Regulating environmental and public health impacts of hydraulic fracturing in the UK: lessons drawn from two case studies in the U.S.

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Abstract

The United Kingdom is in the early stages of exploration and development of its natural gas resources, with the first test well dug in 2010. In 2017 the UK appears poised for commercial drilling to begin. Licenses for shale gas exploration are now being issued in rounds, after a halt in 2011 due to concerns over probable links to earth tremors. The current licensing approvals follow a review[1] on shale gas extraction commissioned by the UK government (2012) that concluded hydraulic fracturing 'can be managed effectively as long as operational best practices are implemented and enforced through regulation.' [2] Hydraulic fracturing or *fracking* remains controversial. Data from the United States with its much longer history of natural gas development provides evidence of risk to environmental and public health from fracking processes, including depletion of water supply, ground and surface water contamination, effects on air quality from emissions, and change in 'quality of life' as communities become heavily industrialized with expansion of gas extraction operations. Sources of risk include potential migration of pollutants from fluids used in the extraction process, migration of toxic gases, liquids and solids that exist naturally underground, and impact on water supply due to the high water volume used in shale gas exploitation. Studies have shown that there is potential for contamination leading to environmental and public health effects at all stages of the development of the natural gas well site, from site preparation to decommissioning at the end of the well's functional life.[3]

The United States has significant experience with the use of fracking to extract natural gas. Therefore, that country's experience may provide useful analogues to the situation of the UK. This research examines two case studies in the U.S. in order to draw lessons useful in enhancing the regulatory structure in the UK.

Keywords: Natural gas; Hydraulic fracturing, Unconventional drilling; fracking

Introduction

Using analogous information known about U.S. deposits, a 2013 British Geological Survey report concluded that shale gas deposits in Northern England are likely much larger than previously estimated, although actual quantities are not possible to determine.[4] [5] While debate continues about the benefits and risks of using the unconventional extraction method of hydraulic fracturing or fracking, proponents cite the U.S. experience to argue that the process is safe and economically beneficial.[6]

Aims and methodology

In order to examine the role of U.S states in identifying and regulating the impacts of fracking, two case studies were conducted. The two U.S. states—New York and California—had different methodologies for managing risks, due to differences in these state's Environmental Protection Acts. The fact that these states followed different procedures for evaluating environmental risk, shows the result of a lack of federal regulation governing risk and impact management. Thus, the following cases demonstrate the difficulty and complications in regulating hydraulic fracturing in the U.S. due to the discordant collage of federal, state, and local regulations.

The two case studies examined arguably point to the potential risks of laxity in Environmental Impact Assessment (EIA) methodologies. While both New York and California performed EIAs (as mandated by their state regulations on environmental protection), they came to different conclusions. New York decided 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.

This divergence elucidates two points: first, that the differences in state regulation and the relative freedom of individual states to determine their process of environmental assessment may lead to drastic differences 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.

Kotsakis (2012) argues that many of the elements that lead to the general public's resistance to fracking (such as non-disclosure of chemicals, extraction processes near drinking water sources, and improper well construction) are a 'product of the very lax and fragmented – between federal and state

level – regulatory framework of the United States.'[7] He contends that as the industry and regulatory framework develops in the UK, policy makers and industry should be prudent with designing regulations and not follow the lead of the U.S. by granting industry exceptions to rules and allowing laxity in monitoring and regulation. As such, a number of lessons and policy recommendations can be adopted from the U.S.'s development of fracking and the subsequent impacts and issues.

New York State Case Study

On June 29, 2015, New York State's Department of Conservation (DEC) concluded its seven-year review of high volume hydraulic fracturing (HVHF), and officially banned HVHF in the State.[8] In 2009, the State's DEC released a Draft Supplemental Generic Environmental Impact Statement (SGEIS), and received over 13,000 public responses, thus prompting DEC to release a revised draft to be reviewed by the public. Following this, the state held several additional hearings, and received nearly 70,000 comments. The Department received a total of 260,000 comments from the public to the SGEIS, thus arguably demonstrating successful engagement of the public in the environmental impact assessment and review process.[9] To satisfy the State Environmental Quality Review Act[10], the final State Environment Quality Review (SEQR)—which officially ended the seven-year review—used the Environmental Impact Statement findings to determine that high-volume hydraulic fracturing should not be allowed anywhere in the State.

