Shale gas and hydraulic fracturing in the United States and Canada

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1. Introduction

The use of hydraulic fracturing (or 'fracking'), combined with horizontal drilling, has opened up production in large shale gas plays across the United States and Canada. Hydraulic fracturing involves the injection of highly pressurised fluids and proppants into shale or other non-porous hydrocarbon formations in order to increase production in oil and gas wells. It allows production companies to boost production from existing formations and to tap into others that were previously considered uneconomical. In spite of its potential long-term economic benefits, fracking attracts substantial criticism in North America.

This chapter provides an overview of the prominent shale gas plays in Canada and the United States. It examines the main regulatory issues and developments in relation to fracking in both jurisdictions and considers emerging litigation.

2 The United States

2.1 Introduction

Obtaining natural gas from shale formations has quickly become a vital part of the United States' future energy plans, not only because of the estimated volume of gas, but also because of the use of horizontal drilling and hydraulic fracturing. Hydraulic fracturing involves the injection of highly pressurised fluids and proppants into shale or other non-porous hydrocarbon formations in order to increase production from oil and natural gas wells. This water-intensive process produces large volumes of fluid called 'flowback' or 'produced water'. Most operators engaged in hydraulic fracturing dispose of their flowback by injecting it into a well (termed a 'Class II well') or by treating it and either disposing of or recycling it.

Hydraulic fracturing has been used in the United States for decades. However, in the past few years, the technique and its alleged impact on water quality have received increasing attention from the media, the US Environmental Protection Agency (EPA), Congress, regulatory agencies, state and local governments and various environmental groups. Concerns have been raised about:

- the reduction in citizens' water supplies due to the volume of water used in the fracturing process;

- the alleged contamination of aquifers that supply drinking water; and
- the appropriate disposal or recycling of produced water.

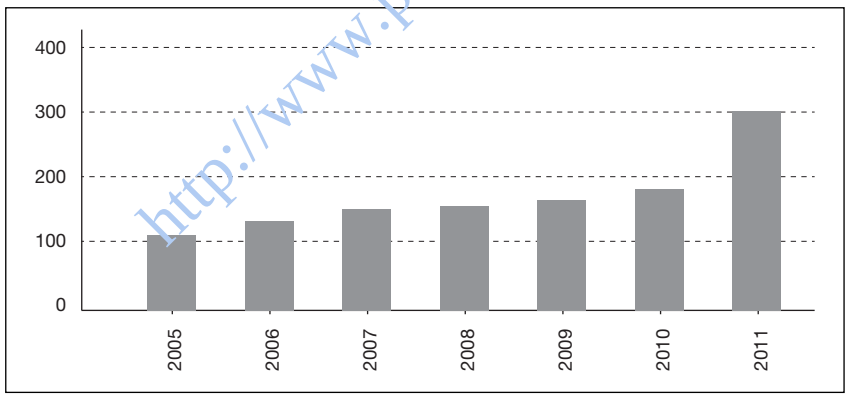
At the heart of these concerns are the additives used in fracturing fluids. It is claimed that these contain potentially toxic substances, such as benzene, toluene, xylene, methanol, formaldehyde, ethylene, glycol and glycol ethers, hydrochloric acid and sodium hydroxide.

This chapter discusses shale plays in the United States and current issues relating to hydraulic fracturing, including:

- regulation at federal, state and local level;
- disclosure of the composition of fracking fluids;
- studies and research relating to environmental concerns, including water contamination and earthquakes; and
- litigation that implicates fracking in personal injuries and property damage.

