Summary

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Hydraulic fracturing in a variety of forms has been widely applied over many decades in California. However, the practice of using well stimulation has mostly been different from the high-volume hydraulic fracturing (using long-reach horizontal wells) conducted elsewhere, such as in the Bakken formation in North Dakota or the Eagle Ford formation in Texas. In California, hydraulic fracturing tends to use less water, the hydraulic fracturing fluids tend to have higher chemical concentrations, the wells tend to be shallower and more vertical, and the target geologies present different challenges. This is because the majority of the oil produced from fields in California is not from oil source rocks (i.e., organic-rich shales in the Monterey Formation), but rather from porous sandstone and diatomite reservoirs, or from naturally fractured siliceous mudstones, porcelanites, and dolomitic mudstones, which contain oil that has migrated from source rocks. Consequently, the experiences in other states are largely not applicable to California.

As to the prospects for expanded oil production in California using hydraulic fracturing in the future, the likelihood of finding major new shale plays similar to what has occurred in other states is quite uncertain. However, about 5 to 16 billion barrels of oil from additional oil production, beyond reported reserves, could be produced through the application of currently used technology in existing oil fields of the San Joaquin and the Los Angeles Basins. Production from Monterey diatomite reservoirs the San Joaquin Basin depends in part on hydraulic fracturing. New production in and around these existing production sites would likely also be amenable to production with hydraulic fracturing. New production in and around existing fields that currently does not depend on well stimulation technologies (WST), such as in the Los Angeles Basin, could well continue to be produced without WST in the future.

Current water demand for well stimulation operations in California is a small fraction of statewide water use. Even so, it can contribute to local constraints on water availability, especially during extreme droughts, such as the drought California is currently experiencing. Most of the chemicals reported for hydraulic fracturing treatments in California are not considered to be acutely toxic, but a few reported chemicals do present concerns for acute toxicity. Groundwater contamination from hydraulic fracturing has not been observed in this state, but a lack of data about the location and quality of groundwater resources, lack of knowledge about existing wells which might provide leakage paths, and inconsistent monitoring of potential groundwater impacts, limit our ability to assess whether and where water contamination from hydraulic fracturing activities have been or will be a problem. In some cases, hydraulic fracturing is taking place in shallow wells, in regions where the quality and location of the groundwater is not specified. These situations lack the inherent safety provided by conducting hydraulic fracturing thousands of feet below potable groundwater resources, and thus deserve closer scrutiny.

Hydraulic fracturing as currently practiced in California does not present a risk for induced seismic events of significance. The duration and extent of pressure increases due to hydraulic fracturing is relatively small compared to what is normally required to produce a felt, let alone a damaging, earthquake. In contrast, disposal of produced water from oil and gas production in deep injection wells has caused felt seismic events across the United States. Protocols similar to those that have been developed for other types of injection wells, such as for geothermal injections, can be applied to limit this risk. The direct emissions of hydraulic fracturing are a small component of total air pollution and methane, but these emissions occur largely in the San Joaquin Valley, which is often out of compliance for air quality. Another consideration is that all greenhouse gas (GHG) emissions are relevant under California's climate laws.

This review focuses on direct environmental impacts of WST, including direct impacts to water supply, water quality, air quality, GHG emissions, seismicity, ecology, traffic and noise, while indirect impacts of WST-enabled oil and gas production receive only cursory treatment. Based on this limited assessment, there is evidence that if the future brings significantly increased production enabled by WST, the primary impacts of WST on California's environment will be indirect impacts, i.e. those due to increases and expansion in production, not the WST activity itself. Impacts of WST-enabled production will vary depending on whether this production occurs in existing rural or urban environments or in regions that have not previously been developed for oil and gas and the nature of the ecosystems, wildlife, geology and groundwater in the vicinity.

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