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An Overview of Unconventional Oil and Natural Gas: Resources and Federal Actions

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Summary

The United States has seen a resurgence in petroleum production, mainly driven by technology improvements—hydraulic fracturing and directional drilling—developed for natural gas production from shale formations. Application of both of these technologies enabled natural gas to be economically produced from shale and other unconventional formations, and contributed to the United States becoming the world's largest natural gas producer in 2009. Use of these technologies has also contributed to the rise in U.S. oil production over the last few years. In 2009, annual oil production increased over 2008, the first annual rise since 1991, and has continued to increase each year since then. Between 2008 and 2012, U.S. annual crude oil production rose by 1.5 million barrels per day, with about 92% of the increase coming from shale and related tight oil formations in Texas and North Dakota. Overall petroleum liquids grew by 2.1 million barrels per day, with much of the increase in natural gas liquids coming from shale gas plays. Other tight oil plays are also being developed, and helped raise the prospect of energy independence, particularly for North America.

The rapid expansion of oil and gas extraction using hydraulic fracturing—both in rural and more densely populated areas—has raised concerns about its potential environmental and health impacts. These concerns have focused primarily on potential impacts to groundwater and surface water quality, public and private water supplies, and air quality.

States broadly regulate oil and gas exploration and production on non-federal lands. State laws and regulations governing unconventional oil and natural gas development have been evolving across the states in response to changes in production practices, largely in response to the use of high-volume hydraulic fracturing in combination with directional drilling. However, state regulations vary considerably, leading to calls for more federal regulation of unconventional oil and natural gas extraction activities.

Although several federal environmental laws can apply to certain activities related to oil and gas production, proposals to expand federal regulation in this area have been highly controversial. Some advocates of a larger federal role point to a wide range of differences among state regulatory regimes, and argue that a national framework is needed to ensure a consistent minimum level of protection for surface and groundwater resources, and air quality. Others argue against more federal involvement, and point to the long-established state oil and natural gas regulatory programs, regional differences in geology and water resources, and concern over regulatory redundancy.

The federal role in regulating oil and gas extraction activities—and hydraulic fracturing, in particular—has been the subject of considerable debate and legislative proposals for several years, but legislation has not been enacted. While congressional debate has continued, the Administration has pursued a number of regulatory initiatives related to unconventional oil and gas development under existing statutory authorities.

This report focuses on the growth in U.S. oil and natural gas production driven primarily by tight oil formations and shale gas formations. It also reviews selected federal environmental regulatory and research initiatives related to unconventional oil and gas extraction, including the Bureau of Land Management (BLM) proposed hydraulic fracturing rule.

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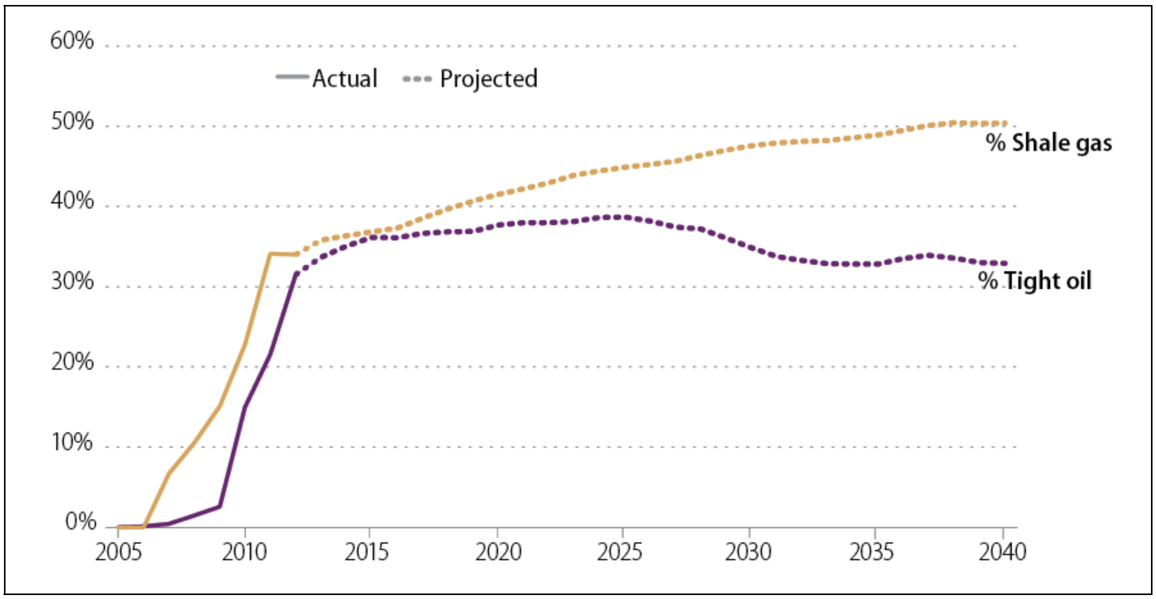
Introduction: Change Is Afoot

