

Part I: California Uses for Natural Gas

Natural gas is the second most widely used energy source in California. Depending on yearly conditions, 40 to 45 percent of the total is burned for electricity generation; 10 percent is consumed in facilitating the extraction of oil and gas, while the rest is used for everything from space heating to fuel for bus fleets. **Table 1** shows the 2012 shares of natural gas consumed by end-use sectors and in-state electricity generation.

Table 1: Natural Gas Burned in California in 2012*

	Million Therms ¹	Percent of End Use	Percent of Total
Residential	4,854	38.3%	20.8%
Commercial**	2,013	15.9%	8.6%
Industrial	3,374	26.6%	14.5%
Mining: Extract Oil/Gas	2,204	17.4%	9.4%
Agriculture	113	0.9%	0.5%
Other	129	1.0%	0.6%
End-Use Subtotal	12,687		
Electricity Generation	10,636		45.6%
TOTAL	23,323		

Source: California Energy Commission staff, compiled from Quarterly Fuel and Energy Reports.

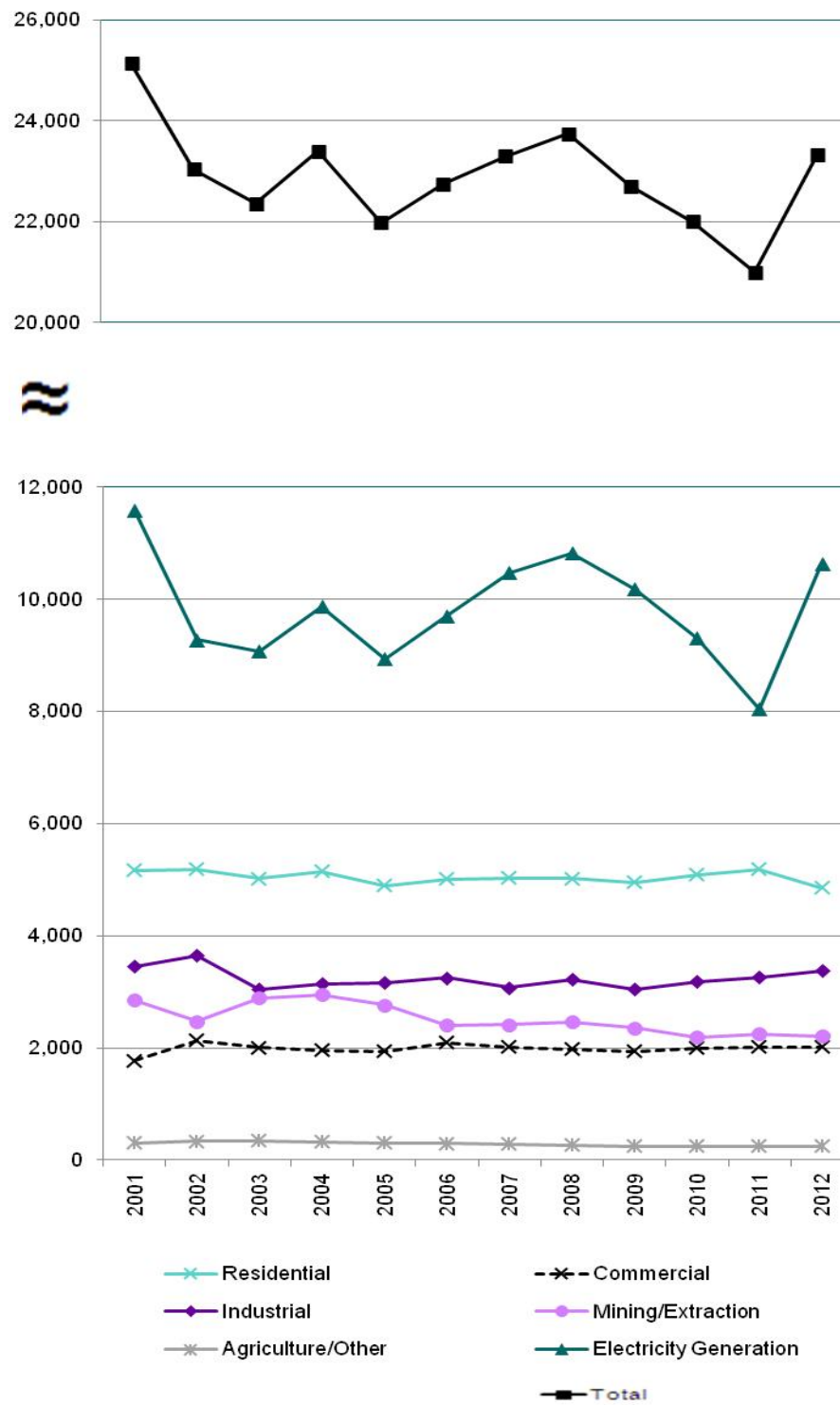
* Does not include out-of-state natural gas used to produce electricity that is imported into California.

