SUBCHAPTER 3.3

ENERGY

3.3 ENERGY

This subsection describes existing regulatory setting relative energy production and demand, including alternative and renewable fuels, and trends within California and the district.

3.3.1 Regulatory Setting

Federal and state agencies regulate energy use and consumption through various means and programs. On the federal level, the United States Department of Transportation (U.S. DOT), United States Department of Energy (U.S. DOE), and United States Environmental Protection Agency (U.S. EPA) are three agencies with substantial influence over energy policies and programs. Generally, federal agencies influence transportation energy consumption through establishment and enforcement of fuel economy standards for automobiles and light trucks, through funding of energy related research and development projects, and through funding for transportation infrastructure projects.

On the state level, the California Public Utilities Commission (CPUC) and California Energy Commission (CEC) are two agencies with authority over different aspects of energy. The CPUC regulates privately-owned utilities in the energy, rail, passenger transportation, telecommunications, and water fields. The CEC collects and analyzes energy-related data, prepares state-wide energy policy recommendations and plans, promotes and funds energy efficiency and renewable energy resources programs, plans and directs state response to energy emergencies, and regulates the power plant siting and transmission process. Some of the more relevant federal and state transportation-energy-related laws and plans are discussed in the following subsections.

3.3.1.1 Federal Regulations

3.3.1.1.1 Energy Policy and Conservation Act

The Energy Policy and Conservation Act of 1975 sought to ensure that all vehicles sold in the U.S. would meet certain fuel economy goals. Through this Act, Congress established the first fuel economy standards for on-road motor vehicles in the U.S. Pursuant to the Act, the National Highway Traffic and Safety Administration, which is part of the U.S. DOT, is responsible for establishing additional vehicle standards and for revising existing standards. Since 1990, the fuel economy standard for new passenger cars has been 27.5 miles per gallon. Since 1996, the fuel economy standard for new light trucks (gross vehicle weight of 8,500 pounds or less) has been 20.7 miles per gallon. Heavy-duty vehicles (e.g., vehicles and trucks over 8,500 pounds gross vehicle weight) are not currently subject to fuel economy standards. Compliance with federal fuel economy standards is not determined for each individual vehicle model, but rather, compliance is determined on the basis of each manufacturer's average fuel economy for the portion of their vehicles produced for sale in the U.S. The Corporate Average Fuel Economy (CAFE) program, which is administered by U.S. EPA, was created to determine vehicle manufacturers' compliance with the fuel economy standards. The U.S. EPA calculates a CAFE value for each manufacturer based on city and highway fuel economy test results and vehicle sales. Based on the information generated under the CAFE program, the U.S. DOT is authorized to assess penalties for noncompliance.

3.3.1.1.2 National Energy Act

The National Energy Act of 1978 included the following statues: Energy Tax Act, National Energy Conservation Policy Act, Power Plant and Industrial Fuel Use Act, and the National Gas Policy Act. The Power Plant and Industrial Fuel Use Act restricted the fuel used in power plants, however, these restrictions were lifted in 1987. The Energy Tax Act was superseded by the Energy Policy Acts of 1992 and 2005. The National Gas Policy Act gave the Federal Energy Regulatory Commission authority over natural gas production and established pricing guidelines. The National Energy Conservation Policy Act (NECPA). The NECPA set minimum energy performance standards, which replaced those in the EPCA. The federal standards preempted state standards. The NECPA was amended by the Energy Policy and Conservation Act Amendments of 1985.

3.3.1.1.3 Public Utility Regulatory Policies Act of 1978 (PURPA) (Public Law 95-617)

PURPA was passed in response to the unstable energy climate of the late 1970s. PURPA sought to promote conservation of electric energy. Additionally, PURPA created a new class of nonutility generators, small power producers, from which, along with qualified co-generators, utilities are required to buy power.

PURPA was in part intended to augment electric utility generation with more efficiently produced electricity and to provide equitable rates to electric consumers. Utility companies are required to buy all electricity from qualifying facilities (Qfs) at avoided cost (avoided costs are the incremental savings associated with not having to produce additional units of electricity). PURPA expanded participation of nonutility generators in the electricity market and demonstrated that electricity from nonutility generators could successfully be integrated with a utility's own supply. PURPA requires utilities to buy whatever power is produced by Qfs (usually cogeneration or renewable energy). The Fuel Use Act (FUA) of 1978 (repealed in 1987) also helped Qfs become established. Under FUA, utilities were not allowed to use natural gas to fuel new generating technologies, but Qfs, which were by definition not utilities, were able to take advantage of abundant natural gas and abundant new technologies (such as combined-cycle).

3.3.1.1.4 Energy Policy Act of 1992

The Energy Policy Act of 1992 is comprised of twenty-seven titles. It addressed clean energy use and overall national energy efficiency to reduce dependence on foreign energy, incentives for clean, radioactive waste protection standards, and renewable energy and energy conservation in buildings and efficiency standards for appliances.

3.3.1.1.5 Energy Policy Act of 2005

The Energy Policy Act of 2005 addresses energy efficiency; renewable energy requirements; oil, natural gas and coal; alternative-fuel use; tribal energy, nuclear security; vehicles and vehicle fuels, hydropower and geothermal energy, and climate change technology. The Act provides revised annual energy reduction goals (two percent per year beginning in 2006), revised renewable energy purchase goals, federal procurement of Energy Star or Federal Energy Management Program-designated products, federal green building standards, and fuel cell vehicle and hydrogen energy system research and demonstration.

3.3.1.1.6 Clean Air Act

Section 211(o) of the Clean Air Act (the Act), as amended by the Energy Policy Act of 2005, requires the Administrator of the U.S. Environmental Protection Agency (U.S. EPA) to annually determine a renewable fuel standard (RFS), which is applicable to refiners, importers, and certain blenders of gasoline, and publish the standard in the Federal Register by November 30 of each year. On the basis of this standard, each obligated party determines the volume of renewable fuel that it must ensure is consumed as motor vehicle fuel. This standard is calculated as a percentage, by dividing the amount of renewable fuel that the Act requires to be blended into gasoline for a given year by the amount of gasoline expected to be used during that year, including certain adjustments specified by the Act.

3.3.1.1.7 Corporate Average Fuel Economy (CAFE) Program

Compliance with federal fuel economy standards is determined on the basis of each manufacturer's average fuel economy for the portion of their vehicles produced for sale in the U.S. The CAFE program, which is administered by the U.S. EPA, was created to determine vehicle manufacturers' compliance with the fuel economy standards. The U.S. EPA calculates a CAFE value for each manufacturer based on city and highway fuel economy test results and vehicle sales. Based on the information generated under the CAFE program, the USDOT is authorized to assess penalties for noncompliance.

3.3.1.1.8 Energy Independence and Security Act of 2007 (EISA)

The Energy Independence and Security Act of 2007 was signed into law by President Bush on December 19, 2007. The Acts objectives are to move the United States toward greater energy independence and security, increase the production of clean renewable fuels, protect consumers, increase the efficiency of products, buildings and vehicles, promote greenhouse gas research, improve the energy efficiency of the Federal government, and improve vehicle fuel economy.

