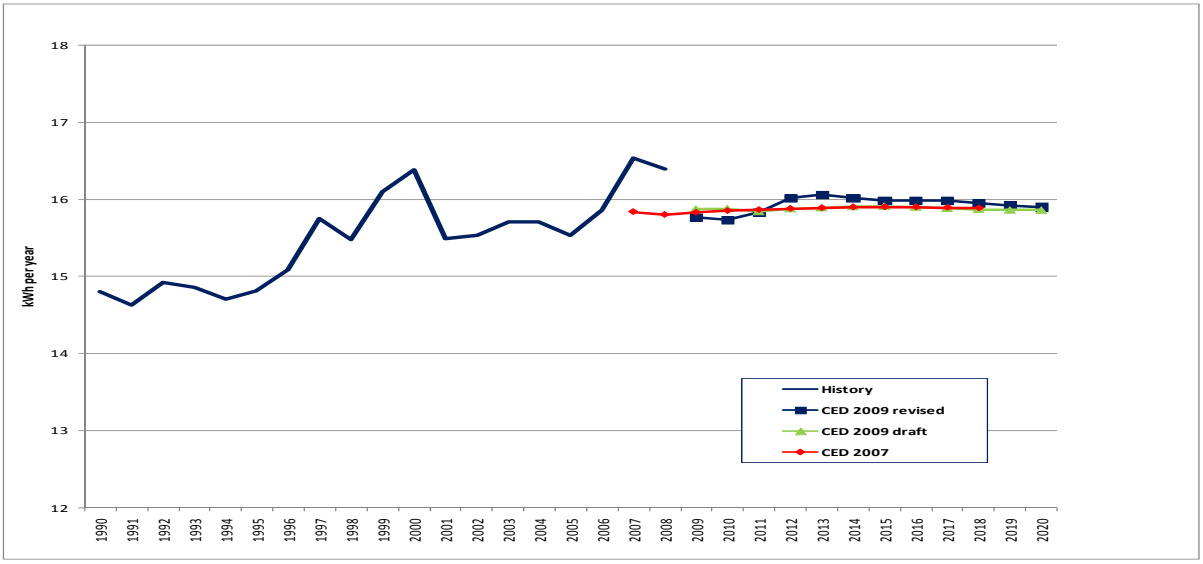
Figure 32: PG&E Planning Area Commercial Floor Space



Source: California Energy Commission, 2009

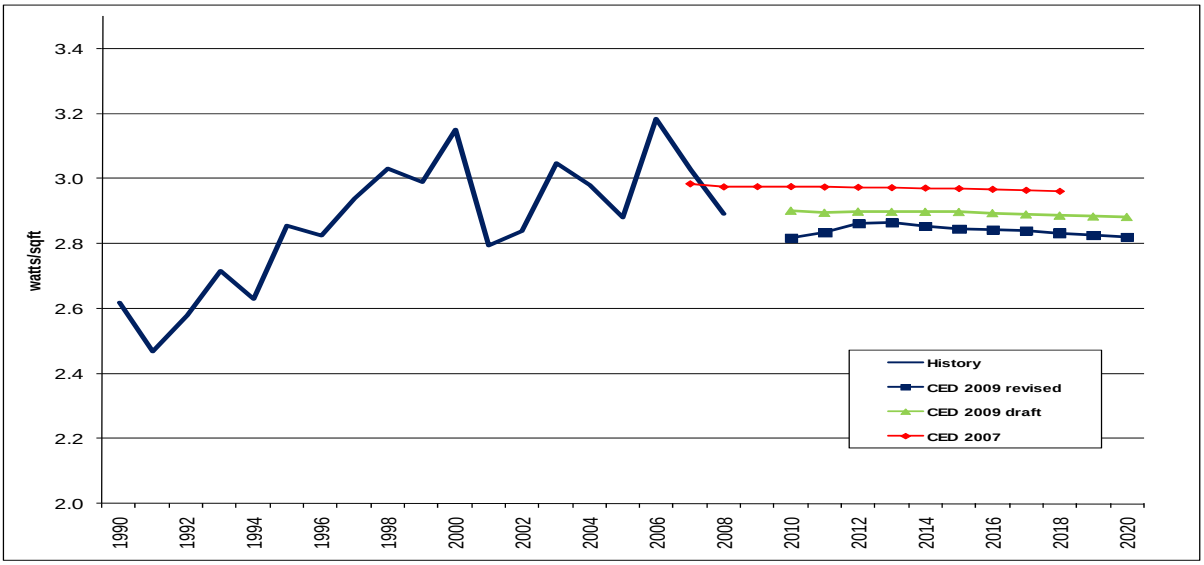
Historical and projected commercial sector annual and peak use per square foot are shown in **Figures 33** and **34**, respectively. Changes in annual use per square foot are based on the historical floor space estimates presented in **Figure 33**. Use per square foot (**Figure 33**) in *CED 2009 Revised* now returns to levels projected in *CED 2007* after recovery from the current economic downturn. Revised peak use per square foot (**Figure 34**) is projected to be lower than both *CED 2009 Draft* and *CED 2007* values. Both the energy and peak forecasts decline slightly over the long-term forecast period because of projected commercial building and appliance standards impacts, as well as increased efficiency program savings.

Figure 33: PG&E Planning Area Commercial kWh per Square Foot



Source: California Energy Commission, 2009

Figure 34: PG&E Planning Area Commercial Watts per Square Foot

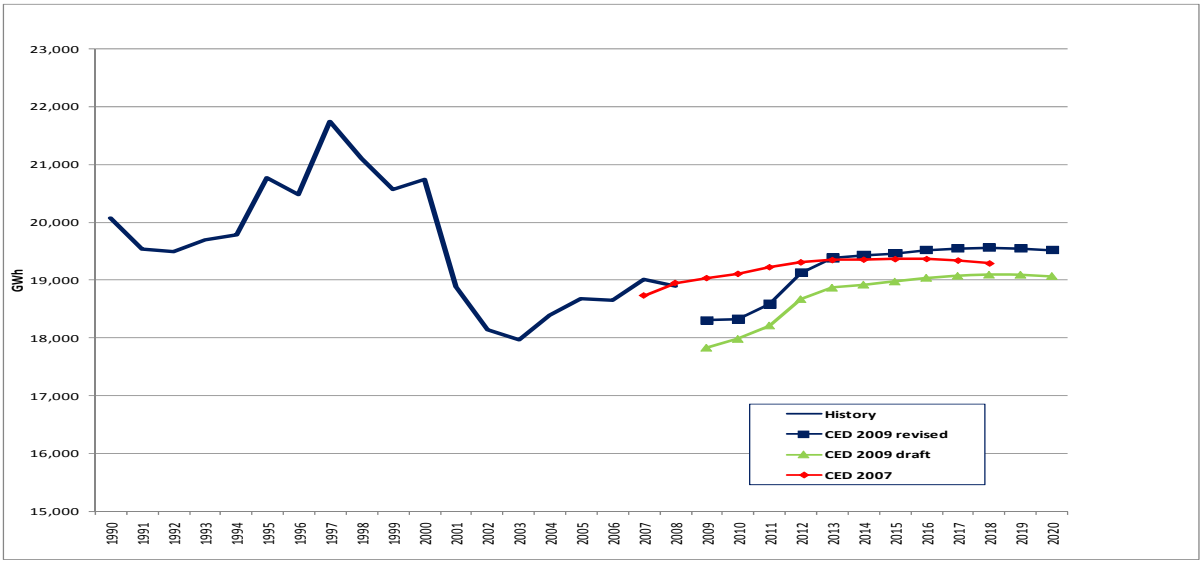


Source: California Energy Commission, 2009

Industrial Sector

Figure 35 provides a comparison of the industrial sector electricity consumption forecasts for the PG&E planning area. *CED 2009 Revised* is higher throughout the entire forecast period than *CED 2009 Draft,* based on a higher assumed starting point related to the inclusion of 2008 consumption estimates as well as revised economic drivers. The long-term *CED 2009 Revised* rises above the level of *CED 2007*.

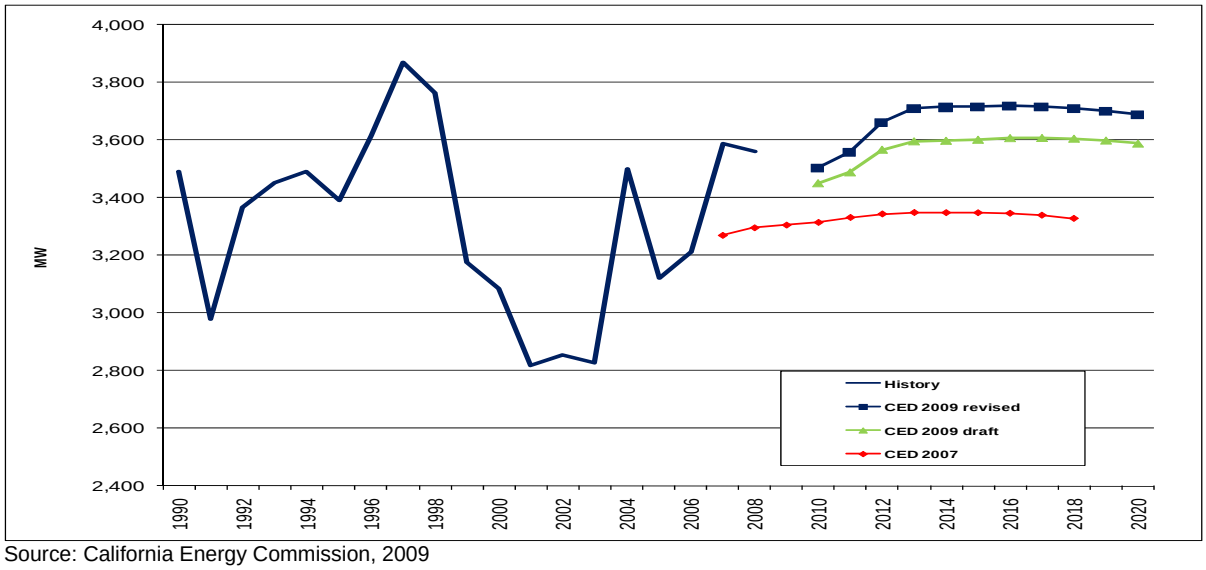
Figure 35: PG&E Planning Area Industrial Consumption



Source: California Energy Commission, 2009

Figure 36 compares industrial sector peak forecasts. The revised peak forecast is higher than *CED 2009 Draft,* mirroring consumption differences.

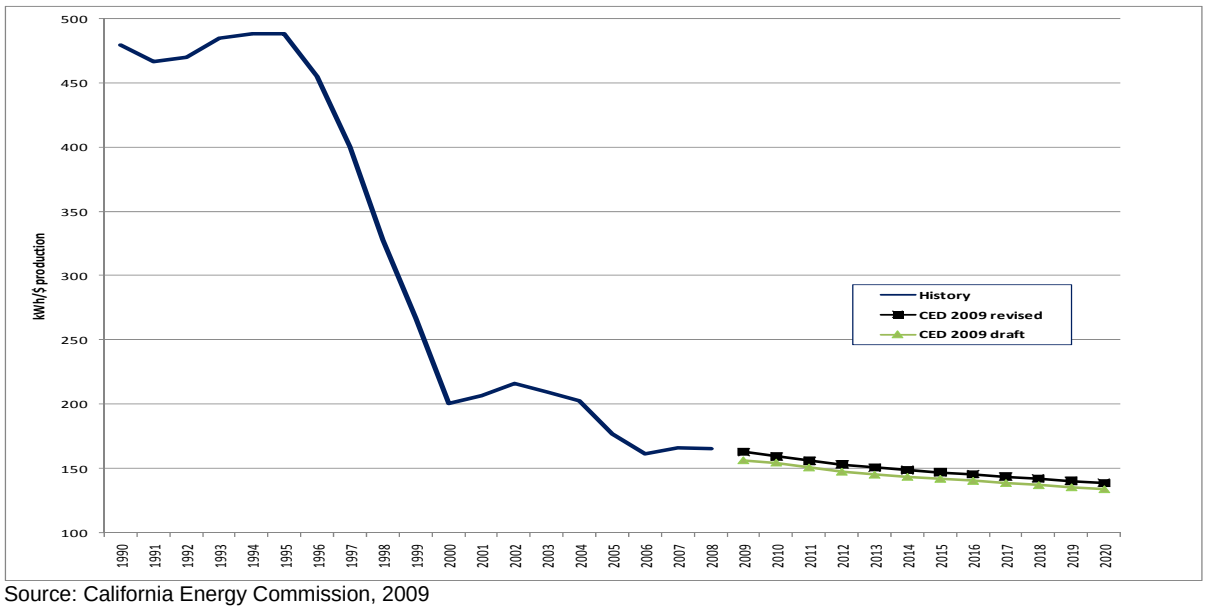
Figure 36: PG&E Planning Area Industrial Sector Peak



Source: California Energy Commission, 2009

Figure 37 compares use per dollar value of industrial production in the revised and draft forecasts. *CED 2009 Revised* has a slightly higher level of electricity use per dollar of value added than *CED 2009 Draft*. The forecasted growth rates are similar.

Figure 37: PG&E Planning Area Industrial Use per Production Unit

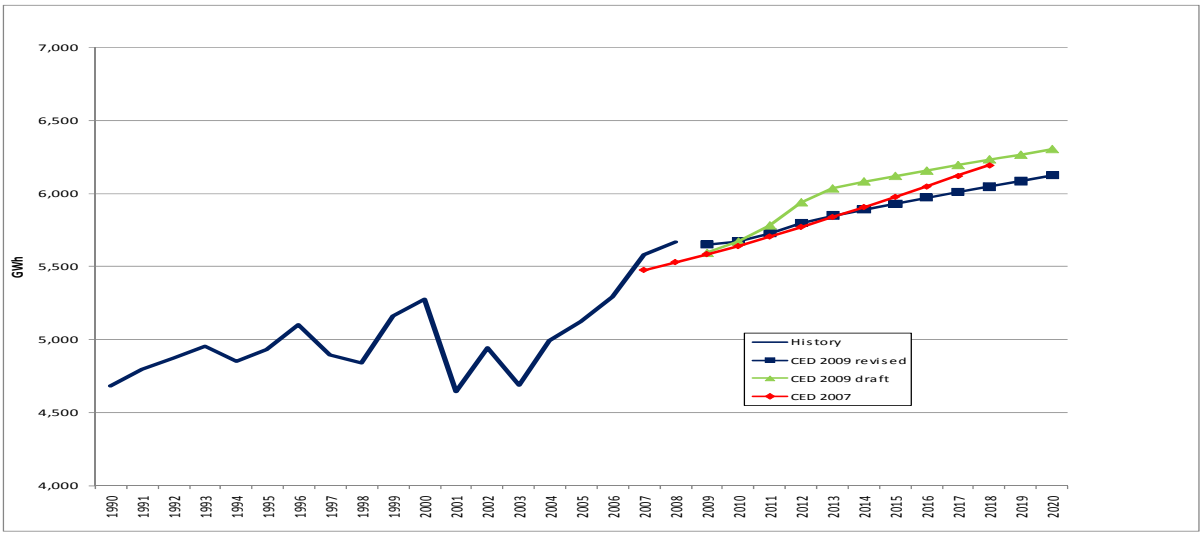


Source: California Energy Commission, 2009

Other Sectors

Figures 38 and **39** compare electricity consumption forecasts for the remaining sectors. **Figure 38** compares transportation, communication, and utilities (TCU) sector forecasts. *CED 2009 Revised* is lower than *CED 2009 Draft*, caused by inclusion of 2008 consumption history for calibration purposes and revised drivers for some of the industries.

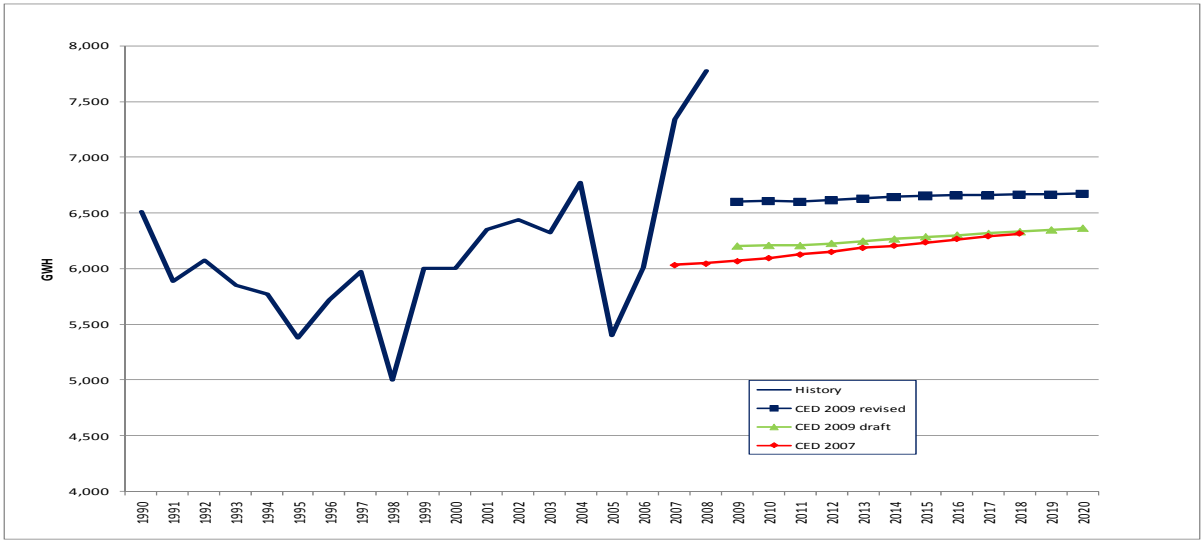
Figure 38: PG&E Planning Area Transportation, Communication, and Utilities Sector Electricity Consumption



Source: California Energy Commission, 2009

Figure 39 compares agriculture and water pumping sector forecasts. *CED 2009 Revised* is higher than *CED 2009 Draft* due to higher estimated historical consumption, but the increase is tempered by an assumed return to normal rainfall conditions in the forecast period.

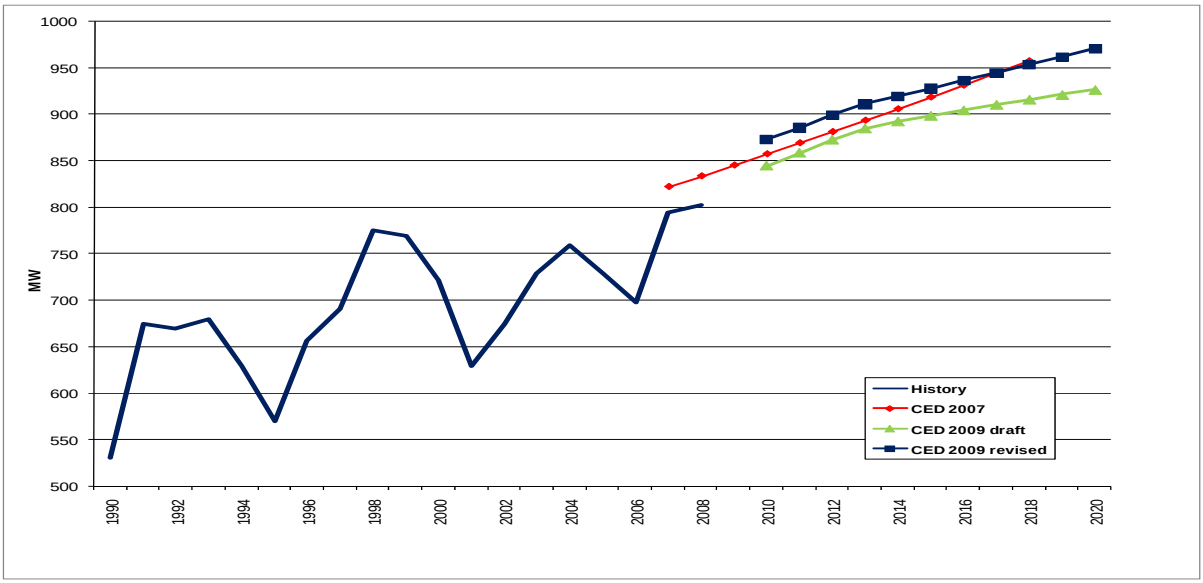
Figure 39: PG&E Planning Area Agriculture and Water Pumping Forecasts



Source: California Energy Commission, 2009

Figure 40 compares combined other sector peaks (TCU and street lighting). *CED 2009 Revised* is now higher than the previous two forecasts and very similar to *CED 2007* in the long term.

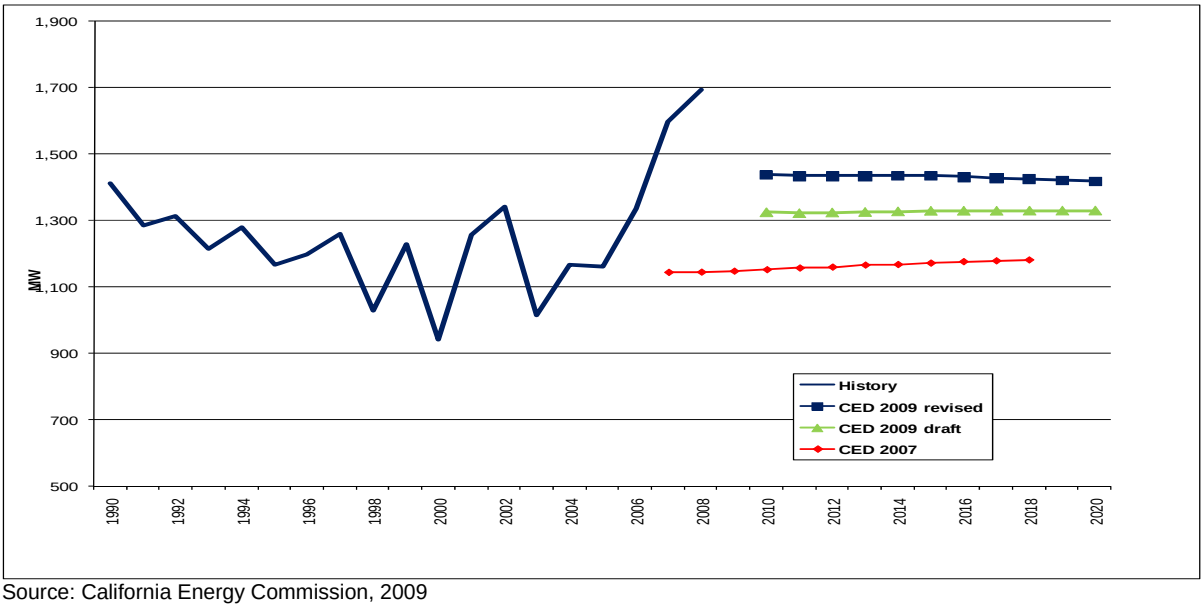
Figure 40: PG&E Planning Area Other Sector Peak



Source: California Energy Commission, 2009

Figure 41 compares agriculture and water pumping sector peaks. *CED 2009 Revised* is higher than *CED 2009 Draft*. Both forecasts are higher than *CED 2007*, which is based on a lower assumed starting point.

Figure 41: PG&E Planning Area Agriculture and Water Pumping Peak

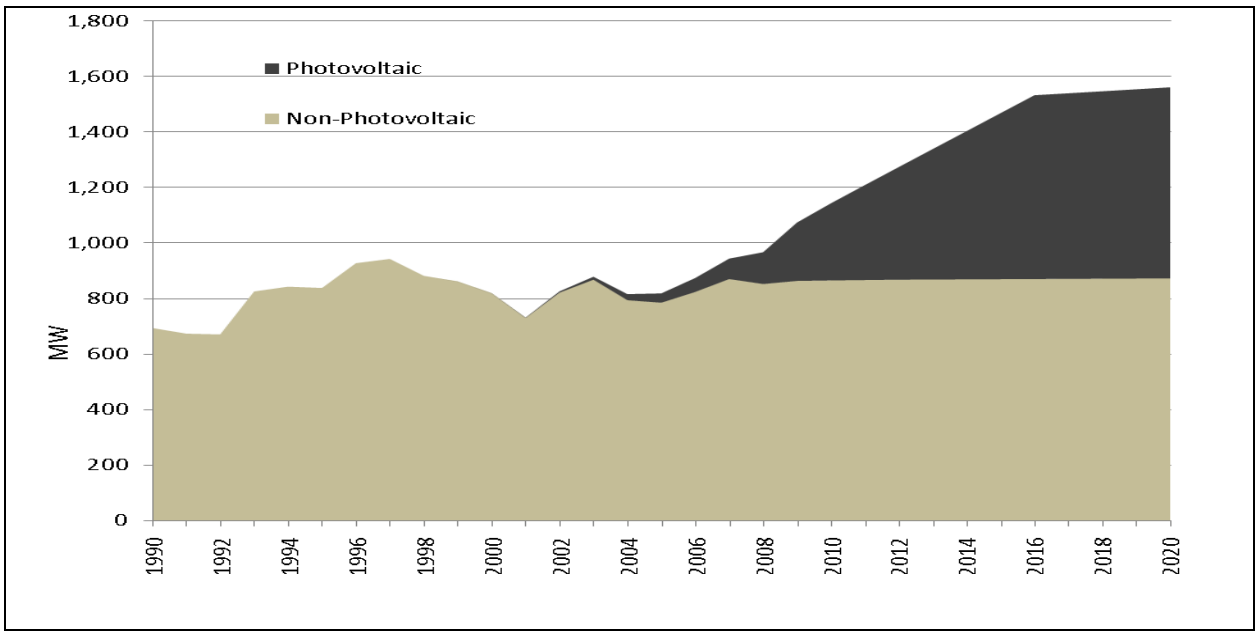


Source: California Energy Commission, 2009

Self-Generation

The peak demand forecast is reduced by self-generation, including the effects of the SGIP, CSI, and other programs, as discussed in Chapter 1. The effects of these programs are forecast based on recent trends in installations. **Figure 42** shows *CED 2009 Draft* peak impacts from photovoltaic and non-photovoltaic self-generation. Based on these trends, staff projects about 690 MW of peak reduction from photovoltaic systems by 2020.

Figure 42: PG&E Planning Area Self-Generation Peak Forecasts



Source: California Energy Commission, 2009

Economic Scenarios

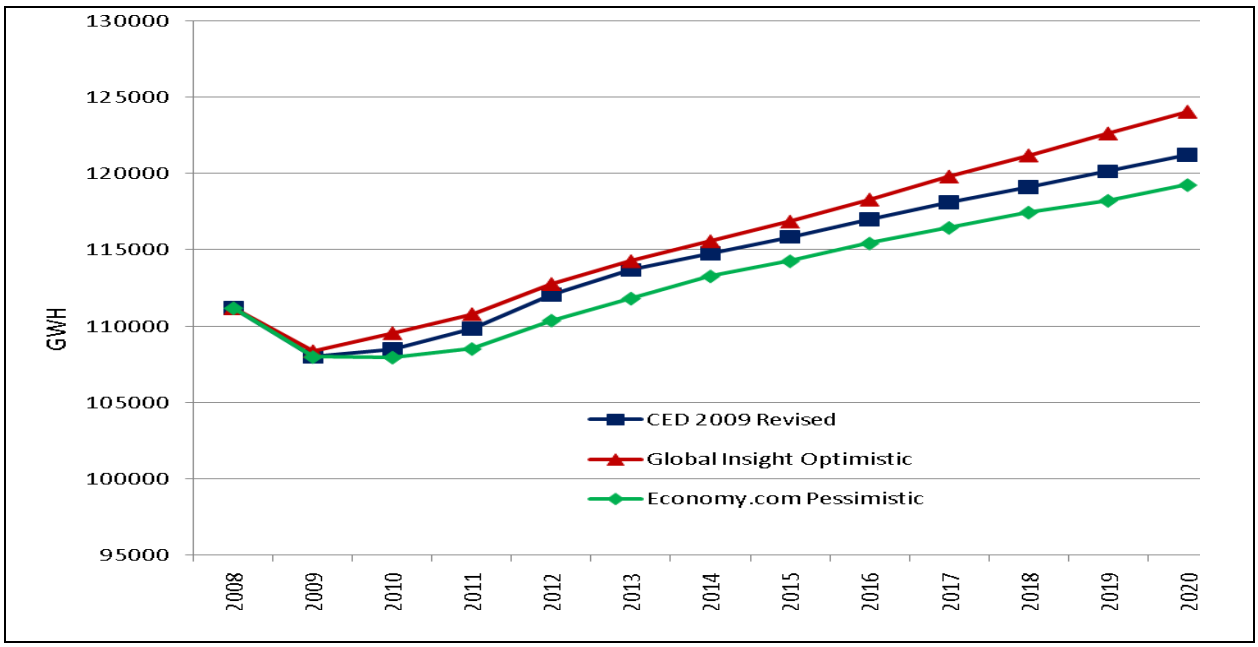
The results presented above rely on economic inputs from the Moody's Economy.com *base case* scenario. Staff also examined the impacts of two alternative economic scenarios for electricity demand: an *optimistic* case provided by HIS Global Insight and an Economy.com *pessimistic* case. These two cases, in general, project the highest and lowest rates of economic growth of the various scenarios provided by the two companies. For this analysis, staff developed econometric models for the three largest sectors (residential, commercial, and industrial plus mining) at the planning area level using historical data for electricity consumption, electricity rates, weather, and various economic and demographic variables. Electricity consumption for the remaining sectors was held constant (*CED 2009* levels) in the alternative scenarios. The Appendix provides details on the scenarios and the econometric models.

The estimated models were run for PG&E for the two economic scenarios as well as the Economy.com base case. The resulting percentage differences in electricity consumption between the two alternative scenarios and the base case were applied to *CED 2007* consumption projections. **Figure 43** shows the projected impacts of the optimistic and pessimistic scenarios on PG&E consumption. Peak demand was developed by applying projected load factors from *CED 2009 Revised* at the sector level to the consumption results for each scenario. Projected peak impacts are shown in **Figure 44**.

Electricity consumption is projected to be 2.4 percent higher than in *CED 2009 Revised* by 2020 in the optimistic economic case and 1.6 percent lower in the pessimistic scenario. The peak demand forecast increases by 2.3 percent under the optimistic scenario by 2020 and falls by 1.9 percent in the pessimistic case. The percentage peak reduction is higher than that of consumption in the pessimistic case because the relative decrease in consumption is projected to be higher for the residential and commercial sectors than for the industrial sector, which has a higher load factor. Annual growth rates from 2010-2020 for electricity consumption and peak demand increase from 1.1 percent and 1.25 percent, respectively, to 1.25 percent and 1.4 percent in the optimistic case, and fall to 1.0 percent and 1.1 percent under the pessimistic scenario.

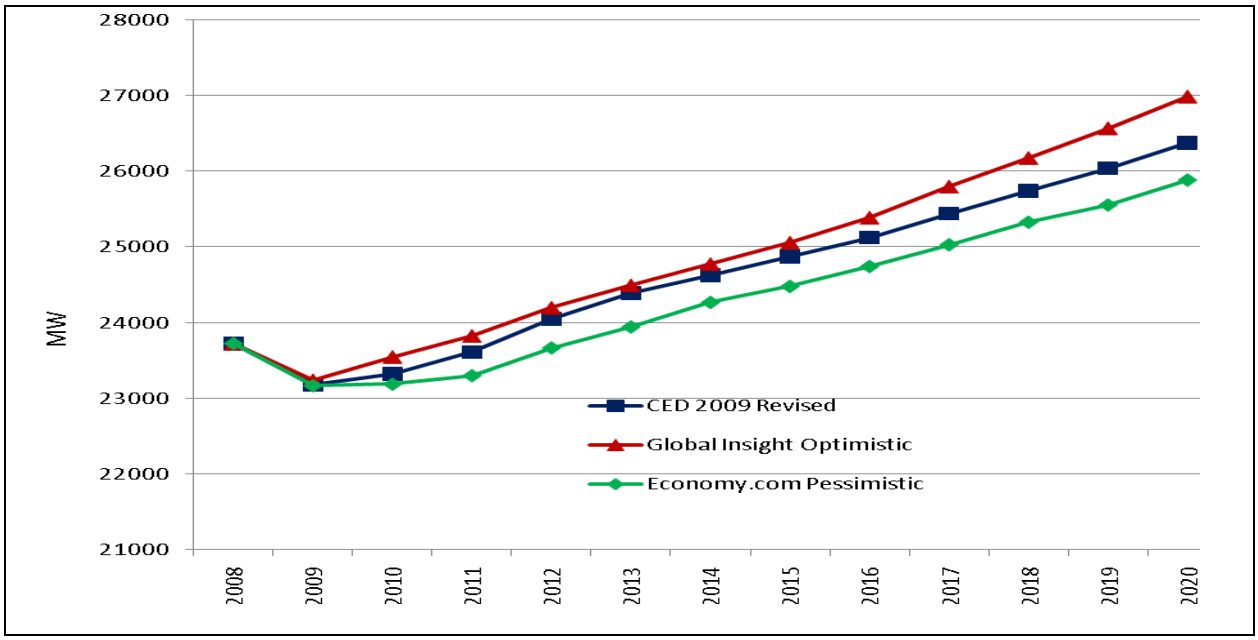
Variation in consumption and peak demand is small compared to *CED 2009 Revised* totals in percentage terms, and this is a reflection of the relatively narrow spread among the three economic scenarios. For example, retail employment is projected to be only 2 percent higher or lower in the alternative scenarios than in the Economy.com base case, and projected industrial output under the pessimistic scenario is almost identical to that of the base case by 2020.

Figure 43: Projected PG&E Electricity Consumption, CED 2009 Revised and Alternative Economic Scenarios



Source: California Energy Commission, 2009

Figure 44: Projected PG&E Peak Demand, *CED 2009 Revised* and Alternative Economic Scenarios



Source: California Energy Commission, 2009

Conservation/Efficiency Impacts

Staff spent a great deal of effort refining methods to account for energy efficiency and conservation impacts while preparing this forecast, particularly for utility efficiency programs. **Tables 10** and **11** show electricity consumption and peak savings estimates for selected years, for building and appliance standards, utility and public agency programs, and "naturally occurring" savings, or savings associated with rate changes and certain market trends not directly related to programs or standards. Savings are measured against a baseline before 1975, so they incorporate more than 30 years of impacts from rate changes and standards. Chapter 8 provides much more detail on staff work related to energy efficiency and conservation.

Table 10: PG&E Planning Area Electricity Consumption Savings Estimates

	1990	1998	2003	2008	2011	2015	2020
Residential Energy Savings (GWH)							
Building Standards	858	1,555	1,992	2,385	2,676	3,092	3,616
Appliance Standards	993	2,605	3,798	5,210	6,067	7,160	8,406
Utility and Public Agency Programs	646	984	997	2,298	3,369	2,674	1,030
Naturally Occurring Savings	83	111	139	188	200	723	2,260
Total Residential Savings	2,580	5,255	6,926	10,080	12,311	13,649	15,311
Commercial Energy Savings (GWH)							
Building Standards	432	815	1,370	1,971	2,292	2,836	3,476
Appliance Standards	238	580	902	1,250	1,410	1,676	1,975
Utility and Public Agency Programs*	167	759	1,021	1,835	1,963	1,237	757
Naturally Occurring Savings	5,806	6,145	9,339	7,182	8,094	8,980	10,669
Total Commercial Savings	6,643	8,299	12,632	12,238	13,759	14,729	16,877
Total Energy Savings	9,223	13,554	19,558	22,319	26,070	28,378	32,189

Source: California Energy Commission, 2009
*Commercial programs also include agricultural program savings.

Table 11: PG&E Planning Area Electricity Peak Savings Estimates

	1990	1998	2003	2008	2011	2015	2020
Residential Energy Savings (MW)							
Building Standards	209	421	507	650	749	881	1,052
Appliance Standards	242	706	966	1,420	1,698	2,040	2,446
Utility and Public Agency Programs	157	267	254	626	943	762	300
Naturally Occurring Savings	20	30	35	51	56	206	658
Total Residential Savings	629	1,423	1,762	2,748	3,445	3,889	4,455
Commercial Energy Savings (MW)							
Building Standards	76	160	266	351	414	509	622
Appliance Standards	42	114	175	222	255	301	353
Utility and Public Agency Programs*	30	149	199	327	355	222	136
Naturally Occurring Savings	1,027	1,204	1,816	1,278	1,462	1,612	1,909
Total Commercial Savings	1,175	1,626	2,456	2,178	2,485	2,645	3,019
Total Energy Savings	1,803	3,049	4,218	4,926	5,930	6,533	7,475

Source: California Energy Commission, 2009
*Commercial programs also include agricultural program

CHAPTER 3: Southern California Edison Planning Area

The Southern California Edison (SCE) planning area includes

- SCE bundled retail customers.
- Customers served by energy service providers (ESPs) using the SCE distribution system to deliver electricity to end users.
- Customers of the various Southern California municipal and irrigation district utilities with the exception of the cities of Los Angeles, Pasadena, Glendale, and Burbank and the Imperial Irrigation District. Also excluded from the SCE planning area is San Diego County and the southern portion of Orange County served by San Diego Gas & Electric. (SDG&E)

This chapter presents forecasted consumption and peak loads for the SCE planning area, including both total and per capita values. For perspective, *CED 2009 Revised* values are compared to both *CED 2009 Draft* and *CED 2007* values. The forecasted load factor, jointly determined by the consumption and peak load estimates, is also discussed. Next, sector consumption and peak load forecasts are presented and compared to the sector level forecast values of the two previous forecasts mentioned above.

For *CED 2009 Draft*, three price scenarios were developed for electricity rates: high rates, low (constant) rates, and a *mid-rate* scenario in between the two. The high-rate case assumed approximately 30 percent higher rates by 2020 relative to 2010, while the mid-rate case assumed 15 percent higher rates over the same period. In the low-rate case, rates remained at 2010 levels through 2020 as was done in *CED 2007*. In *CED 2009 Revised*, the mid-rate price forecast was used, and all comparisons to *CED 2009 Draft* are made to the mid-rate scenario. Chapter 1 provides more details on price assumptions.

Forecast Results

The following summarizes the results presented in this chapter:

- *CED 2009 Revised* forecasts of SCE planning area electricity consumption and peak demand are lower than *CED 2007* levels because of the economic downturn and increased efficiency impacts, but higher than in *CED 2009 Draft*.
- Per capita electricity consumption and peak demand are also projected to be lower than in *CED 2007* but slightly higher than in *CED 2009 Draft*.
- The largest percentage reduction in electricity consumption and peak demand relative to *CED 2007* occurs in the residential and commercial sectors.

- Alternative economic scenarios increase or decrease electricity consumption and peak demand by around 2.5 percent in 2020.
- Self-generation impacts are projected to be higher than in *CED 2007* and *CED 2009 Draft*, mainly because of increased adoption of photovoltaic systems.

Table 12 presents a comparison of the planning area electricity consumption and peak demand forecasts for selected years. *CED 2009 Revised* is compared to both *CED 2009 Draft* mid rate and *CED 2007*. The revised electricity consumption forecast is higher than *CED 2009 Draft* by 5 percent at the end of the forecast period. This is caused mainly by higher economic forecast values provided in the June Moody's Economy.com forecast. The revised consumption forecast is still about 9.5 percent lower than the *CED 2007* forecast at the end of the period. The revised peak forecast is now more than 1 percent higher than *CED 2009 Draft* values by the end of the forecast period. This is still more than 6 percent lower than *CED 2007* projections. The smaller increase in the revised peak forecast relative to the changes in the consumption forecast is caused by increased assumptions regarding self generation. This has the impact of reducing net system peak but does not reduce total electricity consumption. Also contributing to the difference is the impact of efficiency programs that have a greater impact on overall consumption than peak. Long-term growth rates of both the revised consumption and peak forecasts are now just slightly below the growth rates of the *CED 2007* forecast.

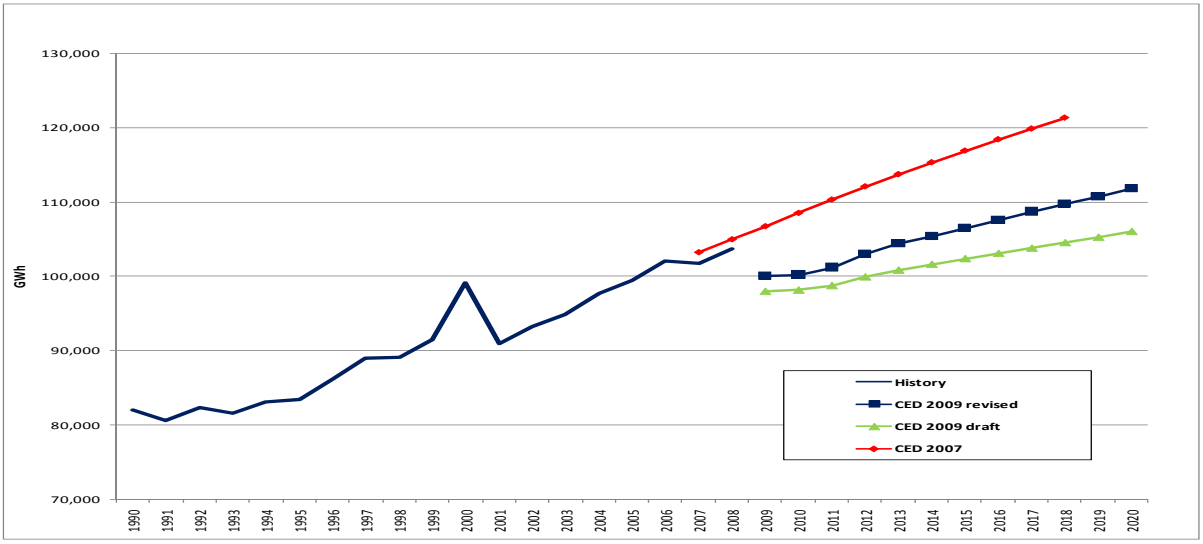
Table 12: SCE Planning Area Forecast Comparison

Consumption (GWH)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* mid-rate case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Percentage Difference *CED 2009 Revised/CED 2007*	Percentage Difference *CED 2009 Revised/CED 2009 Draft*
1990	82,069	82,069	82,069	0.00%	0.00%
2000	99,146	99,146	99,150	0.00%	0.00%
2008	104,957	99,780	103,701	-1.20%	3.93%
2010	108,503	98,190	100,222	-7.63%	2.07%
2015	116,872	102,394	106,520	-8.86%	4.03%
2018	121,298	104,528	109,750	-9.52%	5.00%
Average Annual Growth Rates					
1990-2000	1.91%	1.91%	1.91%		
2000-2008	0.71%	0.13%	0.90%		
2008-2010	1.68%	-0.53%	-1.13%		
2010-2018	1.40%	0.78%	1.14%		
Peak (MW)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* mid-rate case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Percentage Difference *CED 2009 Revised/CED 2007*	Percentage Difference *CED 2009 Revised/CED 2009 Draft*
1990	17,635	17,647	17,647	0.07%	0.00%
2000	19,408	19,506	19,506	0.50%	0.00%
2008	23,272	22,859	22,020	-5.38%	-3.67%
2010	24,082	22,898	22,836	-5.17%	-0.27%
2015	26,013	24,299	24,459	-5.97%	0.66%
2018	27,112	25,108	25,418	-6.25%	1.23%
Average Annual Growth Rates					
1990-2000	0.96%	1.01%	1.01%		
2000-2008	2.30%	2.00%	1.53%		
2008-2010	1.73%	0.09%	1.84%		
2010-2018	1.49%	1.16%	1.35%		
Historical values are shaded					

Source: California Energy Commission, 2009

As shown in **Figure 44**, *CED 2009 Revised* consumption is about 4 percent higher than *CED 2009 Draft* but still below *CED 2007* throughout the forecast period. The dip in the early years of *CED 2009 Revised* is caused by both the revised economic projections and increased expected savings from energy efficiency programs.

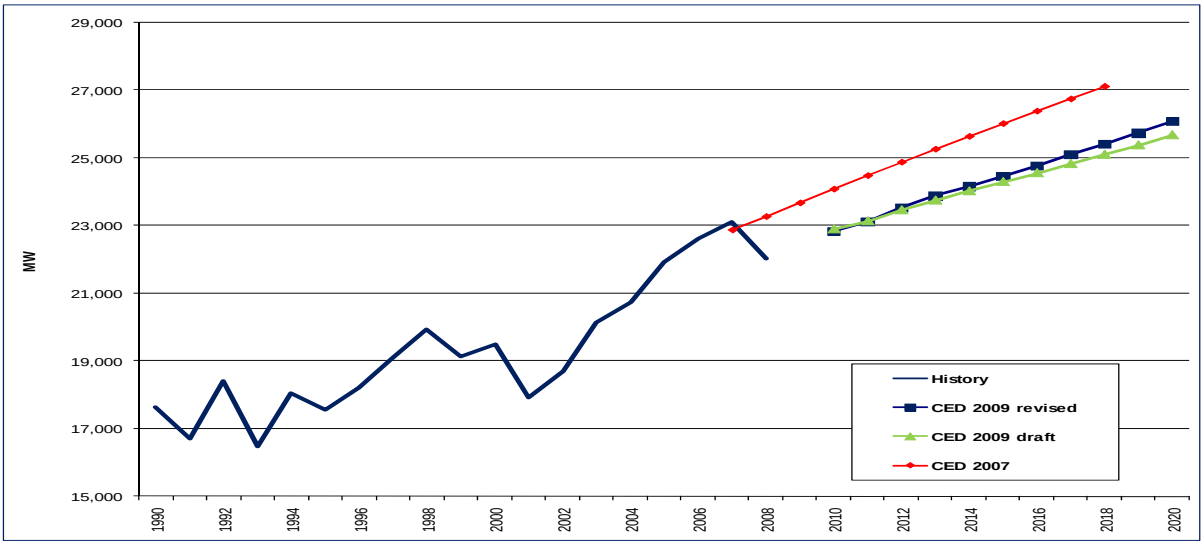
Figure 44: SCE Planning Area Electricity Forecast



Source: California Energy Commission, 2009

CED 2009 Revised SCE planning area peak demand (**Figure 45**) is slightly higher than *CED 2009 Draft* by the end of the forecast period. The difference in relation to the consumption forecast is caused by an increase in peak impacts of self-generation programs assumed in *CED 2009 Revised* as well as increases in consumption that have little impact on peak.

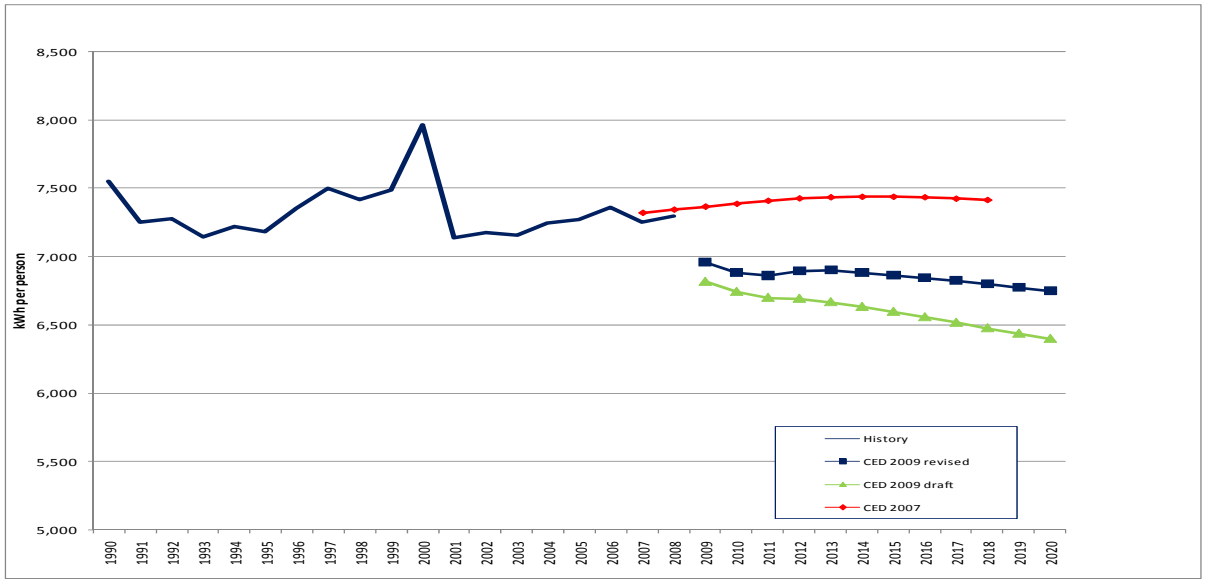
Figure 45: SCE Planning Area Peak



Source: California Energy Commission, 2009

Figure 46 compares forecasted per capita residential electricity consumption. Per capita consumption in *CED 2009 Revised* is higher than *CED 2009 Draft*. It is still below the projection of *CED 2007* forecast. The revised projection declines slightly over the forecast period and is lower than recent recorded history. The short-term dip in per capita consumption is caused by a combination of economic/demographic forecast assumptions and increased savings from energy efficiency programs.

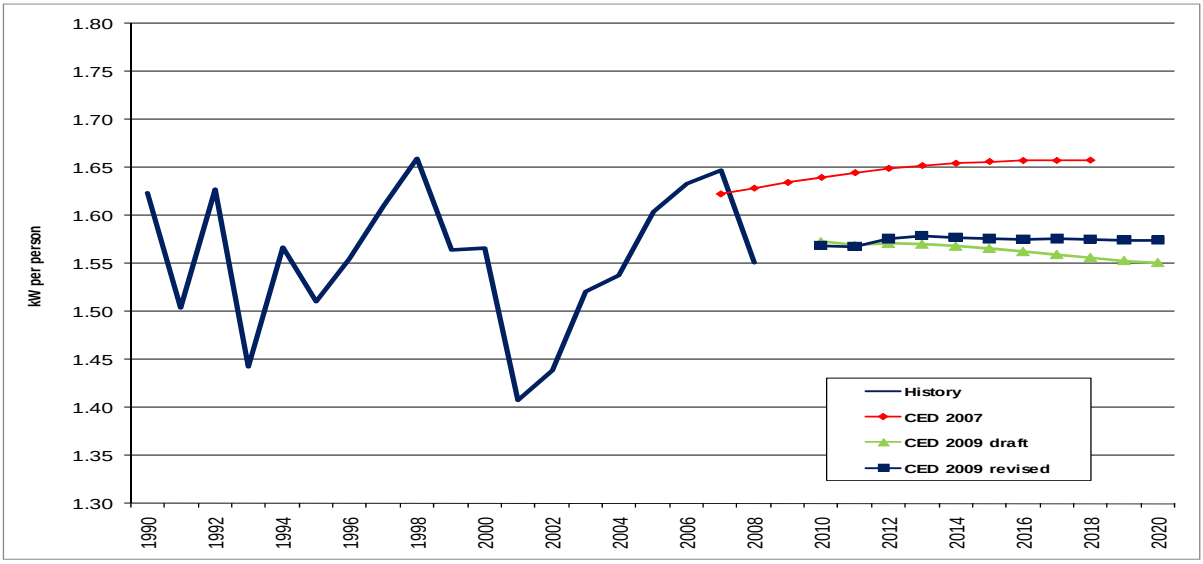
Figure 46: SCE Planning Area per Capita Electricity Consumption



Source: California Energy Commission, 2009

Per capita peak demand for *CED 2009 Revised*, shown in **Figure 47**, is now slightly higher than *CED 2009 Draft* by the end of the forecast period. *CED 2009 Revised* per capita peak demand increases slightly in the short term, then is relatively constant over the remainder of the forecast period rather than the increase projected in *CED 2007* forecast. This is caused by increases in estimates of self-generation and efficiency program impacts as well as reduced economic growth relative to *CED 2007* projections.

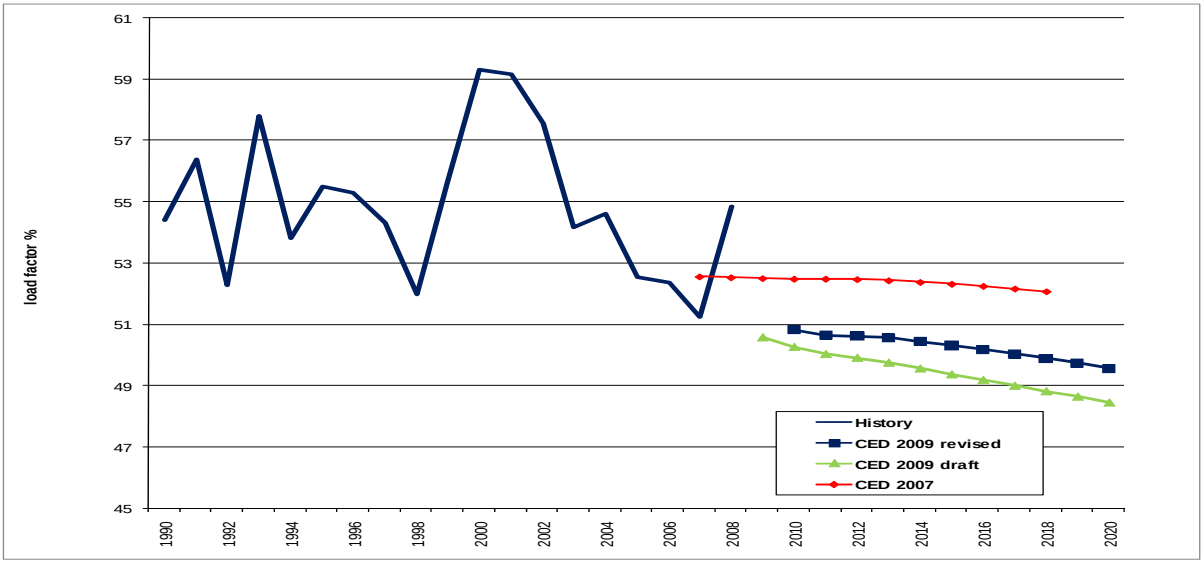
Figure 47: SCE Planning Area per Capita Peak Demand



Source: California Energy Commission, 2009

Figure 48 provides a comparison of the respective forecast load factors. High load factors observed from 1998-2005 are a product of lower-than-average peak temperatures and reaction to the energy crisis. The projected load factor, based on higher, 1-in-2 peak temperatures and a return to normal air conditioning use patterns, should be lower than these recent values. *CED 2009 Revised* load factor is higher than *CED 2009 Draft* because of the revised self-generation estimate, which lowers peak relative to consumption. As in *CED 2009 Draft*, the revised load factor is projected to decline over the forecast period.

Figure 48: SCE Planning Area Peak Load Factor



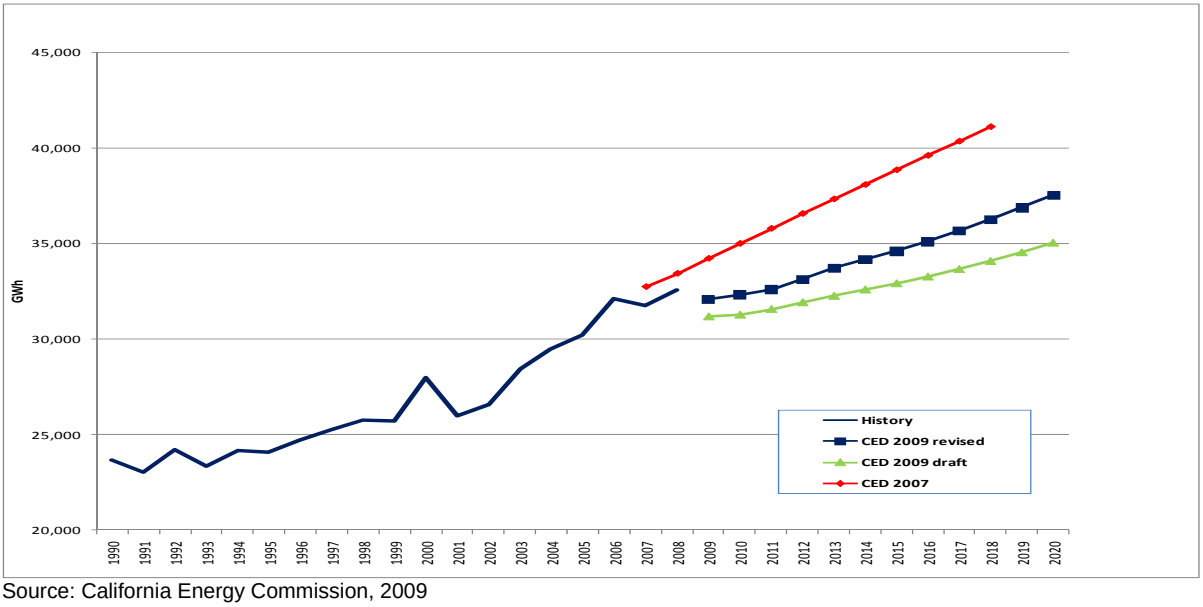
Source: California Energy Commission, 2009

Sector Level Results and Input Assumptions

Residential

Figure 49 provides a comparison of the residential forecasts. *CED 2009 Revised* is higher over the entire forecast period than *CED 2009 Draft* but still well below the level of *CED 2007*. The increase over *CED 2009 Draft* is caused by increased projections of household income and slightly higher persons per household projections as well as an increase in the starting value brought about by inclusion of 2008 sales. The revised household income projections are still below those projected in *CED 2007* forecast.

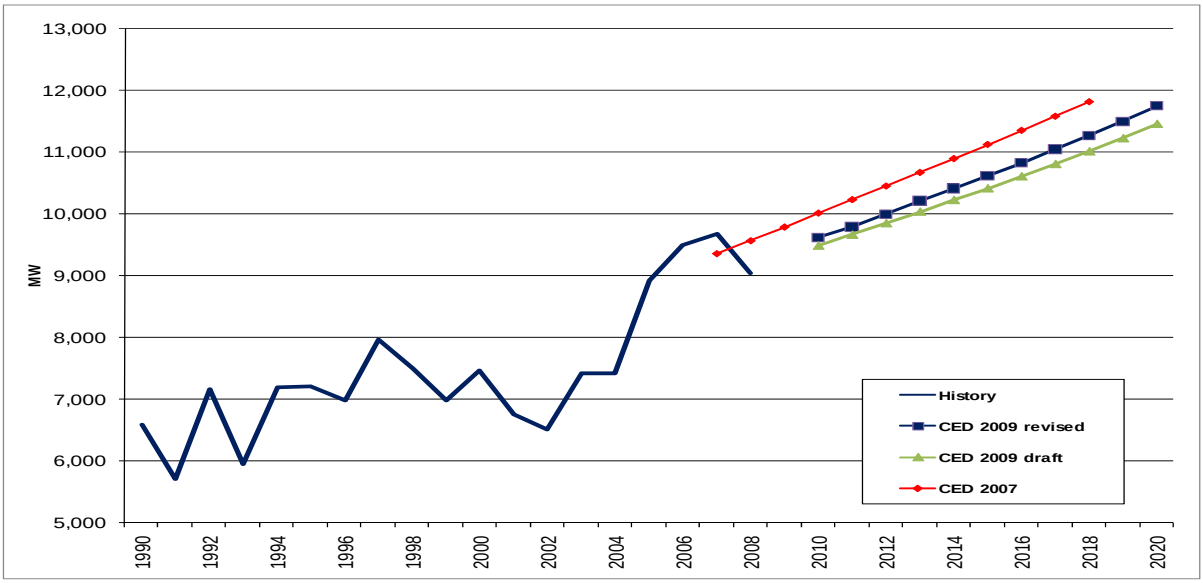
Figure 49: SCE Planning Area Residential Consumption



Source: California Energy Commission, 2009

Figure 50 provides a comparison of the residential peak demand forecasts. Unlike the consumption forecast, there is only a slight increase in *CED 2009 Revised* residential peak over *CED 2009 Draft*. Almost all of the residential consumption increase is caused by end-use consumption that has little impact on peak.