In the past, the oil and natural gas industry considered resources locked in tight, impermeable formations like shale uneconomical to produce. Advances in directional well drilling and reservoir stimulation, however, have dramatically changed this perspective. It is production from these unconventional formations that has changed the U.S. energy posture and global energy markets.

U.S. oil and natural gas production is on the rise, primarily driven by resources from tight formations. The techniques developed to produce shale gas—directional drilling and hydraulic fracturing[1]—have migrated to the oil sector. The United States is the third-largest oil producer in the world, but also the fastest-growing producer. The United States surpassed Russia in 2009 as the world's largest natural gas producer. Production from tight formations is expected to make up a significant part of production of each commodity well into the future (see **Figure 1**).

Figure 1. Percentage of U.S. Oil and Natural Gas from Tight Oil and Shale Gas

2005-2040



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013*, http://www.eia.gov/forecasts/aeo/index.cfm.

Note: Prior to 2007, the Energy Information Administration did not report tight oil and shale gas data.

This report focuses on the growth in U.S. oil and natural gas production driven primarily by tight oil formations and shale gas formations. It does not address other types of unconventional production such as coalbed methane or tight gas, as their contributions to overall U.S. production have not changed as dramatically as shale gas.[2] There has been continued congressional interest

[1] Hydraulic fracturing is an industry technique that uses water, sand, and chemicals under pressure to enhance the recovering of natural gas and oil. It has taken on new prominence as it has been applied to tight oil and shale gas formation as an essential method for producing resources from those types of formations.

[2] Coalbed methane and tight gas accounted for 33% of U.S. natural gas production in 2011, but are projected to account (continued...)

through the 113th Congress related to unconventional natural gas and oil production. In May 2013, the Senate Energy and Natural Resources Committee held three roundtable discussions on natural gas supply and use.[3] The House Energy and Commerce Committee's Subcommittee on Energy and Power held a hearing in June 2013 on U.S. energy abundance.[4]

Geology Is What Makes a Resource Unconventional

Unconventional formations are fine-grained, organic-rich, sedimentary rocks—usually shales and similar rocks. The shales and rocks are both the source of and the reservoir for oil and natural gas, unlike conventional petroleum reservoirs. The Society of Petroleum Engineers describes "unconventional resources" as petroleum accumulations that are pervasive throughout a large area and that are not significantly affected by pressure exerted by water (hydrodynamic influences); they are also called "continuous-type deposits" or "tight formations." In contrast, conventional oil and natural gas occur in porous and permeable sandstone and carbonate reservoirs. Under pressure exerted by water, the hydrocarbons migrated upward from organic sources until an impermeable cap-rock (such as shale) trapped it in the reservoir rock. Although the unconventional formations may be as porous as other sedimentary reservoir rocks, their extremely small pore sizes and lack of permeability make them relatively resistant to hydrocarbon flow. The lack of permeability means that the oil and gas typically remain in the source rock unless natural or artificial fractures occur.

Price Drives Industrial Innovation

Historically, natural gas prices in the United States have been volatile. From 1995 to 1999 the spot price of natural gas averaged $2.23 per million British thermal units (MBtu), but increased to an average price of $4.68 per MBtu, in nominal dollars, during the 2000-to-2004 period, an almost 110% rise. Prices hit a peak in December 2005 at $15.38 per MBtu, but remained relatively high through July 2008, as can be seen in **Figure 2**. Along with the rise in prices, U.S. net imports of natural gas also rose, increasing 32% between 1995 and 2000 and 41% between 1995 and 2007.