** Includes transportation sector natural gas demand.

Total natural gas consumed in-state has seen modest year to year variations, with a slightly downward trend for end-use sectors and a more variable pattern of gas used to fuel electricity generation. **Figure 1** shows the sectors' trends.

1 Compiled from *Quarterly Fuel and Energy Reports* for Demand (<http://ecdms.energy.ca.gov/>) and Supply (http://energyalmanac.ca.gov/electricity/web_qfer), California Energy Commission.

Figure 1: Natural Gas End-Uses in California 2001-2012 (Bcf/Day)



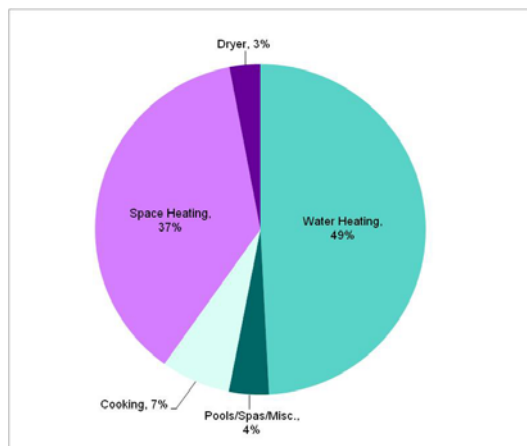
Source: Energy Commission staff, compiled from *Quarterly Fuel and Energy Reports* data.

Natural Gas to Meet Non-Generation End Uses

Over the past decade, aggregate California end-use gas demand has declined slightly from 13,549 million therms in 2001 to 12,686 million therms in 2012. As **Figure 1** shows, industrial and residential use have experienced more declines, while the commercial sector has a slight upward trend. Demand remained essentially flat over the decade despite growth in greater population, commercial square footage and the economy, which is an indication of the effectiveness of energy efficiency programs and standards. Annual per capita demand declined a total of 15 percent from 2001 to the present, although it varies from year to year in response to annual temperatures and business conditions.

Over 90 percent of households with gas service have gas heating, which accounts for 37 percent of all residential gas consumption. Water heating, including that for clothes washers and dishwashers, consumes the largest portion at 49 percent, as shown in **Figure 2**.²

Figure 2: 2009 Residential Uses of Natural Gas



Source: Energy Commission staff, compiled from the 2009 Residential Appliance Saturation Survey.

Natural gas residential energy efficiency savings from appliance and building standards totaled 2,680 million therms in 2010.³ Savings are attributed equally among the building standards, the appliance standards, and a combination of programs and prices.