2.2 Shale plays

The large volumes of natural gas in shale formations make them crucial to the United States' energy future: the country may have at least 100 years of gas reserves, based on current consumption. A recent study by the Energy Institute at the University of Texas at Austin estimates approximately 862 trillion cubic feet (tcf) of shale resource in the continental United States.[1] This estimate is expected to increase as additional resource data is collected. The bar graph below shows how quantities of US proved gas reserves (in tcf) have risen significantly since 2005.[2]

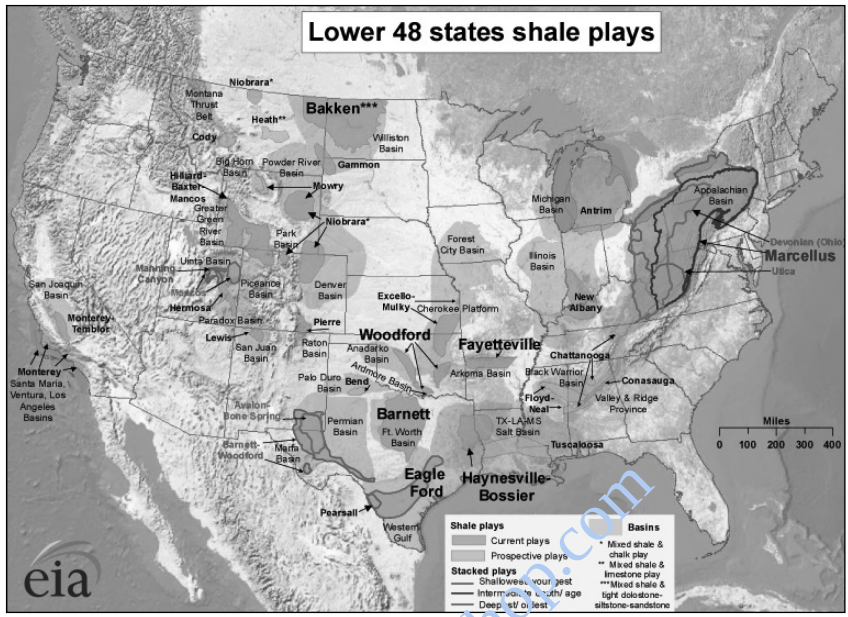


The United States has at least 20 basins that are recognised as sources of shale gas.[3]

1 "Fact-Based Regulation for Environmental Protection in Shale Gas Development", page 4, http://energy.utexas.edu/images/ei_shale_gas_regulation120215.pdf.

2 Ernst & Young US E&P Benchmark Study, June 2011 for years 2005-2010; American Gas Association estimate for 2011.

3 US Department of Energy, "Review of Emerging Resources: US Shale Gas and Shale Oil Plays", ftp://ftp.eia.doe.gov/natgas/usshaleplays.pdf.



Each shale basin has unique exploration criteria and presents particular operational challenges. For example, the Fayetteville Shale is in rural north-central Arkansas, whereas the Barnett Shale lies beneath the urban area of Fort Worth, Texas. Five regions in particular are capable of producing large quantities of natural gas: the northeast (where the Marcellus Shale holds 63% of US resources), the Gulf Coast (13% in the Haynesville and Eagle Ford shales), the southwest (10% in the Barnett and Barnett/Woodford shales), the mid-continent (8% in the Fayetteville and Woodford shales) and the Rocky Mountains (6% in the Mancos and Lewisshales).[4] The top six producing shale formations, as shown on the following page, are Barnett, Haynesville, Fayetteville, Marcellus, Woodford and Eagle Ford.[5]