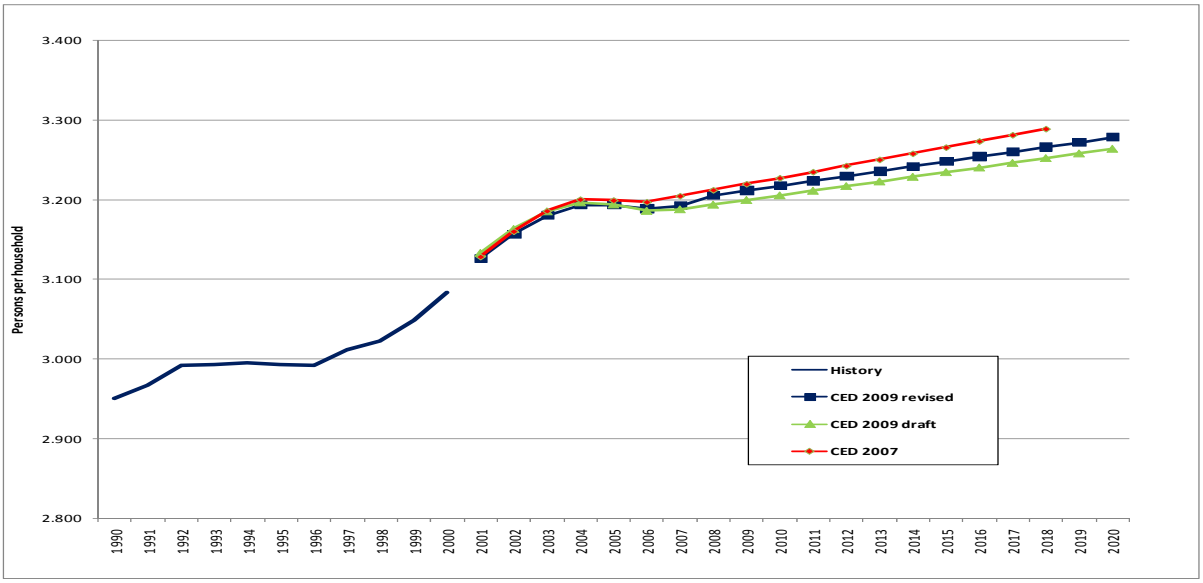
Figure 50: SCE Planning Area Residential Peak



Source: California Energy Commission, 2009

Figures 51 and **52** provide comparisons of the residential drivers used in the forecasts. **Figure 51** provides comparisons of persons per household projections used in the forecasts. There is slight increase in the forecast of persons per household in *CED 2009 Revised* compared *CED 2009 Draft*. The change in *CED 2009 Revised* reduces the household forecast by about 2,000 households by the end of the forecast period compared to *CED 2009 Draft* (less than 0.04 percent).

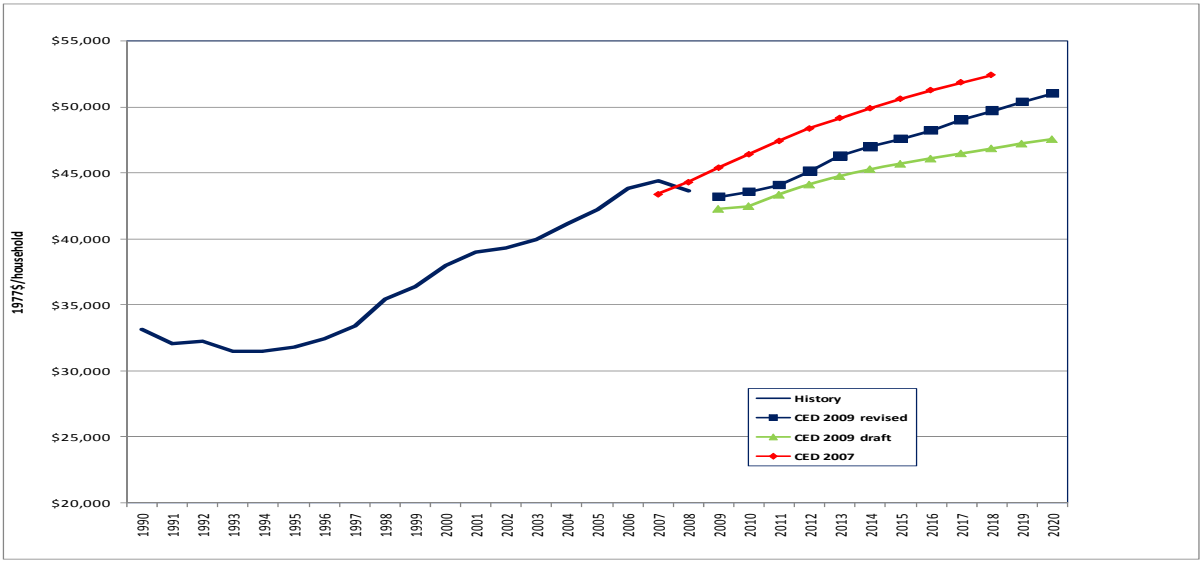
Figure 51: SCE Planning Area Persons-per-Household Projections



Source: California Energy Commission, 2009

Figure 52 provides a comparison of household income used in the respective forecasts. *CED 2009 Revised* projection is higher than that used in *CED 2009 Draft* but still below what was used in *CED 2007*. *CED 2009 Revised* uses the June 2009 projections from Moody's Economy.com while the previous forecasts used earlier vintages. The new projections produce a long-term growth coming out of the current economic slump growth similar to that used in *CED 2007*.

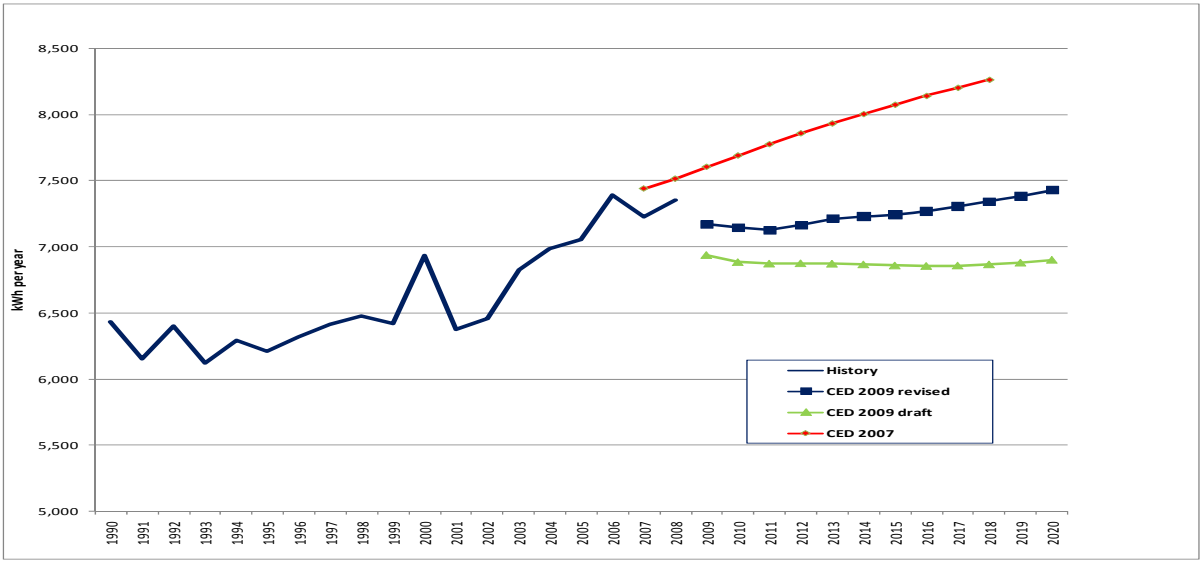
Figure 52: SCE Planning Area Household Income Projections



Source: California Energy Commission, 2009

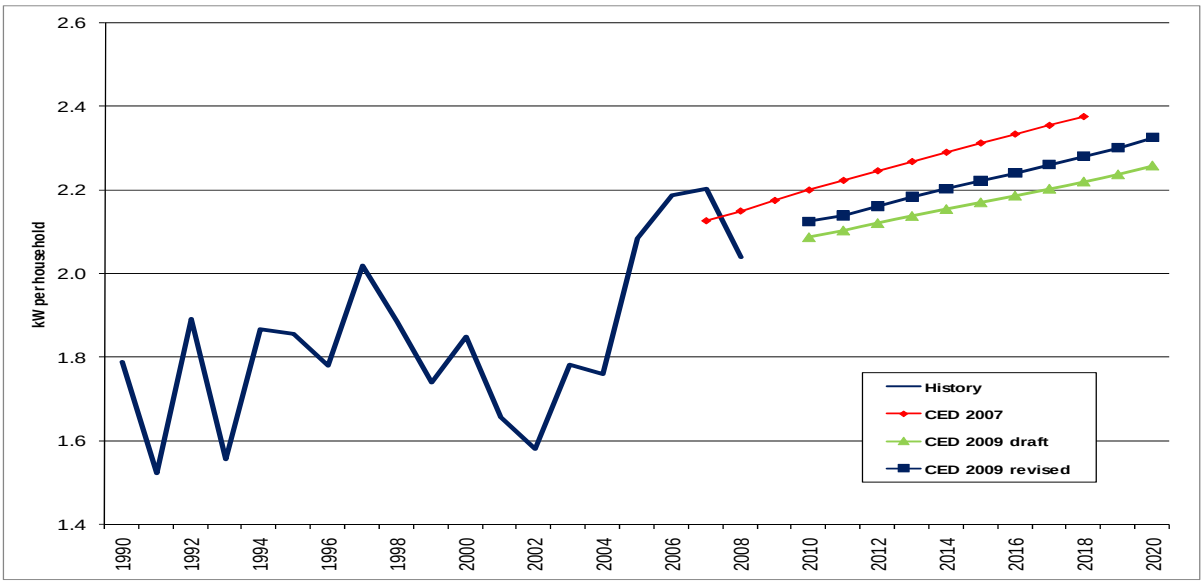
Figures 53 and **54** present comparisons of residential use per household and residential peak use per household, respectively. *CED 2009 Revised* use per household (**Figure 53**) is higher than *CED 2009 Draft*. This is partly caused by inclusion of 2008 sales data, which adjusts the starting point upward, as well as the use of increased household income projections. *CED 2009 Revised* use per household is still below *CED 2007* levels. In contrast, differences in peak use per household (**Figure 54**) are only slightly higher in *CED 2009 Revised* compared to *CED 2009 Draft* because most of the consumption increases do not directly translate into peak impacts.

Figure 53: SCE Planning Area Use per Household



Source: California Energy Commission, 2009

Figure 54: SCE Planning Area Peak Use per Household

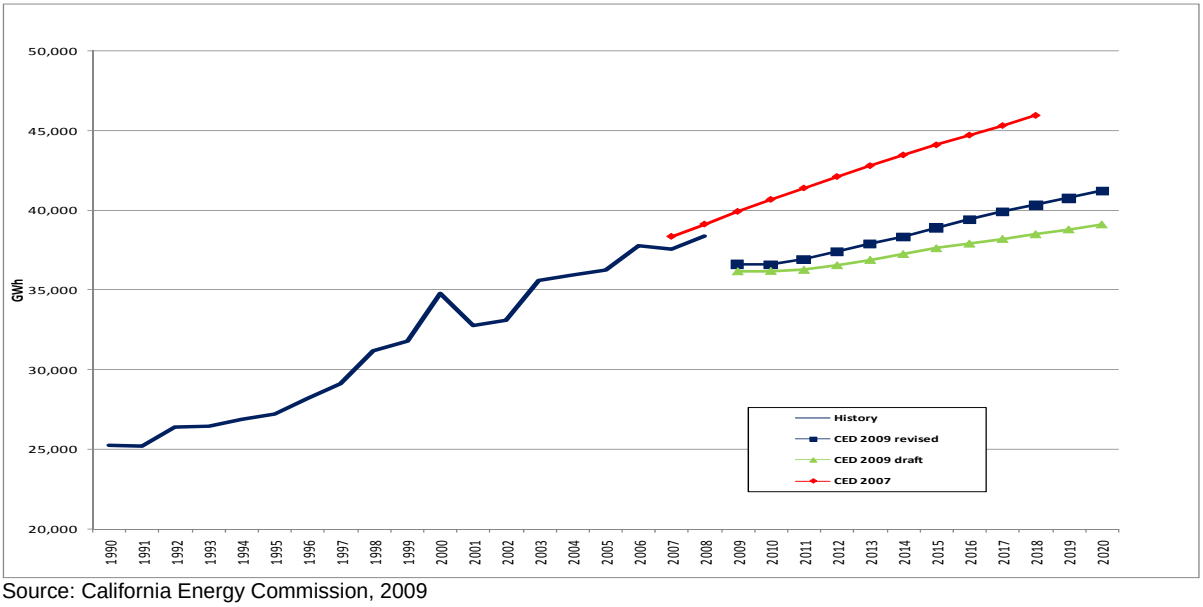


Source: California Energy Commission, 2009

Commercial Building Sector

Figures 55 and **56** provide a comparison of the commercial building sector forecasts. *CED 2009 Revised* is higher than *CED 2009 Draft* because of increased floor space projections as well as inclusion of 2008 consumption data as a revised starting point. *CED 2009 Revised* is still below the forecast levels of *CED 2007*.

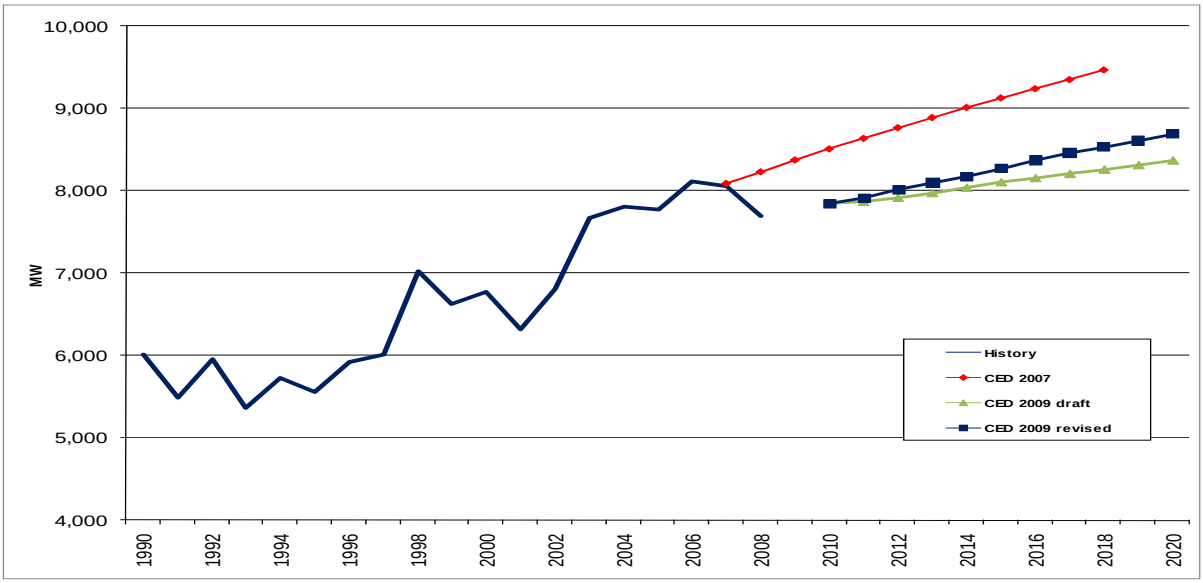
Figure 55: SCE Planning Area Commercial Consumption



Source: California Energy Commission, 2009

Figure 56 provides a comparison of the commercial building sector peak demand forecasts. Differences in the peak forecasts are smaller than those in the consumption forecast because of revised self generation estimates and increases to consumption end uses that have little peak impact.

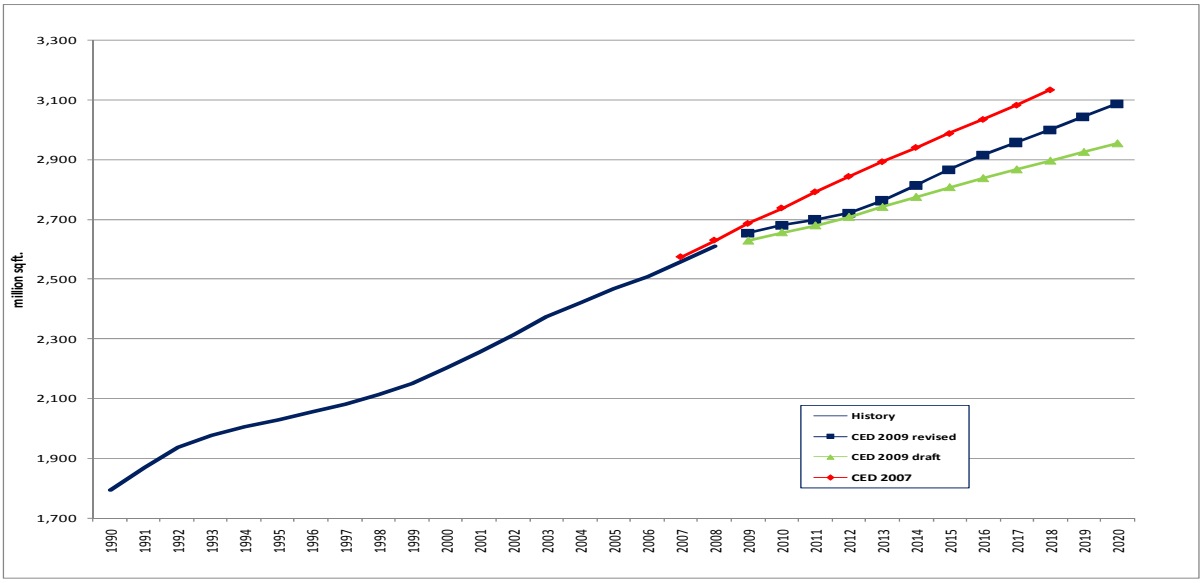
Figure 56: SCE Planning Area Commercial Sector Peak



Source: California Energy Commission, 2009

In staff's commercial building sector forecasting model, floor space by building type (that is, retail, schools, offices, and so forth) is the key driver of energy use for each specific building type. **Figure 57** provides a comparison of total commercial floor space projections. *CED 2009 Revised* is now higher than the draft forecast in the long run because of revisions to economic and demographic drivers as well as changes to the econometric estimates in the floor space model.

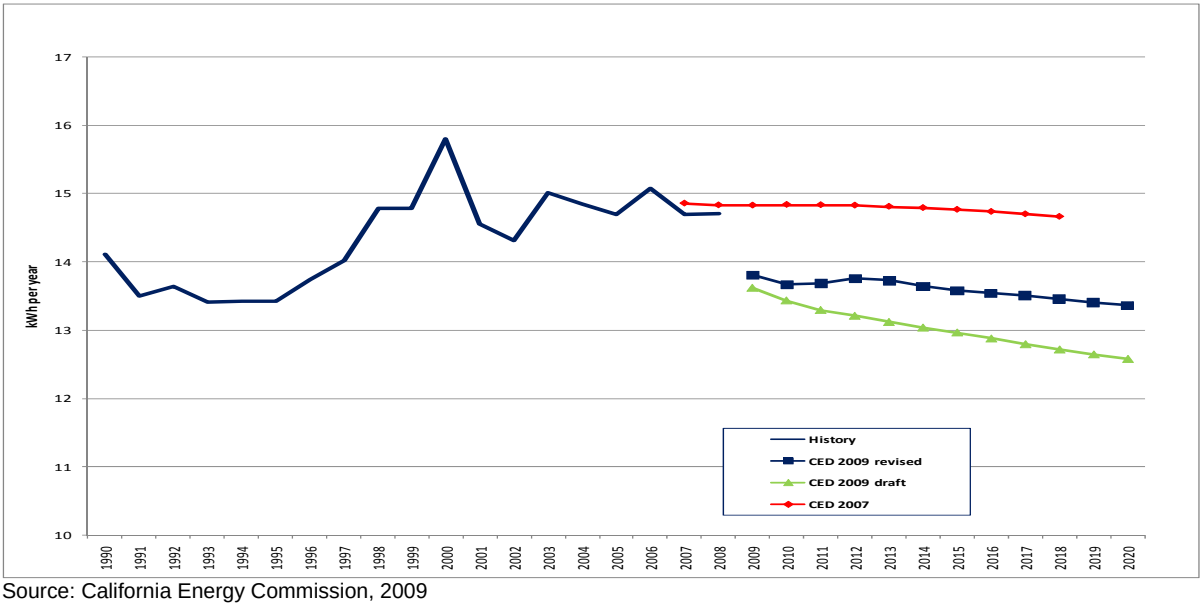
Figure 57: SCE Planning Area Commercial Floor Space



Source: California Energy Commission, 2009

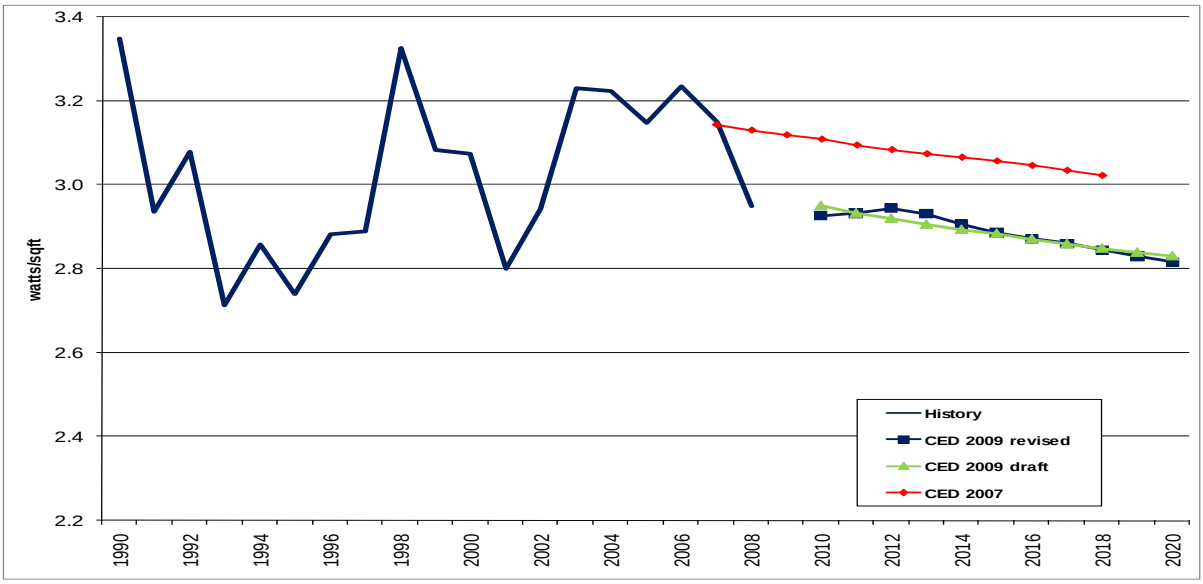
Historical and projected commercial sector annual and peak use per square foot are shown in **Figures 58** and **59**, respectively. Changes in annual use per square foot are based on the historical floor space estimates presented in **Figure 58**. Use per square foot (**Figure 58**) in *CED 2009 Revised* is somewhat higher than *CED 2009 Draft*. This value is still below that projected in *CED 2007*. Revised peak use per square foot (**Figure 59**) is little changed from *CED 2009 Draft* values. Both the energy and peak forecasts decline over the long-term forecast period because of projected commercial building and appliance standards impacts as well as increased efficiency program savings.

Figure 58: SCE Planning Area Commercial kWh per Square Foot



Source: California Energy Commission, 2009

Figure 59: SCE Planning Area Commercial Watts per Square Foot

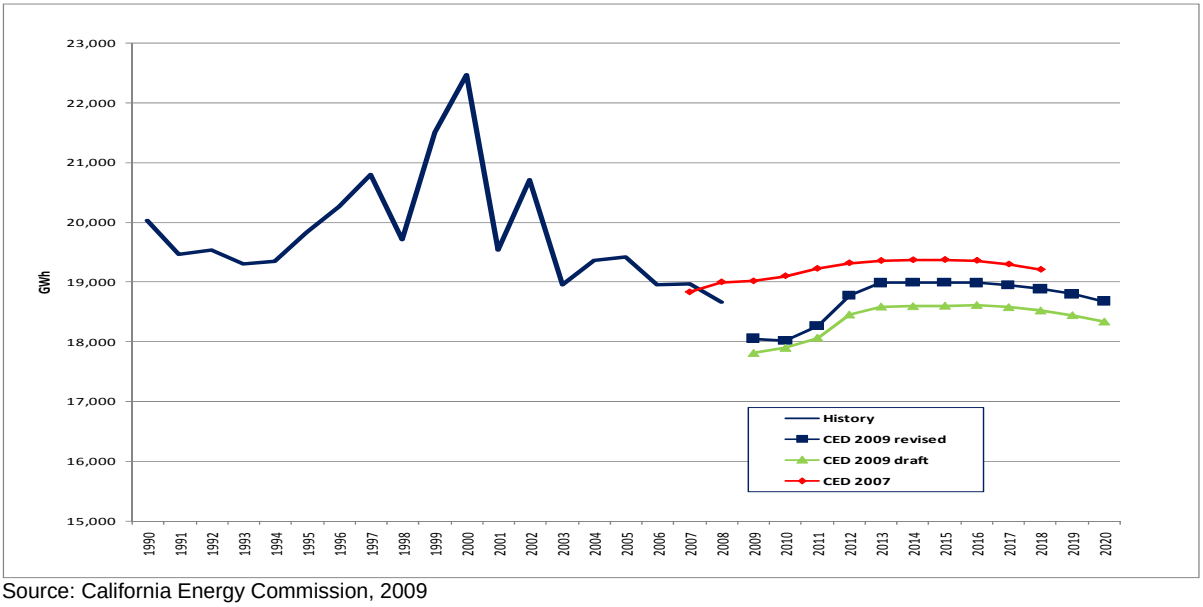


Source: California Energy Commission, 2009

Industrial Sector

Figure 60 compares the industrial sector electricity consumption forecasts for the SCE planning area. *CED 2009 Revised* is slightly higher throughout the entire forecast period than *CED 2009 Draft* based on more positive economic projections. The long-term growth of *CED 2009 Revised* is also higher than *CED 2007* forecast.

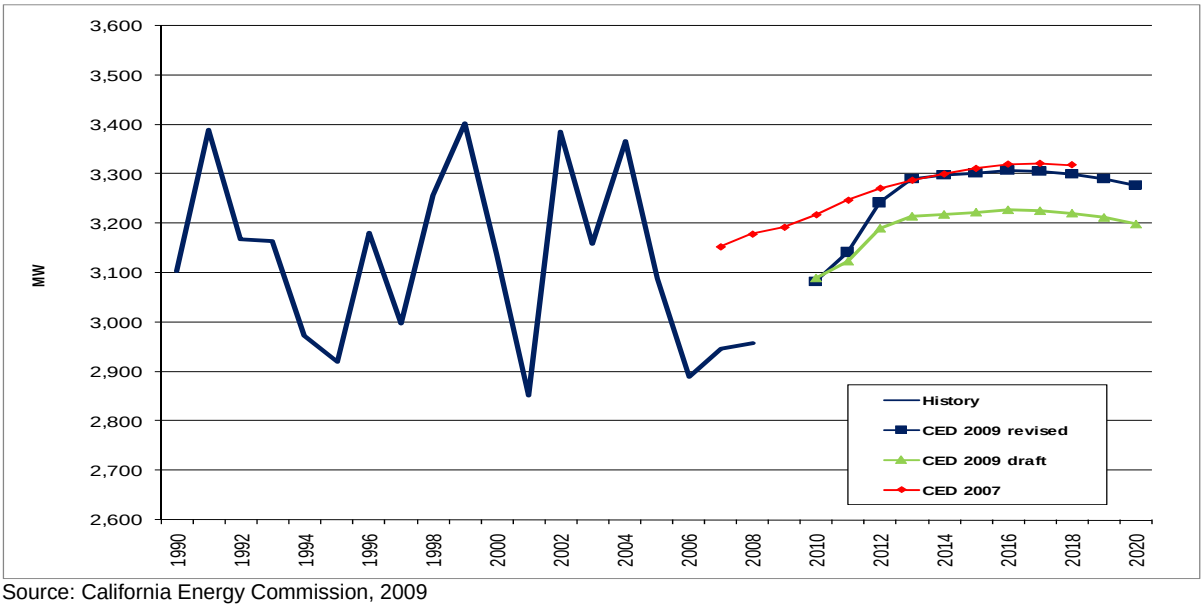
Figure 60: SCE Planning Area Industrial Consumption



Source: California Energy Commission, 2009

Figure 61 compares the industrial sector peak forecasts. The industrial peak *CED 2009 Revised* now returns to the level of *CED 2007* forecast in the latter part of the forecast period.

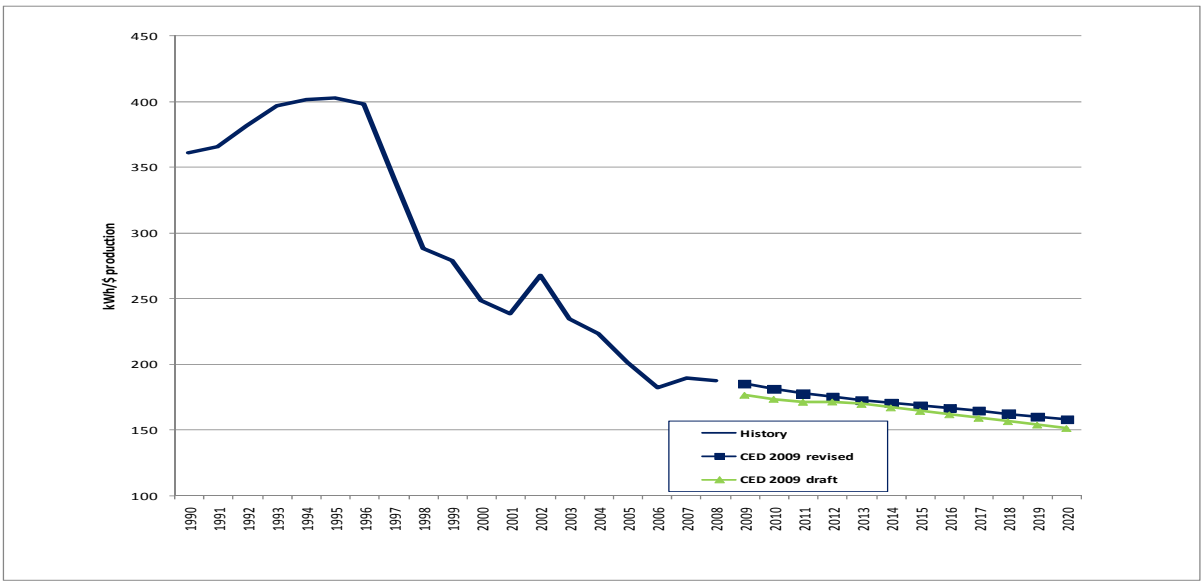
Figure 61: SCE Planning Area Industrial Sector Peak



Source: California Energy Commission, 2009

Figure 62 compares use per dollar value of production between the revised and draft *CED 2009* forecasts. The *CED 2009 Revised* has a slightly higher level of electricity use per dollar of industrial value added than *CED 2009 Draft*. This is primarily caused by a higher historical starting point due to inclusion of 2008 consumption history. The forecasted growth rates are similar in both forecasts.

Figure 62: SCE Planning Area Industrial Use per Production Unit



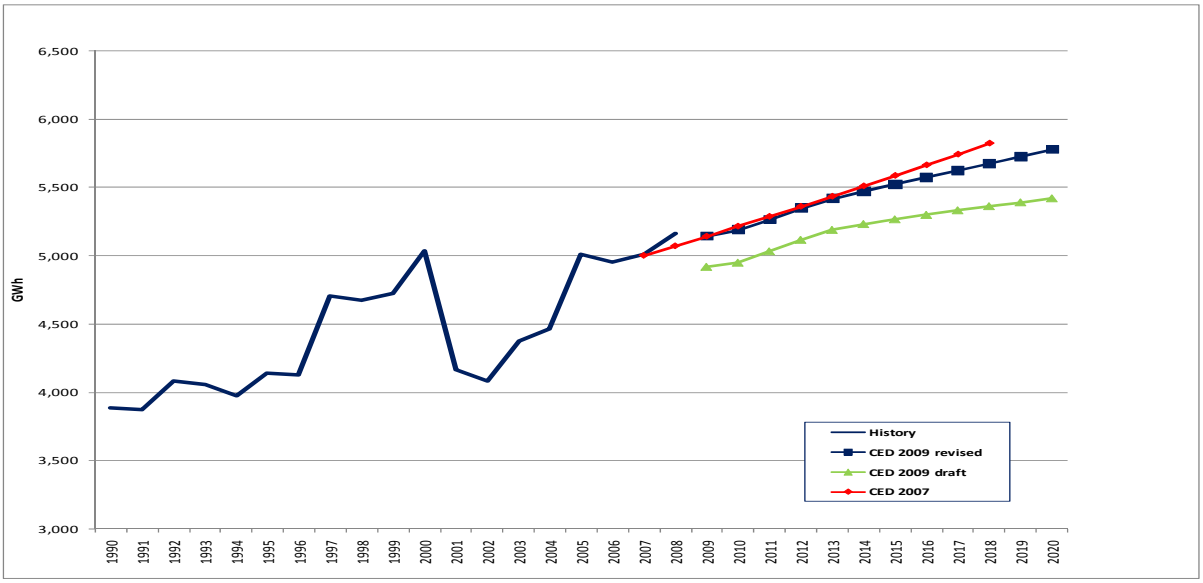
Source: California Energy Commission, 2009

Other Sectors

Figures 63 and **64** provide comparisons of the remaining sector electricity consumption forecasts. **Figure 63** compares the transportation, communication, and utilities (TCU) sector forecasts. *CED 2009 Revised* is slightly higher than *CED 2009 Draft*, caused by inclusion of 2008 consumption history.

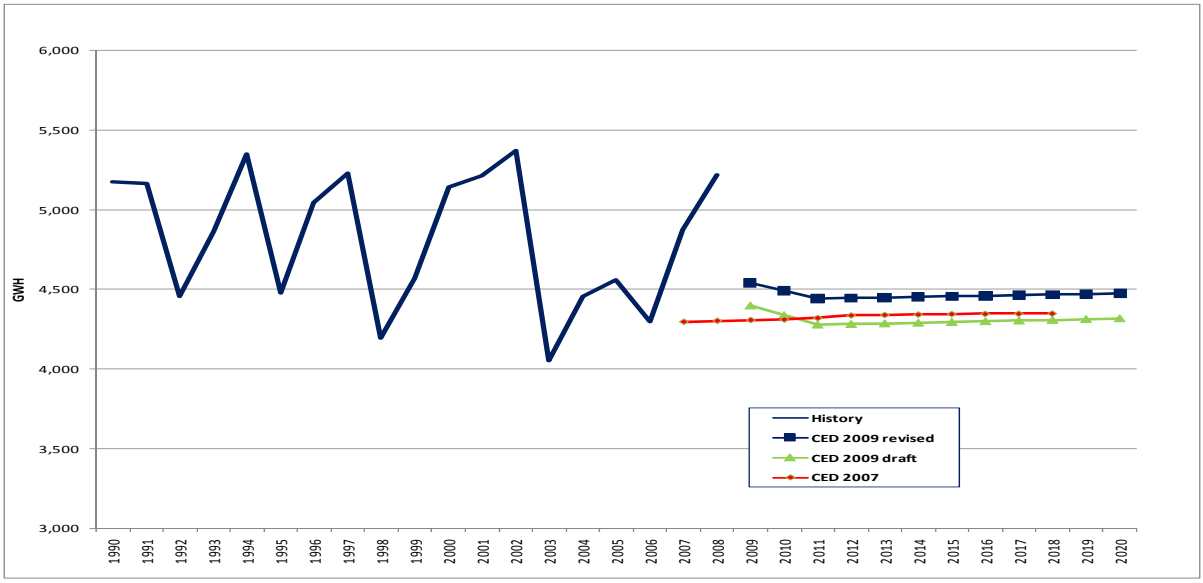
Figure 64 compares the agriculture and water pumping sector forecasts. *CED 2009 Revised* is higher than *CED 2009 Draft* because of higher estimated historical consumption, but the increase is tempered by limitations on water that is available to pump.

Figure 63: SCE Planning Area Transportation, Communication and Utilities Sector Electricity Consumption



Source: California Energy Commission, 2009

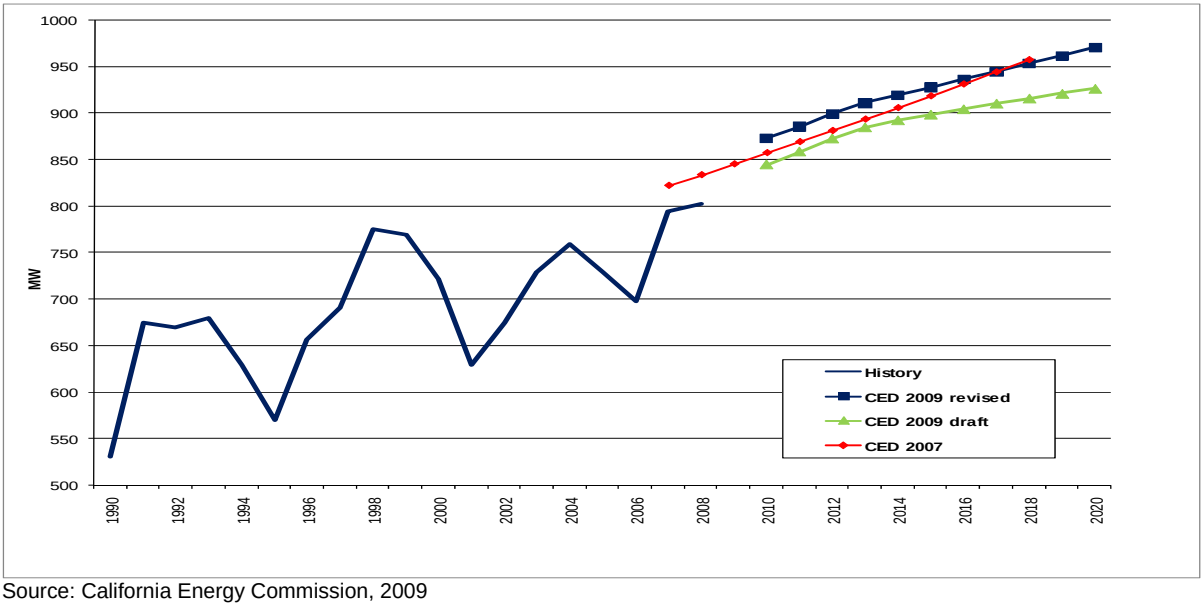
Figure 64: SCE Planning Area Agriculture and Water Pumping Forecasts



Source: California Energy Commission, 2009

Figure 65 compares the other sector peaks (TCU and street lighting). *CED 2009 Revised* is now higher than the previous two forecasts and very similar to *CED 2007* forecast in the long term.

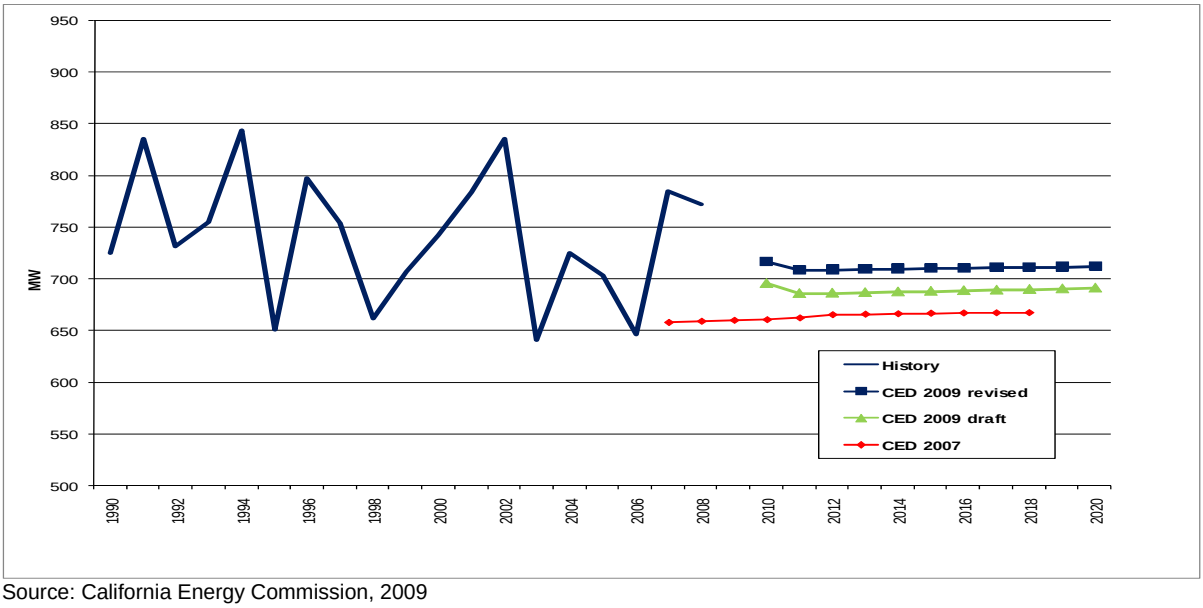
Figure 65: SCE Planning Area Other Sector Peak



Source: California Energy Commission, 2009

Figure 66 compares the agriculture and water pumping sector peaks. *CED 2009 Revised* is higher than *CED 2009 Draft*. Both *CED 2009* forecasts are higher than *CED 2007,* which is based on a lower assumed starting point.

Figure 66: SCE Planning Area Agriculture and Water Pumping Peak

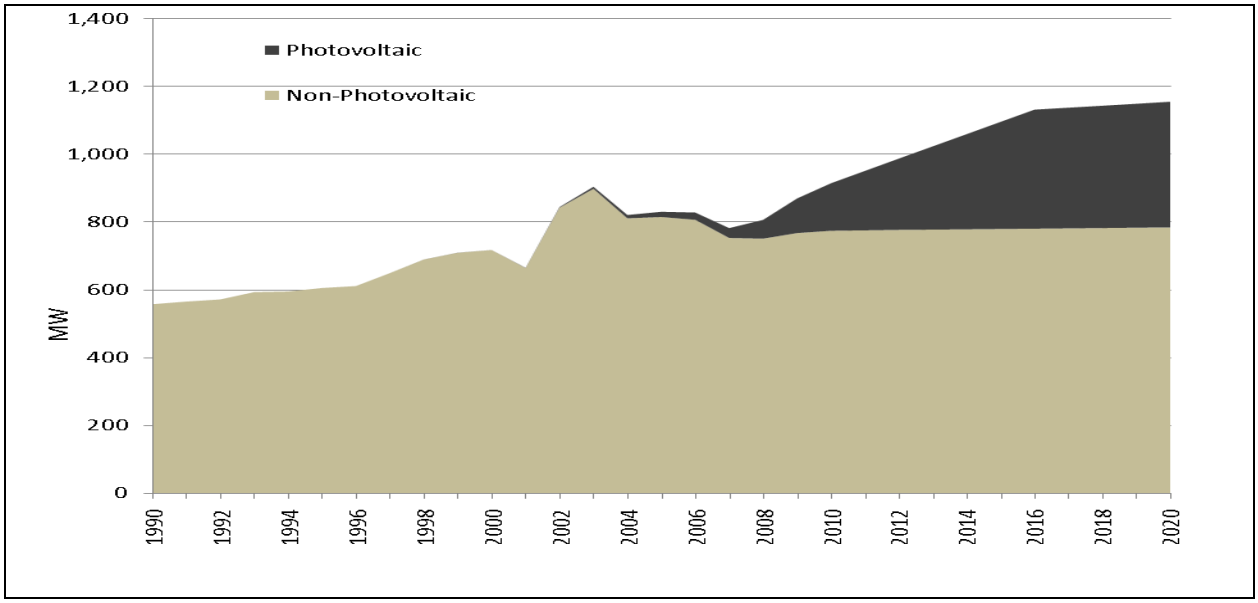


Source: California Energy Commission, 2009

Self-Generation

The peak demand forecast is reduced by self-generation, including the effects of the SGIP, CSI, and other programs, as discussed in Chapter 1. The effects of these programs are forecast based on recent trends in installations. **Figure 67** shows the staff draft forecast of peak impacts from photovoltaic and non-photovoltaic self-generation. Based on these trends, staff projects about 370 MW of peak reduction from photovoltaic systems by 2020.

Figure 67: SCE Planning Area Self-Generation Peak Forecasts



Source: California Energy Commission, 2009

Economic Scenarios

The results presented above rely on economic inputs from the *base case* Moody's Economy.com scenario. Staff also examined the impacts of two alternative economic scenarios for electricity demand: an *optimistic* case provided by Global Insight and an Economy.com *pessimistic* case. These two cases, in general, project the highest and lowest rates of economic growth of the various scenarios provided by the two companies. For this analysis, staff developed econometric models for the three largest sectors (residential, commercial, and industrial plus mining) at the planning area level, using historical data for electricity consumption, electricity rates, weather, and various economic and demographic variables. Electricity consumption for the remaining sectors was held constant (*CED 2009*

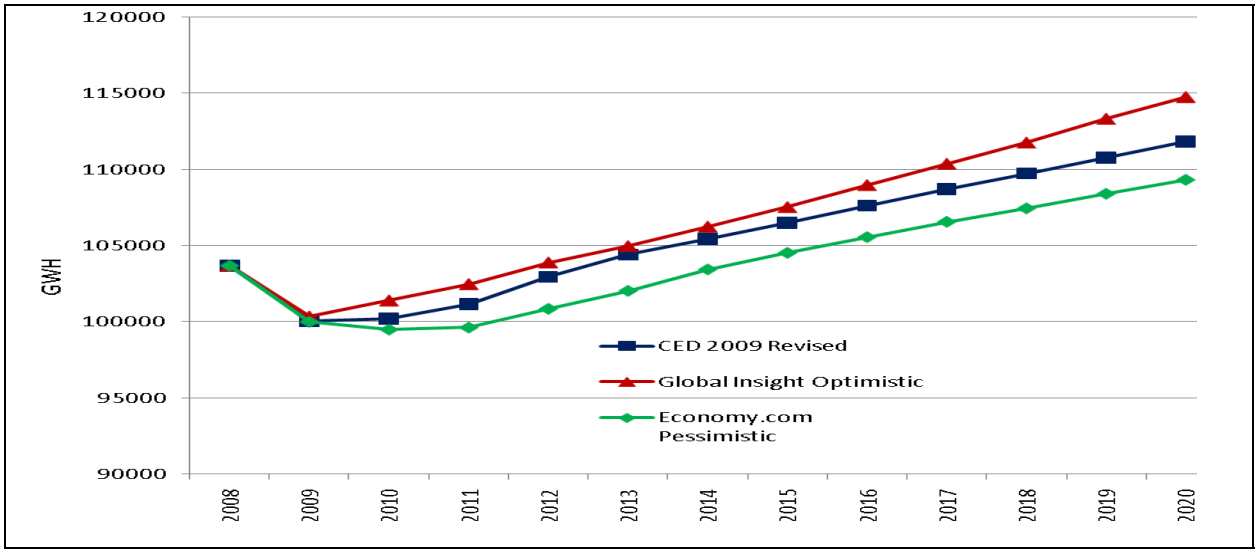
Revised levels) in the alternative scenarios. The Appendix provides details on the scenarios and the econometric models.

The estimated models were run for SCE for the two economic scenarios as well as the Economy.com base case. The resulting percentage differences in electricity consumption between the two alternative scenarios and the base case were applied to *CED 2007 Revised* consumption projections. **Figure 68** shows the projected impacts of the optimistic and pessimistic scenarios on SCE consumption. Peak demand was developed by applying projected load factors from *CED 2009 Revised* at the sector level to the consumption results for each scenario. Projected peak impacts are shown in **Figure 69**.

Electricity consumption is projected to be 2.6 percent higher in the optimistic economic case than in *CED 2009 Revised* by 2020 and 2.2 percent lower in the pessimistic scenario. The peak demand forecast increases by 2.6 percent under the optimistic scenario by 2020 and falls by 2.6 percent in the pessimistic case. The percentage peak reduction is higher than that of consumption in the pessimistic case because the relative decrease in consumption is projected to be higher for the residential and commercial sectors than for the industrial, which has a higher load factor (is less *peaky*). Annual growth rates from 2010-2020 for electricity consumption and peak demand increase from 1.1 percent and 1.35 percent, respectively, to 1.25 percent and 1.5 percent in the optimistic case, and fall to 0.95 percent and 1.15 percent under the pessimistic scenario.

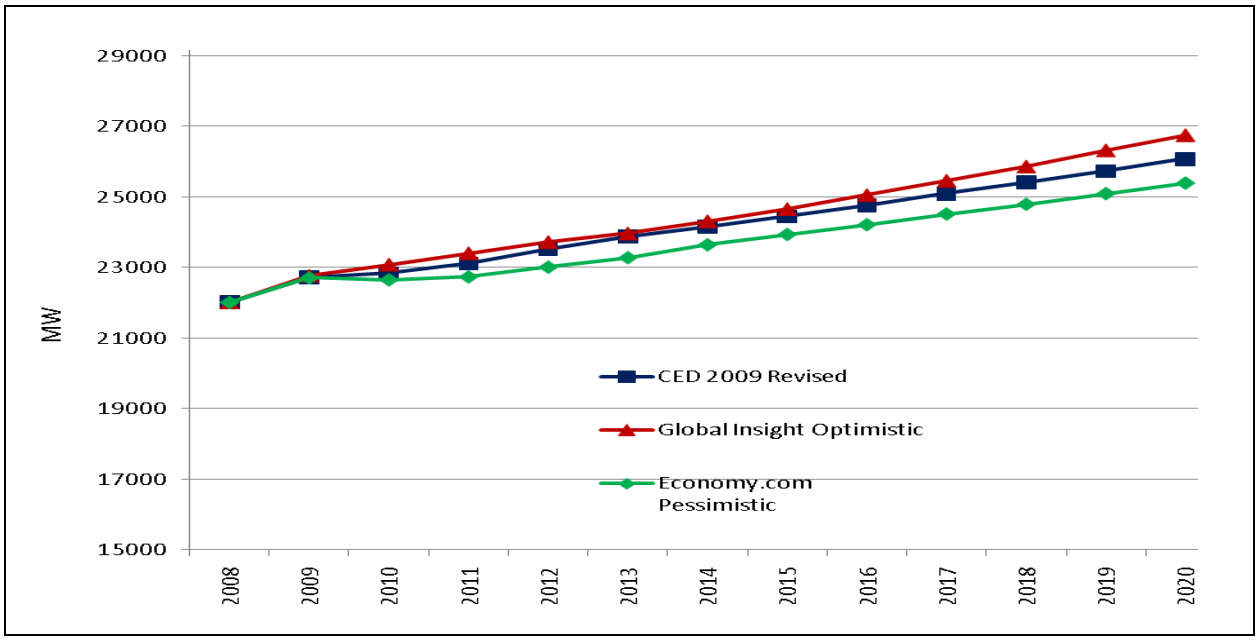
Changes in consumption and peak demand are small compared to *CED 2009 Revised* totals in percentage terms, and this is a reflection of the relatively narrow spread among the three economic scenarios. For example, retail employment is projected to be only 2 percent higher or lower in the alternative scenarios than in the Economy.com base case, and projected industrial output under the pessimistic scenario is almost identical to that of the base case by 2020.

Figure 68: Projected SCE Electricity Consumption, CED 2009 Revised and Alternative Economic Scenarios



Source: California Energy Commission, 2009

Figure 69: Projected SCE Peak Demand, CED 2009 Revised and Alternative Economic Scenarios



Source: California Energy Commission, 2009

Conservation/Efficiency Impacts

Staff spent a great deal of effort refining methods to account for energy efficiency and conservation impacts while preparing this forecast, particularly for utility efficiency programs. **Tables 13** and **14** show electricity consumption and peak savings estimates for selected years, for building and appliance standards, utility and public agency programs, and *naturally occurring* savings, or savings associated with rate changes and certain market trends not directly related to programs or standards. Savings are measured against a baseline before 1975, so they incorporate more than 30 years of impacts from rate changes and standards. Chapter 8 provides much more detail on staff work related to energy efficiency and conservation.

Table 13: SCE Planning Area Electricity Consumption Savings Estimates

	1990	1998	2003	2008	2011	2015	2020
Residential Energy Savings (GWH)							
Building Standards	966	1,138	1,239	1,487	1,669	1,926	2,238
Appliance Standards	990	2,305	3,310	4,656	5,429	6,411	7,500
Utility and Public Agency Programs	176	207	577	2,558	3,280	2,576	938
Naturally Occurring Savings	75	85	122	132	194	867	2,432
Total Residential Savings	2,208	3,736	5,249	8,834	10,573	11,780	13,108
Commercial Energy Savings (GWH)							
Building Standards	508	1,192	1,942	2,851	3,144	3,847	4,734
Appliance Standards	342	833	1,306	1,830	1,966	2,311	2,729
Utility and Public Agency Programs*	89	582	888	1,076	1,578	1,304	981
Naturally Occurring Savings	2,597	1,681	4,050	3,268	4,820	5,480	6,884
Total Commercial Savings	3,536	4,288	8,186	9,025	11,508	12,942	15,328
Total Energy Savings	5,744	8,024	13,435	17,859	22,081	24,721	28,436

Source: California Energy Commission, 2009
*Commercial programs also include agricultural program savings.

Table 14: SCE Planning Area Electricity Peak Savings Estimates

	1990	1998	2003	2008	2011	2015	2020
Residential Energy Savings (MW)							
Building Standards	269	331	321	410	497	586	695
Appliance Standards	276	672	858	1,282	1,616	1,949	2,328
Utility and Public Agency Programs	49	60	150	705	976	783	291
Naturally Occurring Savings	21	25	32	36	58	264	755
Total Residential Savings	615	1,088	1,361	2,433	3,147	3,582	4,069
Commercial Energy Savings (MW)							
Building Standards	121	268	415	571	672	816	995
Appliance Standards	81	188	279	366	420	490	574
Utility and Public Agency Programs*	21	131	190	216	337	276	206
Naturally Occurring Savings	617	379	866	654	1,031	1,162	1,447
Total Commercial Savings	840	965	1,751	1,807	2,461	2,744	3,223
Total Energy Savings	1,455	2,054	3,112	4,240	5,608	6,326	7,291

Source: California Energy Commission, 2009
*Commercial programs also include agricultural program

CHAPTER 4: San Diego Gas & Electric Planning Area

The San Diego Gas & Electric (SDG&E) planning area includes SDG&E bundled retail customers and customers served by various energy service providers (ESPs) using the SDG&E distribution system to deliver electricity to end users.

This chapter is organized in a fashion similar to those for the other planning areas. First, forecasts of total and per capita consumption and peak loads for the planning area are presented. For perspective, *CED 2009 Revised* values are compared to both *CED 2009 Draft* and *CED 2007* values. The forecasted load factor, jointly determined by the consumption and peak load estimates, is also discussed. Then, sector consumption and peak load forecasts are presented and compared to the sector level values of the two previous forecasts.

For the *CED 2009 Draft*, three price scenarios were developed for electricity rates: high rates, low (constant) rates, and a mid-rate scenario in between the two. The high-rate case assumed approximately 30 percent higher rates by 2020 relative to 2010, while the mid-rate case assumed 15 percent higher rates over the same period. In the low-rate case, rates remained at 2010 levels through 2020 as was done in *CED 2007*. In *CED 2009 Revised*, the mid-rate price forecast was used and all comparisons to *CED 2009 Draft* are made to the mid-rate scenario. Chapter 1 provides more details on price assumptions.

Forecast Results

The following summarizes the results presented in this chapter:

- *CED 2009 Revised* electricity consumption forecasts for the SDG&E planning area is lower than *CED 2007* levels because of the economic downturn and increased efficiency impacts, but higher than in *CED 2009 Draft*.
- CED 2009 Revised peak demand is lower than both previous forecasts because of increased estimates of self-generation.
- Per capita electricity consumption and peak demand are projected to be lower than in *CED 2007*.
- The largest percentage reduction in electricity consumption relative to *CED 2007* occurs in the residential and commercial sectors.
- Alternative economic scenarios increase or decrease electricity consumption and peak demand by around 2 percent in 2020.

- Peak self-generation impacts are projected to be higher than in *CED 2007* and *CED 2009 Draft*, mainly because of increased adoption of photovoltaic systems.

Table 15 compares planning area electricity consumption and peak demand forecasts for selected years. *CED 2009 Revised* is compared to both *CED 2009 Draft* mid rate and *CED 2007*. *CED 2009 Revised* electricity consumption is higher than *CED 2009 Draft* by about 5 percent at the end of the forecast period. This is caused mainly by higher economic forecast values provided in the June Moody's Economy.com forecast. *CED 2009 Revised* consumption is still about 5 percent lower than *CED 2007* at the end of the period. *CED 2009 Revised* peak is about 2 percent lower than *CED 2009 Draft* peak and a little over 4 percent lower than *CED 2007*. The reduction in *CED 2009 Revised* peak, relative to the changes in the consumption, is caused by increased assumptions regarding self-generation. This has the impact of reducing net system peak but does not reduce total electricity consumption. Long-term growth rates of both *CED 2009 Revised* consumption and peak are now just slightly below *CED 2007* growth rates.