Building and appliance standards have had a proportionally larger impact on residential natural gas than on electricity and on residential gas use over commercial gas use. Residential gas use is largely concentrated in space heating, water heating, and cooking – all uses that can be addressed by broadly based standards. Commercial uses are more varied, so are impacted more by targeted programs and by prices. Residential standards account for natural gas demand savings of 21 percent in 1990 compared to a 1975 baseline,

² KEMA, *2009 California Residential Appliance Saturation Survey: Executive Summary*, California Energy Commission, October 2010, CEC 200-2010-004,ES, pages 9 and 11

³ CED 2012, Volume 1, and Mid Case Revised Demand Forecast Forms, 2012, Table A-8. http://www.energy.ca.gov/2012_energypolicy/documents/2012-02-23_workshop/mid_case/

33 percent in 2000, and 39 percent in 2010. Commercial standards account for demand savings of 3.8 percent in 1990, 7.0 percent in 2000, and 9.3 percent in 2010.⁴

Except for the industrial and petroleum extraction sectors, natural gas demand is seasonal. In the winter, natural gas consumption spikes as residential and commercial customers ramp up space heating. For gas used in electric generation, it is just the opposite with hot weather causing greater demands to power air conditioning.⁵ These seasonal trends affect both the overall demand for natural gas and the requirements of pipelines and storage to deliver the gas when it is needed and store it when it is not.

Natural Gas to Generate Electricity

Natural gas-fired generation has been the dominant source of electricity in California for many years, as it fuels over half of electricity consumption, both from in-state and imported sources. Because natural gas is a dispatchable resource that fills in the gaps from other resources, use varies greatly from year to year. The availability of hydroelectric resources, the emergence of renewable resources for electricity generation, and overall consumer demand are the variables that shape natural gas use in generation. Gas use was lower in 2011, which experienced above average hydro availability compared to the gas use in 2010 and 2012, which had average hydro availability.⁶ Gas demand variability has also been affected by the widespread additions of variable wind and solar resources.

The thermal efficiency of California's gas-fired generation improved more than 21 percent between 2001 and 2011. An additional 24 newer combined cycle plants and a reduced dependence on generation from aging power plants are the chief reasons. The average heat rate of all gas-fired generation, excluding cogeneration, has declined from 9,997 Btu/kWh to 7,855 Btu/kWh (British thermal units per kilowatt hour) from 2001 to 2011.⁷ The less efficient generation is retained in the system to serve peaking, ramping, and reliability purposes.

Part II: California Natural Gas Supplies

California receives its gas from regionally diverse sources. The majority of its natural gas supply comes from the American Southwest, the Rocky Mountains, and Canada, making up roughly 85 percent of total supplies. The remaining 15 percent is produced in-state, both off-shore and onshore.

Back in 2007, California faced key challenges as the conventional sources of its gas supply appeared to be dwindling and the production costs were increasing. Importing liquefied natural gas (LNG) looked promising and several potential facility sites were proposed. Fast forward to 2012, and the national boom in shale gas has reversed the picture. Unlike electricity which is regional, the natural gas market is continental or even global in scope, so

4 Melissa Jones, Leon Brathwaite, Paul Deaver, et.al., *2012 Natural Gas Market Trends*, California Energy Commission, 2012, CEC-200-2012-004, p. 73.

5 *Ibid*, p. 73-74.

6 Compiled by Jim Woodward from *QFER* resource data, based on DWR water supply indexes.

7 Michael Nyberg, *Thermal Efficiency of Gas-Fired Generation in California: 2012 Update*, California Energy Commission, 2013, CEC-200-2013-002, pages 1-2.
<http://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-200-2013-002>

what happens in the wider market dictates California's supply and prices. The biggest change in continental gas supply has been the expansion of total natural gas production in the Lower 48 United States, which increased 20 percent from 2005 to 2011.

The increase is largely attributed to breakthroughs in horizontal drilling techniques and increased hydraulic fracturing. Shale gas rose from 5 percent of total United States natural gas production a decade ago to 38 percent in 2012.⁸ In addition, the presence of crude oil and natural gas liquids, such as propane, ethane, and butane mixed in with natural gas, boosted the economic viability of seeking gas in marginal shale formations.⁹ It is unclear whether these trends will continue, either because the gas commodity price stays too low to make drilling economic or because environmental concerns may affect the future use of hydraulic fracturing.