The renewable fuel standard in the Act requires 36 billion gallons of ethanol per year by 2022, with corn ethanol limited to 15 billion gallons. The new CAFE standard is for light duty vehicles 35 miles per gallon by 2020. The Act also specifies that vehicle attribute-based standards are to be developed separately for cars and light trucks. The Act creates a CAFE credit and transfer program among manufacturers and across a manufacturer's fleet. It would allow an extension through 2019 of the CAFE credits specified under the Alternative Motor Fuels Act. It establishes appliance energy efficiency standards for boilers, dehumidifiers, dishwashers, clothes washers, external power supplies, commercial walk-in coolers and freezers, federal buildings; lighting energy efficiency standards for general service incandescent lighting in 2012; and standards for industrial electric motor efficiency

3.3.1.2 State Regulations

The CEC and CPUC have jurisdiction over the investor-owned utilities (IOUs) in California. Within the district, the CEC also collects information for the Los Angeles Department of Water and Power (LADWP) and the Burbank, Glendale and Pasadena Municipal Utilities. The applicable state regulations, laws, and executive orders relevant to energy use are discussed below.

3.3.1.2.1 California Building Energy Efficiency Standards: Title 24

California established statewide building energy efficiency standards following legislative action. The legislation required the standards to be cost-effective based on the building life cycle and to include both prescriptive and performance-based approaches. The 2005 Building Energy Efficiency Standards were adopted in November 2003, took effect October 1, 2005, and followed by a 2008 update.

3.3.1.2.2 AB 1007, Alternative Fuels Plan

Assembly Bill (AB) 1007, (Pavley, Chapter 371, Statutes of 2005) requires the CEC to prepare a state plan to increase the use of alternative fuels in California (Alternative Fuels Plan). The CEC prepared the plan in partnership with CARB, and in consultation with the other state, federal and local agencies in December 2007. The Alternative Fuels Plan assessed various alternative fuels and developed fuel portfolios to meet California's goals to reduce petroleum consumption, increase alternative fuels use, reduce GHG emissions, and increase in-state production of biofuels without causing a significant degradation of public health and environmental quality.

3.3.1.2.3 AB 1493, Vehicle Climate Change Standards

AB 1493 required the state to develop and adopt regulations that achieve the maximum feasible and cost-effective reduction of climate change emissions emitted by passenger vehicles and light-duty trucks. Regulations were adopted by CARB in September 2004. Compliance with these standards is expected to improve fuel efficiency.

3.3.1.2.4 Senate Bill (SB) 1368, Greenhouse Gas Emissions Performance Standard for Major Power Plant Investments

This law requires the CEC to develop and adopt by regulation a greenhouse gas emissions performance standard for long-term procurement of electricity by local publicly-owned utilities. The CEC must adopt the standard on or before June 30, 2007 and must be consistent with the standard adopted by the CPUC for load-serving entities under their jurisdiction on or before February 1, 2007. On January 25, 2007, and on May 23, 2007, respectively, the CPUC and the CEC adopted specific regulations regarding greenhouse gas emissions performance standards for IOUs and other electricity service providers under SB 1368. Compliance with these standards is expected to improve fuel use.

3.3.1.2.5 California Solar Initiative

On January 12, 2006, the CPUC approved the California Solar Initiative (CSI), which provides $2.9 billion in incentives between 2007 and 2017. CSI is part of the Go Solar California campaign, and builds on 10 years of state solar rebates offered to California's IOU territories: Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E.) The California Solar Initiative is overseen by the CPUC, and includes a $2.5 billion program for commercial and existing residential customers, funded through revenues and collected from gas and electric utility distribution rates. Furthermore, the CEC will manage $350 million targeted for new residential building construction, utilizing funds already allocated to the CEC to foster renewable projects between 2007 and 2011.

Current incentives provide an upfront, capacity-based payment for a new system. In its August 24, 2006 decision, the CPUC shifted the program from volume-based to performance-based incentives and clarified many elements of the program's design and administration. These changes were enacted in 2007, when the CSI incentive system changed to performance-based payments.

3.3.1.2.6 Reducing California's Petroleum Dependence

The CEC and CARB produced a joint report Reducing California's Petroleum Dependence to highlight petroleum consumption and to establish a performance based goal to reduce petroleum consumption in California over the next thirty years. The report includes the following recommendations to the Governor and Legislature regarding petroleum:

- Adopt the recommended statewide goal of reducing demand for on-road gasoline and diesel to 15 percent below the 2003 demand level by 2020 and maintaining that level for the foreseeable future.
- Work with the California delegation and other states to establish national fuel economy standards that double the fuel efficiency of new cars, light trucks, and sport utility vehicles.
- Establish a goal to increase the use of non-petroleum fuels to 20 percent of on-road fuel consumption by 2020, and 30 percent by 2030.

The CEC will use these recommendations when developing its series of recommendations to the Governor and Legislature for the integrated energy plan for electricity, natural gas, and transportation fuels.

3.3.1.2.7 Renewables Portfolio Standard

California's renewables portfolio standard (RPS) requires retail sellers of electricity to increase their procurement of eligible renewable energy resources by at least one percent per year so that 20 percent of their retail sales are procured from eligible renewable energy resources by 2017. If a seller falls short in a given year, they must procure more renewables in succeeding years to make up the shortfall. Once a retail seller reaches 20 percent, they need not increase their procurement in succeeding years. RPS was enacted via SB 1078 (Sher), signed September 2002 by Governor Davis. The CEC and the CPUC are jointly implementing the standard. In 2006, RPS was modified by Senate Bill 107 to require retail sellers of electricity to reach the 20 percent renewables goal by 2010. In 2011, RPS was further modified by Senate Bill 2 to require retailers to reach 33 percent renewable energy by 2020.

3.3.1.2.8 California Environmental Quality Act (CEQA)

Appendix F of the CEQA Guidelines describes the types of information and analyses related to energy conservation that are to be included in EIRs that are prepared pursuant to CEQA. In Appendix F of the CEQA Guidelines, energy conservation is described in terms of decreased per capita energy consumption, decreased reliance on natural gas and oil, and increased reliance on renewable energy sources. To assure that energy implications are considered in project decisions, EIRs must include a discussion of the potentially significant energy impacts of proposed projects, with particular emphasis on avoiding or reducing inefficient, wasteful and unnecessary consumption of energy.

