

## Environmental Impact Assessments and Hydraulic Fracturing: Lessons from Two U.S. States

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**ABSTRACT** Although the United States has been stimulating well production with hydraulic fracturing (“fracking”)<sup>1</sup> since the 1940s [1], high-volume hydraulic fracturing (HVHF) combined with horizontal drilling is a relatively recent [2, 3] development with potential to adversely impact human health [4], environment [5], and water resources [6], with uncertainty about impacts and gaps in the data on HVHF compared to conventional drilling techniques [7]. Part of protecting environmental and public health is identifying potential risks before licenses are issued and drilling operations proceed. To this end, two case studies, focusing on the environmental impact assessment (EIA) procedures of California and New York, are analyzed in this paper. Both states have histories of strong environmental protection law and policy [8–10] and legally require an EIA to be conducted before development of HVHF sites [11, 12], an outgrowth of the 1969 federal National Environmental Policy Act (NEPA). New York State conducted what appears to be a thorough EIA [13] and concluded that as there were too many gaps in the data on HVHF, fracking *could not proceed*. California’s EIA, which was less extensive, and did not consider health impacts [14], concluded that HVHF *could proceed*, relatively unabated. A comparison of these cases illustrates that the processes designed to ensure adequate identification, monitoring, and assessment of environmental impacts are prone to differences [15]—an outcome of the fact that laws governing HVHF in the US are not consistent across, nor controlled at, the federal level [16, 17].

### KEY MESSAGE

Readers of these case studies will learn how two American states analyzed the potential risks of fracking through their respective environmental impact assessment mechanisms and came to different decisions. New York chose to implement a moratorium on fracking during its seven-year environmental and health review process, and ultimately enacted a statewide ban, while California decided to allow fracking to proceed, relatively unabated, after an EIA process of one year—which, unlike New York, did not include a health impact assessment.

Key substantive content: An overview of fracking; insights into the environmental impact assessment process and its policy bases; outline of key legal instruments.

Key Messages: hydraulic fracturing is contentious; risks need to be managed; environmental assessment is subjective; legislation is complex; politics and the views of the public are not always aligned.

### INTRODUCTION

Hydraulic fracturing (fracking), combined with horizontal drilling, has made previously inaccessible oil and gas reserves trapped in shale rock commercially viable, though research arguably indicates evidence of risk to environment [18] and public health [19]. The technology may cause adverse impacts to water supply, ground and surface water contamination [20], air quality impacts [21, 22], and change in “quality of life,” as communities become

1. A note about terminology: as unconventional gas extraction can refer to a variety of methods, including electronic extraction techniques, this paper is limited to hydraulic fracturing, and will use the shorthand term ‘fracking’ for simplicity. The scope will include not only the explicit process of hydraulic fracturing of shale rock—a roughly two-week process—but also what occurs before and after.

heavily industrialized with expansion of gas extraction operations [23]. There is also evidence of possible seismic activity resulting from fracking activity [24]. Studies have shown that there is potential for contamination [25] leading to environmental and public health effects at all stages of the well's existence, from site preparation to decommissioning at the end of its functional life [26–28].

### CASE EXAMINATION

The US has no comprehensive national regulatory framework to control, monitor, and assess the specific environmental and health impacts of *fracking* per se. Rather, regulation is carried out through regulatory frameworks governing traditional methods of oil and gas extraction and processing and also those designed for general environmental protection [29], consequently varying by state [30]. The National Environmental Policy Act of 1969 (NEPA) [31] mandates that states conduct an environmental impact assessment (EIA) prior to commencing hydraulic fracturing operations, unless the proposed project fits one of the five “rebuttable presumptions” that would *not* require an EIA, such as the case where drilling had previously occurred on a good site within the past 5 years [32]. EIA processes are developed and regulated at the individual state level and applied depending on the type of operation and potential for environmental impacts [33]. An EIA allows information on potential adverse environmental impacts of large-scale physical projects to be identified in advance and mitigated or avoided, and helps to inform the public and decision-makers prior to a project being carried out. It is not designed to result in an automatic veto, but aims to take a balanced “sustainable development” view. Under the requirements of NEPA, state and federal environmental agencies must create an environmental impact statement (EIS), to scope, and evaluate, all possible environmental impacts, and alternatives to the proposed operation (a process that can produce considerable documentation) for projects that could “significantly affect the quality of the human environment.” [34] Stakeholders’ views and public opinion must be included in the EIS. NEPA does not “police” the EIA process, leaving this up to state regulators.