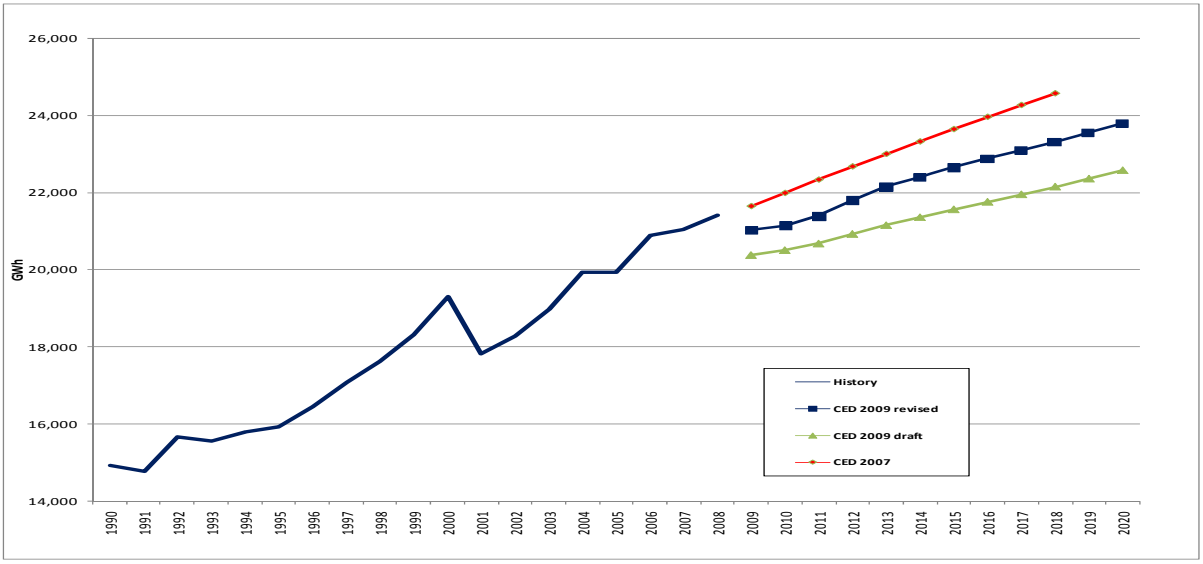
Table 15: SDG&E Planning Area Forecast Comparison

Consumption (GWH)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* mid-rate case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Percentage Difference *CED 2009 Revised/CED 2007*	Percentage Difference *CED 2009 Revised/CED 2009 Draft*
1990	14,926	14,926	14,926	0.00%	0.00%
2000	19,294	19,294	19,294	0.00%	0.00%
2008	21,304	20,361	21,411	0.51%	5.16%
2010	21,991	20,502	21,136	-3.89%	3.09%
2015	23,643	21,568	22,648	-4.21%	5.01%
2018	24,567	22,160	23,321	-5.07%	5.24%
Average Annual Growth Rates					
1990-2000	2.60%	2.60%	2.60%		
2000-2008	1.25%	0.67%	1.31%		
2008-2010	1.60%	0.35%	-0.64%		
2010-2018	1.39%	0.98%	1.24%		
Peak (MW)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* mid-rate case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Percentage Difference *CED 2009 Revised/CED 2007*	Percentage Difference *CED 2009 Revised/CED 2009 Draft*
1990	2,961	2,961	2,978	0.57%	0.57%
2000	3,471	3,471	3,485	0.40%	0.40%
2008	4,568	4,596	4,369	-4.36%	-4.94%
2010	4,714	4,621	4,513	-4.26%	-2.34%
2015	5,023	4,923	4,845	-3.54%	-1.58%
2018	5,247	5,115	5,009	-4.54%	-2.07%
Average Annual Growth Rates					
1990-2000	1.60%	1.60%	1.58%		
2000-2008	3.49%	3.57%	2.87%		
2008-2010	1.59%	0.27%	1.63%		
2010-2018	1.35%	1.28%	1.31%		
Historical values are shaded					

Source: California Energy Commission, 2009

As shown in **Figure 70**, *CED 2009 Revised* consumption is about 5 percent higher than *CED 2009 Draft* consumption, but still below *CED 2007* throughout the forecast period. The dip in the early years of *CED 2009 Revised* is caused by both the current recession and increased savings from energy efficiency programs.

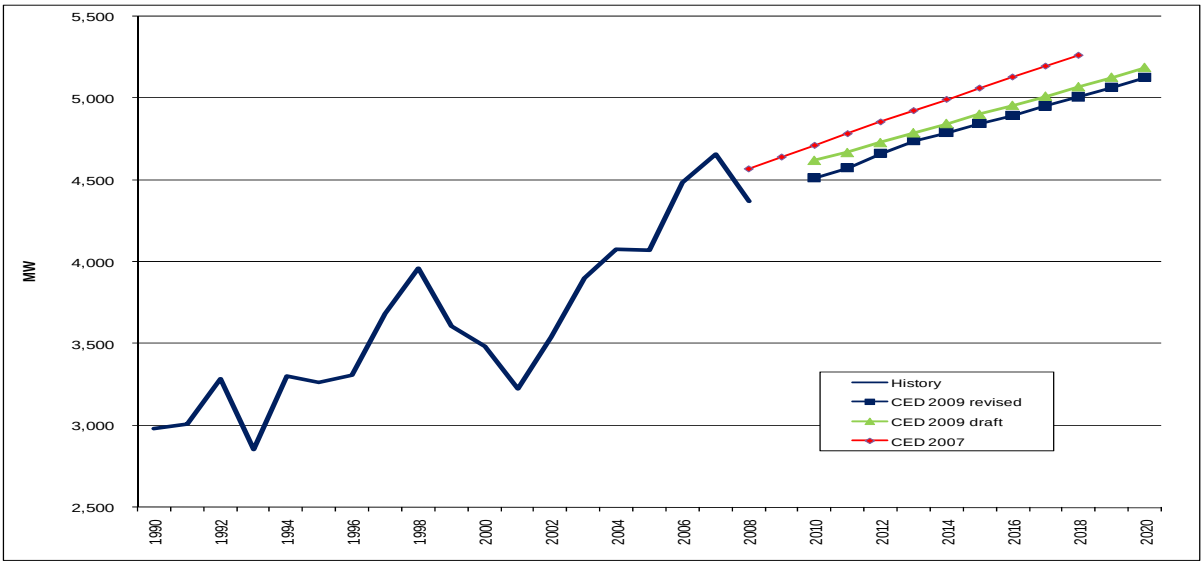
Figure 70: SDG&E Planning Area Electricity Forecast



Source: California Energy Commission, 2009

CED 2009 Revised SDG&E planning area peak demand **(Figure 71)** is slightly lower than *CED 2009 Draft* throughout the forecast period. This is caused by an increase in the peak impact of self-generation programs projected in *CED 2009 Revised*.

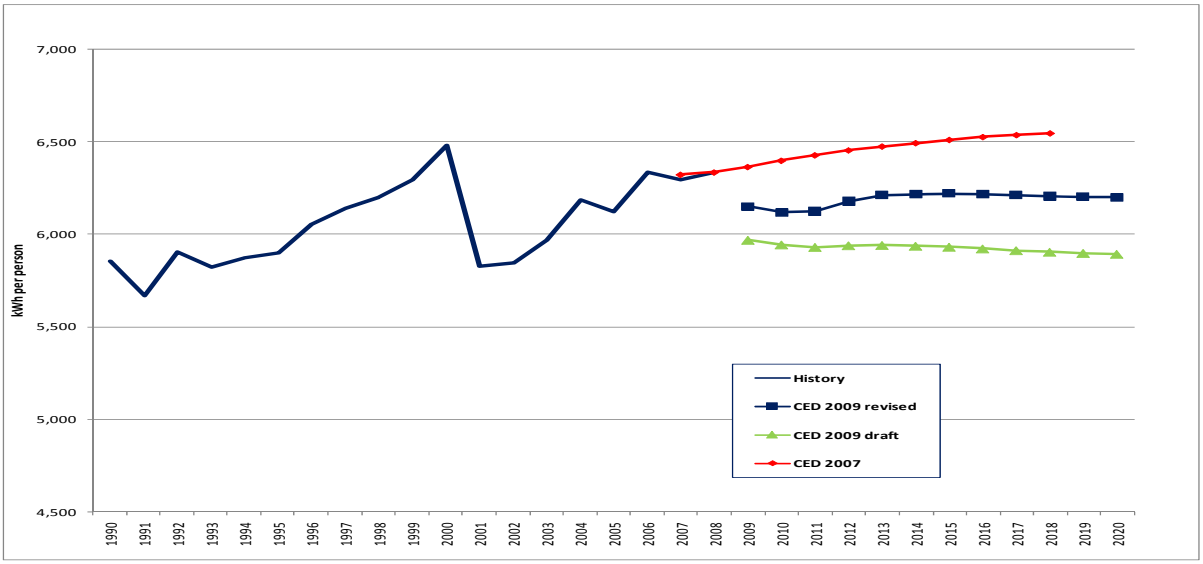
Figure 71: SDG&E Planning Area Peak



Source: California Energy Commission, 2009

Figure 72 compares forecasted per capita residential electricity consumption. *CED 2009 Revised* per capita consumption is higher than in *CED 2009 Draft*, but still well below *CED 2007* projections. The projection remains relatively constant over the forecast period and near the midpoint of values seen in the historical period. The current recession and increased savings from energy efficiency programs combine to cause the short-term dip in per capita consumption.

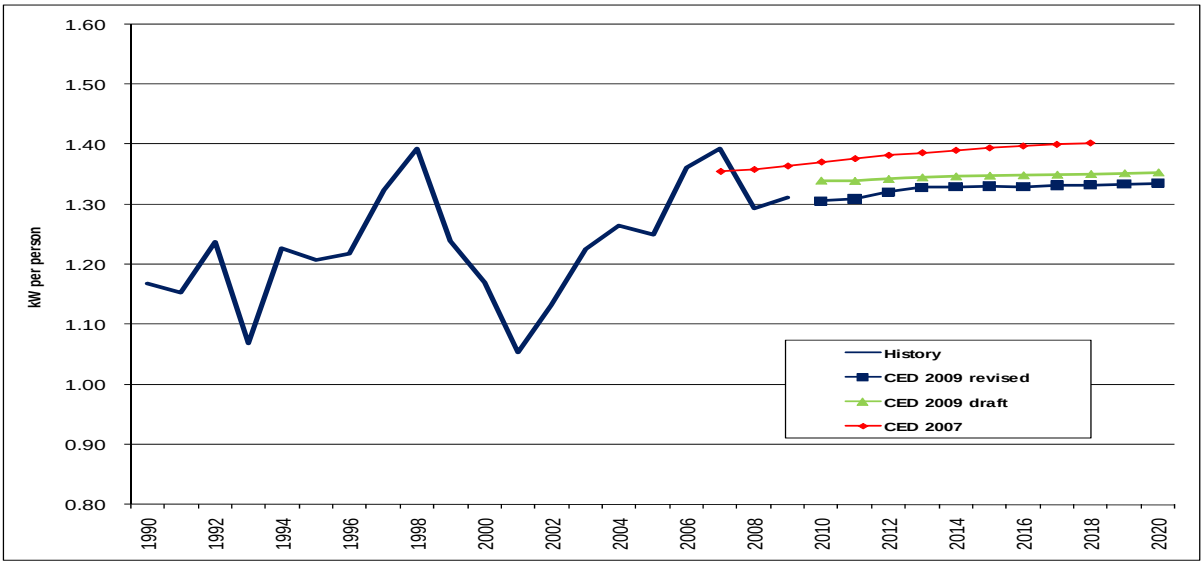
Figure 72: SDG&E Planning Area per Capita Electricity Consumption



Source: California Energy Commission, 2009

CED 2009 Revised per capita peak demand, shown in **Figure 73**, is lower over the entire forecast period because of the inclusion of the higher self-generation peak estimates used in *CED 2009 Revised*. *CED 2009 Revised* per capita peak demand is relatively constant over the forecast period (in contrast to the increase projected in *CED 2007)*. This is caused by increases in estimates of self generation and expected efficiency program impacts, as well as reduced economic growth relative to *CED 2007* values.

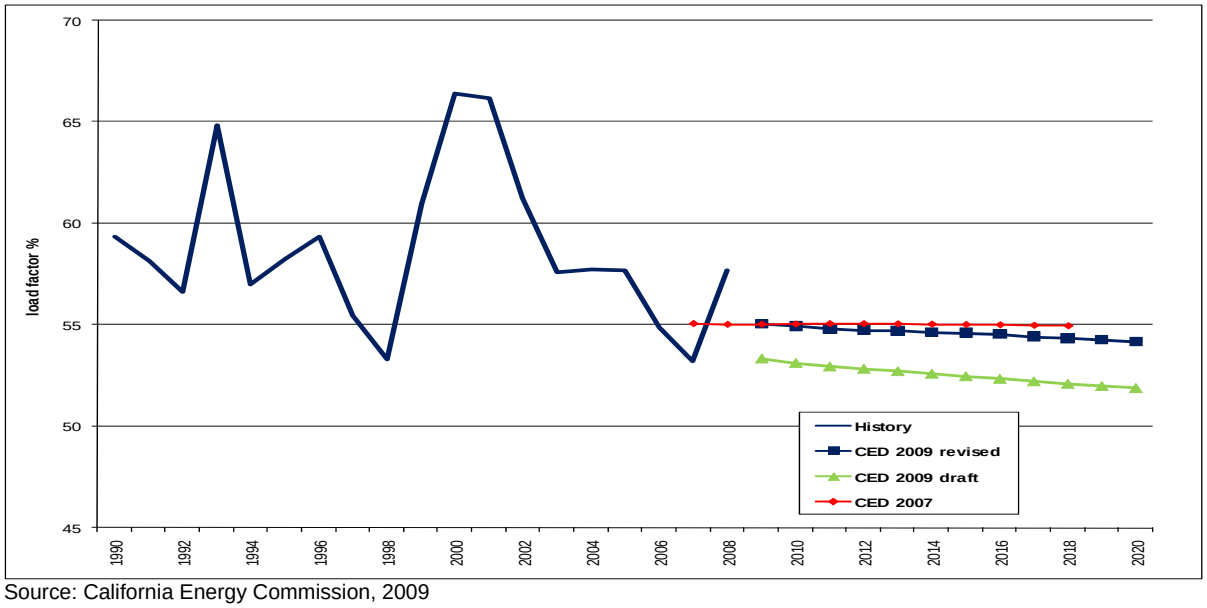
Figure 73: SDG&E Planning Area per Capita Peak Demand



Source: California Energy Commission, 2009

Figure 74 compares respective forecast load factors. High load factors observed from 1998-2005 are a product of lower-than-average peak temperatures and of reaction to the energy crisis. Projected load factor, based on higher, 1-in-2 peak temperatures and a return to normal air conditioning use patterns, are expected to be lower than these recent values. The *CED 2009 Revised* load factor is higher than *CED 2009 Draft* because of revised self-generation projections, which lower peak relative to consumption.

Figure 74: SDG&E Planning Area Peak Load Factor



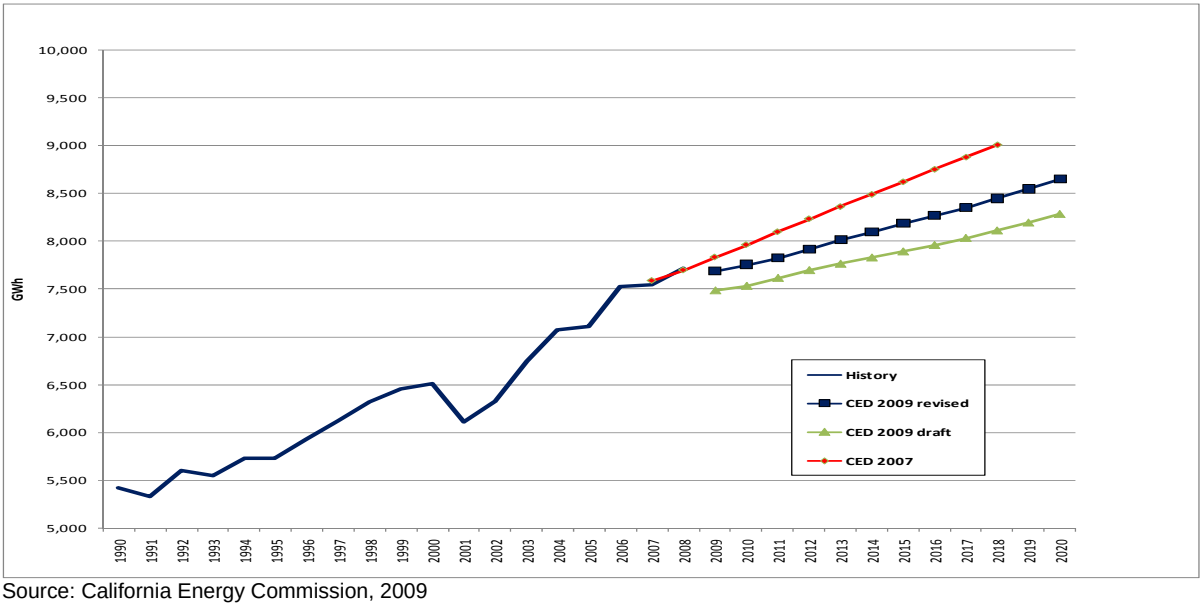
Source: California Energy Commission, 2009

Sector Level Results and Input Assumptions

Residential

Figure 75 compares residential forecasts. *CED 2009 Revised* is higher over the entire forecast period than *CED 2009 Draft* but is still below the level of *CED 2007*. The increase over *CED 2009 Draft* is caused by increased projections of household income and slightly higher persons-per-household projections, as well as an increase in the starting value brought about by inclusion of 2008 sales. The revised household income projections are still below those in *CED 2007*.

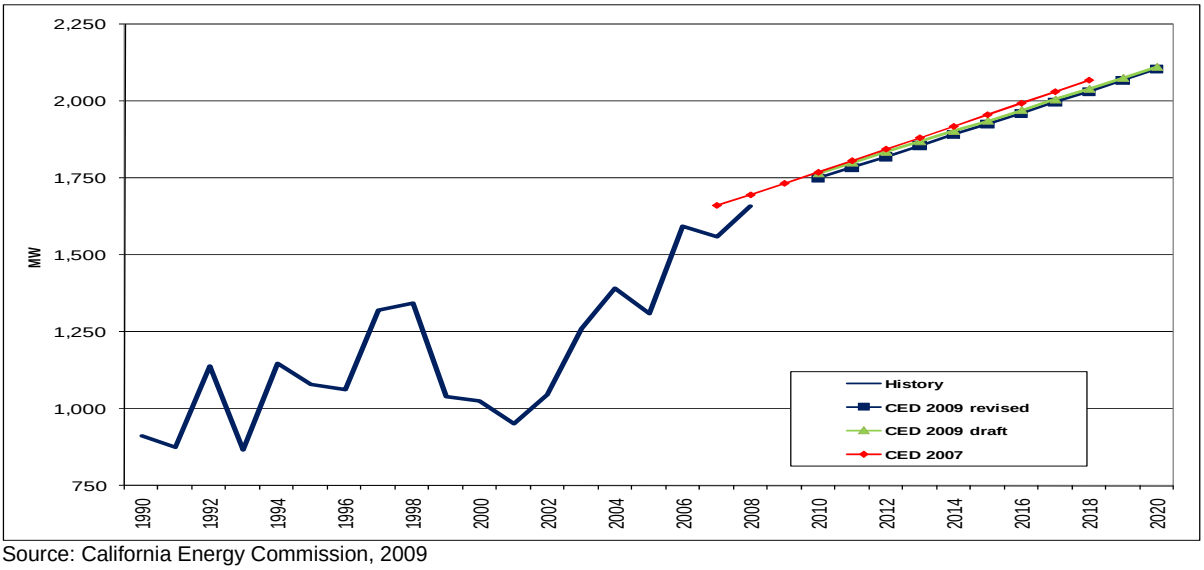
Figure 75: SDG&E Planning Area Residential Consumption



Source: California Energy Commission, 2009

Figure 76 compares residential peak demand forecasts. Unlike the consumption forecast, there is very little difference in the revised and draft residential peak forecasts.

Figure 76: SDG&E Planning Area Residential Peak

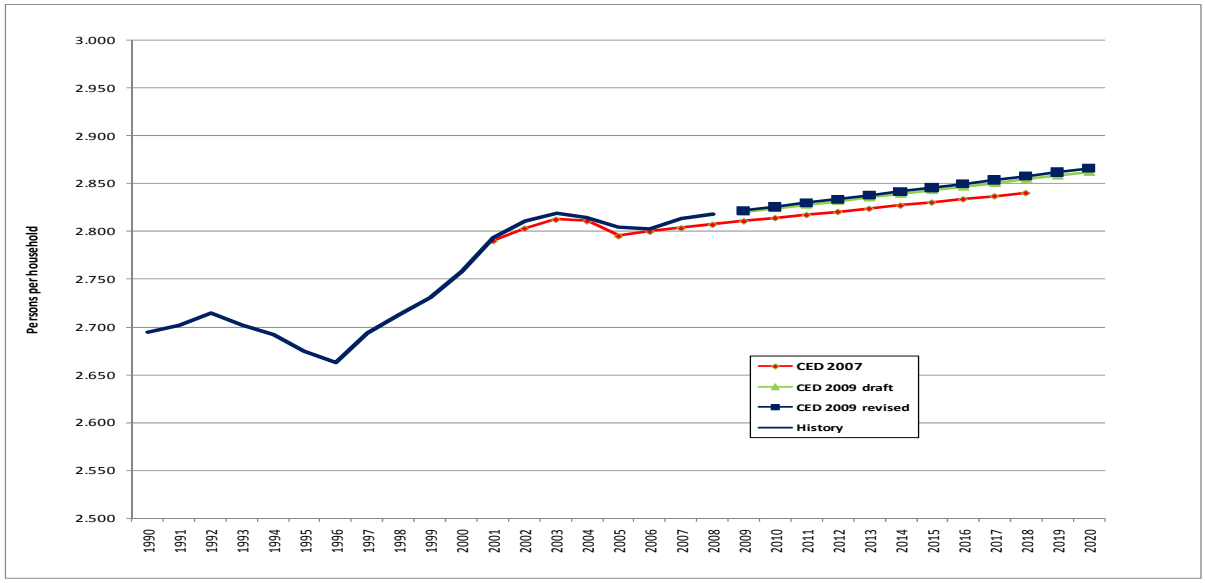


Source: California Energy Commission, 2009

Figures 77 and **78** provide comparisons of the residential drivers used in the forecasts. **Figure 77** shows projections of persons per household. There is slight increase in forecast

persons per household in *CED 2009 Revised* compared to both *CED 2009 Draft* and to *CED 2007*. The change in *CED 2009 Revised* projections reduces the household forecast by 340 households by the end of the forecast period compared to *CED 2009 Draft* (less than 0.05 percent).

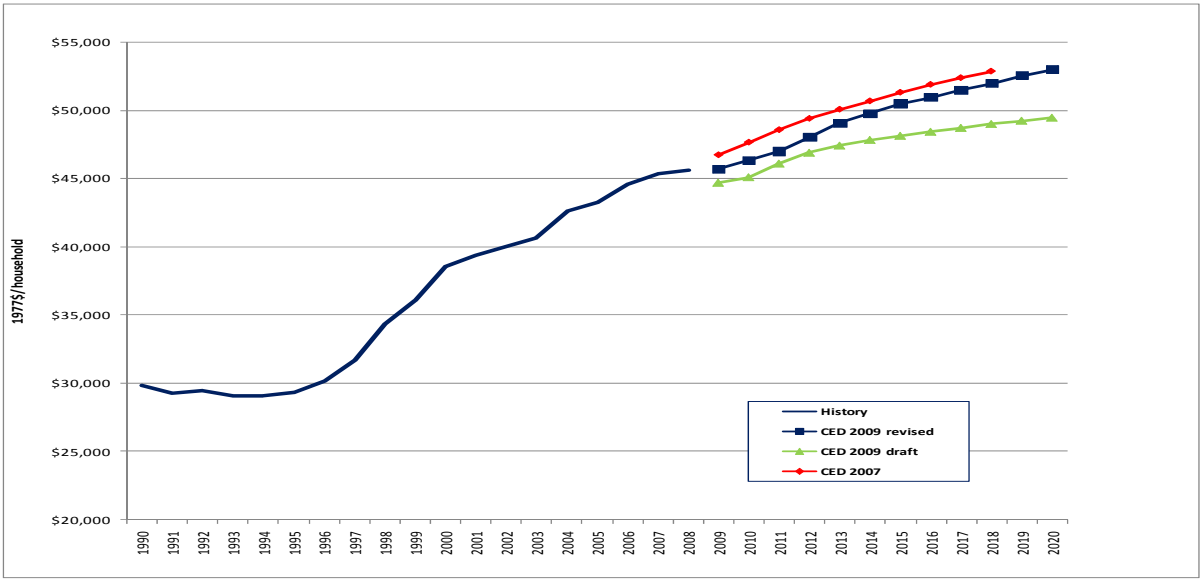
Figure 77: SDG&E Planning Area Persons-per-Household Projections



Source: California Energy Commission, 2009

Figure 78 compares household income used in the respective forecasts. *CED 2009 Revised* projections are higher than in *CED 2009 Draft* but still below what was used in *CED 2007*. *CED 2009 Revised* uses the June 2009 projections from Economy.com while the previous forecasts used earlier vintages of Economy.com projections.

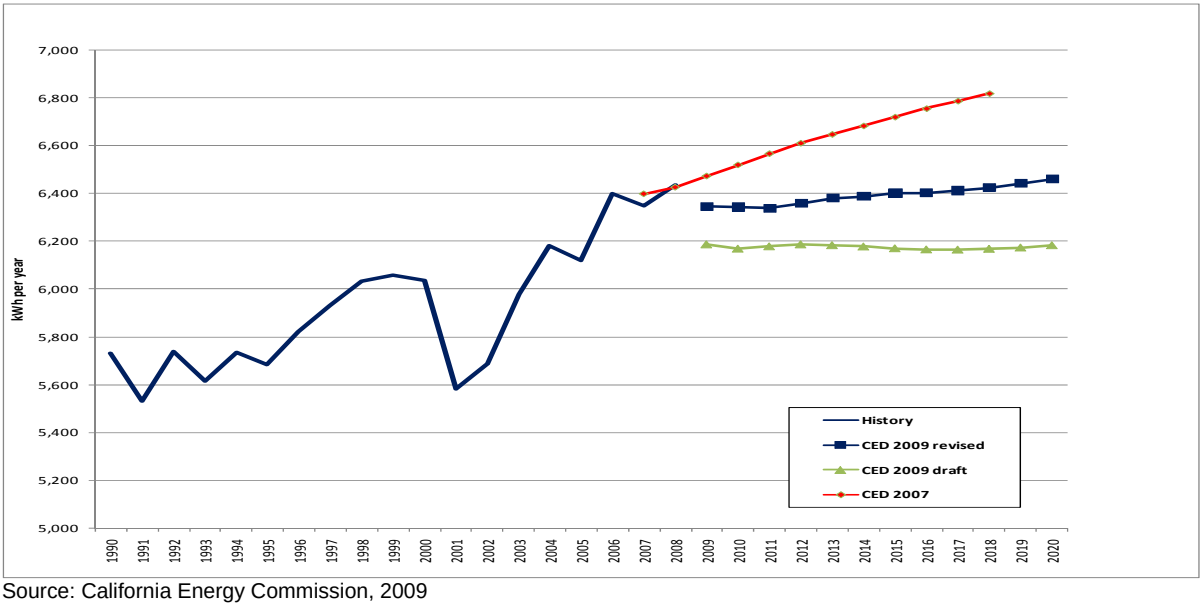
Figure 78: SDG&E Planning Area Household Income Projections



Source: California Energy Commission, 2009

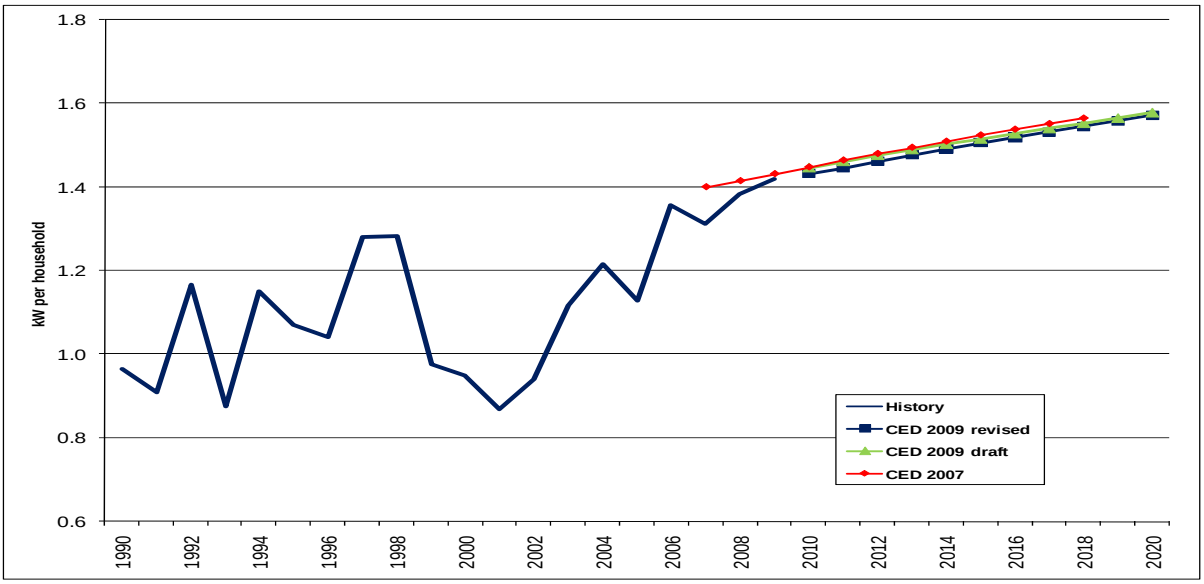
Figures 79 and **80** compare residential use per household and residential peak use per household, respectively. *CED 2009 Revised* use per household (**Figure 79**) is higher than *CED 2009 Draft*, caused by inclusion of 2008 sales data to adjust the starting point. *CED 2009 Revised* increases slightly over the forecast period from increased household income projections. *CED 2009 Revised* use per household is still below the level of *CED 2007* levels. In contrast, differences in peak use per household (**Figure 80**) are very slight because most of the consumption savings does not directly translate into peak savings.

Figure 79: SDG&E Planning Area Use per Household



Source: California Energy Commission, 2009

Figure 80: SDG&E Planning Area Peak Use per Household

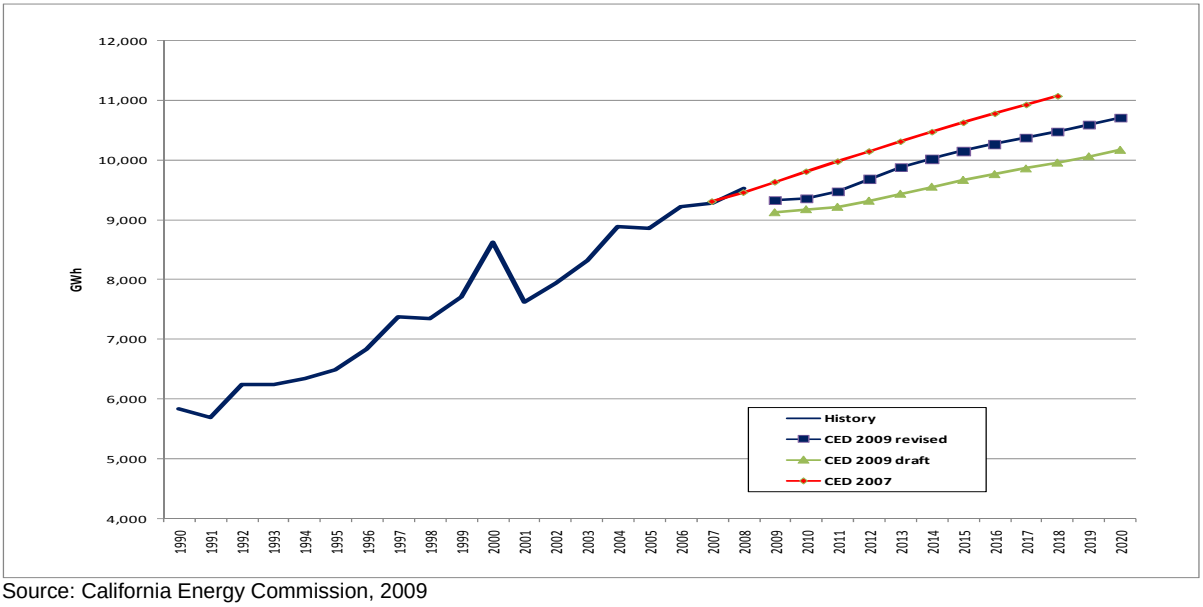


Source: California Energy Commission, 2009

Commercial Building Sector

Figures 81 and **82** compare the commercial building sector forecasts. *CED 2009 Revised* is higher than *CED 2009 Draft* because of increased economic growth as well as inclusion of 2008 consumption data as a revised starting point. *CED 2009 Revised* is still below the projections of *CED 2007*.

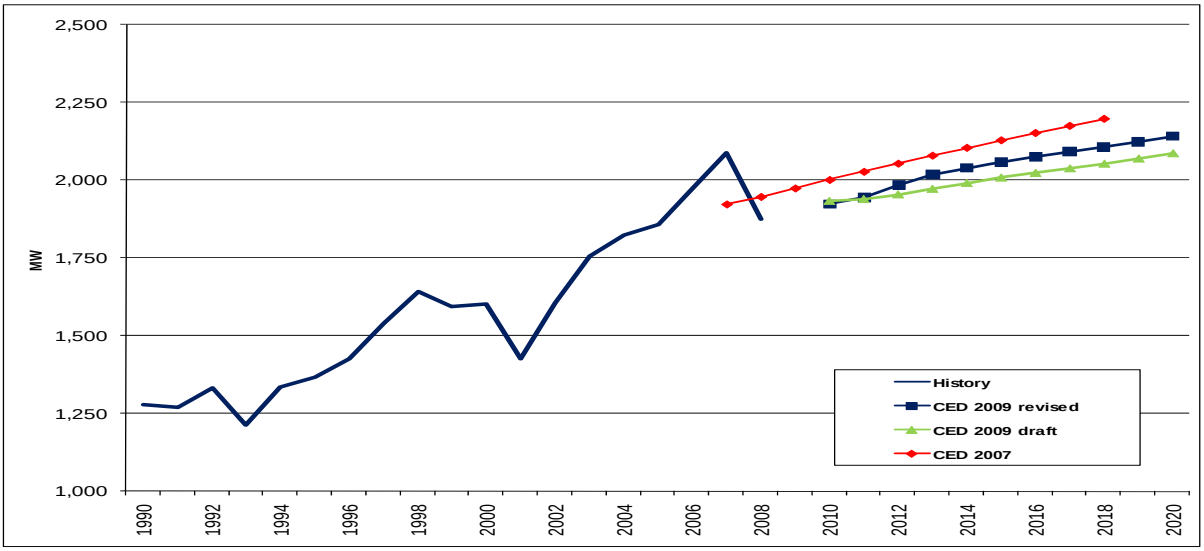
Figure 81: SDG&E Planning Area Commercial Consumption



Source: California Energy Commission, 2009

Figure 82 compares commercial building sector peak demand forecasts. Differences in the peak forecasts are similar to those in the consumption forecasts.

Figure 82: SDG&E Planning Area Commercial Sector Peak

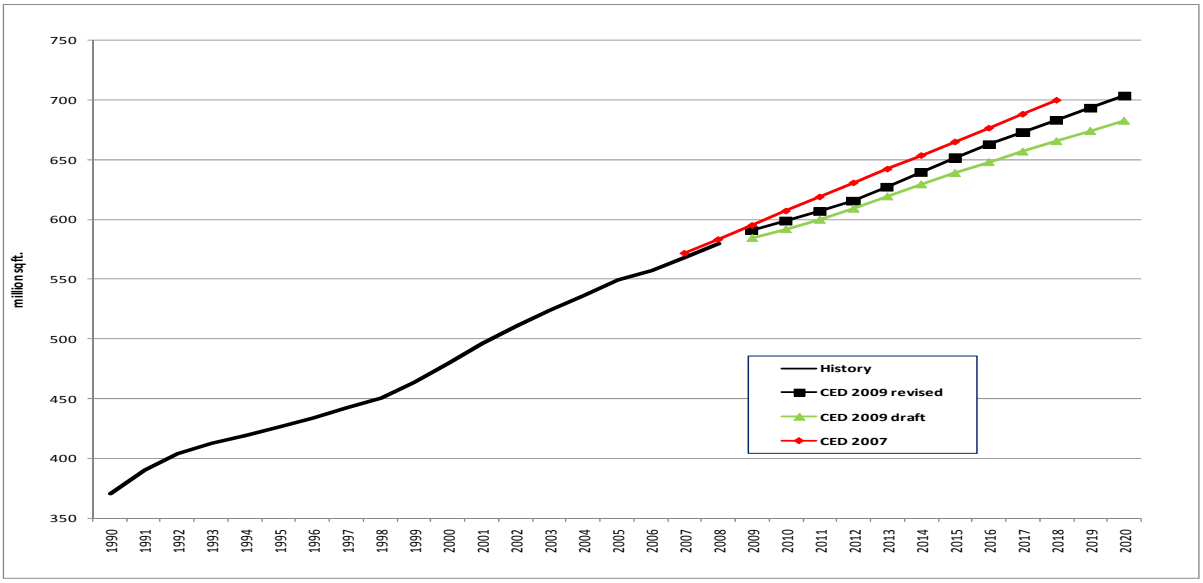


Source: California Energy Commission, 2009

In staff's commercial building sector forecasting model, floor space by building type (that is, retail, schools, offices, and so forth) is the key driver of energy use for each specific building

type. **Figure 83** compares total commercial floor space projections. *CED 2009 Revised* is higher than *CED 2009 Draft* because of revisions to economic and demographic drivers as well as changes to the econometric estimates in the floor space model. The revised floor space projections are still below those used in *CED 2007*.

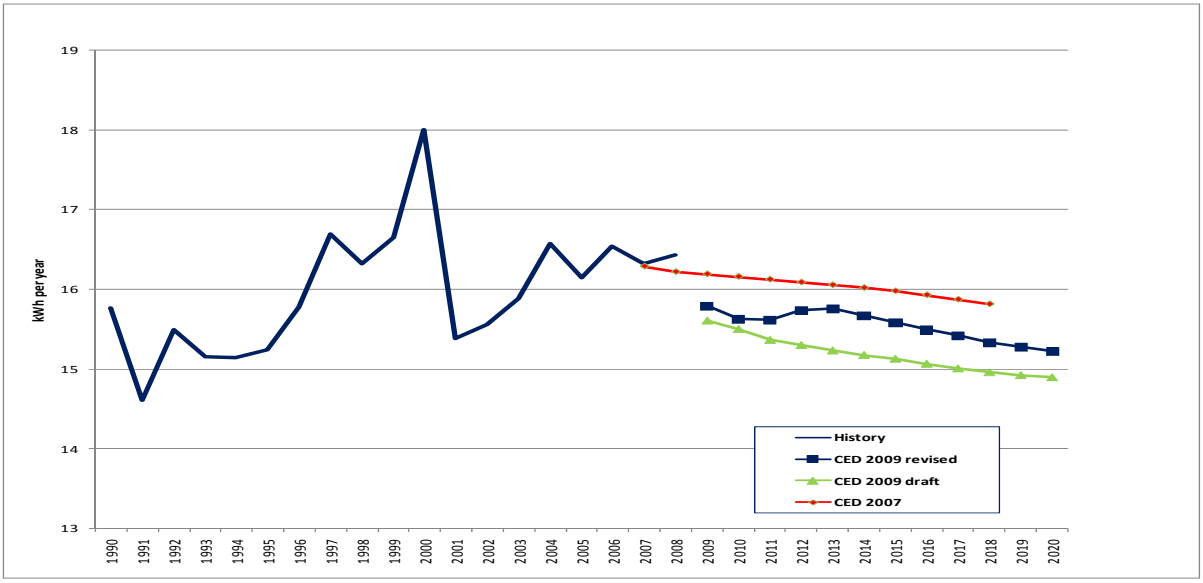
Figure 83: SDG&E Planning Area Commercial Floor Space



Source: California Energy Commission, 2009

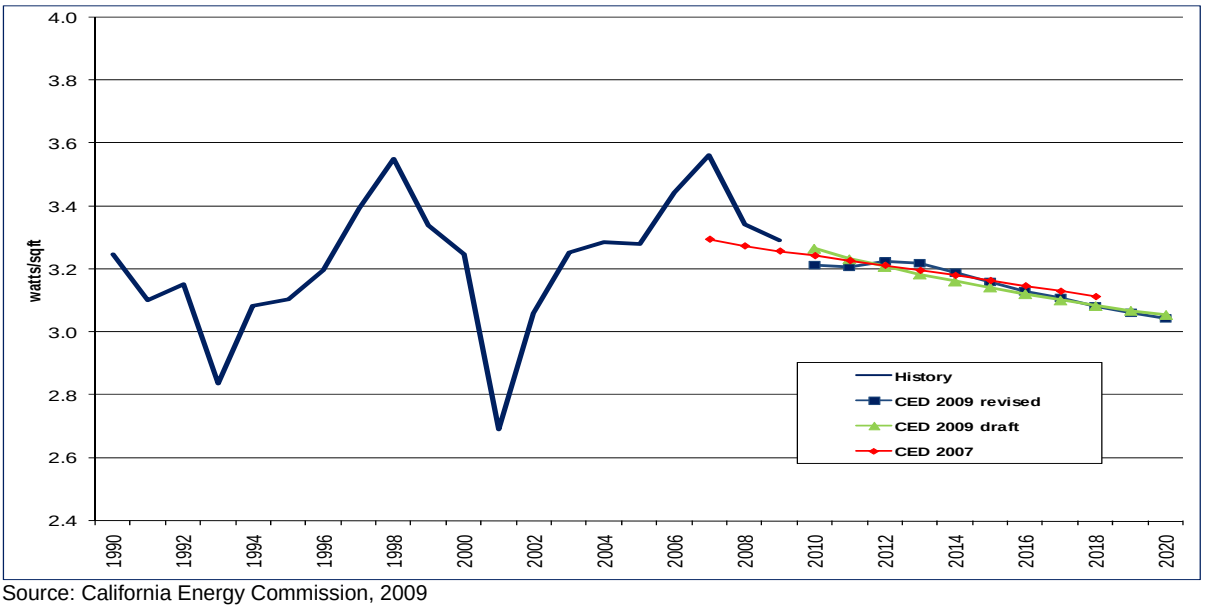
Historical and projected commercial sector annual and peak use per square foot are shown in **Figures 84** and **85**, respectively. Changes in annual use per square foot are based on the historical floor space estimates presented in **Figure 83**. Use per square foot (**Figure 84**) in *CED 2009 Revised* is somewhat higher than *CED 2009 Draft* because of an assumed higher starting value caused by inclusion of 2008 consumption values, as well as revisions to the economic drivers used in the forecast. This value is still below that projected in *CED 2007*. Revised peak use per square foot (**Figure 85**) is virtually unchanged from *CED 2009 Draft* or *CED 2007* projections. Both the energy and peak forecasts decline over the forecast period because of projected commercial building and appliance standards effects as well as increased efficiency program savings.

Figure 84: SDG&E Planning Area Commercial kWh per Square Foot



Source: California Energy Commission, 2009

Figure 85: SDG&E Planning Area Commercial Watts per Square Foot



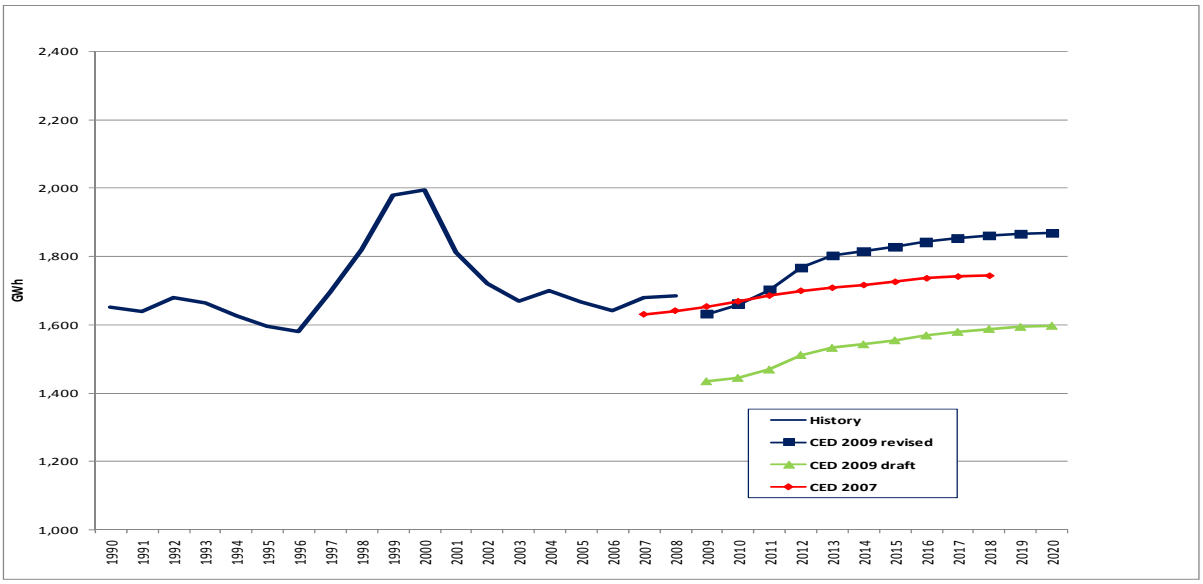
Source: California Energy Commission, 2009

Industrial Sector

Figure 86 compares industrial sector electricity consumption forecasts for the SDG&E planning area. *CED 2009 Revised* is higher throughout the entire forecast period than *CED 2009 Draft* because of a higher assumed starting point from the inclusion of 2008

consumption estimates. The long-term growth of *CED 2009 Revised* is also higher than *CED 2007*.

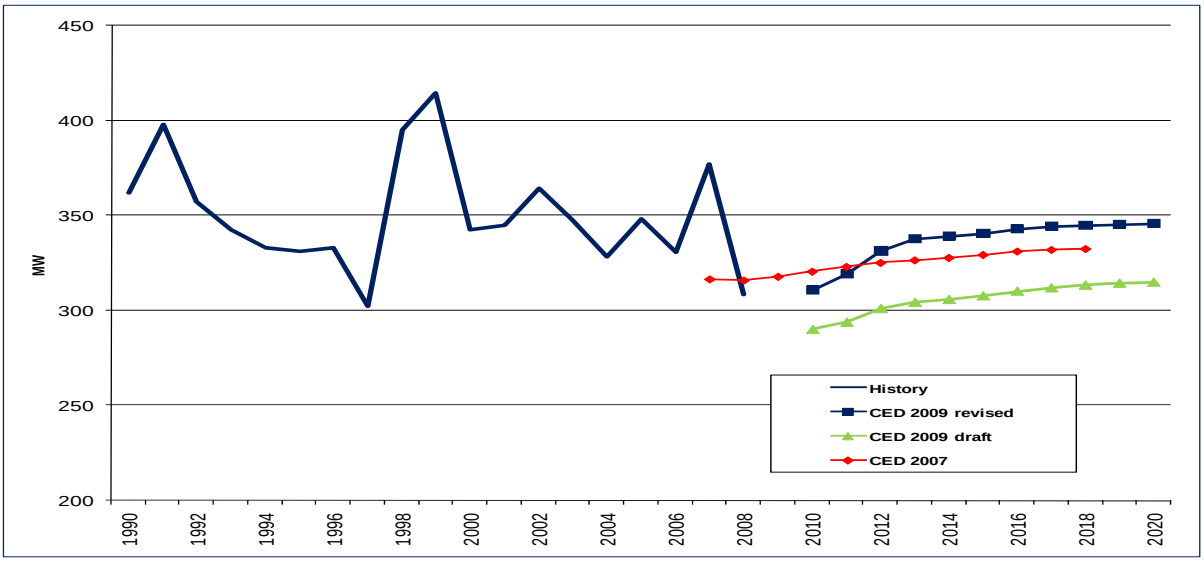
Figure 86: SDG&E Planning Area Industrial Consumption



Source: California Energy Commission, 2009

Figure 87 compares industrial sector peak forecasts. The differences mirror those in the consumption forecasts.

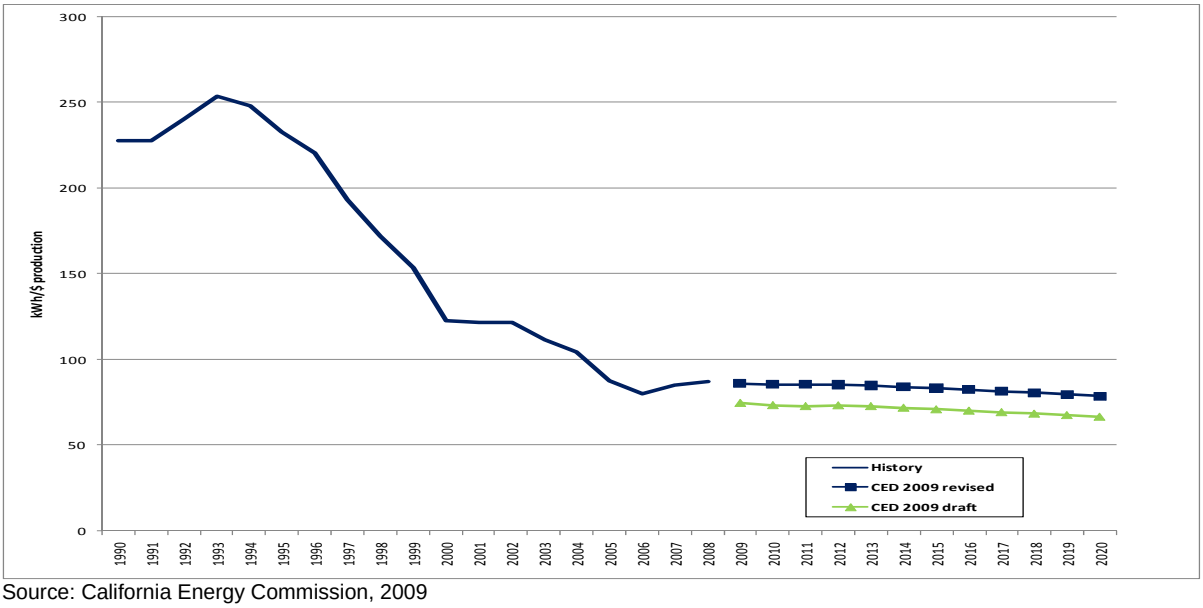
Figure 87: SDG&E Planning Area Industrial Sector Peak



Source: California Energy Commission, 2009

Figure 88 compares use per dollar value of production between the revised and draft forecasts. *CED 2009 Revised* has a higher level of electricity use per dollar of value added than *CED 2009 Draft*. This is primarily caused by a higher historical starting point from inclusion of 2008 consumption history. The forecasted growth rates are similar.

Figure 88: SDG&E Planning Area Industrial Use per Production Unit



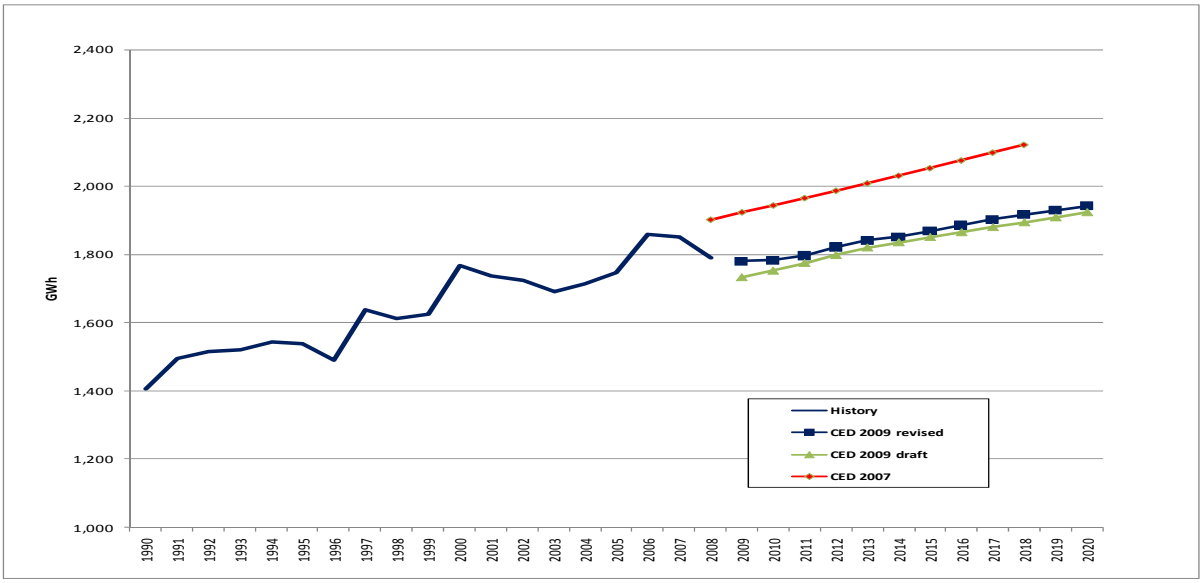
Source: California Energy Commission, 2009

Other Sectors

Figures 89 and **90** compare electricity consumption forecasts for the remaining sectors. **Figure 89** compares transportation, communication, and utilities (TCU) sector forecasts. *CED 2009 Revised* is slightly higher than *CED 2009 Draft*, caused by inclusion of 2008 consumption history.

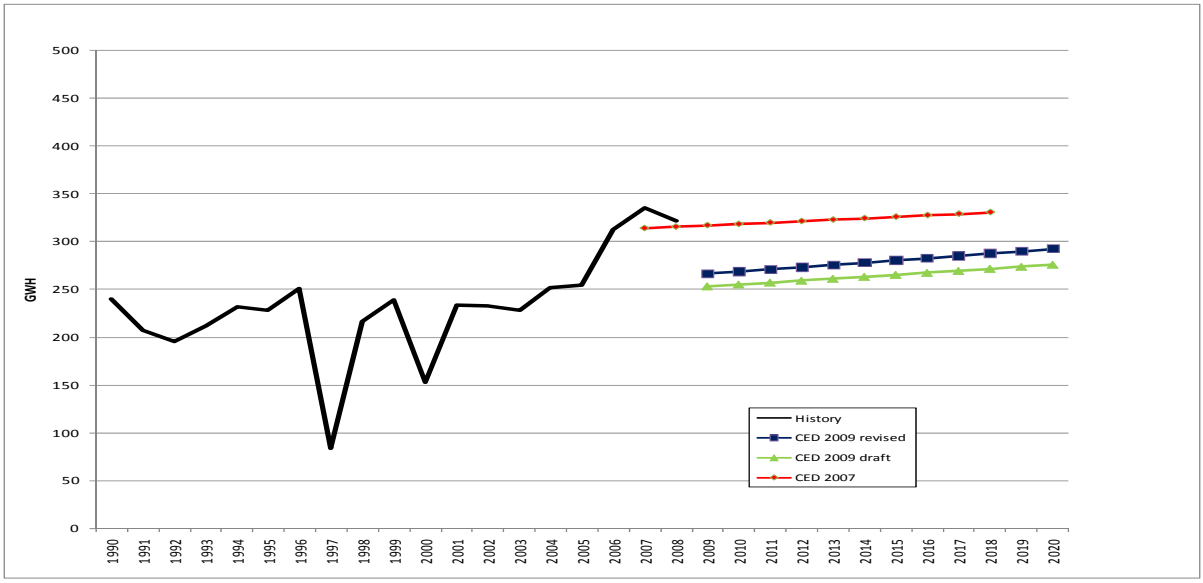
Figure 90 compares the agriculture and water pumping sector forecasts. *CED 2009 Revised* is higher than *CED 2009 Draft* because of higher estimated historical consumption, but the increase is tempered by limitations on water that is available to pump.

Figure 89: SDG&E Planning Area Transportation, Communication and Utilities Sector Electricity Consumption



Source: California Energy Commission, 2009

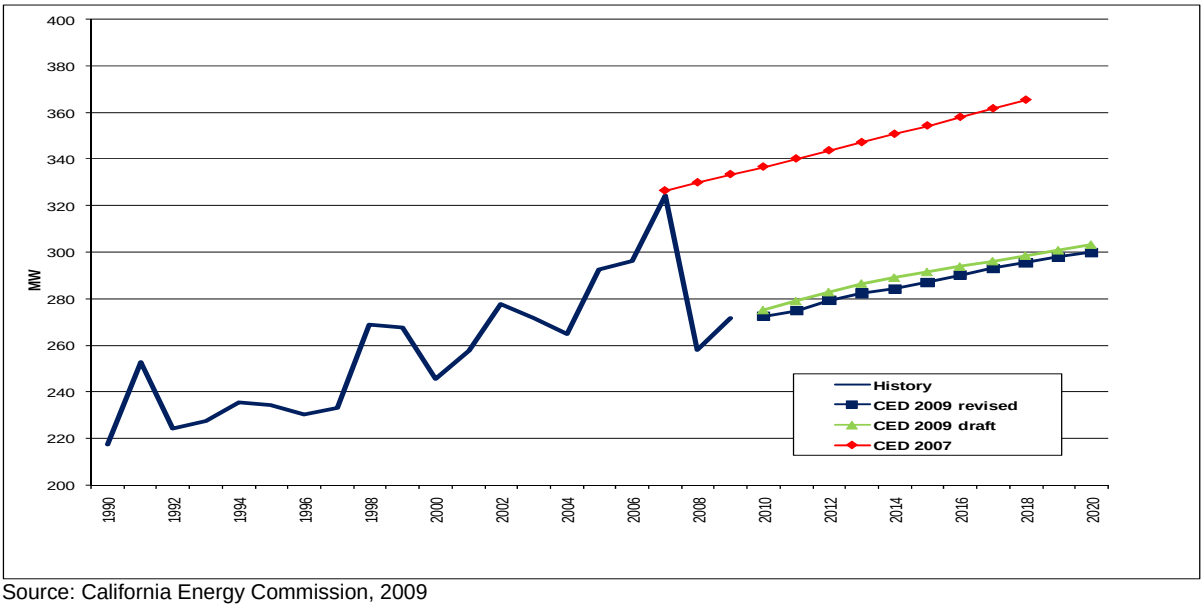
Figure 90: SDG&E Planning Area Agriculture and Water Pumping Forecasts



Source: California Energy Commission, 2009

Figure 91 compares other sector (TCU and street lighting) peaks. *CED 2009 Revised* is very similar to *CED 2009 Draft*. Both *CED 2009* forecasts are lower than the *CED 2007* forecast, which is based on a higher assumed starting point.