3.3.1.3 Local Regulations

3.3.1.1.1 Clean Cities Program

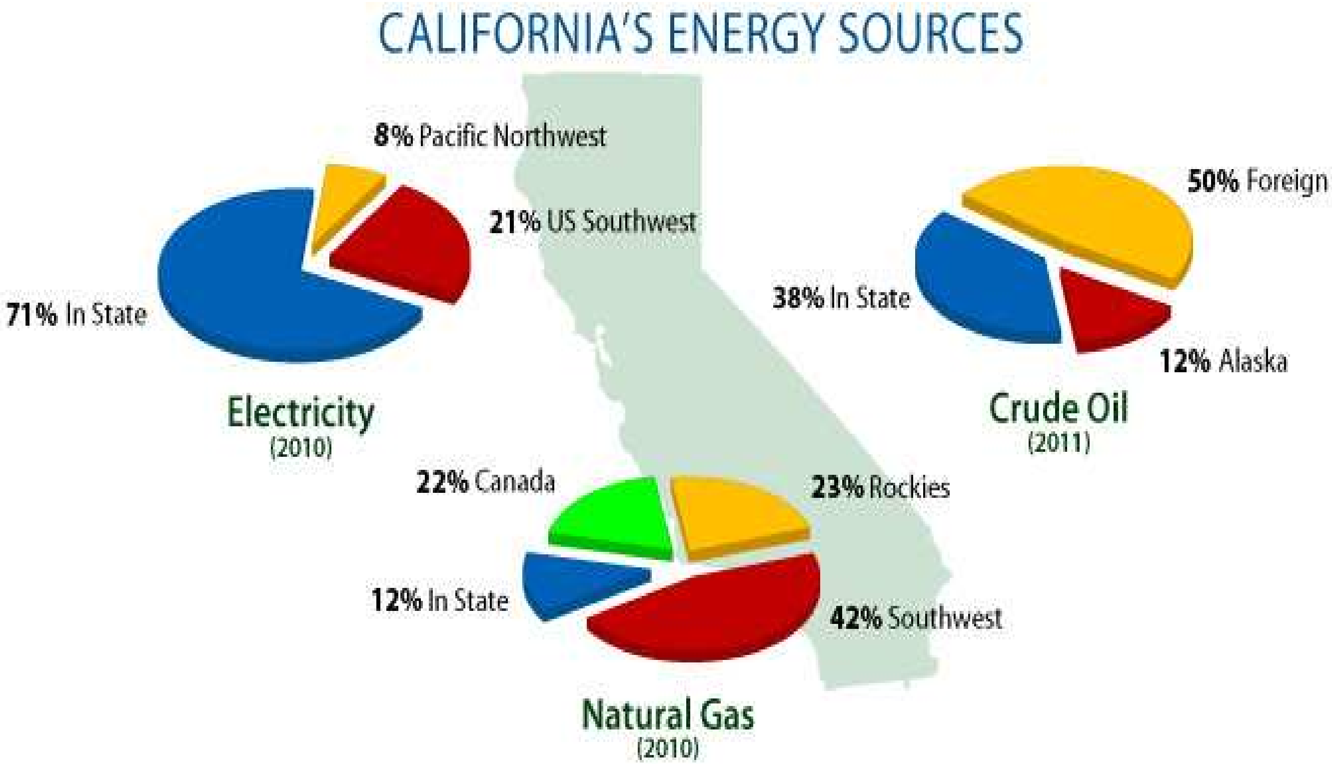
The U.S. DOE Clean Cities Program promotes voluntary, locally based government/industry partnerships for the purpose of expanding the use of alternatives to gasoline and diesel fuel by accelerating the deployment of alternative fuel vehicles and building a local alternative fuel vehicle refueling infrastructure. The mission of the Clean Cities Program is to advance the nation's and energy security by supporting local decisions to adopt practices that contribute to the reduction of petroleum consumption. Clean Cities carries out this mission through a network of more than 80 volunteer coalitions, which develop public/private partnerships to promote alternative fuels and vehicles, fuel blends, fuel economy, hybrid vehicles, and idle reduction.

3.3.1.1.2 San Gabriel Valley Energy Efficiency Partnership

In April 2006, the SCAG's Regional Council authorized SCAG's Executive Director to enter into a partnership with SCE to incentivize energy efficiency programs in the San Gabriel Valley Subregion. The San Gabriel Valley Energy Wise Program (SGVEWP) agreement was fully executed on October 20, 2006 with the main goal to save a combined three million kilowatt-hours (kWh) by providing technical assistance and incentive packages to cities by 2008. The program has been extended seeks to reduce energy usage in the region by approximately five million kWh by 2012. The SGVEWP is funded by California utility customers and administered by SCE under the auspices of the CPUC.

3.3.2 Energy Trends In General (Statewide)

Figure 3.3-1 shows California's major sources of energy. In 2010, 71 percent of the electricity came from in-state sources, while 29 percent was imported into the state. The electricity imported totaled 85,169 gigawatt hours (GWh), with 24,677 GWh coming from the Pacific Northwest, and 60,492 GWh from the Southwest. (Note: A gigawatt is equal to one million kilowatts). For natural gas in 2010, 42 percent came from the Southwest, 22 percent from Canada, 12 percent from in-state, and 23 percent from the Rockies. Also in 2010, 38 percent of the crude oil came from in state, with 12 percent coming from Alaska, and 50 percent being supplied by foreign sources (CEC, 2012).



Source: California Energy Commission

FIGURE 3.3-1

California's Major Sources of Energy

3.3.2.1 Electricity

Power plants in California provided approximately 71 percent of the total in-state electricity demand in 2010 of which 15 percent came from renewable sources such as biomass, geothermal, small hydro, solar, and wind. The Pacific Northwest provided another 8.5 percent of the total electricity demand of which 31 percent came from renewable sources. The Southwestern U.S. provided 20.8 percent of the total electricity demand, with 11.1 percent coming from renewable sources. In total, 13.7 percent of the total in-state electricity demand for 2010 came from renewable sources (CEC, 2012a). Five of the state's largest power plants are located in Basin (U.S. Energy Information Administration, 2012). The largest power plants in California are located in northern California. The Moss Landing Natural Gas Power Plant (net summer capacity 2,529 megawatts (MW)) is located in Monterey Bay in Monterey County and the Diablo Canyon Nuclear Plant (net summer capacity 2,240 MW) is located in Avila Beach in San Luis Obispo County. The third and fourth largest power plants in California are the San Onofre Nuclear Generating Station (net summer capacity 2,150 MW) in San Diego and the AES Alamitos Natural Gas Power Generating Station (net summer capacity 1,997 MW) in Long Beach in Los Angeles County. The San Onofre Nuclear Generating Station is operated by Southern California Edison International, San Diego Gas & Electric Company, and the City of Riverside Utilities Department. It is currently not operating while it is undergoing repairs. The Los Angeles Department of Water and Power (LADWP) ~~County~~ operates the state's fifth and sixth largest power plants: the Castaic Pump-Storage Power Plant[1] in Castaic (net summer capacity 1,620 MW) and Haynes Natural Gas Power Plant (net summer capacity 1,524MW) in Long Beach. The seventh and eighth largest power plants in California are outside of the Basin: the Ormond Beach Natural Gas Power Plant (net summer capacity 1,516 MW) in City and County of Oxnard and Pittsburg Natural Gas Power Plant (net summer capacity 1,311 MW) in the City of Pittsburg in Contra Costa County. The AES Redondo Beach Natural Gas Power Plant (net summer capacity 1,310 MW) in Redondo Beach is the ninth largest in the state (AES, 2010). The Helms Pumped Storage (net summer capacity 1,212 MW) in Sierra National Forest of Fresno County is the tenth largest power plant in the state.

Local electricity distribution service is provided to customers within southern California by one of two investor-owned utilities – either SCE or SDG&E – or by a publicly owned utility, such as the Los Angeles Department of Water and Power (LADWP) and the Imperial Irrigation District. SCE is the largest electric utility company in Southern California with a service area that covers all or nearly all of Orange, San Bernardino, and Ventura Counties, and most of Los Angeles and Riverside Counties. SCE delivers 78 percent of the retail electricity sales to residents and businesses in southern California. SDG&E provides local distribution service to the southern portion of Orange County (SCAG, 2012).

The LADWP is the largest of the publicly owned electric utilities in southern California. LADWP provides electricity service to the most of the customers located in the City of Los Angeles and provides approximately 20 percent of the total electricity demand in the Basin. The other publicly owned utilities in southern California include Anaheim, Azusa, Banning, Burbank, Cerritos, Colton, Glendale, Pasadena, Riverside, Vernon, and the Imperial Irrigation District (SCAG, 2012).

Table 3.3-1 shows the amount of electricity delivered to residential and nonresidential entities in the counties in the Basin.

[1] The Castaic Pump-Storage Power plant is operated by the LADWP in cooperation with the Department of Water Resources (DWR).