The review was conducted because the Department of Conservation received applications for drilling permits in order to assess and implement the use of hydraulic fracturing to extract natural gas primarily from the Marcellus Shale, with the Utica Shale as another possible gas resource.[11] The Review, which also incorporated the State's Department of Health's review, was conducted because 'high-volume hydraulic fracturing… raises new, significant, adverse impacts'[12] not addressed in the previous 1992 Environmental Impact Statement on the Oil, Gas, and Solution Mining Regulatory Program.

In December 2014, New York State's Department of Health released a review (A Public Health Review of High Volume Hydraulic Fracturing for Shale Gas Development) of the State's Department of Environmental Conservation's Environmental Impact Assessment HVHF which illustrated the need to evaluate both 'environmental public health and community health effects,' in addition to an 'analysis of whether such information was sufficient to determine the extent of public health impacts,' and if the mitigation measures currently in use in other states sufficiently reduce the risk of detrimental health effects.[13] According to the state's Commissioner of Health, while it is unlikely to reach 'absolute scientific certainty regarding the relative contributions of positive and negative impacts of HVHF on public health,' Dr. Howard Zucker asserts that there are 'significant uncertainties' regarding the types of negative impacts on health, in addition to uncertainties regarding mitigation methods' ability to preclude or decrease environmental impacts that may in turn impact public health. Because of this, the Commissioner 'recommends that HVHF should not proceed in NYS [New York State].'[14]

In the Review, New York State's Department of Health reviewed scientific literature to determine the adequacy of current research, obtained input from external public health experts, conducted field visits with discussions in states currently implementing HVHF operations, and engaged in communication with 'multiple local, state, federal, international, academic, environmental, and public health stakeholders.' [15] The scope of the review was to evaluate how hydraulic fracturing operations could lead to exposure to the public of '(i) contaminants in air or water; (ii) naturally occurring radiological materials that result from HVHF activities; and (iii) the effects of 3 HVHF operations such as truck traffic, noise, and social changes on communities. The Department of Health (DOH) also reviewed whether those exposures may result in adverse public health outcomes.' [16]

The evaluation revealed several 'major' potential impacts on the environment and health, including 'air impacts' potentially leading to respiratory health issues due to 'increased levels of particulate matter, diesel exhaust, or volatile organic chemicals'; in addition to 'climate change impacts' from releases of VOCs and methane. The study found several potential water impacts including potential 'soil and water contamination' due to surface spills, as well as 'drinking water impacts from underground migration of methane' and other fracfluid chemicals from improper well design, as well 'surface water contamination' from inappropriate disposal or treatment of wastewater.

The study found 'earthquakes induced during fracturing,' as well as social impacts 'associated with boom-town economic effects such as increased vehicle traffic, road damage, noise, odor complaints, increased demand for housing and medical care, and stress.'[17] [18] Another finding of the study was that there were 'critical information gaps' which, the report argues, 'need to be filled to more fully understand the connections between risk factors,' [19] including pollution to the air and water sources, and the impacts on public health of populations living near the fracking activities.[20] [21] [22] [23]

The DOH's review concluded that 'until the science provides sufficient information to determine the level of risk to public health from HVHF to all New Yorkers and whether the risks can be adequately managed … HVHF should not proceed in New York State.'[24] The DEC agreed with the Department of Health's conclusion, and although it considered the potential of expanding the mitigation measures previously proposed during draft impact assessment statements, concluded that 'there are no feasible or prudent alternatives that would adequately avoid or minimise adverse environmental impacts and that address the scientific uncertainties and risks to public health' from hydraulic fracturing.[25]

California Case Study

California, another large and important U.S. state, issued its own Environmental Impact Report, as mandated by Senate Bill No. 4, passed in 2013 which deals with the 'drilling, operation, maintenance, and abandonment of oil and gas wells in the state.' The Final Environmental Impact Report was certified on July 1st, 2015, and analysed environmental impacts of 'oil and gas well stimulation treatments,' with 'well stimulation' defined as 'any treatment of a well designed to enhance oil and gas production or recovery by increasing the permeability of the formation,' including hydraulic fracturing. [26]

The State's Department of Conservation, through the Department's Division of Oil, Gas, and Geothermal Resources (DOGGR) released a Draft Environmental Impact Report (DEIR), to which the Natural Resources Defense Council (NRDC) and other partners submitted a hundred-page comment letter specifying the gaps and shortfalls in the Report. In part the letter 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.'[27]