Figure 91: SDG&E Planning Area Other Sector Peak

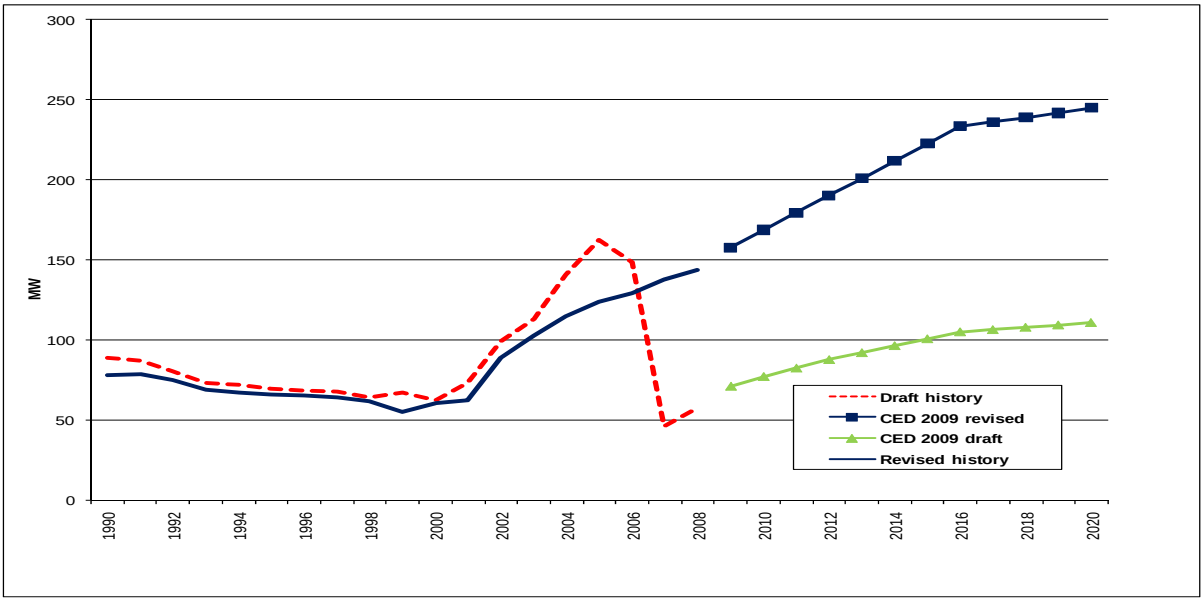


Source: California Energy Commission, 2009

Self-Generation

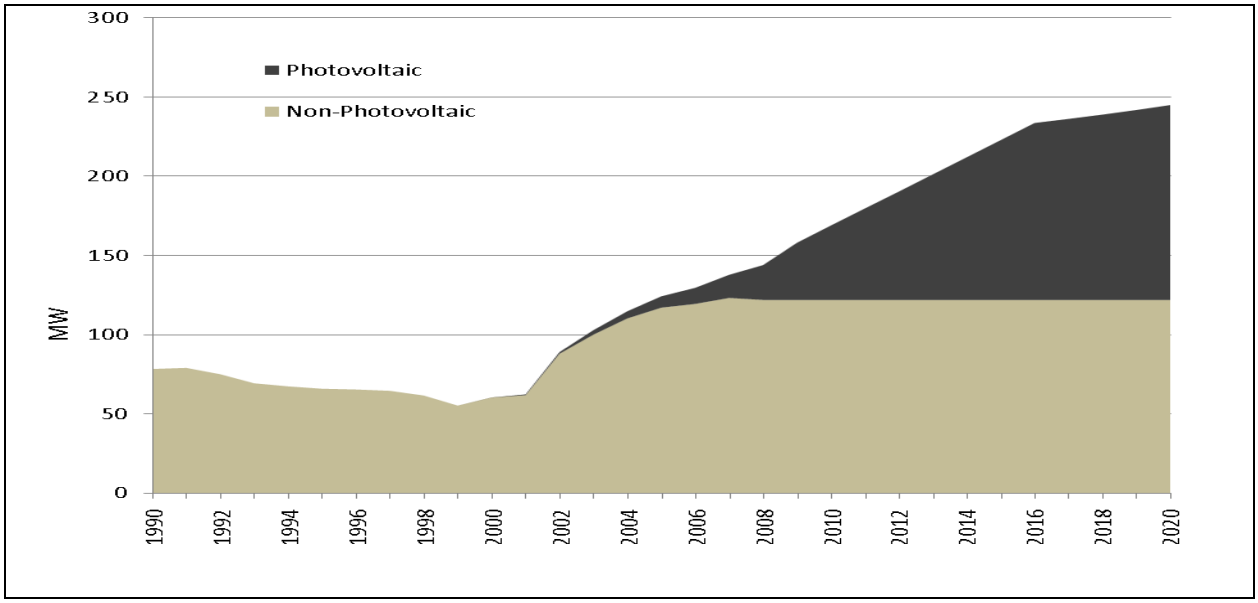
The peak demand forecast is reduced by self-generation, including the effects of the SGIP, CSI, and other programs, as discussed in Chapter 1. The effects of these programs are forecast based on recent trends in installations and associated generation now including 2009. During the *CED 2009 Draft* workshop, SDG&E noted that staff estimates of historical self-generation differed from data that SDG&E had. Since the workshop, staff has worked with SDG&E to reconcile differences in historical self-generation values. **Figure 92** shows staff revised historical and forecast peak impacts of total self-generation as well as those used in the preliminary forecast. **Figure 93** provides a breakdown of peak impacts in the *CED 2009 Revised* forecast from photovoltaic and non-photovoltaic self-generation. Based on current trends, staff now projects about 123 MW of peak reduction from photovoltaic systems by 2020.

Figure 92: SDG&E Planning Area Self-Generation Estimates



Source: California Energy Commission, 2009

Figure 93: SDG&E Planning Area Self-Generation Peak Forecasts



Source: California Energy Commission, 2009

Economic Scenarios

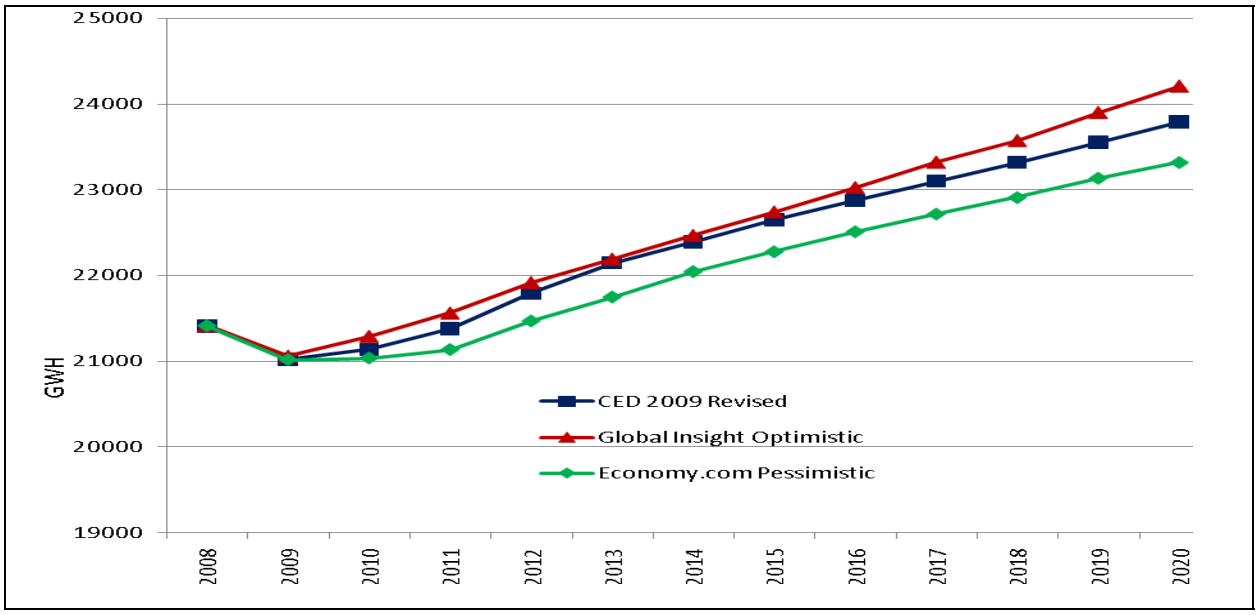
The results presented above rely on economic inputs from the *base case* Economy.com scenario. Staff also examined the effects of two alternative economic scenarios for electricity demand: an *optimistic* case provided by Global Insight and an Economy.com *pessimistic* case. These two cases, in general, project the highest and lowest rates of economic growth among the various scenarios provided by the two companies. For this analysis, staff developed econometric models for the three largest sectors (residential, commercial, and industrial plus mining) at the planning area level, using historical data for electricity consumption, electricity rates, weather, and various economic and demographic variables. Electricity consumption for the remaining sectors was held constant (*CED 2009 Revised* levels) in the alternative scenarios. The Appendix provides details on the scenarios and the econometric models.

The estimated models were run for SDG&E for the two economic scenarios as well as the Economy.com base case. The resulting percentage differences in electricity consumption between the two alternative scenarios and the base case were applied to *CED 2007* consumption projections. **Figure 94** shows the projected impacts of the optimistic and pessimistic scenarios on SDG&E consumption. Peak demand was developed by applying projected load factors from *CED 2009 Revised* at the sector level to the consumption results for each scenario. Projected peak impacts are shown in **Figure 95**.

Electricity consumption is projected to be 1.7 percent higher in the optimistic economic case than in *CED 2009 Revised* by 2020, and 2.0 percent lower in the pessimistic scenario. The peak demand forecast increases by 1.8 percent under the optimistic scenario by 2020 and falls by 2.2 percent in the pessimistic case. The percentage peak reduction is higher than consumption in the pessimistic case because the relative decrease in consumption is projected to be higher for the residential and commercial sectors than for the industrial, which has a higher load factor (is less *peaky*). Annual growth rates from 2010-2020 for electricity consumption and peak demand increase from 1.2 percent and 1.3 percent, respectively, to 1.3 percent and 1.4 percent in the optimistic case, and fall to 1.05 percent and 1.1 percent under the pessimistic scenario.

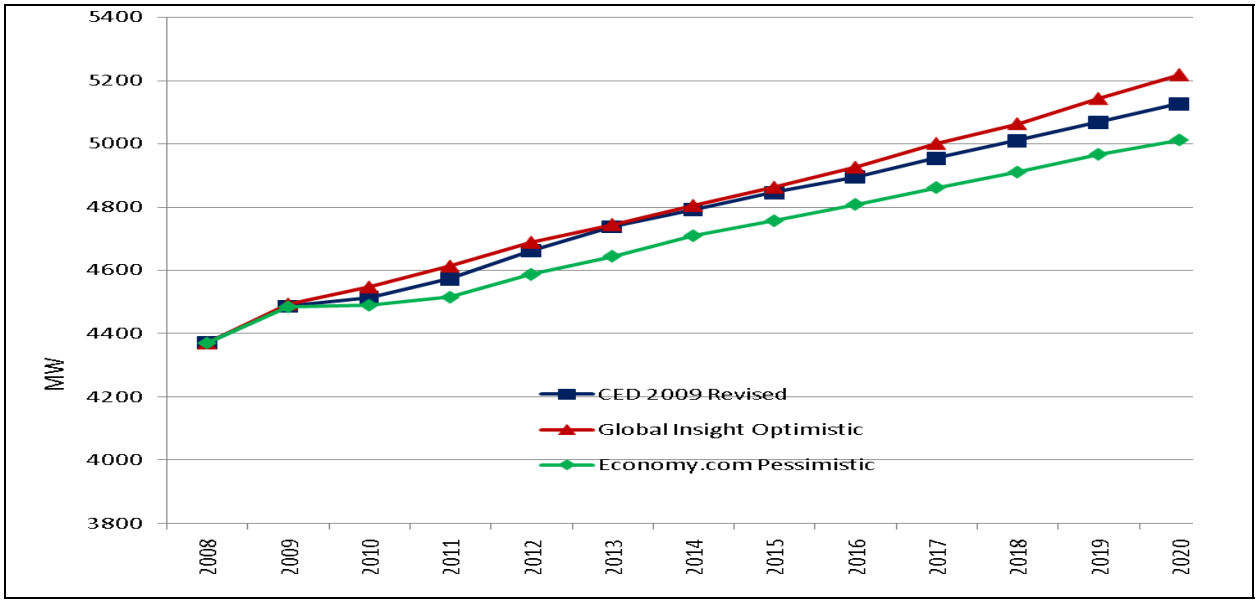
Changes in consumption and peak demand are small compared to *CED 2009 Revised* totals in percentage terms, and this is a reflection of the relatively narrow spread among the three economic scenarios. For example, retail employment is projected to be only 2 percent higher or lower in the alternative scenarios than in the Moody's Economy.com base case, and projected industrial output under the pessimistic scenario is almost identical to that of the base case by 2020.

Figure 94: Projected SDG&E Electricity Consumption, *CED 2009 Revised* and Alternative Economic Scenarios



Source: California Energy Commission, 2009

Figure 95: Projected SDG&E Peak Demand, *CED 2009 Revised* and Alternative Economic Scenarios



Source: California Energy Commission, 2009

Conservation/Efficiency Impacts

Staff spent a great deal of effort refining methods to account for energy efficiency and conservation impacts while preparing this forecast, particularly for utility efficiency programs. **Tables 16** and **17** show electricity consumption and peak savings estimates for selected years, for building and appliance standards, utility and public agency programs, and *naturally occurring* savings, or savings associated with rate changes and certain market trends not directly related to programs or standards. Savings are measured against a baseline before 1975, so they incorporate more than 30 years of impacts from rate changes and standards. Chapter 8 provides much more detail on staff work related to energy efficiency and conservation.

Table 16: SDG&E Planning Area Electricity Consumption Savings Estimates

	1990	1998	2003	2008	2011	2015	2020
Residential Energy Savings (GWH)							
Building Standards	328	312	297	314	329	349	375
Appliance Standards	207	559	847	1,149	1,318	1,524	1,747
Utility and Public Agency Programs	27	61	180	570	657	482	180
Naturally Occurring Savings	14	18	35	54	57	222	510
Total Residential Savings	576	951	1,359	2,087	2,361	2,578	2,812
Commercial Energy Savings (GWH)							
Building Standards	144	334	578	844	969	1,210	1,464
Appliance Standards	90	212	338	480	540	660	768
Utility and Public Agency Programs*	67	268	307	326	404	345	243
Naturally Occurring Savings	599	560	707	702	719	858	1,152
Total Commercial Savings	900	1,374	1,930	2,352	2,632	3,073	3,627
Total Energy Savings	1,477	2,324	3,289	4,439	4,993	5,650	6,439

Source: California Energy Commission, 2009
*Commercial programs also include agricultural program savings.

Table 17: SDG&E Planning Area Electricity Peak Savings Estimates

	1990	1998	2003	2008	2011	2015	2020
Residential Energy Savings (MW)							
Building Standards	55	66	56	68	75	82	91
Appliance Standards	35	119	158	247	301	359	425
Utility and Public Agency Programs	4	13	34	123	150	113	44
Naturally Occurring Savings	2	4	7	12	13	52	124
Total Residential Savings	97	202	254	449	539	607	684
Commercial Energy Savings (MW)							
Building Standards	31	74	122	166	199	245	293
Appliance Standards	20	47	71	94	111	134	154
Utility and Public Agency Programs*	15	60	65	64	83	70	49
Naturally Occurring Savings	131	125	149	138	148	174	230
Total Commercial Savings	197	306	407	463	541	623	725
Total Energy Savings	294	508	661	911	1,079	1,230	1,410

Source: California Energy Commission, 2009
*Commercial programs also include agricultural program

CHAPTER 5: Sacramento Municipal Utility District Planning Area

The Sacramento Municipal Utility District (SMUD) planning area includes SMUD retail customers but does not include the new members of the SMUD control area, Roseville, Redding, and the Western Area Power Administration (WAPA). To support electricity system analysis, staff derives forecasts by control area and California ISO congestion zone from the planning area forecasts. Using historical consumption data and regional population projections, the estimated share of the PG&E forecast for WAPA, Roseville, and Redding forecasts are subtracted from the PG&E planning area and added to the SMUD control area. The results in this chapter are for the SMUD planning area only.

This chapter first discusses forecasted consumption and peak loads for the SMUD planning area; both total and per capita values are presented. *CED 2009 Revised* values are compared to both *CED 2009 Draft* and *CED 2007* and differences between forecasts are explained. The forecasted load factor, jointly determined by the consumption and peak load estimates, is also discussed. Next, sector consumption and peak load forecasts are presented. Residential, commercial, industrial, and other sector forecasts are compared and differences are discussed.

For *CED 2009 Draft*, three price scenarios were developed for electricity rates: high rates, low (constant) rates, and a *mid-rate* scenario in between the two. The high-rate case assumed approximately 30 percent higher rates by 2020 relative to 2010, while the mid-rate case assumed 15 percent higher rates over the same period. In the low-rate case, rates remained at 2010 levels through 2020 as was done in *CED 2007*. In *CED 2009 Revised*, the mid-rate price forecast is used and all comparisons to *CED 2009 Draft* are made to the mid-rate scenario. Chapter 1 provides more details on price assumptions.

Forecast Results

The following summarizes the results presented in this chapter:

- *CED 2009 Revised* forecasts of SMUD planning area electricity consumption and peak demand are lower than both *CED 2009 Draft* and *CED 2007* levels throughout the forecast period.
- Reductions in consumption and peak compared to previous forecasts result from a more pessimistic economic outlook and higher expected efficiency impacts.
- Residential and commercial consumption and commercial peak demand is lower than in the draft forecast; residential peak is slightly higher.

- Alternative economic scenarios increase or decrease electricity consumption and peak demand by between 1.8 and 2.2 percent in 2020.

Table 18 presents a comparison of the planning area electricity consumption and peak demand forecasts for selected years. *CED 2009 Revised* is compared to both the *CED 2009 Draft* mid-rate case and *CED 2007*. The revised electricity consumption forecast is lower than *CED 2009 Draft* by almost 3 percent at the end of the forecast period. This is caused mainly by lower economic forecast values provided in the June 2009 Economy.com forecast. Revised consumption is 8.5 percent lower than *CED 2007* at the end of the period. Revised peak demand is virtually identical to *CED 2009 Draft* by the end of the forecast period. This is still almost 8 percent lower than *CED 2007*. The smaller change in the peak forecast relative to the changes in consumption comes from efficiency programs, which have a greater impact on overall consumption than peak. Short-term growth rates of both the revised consumption and peak forecasts are lower than previous forecasts due to more negative economic projections, but the long-term growth rates are just slightly below the growth rates of *CED 2007*.

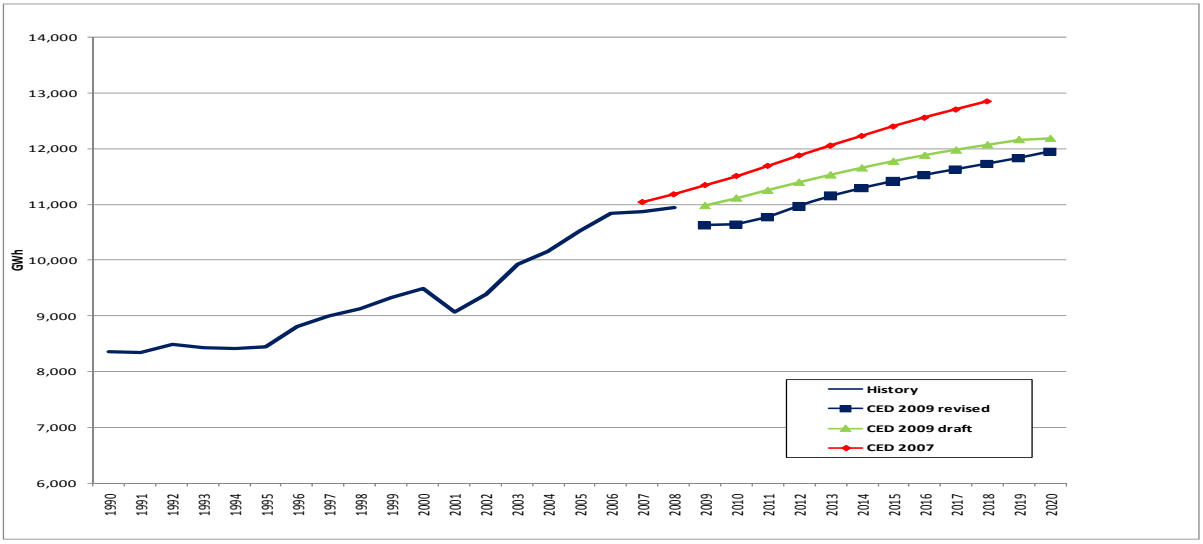
Table 18: SMUD Planning Area Forecast Comparison

Consumption (GWH)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* mid-rate case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Percentage Difference *CED 2009 Revised/CED 2007*	Percentage Difference *CED 2009 Revised/CED 2009 Draft*
1990	8,358	8,358	8,358	0.00%	0.00%
2000	9,491	9,491	9,494	0.04%	0.04%
2008	11,174	10,936	10,956	-1.95%	0.18%
2010	11,506	11,114	10,656	-7.39%	-4.12%
2015	12,397	11,771	11,435	-7.76%	-2.85%
2018	12,851	12,068	11,749	-8.57%	-2.64%
Average Annual Growth Rates					
1990-2000	1.28%	1.28%	1.28%		
2000-2008	2.06%	1.79%	1.81%		
2008-2010	1.47%	0.81%	-1.38%		
2010-2018	1.39%	1.04%	1.23%		
Peak (MW)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* mid-rate case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Percentage Difference *CED 2009 Revised/CED 2007*	Percentage Difference *CED 2009 Revised/CED 2009 Draft*
1990	2,198	2,167	2,167	-1.41%	0.00%
2000	2,693	2,688	2,687	-0.22%	-0.04%
2008	3,174	3,077	3,078	-3.02%	0.03%
2010	3,261	3,077	3,048	-6.53%	-0.94%
2015	3,515	3,276	3,264	-7.14%	-0.37%
2018	3,645	3,363	3,358	-7.87%	-0.15%
Average Annual Growth Rates					
1990-2000	2.05%	2.18%	2.17%		
2000-2008	2.08%	1.70%	1.71%		
2008-2010	1.36%	0.00%	-0.49%		
2010-2018	1.40%	1.12%	1.22%		
Historical values are shaded					

Source: California Energy Commission, 2009

As shown in **Figure 96**, *CED 2009 Revised* consumption is about 3 percent lower than *CED 2009 Draft* and below *CED 2007* throughout the forecast period. The dip in the early years of *CED 2009 Revised* is caused by both the revised economic projections and increased savings from energy efficiency programs.

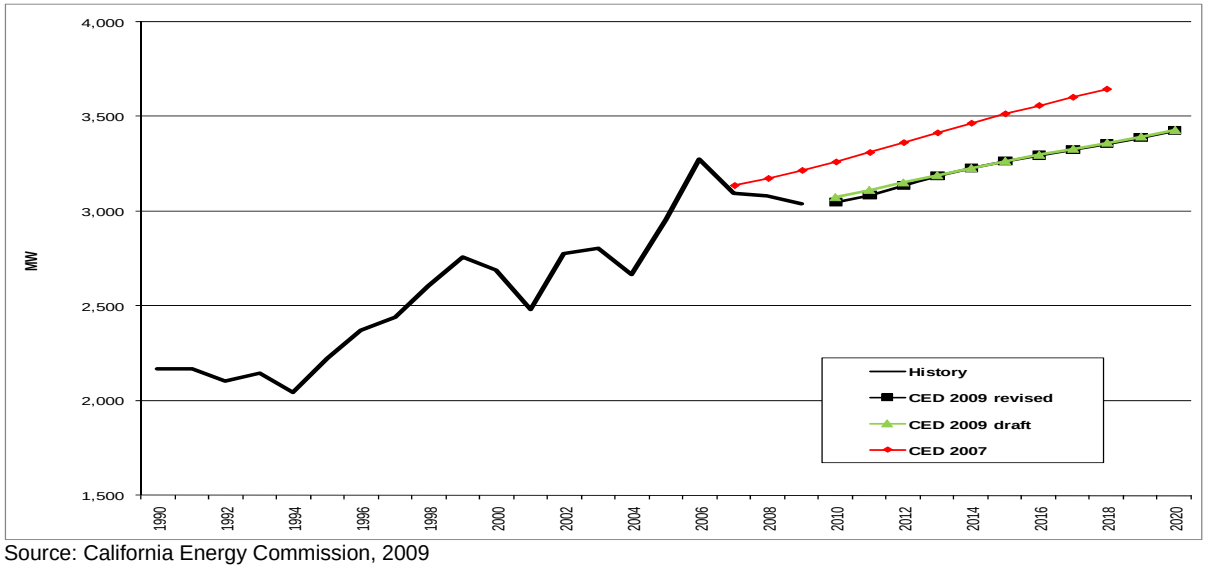
Figure 96: SMUD Planning Area Electricity Forecast



Source: California Energy Commission, 2009

The *CED 2009 Revised* SMUD planning area peak demand forecast, shown in **Figure 97**, is slightly lower than *CED 2009 Draft* by the end of the forecast period. The percentage difference is less than that of consumption because energy efficiency programs have a greater impact on consumption than on peak.

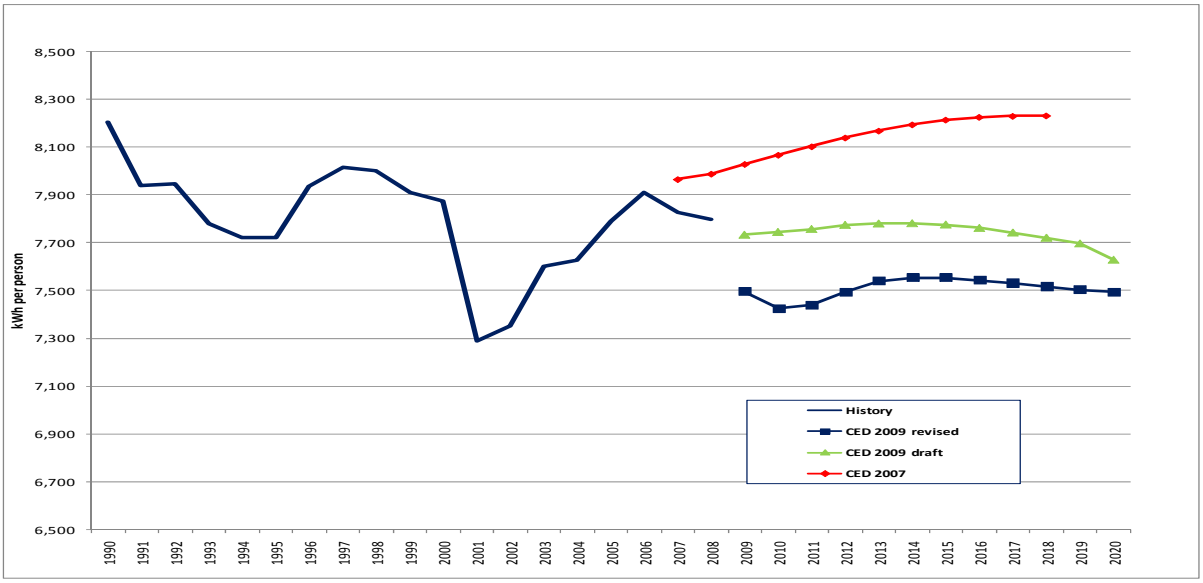
Figure 97: SMUD Planning Area Peak



Source: California Energy Commission, 2009

Figure 98 compares forecasted per capita residential electricity consumption. Per capita consumption in *CED 2009 Revised* is lower than *CED 2009 Draft* and is well below the projection of *CED 2007*. The revised projection begins at a lower level than recently recorded history. This is because of more negative economic projections than were used in previous forecasts. The increase in the mid-term is the result of an improving economy.

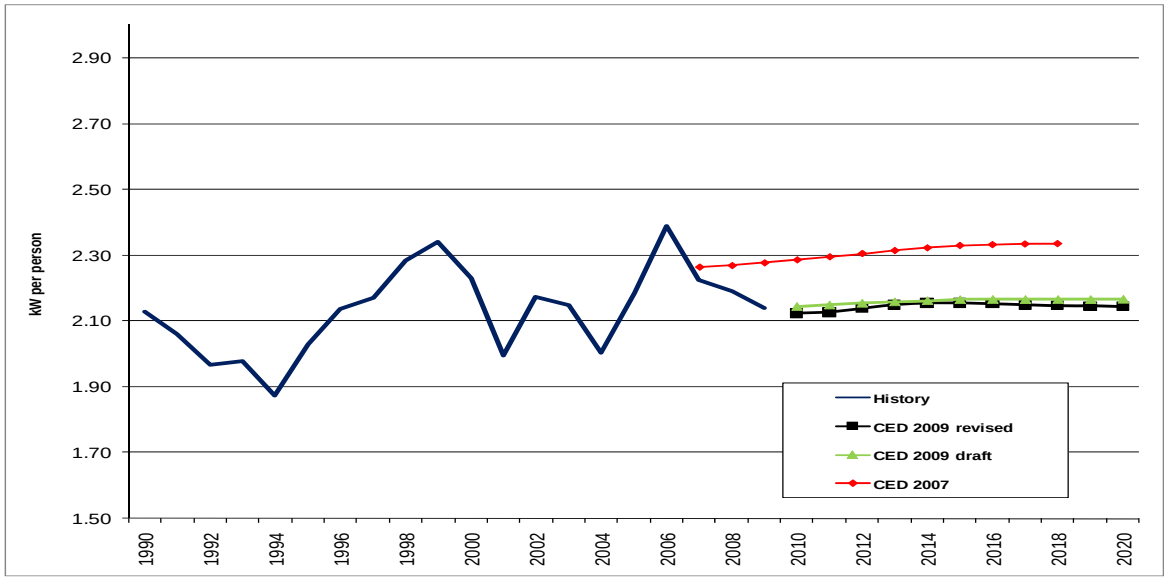
Figure 98: SMUD Planning Area per Capita Electricity Consumption



Source: California Energy Commission, 2009

Per capita peak demand for *CED 2009 Revised*, shown in **Figure 99**, is lower over the entire forecast period because of a lower starting point—the result of a poor economic climate— as well as higher self-generation peak impacts. *CED 2009 Revised* per capita peak demand increases slightly in the mid-term, then is relatively constant over the remainder of the forecast period, in contrast to the increase projected in *CED 2007*. This is also caused by increases in projections of self-generation.

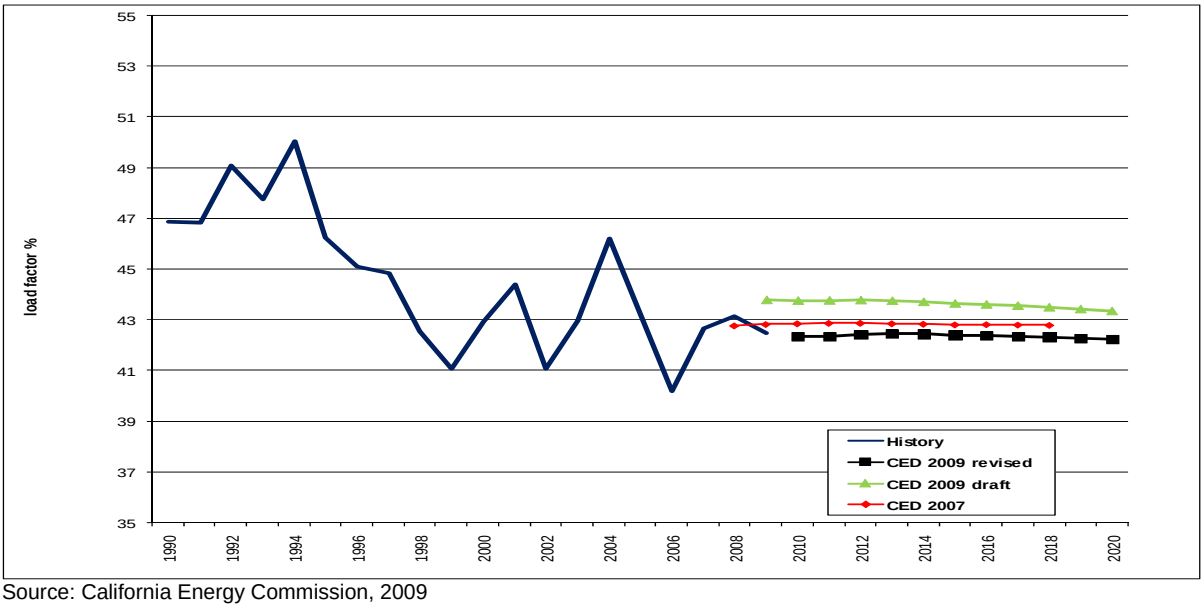
Figure 99: SMUD Planning Area per Capita Peak Demand



Source: California Energy Commission, 2009

Figure 100 compares the load factors of the three forecasts. The load factor represents the relationship between average energy demand and peak: the smaller the load factor, the greater the difference between peak and average hourly demand. The load factor varies with temperature; in extremely hot years (for example, 1998 and 2006) demand is *peakier*. The SMUD load factor has been declining since the mid-1990s as the residential sector—with a continually increasing presence of air conditioning—grew faster than other sectors. The forecasted load factor levels out as air conditioning in the SMUD planning area is projected to reach near complete saturation levels.

Figure 100: SMUD Planning Area Peak Load Factor



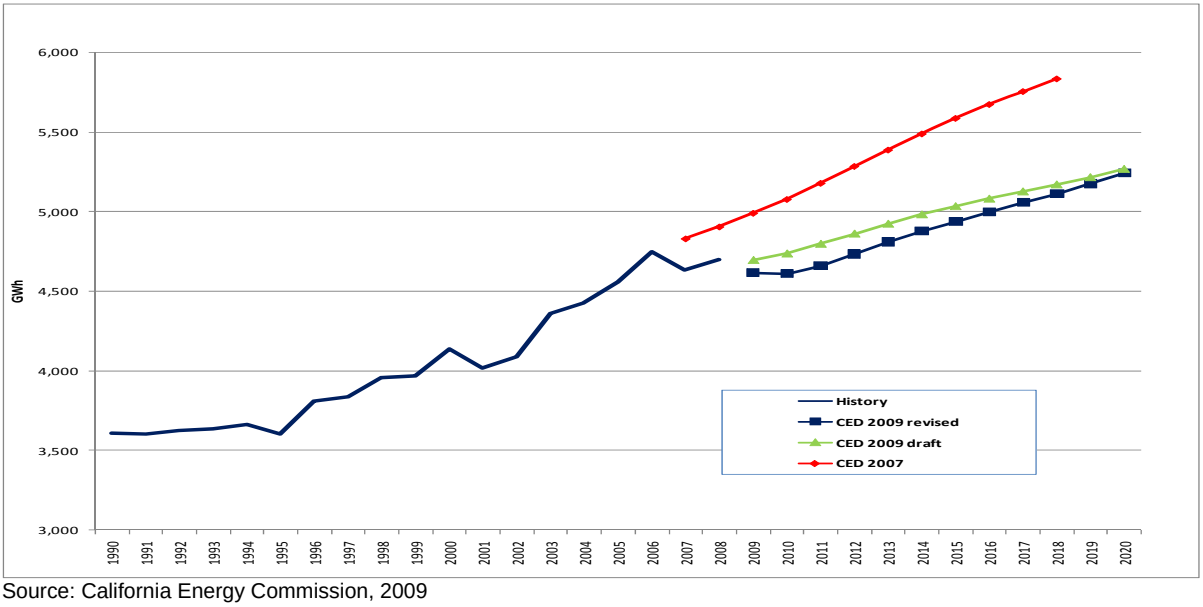
Source: California Energy Commission, 2009

Sector Level Results and Input Assumptions

Residential

Figure 101 compares the residential forecasts. *CED 2009 Revised* is lower over the entire forecast period than *CED 2009 Draft* and well below the level of *CED 2007*. The decrease relative to *CED 2009 Draft* is caused by decreased projections of household income and slightly higher persons-per-household projections.

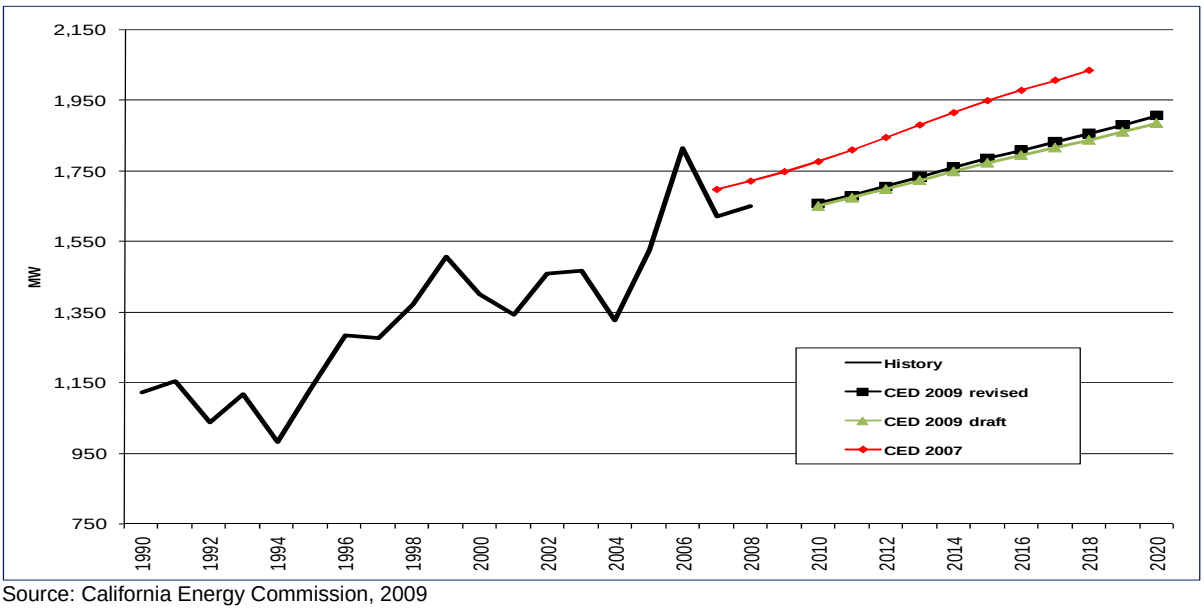
Figure 101: SMUD Planning Area Residential Consumption



Source: California Energy Commission, 2009

Figure 102 compares the residential peak demand forecasts. Unlike the consumption forecast, there is very little difference in *CED 2009 Revised* and draft residential peak forecasts, with *CED 2009 Revised* being slightly higher by the end of the forecast period.

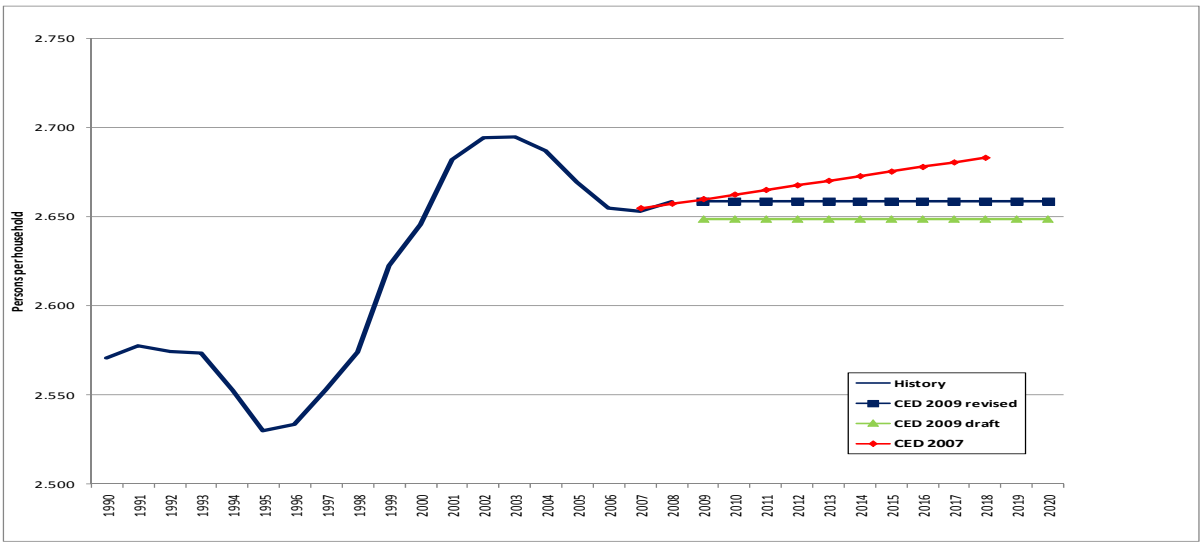
Figure 102: SMUD Planning Area Residential Peak



Source: California Energy Commission, 2009

Figures 103 and **104** provide comparisons of the residential drivers used in the forecasts. **Figure 103** shows persons-per-household projections. There is a slight increase in persons per household in *CED 2009 Revised* compared to *CED 2009 Draft*. This change reduces the household projection by about 2,000 households by the end of the forecast period (less than 0.04 percent).

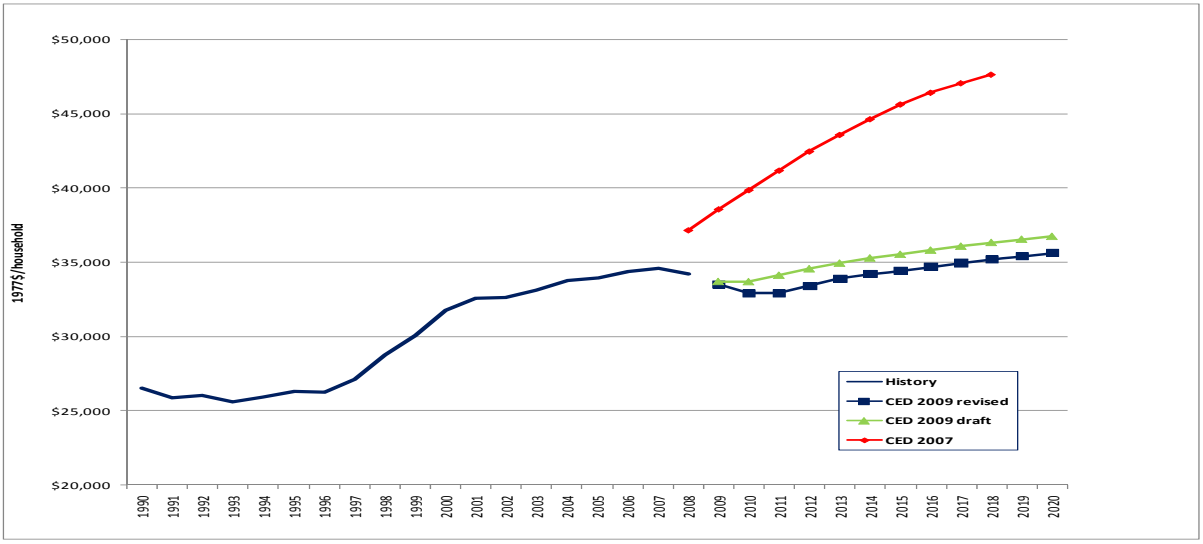
Figure 103: SMUD Planning Area Persons-per-Household Projections



Source: California Energy Commission, 2009

Figure 104 compares household income used in the respective forecasts. The *CED 2009 Revised* projection is lower than that used in *CED 2009 Draft*. Both are far below the income projections used in *CED 2007*. Long-term growth is similar to *CED 2009 Draft* as the economy recovers from the current slump.

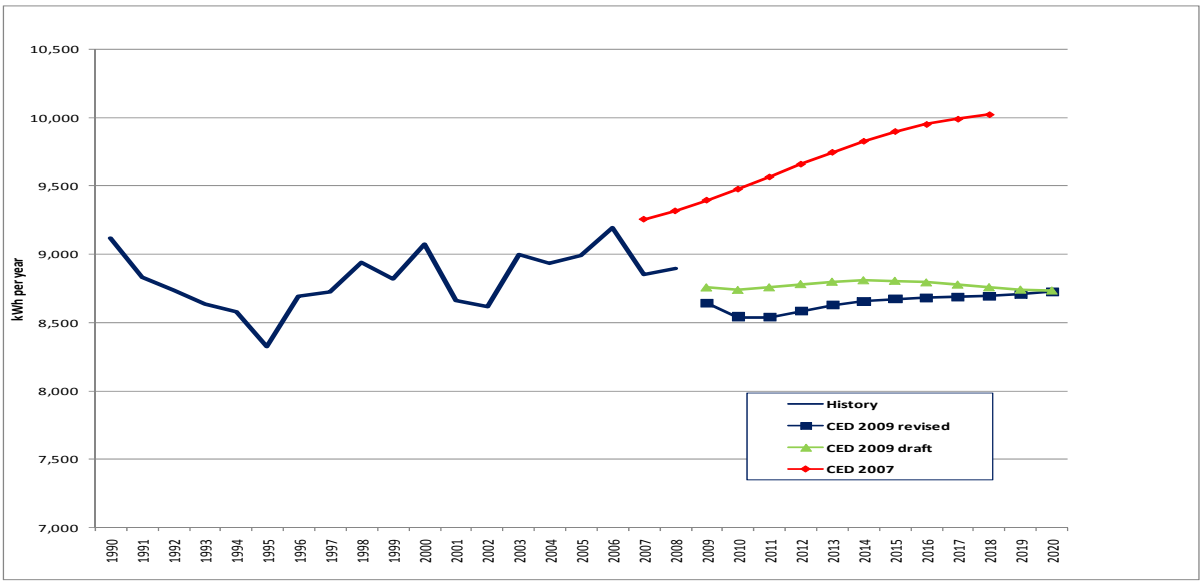
Figure 104: SMUD Planning Area Household Income Projections



Source: California Energy Commission, 2009

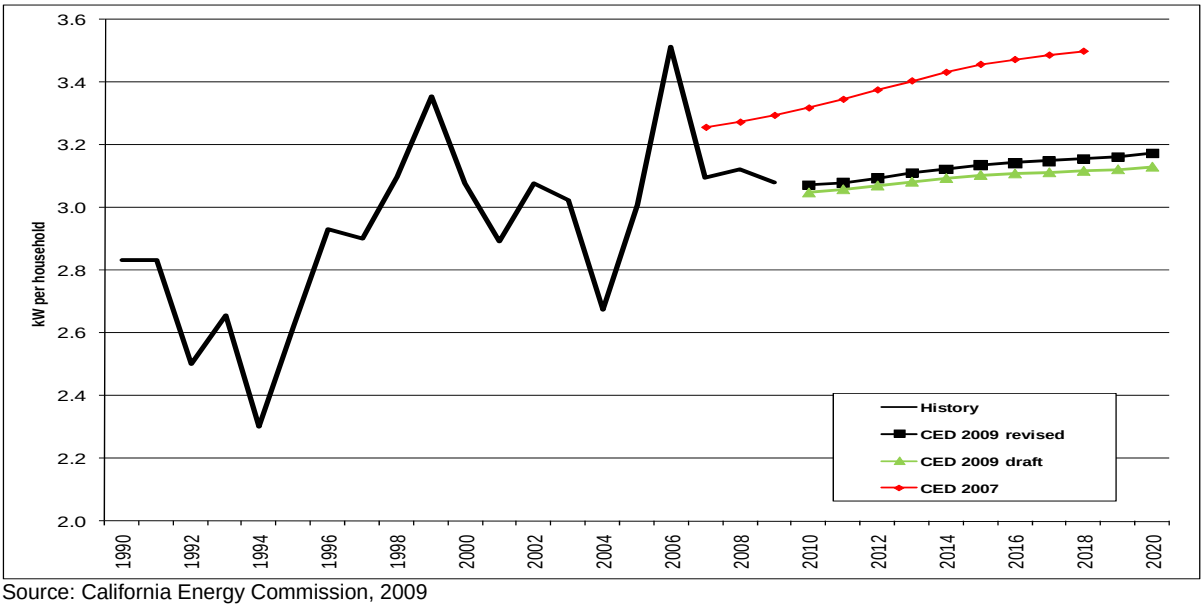
Figures 105 and **106** compare residential use per household and residential peak use per household, respectively. *CED 2009 Revised* use per household (**Figure 105**) is lower than *CED 2009 Draft*. This is primarily caused by decreased household income projections. *CED 2009 Revised* use per household is well below the level of *CED 2007*. There is less of a difference in peak use per household (**Figure 106**) because income-induced reductions in *miscellaneous* consumption have much less impact on peak.

Figure 105: SMUD Planning Area Use per Household



Source: California Energy Commission, 2009

Figure 106: SMUD Planning Area Peak Use per Household

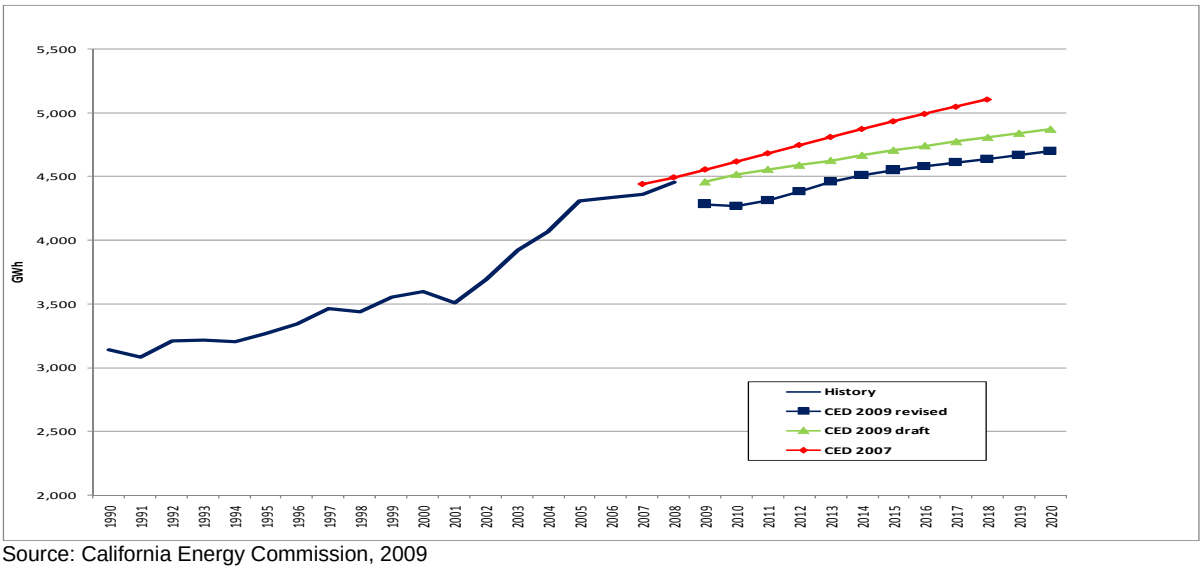


Source: California Energy Commission, 2009

Commercial Building Sector

Figures 107 and **108** compare the commercial building sector forecasts. *CED 2009 Revised* is lower than *CED 2009 Draft* because of lower economic growth. The growth rate in consumption after the economic recovery is very similar to that of *CED 2009 Draft*. Both *CED* 2009 forecasts are lower than *CED* 2007.

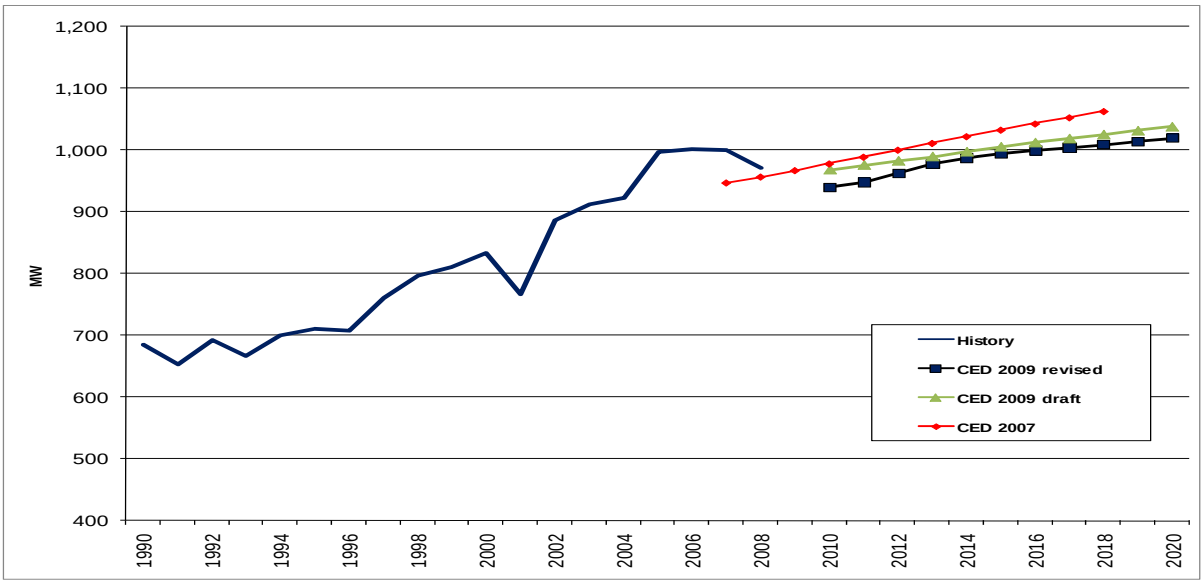
Figure 107: SMUD Planning Area Commercial Consumption



Source: California Energy Commission, 2009

Figure 108 compares the commercial building sector peak demand forecasts. Differences in the peak forecasts are similar to those in the consumption forecasts.

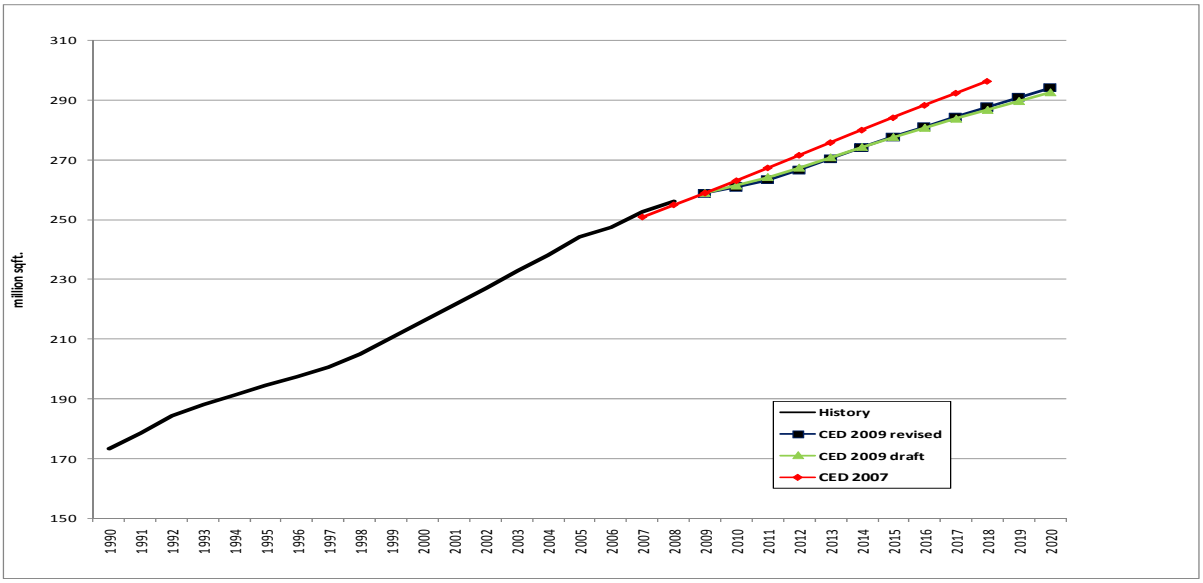
Figure 108: SMUD Planning Area Commercial Sector Peak



Source: California Energy Commission, 2009

In staff's commercial building sector forecasting model, floor space by building type (that is, retail, schools, offices, and so forth) is the key driver of energy use for each specific building type. **Figure 109** compares total commercial floor space projections. The revised floor space forecast is little changed from *CED 2009 Draft*.

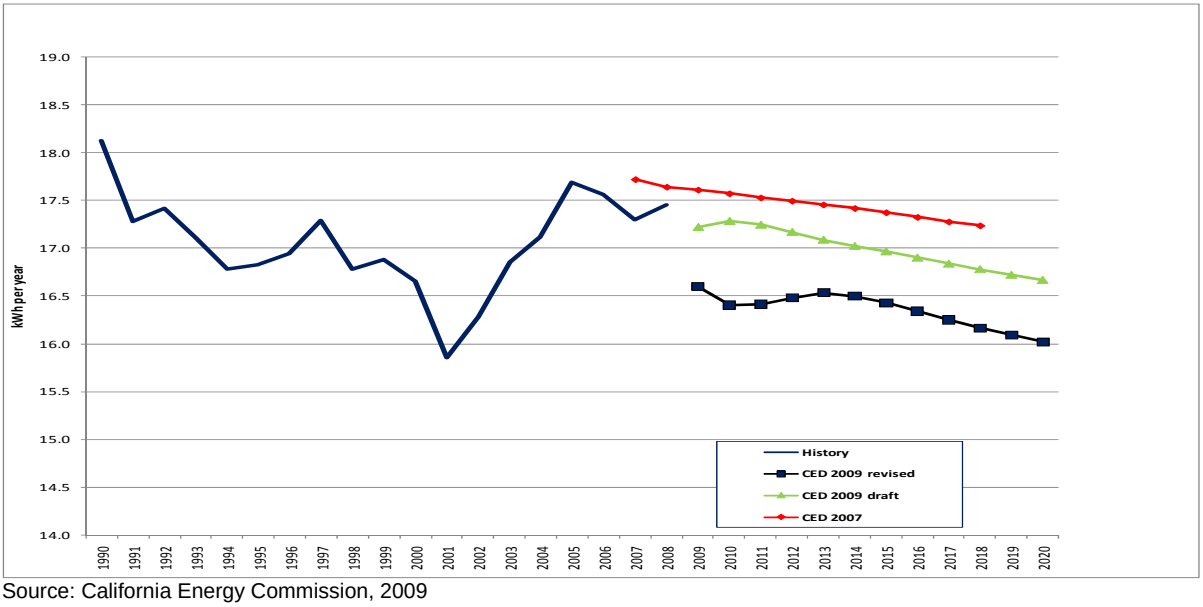
Figure 109: SMUD Planning Area Commercial Floor Space



Source: California Energy Commission, 2009

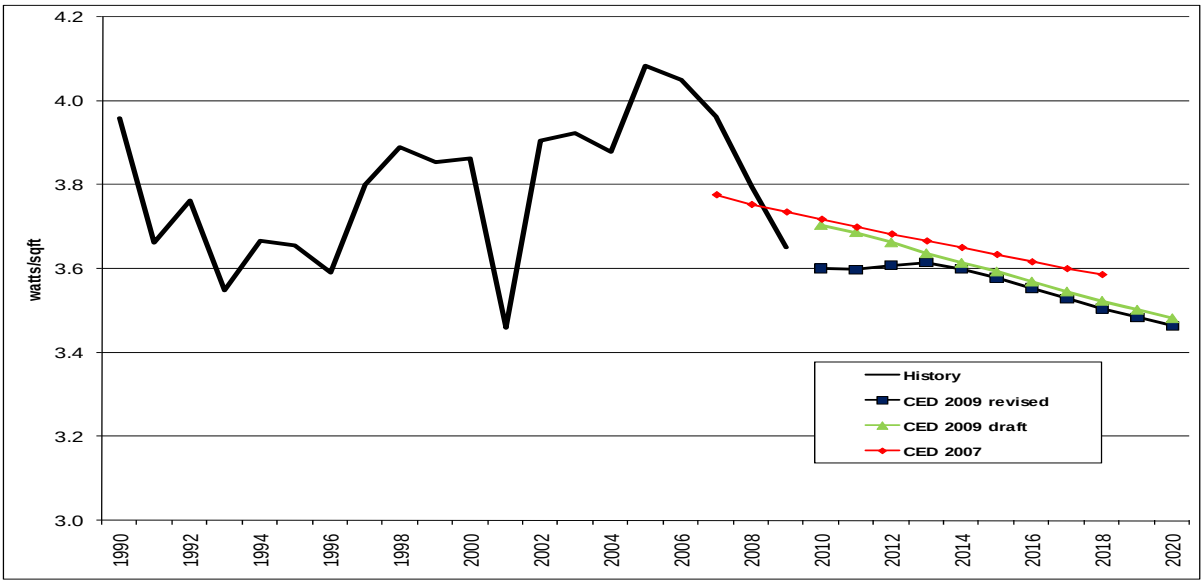
Historical and projected commercial sector annual and peak use per square foot are shown in **Figures 110** and **111**, respectively. Use per square foot (**Figure 110**) in *CED 2009 Revised* is lower than *CED 2009 Draft* because of the current downturn in the economic projections for Sacramento County. This value is also below that projected in *CED 2007*. Revised peak use per square foot (**Figure 111**) follows a similar pattern, especially in the shortterm. However, peak use per square foot returns to the draft level after recovery from the current economic downturn.