### EIA

An EIA is an iterative, precautionary process designed to identify the potential environmental impacts of a project and miti-

gate these before the project is approved and can begin. In the case of an EIA conducted prior to approval of a fracking site, in addition to identifying environmental impacts, baseline data are collected so that impacts that occur during the project and after can be identified. Pre-drilling data typically include measurements of groundwater and surface water, air quality, community health profiles, [35] prediction of impacts to the environment (and human health in some jurisdictions), analysis of the significance of impacts, and, if necessary, plans for mitigation of impacts. The EIA ideally includes stakeholder and public engagement at all stages, and results in an EIS and a non-technical summary to be released to the public [36]. While both New York State and California legally require environmental assessments prior to beginning hydraulic fracturing operations [37], as the processes are not standardized at the federal level, each state determines the breadth, length, and scope of the review [38].

### General Stages of the Iterative Process of EIA [39]

1. **Project Proposal:** consideration of alternate approaches and selection of project approach
2. **Screening:** determination of whether EIA is needed
3. **Scoping:** determination of all issues to be addressed
4. **Baseline Data Collection:** collection of relevant environmental data
5. **Impact Prediction:** anticipation of likely environmental impacts resulting from the development
6. **Impact Assessment:** evaluation of the significance of identified impacts
7. **Mitigation:** measures to prevent or reduce negative effects, or enhance positive impacts
8. **EIS:** produce a formal document detailing required information related to the environmental impacts of the proposed operation; includes information from previous EIA stages (*formal requirement*)
9. **EIS Review:** examination of EIS by relevant authority and other stakeholders and the public (*formal requirement*)
10. **EIA Follow-Up:** monitor environmental impacts and collect data to manage environment

## RESEARCH PROBLEM

This research compares how the EIA process is applied in two states considering proposals to develop oil and/or gas resources using techniques of fracking. California [40] and New York [41] are two large, populous [42] states, with exploitable shale reserves. In California, the shale reserves are predominantly comprised of oil, while in New York, the reserves are mostly shale gas [43]. However, the techniques for extracting both unconventional oil and unconventional gas are similar as they include well stimulation such as hydraulic fracturing and horizontal drilling.

Literature evaluated for this paper has provided mixed evidence of potential environmental and health-related impacts associated with fracking. In some cases, there is the potential for “serious” impact and in others, there is “minimal” impact. What is clear is that there is the potential for health and environmental impacts, *period*, but the scale and risk varies [44]. The purpose of an EIA is thus to determine the scale of impacts of a proposed project, as well as the associated cumulative impacts. The literature makes clear that distance, size, scale, and spatial issues are factors [45] to be considered when evaluating impacts, for example, the size of the fracking site, its location, and so on. The closer the proximity of a fracking well to a water source, the higher the risk potential for contamination of groundwater and drinking well water [46]. Studies have evidenced that humans and natural habitats closest to fracking sites are at greater risk of harm [46].

The purpose of the EIA is to identify potential environmental effects. The way in which EIA is carried out is crucial. Will an EIA be conducted in a manner that covers the bare minimum legal requirements, or in a way that is much more thorough and exceeds the basic minimum legislative requirements?

EIAs are especially important in light of exemptions to several national and Environmental Protection Agency (EPA) laws that would normally regulate certain potential impacts and operations involved in hydraulic fracturing. For example, the Energy Policy Act of 2005 [47] Public Law 109–58, 119 Stat. 594 [48] specifically exempts fluids used in hydraulic fracturing from the protective provision of the Clean Water Act 1972 (as amended) [49, 50], Clean Air Act 1970 (as amended) [51], Safe Drinking Water Act 1974 [52], and Comprehensive Environmental Response, Compensation, and Liability Act of 1980 [53]. Because of these exemptions, the US EPA only has the power to regulate fracking when *diesel fuels* are employed in the process

[54]. Therefore, it can be argued that EIAs carried out by states *prior* to beginning fracking operations are particularly important in order to ensure that the potential risks are acknowledged and mitigated.