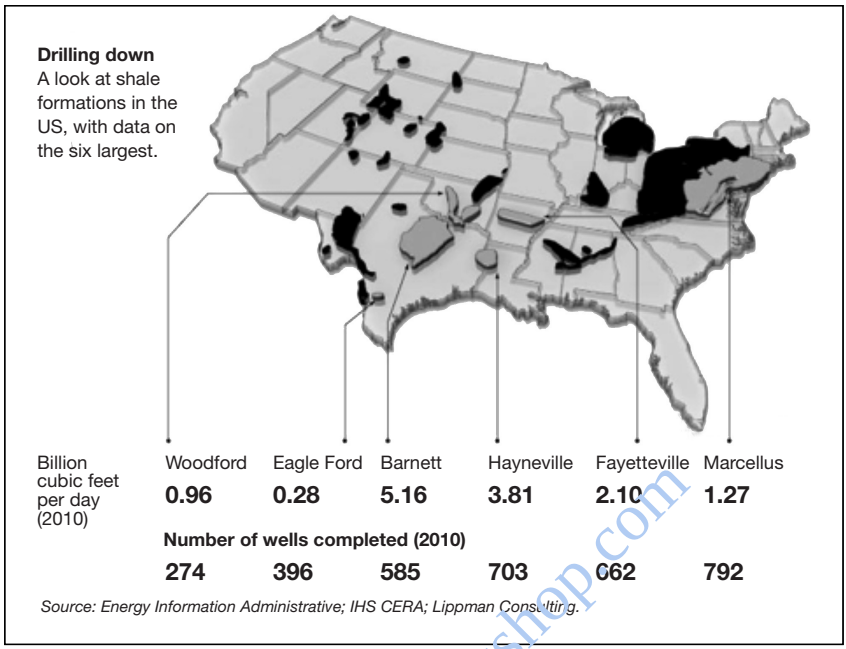
2.3 Regulation of hydraulic fracturing

(a) Federal level

At present, hydraulic fracturing is not regulated at federal level, but proposed statutes and rules from various federal agencies are in the legislative process. In the future, hydraulic fracturing may be regulated by the Federal Safe Drinking Water Act, which directs the EPA to promulgate regulations that protect drinking water sources from contamination. Underground injections of fluids other than diesel fuels are exempt from regulation under the act. Congress has proposed to amend the act so that it governs fracking, but past attempts to do so have failed to achieve consensus.

On May 4 2012 the EPA released draft guidance to clarify the steps that oil and

4 *Id.*
5 Source: Energy Information Administrative; IHS CERA; Lippman Consulting.



gas companies should take in order to obtain an underground injection control permit where diesel fuel is used as a fracturing fluid.[6] The guidance recommends providing the EPA with:

- maps and cross-sections of the area surrounding the injection well, showing the extent and orientation of the planned fracture network and any nearby underground sources of drinking water (with their connections to surface waters, if any);
- a plugging and abandonment plan or pre-permit-expiration plan that incorporates monitoring of underground sources of drinking water;
- a detailed chemical plan that describes the proposed composition of the fracturing fluid, including the volume and range of concentration of each element; and
- baseline geochemical information on underground sources of drinking water and other sub-surface formations of interest.[7]

On April 17 2012 the EPA issued its first-ever regulations aimed at reducing toxic air pollution from fracking operations,[8] targeting emissions from compressors, oil storage tanks and other oil and gas equipment. Under these regulations, owners or

6 EPA, Permitting Guidance for Oil and Gas Hydraulic Fracturing Activities Using Diesel Fuels – Draft: Underground Injection Control Program Guidance 84, http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/upload/hfdieselfuelsguidance.pdf.

7 *Id.*

8 This rulemaking has not yet been published in the Federal Register. A pre-publication version of the rule is available at www.epa.gov/airquality/oilandgas.

operators of fractured and re-fractured wells may reduce pollution through flaring. Each well completion operation that begins on or after January 1 2015 must use technologies that capture harmful emissions.

On May 4 2012 the Department of the Interior's Bureau of Land Management issued proposed rules that set new standards for fractured wells on roughly 700 million acres of public land, as well as 56 million acres of Indian land.[9] The proposed rules include new guidelines on the casing of drilled wells and require that:

- all chemicals used in hydraulic fracturing be publicly disclosed following the completion of fracking; and
- drillers submit, and obtain approval of, water management plans before drilling – such plans must include details of wastewater disposal.

The public comment period for the proposed rules ended on September 10 2012.[10]

On March 15 2011 companion bills entitled the Fracturing Responsibility and Awareness of Chemicals Act were reintroduced[11] in the Senate and the House of Representatives. No actions have yet been taken by the 112th Congress.[12] If passed, hydraulic fracturing operations that are exempt from regulation under the Safe Drinking Water Act would be regulated. States with delegated authority to implement the Safe Drinking Water Act would be required to modify their programmes to remain consistent with new federal regulations. The Fracturing Responsibility and Awareness of Chemicals Act would require persons engaged in fracking activities to disclose the chemical constituents of their fracturing fluids to a regulatory agency; however, they would not be required to disclose proprietary formulas, except in an emergency.