Figure 110: SMUD Planning Area Commercial kWh per Square Foot



Source: California Energy Commission, 2009

Figure 111: SMUD Planning Area Commercial Watts per Square Foot



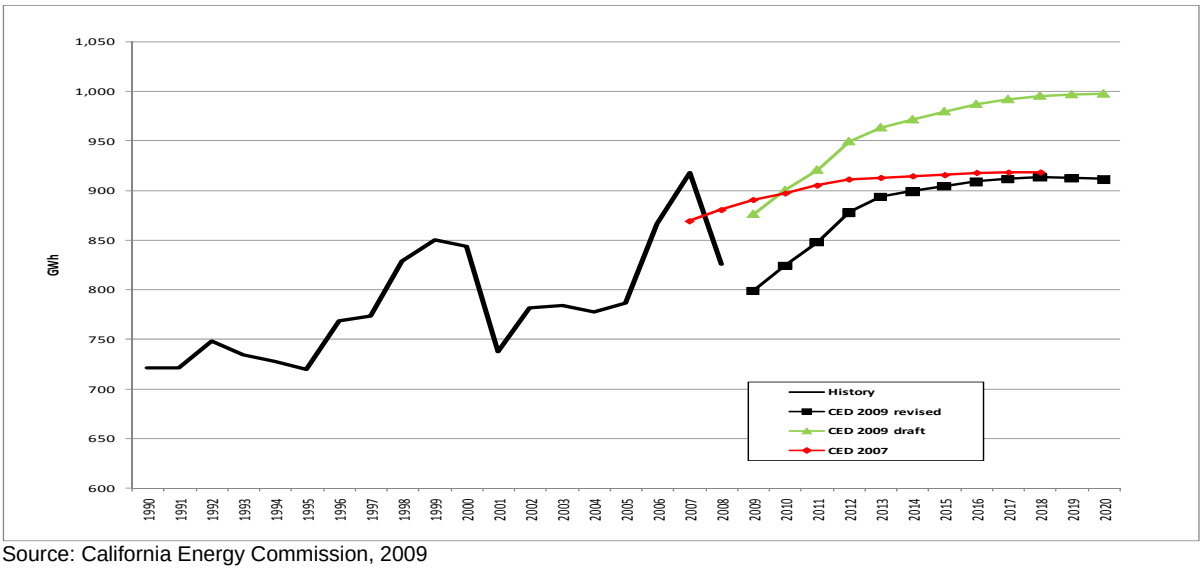
Source: California Energy Commission, 2009

Industrial Sector

Figure 112 compares the industrial sector electricity consumption forecasts for the SMUD planning area. *CED 2009 Revised* is lower throughout the entire forecast period than *CED 2009 Draft*, especially in the early forecast years. This comes from a lower starting point—the

2008 consumption estimate—and also lower economic projections. The long-term growth of *CED 2009 Revised* is similar to *CED 2009* draft.

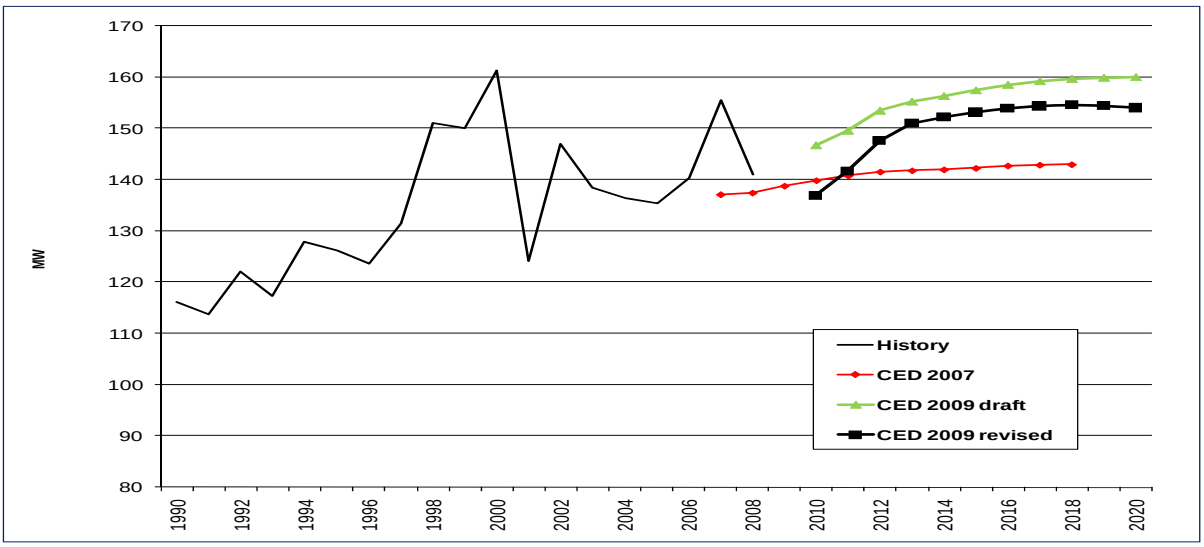
Figure 112: SMUD Planning Area Industrial Consumption



Source: California Energy Commission, 2009

Figure 113 compares the industrial sector peak forecasts. The differences are similar to those in the consumption forecast, meaning a higher growth rate than in *CED 2007* once economic recovery has occurred.

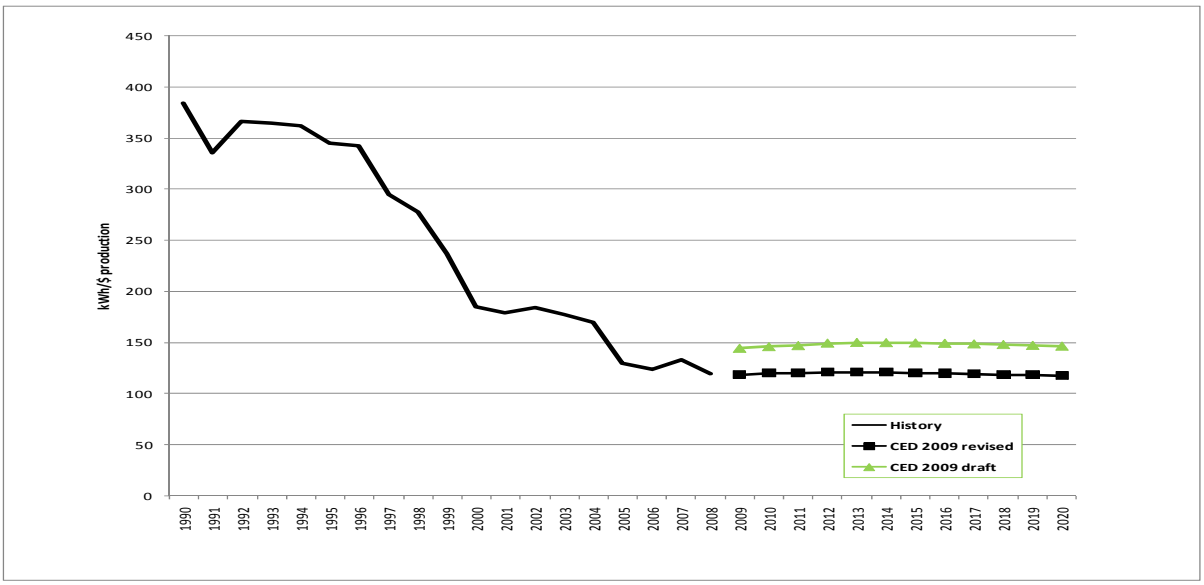
Figure 113: SMUD Planning Area Industrial Sector Peak



Source: California Energy Commission, 2009

Figure 114 compares use per dollar value of production between the revised and draft *CED 2009* forecasts. *CED 2009 Revised* has a lower level of electricity use per dollar of industrial value added than *CED 2009 Draft*. This is primarily caused by a lower historical starting point due to inclusion of 2008 consumption history, which reflects the current economic climate. The forecasted growth rates are similar in both forecasts.

Figure 114: SMUD Planning Area Industrial Use per Production Unit



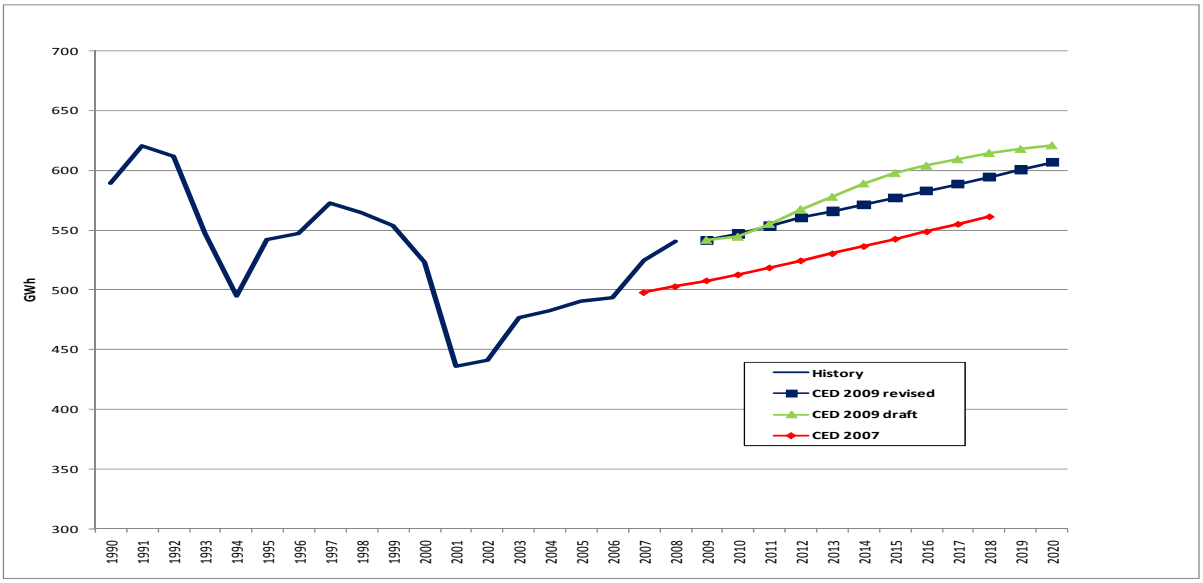
Source: California Energy Commission, 2009

Other Sectors

Figures 115 and **116** compare the remaining sector electricity consumption forecasts. **Figure 115** shows the transportation, communication, and utilities (TCU) sector forecasts. *CED 2009 Revised* is the same as *CED 2009 Draft* in the early years, with the inclusion of 2008 consumption history, but lower economic projections reduce the long-term growth rate.

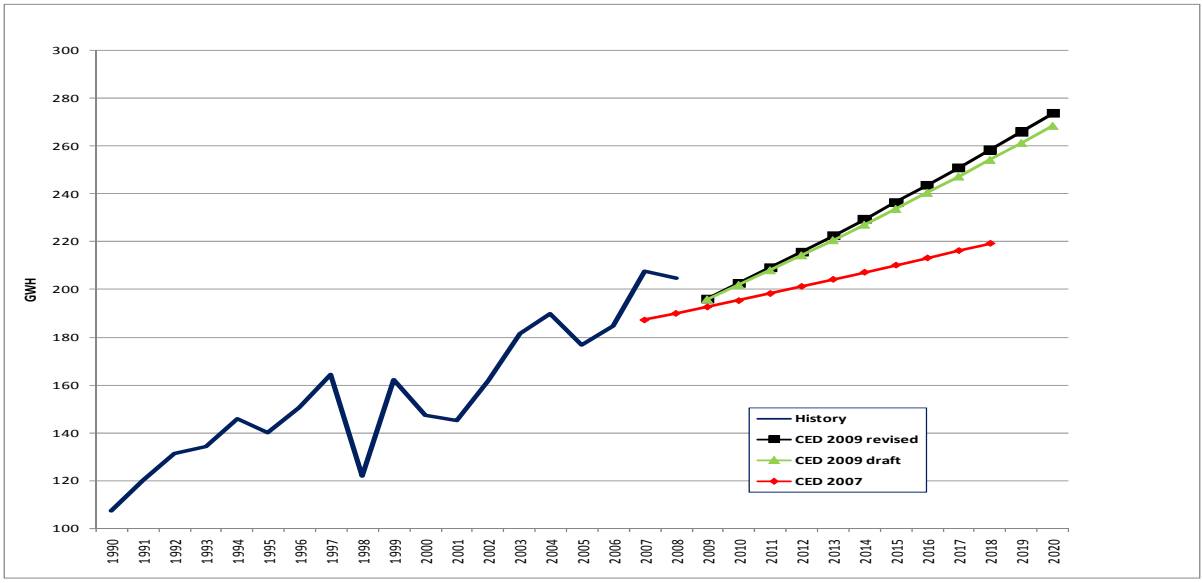
Figure 116 provides comparisons of the agriculture and water pumping sector forecasts. *CED 2009 Revised* is higher than *CED 2009 Draft* because of higher estimated historical consumption, but the increase is tempered by limitations on water that is available to pump.

Figure 115: SMUD Planning Area Transportation, Communication and Utilities Sector Electricity Consumption



Source: California Energy Commission, 2009

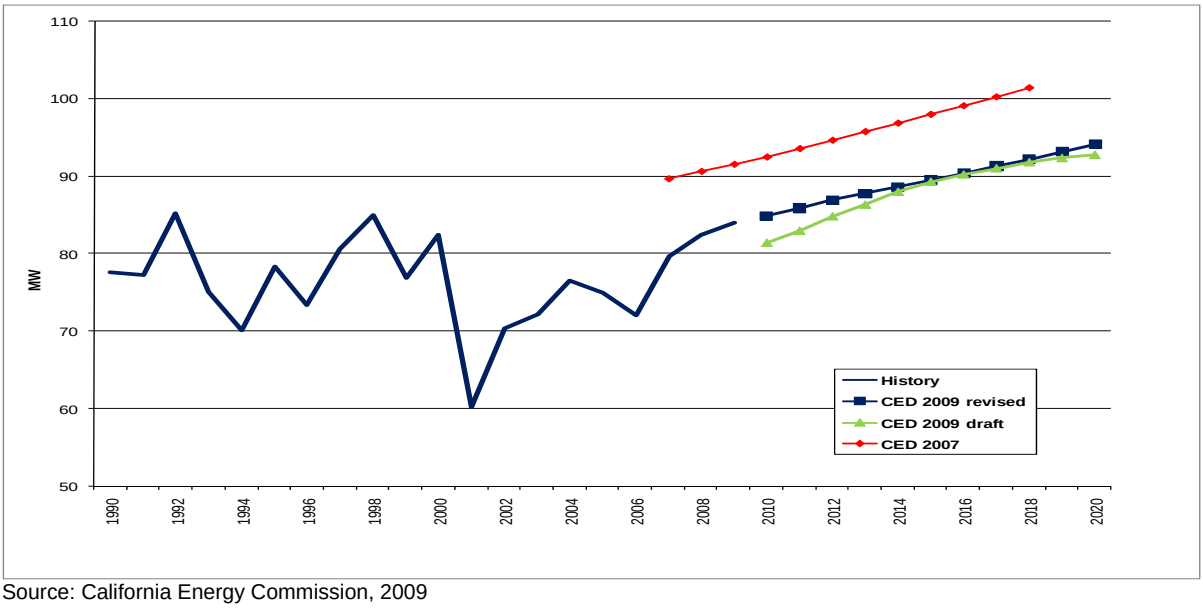
Figure 116: SMUD Planning Area Agriculture and Water Pumping Forecasts



Source: California Energy Commission, 2009

Figure 117 compares combined peaks for the TCU and street lighting sectors. *CED 2009 Revised* is slightly higher than *CED 2009 Draft* until the mid-years of the forecast. *CED 2009 Revised* is still noticeably lower than *CED 2007*.

Figure 117: SMUD Planning Area Other Sector Peak



Source: California Energy Commission, 2009

Self-Generation

The peak demand forecast is reduced by self-generation, including the effects of the SGIP, CSI, and other programs, as discussed in Chapter 1. The effects of these programs are forecast based on recent trends in installations. Based on current trends, staff projects about 17 MW of peak reduction from photovoltaic systems by 2020. Annual values for the SMUD planning area are reported in Form 1.2, available with the forms posted with this report on the Energy Commission's website.

Economic Scenarios

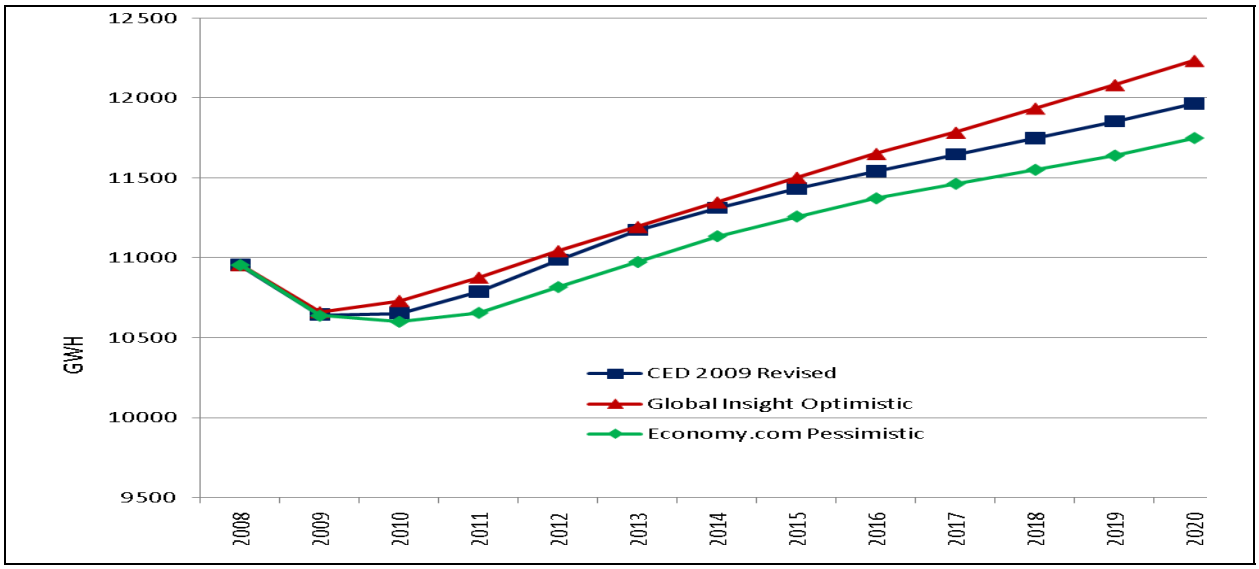
The results presented above rely on economic inputs from the *base case* Economy.com scenario. Staff also examined the effects of two alternative economic scenarios for electricity demand: an *optimistic* case provided by Global Insight and an Economy.com *pessimistic* case. These two cases, in general, project the highest and lowest rates of economic growth among the various scenarios provided by the two companies. For this analysis, staff developed econometric models for the three largest sectors (residential, commercial, and industrial plus mining) at the planning area level, using historical data for electricity consumption, electricity rates, weather, and various economic and demographic variables. Electricity consumption for the remaining sectors was held constant (*CED 2009 Revised* levels) in the alternative scenarios. The Appendix provides details on the scenarios and the econometric models.

The estimated models were run for SMUD for the two economic scenarios as well as the Economy.com base case. The resulting percentage differences in electricity consumption between the two alternative scenarios and the base case were applied to *CED 2007 Revised* consumption projections. **Figure 118** shows the projected impacts of the optimistic and pessimistic scenarios on SMUD consumption. Peak demand was developed by applying projected load factors from *CED 2009 Revised* at the sector level to the consumption results for each scenario. Projected peak impacts are shown in **Figure 119**.

Electricity Consumption is projected to be 2.2 percent higher in the optimistic economic case than in *CED 2009 Revised* by 2020 and 1.8 percent lower in the pessimistic scenario. The peak demand forecast increases by 2.05 percent under the optimistic scenario by 2020 and falls by 2.1 percent in the pessimistic case. The percentage peak reduction is higher than that of consumption in the pessimistic case because the relative decrease in consumption is projected to be higher for the residential and commercial sectors than for the industrial, which has a higher load factor (is less *peaky*). Annual growth rates from 2010-2020 for electricity consumption and peak demand increase from 1.2 percent each to 1.3 percent in the optimistic case and fall to 1.0 percent each under the pessimistic scenario.

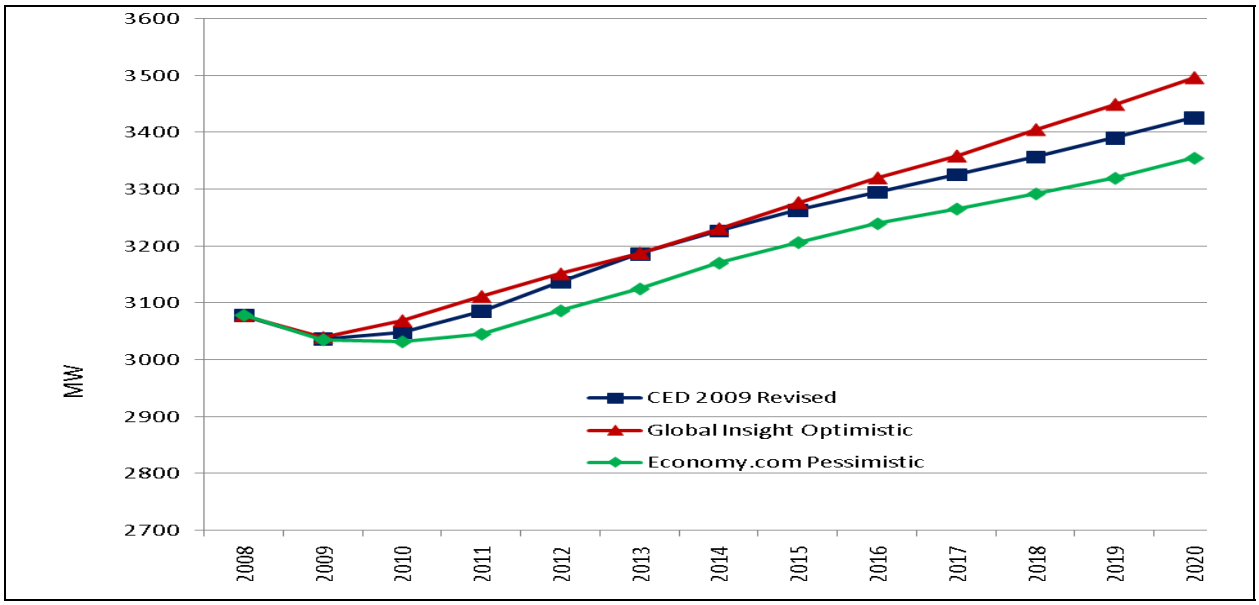
Changes in consumption and peak demand are small compared to *CED 2009 Revised* totals in percentage terms, and this is a reflection of the relatively narrow spread among the three economic scenarios. For example, retail employment is projected to be only 2 percent higher or lower in the alternative scenarios than in the Economy.com base case, and projected industrial output under the pessimistic scenario is almost identical to that of the base case by 2020.

Figure 118: Projected SMUD Electricity Consumption, CED 2009 Revised and Alternative Economic Scenarios



Source: California Energy Commission, 2009

Figure 119: Projected SMUD Peak Demand, CED 2009 Revised and Alternative Economic Scenarios



Source: California Energy Commission, 2009

Conservation/Efficiency Impacts

Staff spent a great deal of effort refining methods to account for energy efficiency and conservation impacts while preparing this forecast, particularly for utility efficiency programs. **Tables 19** and **20** show electricity consumption and peak savings estimates for selected years, for building and appliance standards, utility and public agency programs, and *naturally occurring* savings, or savings associated with rate changes and certain market trends not directly related to programs or standards. Savings are measured against a baseline before 1975, so they incorporate more than 30 years of impacts from rate changes and standards. Chapter 8 provides much more detail on staff work related to energy efficiency and conservation.

Table 19: SMUD Planning Area Electricity Consumption Savings Estimates

	1990	1998	2003	2008	2011	2015	2020
Residential Energy Savings (GWH)							
Building Standards	423	551	641	712	746	793	857
Appliance Standards	163	374	533	705	794	905	1023
Utility and Public Agency Programs	208	259	255	366	378	293	223
Naturally Occurring Savings	15	16	24	27	25	31	50
Total Residential Savings	809	1,200	1,455	1,810	1,944	2,022	2,153
Commercial Energy Savings (GWH)							
Building Standards	72	143	247	368	399	482	570
Appliance Standards	39	81	128	186	196	230	260
Utility and Public Agency Programs*	5	55	55	93	114	87	74
Naturally Occurring Savings	631	575	789	874	891	1,012	1,200
Total Commercial Savings	747	854	1,219	1,521	1,600	1,811	2,104
Total Energy Savings	1,556	2,054	2,674	3,331	3,544	3,833	4,257

Source: California Energy Commission, 2009

*Commercial programs also include agricultural program savings.

Table 20: SMUD Planning Area Electricity Peak Savings Estimates

	1990	1998	2003	2008	2011	2015	2020
Residential Energy Savings (MW)							
Building Standards	131	191	216	250	269	287	312
Appliance Standards	51	130	179	248	286	327	372
Utility and Public Agency Programs	65	90	86	128	136	106	81
Naturally Occurring Savings	5	6	8	9	9	11	18
Total Residential Savings	252	416	489	636	701	731	783
Commercial Energy Savings (MW)							
Building Standards	16	33	58	80	88	105	124
Appliance Standards	9	19	30	41	43	50	56
Utility and Public Agency Programs*	1	13	13	20	25	19	16
Naturally Occurring Savings	138	133	184	191	196	221	260
Total Commercial Savings	163	198	284	332	352	395	456
Total Energy Savings	415	614	773	967	1,052	1,127	1,239

Source: California Energy Commission, 2009

*Commercial programs also include agricultural program

CHAPTER 6: Los Angeles Department of Water and Power Planning Area

The Los Angeles Department of Water and Power (LADWP) planning area includes LADWP bundled retail customers and customers served by any energy service providers (ESPs) using the LADWP distribution system to deliver electricity to end users.

This chapter first discusses forecasted consumption and peak loads for the LADWP planning area; both total and per capita values are presented. *CED 2009 Revised* values are compared to both *CED 2009 Draft* and *CED 2007* and differences between forecasts are explained. The forecasted load factor, jointly determined by the consumption and peak load estimates, is also discussed. Next, the chapter presents sector consumption and peak load forecasts. Residential, commercial, industrial, and other sector forecasts are compared, and differences are discussed.

For *CED 2009 Draft*, three price scenarios were developed for electricity rates: high rates, low (constant) rates, and a *mid-rate* scenario in between the two. The high-rate case assumed approximately 30 percent higher rates by 2020 relative to 2010, while the mid-rate case assumed 15 percent higher rates over the same period. In the low-rate case, rates remained at 2010 levels through 2020 as was done in *CED 2007*. In *CED 2009 Revised,* the mid-rate price forecast is used and all comparisons to *CED 2009 Draft* are made to the mid-rate scenario. Chapter 1 provides more detail on price assumptions.

Forecast Results

The following summarizes the results presented in this chapter:

- *CED 2009 Revised* forecasts of LADWP planning area electricity consumption and peak demand are higher than *CED 2007* levels by 2018.
- Although projected total consumption and peak are higher, per capita electricity consumption and peak demand are forecast to be lower than in *CED 2007* because LADWP planning area population is assumed to make up a higher share of the projected state total than in *CED 2007*.
- Residential and industrial electricity consumption and peak are higher than in *CED 2007*; commercial consumption is lower, but peak demand higher than in *CED 2007*.
- Alternative economic scenarios increase or decrease electricity consumption and peak demand by between 2.2 and 2.6 percent in 2020.
- Self-generation impacts are projected to be higher than in *CED 2007* and *CED 2009 Draft* mainly because of increased adoption of photovoltaic systems.

Table 21 compares planning area electricity consumption and peak demand forecasts for selected years. The revised electricity consumption forecast is higher than *CED 2009 Draft* by more than 6 percent by the end of the forecast period. This is caused by economic forecast revisions specific to the LADWP planning area and use of June 2009 Economy.com data. *CED 2009 Revised* consumption is now at a similar level to *CED 2007* by the end of the period. *CED 2009 Revised* peak is now higher than both previous forecasts after 2012. The *CED 2009 Revised* peak is 2.7 percent higher than *CED 2007* and 2 percent higher than *CED 2009 Draft* by 2018. The smaller increase in the peak forecast relative to the changes in consumption comes from efficiency programs, which have a greater impact on overall consumption than peak. Forecasted short-term growth rates of both consumption and peak are now higher than the two previous forecasts.

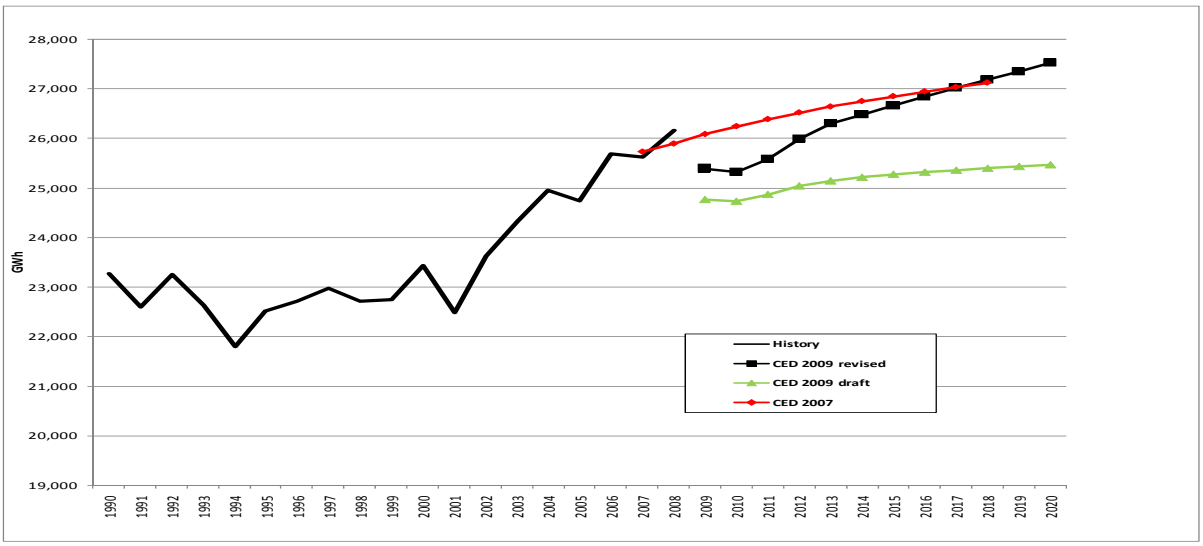
Table 21: LADWP Planning Area Forecast Comparison

Consumption (GWH)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* mid-rate case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Percentage Difference *CED 2009 Revised/CED 2007*	Percentage Difference *CED 2009 Revised/CED 2009 Draft*
1990	23,263	23,263	23,263	0.00%	0.00%
2000	23,437	23,437	23,438	0.00%	0.00%
2008	25,890	25,138	26,153	1.02%	4.04%
2010	26,241	24,729	25,326	-3.49%	2.41%
2015	26,846	25,279	26,665	-0.67%	5.48%
2018	27,120	25,401	27,189	0.25%	7.04%
Average Annual Growth Rates					
1990-2000	0.07%	0.07%	0.08%		
2000-2008	1.25%	0.88%	1.38%		
2008-2010	0.68%	-0.82%	-1.59%		
2010-2018	0.41%	0.34%	0.89%		
Peak (MW)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* mid-rate case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Percentage Difference *CED 2009 Revised/CED 2007*	Percentage Difference *CED 2009 Revised/CED 2009 Draft*
1990	5,326	5,326	5,341	0.28%	0.28%
2000	5,325	5,325	5,344	0.36%	0.36%
2008	5,717	6,223	6,006	5.06%	-3.49%
2010	5,786	5,838	5,779	-0.12%	-1.01%
2015	5,907	5,978	6,032	2.12%	0.90%
2018	5,966	6,008	6,128	2.72%	2.00%
Average Annual Growth Rates					
1990-2000	0.00%	0.00%	0.01%		
2000-2008	0.89%	1.97%	1.47%		
2008-2010	0.60%	-3.14%	-1.91%		
2010-2018	0.38%	0.36%	0.74%		
Historical values are shaded					

Source: California Energy Commission, 2009

As shown in **Figure 120**, *CED 2009 Revised* consumption forecast is about 1.7 percent higher than *CED 2009 Draft* in the beginning of the forecast period and grows to more than 6 percent higher by the end of that period. The dip in the early years of *CED 2009 Revised* is caused by both the revised economic projections and by expectations of increased savings from energy efficiency programs.

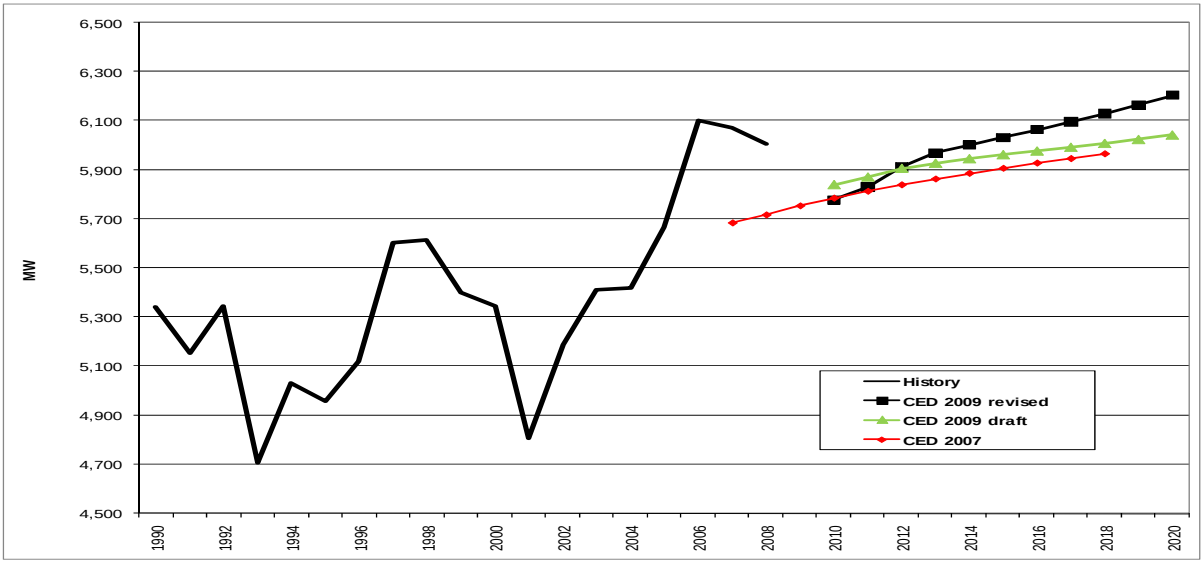
Figure 120: LADWP Planning Area Electricity Forecast



Source: California Energy Commission, 2009

The *CED 2009 Revised* LADWP planning area peak demand forecast, shown in **Figure 121**, is slightly lower than *CED 2009 Draft* at the start of the forecast period. It then grows to more than 2 percent higher than the previous two forecasts by the end of the forecast period.

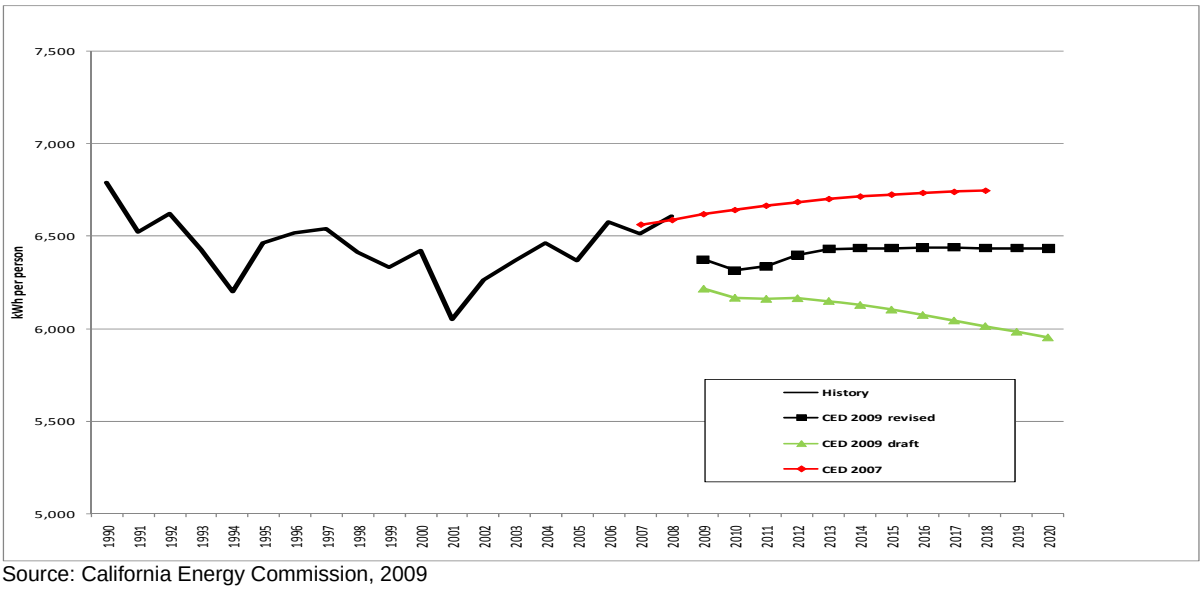
Figure 121: LADWP Planning Area Peak



Source: California Energy Commission, 2009

Figure 122 compares forecasted per capita electricity consumption. *CED 2009 Revised* per capita consumption is higher than in *CED 2009 Draft* but is well below the projection of *CED 2007*. The revised projection begins at a lower level than recently recorded history. *CED 2009 Revised* is relatively constant after recovery from the current economic downturn.

Figure 122: LADWP Planning Area per Capita Electricity Consumption

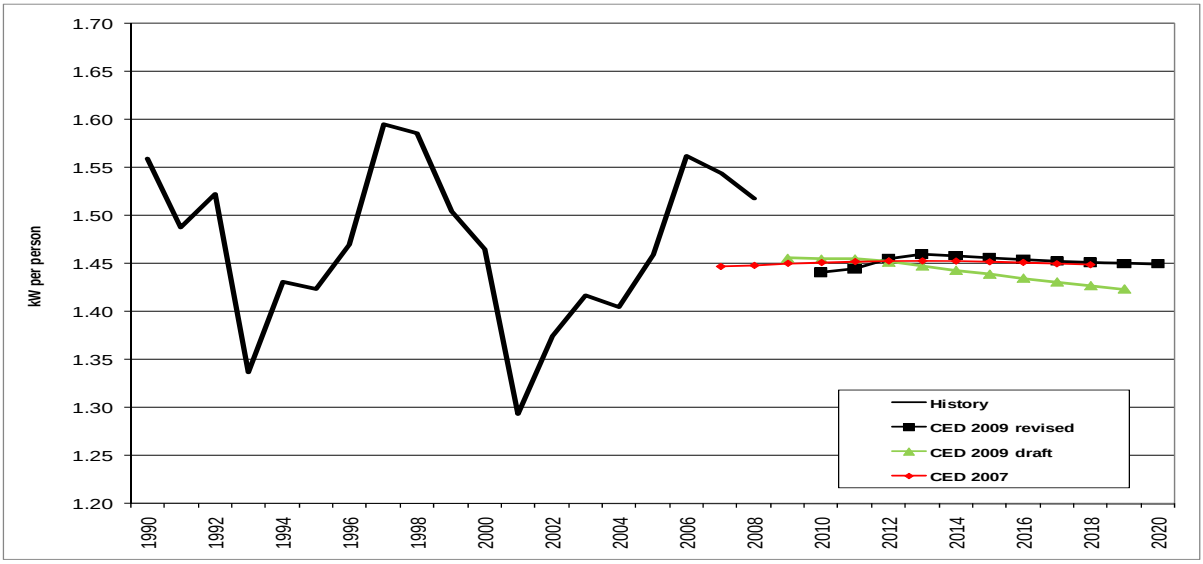


Source: California Energy Commission, 2009

CED 2009 Revised per capita peak demand, shown in **Figure 123**, is higher than *CED 2009 Draft* in the mid- to long-term. *CED 2009 Revised* per capita peak demand increases slightly in the mid-term, then is relatively constant over the remainder of the forecast period, in contrast to the decrease projected in the draft forecast.

Although projected total consumption and peak are higher in *CED 2009 Revised*, per capita electricity consumption and peak demand are forecast to be lower than in *CED 2007* because LADWP planning area population is assumed to make up a higher share of the projected state total than in *CED 2007*.

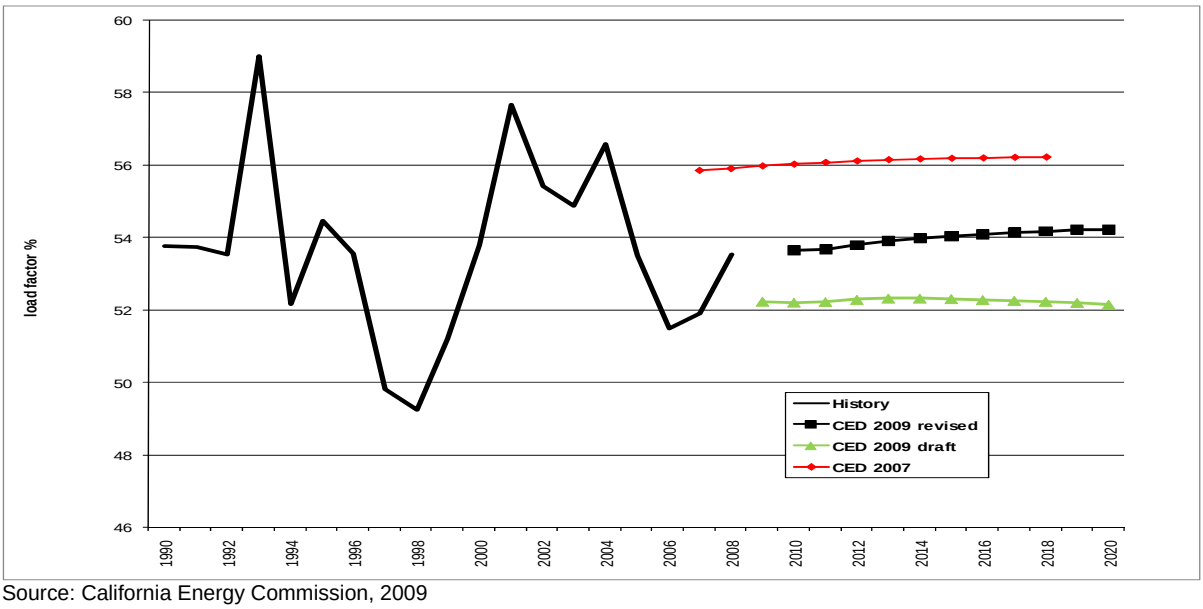
Figure 123: LADWP Planning Area per Capita Peak Demand



Source: California Energy Commission, 2009

Figure 124 compares the load factors of the three forecasts. The load factor represents the relationship between average energy demand and peak: the smaller the load factor, the greater the difference between peak and average hourly demand. The load factor varies with temperature; in extremely hot years (for example, 1998 and 2006) demand is *peakier*. The LADWP load factor has varied in recent history. The revised load factor is higher than the draft load factor and increases slightly over the forecast period because of high relative growth in the commercial and industrial sectors, which are less *peaky* than the residential sector.

Figure 124: LADWP Planning Area Peak Load Factor



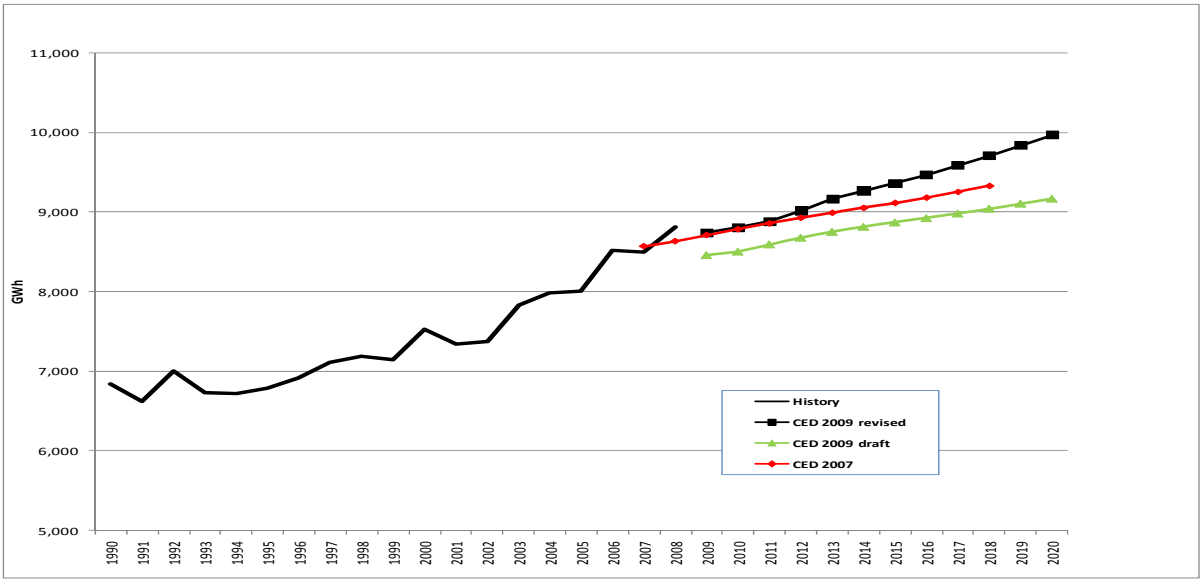
Source: California Energy Commission, 2009

Sector Level Results and Input Assumptions

Residential

Figure 125 compares residential forecasts. *CED 2009 Revised* is higher over the entire forecast period compared to *CED 2009 Draft*. The increase comes from higher projections of household income and slightly more projected households caused by a revision to persons per household.

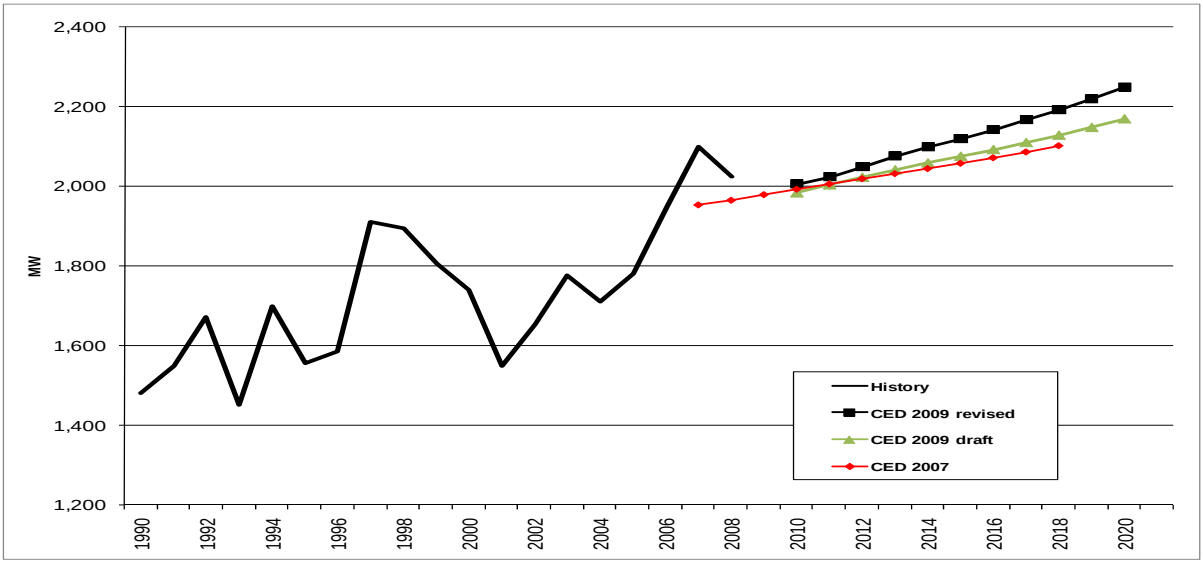
Figure 125: LADWP Planning Area Residential Consumption



Source: California Energy Commission, 2009

Figure 126 compares residential peak demand forecasts. The differences in peak demand mirror those in consumption.

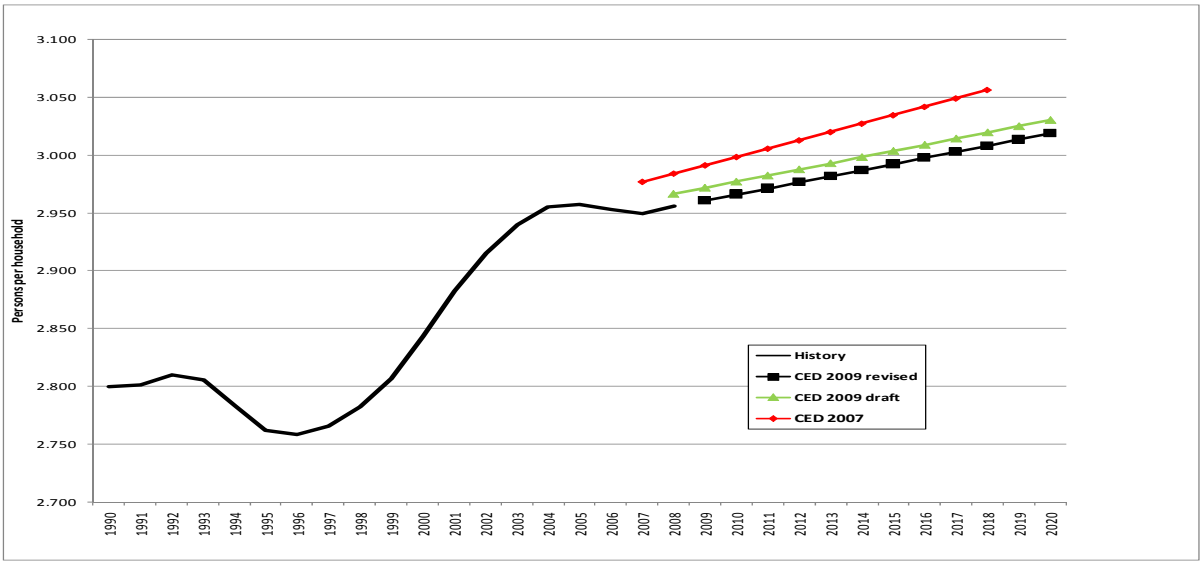
Figure 126: LADWP Planning Area Residential Peak



Source: California Energy Commission, 2009

Figures 127 and **128** compare the residential drivers used in the forecasts. **Figure 127** shows persons-per-household projections. There is a slight decrease compared to *CED 2009 Draft*. The change in *CED 2009 Revised* projections compared to *CED 2009 Draft* increases the household forecast by about 5,400 households by the end of the forecast period (less than 0.4 percent).

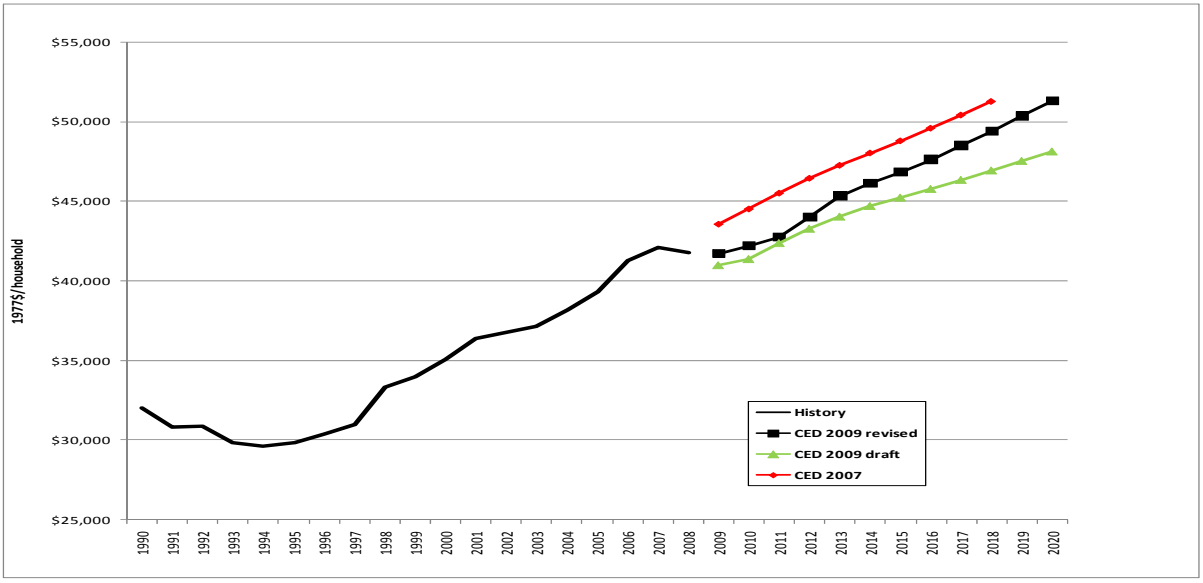
Figure 127: LADWP Planning Area Persons per Household Projections



Source: California Energy Commission, 2009

Figure 128 compares household income used in the respective forecasts. The *CED 2009 Revised* projections are higher than in *CED 2009 Draft*. Both are still below the income projections used in *CED 2007*. *CED 2009 Revised* uses the June 2009 projections from Economy.com while the previous forecasts used earlier vintages of Economy.com projections. The new projections produce long-term growth that is slightly higher than that in *CED 2009 Draft* as the economy recovers from the current slump.

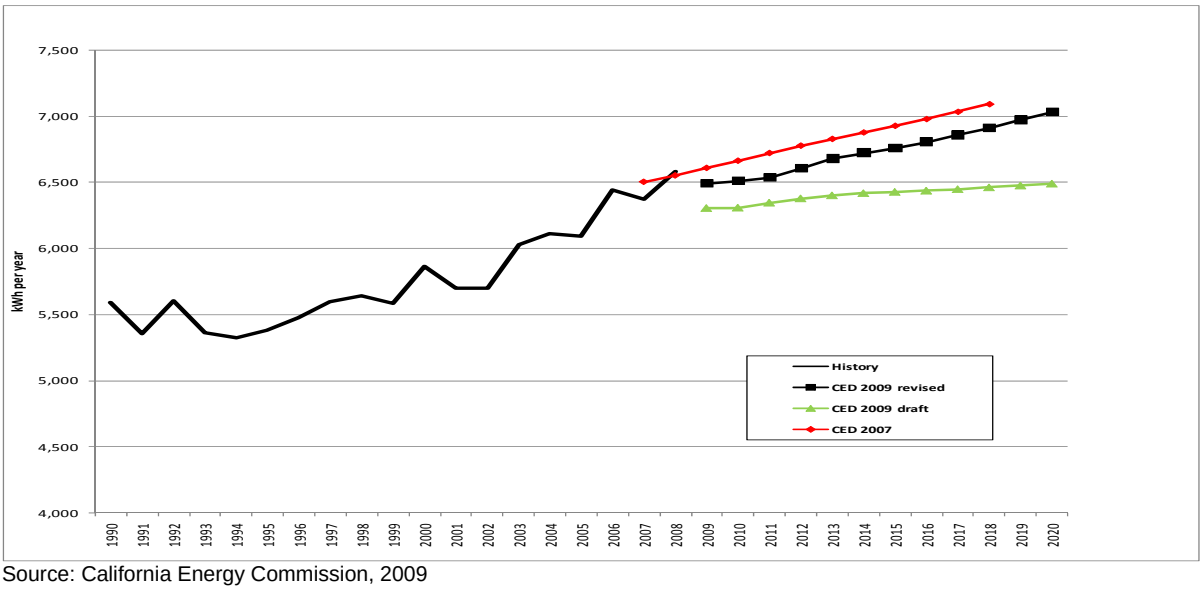
Figure 128: LADWP Planning Area Household Income Projections



Source: California Energy Commission, 2009

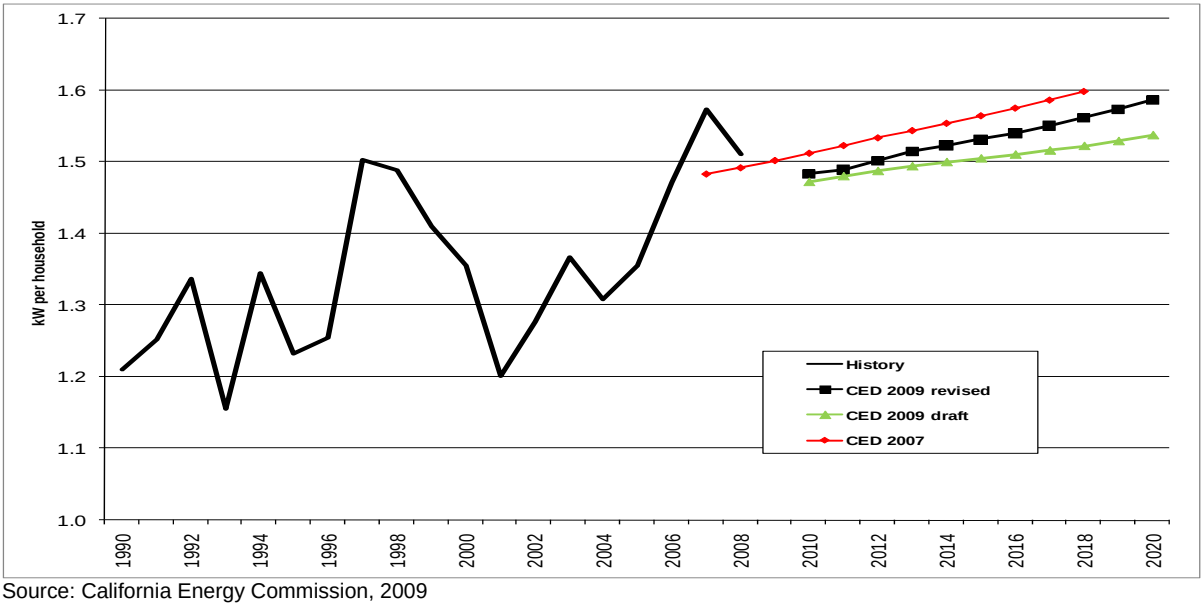
Figures 129 and **130** compare residential use per household and residential peak use per household, respectively. *CED 2009 Revised* use per household (**Figure 129**) is higher than *CED 2009 Draft*. This is primarily caused by increased household income projections. *CED 2009 Revised* use per household is well below the level of *CED 2007*. The difference in peak use per household (**Figure 130**) is very similar to the difference in the consumption forecast.