(...continued)

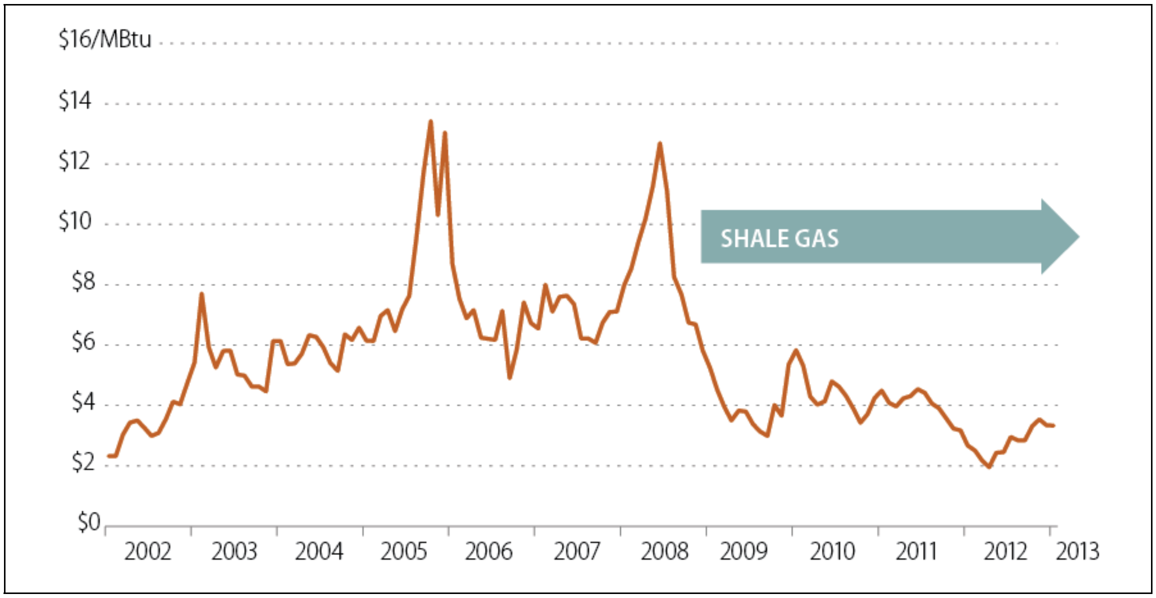
for only 28% in 2040, according to the Energy Information Administration (EIA).

3 Full Committee Forum: Domestic Supply and Exports, Senate Energy and Natural Resources Committee, May 21, 2013, http://www.energy.senate.gov/public/index.cfm/hearings-and-business-meetings?ID=0380bed7-f9ef-4450-bfa0-a3af60f7a184.

4 "U.S. Energy Abundance: Regulatory, Market, and Legal Barriers to Export," House Energy and Commerce Committee, Subcommittee on Energy and Power, June 18, 2013, http://energycommerce.house.gov/hearing/us-energy-abundance-regulatory-market-and-legal-barriers-export.

Figure 2. Daily U.S. Natural Gas Prices

2002-2012



Source: U.S. Energy Information Administration.

Note: Units = nominal dollars per million British thermal units (MBtu).

As U.S. prices and imports continued to trend up, industry undertook two competing solutions to meet the need for more natural gas—increased liquefied natural gas (LNG) imports and development of techniques to produce shale gas. The LNG import facilities were much higher-profile and were cited extensively in industry and popular press. Approximately 50 import projects were proposed, and eight were eventually constructed during the mid- to late 2000s, along with the recommissioning of older facilities.

Although horizontal drilling and hydraulic fracturing have been industry techniques for some time, their application to shale gas formations is relatively new. Advances in directional drilling, particularly steerable down-hole motors, allowed drilling operators to better keep the well bore in the hydrocarbon-bearing shale formations. Well stimulation was also required, and improvements in hydraulic fracturing techniques, particularly multistage hydraulic fracturing and the ability to better control the fractures, contributed to making shale gas production a profitable venture.