## CALIFORNIA CASE STUDY

While California has a long history of oil and natural gas development, attention began to focus on potential risks of unconventional methods of well development around 2010, in part because of public awareness, and because the potential for using the technique for previously inaccessible reserves was ramping up [55]. Following law suits [56] brought by environmental groups against the State’s Department of Conservation for potential environmental impacts of hydraulic fracturing, California’s State Legislature began to consider regulation specific to the technology [54]. California’s Senate Bill 4 (SB 4) was ultimately passed by the legislature and signed into law by Governor Jerry Brown (Democrat) in September 2013, the first law specifically designed to regulate fracking in the state, overseeing “drilling, operation, maintenance, and abandonment of oil and gas wells.” [57] SB 4 required the DOGGR to consult with stakeholders to develop regulations [58], implement a new permitting system [59], and require operators of oil and gas wells to disclose to the public the amounts and types of chemicals used in fracking or acidization fluids [59]. SB 4 mandated two reports: first, an environmental impact report (EIR), to be written by the California Department of Conservation’s Division of Oil, Gas and Geothermal Resources (DOGGR), to provide information on the potential environmental impacts of hydraulic fracturing. The final draft of the EIR, [60] “Analysis of Oil and Gas Well Stimulation Treatments in California,” was certified by DOGGR Supervisor Dr. Steven Bohlen on July 1, 2015 [57], *before* the completion of the second mandated report—a three-part independent scientific report commissioned by California’s Natural Resources Agency and developed by the California Council on Science and Technology (CCST) [59]. This latter “surveys past and current hydraulic fracturing operations in California and assesses where and to what extent hydraulic fracturing operations will continue.” [61] Importantly, both evaluative reports were released only *after* California had issued its final regulations on fracking—it does not seem that the regulations were revised much after the reports had been issued and is also unclear if they will lead to future amendments [62, 63].

## CALIFORNIA'S ENVIRONMENTAL IMPACT REPORTS AND FEEDBACK

California's final EIR was conducted relatively quickly with the review lasting only one year [14]. This is arguably because of pressure on the legislature, both from environmental groups and non-governmental organizations (NGOs) who contended that fracking was allowed to proceed without proper assessment and regulation. In 2013, 13 bills were proposed but only one was enacted, SB 4, arguably a result of compromises that left neither industry nor environmental groups satisfied [62]. Pursuant to California's Environmental Quality Act (CEQA), California Department of Conservation's DOGGR released a first draft of the Environmental Impact Report (DEIR) for review, to which the Center for Biological Diversity, the Sierra Club, the Natural Resources Defense Council (NRDC), and Los Angeles Waterkeeper responded with a 100-page comment letter, on March 16, 2015, outlining the shortcomings and gaps in the report. The cover letter for the report stated:

“Our evaluation of the Project, as well as that of two independent experts retained by NRDC, concludes that well stimulation will result in significant environmental impacts that have not been disclosed or mitigated in the [Draft Environmental Impact Review].

Well stimulation puts California communities at risk of surface and groundwater contamination, fresh water depletion, air pollution, greenhouse gas emissions, induced seismicity, land degradation, wildlife habitat fragmentation, and a host of other harmful consequences.

We urge the Department and its Division to adhere to its mandate under the California Public Resources Code ‘to prevent, as far as possible, damage to life, health, property... natural resources’ and ‘damage to underground and surface waters’ and to, for that reason, impose an immediate moratorium on hydraulic fracturing, acidizing, and other forms of well stimulation in California” [64]

The letter identifies several problems and gaps, asserting that the “DEIR's project description is inaccurate, obscure, and misleading,” [65] and lacks “critical information on the lifecycle effects of well stimulation activities,” [66] “overly narrow objectives” [67], and relies on regulations that have not yet been implemented.

Another criticism of the report was its “lack of science.” This was apparently because the independent assessment

by the CCST report [68] was due to be released after the EIR was finalized and was therefore not included in the report [14]. The groups also enumerated problems with the mitigation efforts, explaining that the “DOGGR cannot assure that the limited set of mitigation measures it mentions will be enforceable, even at sites where it will serve as Lead Agency, because it has not clearly specified which measures it intends to enforce.” [69] Additionally, although there is evidence of significant [70] impacts to health [71–73], no separate public health study was conducted [14].