Figure 129: LADWP Planning Area Use per Household



Source: California Energy Commission, 2009

Figure 130: LADWP Planning Area Peak Use per Household

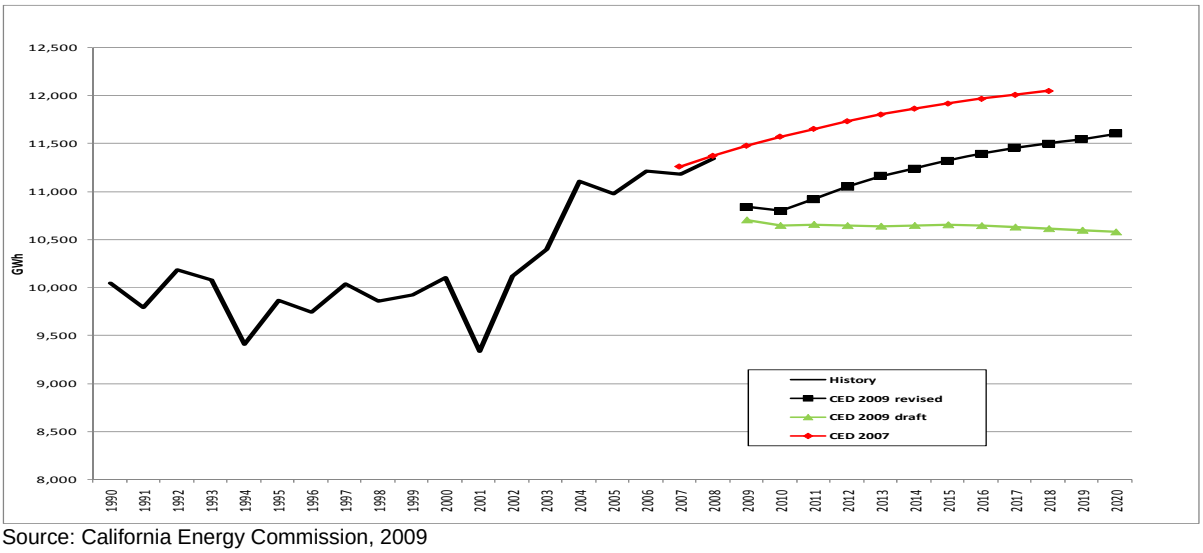


Source: California Energy Commission, 2009

Commercial Building Sector

Figures 131 and **132** compare commercial building sector forecasts. *CED 2009 Revised* is higher than *CED 2009 Draft* because of increases in commercial sector floor space. The growth rate in consumption after the economic recovery is very similar to that of *CED 2007,* although both *CED 2009* forecasts are lower than *CED 2007*.

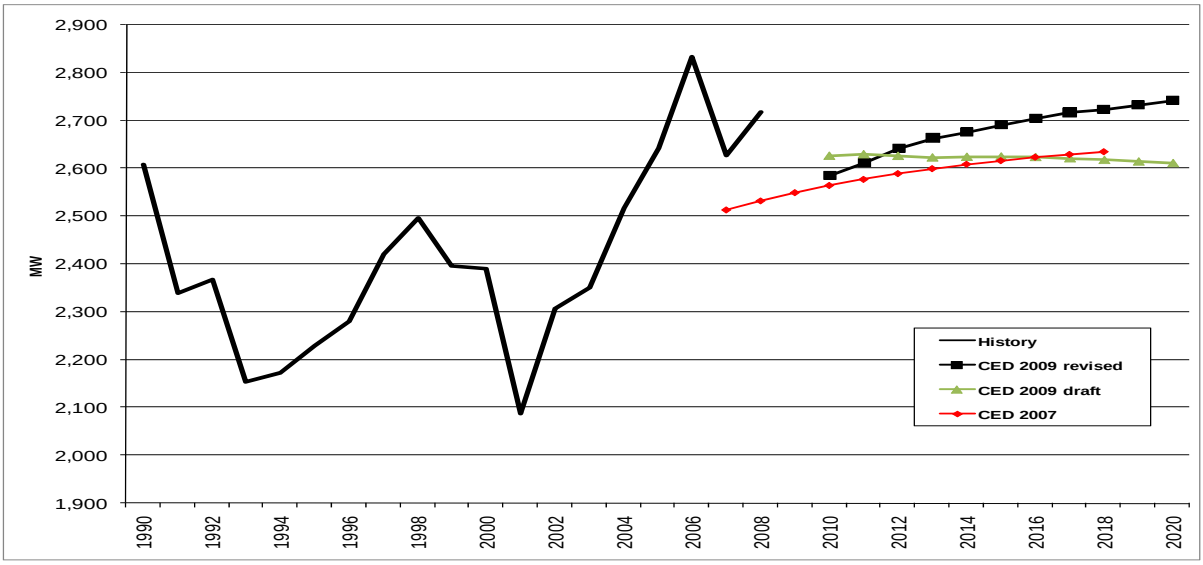
Figure 131: LADWP Planning Area Commercial Consumption



Source: California Energy Commission, 2009

Figure 132 compares commercial building sector peak demand forecasts. *CED 2009 Revised* is higher than both *CED 2009 Draft* and *CED 2007*. The differences between the revised and draft forecasts are similar to the differences in consumption forecasts. Both *CED 2009* forecasts start from a higher value than was assumed in *CED 2007*.

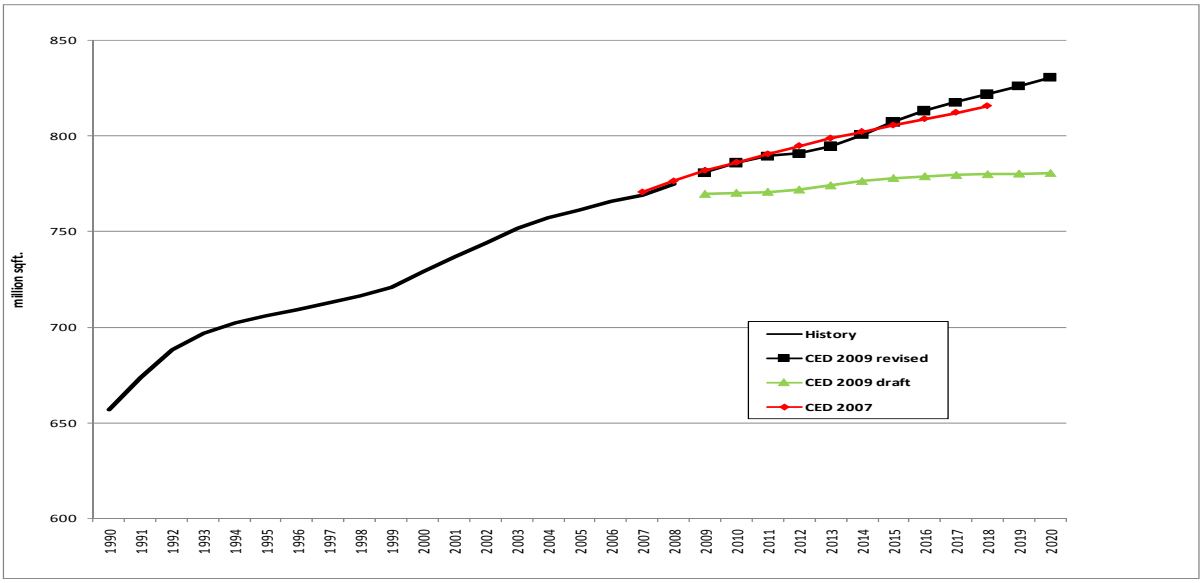
Figure 132: LADWP Planning Area Commercial Sector Peak



Source: California Energy Commission, 2009

In staff's commercial building sector forecasting model, floor space by building type (that is, retail, schools, offices, and so forth) is the key driver of energy use for each specific building type. **Figure 133** compares total commercial floor space projections. *CED 2009 Revised* floor space is higher than the draft values. This is caused by revised estimates of economic drivers, specifically for the LADWP planning area, along with use of a different floor space forecasting method than in the draft forecast, as discussed in Chapter 1. *CED 2009 Revised* is now essentially the same in the near term and slightly higher in the long term than *CED 2007*.

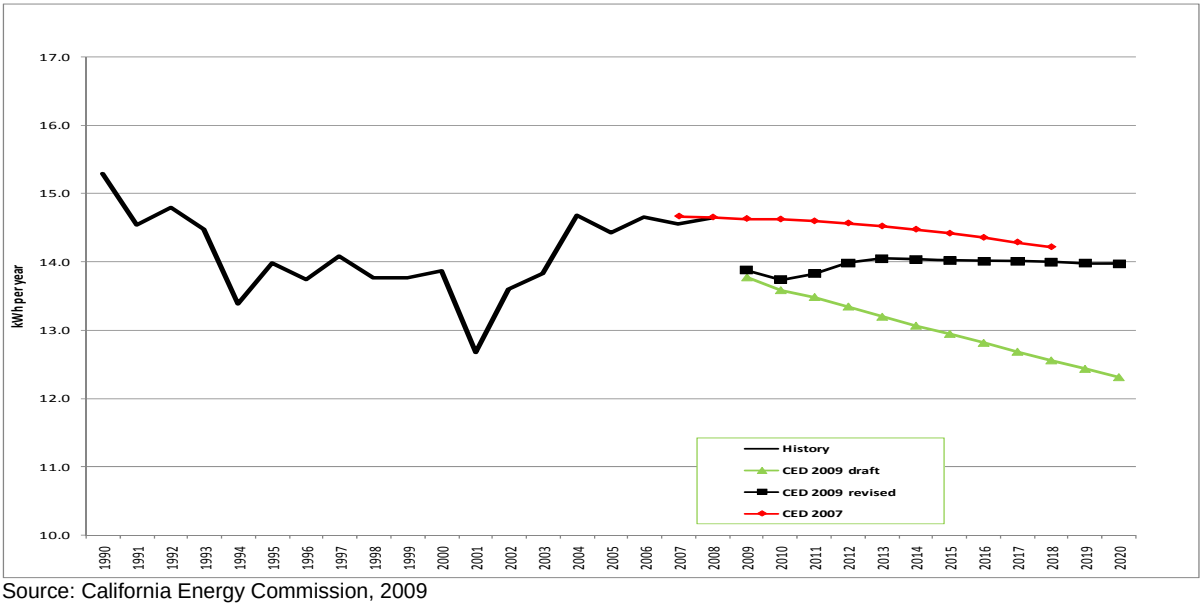
Figure 133: LADWP Planning Area Commercial Floor Space



Source: California Energy Commission, 2009

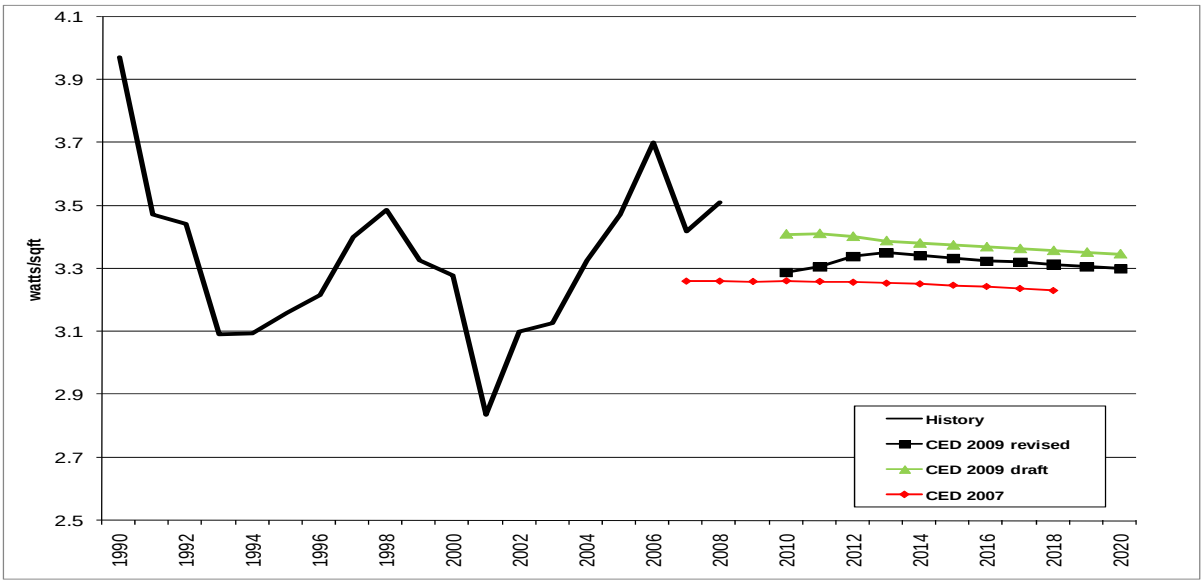
Historical and projected commercial sector annual consumption and peak use per square foot are shown in **Figures 134** and **135**, respectively. Use per square foot (**Figure 134**) in *CED 2009 Revised* is higher than *CED 2009 Draft* once the economy improves. This value is still below that projected in *CED 2007*. Revised peak use per square foot (**Figure 135**) is now lower than *CED 2009 Draft* because of revisions to the expected commercial contribution to total peak.

Figure 134: LADWP Planning Area Commercial kWh per Square Foot



Source: California Energy Commission, 2009

Figure 135: LADWP Planning Area Commercial Watts per Square Foot



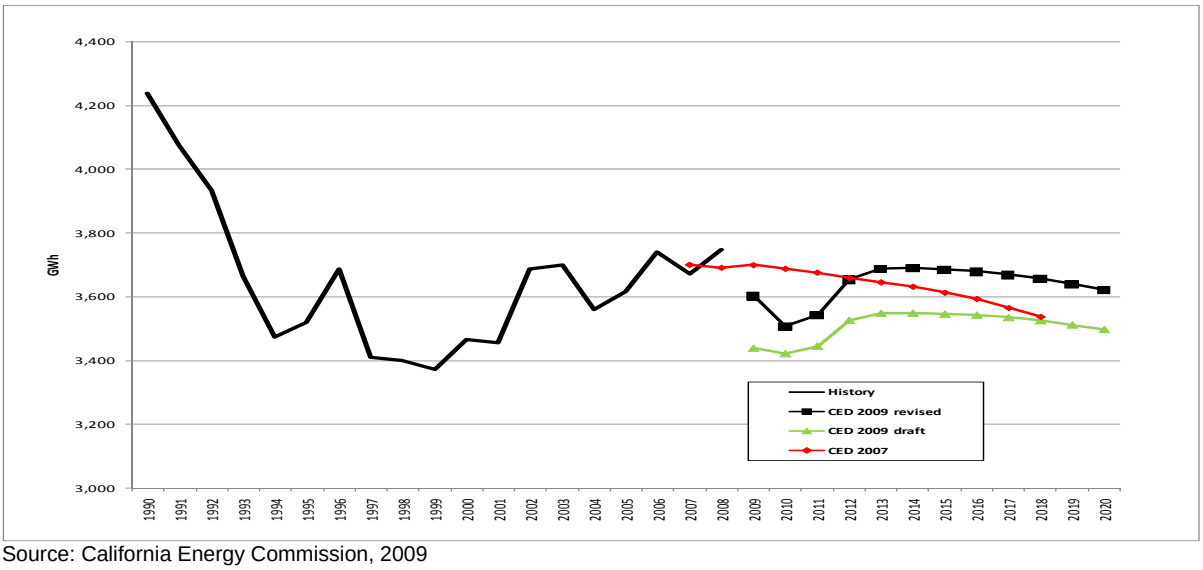
Source: California Energy Commission, 2009

Industrial Sector

Figure 136 compares industrial sector electricity consumption forecasts for the LADWP planning area. *CED 2009 Revised* is higher throughout the entire forecast period than *CED 2009 Draft* because of a higher assumed starting value resulting from inclusion of 2008

consumption in the historical period. The long-term growth of *CED 2009 Revised* is similar to *CED 2009 Draft*.

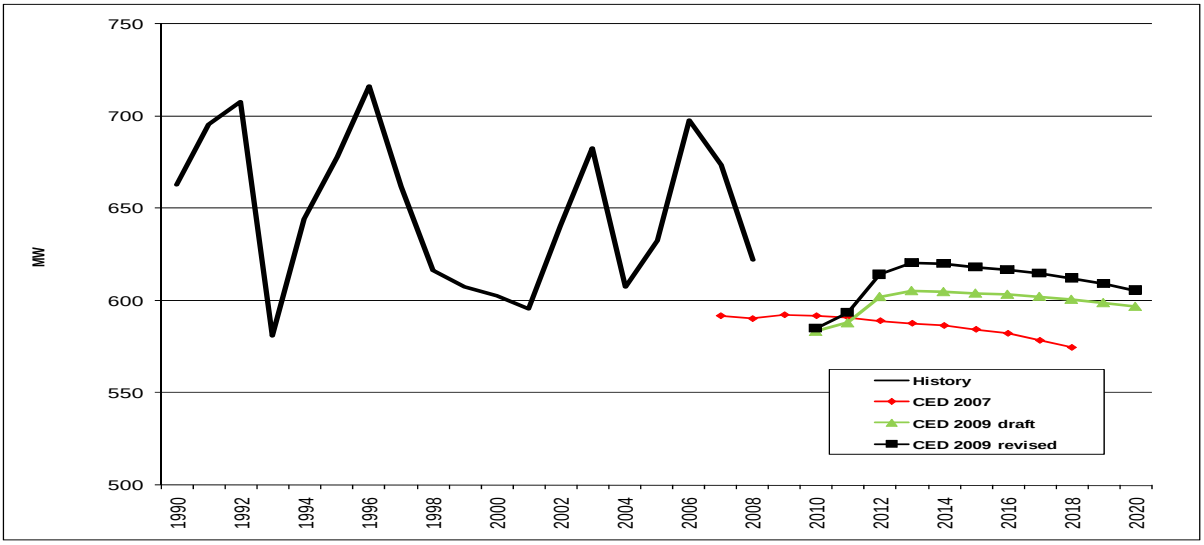
Figure 136: LADWP Planning Area Industrial Consumption



Source: California Energy Commission, 2009

Figure 137 compares industrial sector peak forecasts. The differences are similar to the differences in the consumption forecast. The expected short-term recovery produces a revised peak, which is higher than *CED 2007*.

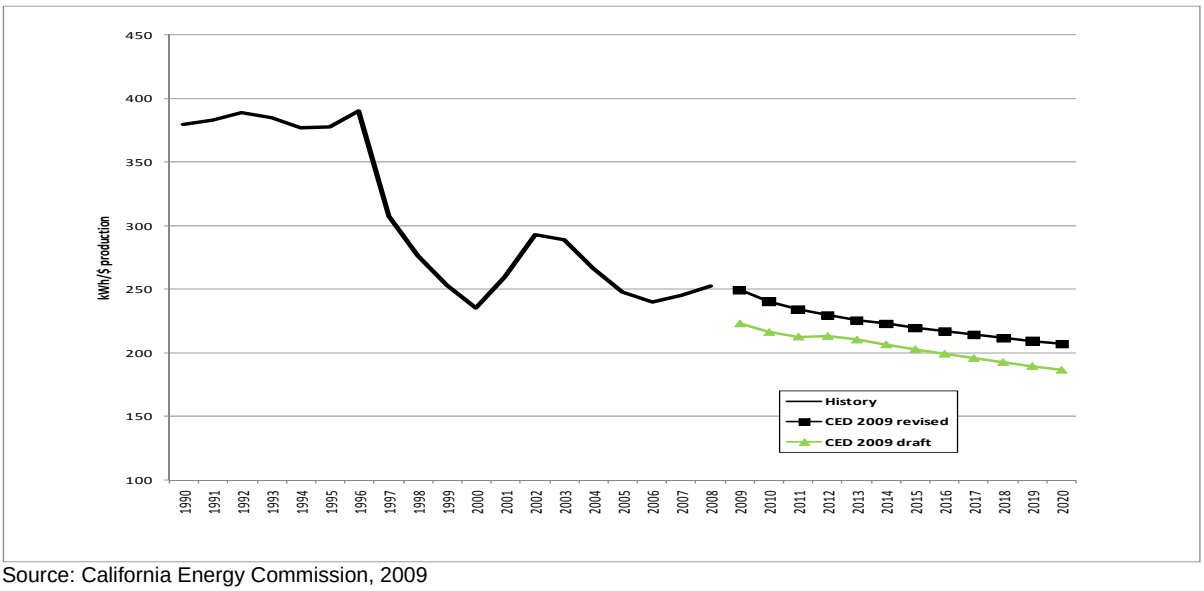
Figure 137: LADWP Planning Area Industrial Sector Peak



Source: California Energy Commission, 2009

Figure 138 compares use per dollar value of production between *CED 2009 Revised* and *CED 2009 Draft*. *CED 2009 Revised* has a higher level of electricity use per dollar of value added than *CED 2009 Draft*. This is primarily caused by a higher historical starting point from inclusion of 2008 consumption history. The forecasted growth rates are similar in both forecasts.

Figure 138: LADWP Planning Area Industrial Use per Production Unit

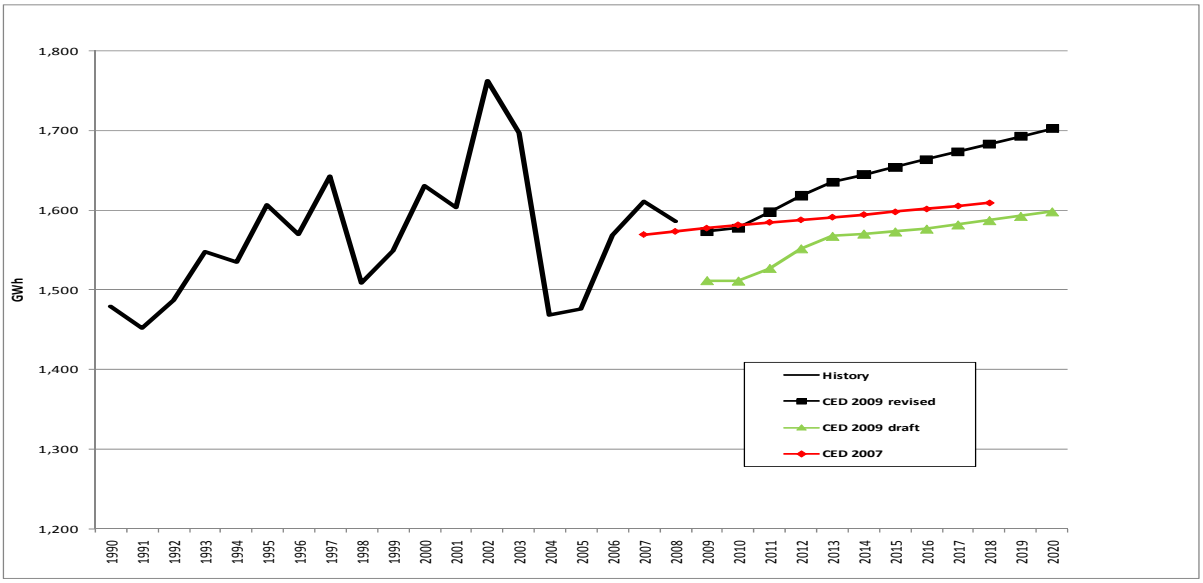


Source: California Energy Commission, 2009

Other Sectors

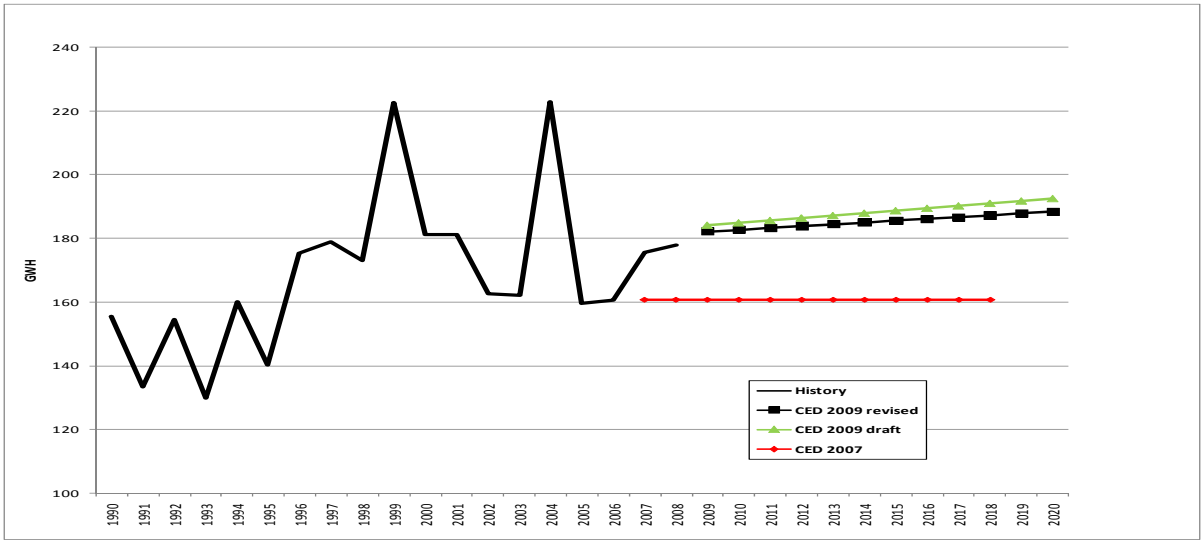
Figures 139 and **140** compare the remaining sector electricity consumption forecasts. **Figure 139** compares transportation, communication, and utilities (TCU) sector forecasts. *CED 2009 Revised* is higher than *CED 2009 Draft* because of an assumed higher starting point. Growth in both *CED 2009* forecasts is similar. *CED 2009 Revised* has a higher growth rate than *CED 2007.* **Figure 140** compares the agriculture and water pumping sector forecasts. *CED 2009 Revised* is only slightly lower than *CED 2009 Draft*.

Figure 139: LADWP Planning Area Transportation, Communication and Utilities Sector Electricity Consumption



Source: California Energy Commission, 2009

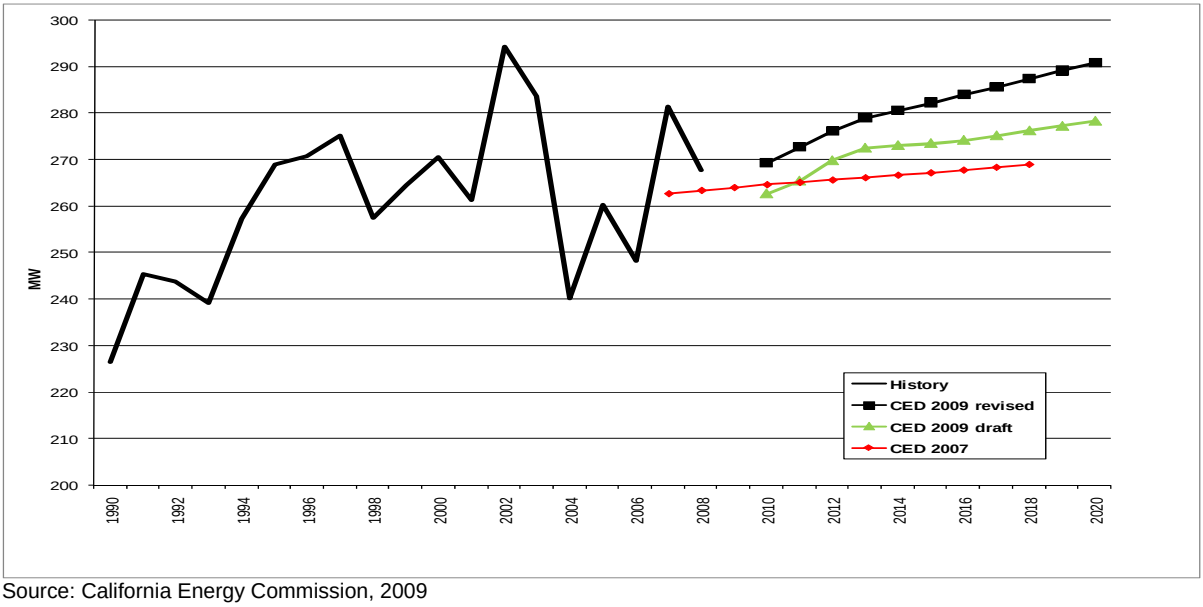
Figure 140: LADWP Planning Area Agriculture and Water Pumping Forecasts



Source: California Energy Commission, 2009

Figure 141 compares combined peaks for the TCU, street lighting, and agricultural sectors. *CED 2009 Revised* is higher than *CED 2009 Draft* over the entire forecast period. This is caused by an assumed higher starting point for *CED 2009 Revised*. *CED 2009 Revised* is also higher than *CED 2007*.

Figure 141: LADWP Planning Area Other Sector Peak

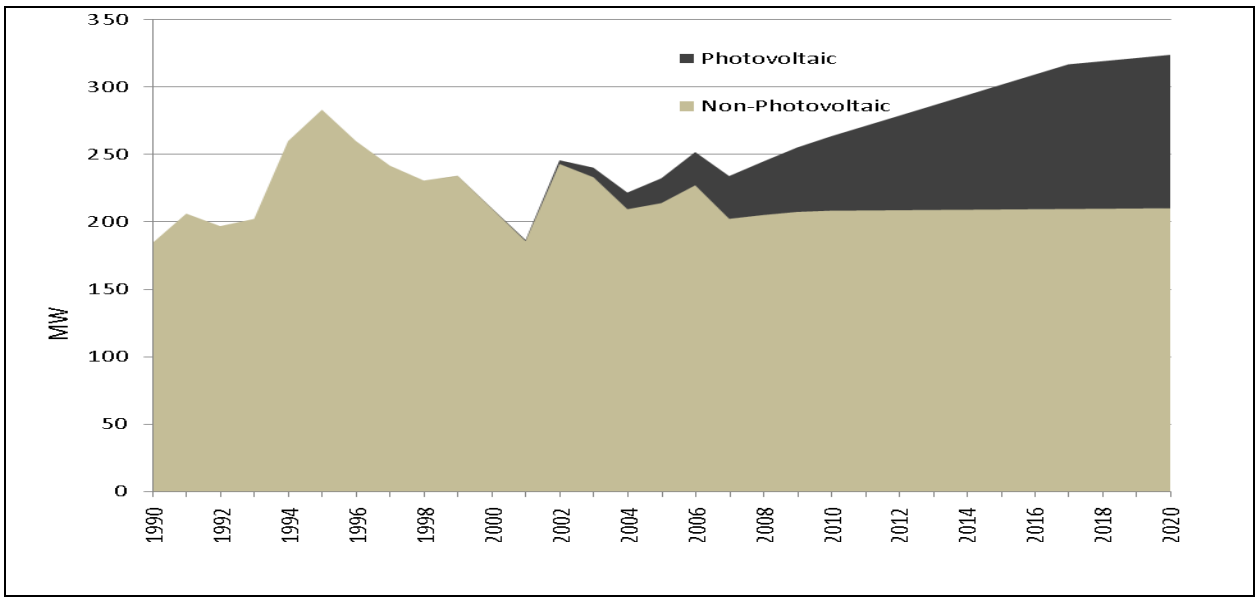


Source: California Energy Commission, 2009

Self-Generation

The peak demand forecast is reduced by self-generation, including the effects of the SGIP, CSI, and other programs, as discussed in Chapter 1. The effects of these programs are forecast based on recent trends in installations. **Figure 142** shows *CED 2009 Revised* peak impacts from photovoltaic and non-photovoltaic self-generation. Based on these trends, staff projects about 114 MW of peak reduction from photovoltaic systems by 2020.

Figure 142: LADWP Planning Area Self Generation Peak Forecast



Source: California Energy Commission, 2009

Economic Scenarios

The results presented above rely on economic inputs from the *base case* Economy.com scenario. Staff also examined the effects of two alternative economic scenarios for electricity demand: Global Insight's *optimistic* case and Economy.com's *pessimistic* case. These two cases, in general, project the highest and lowest rates of economic growth among the various scenarios provided by the two companies. For this analysis, staff developed econometric models for the three largest sectors (residential, commercial, and industrial plus mining) at the planning area level, using historical data for electricity consumption, electricity rates, weather, and various economic and demographic variables. Electricity consumption for the remaining sectors was held constant (*CED 2009 Revised* levels) in the alternative scenarios. The Appendix provides details on the scenarios and the econometric models.

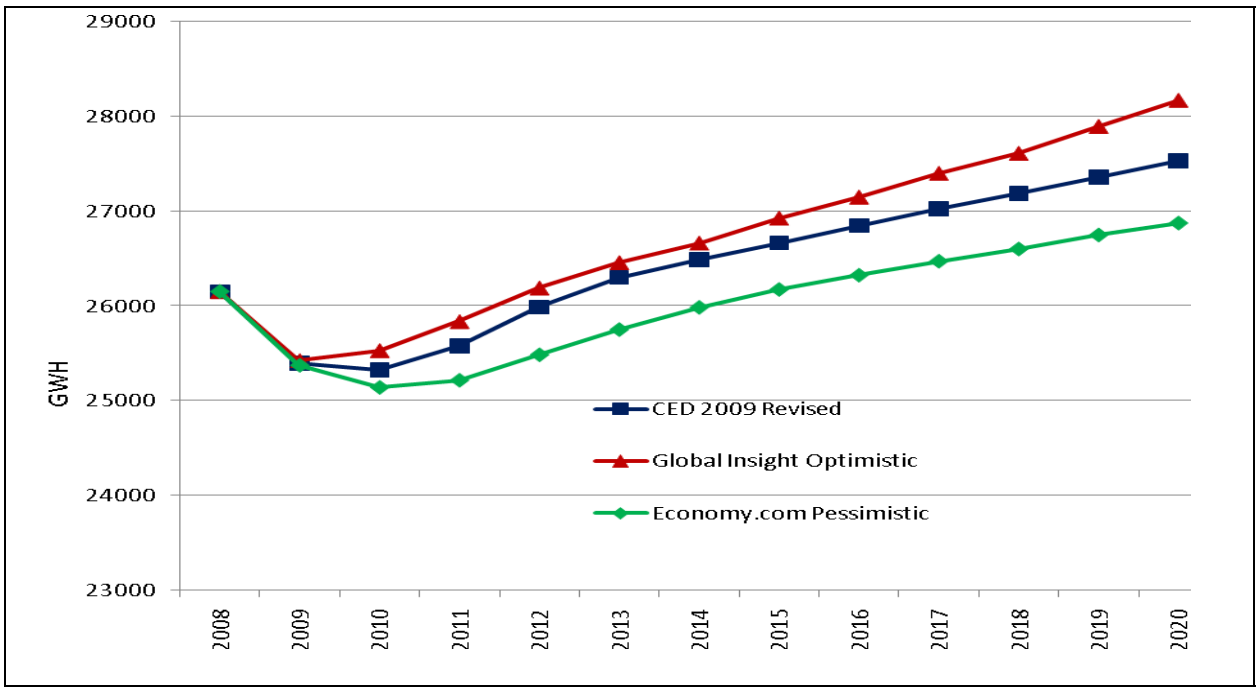
The estimated models were run for LADWP for the two economic scenarios as well as for the Economy.com base case. The resulting percentage differences in electricity consumption between the two alternative scenarios and the base case were applied to *CED 2009 Revised* consumption projections. **Figure 143** shows the projected impacts of the optimistic and pessimistic scenarios on LADWP consumption. Peak demand was developed by applying projected load factors from *CED 2009 Revised* at the sector level to the consumption results for each scenario. Projected peak impacts are shown in **Figure 144**.

Electricity consumption is projected to be 2.3 percent higher in the optimistic economic case than in *CED 2009 Revised* by 2020 and 2.4 percent lower in the pessimistic scenario. The peak demand forecast increases by 2.4 percent under the optimistic scenario by 2020 and falls by

2.6 percent in the pessimistic case. The percentage peak reduction is higher than that of consumption in the pessimistic case because the relative decrease in consumption is projected to be higher for the residential and commercial sectors than for the industrial, which has a higher load factor (is less *peaky*). Growth rates from 2010-2020 for electricity consumption and peak demand increase from 0.9 percent and 0.7 percent, respectively, to 1.0 percent and 0.9 percent in the optimistic case, and fall to 0.7 percent and 0.5 percent under the pessimistic scenario.

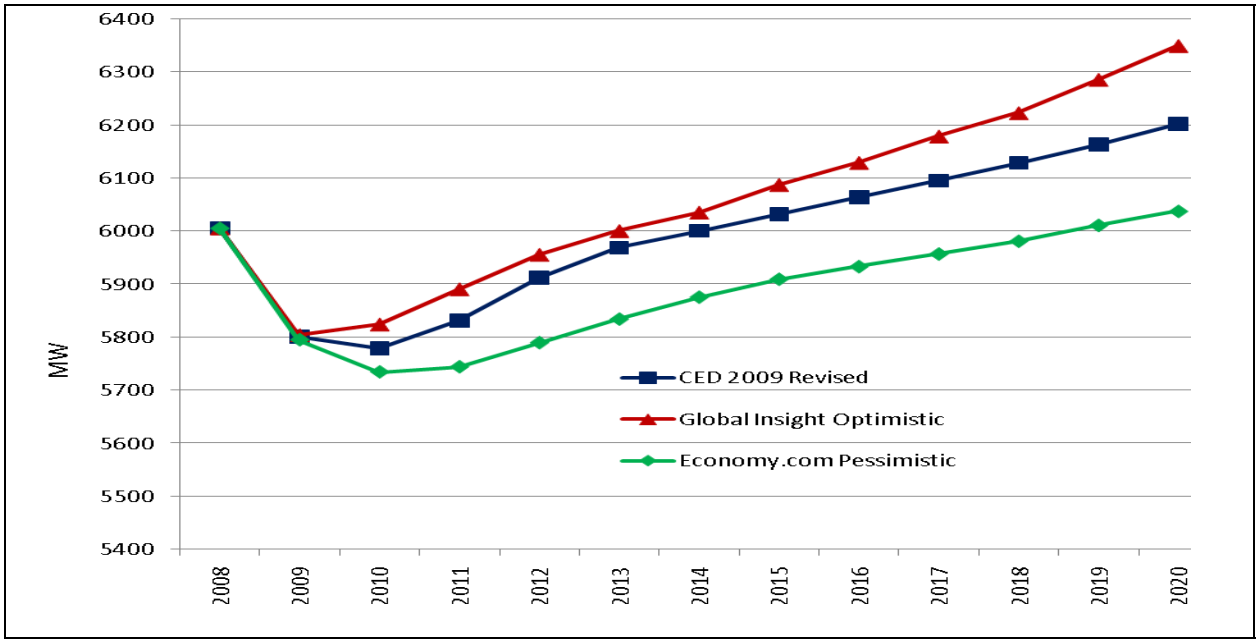
Changes in consumption and peak demand are small compared to *CED 2009 Revised* totals in percentage terms, and this is a reflection of the relatively narrow spread among the three economic scenarios. For example, retail employment is projected to be only 2 percent higher or lower in the alternative scenarios than in the Economy.com base case, and projected industrial output under the pessimistic scenario is almost identical to that of the base case by 2020.

Figure 143: Projected LADWP Electricity Consumption, CED 2009 Revised and Alternative Economic Scenarios



Source: California Energy Commission, 2009

Figure 144: Projected LADWP Peak Demand, CED 2009 Revised and Alternative Economic Scenarios



Source: California Energy Commission, 2009

Conservation/Efficiency Impacts

Staff spent a great deal of effort refining methods to account for energy efficiency and conservation impacts while preparing this forecast, particularly for utility efficiency programs. **Tables 22** and **23** show electricity consumption and peak savings estimates for selected years, for building and appliance standards, utility and public agency programs, and *naturally occurring* savings, or savings associated with rate changes and certain market trends not directly related to programs or standards. Savings are measured against a baseline before 1975, so they incorporate more than 30 years of impacts from rate changes and standards. Chapter 8 provides much more detail on staff work related to energy efficiency and conservation.

Table 22: LADWP Planning Area Electricity Consumption Savings Estimates

	1990	1998	2003	2008	2011	2015	2020
Residential Energy Savings (GWH)							
Building Standards	159	299	358	405	430	463	710
Appliance Standards	60	364	583	856	1,008	1,189	1,378
Utility and Public Agency Programs	31	77	30	64	138	137	76
Naturally Occurring Savings	8	10	9	9	40	63	94
Total Residential Savings	258	750	980	1,333	1,616	1,851	2,258
Commercial Energy Savings (GWH)							
Building Standards	129	280	422	599	698	879	1,095
Appliance Standards	86	188	260	357	399	479	572
Utility and Public Agency Programs*	37	14	2	69	125	79	69
Naturally Occurring Savings	961	1,142	785	538	979	1,149	1,525
Total Commercial Savings	1,213	1,624	1,469	1,563	2,201	2,586	3,261
Total Energy Savings	1,470	2,374	2,449	2,897	3,817	4,437	5,519

Source: California Energy Commission, 2009
*Commercial programs also include agricultural program savings.

Table 23: LADWP Planning Area Electricity Peak Savings Estimates

	1990	1998	2003	2008	2011	2015	2020
Residential Energy Savings (MW)							
Building Standards	34	79	81	94	99	106	160
Appliance Standards	13	96	132	198	232	272	310
Utility and Public Agency Programs	7	20	7	15	32	31	17
Naturally Occurring Savings	2	3	2	2	9	14	21
Total Residential Savings	56	198	223	309	372	423	507
Commercial Energy Savings (MW)							
Building Standards	34	71	96	144	168	210	260
Appliance Standards	22	48	59	86	96	115	136
Utility and Public Agency Programs*	10	4	0	17	30	19	16
Naturally Occurring Savings	250	289	178	130	236	275	362
Total Commercial Savings	315	412	333	377	530	618	775
Total Energy Savings	371	610	556	686	901	1,042	1,282

Source: California Energy Commission, 2009
*Commercial programs also include agricultural program

CHAPTER 7: End-User Natural Gas Demand Forecast

This chapter presents the *CED 2009 Revised* forecast of end-user natural gas demand for the Pacific Gas and Electric (PG&E), Southern California Gas (SCG), and San Diego Gas & Electric (SDG&E) natural gas planning areas. Staff prepares these forecasts in parallel with its electricity demand forecasts. The models used by staff are organized along electricity planning area boundaries. The gas demand forecasts presented here are the aggregate of gas demand in the corresponding electricity planning areas. These forecasts do not include natural gas used by utilities or others for electric generation.

CED 2009 Revised incorporates forecasts of historical consumption data through 2008. See Chapter 1 for a discussion of economic and demographic assumptions. *CED 2009 Revised* uses the mid-rate scenario[17] from *CED 2009 Draft* for natural gas prices, rates lower than those used in *CED 2007*.

The following summarizes the results presented in this chapter:

- *CED 2009 Revised* projected natural gas consumption is below *CED 2007* because of lower recorded consumption in 2007 and 2008 than predicted in the 2007 forecast and because of the current recession.
- As the economy recovers, projected annual growth in natural gas consumption is expected to exceed *CED 2007* forecast growth.
- Per-capita natural gas consumption is projected to continue the historical downward trend.
- Annual growth in natural gas consumption beyond 2010 is projected to be highest for the SDG&E planning area and lowest for PG&E.

Statewide Forecast Results

Table 24 compares *CED 2009 Revised* and *CED 2009 Draft* natural gas forecasts with *CED 2007* for selected years. *CED 2009 Revised* corresponds to the mid-rate scenario in *CED 2009 Draft*; thus the comparison is made to the draft mid-rate case. *CED 2009 Revised* uses slightly higher rates, roughly equivalent to those in the draft high-rate scenario.

Reported 2008 natural gas consumption for *CED 2009 Revised* is well below that predicted in *CED 2009 Draft* and *CED 2007*. This difference, along with a projected reduction from 2008-

[17] In *CED 2009 Draft*, three price scenarios were developed for natural gas rates: high rates, low (constant) rates, and a rate scenario in between the two, the mid-rate case, which assumed a 10 percent rate increase between 2010 and 2020.

2010 for industrial and mining consumption, leads to a lower forecast through 2020. However, as the economy recovers beyond 2010, the growth rate exceeds that of the two previous forecasts because of lower projected rates in the case of *CED 2007* and higher economic growth in the case of *CED 2009 Draft*.

Figure 145 compares the forecast by region. As in the state forecast, gas consumption projections in both Southern and Northern California fall in the short term and increase thereafter at a higher rate compared to *CED 2009 Draft* and *CED 2007*. In Southern California, a strong recovery in the industrial and mining sectors projected in the more recent economic forecast (relative to *CED 2009 Draft*) pushes *CED 2009 Revised* gas consumption above *CED 2009 Draft* levels by 2012.

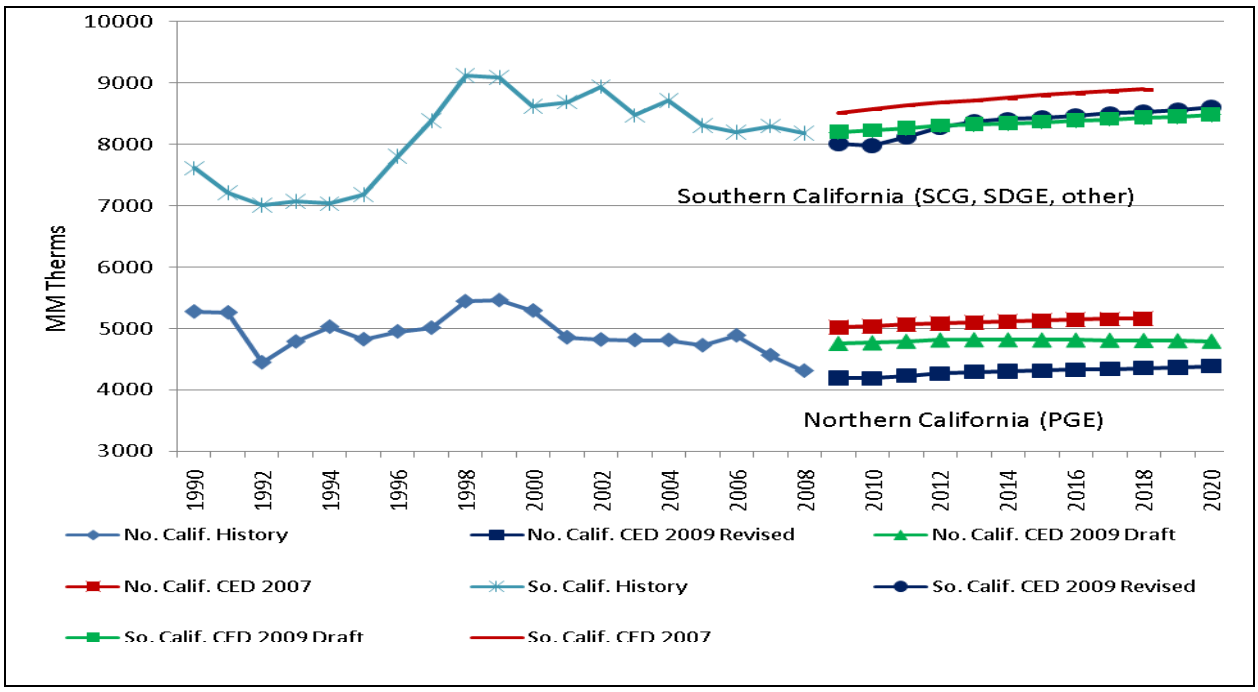
Figure 146 compares *CED 2009 Revised* per capita natural gas consumption with *CED 2009 Draft* and *CED 2007*. Annual per capita demand varies in response to annual temperatures and business conditions but has generally been declining over time. As would be expected from statewide consumption results, per capita natural gas consumption is below *CED 2009 Draft* and *CED 2007* levels. All three forecasts project a decline in per capita consumption over the forecast period, although the rate of decrease is lower in *CED 2009 Revised* than in the two previous forecasts.

Table 24: Statewide End-User Natural Gas Forecast Comparison

End-User Consumption (MM Therms)					
	CED 2007 (Oct. 2007)	*CED 2009 Draft* Mid-rate Case (June 2009)	*CED 2009 Revised* (Sept. 2009)	Difference, *CED 2009 Revised* and *CED 2007*	Difference, *CED 2009 Revised* and *CED 2009 Draft*
1990	12,893	12,893	12,893	0.00%	0.00%
2000	13,913	13,913	13,913	0.00%	0.00%
2008	13,445	12,941	12,494	-7.07%	-3.46%
2010	13,616	12,992	12,162	-10.68%	-6.48%
2015	13,932	13,218	12,751	-8.48%	-3.54%
2018	14,058	13,319	12,894	-8.28%	-3.20%
Average Annual Growth Rates					
1990-2000	0.76%	0.76%	0.76%		
2000-2008	-0.43%	-0.90%	-0.89%		
2008-2010	0.63%	0.19%	-1.34%		
2010-2018	0.40%	0.31%	0.73%		
Historical values are shaded					
End-user consumption excludes natural gas used to generate electricity					

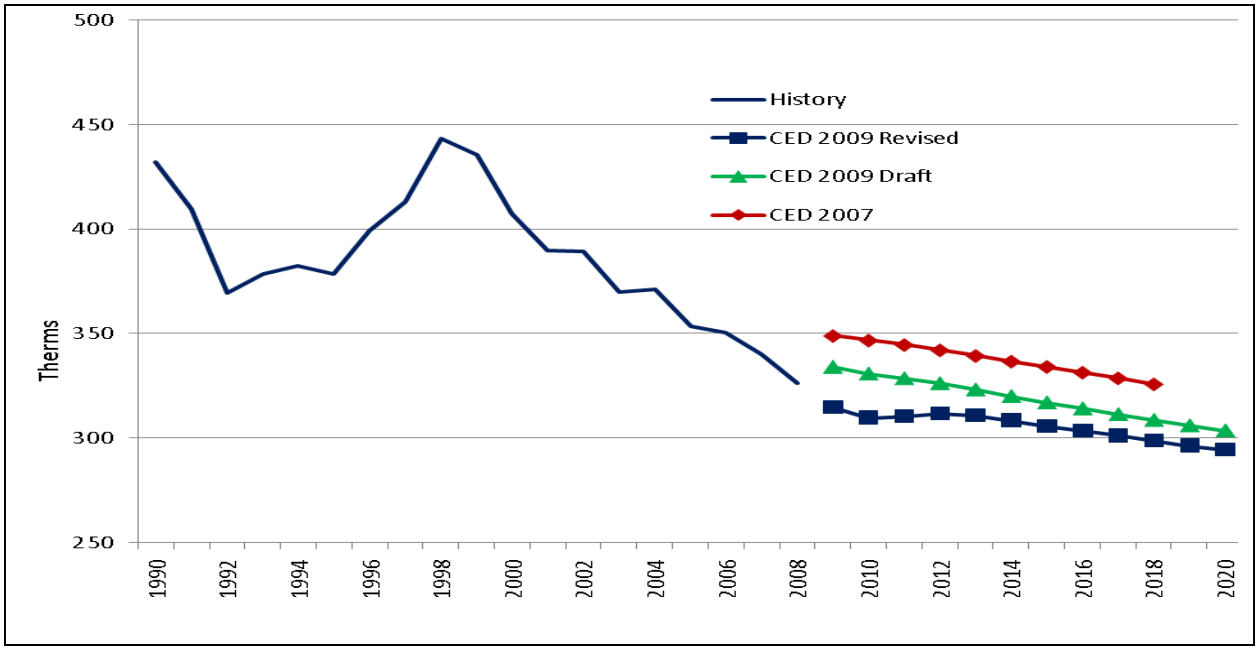
Source: California Energy Commission, 2009

Figure 145: End-User Natural Gas Consumption Forecast



Source: California Energy Commission, 2009

Figure 146: Statewide per Capita Natural Gas Consumption



Source: California Energy Commission, 2009

Planning Area Results

This section presents *CED 2009 Revised* results for each of the three planning areas, including sector level projections. Comparisons are made to *CED 2007* only. In general, results for *CED 2009 Revised* are similar to those of the draft forecast, with a difference in 2008 as a result of updated historical data and a slightly higher long-term growth rate.

Pacific Gas and Electric Planning Area

The PG&E natural gas planning area is defined as the combined PG&E and SMUD electric planning areas. It includes all PG&E retail gas customers and customers of private marketers using the PG&E natural gas distribution system.

Table 25 compares the revised PG&E planning area forecast with *CED 2007*. As in the statewide case, demand drops from 2008 to 2010, so consumption is projected to be almost 17 percent less than *CED 2007* by 2010. Most of this decrease is from lower recorded consumption in 2007 and 2008 compared to *CED 2007* projections, and the remainder is a result of economic decline. Longer-term growth is expected to be higher than in the 2007 forecast, reducing the difference between the two forecasts to 15.6 percent by 2018.

Table 25: PG&E Natural Gas Forecast Comparison

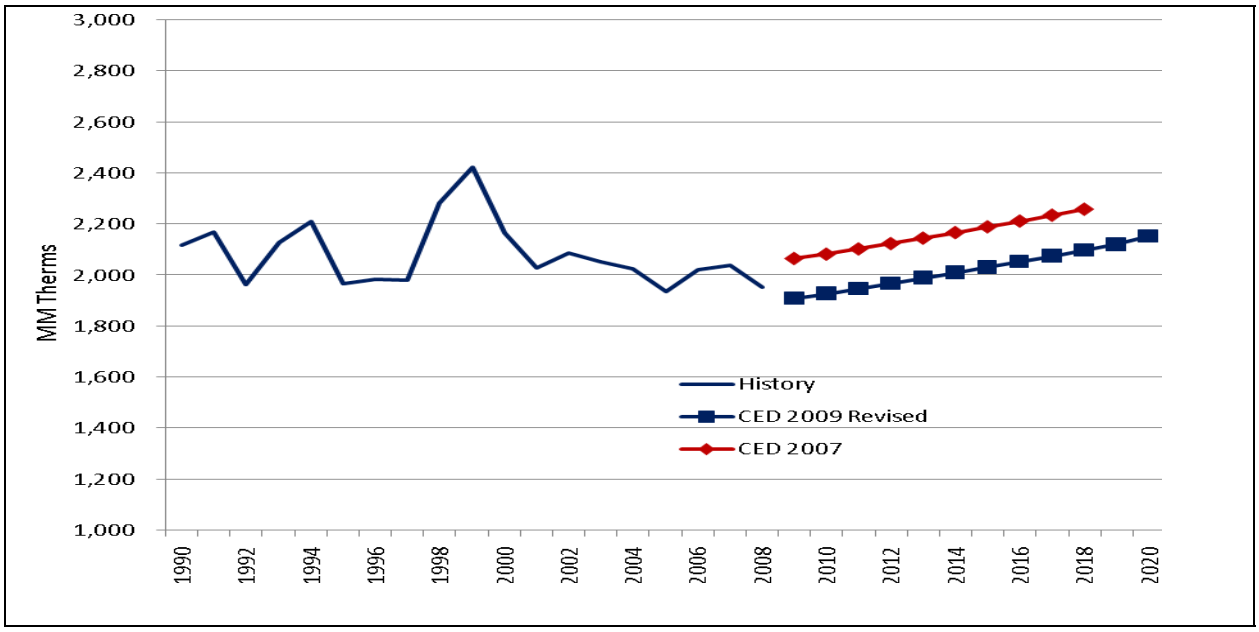
	Consumption (MM Therms)		
	CED 2007	*CED 2009* Revised	Percentage Difference
1990	5,275	5,275	0. 00%
2000	5,291	5,291	0. 00%
2008	4,985	4,309	-13.50%
2010	5,038	4,186	-16.90%
2018	5,163	4,358	-15.60%
Historical values are shaded			
	Annual Average Growth Rates		
1990- 2000	0. 03%	0. 03%	
2000- 2008	-0. 74%	-2. 53%	
2008- 2010	0. 52%	-1.43%	
2010- 2018	0. 31%	0. 50%	

Source: California Energy Commission, 2009

Figure 147 compares *CED 2009 Revised* and *CED 2007* PG&E planning area residential forecasts. *CED 2009 Revised* is lower throughout the entire forecast period, as actual consumption recorded in 2008 was lower than predicted in *CED 2007*, but the two forecasts have nearly the same growth rate from 2010-2020, just over 1 percent.

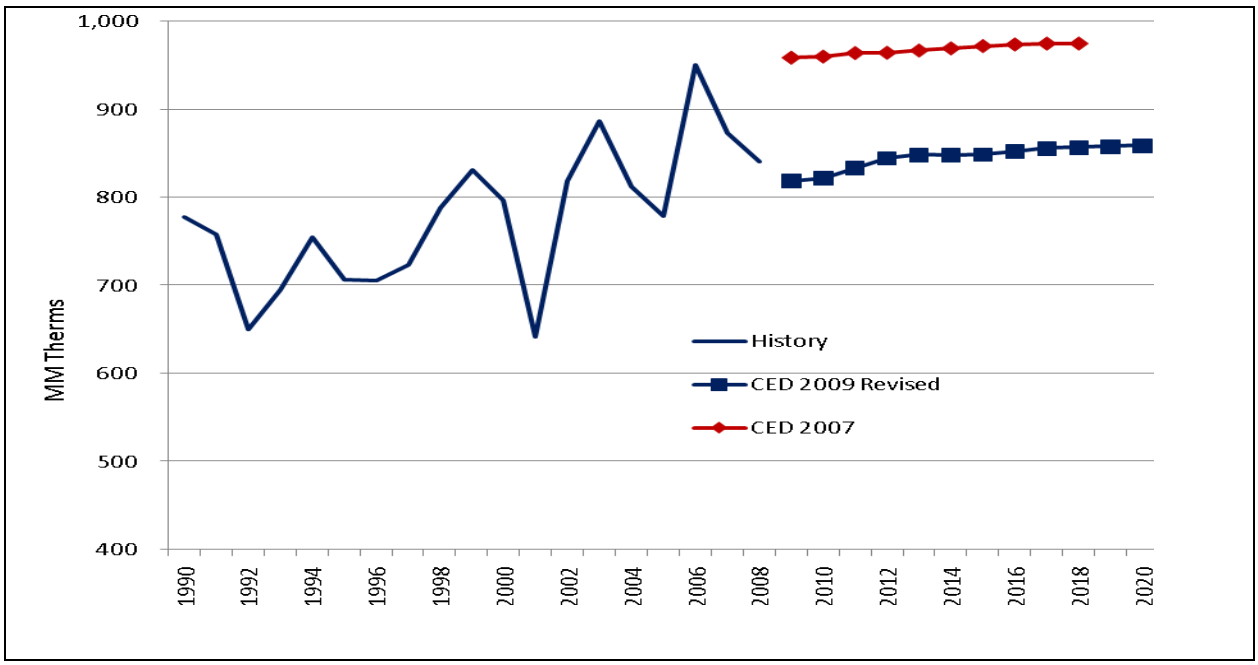
Figures 148 and **149** show the forecasts for the PG&E commercial and industrial plus mining sectors, the latter responsible for most of the reduction in recorded 2007 and 2008 consumption relative to *CED 2007* projections. In 2010, projected consumption is down by around 14 percent in the commercial sector and by more than 27 percent in the industrial sector. Commercial consumption grows at a higher rate in *CED 2009 Revised* than in *CED 2007*, while the rate of consumption decline in the industrial plus mining sector is slightly higher.