TABLE 3.3-1

2011 Electricity Use GWh (Aggregated, includes self generation and renewables)

Sector	Los Angeles	Orange	Riverside	San Bernardino	Total
Ag & Water Pump	1,453	1,600	623	483	4,159
Commercial	26,093	9,151	5,137	4,510	44,890
Industry	11,384	2,588	1,071	2,620	17,662
Mining	1,346	356	129	214	2,045
Residential	19,292	6,682	6,644	4,717	37,334
Streetlight	267	115	80	56	517
TCU	4,065	979	504	953	6,501
Total	63,899	21,470	14,188	13,553	113,109

Source: California Energy Commission –email sent by Steven Mac on August 24, 2012.

3.3.2.2 Natural Gas

Four regions supply California with natural gas. Three of them—the Southwestern U.S., the Rocky Mountains, and Canada—supplied 88 percent of all the natural gas consumed in California in 2010. The remainder is produced in California (CEC, 2012c).

Southern California Gas Company (SoCalGas), an investor-owned utility company, provides natural gas service throughout the district, except for the southern portion of Orange County, portions of San Bernardino County, and the City of Long Beach. The Long Beach Gas & Oil Department (LBGOD) is municipally owned and operated by the City of Long Beach, providing gas service for the cities of Long Beach and Signal Hill (LBGOD, 2012). San Diego Gas & Electric Company provides natural gas services to the southern portion of Orange County. In San Bernardino County, Southwest Gas Corporation provides natural gas services to Victorville, Big Bear, Barstow, and Needles (SCAG, 2012).

Table 3.3-2 provides the estimated use of natural gas in California by residential, commercial and industrial sectors. In 2010, about 50 percent of the natural gas consumed in California was for electric generation purposes (2,312 + 784/6,133).

California is currently ranked fourth among the oil producing states, behind Texas, Louisiana, and Alaska, respectively. Crude oil production in California averaged 629,500 barrels per day in 2009, a decline of 3.04 percent from 2008. Statewide oil production has declined to levels not seen since 1941 (DOGGR, ~~2009~~2010). California also ranks first in gasoline and jet fuel consumption and third in distillate fuel consumption (U.S. EIA, 2012).

3.3.2.3 Liquid Petroleum Fuels

California relies on oil produced within the state, Alaska, and foreign nations to supply its refineries and produce the petroleum that is used in automobiles and for other purposes. The percentage of oil that is imported from foreign nations has increased dramatically over the past 20 years. For example, in 1991, California imported just four percent of oil from foreign sources (30.7 million barrels out of a total of 683.5 million barrels), and in 2011, California imported 49.9 percent of oil from foreign sources (300 million barrels out of a total of 600.7 million barrels). The long-term oil supply outlook for California remains one of declining in-state and Alaska supplies leading to increasing dependence on foreign oil sources (CEC, 2012d).

TABLE 3.3-2

California Natural Gas Demand 2010
(Million Cubic Feet per Day – MMcf/d)

Sector	Utility	Non-Utility	Total
Residential	1,193	--	1,193
Commercial	493	--	493
Natural Gas Vehicles	33	--	33
Industrial	810	--	810
Electric Generation	1,856	456	2,312
Enhanced Oil Recovery (EOR) Steaming	30	784	814
Wholesale / International + Exchange	230	--	230
Company Use and Unaccounted-for	85	--	85
EOR Cogeneration / Industrial	--	784	784
Total	**4,729**	**1,403**	**6,133**

Source: California Gas Report, 2010

Most gasoline and diesel fuel sold in California for on-road motor vehicles is refined in California to meet state-specific formulations required by CARB. Major petroleum refineries in California are concentrated in three counties: Contra Costa County in northern California, Kern County in central California, and Los Angeles County in southern California. In Los Angeles County, petroleum refineries are located mostly in the southern portion of the county (SCAG, 2012). In 2010 14,860 million gallons of gasoline and 1,414 million gallons of diesel were sold by retail facilities. Sales data reported does not include commercial fleets, government entities, private cardlocks (facilities open only to participating companies and not the general public), or rental facilities/equipment yards. The state total and sales by county are presented in Table 3.3.-3. In fiscal year 2011, 14,728,734,063 gallons of gasoline and 2,564,017,901 gallons of diesel were sold in California (California State Board of Equalization, 2012). The volume of gasoline also includes aviation fuel.

3.3.3 Alternative Clean Transportation Fuels

The demand for transportation fuels in California is increasing at a rapid rate. It is projected to grow by almost 35 percent over the next 20 years. Unless habits change, petroleum will be the primary source of California's transportation fuels for the foreseeable future. As demand continues to rise and in-state and Alaskan petroleum supplies diminish, California will rely more and more on foreign imports of crude oil (Consumer Energy Center, 2012).

TABLE 3.3-3

Retail Gasoline Sales by California Total and by County
(millions of gallons per year)

Description	California	Los Angeles	Orange	Riverside	San Bernardino
Gasoline [a]	14,860	3,658	1,406	952	902
Diesel [b]	1,414	235	47	93	149

[a] CEC, 2012k
[b] CEC, 2012l

Alternative fuels, as defined by the Energy Policy Act of 1992, include ethanol, natural gas, propane, hydrogen, biodiesel, electricity, methanol, and P-Series fuels, a family of renewable, non-petroleum liquid fuels that can substitute for gasoline. These fuels are being used worldwide in a variety of vehicle applications. Use of these fuels for transportation can generally reduce air pollutant emissions and can be domestically produced and, in some cases, derived from renewable sources. The Energy Policy Act of 2005 directed the U.S. DOE to carry out a study to plan for the transition from petroleum to hydrogen in a significant percentage of vehicles sold by 2020.

Use of renewable and other alternative fuels in the United States and California is expected to continue growing, primarily as a consequence of federal and state regulations mandating ever-increasing levels of renewable content in gasoline and diesel fuel, carbon reduction rules, and incentives for increasing alternative fuel consumption.

3.3.3.1 Biodiesel

Biodiesel is a domestically produced, renewable fuel that can be manufactured from vegetable oils, animal fats, or recycled restaurant greases. According to the U.S. DOE, pure biodiesel (B100) is considered an alternative fuel under Energy Policy Act. Lower-level biodiesel blends are not considered alternative fuels, but covered fleets can earn one Energy Policy Act credit for every 450 gallons of B100 purchased for use in blends of 20 percent or higher (SCAG, 2012).

Biodiesel is the only alternative fuel to have fully completed the health effects testing requirements under the Clean Air Act (CCA). The use of biodiesel in a conventional diesel engine results in substantial reductions of unburned hydrocarbons, carbon monoxide, and particulate matter compared to emissions from diesel fuel (Consumer Energy Center, 2012a).

Production of biodiesel in the United States dramatically increased in response to federal legislation that went into effect in 2005 included a $1 per gallon blending credit for all biodiesel blended with conventional diesel fuel, but declined in 2009 and 2010 with the temporary loss of the subsidy in conjunction with poor production economics (high feedstock costs relative to market price of diesel fuel). Output is expected to rebound as refiners and other obligated parties strive to meet biodiesel blending requirements mandated by the Renewables Fuels Standard Expansion (RFS2) and could set record levels of production (CEC, 2011).