## NEW YORK CASE STUDY

In 2008, there were initial estimates that the Marcellus Shale formation that includes regions in West Virginia, Pennsylvania and New York, might contain at least 350 trillion cubic feet of natural gas (since lowered), leading to a rush to lease land in expectation of future production, and West Virginia and Pennsylvania began drilling [74, 75]. But in New York, there was also concern about the potential impact on the state's water supply, raised by New York City [76], which drew part of its water supply from the watershed in the Marcellus region. New York City conducted a study that showed potential for environmental damage, and vowed that no drilling would be allowed in the watershed [77]. The State of New York has thus had a “de facto ban on the controversial drilling practice...” dating back to 2008. With this background, and as the State moved to more fully assess the potential risks and reach a final decision, some towns independently initiated their own bans. By 2014, some 150 had moratoria on the process [78]. In order to reach a permanent decision, New York State's Department of Conservation (DEC) was tasked with conducting a formal assessment of environmental impacts of high-volume hydraulic fracturing (HVHF) after receiving applications for drilling permits in the Marcellus Shale, with the Utica Shale as another possible gas resource [79]. The State's Environmental Quality Review (SEQR) was mandated by the State's Environmental Quality Review Act [80], because “high-volume hydraulic fracturing ... raises new, significant, adverse impacts” not previously addressed in New York State's 1992 EIS on the Oil, Gas, and Solution Mining Regulatory Program [81]. Table 1 shows the relative populations, land areas, and water areas for both New York and California.

Unlike California, New York produced a report specifically on potential health impacts of fracking. In December 2014, New York’s Department of Health released “A Public Health Review of High Volume Hydraulic Fracturing for Shale Gas Development,” which demonstrated the need to evaluate both the environmental and public health impacts. In addition, the report pointed to the need for “analysis of whether such information was sufficient to determine the extent of public health impacts” and, further, an analysis of whether the mitigation efforts currently in place in other states to reduce these impacts would be sufficient in the case of New York’s proposed well development [82].

Dr. Howard Zucker, New York’s Health Commissioner, contended that although it is unlikely to obtain “absolute scientific certainty regarding the relative contributions of positive and negative impacts of HVHF on public health,” there remained “significant uncertainties” about the potential detrimental health impacts, as well as uncertainties regarding the ability of mitigation methods’ to prevent or reduce environmental impacts that may also negatively affect public health [82]. In light of this, the Commissioner of Health held that high-volume fracking “should not proceed in NYS [New York State].” [83]

New York State’s Department of Conservation (DEC) first released a Draft Supplemental Generic Environmental Impact Statement (SGEIS) at the beginning of the process in 2009, which received over 13,000 public responses [84]. The huge number of public responses prompted the State’s DEC to release a revised Draft SGEIS, for public review, after which New York State conducted additional public hearings, receiving roughly 70,000 additional comments. In total, the Department of Conservation reviewed more than 260,000 comments from the public—arguably an effective demonstration of public engagement in the environmental review and

impact assessment process. The final EIS, which officially ended the extensive seven-year review (SEQR), concluded that HVHF should be banned in New York State due to gaps in the scientific data and the potential for risks [85].

During the full seven-year review, there was a moratorium on the technology, and during this period, extensive public review and feedback were collected [86, 87]. On June 29, 2015, at the end of the review [80], New York State’s DEC came to the conclusion that due to potential risks and lack of HVHF data would be banned in the State [88]. While Governor Andrew Cuomo (Democrat) had announced that he was banning fracking December 17, 2014, it was not until June 29, 2015, that legislation—and the end of the lengthy review made—led to an official ban [89].

### CONCLUSION

In conclusion, the two case studies examined arguably shed light on the differences in the identification of potential impacts, thus leading to different outcomes and regulation, in two states with robust environmental protection. While New York State conducted a largely precautionary based, thorough and extensive review and ultimately concluded that there were too many gaps in the data and knowledge with regard to HVHF, California’s own review was not extensive enough to conclusively prove the safety and mitigation of negative impacts [90], and should either conduct more extensive environmental and health reviews before coming to any conclusions or else enact a temporary moratorium on the process until more complete information becomes available [91]. What is evident is that getting the “balance right” between different stakeholder interests is a challenge. The oil and gas regulators of California have a different *modus operandi* to the conservation authorities of New York State. Finding a compromise between what may be a strong precautionary environmental/health approach while not stifling the job market and economic development has led to vast differences in these two state-level EIA processes, with polarization between, in simplified terms, NGOs/public *versus* industry. At what point ought the federal authorities have anticipated such differences of opinion toward a “new technology” and have developed the regulatory regime, from the bottom-up approach of EIA to the top-down approach of licensing and permitting [33]? We concede that development of a federal regime would not be unproblematic and would take considerable time to develop. However, perhaps some national draft guidelines would have been

**TABLE 1.** Population and Land/Water Area.

	California	New York
Population*	37,253,956	19,378,102
Land area (square miles)	155,779	47,126
Water area (square miles)	7,916	7,429
Total area (square miles)	163,695	54,555

\*2010 census.

