Issue Brief | FEBRUARY 2016

PACIFIC INSTITUTE

FRACKING IN CALIFORNIA
Overview

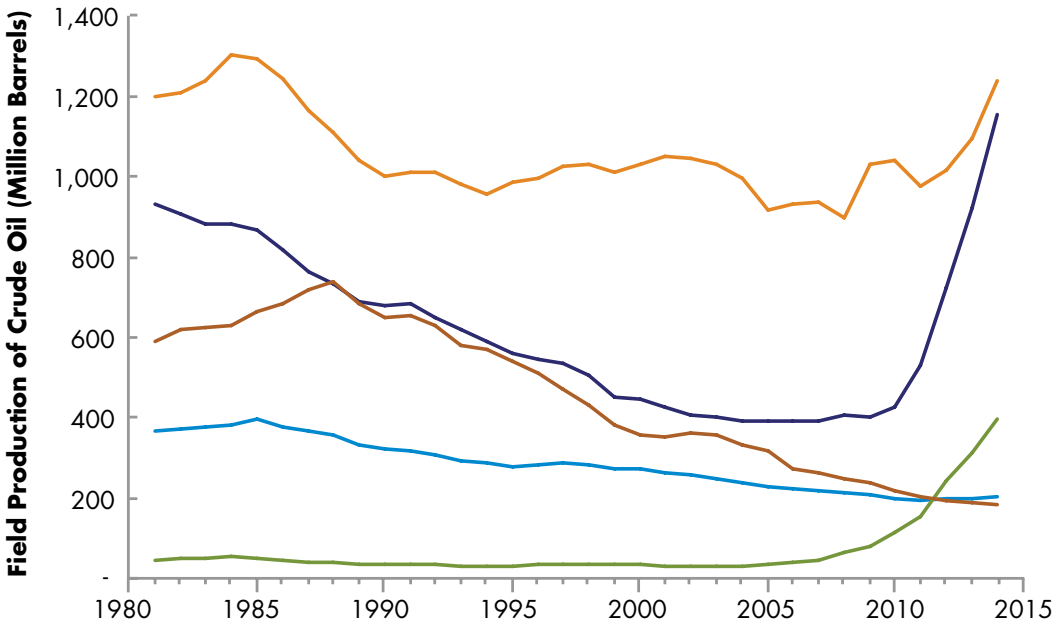
In recent years, the U.S. has seen a massive increase in domestic oil and gas production, driven, in part, by advances in directional drilling and hydraulic fracturing, or "fracking". These new techniques have driven an expansion of oil and gas drilling into areas of the U.S. where there was none before. It has also raised serious concerns about the impacts to communities and the environment, especially related to the pollution of water supplies. Much of the debate around fracking has been informed by experiences in natural gas shale formations, particularly the Marcellus Shale in New York and Pennsylvania. However, fracking in California is different from other parts of the U.S., and the risks to human health and the environment are also different. This Issue Brief provides an overview of oil and gas production in California and the current use of fracking.

OIL AND GAS PRODUCTION IN CALIFORNIA

California has a long history of oil production, with the first commercial oil rigs coming into operation beginning in the mid-19th century. By 1930, the state accounted for 25% of the nation's crude oil production (Ritzius 1993; US EIA 2015a). Production in California peaked in the mid-1980s at 400 million barrels per year and steadily declined for most of the last thirty years (US EIA 2015a). In 2011, however, oil production began increasing for the first time in decades. Today, California is the third highest oil-producing state in the nation, behind Texas and North Dakota (Figure 1).

Figure 1.

United States production of crude oil (in million barrels).



Source: US EIA (2015a)

Oil is produced in 20 of California's 55 counties, from Yolo County in the north to as far south as Orange County (DOGGR 2014). Nearly 71% (or 142 million barrels) comes from Kern County (Table 1). The second largest oil producer in the state is Los Angeles County, which is perched above the largest urban field in the United States. California also produces natural gas from gas production wells and as a byproduct of oil production; however, natural gas production is modest, accounting for less than 1% of gas production in the United States (US EIA 2015b).

Table 1.

Top Oil Producing Counties in California in 2013.

County	Oil production (million barrels)	Percent of California's total oil production
Kern	142	71%
Los Angeles	25	12%
Ventura	9.0	4%
Monterey	7.4	4%
Santa Barbara	6.0	3%
Fresno	5.9	3%
Orange	4.5	2%
San Luis Obispo	0.42	0.2%
Kings	0.12	0.1%
Tulare	0.05	0.02%
All other counties	0.10	0.05%
Total	200	100%

Source: DOGGR (2014)

FRACKING IN CALIFORNIA

Fracking is a technique used to increase oil and gas production from a reservoir. It uses high-pressure fluid – known as "fracking fluid" – to create fractures in the underground rock formation. These fractures are then filled with a granular material ("proppant") that keeps the fracture open after the fluid pressure is relieved and acts as pathways for hydrocarbons to flow to the production well. The first oil production well was hydraulically fractured in Oklahoma in 1949, and the earliest fracturing reported in California dates back to 1953 (CCST and LBNL 2015). Fracking became common in the production of oil starting in the late 1960s, and further technological developments led to widespread application by the late 1970s. Oil companies also use other techniques to increase the permeability of oil formations using strong acids. However, these techniques, specifically matrix acidizing and acid fracking, are neither widely employed in California nor do experts expect them to be in the near future (CCST and LBNL 2015).