Biodiesel use in California has been modest over the last several years due to an inadequate level of distribution infrastructure (lack of storage tanks at terminals) and varying approaches and interpretations of regulations controlling the concentration of biodiesel that is permissible in USTs. As such, biodiesel use in California is estimated to have been no higher than 20 million gallons over the last several years. Table 3.3-4 shows the reported retail sale of biodiesel was 1,673,555 gallons in 2010 (CEC, 2012m). Retail sales do not include distributed by commercial fleets, government entities, private cardlocks (unattended dispensing facilities not open to the public), rental facilities/equipment yards, and special user groups. Biodiesel use is expected to increase in California as the distribution and retail infrastructure improves, storage tank issues are fully resolved, and obligated parties under the state's LCFS turn to greater quantities of biodiesel to help achieve compliance with their sales of diesel fuel (CEC, 2011).

TABLE 3.3-4

Reported Retail Biodiesel Sales in California in 2010
(gallons per year)

Reporting Year	Conventional Fuel Component (Gallons)	Biodiesel Component (Gallons)	Total Biodiesel Throughput (Gallons)	Stations Reported
2010	926,043	747,512	1,673,555	44

Source: CEC, 2012m

3.3.3.2 Natural Gas

Natural gas is a mixture of hydrocarbons - mainly methane (CH4) - and is produced either from gas wells or in conjunction with crude oil production worldwide and locally at relatively low cost. The interest in natural gas as an alternative fuel for automobiles stems mainly from its clean burning qualities, its domestic resource base, and its commercial availability to end users. Because of the gaseous nature of this fuel, it must be stored onboard a vehicle in either a compressed gaseous state (CNG) or in a liquefied state (LNG) (SCAG, 2012).

Natural gas vehicles have been introduced in a wide variety of commercial applications, from light-duty trucks and sedans (e.g., taxi cabs), to heavy-duty vehicles (e.g., transit buses, street sweepers, and school buses). In California, transit agency buses are some of the most visible CNG vehicles.

With consumption of natural gas increasing nationwide, 21 percent from 2006 to 2010 (U.S. EIA, 2012a), and California's demand expected to grow up to 96 percent in 2030 (CEC, 2011a), the fueling infrastructure for natural gas vehicles continues to grow. California has over 260 natural gas fueling stations. In southern California alone, there are more than 100 public fueling stations in major metropolitan areas from Los Angeles to the Mexican border (U.S. DOE, 2012).

3.3.3.3 Electricity

Electricity can be used as a transportation fuel to power battery electric and fuel cell vehicles. When used to power electric vehicles (EVs), electricity is stored in an energy storage device such as a battery. Fuel cell vehicles use electricity produced from an electrochemical reaction that takes place when hydrogen and oxygen are combined in the fuel cell "stack." The production of electricity using fuel cells takes place without combustion or pollution and leaves only two byproducts, heat and water.

Electric vehicles have several different charging systems: 120-volt, 240-volt, direct-current, and inductive charging. An electric vehicle that accepts 120-volt power can do so from any standard electrical outlet with a 12- or 16-amp dedicated branch circuit (with no other receptacles or loads on the circuit). A 240-volt system requires the installation of a home charging station and is available at most public charging stations. Direct current (DC) fast charging equipment (480 volt) provides 50 kW to the battery. This option enables charging along heavy traffic corridors and at public stations. Inductive charging equipment was installed for all electric vehicles in the early 1990s, such as the GM/Saturn EV-1, Toyota RAV4 EV, and the Chevy S10, and is still being used in certain areas. Some companies are working on inductive charging options for future electric drive vehicles. The most common types of EVs use either 120-volt or 240-volt electrical systems (SCAG, 2012).

The U.S. DOE's Advanced Vehicle Testing Activity (AVTA) promotes the use of EVs in commercial fleets in the United States. During 1996, AVTA requested and received proposals from interested groups to become qualified vehicle testers (QVT). SCE headed one QVT. According to SCE, California’s approximately 20,000 megawatts of excess off-peak (nighttime) electricity capacity would allow the charging of millions of electro-drive technologies without the need for new power generation facilities (SCAG, 2012).

By 2020, the CEC estimates there will be more than 2.5 million plug-in electric vehicles (PEVs) in California. Over the 2011-2012 period, there will be significant investment in California’s charging infrastructure. The Federal government’s American Recovery and Reinvestment Act of 2009 funds matched with CEC program funds in California and other private and public funding are available to support PEV charging infrastructure for the deployment of PEVs in California. Currently there are about 250 public/commercial plug-in stations in Southern California, with more than 2,400 additionally planned (CEC, 2011).

One of the attractions of PEVs compared to internal combustion engine vehicles is the convenience of home charging instead of fueling at a gas station. ICF International estimates that in the early market, roughly 95 percent of charging will either be at home or at fleet facilities. Charging at home may require additional equipment and the broad consensus is that residential charging is the highest priority for deployment because consumers like the convenience and it encourages charging during periods of off-peak electrical demand. The CEC will consider providing PEV consumers with incentives to help defray the cost of home electric vehicle supply equipment (EVSE) (CEC, 2011).

3.3.3.4 Ethanol and E85

Ethanol, or ethyl alcohol, is a clear, colorless liquid that is the same alcohol that is found in alcoholic beverages. In California, ethanol is blended into gasoline (up to 10 percent) for use by most automobiles or in a more pure state (85 percent) as an alterative fuel.

As of June 2011, there was an estimated 472 million gallons of idle ethanol production capacity in the United States, about 3.2 percent of total production capacity of 14.65 billion gallons. Most of these facilities use corn as their sole or primary feedstock. The pace of construction and expansion of additional ethanol plants that use corn for a feed stock has slowed because the RFS2 regulations restrict affected facilities to use a maximum 15 billion gallons of year by 2015 of that corn based ethanol. Refiners and marketers can use even greater quantities of conventional ethanol but they would not earn additional RFS2 compliance credits.

Most ethanol used for fuel in California is being blended into gasoline at concentrations from five to ten percent, and has replaced methyl tertiary butyl ether (MTBE) as a gasoline component. Most gasoline supplied in the state today contains at least six percent ethanol (Consumer Energy Center, 2012b).

Blends of at least 85 percent ethanol are considered alternative fuels under the Energy Policy Act. E85, a blend of 85 percent ethanol and 15 percent gasoline is used in flexible fuel vehicles (FFVs) that are currently offered by most major auto manufacturers. FFVs can run on gasoline, E85, or any combination of the two and qualify as alternative fuel vehicles under Energy Policy Act regulations (SCAG, 2012).

In the United States, ethanol is most widely produced through fermentation and distillation of corn. Due to poor economic conditions, only three of the five California corn-based ethanol facilities are operating. These three facilities collectively produce 170 million gallons of ethanol per year. The two idle facilities have a production capacity of an additional 71 million gallons per year (CEC, 2011).

As of October 2009, there were nearly 409,636 registered FFVs in California which could use either gasoline or E85. Although there is a large population of FFVs in California, there are a modest but growing number of retail stations that offer E85. As of July 2011, there were approximately 60 stations that offered E85 to the public. Table 3.3-5 shows the reported retail sale of E85 was 1,995,812 gallons in 2010 (CEC, 2012m). Retail sales does not include distributed by commercial fleets, government entities, private cardlocks (unattended dispensing facilities not open to the public), rental facilities/equipment yards, and special user groups. With upgraded infrastructure and increasing availability of E85, sales in California are forecast to rise from 13.2 million gallons in 2009 to more than 3,000 million gallons by 2030 (CEC, 2011n).

