

# Powering California: The Monterey Shale & California's Economic Future



USC Global Energy Network  
A Joint Initiative of  
USC Price School of Public Policy & USC Viterbi School of Engineering  
In association with The Communications Institute

## Overview

The Monterey Shale Formation in California contains vast reserves of oil. This study presents a preliminary examination of one important aspect of developing the resource – the economic impact on the state's economy. Working from a model created by economists from the University of Southern California (USC) Price School of Public Policy and informed by and applied to a development scenario formulated by the USC Viterbi School of Engineering, the study concluded: *“the prudent development of the Monterey Shale could add hundreds of thousands of new jobs to California over the next decade while stimulating economic growth and generating significant new state and local tax revenues.”*

Reaching the oil locked within the shale requires advanced oil-extraction technologies, including advanced geophysical monitoring technologies, horizontal drilling and hydraulic fracturing, the latter of which may pose as yet undefined environmental risks. Moreover, development will place large demands on local physical and social infrastructure.

The study was funded in part by a grant from the Western States Petroleum Association but was conducted by an independent USC research team. The study also drew upon USC resources for on-going research of various aspects of shale-oil development.

## California Faces Continuing Economic Challenges

California has long served as the incubator for emerging energy technologies, and the state has taken advantage of both these advances and its bountiful natural resources to become a leader in the generation of renewable power. Now, these same technological and resource advantages can enable the state to return to leadership in another key energy field: the production of oil.

**Oil and California** - Increasing California's oil production might seem an unlikely prospect given historical patterns: according to the California Energy Commission, California's crude oil production fell by 47% between 1985 and 2010. And yet the recent experience in other states is instructive. North Dakota, South Dakota, Wyoming, Pennsylvania, Ohio, and Texas are witnessing powerful economic revivals stimulated in large part by a boom in oil and gas production within their borders. In North Dakota, for example, as oil production soared from some 200,000 barrels per day in 2008 to more than 750,000 barrels per day in 2012 (and as natural gas production throughout the state rose as well), that state's gross domestic product grew by an annual average of 6.7% for the years 2008 to 2011—the nation's fastest growth rate—while unemployment fell to 3.2% —the nation's lowest.

**U.S. Energy Security** - A key factor in the North Dakota energy boom has been the extraction of oil and gas from deep-shale reserves—specifically, the Bakken Shale Formation—primarily through advanced oil-extraction technologies like horizontal drilling and hydraulic fracturing. These advanced extraction techniques, in fact, underlie independent forecasts of an oil and gas production boom in the United States during the decades ahead. For instance, in its World Energy Outlook 2012, released in November 2012, the International Energy Agency projected that, by 2035, the United States would become 97% energy self-sufficient in net terms—a sharp reversal from historically persistent U.S. import-dependency—in large part due to the surge in advanced-technology production of natural gas and, to a lesser extent, of oil up to now.

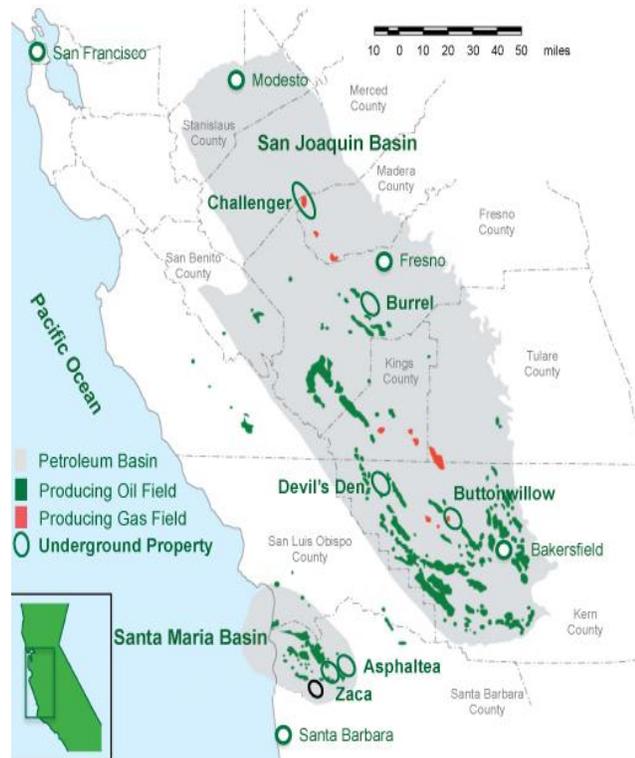
### Exploring the Potential of Monterey Shale Development

Why are these trends relevant for California? Simply put, California boasts perhaps the largest deep-shale reserves in the world. Those reserves exist within the Monterey Shale Formation, a 1,750 square mile swath of mostly underground shale rock that runs lengthwise through the center of the state, with the major portion in the San Joaquin Basin. The U.S. Energy Department estimates that the Formation contains more than 15 billion barrels of oil, accounting for approximately two-thirds of the shale-oil reserves in the United States.