Over the past decade, oil companies have fracked about half of all the new oil wells drilled in California, or about 1,800 of the 3,600 new oil wells drilled each year. The vast majority of fracking is concentrated in the southwestern portion of the San Joaquin Valley in Kern County, with 85% occurring in just four oil fields: South and North Belridge, Lost Hills, and Elk Hills (Figure 2) (CCST and LBNL 2015).

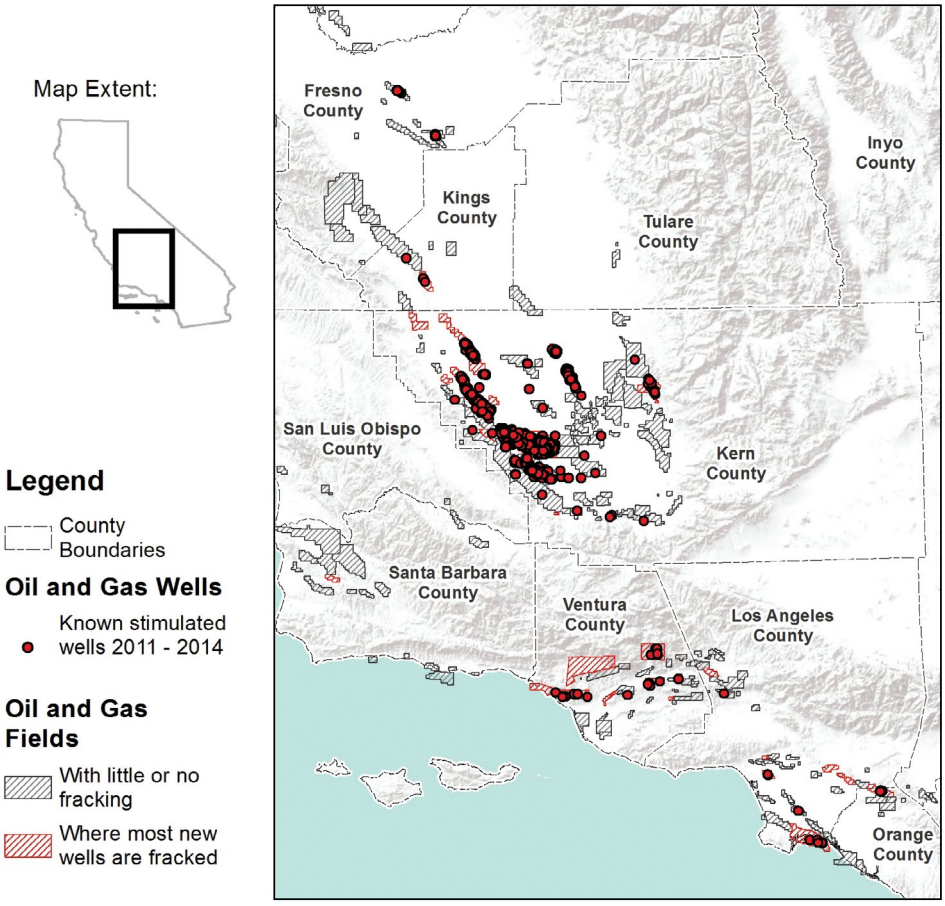
Although data are limited, a smaller number of wells off the coast of California are fracked each year. Since a catastrophic oil leak in 1969 from a platform off of Santa Barbara, the state has not issued new leases for offshore oil and gas development. However, there are still 29 active platforms remaining based on leases issued before 1969. While scientists have found that most offshore production does not use fracking, about 10% of new offshore wells, or 24 wells, are fracked each year in state waters off the coast. There are also oil wells on platforms in federal waters more than 3.5 miles from shore. These facilities are regulated by the federal government rather than the state, and the limited data available suggest that, over the last two decades, about one oil well per year has been fracked in federal waters off of California's coast.

The application of fracking in California differs from elsewhere in the United States in two important ways. First, wells in California are most often stimulated to produce oil, not natural gas. Second, fracturing in California tends to occur in shallower, vertical wells at depths of less than 2,000 feet (CCST and LBNL 2015). In other regions, such as in Texas and North Dakota, fracking takes place along horizontal wells extending several miles in length

and at depths of more than 10,000 feet below ground (Scanlon, Reedy, and Nicot 2014; Siegel 2013). As a result, fracking in California uses far less water per well, on average, than is used in other states. The average water volume used for each fracking operation in California is 140,000 gallons, compared to 4.3 million gallons per well in Texas' Eagle Ford Shale (CCST and LBNL 2015). While using less water, fracking at shallow depths increases the risk of near-surface groundwater contamination. In a study commissioned by the state legislature, scientists concluded that shallow fracturing warrants additional scrutiny and should not be allowed near protected groundwater sources (CCST and LBNL 2015).

Figure 2.