During 2010, rail imports represented 95.8 percent of the ethanol consumed and in state production represented 4.2 percent. There were no marine imports of ethanol during 2010 due to unfavorable economics in foreign source countries. However, it is projected that ethanol imports from Brazil will be needed to meet demand mandated by the RFS2 and

LCFS requirements. Especially, since ethanol produced from sugarcane in Brazil is the type of commercially available ethanol that has the lowest carbon intensity

3.3.3.5 Methanol and M85

Methanol, also known as wood alcohol, can be used as an alternative fuel in flexible fuel vehicles that run on M85 (a blend of 85 percent methanol and 15 percent gasoline). Methanol was sold in California as part of a public-private partnership demonstration program between the state of California and oil companies. After the demonstration program ended, however, the oil companies discontinued selling M85. M85 is no longer available.

TABLE 3.3-5

Reported Retail E-85 Sales in California in 2010
(gallons per year)

Conventional Fuel Component)	Ethanol Component	Total E-85 Throughput	Count of Facilities
299,372	1,696,440	1,995,812	36

Source: CEC, 2012m

3.3.3.6 Hydrogen as a Transportation Fuel

Hydrogen is the simplest and lightest fuel. At atmospheric pressure and ambient temperatures hydrogen is a colorless, orderless, tasteless, and non-toxic gas that burns invisibly. Hydrogen is being explored for use in combustion engines and fuel cell electric vehicles. The ability to create hydrogen from a variety of resources and its clean-burning properties make it a desirable alternative fuel.

In 2011, there were approximately 250 hydrogen fuel cell vehicles (FCVs) operating in California, compared to only 15 registered in 2009. These vehicles use stored hydrogen, which is combined with oxygen from the atmosphere through an electrochemical reaction to produce electricity, which is then used to power an electric motor. Like battery electric vehicles, FCVs produce no tailpipe emissions and store the hydrogen fuel in on-board pressure tanks. Today's FCVs hold enough hydrogen in their on-board tanks to support driving ranges of roughly 250 miles. Current refueling is relatively quick, taking about three to five minutes per fill for a 700 bar tank (CEC, 2011).

Although there is no significant transportation distribution system currently for hydrogen transportation use, hydrogen could be transported and delivered using the established hydrogen infrastructure; for significant market penetration, the infrastructure will need further development (SCAG, 2012). Currently, there are 23 hydrogen stations in California, only five of which are public (U.S. DOE, 2012).

3.3.3.7 Propane (LPG)

Propane (C_3H_8) is a three-carbon alkane gas used as a clean-burning, high-energy alternative fuel for decades to power light-, medium-, and heavy-duty propane vehicles.

Propane, also known as liquefied petroleum gas (LPG) or autogas, is produced as a by-product of natural gas processing and petroleum refining. As an alternative fuel, it is stored under pressure inside a tank, as a colorless, odorless liquid and as pressure is released, the liquid propane vaporizes and turns into gas that is used for combustion. Propane has a high octane rating and excellent properties for spark-ignited internal combustion engines. It is non-toxic and presents no threat to soil, surface water, or groundwater.

Propane is a popular fuel choice for vehicles because there is already an infrastructure of pipelines, processing facilities, and storage for its efficient distribution. Domestic availability, high-energy density, clean-burning qualities, and its relatively low cost also add to its popularity.

Propane is the third most commonly used transportation fuel used in the United States, behind gasoline and diesel. Over time, propane has been used in several niche applications such as for fork-lifts, both inside and outside warehouses, and at construction sites. Use of propane can result in lower vehicle maintenance costs, lower emissions, and fuel costs savings when compared to conventional gasoline and diesel. In 2010, the California state fleet operated more than 1,100 vehicles that use propane as an alternative fuel and there are more than 2,200 facilities in California that dispense propane (U.S. DOE, 2012). Propane is an unregulated fuel in California (except for storage and safety issues). Prices are set by supply and demand. Because it is an unregulated commodity, no data is collected by the state on LPG sales or usage. The latest usage data presented by the CEC is that 26 million gallons of propane were dispensed in 2004 (CEC, 2012o).

3.3.4 Renewable Energy

Renewable energy is energy that comes from sources that regenerate and can be sustained indefinitely, unlike fossil fuels, which are exhaustible. The five most common renewable sources are biomass, hydropower, geothermal, wind, and solar. Unlike fossil fuels, non-biomass renewable sources of energy do not directly emit greenhouse gasses.

The production and use of renewable fuels has grown quickly in recent years as a result of higher prices for oil and natural gas, and a number of state and federal government incentives, including the Energy Policy Acts of 2002 and 2005. The use of renewable fuels is expected to continue to grow over the next 30 years, although projections show that reliance on non-renewable fuels to meet most energy needs will continue.

In 2011, consumption of renewable sources in the United States totaled about nine quadrillion British thermal units (Btu) or about nine percent of all energy used nationally. About 13 percent of U.S. electricity was generated from renewable sources in 2011 (U.S. EIA, 2012c). In 2009, 11.6 percent of all electricity came from renewable sources in California (CEC, 2012p).

The Renewables Portfolio Standard (RPS) requires investor-owned utilities, electric service providers, and community choice aggregators regulated by the CPUC to procure 33 percent of retail sales per year from eligible renewable sources by 2020. CPUC issues quarterly renewable energy progress report to the state Legislature, showing that the state's utilities have met the goal of serving 20 percent of their electricity with renewable energy and are already on track to far surpass that goal in 2012 (CEC, 2012n). The quarterly reports report focuses on California's three large investor-owned utilities: Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E). These investor-owned utilities currently provide approximately 68 percent of the state's electric retail sales and analyzing this data provides significant insight into the state's RPS progress. On March 1, 2012, the large investor-owned utilities reported in their 2012 RPS. Procurement Progress Reports that they served 20.6 percent of their electricity with RPS-eligible generation in 2011. Table 3.3-6 shows the renewable electricity use in Los Angeles, Orange, Riverside and San Bernardino in 2011.

TABLE 3.3-6

2011 Renewable Electricity Use in GW

Sector	Los Angeles	Orange	Riverside	San Bernardino	Total
Ag & Water Pump	5	0	3	1	10
Commercial	127	32	48	44	252
Industry	10	3	0	3	16
Mining	7	0	1	0	8
Residential	77	32	37	20	166
TCU	51	0	4	12	68
Total	277	67	94	80	519

Source: California Energy Commission –email sent by Steven Mac on August 24, 2012.

3.3.4.1 Hydroelectric Power

Hydroelectric power, or hydropower, is generated when hydraulic turbines connected to electrical generators are turned by the force of flowing or falling water. In 2007, hydro-produced electricity used by California totaled nearly 43,625 GWh or 14.5 percent of the total system power. In-state production accounted for 69.5 percent of all hydroelectricity, while imports from other states totaled 30.5 percent (CEC, 2012e).

California has nearly 343 hydroelectric facilities with an installed capacity about 13,057 MW. Hydro facilities are broken down into two categories: larger than 30 MW capacity facilities are called "large hydro"; smaller than 30 MW capacity facilities are considered "small hydro" and are totaled into the renewable energy portfolio standards. The amount of hydroelectricity produced varies each year, largely dependent on rainfall. During the drought from 1986 to 1992, production fell to less than 22,400 GWh (CEC, 2012e), while total generation increased from 211,028 GWh to 245,535 GWh over the same period of time.