Natural gas prices spiked in 2008, then began to drop rapidly. The monthly Henry Hub spot price, which is the United States benchmark price, increased 29 percent per year on average between 2000 and 2008. In contrast, from January 2009 to April 2012, Henry Hub spot prices decreased at an average annual rate of 19 percent. Prices continued to drop through 2012. In 2010 and 2011 they averaged around \$4/MMBtu (million British thermal units). Temporary oversupply caused the price to average under \$3/MMBtu in 2012, which was a 10-year low. In 2013 prices started back up into the \$3-4/MMBtu range as oversupply conditions were resolved.¹⁰

Pipelines and Storage

Six major interstate pipelines deliver natural gas to the California border, and from there, intrastate pipelines take the natural gas to customers for immediate consumption or to storage facilities for later use. The latest interstate pipeline additions are the Ruby Pipeline, LLC, which began operation in July 2011, and the Kern River Expansion, which came on-line in October 2011.¹¹

Over 100,000 miles of natural gas utility transmission and distribution pipelines deliver supplies to California consumers.¹² The regulated natural gas utilities deliver about 80 percent of the gas consumed in California. Another 20 percent is delivered directly off the Kern River/Mojave interstate pipeline system or directly from California production. Utilities procure natural gas for most residential and small commercial customers, referred to as "core" gas customers. Almost all larger volume customers ("noncore" gas customers), such as industrial or electric generation customers, procure their own natural gas supplies.

Natural gas is injected into storage when demand levels are low and spare production is available, and then withdrawn when demand increases. There are 10 operating natural gas

8 Federal Energy Regulatory Commission, *State of the Market 2012*, May 16, 2013, slide 3.

9 *2012 Natural Gas Market Trends*, page 1.

10 FERC *OE Energy Market Snapshot*, January 20, 2013, and *2012 Natural Gas Market Trends*, page 2.

11 *2012 Natural Gas Market Trends*, pages 87-88.

12 CPUC, *California Natural Gas Supply Infrastructure*, January 2010, <http://www.cpuc.ca.gov/PUC/energy/gas>.

storage facilities in California, which use depleted oil or natural gas production fields. All but three of them are owned by either Pacific Gas and Electric or Southern California Gas Company. The other three facilities are independently owned. Utility and independent facilities combined had a storage capacity of 313.7 billion cubic feet in 2012. An additional Southern California facility was approved by the Federal Energy Regulatory Commission in September 2011 and is expected to be available in 2013.¹³

For more information on trends and natural gas issues, please see:

Kavalec, Chris, Nicholas Fugate, Tom Gorin, et.al., 2012. *California Energy Demand Forecast 2012-2022, Volume 1*, California Energy Commission, Electricity Supply Analysis Division, CEC-200-2012-001-CMF.V1.

<http://www.energy.ca.gov/2012publications/CEC-200-2012-001/CEC-200-2012-001-CMF-V1.pdf>

Jones, Melissa, Leon Brathwaite, Paul Deaver, et.al., 2012. *2012 Natural Gas Market Trends*, California Energy Commission. CEC-200-2012-004.

Brathwaite, Leon D., Paul Deaver, Robert Kennedy, et.al., 2012. *2011 Natural Gas Market Assessment: Outlook*, California Energy Commission, Electricity Supply Analysis Division. CEC-200-2012-012-SF.

http://www.energy.ca.gov/2011_energypolicy/documents/index.html#09272011

2012 California Gas Report, prepared by the California Gas and Electric Utilities, July 2012, www.pge.com/pipeline/library/regulatory/downloads/cgr12.p.

¹³ 2012 *Natural Gas Market Trends Report*, page 94.