Figure 147: PG&E Planning Area Residential Gas Consumption



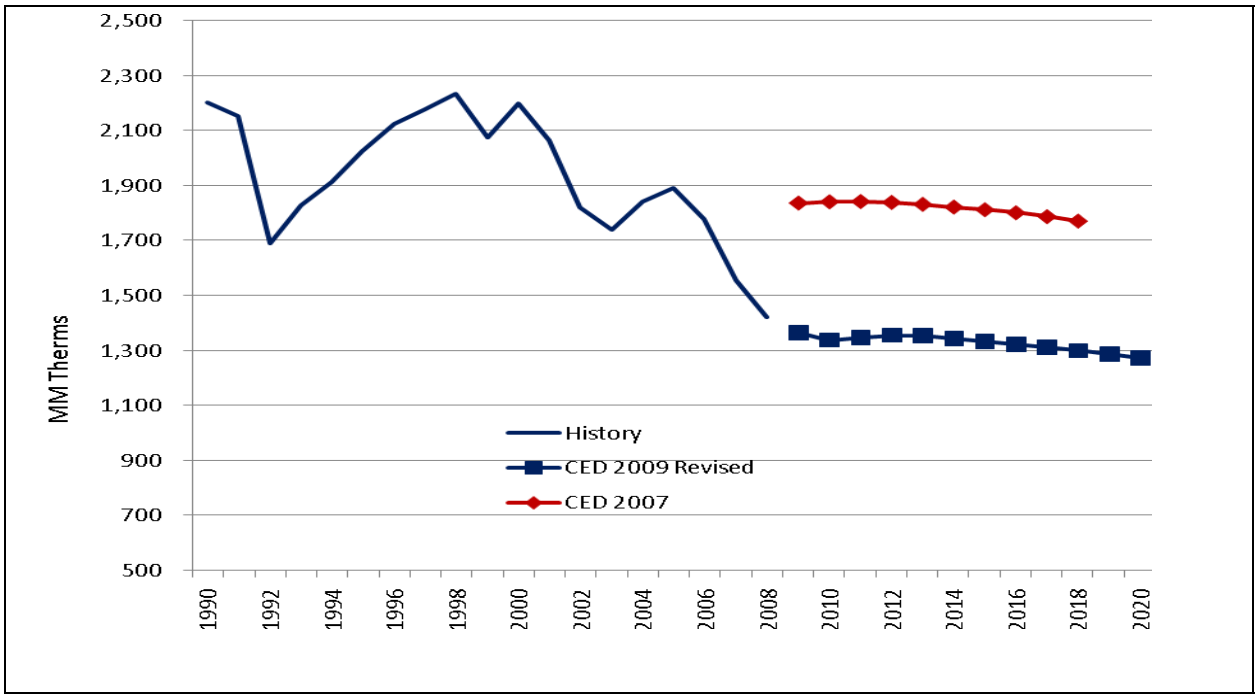
Source: California Energy Commission, 2009

Figure 148: PG&E Planning Area Commercial Gas Consumption



Source: California Energy Commission, 2009

Figure 149: PG&E Planning Area Industrial Plus Mining Gas Consumption



Source: California Energy Commission, 2009

Southern California Gas Company Planning Area

The SCG planning area is composed of the SCE, Burbank/Glendale, Pasadena, and LADWP electric planning areas. It includes customers of those utilities, plus customers of private marketers using the SCG natural gas distribution system.

Table 26 compares the revised SCG planning area forecast with *CED 2007*. Recorded consumption is lower in 2007 and 2008 than *CED 2007* projections; this reduction and the impacts of the current recession drive *CED 2009 Revised* gas consumption almost 7 percent below the 2007 forecast by 2010. The projected economic recovery leads to higher longer-term growth: 0.8 percent per year from 2010-2018 in *CED 2009 Revised* compared to 0.4 percent in *CED 2007*.

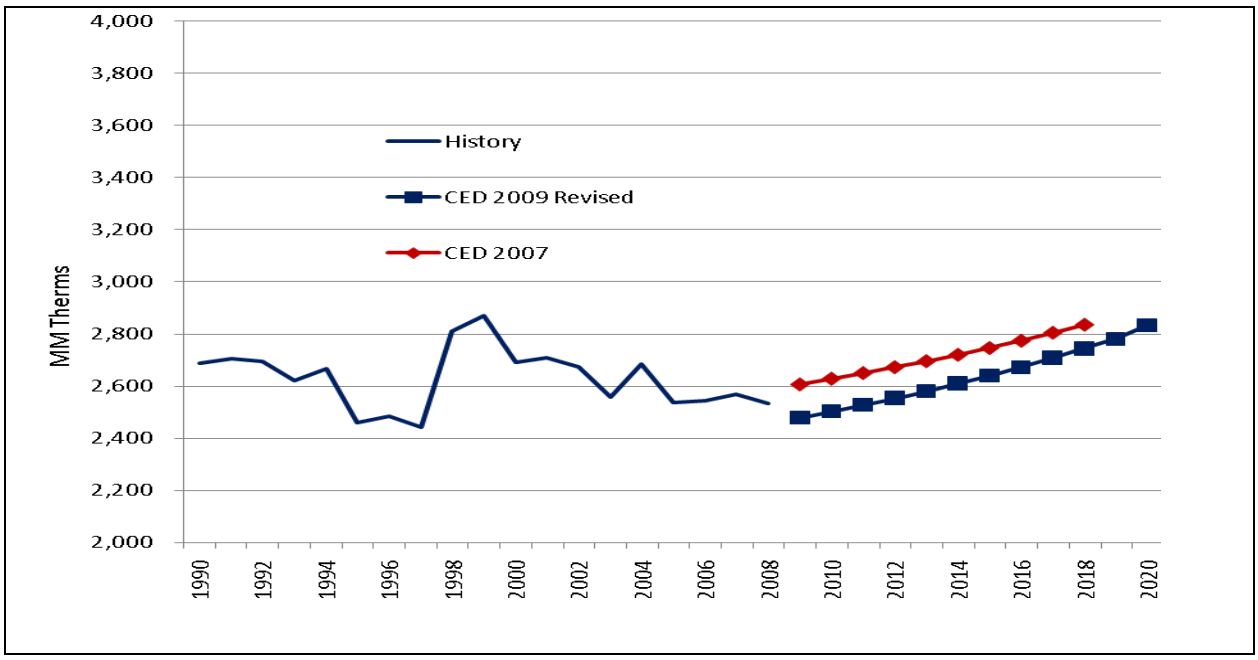
Table 26: SCG Natural Gas Forecast Comparison

	Consumption (MM Therms)		
	CED 2007	*CED 2009 Revised*	Percentage Difference
1990	6,806	6,806	0. 00%
2000	7,938	7,938	0. 00%
2008	7,734	7,491	-3.14%
2010	7,835	7,290	-6.96%
2018	8,083	7,772	-3.85%
Historical values are shaded			
	Annual Average Growth Rates		
1990- 2000	1. 55%	1. 55%	
2000- 2008	-0. 33%	-0. 72%	
2008- 2010	0. 65%	-1. 35%	
2010- 2018	0. 39%	0. 80%	

Source: California Energy Commission, 2009

Figure 150 compares *CED 2009 Revised* and *CED 2007* SCG planning area residential gas forecasts. *CED 2009 Revised* projects a higher rate of growth than the 2007 forecast between 2010 and 2018, so the difference in projected residential consumption is reduced from almost 5 percent in 2010 to just over 3 percent by 2018.

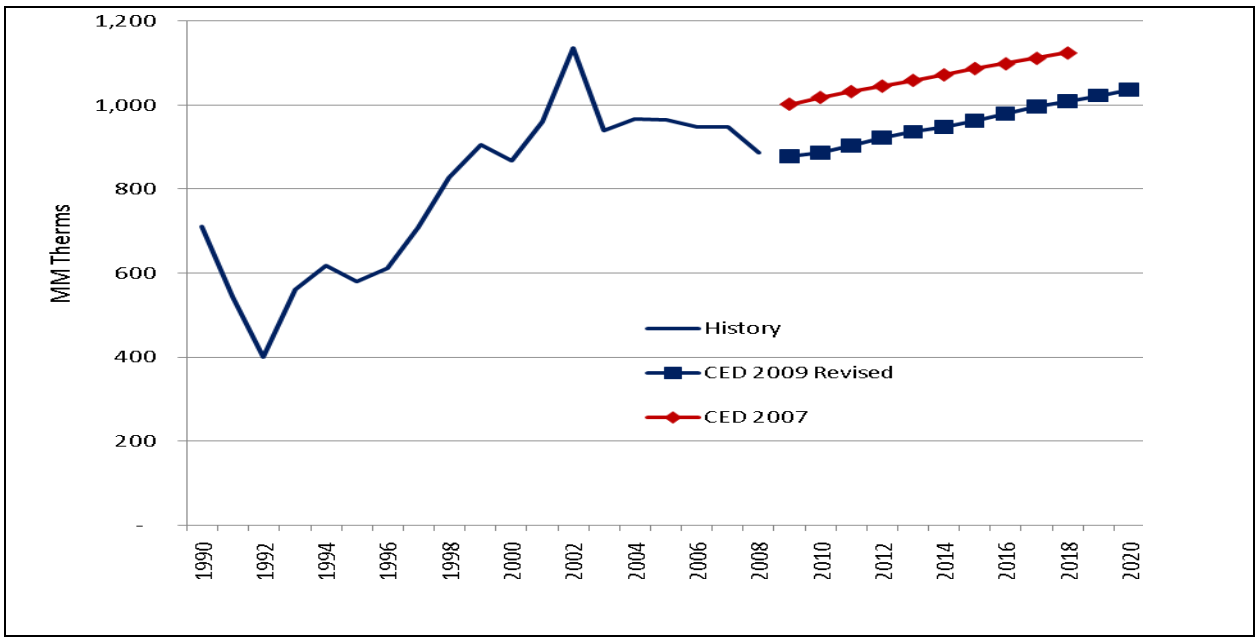
Figure 150: SCG Planning Area Residential Gas Consumption



Source: California Energy Commission, 2009

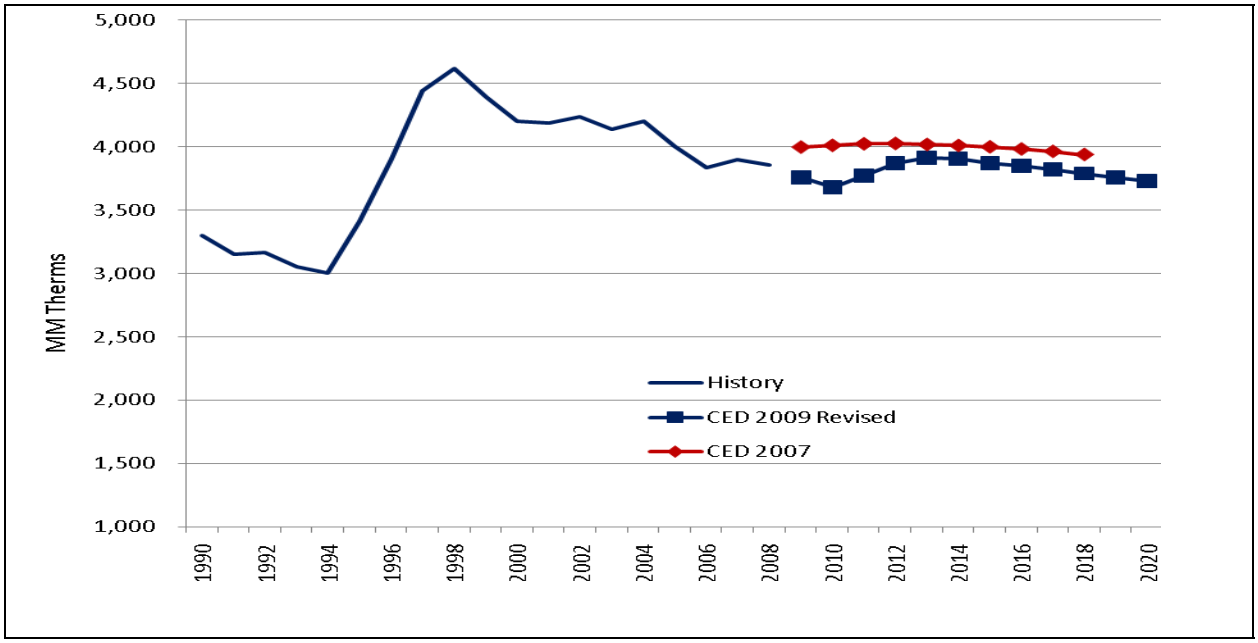
Figures 151 and **152** show the forecasts for the SCG commercial and industrial plus mining sectors compared to *CED 2007*. As in the residential sector, commercial consumption increases at a higher rate than in the 2007 forecast from 2010-2018, so the difference in projected consumption is reduced from around 12 percent in 2010 to just over 10 percent by 2018. The projected economic recovery increases industrial plus mining consumption to just below *CED 2007* level by 2012, although the rate of decline thereafter is slightly higher than in the 2007 forecast.

Figure 151: SCG Planning Area Commercial Gas Consumption



Source: California Energy Commission, 2009

Figure 152: SCG Planning Area Industrial Plus Mining Gas Consumption



Source: California Energy Commission, 2009

San Diego Gas & Electric Planning Area

The SDG&E planning area contains SDG&E customers plus customers of private marketers using the SDG&E natural gas distribution system.

Table 27 compares the revised SDG&E planning area gas forecast with *CED 2007*. As in the other two planning areas, recorded consumption is lower in 2008 than projected in the 2007 forecast, and this difference combined with current economic conditions reduces projected consumption to almost 10 percent below *CED 2007* in 2010. The projected economic recovery leads to a higher growth rate from 2010-2018 than in the 2007 forecast, so the difference in projected consumption falls to 7.5 percent by 2018.

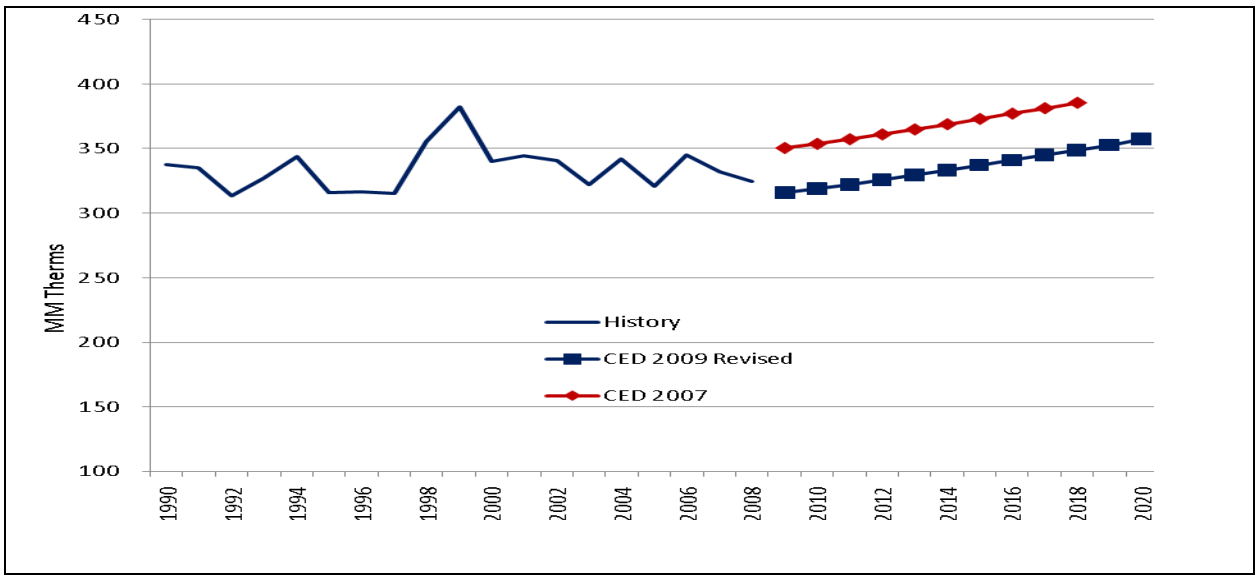
Table 27: SDG&E Natural Gas Forecast Comparison

	Consumption (MM Therms)		
	CED 2007	*CED 2009 Revised*	Percentage Difference
1990	717	717	0. 00%
2000	565	565	0. 00%
2008	573	541	-5.53%
2010	588	531	-9.78%
2018	645	596	-7.49%
Historical values are shaded			
	Annual Average Growth Rates		
1990- 2000	-2. 35%	-2. 35%	
2000- 2008	0.17%	-0. 54%	
2008- 2010	1. 30%	-1. 01%	
2010- 2018	1. 16%	1. 47%	

Source: California Energy Commission, 2009

Figure 153 compares the *CED 2009 Revised* and *CED 2007* SDG&E planning area residential forecasts. The growth rate in *CED 2009 Revised* is slightly higher than in the 2007 forecast, so the difference in projected consumption falls from 9.8 percent in 2010 to 9.5 percent by 2018.

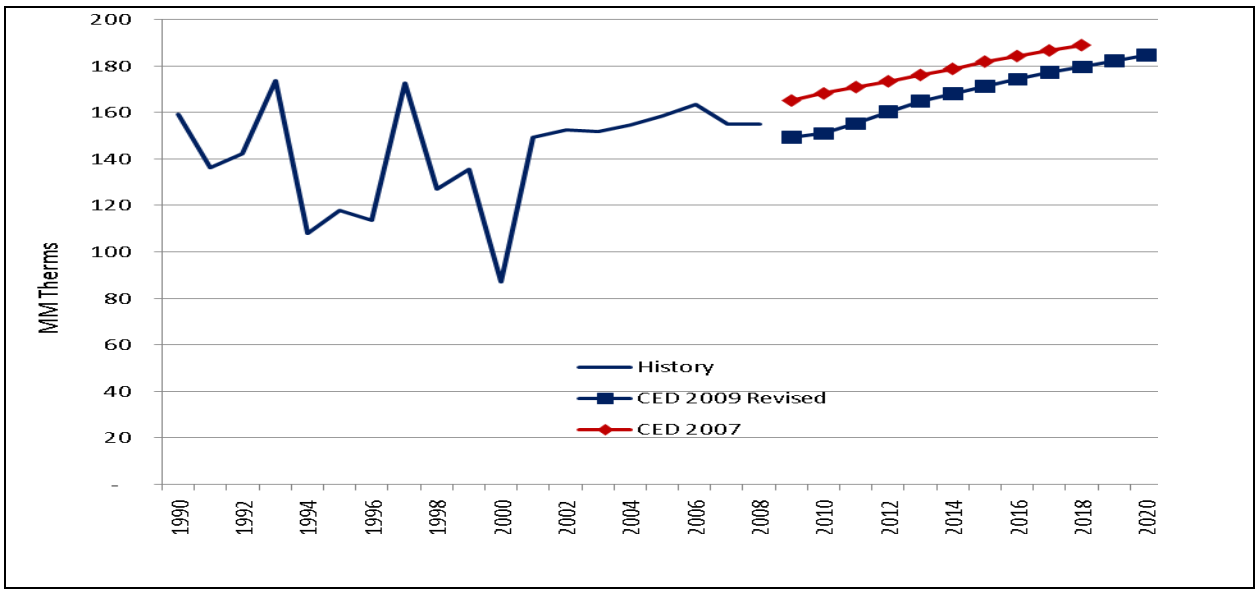
Figure 153: SDG&E Planning Area Residential Gas Consumption



Source: California Energy Commission, 2009

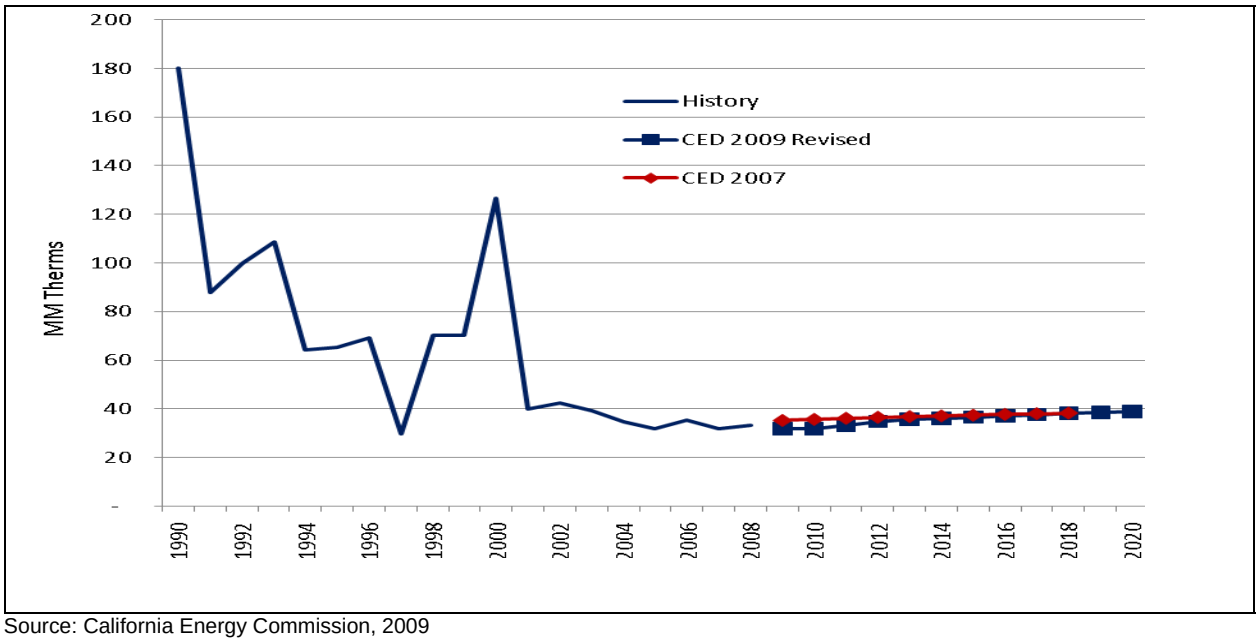
Figures 154 and **155** show *CED 2009 Revised* projections for the SDG&E commercial and industrial plus mining sectors relative to *CED 2007.* Growth is higher for both sectors from 2010-2018 compared to the 2007 forecast. Between 2010 and 2018, the difference in projected commercial consumption between the two forecasts decreases from almost 10 percent to less than 5 percent, while the difference in industrial plus mining consumption falls from around 10 percent to less than 1 percent.

Figure 154: SDG&E Planning Area Commercial Gas Consumption



Source: California Energy Commission, 2009

Figure 155: SDG&E Planning Area Industrial plus Mining Gas Consumption



Source: California Energy Commission, 2009

CHAPTER 8: Energy Efficiency and Conservation

Introduction

With the state's adoption of the first *Energy Action Plan (EAP)* in 2003, energy efficiency became the resource of first choice for meeting the state's future energy needs. Assembly Bill 2021 (Levine, Chapter 734, Statutes of 2006) set a statewide goal of reducing total forecasted electricity consumption by 10 percent over the next 10 years. Under AB 2021, the Energy Commission, in consultation with the CPUC, is responsible for setting annual statewide efficiency potential estimates and targets in a public process every three years using the most recent IOU and publicly owned utility data. These targets, combined with California's greenhouse gas emission reduction goals, make it essential for the Energy Commission to properly account for energy efficiency impacts when forecasting future electricity and natural gas demand.

Utilities and other stakeholders expressed concern during the *2007 IEPR* process about the lack of transparency in staff methods that account for efficiency program impacts in the Energy Commission's demand forecast. In particular, parties asked for clarification of how much uncommitted savings — savings from efficiency programs reasonably expected to occur but not yet implemented or funded — are accounted for in the forecast. Prompted by these concerns, the *2007 IEPR* committed the Energy Commission in 2009 and beyond to examining these methods in a public process that includes the CPUC staff, utilities, and other stakeholders.

To better measure and attribute energy efficiency impacts, staff has undertaken the following steps, as detailed in the *2008 IEPR Update*, during the *2009 IEPR* process:

1. Develop a standardized taxonomy of terms encompassing all major concepts applying to efficiency potential studies and energy demand forecasts.
2. Organize and participate in a stakeholder working group designed to address technical efficiency issues and to develop consistent metrics for efficiency analysis across utilities and various agencies.
3. Review and compare the modeling methods, inputs, and data sources used in Commission forecasts of efficiency savings with the consulting firm Itron's Asset Model. Compare interim savings estimates from the Energy Commission's demand forecast and Asset Model for selected programs given common sets of input and modeling assumptions.
4. Refine and improve the Energy Commission's forecasting models to allow more detailed and complete output of committed efficiency savings. Committed savings are those from efficiency programs that have already been implemented or have been approved and funded.

5. Investigate alternative forecasting methods

6. Develop an uncommitted energy efficiency projection capability.

Step 1 is designed to improve communication between the Energy Commission, the CPUC, energy utilities, and other interested parties on matters related to energy efficiency impacts. This ongoing, effort includes Energy Commission and CPUC staff, as well as input from various utilities.

The stakeholder working group (Step 2) has been meeting since November 2008 and has provided valuable information related to available energy efficiency program data. Step 2, along with progress made in Steps 3 and 4, provides the basis for the committed (funded and/or implemented) energy efficiency program impacts presented below. Step 5 is discussed in the Appendix. Estimation of uncommitted efficiency savings (Step 6) is ongoing, and will be finalized later this year.

Statewide Results

The following summarizes the results presented in this chapter:

- Total projected efficiency/conservation electricity consumption savings reach almost 79,000 GWH by 2020; peak savings reach more than 19,000 MW by 2020.
- The majority of savings comes from building and appliance standards.
- Impacts from utility efficiency programs are responsible for around 20 percent of total savings in 2011.
- Compared to *CED 2007*, IOU efficiency program consumption impacts are projected to be more than five times higher in 2011; publicly owned utility consumption impacts are projected to be around four times higher in 2009.
- Additional residential lighting savings beyond utility program effects are projected to reach around 5,000 GWH in 2020.

Staff estimates the savings in energy demand associated with three sources: committed utility and public agency efficiency programs, building and appliance standards, and *naturally occurring* savings, which are intended to capture the impacts from energy price changes and certain market trends not directly associated with programs or standards. Each of these sources is discussed in the following sections. **Table 28** shows the estimated statewide historical and projected impacts on residential and commercial electricity consumption and peak demand from each source estimated for *CED 2009 Revised*. The *Total Savings* column represents the amount of savings from programs, standards, and naturally occurring savings explicitly accounted for in the demand forecast.

To give some perspective on the impacts of these savings, **Table 28** also shows historical and projected electricity use from *CED 2009 Revised*, as well as historical and projected *unmanaged* use, which refers to use in the absence of these savings impacts. The last column shows the percentage reduction in use attributed to the impacts of the three sources of savings, calculated by dividing total savings by unmanaged use. **Table A-8**, included in the forms posted with this report on the Energy Commission's website, provides detailed results for the five major planning areas.

Table 28: Statewide Electricity Savings by Category

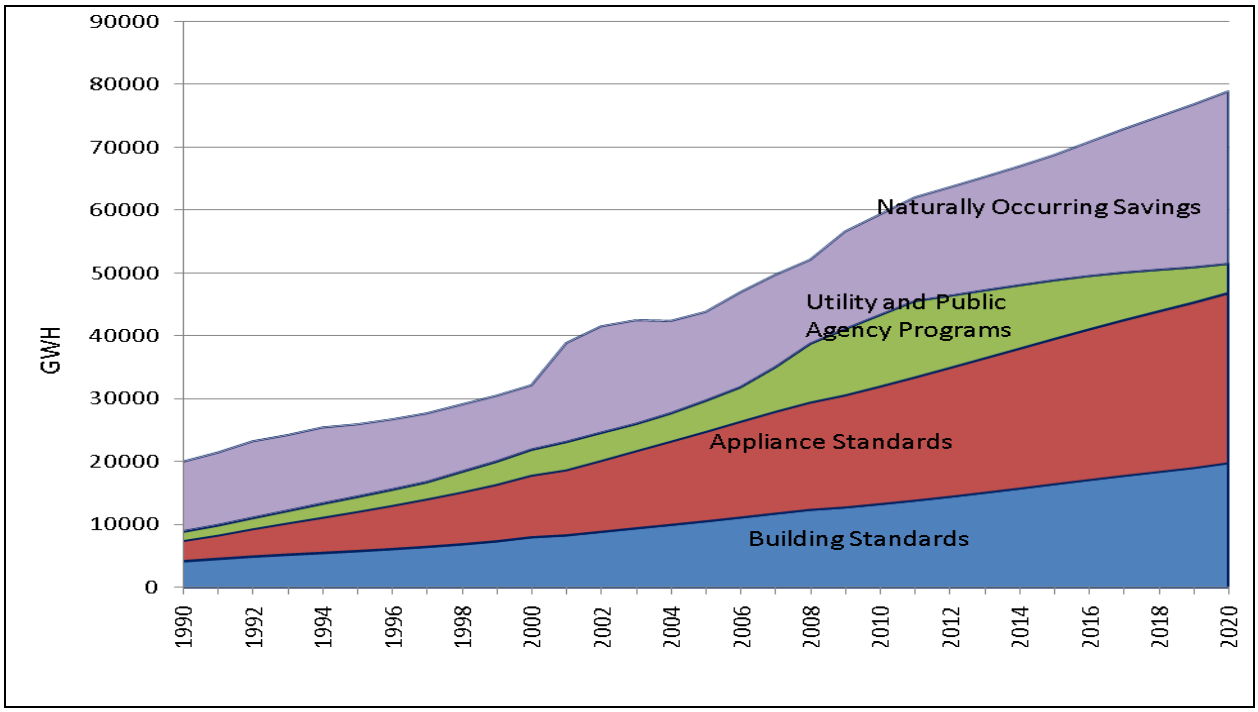
Year	Building and Appliance Standards	Utility and Public Agency Programs	Total Savings-Programs, Standards	Naturally Occurring Savings	Total Savings	Elec. Use *CED 2009 Revised*	Elec. Use 2009 Un-managed Forecast	Percentage Reduction in Use from Savings
Residential plus Commercial* Consumption Impacts (GWH)								
1990	7,411	1,453	8,863	11,085	19,948	228,473	248,421	8.0
1998	15,177	3,267	18,384	10,675	29,059	242,561	271,620	10.7
2003	21,676	4,313	25,989	16,502	42,491	262,094	304,585	14.0
2008	29,419	9,322	38,741	13,380	52,120	285,574	337,694	15.4
2011	33,410	12,116	45,526	16,531	62,057	283,058	345,116	18.0
2015	39,537	9,310	48,847	19,958	68,806	297,770	366,576	18.8
2020	46,838	4,639	51,478	27,480	78,958	311,475	390,433	20.2
Residential plus Commercial* Peak Impacts (MW)								
1990	1,812	358	2,170	2,272	4,442	47,521	51,964	8.5
1998	3,934	806	4,740	2,267	7,007	54,525	61,531	11.4
2003	5,185	996	6,182	3,379	9,561	55,106	64,667	14.8
2008	7,182	2,258	9,440	2,579	12,019	61,682	73,700	16.3
2011	8,520	3,098	11,618	3,318	14,936	63,023	77,959	19.2
2015	10,145	2,429	12,574	4,104	16,679	66,475	83,153	20.1
2020	12,099	1,175	13,274	5,923	19,197	70,387	89,584	21.4

Source: California Energy Commission, 2009
*Commercial also includes agricultural program savings.

Figure 156 shows the distribution of savings by source from 1990-2020, with building and appliance standards broken out separately. Staff tracks historical impacts back to 1975, so naturally occurring savings in 1990 includes the impacts from rate increases in the 1970s and 1980s. Similarly, the entries for 1990 building and appliance standards include accumulated savings from standards implemented before 1990. Naturally occurring savings increase significantly from 2001-2004 because of substantial rate increases in the IOU planning areas, mainly in the commercial sector. From 2010 on, this category increases once again as a result of rate increases assumed in *CED 2009 Revised* and lighting savings, as discussed later in the chapter. Savings from building and appliance standards together make up the largest share of the total from 1995 on. Utility and public agency program savings reach a maximum share of almost 20 percent of consumption in 2011, the end of the current three-year CPUC

program cycle. Beyond 2011, program savings decline since *CED 2009 Revised* incorporates only committed impacts.

Figure 156: Distribution of Efficiency/Conservation Consumption Savings by Source

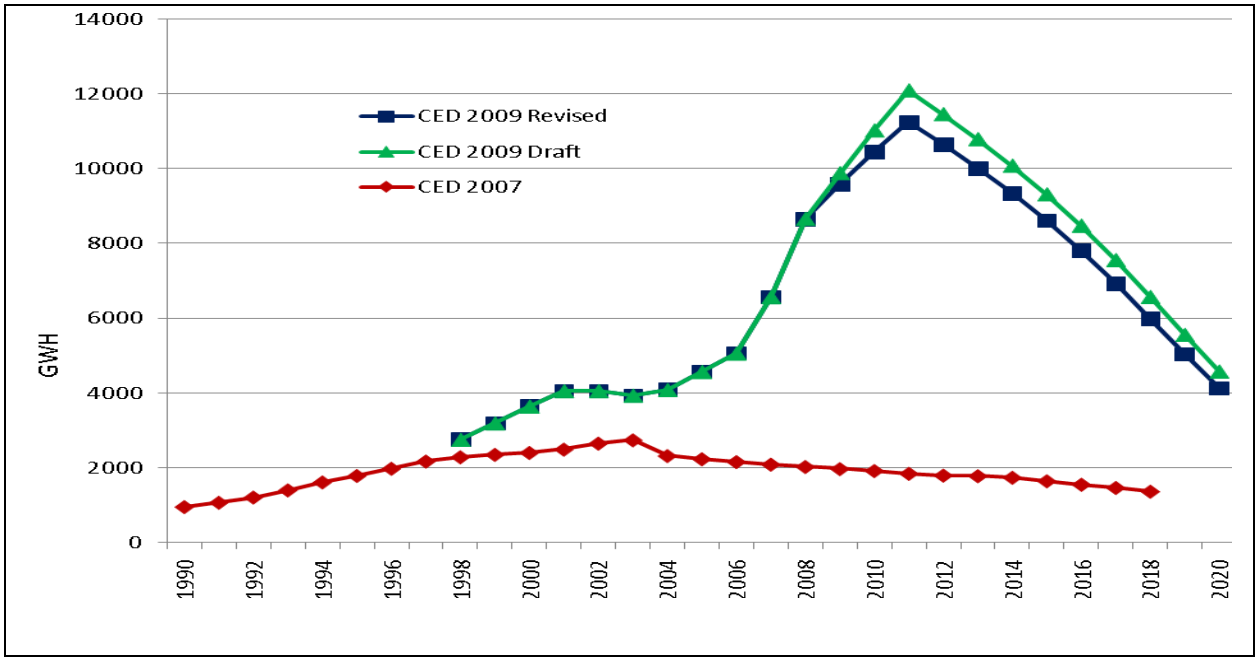


Source: California Energy Commission, 2009

Utility and Public Agency Programs

The main focus of the effort by staff since the *2007 IEPR* process has been to revise and update estimates of the impacts of utility programs on electricity demand. With the help of the CPUC and the consulting firm Itron, staff set out to re-estimate the historical electricity savings from utility programs as well as to measure the impacts of the 2009-2011 program plans, with the idea of estimating program impacts not previously incorporated in Energy Commission forecasts. **Figure 157** shows the results of this analysis for IOUs for the draft and revised forecasts compared to *CED 2007*. The *CED 2009 Revised* forecast estimates are lower than in *CED 2009 Draft* beginning in 2009 because staff assumed a lower realization rate for 2009-11 IOU efficiency programs, as discussed later in this chapter.

Figure 157: Comparison of Committed Utility Program Consumption Impacts for IOUs

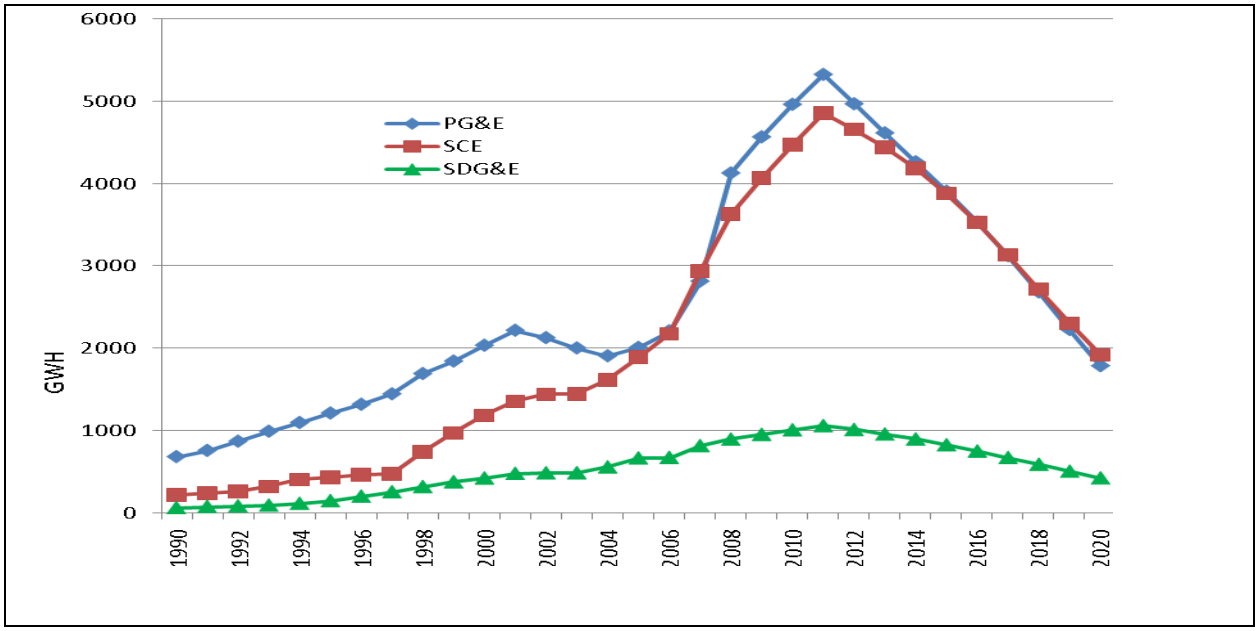


Source: California Energy Commission, 2009

The main difference between impacts in the revised (and draft) forecast and *CED 2007* occurs in 2008 and beyond, particularly during the 2009-11 program period, which was not included in the 2007 forecast as the programs were not considered committed. Staff updated program impacts beginning in 1998; the savings estimates from *CED 2007* are used for the 1990-1997 period. Further savings from possible future programs are not considered since the forecast incorporates only committed programs. Additional savings potential will be examined in staff's uncommitted efficiency savings forecast.

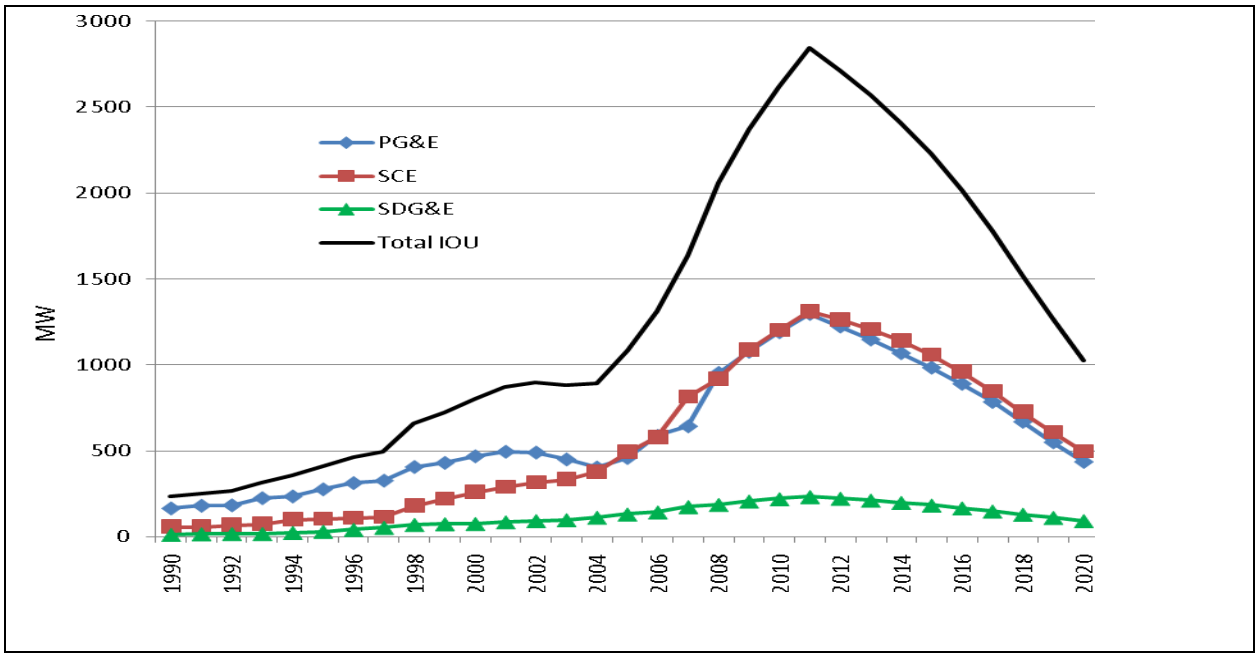
Figure 158 shows the impacts on electricity consumption from utility programs by IOU. The impact of IOU utility programs reaches a maximum in 2011 and then declines as measure savings decay. **Figure 159** provides corresponding peak load impacts and includes the total for the IOUs. **Table 29** breaks out the IOU program consumption impacts by sector.

Figure 158: Estimated Cumulative Consumption Impacts from Utility Programs by IOU



Source: California Energy Commission, 2009

Figure 159: Estimated Cumulative Peak Impacts from IOU Programs



Source: California Energy Commission, 2009

Table 29: Estimated IOU Cumulative Program Impacts by Sector

	Consumption Impacts (GWh)				Peak Impacts (MW)			
	Resid.	Commer.	Agricult.	Total	Resid.	Commer.	Agricult.	Total
1990	849	110	0	959	211	23	0	234
1998	1,253	1,499	0	2,751	340	316	0	656
2003	1,755	2,178	0	3,933	437	445	0	882
2008	5,426	3,080	155	8,661	1,454	577	29	2,060
2011	7,306	3,589	356	11,251	2,070	710	65	2,845
2015	5,731	2,589	356	8,617	1,659	504	64	2,228
2020	2,148	1,628	353	4,129	635	327	63	1,026

Source: California Energy Commission, 2009

Staff emphasizes that the IOU 2009-2011 program plans are still under review by the CPUC and, thus, may be modified to some degree. It is also possible that the CPUC program cycle may be shifted to 2010-2012, given the delay in program approval.

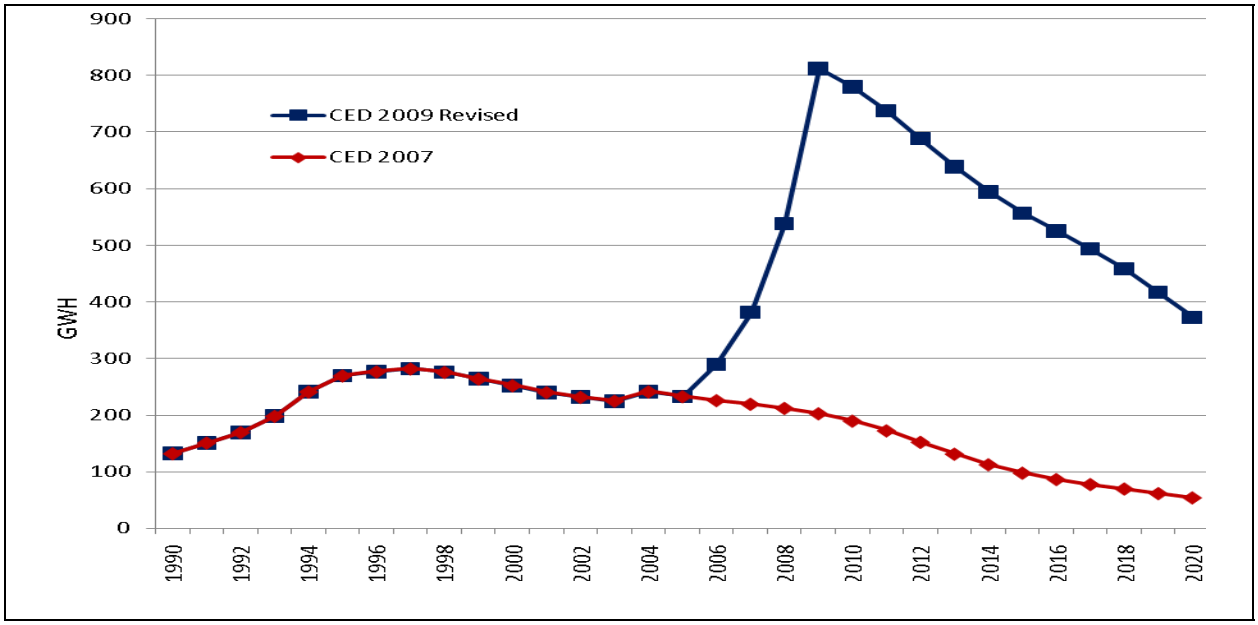
The *CED 2009 Revised* forecast includes updated efficiency program impacts for the publicly owned utilities, based on reported and estimated savings for 2006-2009 filed per the requirements of Senate Bill 1037 (Kehoe, Chapter 366, Statutes of 2005). Assumptions for realization rates, expected useful life of measures, and net-to-gross impacts were similar to those used for the IOUs, as discussed in the next section.

Figure 160 provides a comparison of cumulative publicly owned utility program impacts estimated for the *CED 2009 Revised* forecast with *CED 2007* estimates.[18] The impacts begin to decline beyond 2009, as potential future year new efficiency savings are not considered committed.[19] **Table 30** shows estimated cumulative program impacts by sector.

[18] The *CED 2009 Draft* forecast used *CED 2007* estimates.

[19] Publicly owned utility efficiency goals extend out to 2016, but no specific program plans are available beyond 2009.

Figure 160: Estimated Efficiency Program Cumulative Impacts for Publicly Owned Utilities



Source: California Energy Commission, 2009

Table 30: Estimated Publicly Owned Utility Cumulative Program Impacts by Sector

	Consumption Impacts (GWh)			Peak Impacts (MW)		
	Residential	Commercial	Total	Residential	Commercial	Total
1990	132	1	132	41	0	41
1998	221	55	276	73	13	85
2003	170	56	225	56	13	69
2006	214	76	290	90	14	104
2009	490	322	812	153	79	232
2015	358	199	557	108	49	157
2020	204	169	373	63	41	105

Source: California Energy Commission, 2009

Method

To develop efficiency program impacts, staff, with the support of Itron, reviewed data associated with historical, current, and near-term energy efficiency programs as reported to the CPUC and the Energy Commission. To estimate verified cumulative program savings by end use for each year, staff and Itron took the following steps:

- Collected reliable data for first-year efficiency program impacts in a disaggregated form such that gross GWh impacts could be attributed to categories that align with Energy Commission end-use models. In the program years where only highly aggregate data was available for the IOUs (1998-2002), allocations were made for residential and commercial programs to specific end-use categories using distributions from the 2003 data. Industrial and agricultural program savings were not separated; models for these sectors do not operate at the end-use level.
- Applied net-to-gross (NTG) ratios to estimate net GWh impacts by end use category. This adjustment is intended to account for free ridership; that is, to account for measure adoptions that would have occurred without any utility program.
- Applied realization rates to adjust for *real world* effects. Although staff assumes that the utilities' estimates of their own portfolio performance are consistent with all relevant mandates, additional data sources such as evaluation, measurement, and verification (EM&V) reports suggest that the reported impacts are typically higher than the realized impacts. This occurs for various reasons including measures purchased and not installed and lower actual savings per measure than anticipated. EM&V data yielded estimates of realized savings.
- Estimated residual impacts for measures beyond the installation year. As is common practice, staff assumed a logistic decay of measure savings, so that 50 percent of installations remain in operation at the end of the estimated expected useful life (EUL). The logistic function models decay in such a way that installations are taken out of service at a rapid rate shortly before and after reaching the EUL.

Table 31 summarizes the data inputs and assumptions made in this process for the IOUs. The realization rate of 70 percent, applied throughout, derives from CPUC Energy Division recommendations for *ex-post* adjustment of program savings. [20] For *CED 2009 Draft*, the rate was assumed to increase from 70 to 85 percent for the IOUs in the 2009-11 program cycle, consistent with expectations of more efficient delivery mechanisms. However, in the *CED 2009 Revised* forecast, no increase was assumed for this period, as staff felt that realization rates should be based on empirical evidence, which consistently shows rates of around 60-70 percent. Staff will re-evaluate realization rates in the *2011 IEPR* cycle if there is evidence of improved delivery in 2009 and 2010.

Publicly owned utility savings impacts were based on reported and estimated savings for 2006-2009 filed with the Energy Commission per the requirements of Senate Bill 1037. Staff applied the assumed IOU realization rate and expected useful life and decay by end use to publicly owned utility reported savings. Net to gross ratios were assumed to be 80 percent.

[20] CPUC Energy Division, *Energy Efficiency 2006-2007 Verification Report*, November, 2008. Energy Division staff recommended adjustment (realization) rates from 60 to 80 percent, depending on the utility.

The appendix to this report provides more details on assumptions and includes first-year reported program impacts.

Table 31: Data Sources and Assumptions for IOU Efficiency Program Impacts

Program Year	1998-2002	2003-2007	2008	2009-2011
Program Accomplishments	IOU Annual Reports	Monthly and Quarterly IOU Reports—Processed by Itron	IOU Quarterly Reports	March 2009 IOU Filings
Level of Disaggregation	Sector (residential, commercial, etc.)	End Use Category for Residential and Commercial	Measure	End Use Category for Residential and Commercial
Attribution to End Use	Applied 2003 Distribution for Residential and Commercial	Residential and Commercial—Provided by Itron	By Measure Description	IOU Projections
Net-to-Gross Ratios	Assumed 80 Percent	Provided by Itron	From IOU Workbooks	Assumed 80 Percent
Realization Rates	Assumed 70 Percent			
Expected Useful Life of Measures	Averages determined for each end use category based on 2006 – 2008 program workbook data			
Decay of Measures	Logistic decay of *realized* savings – 100 percent first year, 50 percent at the end of expected useful life			

Source: California Energy Commission, 2009

Following Steps 1-4, and using the assumptions given above, staff developed estimates of cumulative realized savings for each year–that is, savings adjusted by net-to-gross ratios and realization rates. **Table 32** shows these estimates for selected years by end use/sector for the IOUs, and **Table 33** provides the same information for the publicly owned utilities.

Once cumulative realized program savings were developed for each year, staff determined whether these savings actually represented reductions in consumption or could be considered overlapping with savings impacts already incorporated in the model through building and appliance standards or some other source of savings. This step eliminated commercial (non-CFL) lighting, considered redundant with existing lighting standards, and industrial program savings, assumed to overlap with savings attributable to *natural* competitive market forces in this sector. [21]

[21] The effects of reduced energy intensity for industrial processes caused by market competition dwarf the impacts of industrial programs.

Table 32: Estimated IOU Accumulated Program Savings (GWh)

Sector	End Use	1998	2002	2006	2011	2015	2020
Residential	Heating, Ventilation, Air Conditioning*	11	65	119	280	243	130
	Compact Fluorescent Lighting	53	303	1,632	4,842	3,840	1,057
	Other Residential Lighting	10	56	245	673	653	538
	New Construction	9	49	63	64	62	39
	Pool Pumps	7	42	63	47	20	2
	Refrigerator Recycling	62	358	492	695	477	180
	Other Refrigerator	0	0	6	101	89	18
	Water Heating	2	13	25	57	49	29
	Misc. /Non-descriptive	0	0	6	293	110	4
	Accumulated from Pre-1998**	396	275	39	1	0	0
	Total Residential	550	1,162	2,691	7,054	5,543	1,998
Commercial	Heating, Ventilation, Air Conditioning*	33	143	300	1,215	1,143	949
	Compact Fluorescent Lighting	138	352	332	756	95	3
	Other Commercial Lighting	121	521	1,052	2,371	1,965	1,005
	New Construction	162	694	860	882	856	514
	Refrigeration	26	97	175	369	119	5
	Water Heating	0	0	1	1	1	0
	Misc. /Non-descriptive	84	287	195	364	315	157
	Accumulated from Pre-1998**	1,056	734	103	3	0	0
	Total Commercial	1,620	2,828	3,017	5,959	4,494	2,634
Industrial	--	0	0	86	1,251	1,249	1,183
Agricultural	--	0	0	7	356	356	353
Grand Total	--	2,170	3,991	5,801	14,620	11,642	6,167

Source: California Energy Commission, 2009
* Includes building shell measures
** Represents continuing savings from 1997 and previous years from measures not yet decayed.

For those program impacts determined to correspond to load reductions, staff incorporated these effects in *CED 2009 Revised* either through *post-processing* (subtracting estimated impacts from model output) or by integrating estimated savings directly into the model through changes in inputs. **Table 33** summarizes the treatment by end use/sector. **Figure 161** shows the effects of these treatments for the IOUs, starting with the total realized program savings given in **Table 32**. **Figure 162** shows the effects for publicly owned utilities, starting with the estimates shown in **Table 33**.

Table 33: Estimated Publicly Owned Utility Accumulated Program Savings (GWh)

Sector	End Use	2006	2008	2009	2011	2015	2020
Residential	Heating, Ventilation, Air Conditioning*	8	34	61	61	60	36
	Lighting	29	111	180	180	177	141
	New Construction	0	2	6	6	6	6
	Pool Pumps	1	3	7	6	6	2
	Refrigerator Recycling	3	31	66	65	59	15
	Water Heating	0	1	2	2	2	2
	Misc. /Non-descriptive	0	6	18	14	3	0
	Accumulated from Pre-2006**	171	157	147	117	43	0
	Total Residential	213	345	487	453	355	202
Commercial	Heating, Ventilation, Air Conditioning*	10	36	57	57	56	49
	Lighting	25	104	180	160	134	65
	New Construction	2	26	58	58	58	58
	Refrigeration	1	5	10	9	3	0
	Misc. /Non-descriptive	8	47	97	78	24	7
	Accumulated from Pre-2006**	56	56	56	56	56	55
	Total Commercial	100	274	458	418	330	234
Grand Total	--	313	619	945	871	686	436

Source: California Energy Commission, 2009
* Includes building shell measures
** Represents continuing savings from 1997 and previous years from measures not yet decayed.

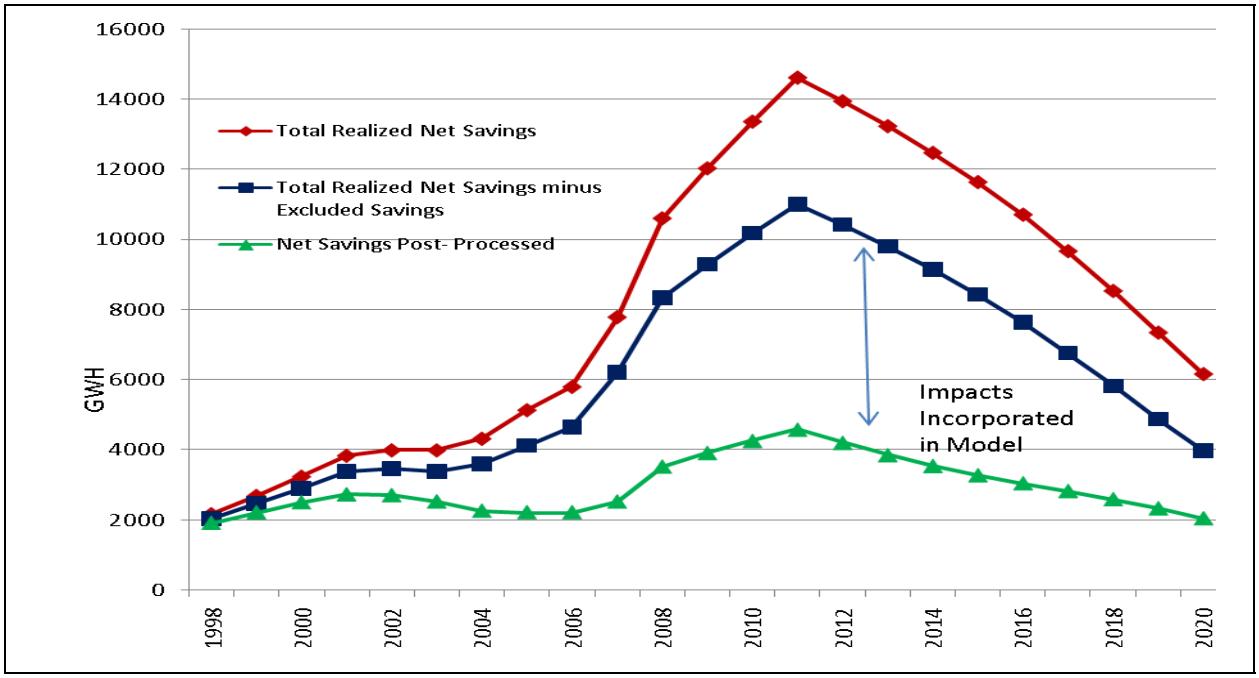
For years prior to 1998 (IOUs) and 2006 (publicly owned utilities), staff used the same Energy Commission estimates for historical efficiency program impacts as in *CED 2007*. For the later years, staff added the pre-1998 and pre-2006 historical impacts not yet fully decayed to the estimates represented by the curves labeled *Total Realized Net Savings Less Excluded Savings* in **Figure 161** and **Figure 162** to give the totals for *CED 2009 Revised* shown in **Figure 158** and **Figure 160**, respectively. **Figure 161** and **Figure 162** also show the savings incorporated directly in the forecasting models, as indicated in **Table 34**, represented by the vertical distance between the *Total Realized Net Savings Less Excluded Savings* and *Net Savings Post-Processed* curves.