The larger hydro plants on dams in California (such as Shasta, Folsom, Oroville, etc.) are operated by the U.S. Bureau of Reclamation and the state's Department of Water Resources. Smaller plants are operated by utilities, mainly PG&E and Sacramento Municipal Utility District. Licensing of hydro plants is done by the Federal Energy Regulatory Commission with input from state and federal energy, environmental protection, fish and wildlife, and water quality agencies.

3.3.4.2 Geothermal Energy

Geothermal energy technologies use the clean, sustainable heat from the earth. Geothermal resources include the heat retained in shallow ground, hot water and rock found a few miles beneath the Earth's surface, and extremely high-temperature molten rock, also known as magma, located deep in the Earth. Geothermal energy can be used to generate electricity or used directly in many commercial and industrial applications.

The energy from high-temperature reservoirs (225°F - 600°F) can be used by three different types of geothermal power plants to produce electricity. Dry steam plants use steam from underground wells to rotate a turbine, which activates a generator to produce electricity. Binary cycle plants use the heat from lower-temperature reservoirs (225°F - 360°F) to boil a working fluid, which is then vaporized in a heat exchanger and used to power a generator. The water, which never comes into direct contact with the working fluid, is then injected back into the ground to be reheated. The flash stream plant, the most common type of geothermal power plant, uses water at temperatures above 360°F. As this hot water flows up through wells in the ground, the decrease in pressure causes some of the water to boil into steam which is then used to power a generator (U.S. DOE, 2012a).

The most developed of the high-temperature resource areas of the state is the Geysers. North of San Francisco, the Geysers were first tapped as a geothermal resource to generate electricity in 1960. It is one of only two locations in the world where a high-temperature, dry steam is found that can be directly used to turn turbines and generate electricity. Dry steam does not create condensation, which damages steam turbine blades. Other major geothermal locations in the state include the Imperial Valley area east of San Diego and the Coso Hot Springs area near Bakersfield.

Because of its location on the Pacific's "ring of fire" and because of tectonic plate conjunctions, California contains the largest amount of geothermal generating capacity in the United States. In 2007, geothermal energy in California produced 13,000 GWh of electricity. Combined with another 440 GWh of imported geothermal electricity, then geothermal energy produced 4.5 percent of the state's total system power. A total of 42 operating geothermal power plants with an installed capacity of 1,727 MW are in California, about two-thirds of the total United States' geothermal generation (CEC, 2012q).

Direct use systems harness the energy from low to moderate temperature reservoirs (68°-302°F) for various commercial and industrial uses, such as heating buildings, growing plants in greenhouses, drying crops, heating water at fish farms, and pasteurizing milk. Usually, a well is drilled into a geothermal reservoir to provide a steady stream of hot water. The water is brought up through the well, and a mechanical system -- piping, heat exchangers and controls -- delivers the heat directly for its intended use. A disposal system then either injects the cooled water underground or disposes of it on the surface (CEC, 2012f).

Forty-six of California's 58 counties have lower temperature resources for direct-use geothermal. In fact, the City of San Bernardino has developed one of the largest geothermal direct-use projects in North America, heating at least three dozen buildings - including a 15-story high-rise and government facilities - with fluids distributed through 15 miles of pipelines (Consumer Energy Center, 2012c).

3.3.4.3 Biomass Electricity

Biomass technologies break down organic matter to release stored energy from the sun. There are many types of biomass - organic matter such as plants, residue from agriculture and forestry, and the organic component of municipal and industrial wastes - that can now be used to produce fuels, chemicals, and power. This flexibility has resulted in the increased use of biomass technologies with 53 percent of all renewable energy consumed in the United States in 2007 coming from biomass (U.S. DOE, 2012b).

Biopower is the production of electricity or heat from biomass resources by technologies including direct combustion, co-firing, and anaerobic digestion.

3.3.4.3.1 Direct Combustion

Direct combustion using conventional boilers is the most common method of producing electricity from biomass. Boilers primarily burn waste wood products from the agriculture and wood-processing industries to produce steam that spins a turbine connected to a generator to produce electricity. Municipal solid waste power plants use direct combustion to create electricity through three methods:

- Mass Burn: Sorted municipal refuse is fed into a hopper to feed a boiler. The heat from the combustion process is used to turn water into steam to power a turbine-generator.
- Refuse-Derived Fuel: Pelletized or fluff municipal refuse, which comes from a by-product of a resource recovery operation where non-combustible materials are removed, are used to feed a boiler. The heat from the combustion process is used to turn water into steam to power a turbine-generator.
- Pyrolysis/Thermal Gasification: Related technologies where thermal decomposition of organic material at elevated temperatures with little (Thermal Gasification) to no (Pyrolysis) oxygen or air produces combustible gases. The gases are combusted to produce heat and turn water into steam to power a turbine-generator.

3.3.4.3.2 Co-Firing

Co-firing involves replacing a portion of the petroleum-based fuel in high-efficiency coal-fired boilers with biomass. Co-firing has been successfully demonstrated in most boiler technologies, including pulverized coal, cyclone, fluidized bed, and spreader stoker units.

Co-firing biomass can significantly reduce the sulfur dioxide emissions of coal-fired power plants and is a least-cost renewable energy option for many power producers.

3.3.4.3.3 Anaerobic Digestion

Anaerobic digestion, or methane recovery, is a common technology used to convert organic waste to electricity or heat. It is widely used in the agriculture, municipal waste, and brewing industries. In anaerobic digestion, organic matter is decomposed by bacteria in the absence of oxygen to produce methane and other byproducts that form a renewable natural gas (U.S. DOE, 2012b).

The Los Angeles County Sanitation District (LACSD) operates a combined cycle turmbine facility in Carson that uses digester gas to produce 20 MW. In addition, the LACSD operates a landfill gas Rankine cycle steam plant at the Puente Hills Landfill to produce approximately 48 MW.

Lastly, Royal Farms No. 1 in Tulare, California is a third example of ~~uses~~ anaerobic digestion use~~at their facility~~. Hog manure is slurried and sent to a Hypalon-covered lagoon for biogas generation. The collected biogas fuels a 70 kW engine-generator and a 100 kW engine-generator which helps the farm to be able to meet its own monthly electric and heat energy demand (CEC, 2012g).

There are about 132 waste-to-energy plants in California, with a total capacity of almost 1,000 MW. In 2007, 6,236 GWh of electricity in homes and businesses was produced from biomass: burning forestry, agricultural, and urban biomass; converting methane-rich landfill gas to energy; and processing wastewater and dairy biogas into useful energy. Biomass power plants produced 2.1 percent of the total electricity in California in 2007, or about one-fifth of all the renewable energy (CEC, 2012g).

3.3.4.4 Wind Power

Wind power is the conversion of the kinetic energy of the wind into a useful form of energy. Wind can be harnessed by wind turbines, windmills, windpumps, or sails. These technologies use wind power for practical purposes such as generating electricity, grinding grain, pumping water, or propelling a boat.

A wind turbine works much like the propeller of an airplane. The blades of a turbine are tilted at an angle and contoured such that the movement of the air is channeled creating low and high pressures on the blade that force it to move. The blade is connected to a shaft, which in turn is connected to an electrical generator. The mechanical energy of the turning blades is changed into electricity.

California has several wind farms, a group of wind turbines in the same location used to produce electricity, strategically placed in windy areas, as one of the problems with using wind to generate power is that wind is not always constant.

Wind energy plays an integral role in California's electricity portfolio. In 2007, turbines in wind farms generated 6,802 GWh of electricity - about 2.3 percent of the state's gross system power. Additionally, hundreds of homes and farms are using smaller wind turbines to produce electricity (CEC, 2012h).