Some of the NRDC and other organisations' criticisms of the DEIR included the lack of 'critical information on the lifecycle effects of well stimulation activities' and 'overly narrow' objectives which, they argue, focus on the extraction and production of hydrocarbon resources, but should, arguably also focus on the necessity of understanding and preventing environmental and health impacts; the 'need for transparency around emissions and waste disposal'; public disclosure of the chemicals utilised; and water reuse potentials.[28] Another key criticism was the 'lack of science': the letter states that the DEC have 'put the cart in front of the horse'[29] because the California Natural Resources Agency had commissioned an independent assessment[30] by the State's Council on Science and Technology (CCST) to examine well stimulation operations including hydraulic fracking.[31] However, the study was not due to be released until after the Environmental Impact Report (EIR) was finalized.[32]

While the Final EIR did address some of the NRDC and others' comments, many of the problems identified in the groups' response to the draft were not rectified.[33] The NRDC argues that the analysis of alternatives 'remains unfairly rigged,' to favour 'unrestricted statewide fracking,' with their 'no action' alternative that 'fracking would continue unabated.'[34]

Furthermore, because the final EIR was released before the CCST's Independent Study, the Report 'does not benefit from…findings of the scientific study and, therefore, is not as protective of public health or the environment as it could be.'[35] Additionally, the regulation changes that were released with the final EIR had actually been finalised several months before and therefore did not take into account the EIR or the CCST study's findings.[36] The CCST report explains that hydraulic fracturing in California differs from the experiences of other states because 'California wells tend to be shallow and the reservoirs more permeable,' so well operators, in contrast to those in New York, 'do not conduct high-volume hydraulic fracturing from long-reach horizontal wells, and for this reason use far less water.'[37]

However, the CCST study found that because the fracturing occurs in more shallow wells, 'hydraulic fractures could possibly intersect protected groundwater in a few locations.'[38] Furthermore, the study found that operators 'likely have injected wastewater contaminated with stimulation chemicals into protected groundwater,' and calls for the cessation of these and other practices 'in order to prevent possible environmental and health impacts.'[39] The study sheds light on several gaps in data and knowledge (such as the relationship between fluid injection and the State's earthquakes) and the need for public health studies[40] to assess air pollutants and toxic emissions concentrated near wells.[41] The CCST study explains that 'questions remain at the end of this initial assessment of the impacts of well stimulation in California that can only be answered by new research and data collection,' and explains that the subsequent two volumes of the report provide recommendations for further research that should be conducted.[42]

The outcome of the final Environmental Impact Report (which did not take into account the results of the CCST study) was a conclusion that hydraulic fracturing may have 'significant and unavoidable impacts' on emissions of greenhouse gases, public health and safety, and air quality, but the proposed mitigation measures are merely 'suggestions.'[43] While California's Final EIR did enable some final regulations on well production and stimulation, the mitigation measures were not mandated and the report was concluded without addressing several gaps in knowledge and data, and the need for further research.[44]

Discussion and analysis

California's Final EIR was released just after New York State's own environmental review process, but in contrast to New York's thorough, seven-year review (which concluded that due to gaps in available data, potential impacts from fracking could not be avoided or mitigated with current knowledge and technology, and led to a statewide moratorium), California's study was merely a year in duration, and ultimately concluded that a majority of the environmental and health impacts could be 'reduced to a level of less than significant.'[45] However, considering the knowledge gaps identified both in the NRDC and other groups' analysis, in addition to the CCST study findings, California's Department of Conservation cannot, without further research, definitively conclude that the negative impacts of fracking can be minimised or prevented.

Thus, while New York State conducted a thorough and extensive review and ultimately concluded that there were too many gaps in the data and knowledge with regards to HVHF, California's own review was not extensive enough to prove the safety and mitigation of negative impacts, 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.

Therefore, 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 United States. These case studies arguably shed light on the potential difficulty in the process for regulating hydraulic fracturing and unconventional gas extraction in the UK, and one recommendation that can be drawn is ensuring that the processes in place for identifying and mitigating environmental risk are robust and uniformly applied, and include evaluation of the potential health impacts as well.

Conclusion

There is ample evidence from U.S. studies that fracking has potential to harm community and environmental health through toxic atmospheric emissions, strain on water supplies, particularly in water-stressed regions, contamination of ground and surface water, transformation of communities to industrial sites, and other effects. Gaps in current data mean that we cannot conclude with certainty what the precise effects of fracking are in the short- and long-term. Studies that claim fracking can be conducted safely assume that operations follow 'best practices'. We can reasonably say that there is not scientific certainty that fracking under present conditions is safe; and therefore we can also conclude that the preferred strategy to fracking should be a precautionary approach. Goldberg[1] *et al*., and others, argue that when faced with uncertainty and gaps in the data, combined with potential detriment to human and public health, the only way to ensure protection of the public's health is to instill a moratorium on the technology. This precautionary approach, however, may not be practical or realistic, as currently there is strong political will within the UK government to develop shale gas resources. It is likely that fracking will occur there in the near future, as evidenced by the fact that licenses for exploration and permits for drilling have now been awarded. The site is now being prepared in Lancashire by Cuadrilla Resources, with that company expecting drilling to begin in spring, 2017.