Table 34: Treatment of IOU Program Savings by End Use/Sector

Sector	End Use	Treatment
Residential	Heating, Ventilation, Air Conditioning*	Subtracted from model output
	Compact Fluorescent Lighting	Incorporated in model
	Other Residential Lighting	Subtracted from model output
	New Construction	Subtracted from model output
	Pool Pumps	Incorporated in model
	Refrigerator Recycling	Incorporated in model
	Other Refrigerator	Subtracted from model output
	Water Heating	Subtracted from model output
	Misc. /Non-descriptive	Subtracted from model output
	Accumulated from Pre-1998**	Subtracted from model output
Commercial	Heating, Ventilation, Air Conditioning*	Subtracted from model output
	Compact Fluorescent Lighting	Subtracted from model output
	Other Commercial Lighting	Excluded
	New Construction	Subtracted from model output
	Refrigeration	Subtracted from model output
	Water Heating	Subtracted from model output
	Misc. /Non-descriptive	Subtracted from model output
	Accumulated from Pre-1998**	Subtracted from model output
Industrial	--	Excluded
Agricultural	--	Subtracted from model output

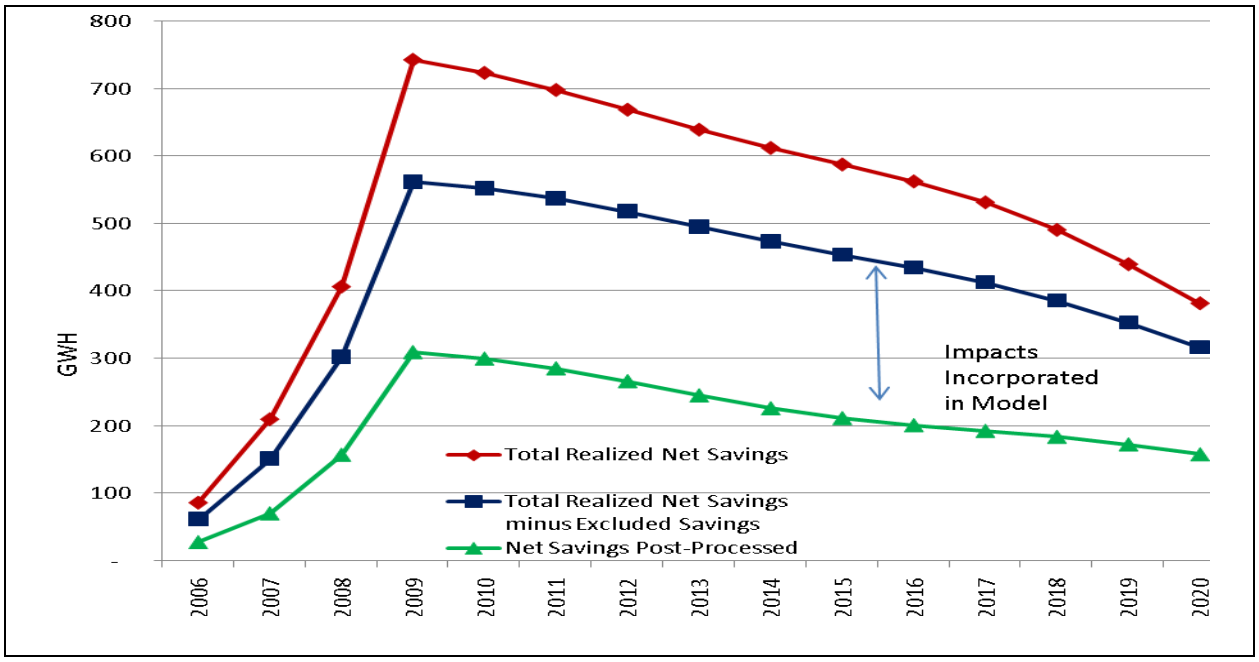
Source: California Energy Commission, 2009
* Includes building shell measures.
** Represents continuing savings from 1997 and previous years from measures not yet fully decayed.

Figure 161: Estimated Historical and Projected IOU Program Savings and Consumption Impacts (GWh)



Source: California Energy Commission, 2009

Figure 162: Estimated Historical and Projected Publicly Owned Utility Program Savings and Consumption Impacts (GWh)



Source: California Energy Commission, 2009

Building and Appliance Standards

Energy Commission forecasting models incorporate building and appliance standards through changes in inputs: estimated end use consumption per household in the residential sector and end-use consumption per square foot in the commercial sector. **Table 35** shows the standards currently included in the *CED 2009 Revised* forecast by sector.

To measure the impact of each set of standards, staff removed the input effect from standards one set at a time, beginning with the most recent standards, and calculated savings as the difference in energy demand output between model runs with the set of standards incorporated and without. For example, for the commercial sector, staff began by running the Commercial Model with all sets of standards included and then ran the model excluding changes in inputs associated with the *2005 Title 24 Nonresidential Building Standards* (the most recent standards). The difference in output between the two model runs gives an estimate of the electricity savings associated with the 2005 standards. Next, staff removed the input changes associated with the next-most recent set of standards, the *2004 Title 20 Equipment Standards*, and compared the results from model runs without the 2005 standards and without both the 2005 and 2004 standards, which provided an estimate of the impact of the 2004 standards. The process was repeated until all sets of standards had been "removed" from the model.

Table 35: Building and Appliance Standards Incorporated in the CED 2009 Forecast

Residential Model	
1975 HCD Building Standards 1978 Title 24 Residential Building Standards 1983 Title 24 Residential Building Standards 1991 Title 24 Residential Building Standards 2005 Title 24 Residential Building Standards	1976-82 Title 20 Appliance Standards 1988 Federal Appliance Standards 1990 Federal Appliance Standards 1992 Federal Appliance Standards 2002 Refrigerator Standards
Commercial Model	
1978 Title 24 Nonresidential Building Standards 1978 Title 20 Equipment Standards 1984 Title 24 Nonresidential Building Standards 1984 Title 20 Nonres. Equipment Standards 1985-88 Title 24 Nonresidential Building Standards	1992 Title 24 Nonresidential Building Standards 1998 Title 24 Nonresidential Building Standards 2001 Title 24 Nonresidential Building Standards 2004 Title 20 Equipment Standards 2005 Title 24 Nonresidential Building Standards

Source: California Energy Commission, 2009

Naturally Occurring Savings

Staff estimates of naturally occurring savings are meant to capture load impacts of rate changes, certain market trends, and other changes in consumption not directly associated with standards or efficiency programs. For the *CED 2009 Revised* forecast, staff included impacts from historical and projected rate changes, referred to as *price effects*, and expected reductions in average lighting use. There are certainly other consumption trends leading to reduced energy that could be included in this category,[22] but staff focused on those savings that potentially overlap with programs and standards. Rate increases provide a greater incentive to participate in utility programs and help improve standards compliance rates. Therefore, at least some price impacts could be attributed to programs and standards; for example, a rate increase could yield savings beyond what would otherwise occur because of the availability of program measures. [23] Utility programs currently tend to emphasize lighting measures, so naturally occurring savings from lighting assumed in this forecast could overlap with program impacts.

Lighting Savings

For the *CED 2009 Revised* forecast, residential lighting was broken out as a separate end use to better capture the impacts of residential lighting efficiency programs. The Appendix provides details on this process and on estimated average lighting use per household. The focus of utility programs and state and federal legislation related to lighting led staff to assume some additional residential[24] savings for this end use, incorporated in the Residential Model.

No direct IOU lighting programs impacts were assumed beyond 2011, the end of the current three-year program cycle. Similarly, no lighting impacts were assumed for publicly owned utilities beyond 2009. However, staff assumed average lighting per household would remain at 2011 levels in the IOU planning areas and at 2009 levels for the publicly owned utilities without incentives through the rest of the forecast period. The difference between the 2009 or 2011 average and an increasing average that would have occurred as utility impacts decayed was assigned to naturally occurring savings. Admittedly these are somewhat crude estimates, but staff felt that it was unrealistic to assume no continued

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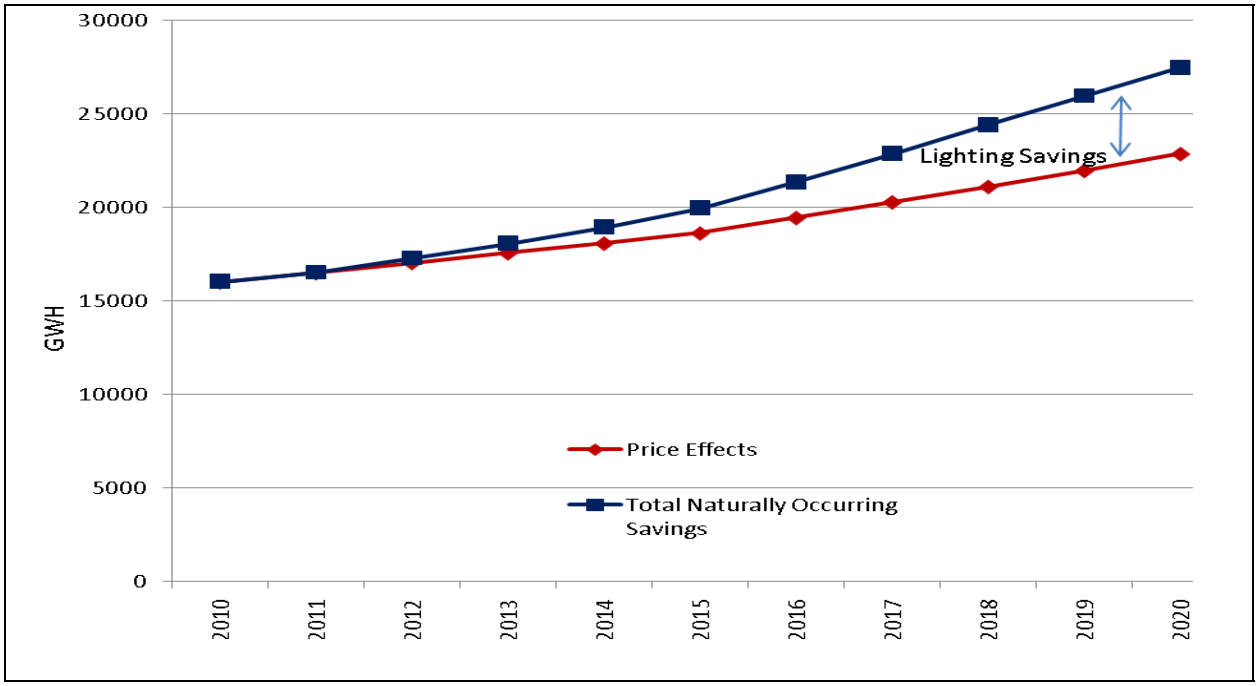
[22] Although not included in naturally occurring savings, other trends are accounted for in the forecast. For example, personal computers have become more efficient in recent years for technological/competitive reasons, and savings associated with this trend are captured through model inputs and calibration to actual consumption.

[23] A utility customer, faced with a rate increase, could reduce electricity usage by switching to incandescent light bulbs with a lower wattage. However, if the utility is offering incentives for CFL bulbs, the incentive might be enough that the customer instead begins to use CFLs and saves even more energy.

[24] Staff assumed that savings in the commercial sector would be covered by lighting standards incorporated in the Commercial Model.

lighting savings beyond utility programs. These numbers are meant to provide a placeholder for further refinement in the uncommitted forecast. **Figure 163** shows the statewide savings associated with these assumptions relative to price effects and total naturally occurring savings.

Figure 163: Statewide Naturally Occurring Savings, Price Effects, and Additional Residential Lighting Savings



Source: California Energy Commission, 2009

Uncommitted Energy Efficiency Forecast

Clearly defining and measuring the conservation impacts incorporated in the *CED 2009 Revised* forecast are necessary steps in developing the uncommitted forecast to be used for CPUC long-term procurement. Staff and Itron will use *CED 2009 Revised* as a starting point for the uncommitted forecast and estimate the *incremental* impacts from future efficiency programs and standards reasonably expected to occur but not yet committed. The *2009 IEPR* workshop scheduled for September 21, 2009, will include an update on work done so far for the uncommitted forecast.

APPENDIX: *CED 2009 Revised* Supporting Documentation

This Appendix provides additional details on work related to the *California Energy Demand 2010-2020 Staff Revised Forecast* (*CED 2009 Revised*). The following sections include information on the economic scenarios, the impact of climate change on electricity peak demand, model performance relative to historical electricity use, residential lighting, self-generation, utility efficiency program impacts, and an ongoing evaluation of staff modeling methods and alternative forecasting approaches. Forms posted with this report on the Energy Commission's website provide additional detail on model inputs and forecast results.

Economic Scenarios

Staff examined the impacts of two alternative economic scenarios for California electricity demand: an *optimistic* case provided by IHS Global Insight and a *pessimistic* case provided by Moody's Economy.com. The scenarios include changes for a host of variables, including total employment and employment by economic sector (for example, retail), gross state product and output by sector, personal income, and average household size.[25]

In general, the two cases project the highest and the lowest rates of economic growth for California among the various scenarios provided by each of the two companies. The Global Insight optimistic case includes the following characteristics:

- The federal stimulus package has significant impact in the near term, producing growth in gross domestic product (GDP) of more than 3 percent in the third quarter of 2009.
- GDP rises by 3.5 percent in 2010.
- The unemployment rate nationwide peaks at less than 10 percent and falls to less than 7 percent by 2014.
- Business fixed investment rebounds to increase by 6.5 percent in 2010 after suffering a severe contraction in 2009.

The pessimistic case, referred to by Economy.com as *aborted recovery*, incorporates the following assumptions:

- Consumer demand growth remains relatively weak.
- Unemployment rises higher than in the baseline case and remains above 10 percent from the beginning of 2010 through the end of 2011.

[25] The scenarios assume no change in total population, only in number of households.

- Real GDP growth averages 1 percent per year lower than in the baseline case over the next five years.

The state forms posted with this report on the Energy Commission's website show the differences in California for various projected economic and demographic variables among the scenarios.

For this analysis, staff developed econometric models for the three largest sectors (residential, commercial, and industrial plus mining) at the planning area level, using historical data for electricity consumption, electricity rates, weather, and various economic and demographic variables. **Table A-1** shows the predicted and explanatory variables used for each sector.

Table A-1: Variables Used for Econometric Models by Sector

Sector	Predicted (dependent) Variable	Explanatory Variables
Residential	Electricity Consumption per Household	Average Household Income, Unemployment Rate, Average Persons per Household, Cooling Degree Days, Heating Degree Days, Percentage of Single-Family Homes out of Total Homes, Residential Electricity Rate
Commercial	Total Commercial Electricity Consumption	Total Commercial Floor Space, Total Employment, Percent of Floor Space Refrigerated, Cooling Degree Days, Commercial Electricity Rate
Industrial (plus mining)	Industrial Energy Use per Dollar of Output	Ratio of Manufacturing Employment to Total Industrial Employment, Ratio of High Tech Employment to Total Manufacturing Employment, Industrial Electricity Rate, Trend

Source: California Energy Commission, 2009

Table A-1 lists the final explanatory variables included in the regressions; many other variables were tested. Regressions included cross sections of the eight planning areas for 29 years (1980-2008), accounting for correlation among planning areas and over time (autocorrelation). Electricity consumption for the remaining sectors was held constant (*CED 2009 Revised* levels) in the alternative scenarios. Full estimation results are available upon request.

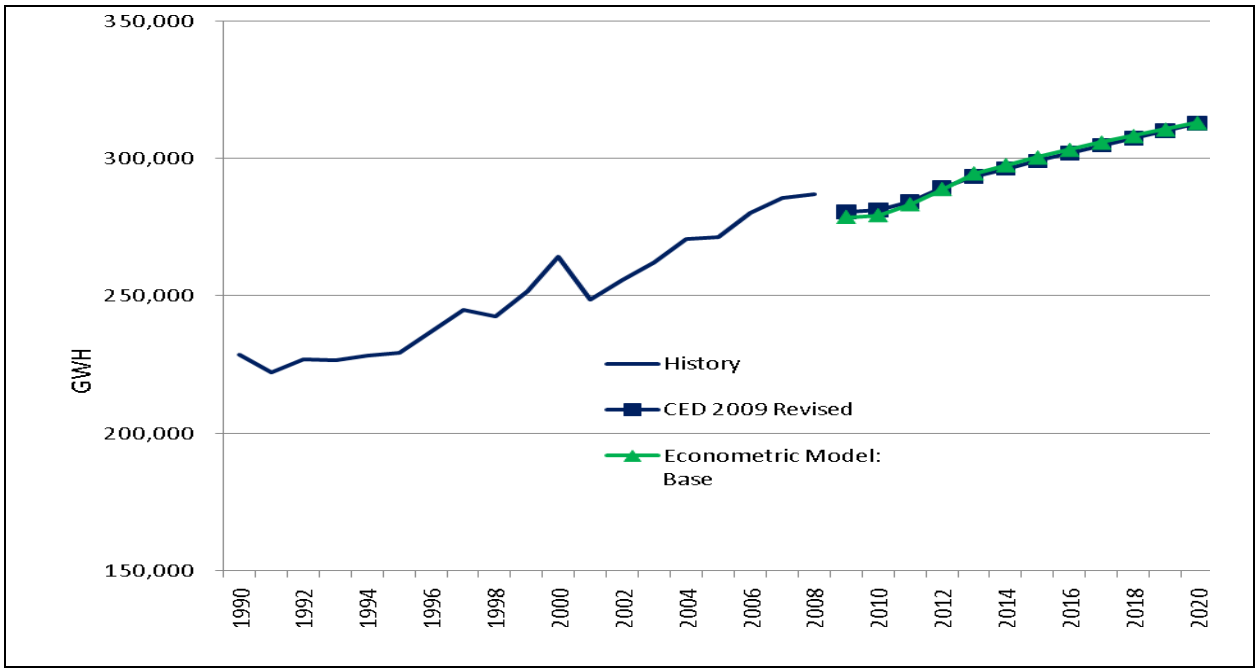
Residential electricity consumption was forecast by multiplying predicted consumption per household by projected number of households for each planning area. Average persons per household is projected to increase and total number of households decrease in the pessimistic scenario, the typical case during an economic downturn. The opposite is true in the optimistic case.

For the commercial scenarios, the impact (coefficient) of commercial floor space on electricity consumption was adjusted downward over the forecast period to account for increasing floor space efficiency as a result of building and appliance standards and utility efficiency programs. In addition, the coefficient for the commercial electricity rate was adjusted to match the elasticity of demand relative to price assumed in the Commercial Model.

Industrial electricity consumption is heavily influenced by processes and efficiencies that have led to a marked decline in energy use per dollar of output over the last 30 years, factors beyond the scope of a relatively simple econometric model. Instead, staff took the historical and projected (by the Energy Commission's Industrial Model) trend in consumption per output dollar as given and estimated the impact of the composition of industry by planning area, which differs by economic scenario, and average industrial electricity rate on this trend. To forecast industrial electricity use for each scenario, predicted energy consumption per dollar of output was multiplied by projected industrial output.

Figure A-1 shows a comparison of forecast statewide electricity consumption using the estimated econometric models with *CED 2009 Revised*, assuming the same economic/demographic inputs. The two forecasts match quite closely between 2009 and 2020, with a difference of less than 0.1 percent at the end of the forecast period. Among the five major planning areas, the largest difference between the base econometric forecast and *CED 2009 Revised* in 2020 was less than 1 percent.

Figure A-1: Comparison of *CED 2009 Revised* With Econometric Forecast



Source: California Energy Commission, 2009

The estimated models were run for the two economic scenarios and for the Economy.com base case. The resulting percentage differences in electricity consumption between the two alternative scenarios and the base case were applied to *CED 2009 Revised* consumption projections. Peak demand for each planning area was developed by applying projected load factors from *CED 2009 Revised* at the planning area and sector level to the consumption results for each scenario.

Peak Demand and Climate Change

The Energy Commission demand forecasting process incorporates the potential impacts of global climate change by adjusting upward the number of cooling and heating degree days in the forecast period, based on the historical ratio of degree days in the last 12 years to that of the last 30 years. The result of this adjustment is an increase in the projected amount of cooling and a reduction in projected heating relative to the historical period. This correction attempts to account for the likelihood of a general warming trend. However, temperatures assumed in the peak forecast, an average of daily temperatures over the last 30 years, are not affected by the adjustment. Therefore, the forecast may not fully capture the impact on peak demand of possibly more frequent *heat storm* weather events, in the form of higher maximum temperatures in a given year.

To examine the impact of maximum temperatures on annual peaks, staff developed an econometric model using estimated historical system peaks by planning area for 1980-2008. Peak demand per capita by planning area was specified as a function of per capita income, the unemployment rate, average residential and commercial electricity rates, and *631* maximum annual temperatures. The latter variable results from an adjustment of daily maximums recorded at each weather station representing the 16 Energy Commission forecasting climate zones in California, as follows:

$$\begin{gathered} \textit{631 Daily Maximum} = \\ \textit{Daily Maximum Temperature} \times 0.6 \\ + \textit{Previous Day's Maximum Temperature} \times 0.3 \\ + \textit{Two Day's Previous Maximum Temperature} \times 0.1. \end{gathered}$$

This adjustment is meant to provide a better indicator of sustained temperature warming than a simple daily maximum.[26] The maximum of these values occurring on a weekday in a given year and planning area[27] was used in the regression.

[26] Evidence shows that response to high temperatures increases if warming is sustained over a period of days, as customers do not always adjust immediately to changing weather.

[27] For planning areas consisting of more than one climate zone, *631* maximum annual temperatures were weighted according to population in each climate zone.

The regression accounted for correlation among planning areas and over time (autocorrelation). All variables in the regression yielded statistically significant (at least 10 percent level) coefficients with the expected signs. The estimated coefficient for temperature corresponds to an elasticity of peak demand with respect to temperature of 0.47: a 10 percent increase in annual *631* maximums was estimated to increase system peak by an average of 4.7 percent. Full estimation results are available upon request.

To gauge the potential impact of climate change on *631* annual maximum temperatures through 2020, staff took advantage of a recent climate change impact assessment by the California Climate Change Center, sponsored by the Energy Commission.[28] This assessment evaluated a set of 12 climate change model simulations for California using six different models, providing scenario results for daily maximum and minimum temperatures, average daily humidity, and sea level rises through 2099.

Climate change model simulations were performed for *grids* of 50 square miles within the state. For the peak analysis, staff used simulated daily maximum and minimum temperatures for grids corresponding to the 10 weather stations used for the 16 climate zones. Staff chose the two climate change scenarios that resulted in the most and least temperature impact on the state as a whole.[29] These scenarios are referred to below as the *high* and *low temperature increase scenarios*, respectively. Staff converted simulated daily maximums for each weather station to *631* daily and annual maximums for each planning area, as described above.

Rather than using the resulting 2020 *631* annual maximum temperatures directly, staff used an average of annual *631* maximums for each temperature scenario for 2018-2022, to better capture the general trend upward in temperature and avoid cases where simulated temperatures in 2020 in a given planning area varied well above or below this trend. Staff then applied the estimated econometric peak model to a *base case* for 2020, which assumed no increase in maximum temperature above the 30-year average for 1979-2008,[30] and each of the two temperature scenarios. **Figures A-2** and **A-3** show the increase in annual *631* maximum temperatures and resulting estimated percentage increases in peak demand for the five major planning areas and for the state as a whole for the high and low temperature increase scenarios, respectively, relative to the base case. The figures also show the impact in MW, applying the estimated percentage increases to the *CED 2009 Revised* peak forecast.

For the state as a whole, non-coincident[31] peak impacts vary from less than 500 MW (0.7 percent) to more than 1,300 MW (1.9 percent). The climate change models, in general,

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[28] California Energy Commission, *Climate Change Scenarios and Sea Level Rise Estimates for the California 2008 Climate Change Scenarios Assessment*, March 2009, CEC-500-2009-014-D.

[29] Staff wishes to thank Mary Tyree at the Scripps Institute of Oceanography for providing the simulation data.

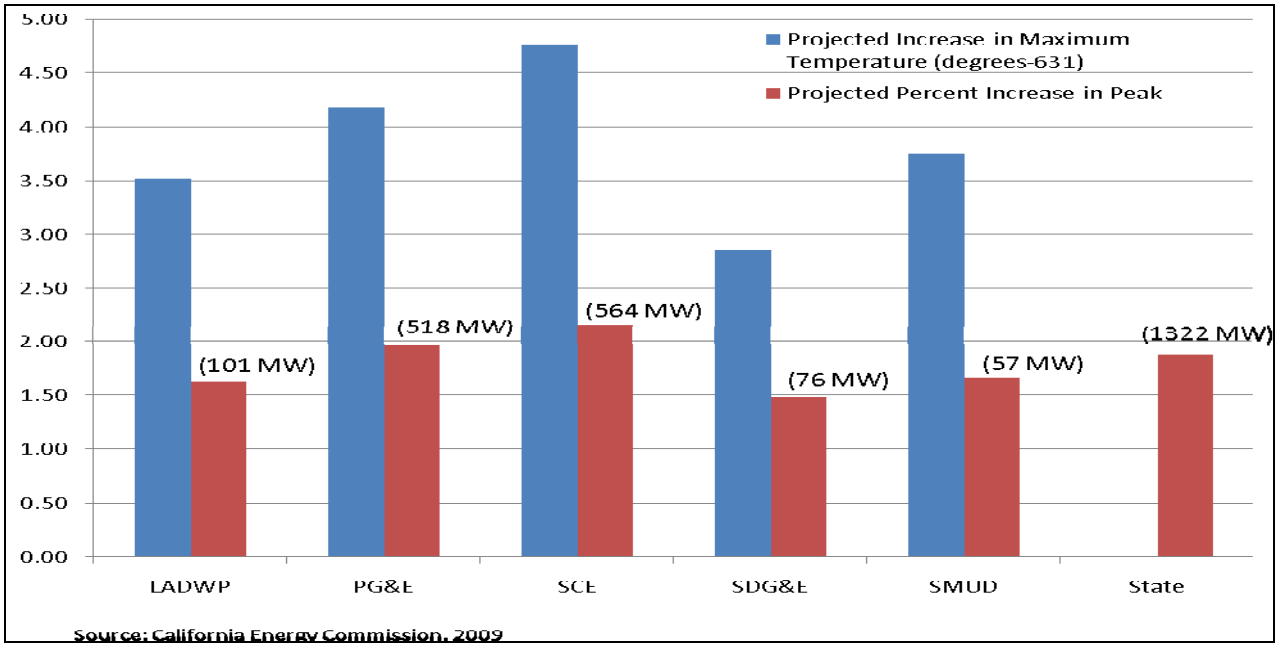
[30] This is consistent with assumed temperatures used in the Energy Commission Peak Model for *CED 2009 Revised*.

[31] The state totals are simply the sum of planning area coincident peaks.

predict more temperature impact in the inland areas than on the coast. Thus, SDG&E peak impacts are smaller than in the other planning areas and become negative in the low temperature increase scenario as maximum temperatures drop below the 30-year average during the 2018-2022 period. Otherwise, the difference in peak impacts between scenarios is largest for PG&E, as the coastal portions of the planning area experience little or no change in maximum temperatures in the low temperature increase scenario.

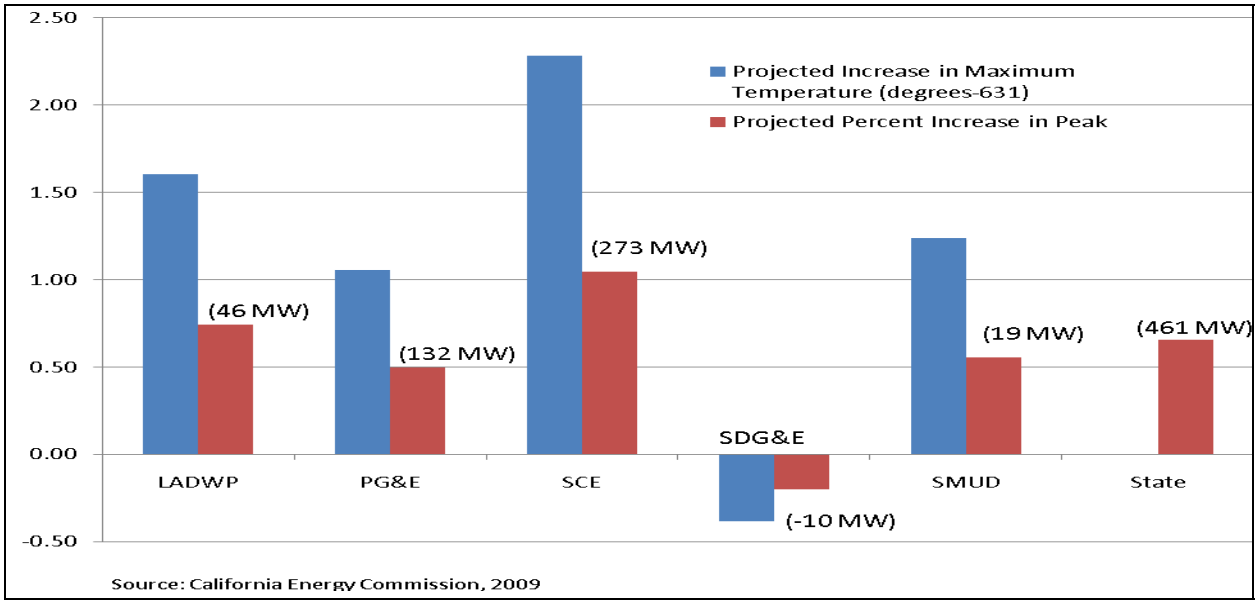
It is important to note that the climate change simulations are not meant to be predictions, but rather "possible scenarios of plausible climate sequences,"[32] and, therefore, are not incorporated directly into the *CED 2009 Revised*. In addition, as discussed above, staff already includes an adjustment to the forecast that increases projected peak demand, meaning impacts presented here are likely overstated. However, the results of this analysis suggest the need to incorporate temperatures directly in any climate change adjustment for the forecast. Staff plans to revisit and refine climate change adjustment methods for the *2011 IEPR* process.

Figure A-2: Projected Impact on Peak Demand of High Temperature Increase Scenario, 2020



[32] *Climate Change Scenarios and Sea Level Rise Estimates for the California 2008 Climate Change Scenarios Assessment*, p. xi.

Figure A-3: Projected Impact on Peak Demand of Low Temperature Increase Scenario, 2020



Energy Commission Model Performance

This section discusses the performance of the demand forecasting models relative to actual electricity consumption. First, *CED 2009 Revised backcasts* are compared to historical consumption in the residential and commercial sectors. Models for the other sectors do not provide full backcasts, but rather index base year (currently 2008) results to actual consumption in that year. Second, past forecasts are compared to subsequent actual consumption.

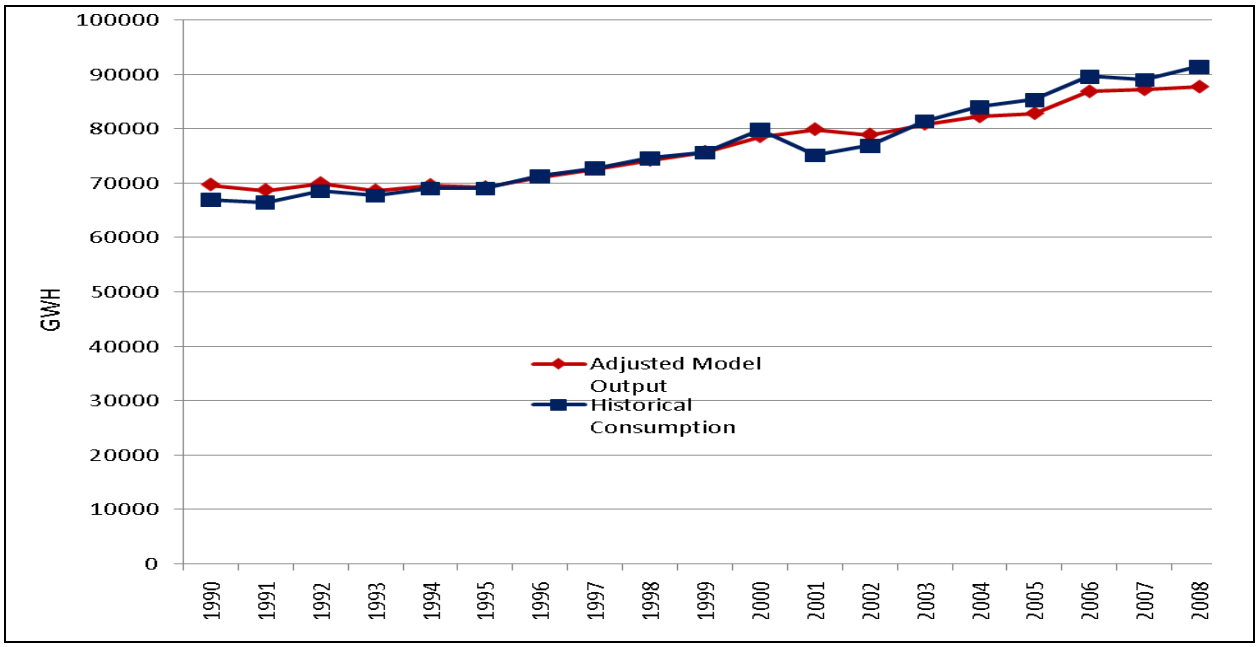
Raw output from the Residential and Commercial Models is weather-adjusted— modified to account for differences between weather averaged over a period of years and actual historical weather— by scaling results based on the number of actual heating and cooling degree days in a given year relative to long-term averages. Next, impacts from efficiency programs not incorporated directly in the models are subtracted from weather-adjusted results. After the efficiency adjustment, results are calibrated to actual 2008 consumption. **Figures A-4** and **A-5** compare the statewide weather- and efficiency-adjusted model output from *CED 2009 Revised* with historical consumption at the statewide level for 1990-2008, before calibration.

The Residential Model performs well through the 1990s but does not simulate the full impact of the electricity crisis in 2001. To some degree, this is a result of a lack of strong price responsiveness in the model, but also because 2001 decreases in consumption came about through events difficult for any forecasting model to capture properly. After 2002, the

Residential Model output falls below historical consumption, although model results capture the general trend upward.

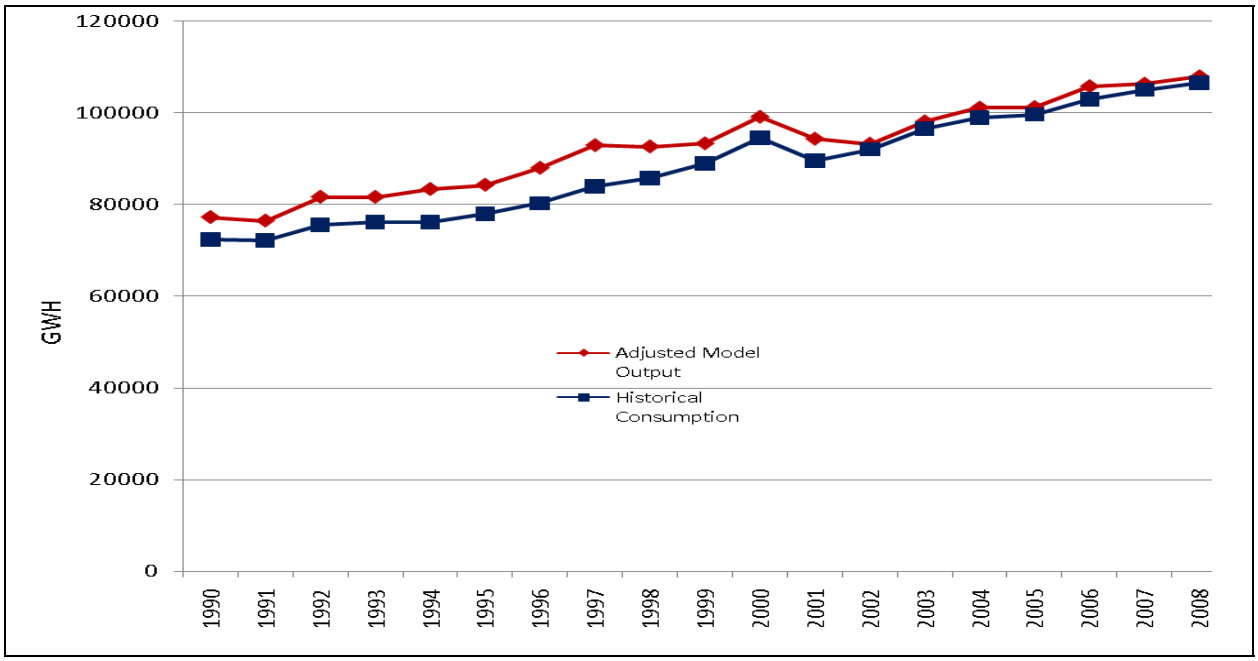
Adjusted Commercial Model output is significantly higher than historical consumption through the 1990s, and staff will analyze the reasons for this difference after the *2009 IEPR* cycle. However, the model simulates the magnitude of the impact of the electricity crisis in 2001 properly and follows the trend in consumption after 2001 fairly accurately.

Figure A-4: Statewide Comparison of Historical Residential Consumption With Adjusted Residential Model Output



Source: California Energy Commission, 2009

Figure A-5: Statewide Comparison of Historical Commercial Sector Consumption With Adjusted Commercial Model Output



Source: California Energy Commission, 2009

Staff also compared electricity consumption predictions from previous forecasts with subsequent electricity use. **Figure A-6** shows actual and forecasted electricity consumption for California from 1980 to 2020, including all staff forecasts from 1990 through 2005.[33] The starting points of the forecasts typically differ from historical consumption because staff relied on billing data for years before to the dated forecast year.[34] Long-term trends in these forecasts generally correlate with electricity consumption in subsequent years. Short-term patterns are often missed, usually due to unforeseen short-term economic and other impacts. For example, pre-1999 forecasts underpredicted the consumption increase in the late 1990s as actual economic growth exceeded growth projected for these forecasts.

Given the importance of the economy and demographics to electricity consumption growth, a proper comparison of the forecasts with actual use would require replacing projected economic and demographic growth with subsequent realized growth for each forecast.[35] Therefore, the backcasts shown in **Figures A-4** and **A-5**, which by definition incorporate

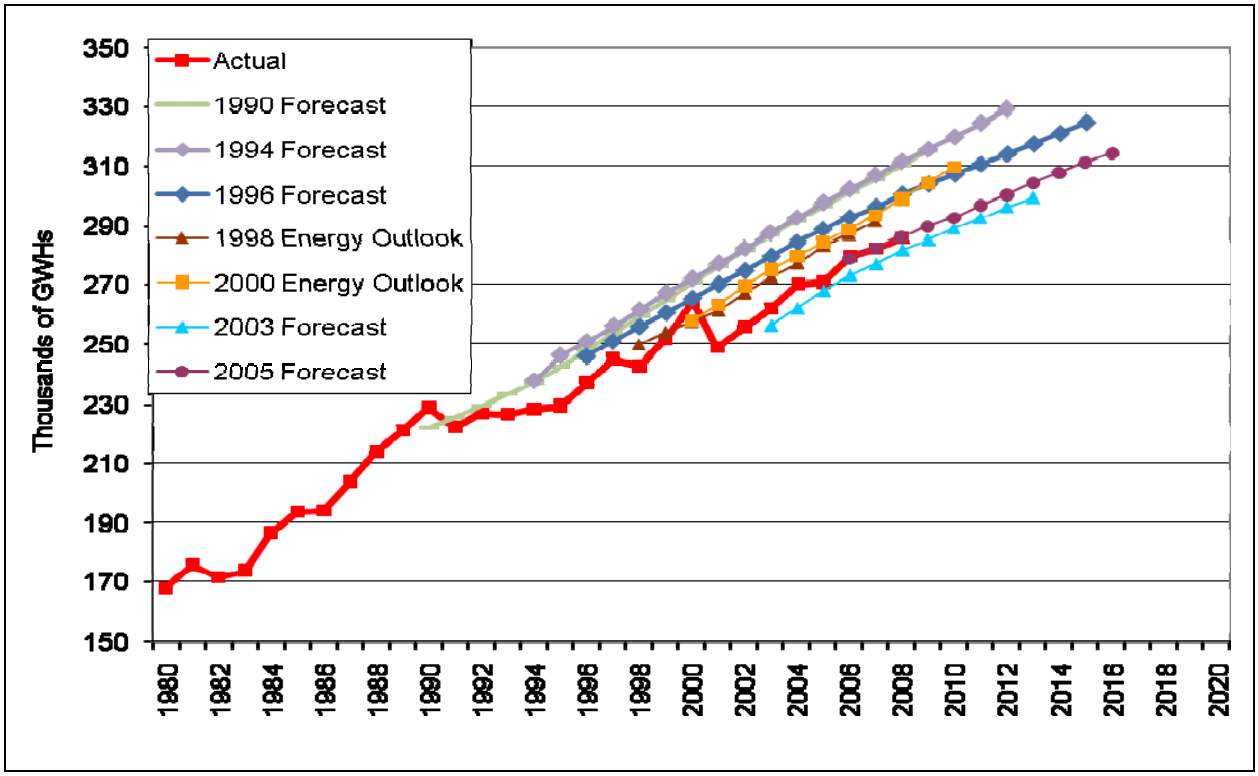
[33] The 1998 and 2000 *Energy Outlook* provided less comprehensive forecasts based on key economic and demographic variables.

[34] That is, the first year in the forecast is actually a projection using a previous years' recorded consumption.

[35] Staff nevertheless calculated averages of annual percentage error (or difference) in the forecasts relative to subsequent consumption. These errors ranged from 0.15 percent for the 2005 forecast to 7 percent for the 1994 forecast.

actual economic/demographic changes, provide a more meaningful evaluation of the Energy Commission forecasting models.

Figure A-6: Past State Electricity Forecasts Versus Historical Consumption



Source: California Energy Commission, 2009

Residential Lighting

To estimate residential lighting use separately within the Residential Model, staff developed estimates of statewide average lighting energy consumption per household by household type (single and multi-family homes) for 1980 through 2004. Data for this purpose came from the consulting firm Itron and various *California Lighting and Appliance Saturation Studies*. Staff then created a new end use for the model, breaking out lighting from the *miscellaneous* category of end uses so that total lighting use plus revised miscellaneous use equaled original miscellaneous consumption for the historical period.

For the investor-owned utility (IOU) planning areas, staff used reported lighting program savings for 2005-2008 and program plans for 2009-2011, adjusted as described in Chapter 8, to estimate reductions to average lighting values for 2005-2011. For the publicly owned utilities, reported program savings for 2006-2008 and projected impacts in 2009 were used to estimate averages for 2006-2009. No direct lighting programs impacts were assumed beyond

2011 for the IOU service territories and beyond 2009 for the publicly owned utilities. However, staff assumed average lighting per household would remain at 2011 levels in the IOU planning areas and at 2009 levels for the publicly owned utilities without incentives through the rest of the forecast period. The difference between the 2009 or 2011 average and an increasing average that would have occurred as utility impacts decayed was assigned to naturally occurring savings. **Table A-2** shows historical estimates for average lighting use per household by type for selected years and gives projected values for each of the five major planning areas based on lighting program impacts.

Given the focus of utility programs and state and federal legislation related to lighting, staff felt it was unrealistic to assume no lighting savings beyond 2009 for the publicly owned utilities and 2011 for the IOUs. These numbers are meant to provide a placeholder for further refinement in the uncommitted forecast.

Table A-2: Estimated Historical and Projected Lighting Use per Household for the Investor-Owned Utilities (kWh per Year)

Planning Area	Housing Type	1980	1990	1995	2000	2004	2009	2011 and Beyond
PGE	Single Family	1,093	1,597	1,719	1,764	1,800	1,412	1,355
	Multi-Family	607	887	955	980	1,000	816	753
SCE	Single Family	1,093	1,597	1,719	1,764	1,800	1,391	1,247
	Multi-Family	607	887	955	980	1,000	773	693
SDGE	Single Family	1,093	1,597	1,719	1,764	1,800	1,465	1,345
	Multi-Family	607	887	955	980	1,000	814	747
LADWP	Single Family	1,093	1,597	1,719	1,764	1,800	1,791	1,791
	Multi-Family	607	887	955	980	1,000	995	995
SMUD	Single Family	1,093	1,597	1,719	1,764	1,800	1,737	1,737
	Multi-Family	607	887	955	980	1,000	965	965

Source: California Energy Commission, 2009

Self-Generation

Staff has developed a method to predict adoption of residential photovoltaic (PV) systems, based on the self-generation model used by the Energy Information Agency (EIA).[36] The new model includes two distinct steps. The first step examines the private financial benefit from investing in a PV system. This essentially casts the decision to purchase a system as an investment decision to be made by a prospective homeowner. Under this framework, the homeowner will evaluate the direct financial benefits relative to the cost of investing in a PV system. If the total private financial benefit exceeds the cost, it is assumed that the homeowner will invest in the system. The metric used to capture the overall financial attractiveness of investing in a PV system is the payback period, which measures how long it would take a household to recoup its initial investment in a project given projected returns, a function of the present value of expected annual electricity cost savings.

The extent of investment in PV systems made by households is handled in the second step of the model, which uses a logistic or *s shaped* penetration function to estimate the share of households that would invest in a system in any given year, based on payback. Systems with relatively fast payback will achieve greater penetration than systems with longer payback. As in the EIA model, projects with a payback period of one year are limited to capturing 30 percent of the market for new single family residential construction while projects with less than a one-year payback are limited to capturing 50 percent of the market.

Once the penetration rate is determined, it is multiplied by the projected amount of new single-family residential units to arrive at an estimate of the projected number of new homes that purchase a PV system. Multiplying the number of homes adopting a system by system size provides an estimate of the incremental PV capacity installed.

The method is applied separately for the existing stock of single-family homes. Given the size of the existing housing stock relative to new construction, the penetration of PV systems in the existing housing stock is limited to a maximum of 15 percent under a one-year payback scenario and 25 percent under a scenario with less than a one-year payback. For each projected year, the existing stock in each year is adjusted to account for PV penetration occurring in prior years.

Utility Efficiency Program Impacts

Staff, along with Itron, began the process of measuring the savings impacts from utility efficiency programs described in Chapter 8 by collecting first-year reported and projected

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[36] The description of the EIA self-generation model begins on page 124 of *Model Documentation Report: Residential Sector Demand Module of the National Energy Modeling System*, DOE/EIA-MO67, April 2007, Office of Integrated Analysis and Forecasting, Energy Information Administration. http://tonto.eia.doe.gov/FTPROOT/modeldoc/m067(2007).pdf.

savings data from the IOUs for 1998-2011 and distributing the savings into end uses. Where specific end-use attribution was unavailable in the data (1998-2002), staff assigned savings to each end use based on the 2003 distributions. **Tables A-3** through **A-6** give the results of this initial process for selected years, showing *ex-ante* first-year net savings[37] for each IOU and for combined publicly owned utilities by end use and sector. The tables clearly show the predominance of lighting measures in each utility; for example, reported first-year lighting savings make up more than 70 percent of the total for each of the IOUs in 2007.

[37] Savings estimates have been adjusted from gross totals using net-to-gross ratios (adjusting for free-ridership), but not adjusted by realization rates.

Table A-3: Reported and Projected First-Year Program Savings (GWH) for PG&E by End Use and Sector

Sector	End Use	1998	2001	2005	2006	2007	2008	2009-2011*
Residential	Heating, Ventilation, Air Conditioning**	4	17	12	3	24	14	13
	Compact Fluorescent Lighting	21	80	165	264	476	878	360
	Other Residential Lighting	4	15	20	22	77	68	40
	New Construction	3	13	0	0	1	0	0
	Pool Pumps	3	11	2	1	3	3	0
	Refrigerator Recycling	24	95	7	17	32	0	82
	Other Refrigerator	0	0	0	0	0	32	0
	Water Heating	1	3	3	5	17	28	0
	Misc./Non-descriptive	0	0	0	0	0	1	139
	Total Residential	60	234	209	312	630	1,024	633
Commercial	Heating, Ventilation, Air Conditioning**	21	22	13	26	51	121	95
	Compact Fluorescent Lighting	109	111	26	228	385	683	255
	Other Commercial Lighting	78	80	66	45	124	255	51
	New Construction	104	106	3	1	5	0	0
	Refrigeration	17	17	15	23	68	162	46
	Water Heating	0	0	0	1	0	1	0
	Misc./Non-descriptive	57	58	8	10	29	188	0
	Total Commercial	388	394	131	334	662	1,410	447
Industrial	--	0	0	1	3	17	105	24
Agricultural	--	0	0	3	13	4	220	168
Grand Total	--	448	628	344	662	1,313	2,759	1,272

Source: California Energy Commission, 2009
* Utility projected first year savings are the same in each year 2009-2011.
** Includes building shell measures.

Table A-4: Reported and Projected First-Year Program Savings (GWH) for SCE by End Use and Sector

Sector	End Use	1998	2001	2005	2006	2007	2008	2009-2011*
Residential	Heating, Ventilation, Air Conditioning**	7	10	13	8	29	66	21
	Compact Fluorescent Lighting	33	48	297	334	787	487	302
	Other Residential Lighting	6	9	33	52	124	34	43
	New Construction	5	8	0	0	0	0	0
	Pool Pumps	5	7	6	1	2	4	0
	Refrigerator Recycling	39	57	34	48	79	0	63
	Other Refrigerator	0	0	2	2	3	89	0
	Water Heating	1	2	0	0	0	0	0
	Misc./Non-descriptive	0	0	3	0	0	0	17
	Total Residential	96	141	388	445	1024	680	446
Commercial	Heating, Ventilation, Air Conditioning**	23	17	15	15	50	80	205
	Compact Fluorescent Lighting	118	88	51	36	40	296	67
	Other Commercial Lighting	85	63	68	95	181	188	289
	New Construction	113	84	6	16	10	0	0
	Refrigeration	18	14	15	27	7	32	25
	Water Heating	0	0	0	0	0	0	0
	Misc./Non-descriptive	62	46	3	43	60	62	4
	Total Commercial	419	313	158	232	348	658	590
Industrial	--	0	0	0	0	48	40	72
Agricultural	--	0	0	14	0	195	223	160
Grand Total	--	515	454	560	677	1615	1601	1268

Source: California Energy Commission, 2009
* Utility projected first year savings are the same in each year 2009-2011.
** Includes building shell measures.

Table A-5: Reported and Projected First-Year Program Savings (GWH) for SDG&E by End Use and Sector

Sector	End Use	1998	2001	2005	2006	2007	2008	2009-2011*
Residential	Heating, Ventilation, Air Conditioning**	5	4	3	0	5	3	2
	Compact Fluorescent Lighting	22	20	101	38	151	67	46
	Other Residential Lighting	4	4	9	7	25	17	7
	New Construction	4	3	3	0	0	0	0
	Pool Pumps	3	3	1	3	2	1	0
	Refrigerator Recycling	26	23	7	5	11	0	16
	Other Refrigerator	0	0	2	0	1	8	1
	Water Heating	1	1	1	0	0	2	0
	Misc./Non-descriptive	0	0	0	0	0	0	0
	Total Residential	64	57	127	53	195	98	73
Commercial	Heating, Ventilation, Air Conditioning**	3	5	15	5	18	15	30
	Compact Fluorescent Lighting	14	26	8	3	6	0	3
	Other Commercial Lighting	10	19	33	45	105	134	51
	New Construction	14	25	30	6	4	0	5
	Refrigeration	2	4	6	9	12	21	7
	Water Heating	0	0	0	0	0	0	0
	Misc./Non-descriptive	7	14	12	0	28	34	20
	Total Commercial	50	92	104	68	173	204	116
Industrial	--	0	0	0	0	1	0	0
Agricultural	--	0	0	0	0	38	0	0
Grand Total	--	114	149	231	121	407	302	189

Source: California Energy Commission, 2009
* Utility projected first year savings are the same in each year 2009-2011.
** Includes building shell measures.

Table A-6: Reported and Projected First-Year Program Savings (GWh) for Publicly Owned Utilities by End Use and Sector

Sector	End Use	2006	2007	2008	2009
Commercial	Heating, Ventilation, Air Conditioning**	9.6	9.3	17.5	20.1
	Lighting	25.6	35.4	49.9	86.7
	New Construction	1.6	8.8	15.7	32.3
	Refrigeration	0.6	1.6	2.7	5.7
	Water Heating	0.0	0.0	0.0	0.0
	Misc./Non-Descriptive	8.0	15.1	27.5	56.2
	Total Commercial	45.4	70.2	113.4	201.0
Residential	Heating, Ventilation, Air Conditioning**	8.1	6.1	19.9	27.3
	Lighting	28.9	35.0	47.2	68.9
	New Construction	0.3	0.6	1.2	4.0
	Pool Pumps	0.8	0.7	1.4	3.6
	Refrigeration	3.3	11.8	15.6	35.0
	Water Heating	0.1	0.3	0.5	1.1
	Misc./Non-descriptive	0.4	2.0	4.6	12.5
	Total Residential	42.0	56.4	90.5	152.4
Grand Total	--	87.4	126.7	203.9	353.4

Source: California Energy Commission, 2009
** Includes building shell measures.

Table A-7 shows the expected useful lives (EULs) of adopted efficiency measures estimated for each end use/sector, applied to decay measure savings over time. These were calculated by averaging IOU reported EULs over all measures within an end use for residential and commercial programs and over the entire sector in the case of the agricultural and industrial programs.

The EULs were applied in a logistic decay function to develop accumulated program savings in each year. The function was specified as follows:

$$\text{Decay Rate} = 1 - 1 / (1 + \exp(-.75 * (\text{Years after implementation} - \text{EUL}))).$$

This function yields an *s shaped* curve with the following characteristics: little initial decay over time, accelerated decay in the years immediately before and after the EUL, and little decay throughout the rest of the forecast period.

Table A-7: Estimated Expected Useful Life by End Use/Sector

End Use	Average Expected Useful Life (Years)	End Use	Average Expected Useful Life (Years)
Residential Sector			
Heating, Ventilation, Air Conditioning	12	Refrigerator Recycling	10
Building Shell	18	Other Refrigerator	10
Compact Fluorescent	10	Water Heating	14
Other Residential	16	Miscellaneous	4
New Construction	20	Non-Descriptive	4
Pool Pumps	10		
Commercial Sector			
Heating, Ventilation, Air Conditioning	15	Refrigeration	5
Building Shell	13	Water Heating	12
Compact Fluorescent	2	Misc	12
Other Commercial	12	Non-descriptive	4
New Construction	20		
Agricultural	18	Industrial	16

Source: California Energy Commission, 2009

Electricity Consumption Savings From All Sources

Table A-8 shows total savings for the five major California utilities as well as state totals and is available on-line at http://www.energy.ca.gov/2009_energypolicy/documents/index.html#092109.

Evaluation of Staff Forecasting Methods

As discussed in *CED 2009 Revised Chapter 8*, various parties expressed confusion during the *2007 IEPR* process about energy efficiency impacts incorporated within the Energy Commission Demand Forecast. Prompted by these concerns, the *2007 IEPR* committed the Energy Commission, in 2008 and beyond, to examine the methods used to incorporate efficiency in the Commission's demand forecast. Also, the Commission launched an effort to evaluate the forecasting models themselves to identify potential areas for improvement in the forecasting process. Aspen Environmental Group and R.W. Beck, consultants in this effort, completed a preliminary assessment of the staff demand forecasting method. Key findings include:

- The Energy Commission end-use approach is useful, has many advantages, and is a valuable counterweight to the econometric models used by the utilities. However, the approach is data-intensive, and requires major staff effort to maintain and update the individual models. Currently, updated data is lacking in some areas and staff resources may not be adequate to take full advantage of the end-use approach.
- If the end-use approach is continued, the Energy Commission should consider adding more flexible, short-term econometric models to address policy questions.
- The current method requires:
  - An updated and more comprehensive price response capability.
  - A more transparent backcasting/calibration procedure.
  - An uncertainty analysis capability.
- Staff's forecast is undermined by inconsistency in energy demand reporting and data sources through time, which may be driven in part by a changing regulatory regime, historically, and a lack of consistency through time with respect to data management and submission protocols on the part of individual utilities to the Energy Commission.

The consultants also suggested the Energy Commission evaluate whether continuing to meet all of the individual tailored needs for the demand forecast is feasible given current methods, data requirements, reporting requirements, and resource limitations. This suggestion prompted staff to begin a second evaluation phase involving an assessment of the applications of the demand forecast, a judgment whether all of these applications are feasible given stakeholder needs and staff resource constraints, and consideration of alternative or additional methods for those applications considered feasible. Phase II of the evaluation effort has begun and will be completed by May 2010.

Revised Demand Forecast Forms Completed by Energy Commission Staff

The list of revised demand forecast forms completed by Energy Commission staff in support of the *2009 Integrated Energy Policy Report* is below. The staff's completed forms are available on-line at http://www.energy.ca.gov/2009_energypolicy/documents/index.html#092109.

Statewide Forms

1.1 Electricity Consumption by Sector
1.1b Electricity Sales by Sector
1.2 Net Energy for Load
1.3 Coincident Peak Demand by Sector
1.4 Noncoincident Peak Demand

1.5a Net Energy for Load by Agency and Balancing Authority
1.5b-e Electric Peak Demand by Agency and Balancing Authority
1.7 Private Supply by Sector
2.2 Economic and Demographic Assumptions
2.2a Economic and Demographic Assumptions by Economic Scenario

Pacific Gas and Electric Planning Area Forms

1.1 Electricity Consumption by Sector
1.1b Electricity Sales by Sector
1.2 Net Energy for Load
1.3 Coincident Peak Demand by Sector
1.4 Peak Demand
1.5 Extreme Energy Peak Demand
1.7 Private Supply by Sector
2.2 Economic and Demographic Assumptions and Electricity Prices
2.3 Electricity Prices

Southern California Edison Planning Area Forms

1.1 Electricity Consumption by Sector
1.1b Electricity Sales by Sector
1.2 Net Energy for Load
1.3 Coincident Peak Demand by Sector
1.4 Peak Demand
1.5 Extreme Energy Peak Demand
1.7 Private Supply by Sector
2.2 Economic and Demographic Assumptions and Electricity Prices
2.3 Electricity Prices

San Diego Gas & Electric Planning Area Forms

1.1 Electricity Consumption by Sector
1.1b Electricity Sales by Sector
1.2 Net Energy for Load
1.3 Coincident Peak Demand by Sector
1.4 Peak Demand
1.5 Extreme Energy Peak Demand
1.7 Private Supply by Sector
2.2 Economic and Demographic Assumptions and Electricity Prices
2.3 Electricity Prices

Sacramento Municipal Utility District Planning Area Forms

1.1 Electricity Consumption by Sector

1.1b Electricity Sales by Sector
1.2 Net Energy for Load
1.3 Coincident Peak Demand by Sector
1.4 Peak Demand
1.5 Extreme Energy Peak Demand
1.7 Private Supply by Sector
2.2 Economic and Demographic Assumptions and Electricity Prices
2.3 Electricity Prices

Los Angeles Water and Power Department Planning Area Forms

1.1 Electricity Consumption by Sector
1.1b Electricity Sales by Sector
1.2 Net Energy for Load
1.3 Coincident Peak Demand by Sector
1.4 Peak Demand
1.5 Extreme Energy Peak Demand
1.7 Private Supply by Sector
2.2 Economic and Demographic Assumptions and Electricity Prices
2.3 Electricity Prices

Natural Gas Planning Areas Forms

1.1 Natural Gas Consumption
2.3 Natural Gas Prices