(b) State level

Hydraulic fracturing is largely regulated at the state level, generally through oil and gas well regulations or Class II well regulations. Some states require that permits be issued before hydraulic fracturing can begin.[13] Others have issued a moratorium on hydraulic fracturing. In New York, an updated environmental impact study is due to be completed by mid-2012,[14] while Maryland has a *de facto* moratorium by virtue of its failure to grant new permits for activities using hydraulic fracturing.[15] Pennsylvania also has a moratorium in place for parts of the watershed of the Delaware River Basin.[16] Vermont has banned hydraulic fracturing.[17]

Most states have departments of environmental protection or other agencies,

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9 See www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&pageid=293916.
10 See www.blm.gov/wo/st/en/info/newsroom/2012/june/NR_06_25_2012.html.
11 The act was originally introduced on June 9 2009, during the 111th Congress, but Congress took no further action. See www.govtrack.us/congress/bills/111/s1215.
12 See www.govtrack.us/congress/bills/112/s587.
13 Arkansas, Oklahoma, West Virginia and Wyoming.
14 New York Executive Order 41: Requiring Further Environmental Review, www.governor.ny.gov/archive/paterson/executiveorders/EO41.html.
15 Maryland Executive Order January 1 2011: The Marcellus Shale Safe Drilling Initiative, www.governor.maryland.gov/executiveorders/01.01.2011.11.pdf.
16 "Delaware River Basin Commission Declares Moratorium on Sale Gas Production Wells", www.delawareriverkeeper.org/resources/PressReleases/DRBC_moratorium_5_10.pdf.

such as the Railroad Commission in Texas, that control the permitting process for oil and gas development, exploration and production.

2.4 Disclosure of hydraulic fracturing fluids

An April 2011 report of the minority staff of the US House of Representatives Committee on Energy and Commerce, entitled "Chemicals Used in Hydraulic Fracturing", indicates that the chemicals used in hydraulic fracturing are not widely disclosed.[18] The FracFocus website was launched to provide the public with objective information on hydraulic fracturing, the chemicals used, the purposes they serve and the means by which groundwater is protected.[19]

On August 4 2011 Earthjustice, a non-profit environmental law firm, filed a citizen petition with the EPA on behalf of 114 national and state conservation and public interest groups. The petition demanded that the EPA use the Toxic Substances Control Act to order oil and gas drilling companies to disclose the chemicals that they use in hydraulic fracturing and to conduct safety and health tests on the effects of such chemicals.[20] In November 2011 the EPA responded to the petition, stating that it would initiate a proposal which would "focus on providing aggregate pictures of the chemical substances and mixtures used in hydraulic fracturing". It stated that "[t]his would not duplicate, but instead complement, the well-by-well disclosure programs of states".[21]

At present, 15 states[22] have disclosure regulations in force; four more[23] are working on regulations. Several states require that disclosures be made public on the FracFocus website; others require disclosure to state agencies. The level of disclosure often depends on the extent to which the state allows protection for trade secrets. For example, some states allow companies to withhold information at their discretion or to submit fewer details about proprietary chemicals, except in emergencies. In a few states, material safety data sheets must be submitted for certain chemicals. Some states require a degree of disclosure before fracking begins, whereas others require disclosure within a certain period following well completion – in Texas, for example, the period is 30 days. Certain states require disclosure both before and after.

In addition to the calls for disclosure from government and environmental activist groups, many oil and gas company shareholders have sought resolutions to

17 On May 16 2012 Vermont became the first US state to outlaw hydraulic fracturing and to prohibit the storage or treatment of hydraulic fracturing wastewater anywhere in the state. There has never been a productive oil or gas well in Vermont and the last dry hole was drilled in 1984. A copy of the bill, as passed by the Vermont House and Senate, can be found at www.leg.state.vt.us/docs/2012/bills/Passed/H-464.pdf. See also www.upi.com/Top_News/US/2012/05/17/Vermont-gov-signs-fracking-ban-into-law/UPI.

18 See http://democrats.energycommerce.house.gov/sites/default/files/documents/Hydraulic%20Fracturing%20Report%204.18.11.pdf.