There are many windy areas in California. Problems with using wind to generate power are that it is not windy all year long nor is the wind speed constant. It is usually windier during the summer months when wind rushes inland from cooler areas, such as near the ocean, to replace hot rising air in California's warm central valleys and deserts. By placing wind turbines in these windy areas, California's wind power supply variance can be minimized. Utility-scale wind power generation facilities can be found in Altamont Pass, Solano, Pacheco Pass, the Tehachapi Ranges, and San Gorgonio Pass.

3.3.4.5 Solar (Photovoltaic Cells)

Solar energy technologies produce electricity from the energy of the sun through photovoltaic (PV) cells, also known as solar cells. PV cells are electricity-producing devices made of semiconductor materials coming in many sizes and shapes, often connected together to ultimately form PV systems. When light shines on a PV cell, the energy of absorbed light transfers to electrons in the atoms of the PV cell semiconductor material causing electrons to escape from their normal positions in the atoms and become part of the electric flow, or current, in an electrical circuit. While small PV systems can provide electricity for homes, businesses, and remote power needs, larger PV systems provide much more electricity for contribution to the electric power system.

The PV cells for small systems can be purchased in two formats: 1) as a stand-alone module that is attached to the roof or on a separate system; or, 2) using integrated roofing materials with dual functions -- as a regular roofing shingle and as a solar cell making electricity.

California's cumulative installed capacity of PV systems in 1998 was 6.3 MW. In 2008, the capacity of PV systems reached about 440 MW, producing 661.5 GWh of electricity for the state (CEC, 2012i).

3.3.4.6 Solar Thermal Energy

Solar thermal energy (STE) is the technology for converting the sun's energy into thermal energy (heat) through solar thermal collectors. The U.S. EIA classifies solar thermal collectors into three categories:

- Low-temperature: Flat plate collectors are used to warm homes, buildings, and swimming pools.
- Medium-temperature: Flat plate collectors are used to heat water or air for residential and commercial uses.
- High-temperature: Mirrors or lenses are used to concentrate STE for electric power production.

Low and medium-temperature collectors can be further classified as either passive or active heating systems. In a passive system, air is circulated past a solar heat surface and through the building by convection (meaning that less dense warm air tends to rise while denser cool air moves downward). No mechanical equipment is needed for passive solar heating. Active heating systems require a collector to absorb and collect solar radiation. Fans or pumps are used to circulate the heated air or heat absorbing fluid. Active systems often include some type of energy storage system.

High-temperature systems used in solar thermal power plants use the sun's rays to heat a fluid to very high temperatures through the use of mirrors or lenses. The fluid is then circulated through pipes so it can transfer its heat to water to produce steam. The steam, in turn, is converted into mechanical energy in a turbine and into electricity by a conventional generator coupled to the turbine.

California has 11 of the 13 solar thermal power plants in the United States. These facilities are concentrated in the desert areas of the state in the Mojave area. Solar thermal plants produced 675 GWh in 2007, or 0.22 percent of the state's total electricity production (CEC, 2012i).

California's electric utility companies are required to use renewable energy to produce 20 percent of their power by 2010 and 33 percent by 2020 and a main source of the required renewable energy will be solar energy. Many large solar energy projects are being proposed in California's desert area on federal Bureau of Land Management (BLM) land. The developments of 34 large solar thermal power plants have been proposed with a planned combined capacity of 24,000 MW (CEC, 2012i).

3.3.5 Consumptive Uses

3.3.5.1 Transportation

Transportation (i.e., the movement of people and goods from place to place) is an important end use of energy in California, accounting for approximately 40 percent of total statewide energy consumption in 2010, and 11.3 percent of total U.S. energy consumption (U.S. EIA, 2012). Nonrenewable energy products derived from crude oil, including gasoline, diesel, kerosene, and residual fuel, provide most of the energy consumed for transportation purposes by on-road motor vehicles (e.g., automobiles and trucks), locomotives, aircraft, and ships. In addition, energy is consumed in connection with construction and maintenance of transportation infrastructure, such as highways, rail facilities, runways, and shipping terminals. Trends in transportation-related technology foretell increased use of electricity and natural gas for transportation purposes.

Transportation energy is derived from a wide variety of petroleum products. Automobiles and trucks consume gasoline and diesel fuel. Turbine aircraft consume kerosene fuel; trucks and locomotives consume diesel fuel; and ships consume residual fuel oil. The transportation sector consumes relatively minor amounts of natural gas or electricity but propelled mainly by air quality laws and regulations, technological innovations in transportation are expected to increasingly rely on compressed natural gas and electricity as energy sources. Biodiesel, derived from plant sources such as used vegetable oils, is a small but growing source of transportation fuel. Vehicles powered by fuels other than gasoline or diesel are referred to as "alternative fuel vehicles" (SCAG, 2008).

3.3.5.2 Residential, Commercial, Industrial, and Other Uses

Major energy consumption sectors (in addition to transportation) include residential, commercial, industrial uses as well as street lighting, mining, and agriculture. Unlike transportation, these sectors primarily consume electricity and natural gas. Total annual electricity consumption in the SCAG region is approximately 123,678 million kWh (39,432 kWh for residential uses and 84,246 kWh for nonresidential uses) (SCAG, 2008). The residential, commercial, and industrial sectors account for approximately 30, 39, and 19 percent, respectively, of total regional electricity consumption. The agriculture, mining and other uses account for another 14 percent (CEC, 2005).

Within the residential sector, lighting, small appliances, and refrigeration account for most (approximately 60 percent) of the electricity consumption, and within the industrial and commercial sector, lighting, motors, and air cooling account for most (approximately 65 percent) of the electricity consumption. Electricity use by households varies depending on the local climate and on the housing type (e.g., single-family vs. multi-family), as per the four distinct geographic zones in the SCAG region: the cooler and more temperate coastal zone; an inland valley zone; the California central valley zone, and the desert zone, where temperatures are more extreme.

Californians consumed approximately 12,774 million therms of natural gas per year in 2010 (CEC, 2012r). Approximately, 4,662 million therms of natural gas per year were consumed in Los Angeles, Orange, Riverside and San Bernardino Counties (CEC, 2012s). The California Energy Commission (CEC) expects residential natural gas use to increase by 1.3 percent per year and commercial natural gas use to increase by 1.8 percent per year. Industrial natural gas demand increased in 2010 over 2009. The most recent data from the CEC show that the residential sector uses the largest amount of natural gas, both across the state and in the SCAG region. Statewide, the industrial sector was second in the amount of natural gas consumed. The commercial sector falls behind residential, mining, and industrial uses in natural gas consumption in the SCAG region and statewide. The agricultural sector accounts for only one percent of the natural gas use statewide and in the SCAG region.

3.3.5.3 Consumption Reduction Efforts

There are various policies and initiatives to reduce petroleum vehicle fuel consumption and increase the share of renewable energy generation and use in the region. These strategies include energy efficient building practices, smarter land use with access to public transportation, increasing automobile fuel efficiency, and participating in energy efficiency incentive program. All publicly-owned utilities and most municipal-owned utilities that provide electric and natural gas service also administer energy conservation programs. These programs typically include home energy audits; incentives for replacement of existing appliances with new, energy-efficient models; provision of resources to inform businesses on development and operation of energy-efficient buildings; and construction of infrastructure to accommodate increased use of motor vehicles powered by natural gas or electricity (CEC, 2012s).