Location of known fracked wells from 2011–2014, and oil and gas fields where most new wells are fracked.



THE FUTURE OF FRACKING IN CALIFORNIA

Fracking has come under increased scrutiny in recent years, particularly in response to a series of reports indicating that California might soon see a huge shale oil boom. In 2011, the U.S. Energy Information Administration released a report stating that California's Monterey Formation holds more than 15 billion barrels of oil that could be extracted with fracking (INTEK Inc. 2011). To put this in perspective, this would mean that California possessed two-thirds of the country's proven oil reserves, a volume equivalent to more than 75 years' worth of production at current levels. This would result in thousands of new wells drilled each year, potentially in water-scarce areas where there had not been oil and gas extraction in the past. Economists at the University of Southern California released a report funded by the Western States Petroleum Association estimating that the Monterey Shale boom could help the state add 2.8 million new jobs by 2020 and collect $25 billion in new tax revenues (Gordon et al. 2013), transforming the California economy by creating 18% growth in the labor force and a 22% increase in state revenue. This optimistic estimate was later downgraded more than once, with the latest estimating that the Monterey Shale contains only 21 million barrels of recoverable oil, a reduction of 99.9% from the 2011 estimate (Sahagun 2014; US EIA 2014; Demas and Schenk 2015).

Early estimates of the oil production potential of the Monterey Shale proved to be over-optimistic, and it no longer seems that California is on the verge of a new oil boom enabled by fracking. Nevertheless,

California oil companies have embraced fracking as a way to extract more oil and gas from oil fields where production has been declining for most of the past three decades. Yet, unlike in other parts of the U.S., fracking in California has not greatly expanded production into new areas, nor does it use millions of gallons of water for each frack. It does, however, bring a unique set of environmental concerns that must be addressed. These issues are covered in subsequent briefs on water use and waste disposal.

REFERENCES

California Council on Science & Technology (CCST), and Lawrence Berkeley National Laboratory (LBNL). (2015). An Independent Scientific Assessment of Well Stimulation in California, Volume I: Well Stimulation Technologies and Their Past, Present, and Potential Future Use in California. Vol. I. Sacramento, California: California Council on Science and Technology and Lawrence Berkeley National Laboratory. http://ccst.us/projects/hydraulic_fracturing_public/SB4.php.

Demas, A., and C. Schenk. (2015). USGS Estimates 21 Million Barrels of Oil and 27 Billion Cubic Feet of Gas in the Monterey Formation of the San Joaquin Basin, California. USGS. October 6. http://www.usgs.gov/newsroom/article.asp?ID=4352.

Division of Oil, Gas, and Geothermal Resources (DOGGR). (2014). Well Counts and Production of Oil, Gas, and Water by County – 2013. ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2013/2013%20County%20Production.pdf.

Gordon, P., J. Park, F. Aminzadeh, A. Rose, J. E. Cox, and K. Hopkins. (2013). Powering California: The Monterey Shale & California's Economic Future. Los Angeles: University of Southern California Global Energy Network. http://gen.usc.edu/assets/001/84955.pdf.

INTEK Inc. (2011). Review of Emerging Resources: Us Shale Gas and Shale Oil Plays. U.S. Energy Information Administration. http://www.eia.gov/analysis/studies/usshalegas/pdf/usshaleplays.pdf.

Ritzius, D.E. (1993). California Oil, Gas, and Geothermal Resources: An Introduction, Fifth Edition. Sacramento, CA: California Department of Conservation, Division of Oil, Gas, and Geothermal Resources. ftp://ftp.consrv.ca.gov/pub/oil/publications/tr03.pdf.

Sahagun, L. (2014). U.S. Officials Cut Estimate of Recoverable Monterey Shale Oil by 96%. LA Times, May 20. http://www.latimes.com/business/la-fi-oil-20140521-story.html.

Scanlon, B.R, R.C. Reedy, and J. Nicot. (2014). Comparison of Water Use for Hydraulic Fracturing for Shale Oil and Gas Production versus Conventional Oil. Environmental Science & Technology, September. doi:10.1021/es502506v.

Siegel, H. (2013). Bakken 5-Year Drilling & Completion Trends. DTC Energy Group, Inc. http://www.dtcenergygroup.com/bakken-5-year-drilling-completion-trends/.

United States Energy Information Administration (US EIA). (2014). Annual Energy Outlook 2014. DOE/EIA-0383. Washington, DC: United States Energy Information Administration. http://www.eia.gov/forecasts/archive/aeo14/.

United States Energy Information Administration (US EIA). (2015a). Crude Oil Production. Petroleum & Other Liquids. September 30. http://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_a.htm.

United States Energy Information Administration (US EIA). (2015b). Natural Gas Gross Withdrawals and Production. Natural Gas. September 30. http://www.eia.gov/dnav/ng/ng_prod_sum_a_EPG0_FGW_mmcf_a.htm.

Acknowledgements

This work was made possible by support from the Kindling Foundation.

Pacific Institute

654 13th Street, Preservation Park, Oakland, CA 94612

510-251-1600 | info@pacinst.org | pacinst.org

ISBN: 978-1-893790-68-1