Source: <http://www.census.gov>.

useful—though likely contentious—would the US ever collectively agree a uniform national approach to the regulation of fracking? Furthermore, at what point in the development and advancement of fracking ought the regulators have stepped in and developed the regime? More significantly, *which regulators* ought to have had responsibility for this, noting that there are environmental, energy and health issues at play? Thus, as seen through the two cases illustrated, even the very processes designed to ensure adequate identification, monitoring, and assessment of impacts are prone to discrepancies in the stringency of regulations due to the piecemeal nature of regulations that govern fracking in the US.

### Analysis

While both New York and California performed EIAs (as mandated by their state regulations on environmental protection), they came to different conclusions. New York concluded that the gaps in knowledge and data on environmental and public health impacts were too great to ensure that fracking could “safely” proceed, while California concluded that the process could proceed, relatively unabated [14]. This decision to not proceed seems to be based on the precautionary principle, even though this was a decision based on an impact assessment and not a cost–benefit analysis or a risk assessment (the latter normally associated with invocation of the precautionary principle). Perhaps, a more conciliatory approach would have been one based on the principle of prevention, which would not require the absolute negation of risk, but its management, triggered through the evidence of environmental and human impacts that we have to date for each specific case and also through other state and country examples.

This paper elucidates two points: first, that the differences in state regulations and the relative freedom of individual states to determine their process of environmental assessment lead to considerable variations in the scope and breadth of the assessment processes and the level of stakeholder and expert involvement (i.e., public health officials); and second, that the EIA process is a significant part of the evaluation of the safety and viability of extraction technologies, and plays a central role in affecting the course of regulation.

Another key difference is that California already has a long-established oil and gas industry, as “Big Oil has had a foothold since the late 1800s, when offshore oil drilling

was pioneered in the Santa Barbara Channel,” [92] and it can be argued that this history may have influenced the degree and more narrow scope of the EIA as compared with New York’s. We cannot rule out that political, economic, and cultural influences affect the thoroughness, or not, with which an EIA is undertaken [93]. If the minimum criteria are met in terms of procedure, the decision may be vastly different to one where there was a more thorough process extending well beyond the minimum approach, with large number of public hearings, lobbying, demonstrations, media portrayal, and so on—these factors would arguably require the decision-makers to apply more scrutiny to the decision-making process. On the other hand, New York State, which does not have a long-standing industry presence, supplies water to roughly 16 million people [94] in the Delaware River Basin, something that was arguably of high concern to citizens and lawmakers alike. However, the issue of the large amount of water used in fracking [95, 96] is not unique to New York: in 2014, California’s Governor Jerry Brown declared a “drought emergency”—the most severe drought in the State’s 163-year history [54].

### BOX 1. Summary of Complications of US Federal and State Regulations

- Lack of comprehensive federal oversight
- Diverse and inconsistent state regulations, even for methods of impact assessment
- Broad exemptions under federal EPA regulations
- Industry not required to identify all chemicals
- Lack of comprehensive baseline data
- Conflicts between state and community right to regulate
- Lack of enforcement “teeth” at all levels

### CASE STUDY QUESTIONS

1. Why do you think the two states varied so differently in their decision-making?
2. To what extent do you think states should be left to regulate fracking and related processes, individually?

3. How can we account for “subjectivity” and politics in the EIA process?
4. Compare the two case studies—how important do you consider the role of public participation to be?
5. How can we (and should we?) detach emotion and politics from reasoned policy- and science-based decision-making?
6. What might be the pros and cons of a distinct federal regime for the regulation of fracking?
7. In the above cases, EIA is regulated under *environmental* law (NEPA 1969, and state implementing legislation) and fracking is regulated under *energy* law (Energy Policy Act 2005). To what extent do you think this might create conflict for decision-makers?
8. Under NEPA, federal agencies have to create an EIS, to scope, and evaluate all potential environmental impacts and alternatives for projects that could “significantly affect the quality of the human environment.” Referring to the latter part of this sentence, to what extent does the word *human* affects the level of scrutiny that we ought to apply to the regulation of fracking?
9. If we do not have all available and conclusive evidence as to risks to health and environment associated with fracking, should we approve or ban the processes? Discuss.

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All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript.

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