19 See http://fracfocus.org/.

20 See www.epa.gov/1758BE18-32DA-42BE-8B3E-B0418FFC4B14/FinalDownload/DownloadId-8F1CE9F26975528EADEFA7E78EA100B1/1758BE18-32DA-42BE-8B3E-B0418FFC4B14/oppt/chemtest/pubs/Section_21_Petition_on_Oil_Gas_Drilling_and_Fracking_Chemicals8.4.2011.pdf.

21 See www.epa.gov/oppt/chemtest/pubs/EPA_Letter_to_Earthjustice_on_TSCA_Petition.pdf.

22 Arkansas, Colorado, Idaho, Louisiana, Michigan, Montana, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Texas, West Virginia and Wyoming.

23 California, Illinois, Nebraska and New York.

compel public disclosure. In May 2011 and May 2012 a coalition of shareholder groups filed proxy documents to order ExxonMobil, Chevron and Ultra Petroleum to establish a process for disclosure of the chemicals that the companies use in fracking fluid. The resolutions also asked that the companies report on the environmental and financial risks of fracking in natural gas drilling. In 2011 the ExxonMobil resolution garnered 28% support from the shareholders, while the Chevron resolution garnered 41%.[24] In 2012, 30% of Exxon shareholders[25] and 27% of Chevron shareholders supported the resolutions.[26]

2.5 Studies into hydraulic fracturing and water contamination

Pennsylvania State University, Duke University, the EPA and the University of Texas at Austin have studied the water quality in wells located near gas wells where fracking has been used. In their 2011 report the Pennsylvania State researchers found no statistically significant link between shale gas drilling and methane contamination because methane had been present before the drilling had begun.[27] In the same year the Duke University study found no evidence of contamination from the chemicals used in the fracking process, but measured high levels of methane.[28]

The results of a 2010 EPA study of groundwater in Pavillion, Wyoming indicated that three wells out of 39 were contaminated with fracking-related fluid, but this study has been criticised as being based on limited and questionable data and as failing to consider the historical problems with groundwater in that area. The EPA has stated that additional studies will be conducted in the Pavillion area,[29] as well as in Colorado, North Dakota, Texas and Louisiana; initial results are due in 2013, with a final report in 2014.[30] In early May 2012 the EPA released findings relating to tests of water in 61 homes in Dimock, Pennsylvania. The EPA concluded that the sampling results do not "show levels of contaminants that would give… reason to take further action". No results were found to be outside federal drinking water standards, even though some samples showed concentrations of sodium, methane, chromium, arsenic and bacteria.[31]

In November 2011 the University of Texas at Austin released a preliminary report entitled "Boon or Bane? A Report on Hydraulic Fracturing of Shale". Its researchers concluded that many allegations of groundwater contamination appeared to be related to above-ground spills or other mishandling of the wastewater produced from shale gas drilling, rather than from hydraulic fracturing itself.[32] The key findings of the report, which was released in February 2012, are as follows:

24 See www.triplepundit.com/podium/chevron-exxon-shareholders-send-strong-message-today-about-need-disclose-environmental-financial-risks-fracking/.
25 See http://articles.marketwatch.com/2012-05-30/industries/31895092_1_fracking-shareholder.
26 See www.newsdaily.com/storeis/bre84t18f-us-chevron/.
27 See www.rural.palegislature.us/documents/reports/Marcellus_and_drinking_water_2011_rev.pdf.
28 See www.nicholas.duke.edu/hydrofracking/Osborn%20et%20al%20%20Hydrofracking%202011.pdf.
29 See www.epa.gov/37BEE7A9-42DD-4675-977D-DA20104A3260/FinalDownload/DownloadId-E73EC02AA3D46610BE62476AE59BB5CD/37BEE7A9-42DD-4675-977D-DA20104A3260/region8/superfund/wy/pavillion/EPA_ReportOnPavillion_Dec-8-2011.pdf.
30 See www.epa.gov/hfstudy/ProgressUpdate02_2012.pdf.
31 See www.epaosc.org/sites/7555/files/Dimock%20W1,2,3,4,5%20Compulation%20Report%202.pdf.
32 See www.energy.utexas.edu/images/stories/HydrlicFracOnlineBrochF.pdf.