Recognizing the likelihood of drilling, policy should reflect as far as possible the idea of exercising precaution. This is particularly important as potential damage may have long-term effects that impact areas that stretch beyond member states' borders. Many of the problems identified the U.S. experience arguably are due to the technology's rapid development. The number of wells fracked and percentage of natural gas produced in the U.S. drawn from shale increased from 1% in 2000 to 20% within 10 years. In the U.S, data collection and analysis, and development of regulation and policy, has been outpaced by the industry's extraordinarily fast-paced expansion. In particular, there are not adequate long-term studies of the effects of fracking. This leaves the problem of data, particularly that on public health issues, in a position to catch up, both because of the inherent lags in the data collection and time for impacts to be evidenced in health, and because of issues with data collection and monitoring. This problem is further exacerbated by the fact that the U.S. oversees the industry through a complicated patchwork of bodies, including federal, state, and local, with most of the regulations not developed specifically with fracking technology combined with horizontal drilling in mind. The UK government—at national and local levels—needs to be aware that comprehensive scientific understanding of the process based on the U.S. experience is inadequate for informed decision-making.

The UK's oversight structure is different and presents its own challenges that must be considered. For example, control over the industry—and ownership of mineral rights—is in the hands of the Crown (in the U.S., property owners also own mineral rights and can lease them independently to gas production companies). This means that it is particularly important as regulations are modified for fracking to develop community-involvement mechanisms. Furthermore, the issue of a novel technology being regulated with existing frameworks leaves the governing framework in a position of potentially lagging, as the regulations have to 'catch up' to a rapidly developing and proliferating technology. Therefore, in the present absence of long term studies, particularly regarding public health impacts, the UK should ensure the viability of ways of adapting and implementing what we continue to learn from the rapid and often unchecked expansion of use of these technologies in the U.S. This is necessary in order to allow time for both the data and potential gaps or regulatory issues to be identified rather than a reactive approach where only after the technology has proliferated widely, do problems begin to be identified as has happened in some American states.

Another key issue to highlight based on the U.S. experience is the lack of communication across multiple levels. For example, industry may not be required to disclose chemicals used in the fracking fluids by well operators, making it difficult to evaluate and remediate problems that occur. Also, there may be insufficient coordination among health care experts and researchers, and environmental scientists, politicians, and the general public.

Particularly as there is already evidence of widespread opposition to the technology in the UK, focusing on mechanisms for public engagement and citizen science is key to ensuring that the public has access to information on the technologies and risks involved with shale gas extraction, and can also help fill in gaps in the data for better risk assessment. Thus, as the UK looks to develop the technology, increased modes of communication, both among health care providers and researchers, scientists, and the industry, in addition to facilitation of public engagement should be encouraged. Similarly, increased coordination among European Union (EU) member states in terms of energy policies and technology sharing should be encouraged. As demonstrated in the U.S. experience, regulation of a new technology with unique implications for public health and the environment is made particularly difficult because of the patchwork of federal, state, and local regulations. Due to the lack of federal enforcement, environmental and health assessments, monitoring schemes, and regulations vary widely from state to state, while the potential issues and problems have long-term and far-reaching impacts. Therefore, the U.S. experience can be taken as a wider model to help the EU develop energy policy, and provide an important lesson in the need for communication on wider scales.

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In the U.S., federal and state regulations were specifically designed to allow the greatest freedoms where possible, yet the risk of allowing states control over regulations governing fracking technologies is a lack of coordination and a reduction of enforcement on the federal level. Particularly as evidenced by the deregulation and exemptions afforded the shale gas industry, the challenges in ensuring environmental quality and safety across an entire country are exacerbated. This challenge can be taken as an analogy to the EU and the environmental and health protections in EU member states, as the intergovernmental institutions within the EU should aim to set mandatory minimums and standards to be applied uniformly across member states, in order to ensure the highest level of environmental protection, particularly in relation to new technologies such as hydraulic fracturing.

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