### California’s Monterey Shale Formation

**Projecting Economic Impacts** - Recognizing this potential, study research team sought to quantify the economic consequences of the increased production of oil from the Monterey Shale via such advanced extraction technologies as hydraulic fracturing. Describing economic impacts many years into the future is challenging, and precise forecasts are tenuous. Models develop numerical results that can give an impression of pinpoint accuracy. A better way to proceed is to interpret the numerical results so as to identify a range of the most likely *patterns* of development, and to set forth a set of conservative, median-scenario numerical results, but keeping in mind that it is the patterns we want to identify. The ones presented here are based on the development witnessed in recent years in North Dakota’s oil boom – which had the most moderate expansion of the oil-boom states up to the year 2010 (the year for which we had all necessary economic data). We also adapted U.S.national averages of unconventional to conventional oil extraction, and very limited data from California oil producers to which we applied oil well“ decline curves.”

Source: Underground Energy ([ugenergy.com](http://ugenergy.com))



## The Potential Economic Impact of Monterey Shale Development

The research team employed sophisticated economic modeling (the widely used ARMA econometric models in this case) to determine the likeliest potential consequences of shale-oil development on California's economy. The study's main results are shown in the accompanying table.

1. **Create more jobs.** Developing oil from the Monterey Shale could **add from 512,000 to 2.8 million new jobs** in California, depending upon the year.
2. **Stimulate economic growth.** Total economic activity in the state, as measured by the state's gross domestic product (GDP), could **increase by 2.6% to 14.3%** on a per-person basis.
3. **Increase personal income.** On a statewide basis, aggregate personal income could **grow by an average of from 2.1% to 10.0%**.
4. **Boost government revenue.** Tax revenue collected by California state and local governments could **grow by \$4.5 billion to \$24.6 billion**.

### Overview of Incremental California Economic Impacts

	Year	Baseline <sup>1</sup>	Increment <sup>2</sup>
<b>Per Capita GDP (\$)</b>	2015	62,000	1,600
Economic activity within the state, divided by the state's population	2020	72,000	10,300
	2025	82,000	11,000
	2030	93,000	8,300
<b>Employment (jobs)</b>	2015	24,329,100	512,000
Total number of people employed in the state	2020	28,253,200	2,815,800
	2025	32,177,200	2,652,800
	2030	36,493,700	1,770,900
<b>Personal Income (\$ millions)</b>	2015	1,928,600	40,600
Total of all income earned by all people within the state	2020	2,239,700	223,200
	2025	2,550,700	210,300
	2030	2,892,900	140,400
<b>Tax Collections (\$ millions)</b>	2015	212,900	4,500
Tax revenue by state, local, & county government	2020	247,300	24,600
	2025	281,600	23,200
	2030	319,400	15,500

Source: *Powering California: The Monterey Shale & California's Economic Future*

<sup>1</sup> Baseline values refer to economic activity in the absence of accelerated shale-oil development.

<sup>2</sup> Incremented values are the additions to the baseline from accelerated shale-oil development.

The increase in economic activity would take place not only in the oil industry but would extend to every sector up and down the supply-chain and from increases in income and consumer spending. Likewise employment opportunities would arise in every sector. Based on the experience of other states, not only would state unemployment fall, but significant migration of properly skilled workers into California would occur. More job gains can be captured by Californians with appropriate education and training.

The project originated from ongoing research conducted by the Reservoir Monitoring Consortium (RMC) and Induced Seismicity Consortium (ISC) under the leadership of Viterbi research professor Fred Aminzadeh, the report's principal investigator, who also serves as director of the USC Global Energy Network. The Viterbi and Price Schools partnered on the study, as they did in projects last year on energy and sustainability. Adam Rose, who has worked on energy and environmental economics for 40 years, served as liaison between researchers from different fields working on the report.

USC Price School Professor Peter Gordon and Professor JiYoung Park, of the University at Buffalo, are co-authors with Aminzadeh of the core chapter titled "Macroeconomic Impacts of Advanced-Technology Oil Drilling in the Monterey Shale." The study also contains two background chapters on energy and the California Economy written by Kevin Hopkins, TCI Director of Research. TCI President Jack Cox also contributed to the development and production of the full report.

The authors named six concerns for shale drilling that need to be addressed: potential contamination of water supply, increased seismic activity, land-use challenges, overwhelming small communities, a continued reliance on oil, and criteria air pollutants and greenhouse gases. The authors intend to study these environmental and technological issues, including risks and uncertainties, in a series of follow-on reports. The researchers anticipate that a wide range of funding sources including foundations, government agencies, industry, environmental, and public-interest groups.

## Conclusion

As the experience in other states demonstrates, development of shale-oil reserves has resulted in significant increases in employment, incomes, and government tax revenues. The current study suggests that, through the prudent and carefully regulated development of the Monterey Shale, the state of California could potentially achieve proportionately large increases in the production of crude oil, leading to similarly large economic gains. The study is intended to expand the base of information that will lead to improved policy decisions for the people and businesses of California.

**Note:** This study is based on careful analysis of available data from U.S.DOE, industry, and other sources. However, the available data are limited, and thus the report represents only a preliminary overview of the economic impact of development of the Monterey Shale on California. More conclusive estimates will require more reliable production data. Moreover, this report is intended to set forth facts and projections with regard only to the potential economic impacts of the development of oil the Monterey Shale in order to serve as a foundation for informed decision-making. Further research will be undertaken subsequently to review relevant environmental and other issues. This study does not offer any conclusions or judgments as to the operational, environmental, and regulatory practices involved with the use of advanced extraction technologies in the development of shale oil. This work was made possible in part through a grant from the Western States Petroleum Association. However, the study's conclusions were independently researched by the study's authors.

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