In 2007, the Energy Information Administration (EIA) first recorded shale gas production, when it accounted for just 7% of U.S. natural gas production. In 2012, shale gas production accounted for more than 30% of U.S. production, while almost all the LNG import terminals are idle and many have applied to become export terminals.[5]

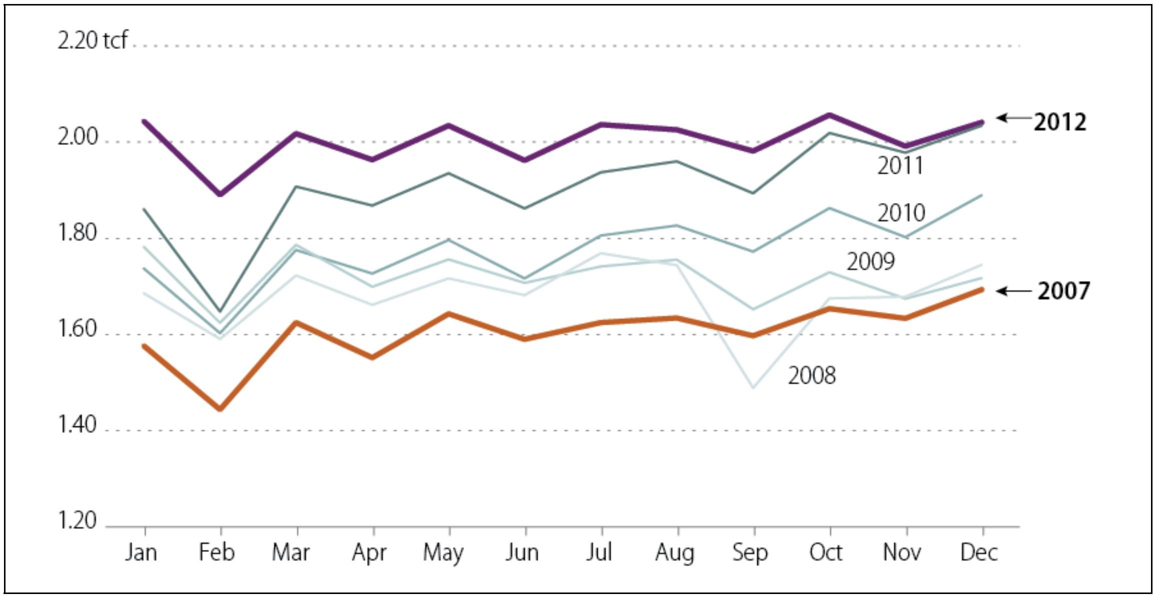
[5] For additional information on U.S. natural gas exports, see CRS Report R42074, *U.S. Natural Gas Exports: New Opportunities, Uncertain Outcomes*, by Michael Ratner et al.

Technologies Stimulate Shale Gas Production First

The application of advances in directional drilling and hydraulic fracturing were first applied to shale gas formations, particularly as natural gas prices increased in the mid-2000s. Methane molecules and those of natural gas liquids (NGLs) are smaller than crude oil molecules and therefore tend to be more responsive to hydraulic fracturing. The success of shale gas development has driven U.S. natural gas production to increase almost every month on a year-on-year basis (see **Figure 3**) from 2006 through 2012. The rise in shale gas development has also resulted in natural gas prices declining, as shown in **Figure 2**.

Figure 3. Monthly U.S. Natural Gas Production

2007-2012



Source: U.S. Energy Information Administration.

Note: Units = million British thermal units (MBtu).

The decline in prices and production in the latter half of 2008 was mainly the result of the economic downturn. However, as the economy picked up in 2009, natural gas resumed its upward production trajectory while prices stayed low. Overall U.S. natural gas production grew, as did the contribution from shale. The continued increase in production can be attributed, in part, to industry improvements in extracting more of the natural gas from the shale formations. Continued progress in hydraulic fracturing and directional drilling techniques has enabled companies to drive down production costs while increasing output.

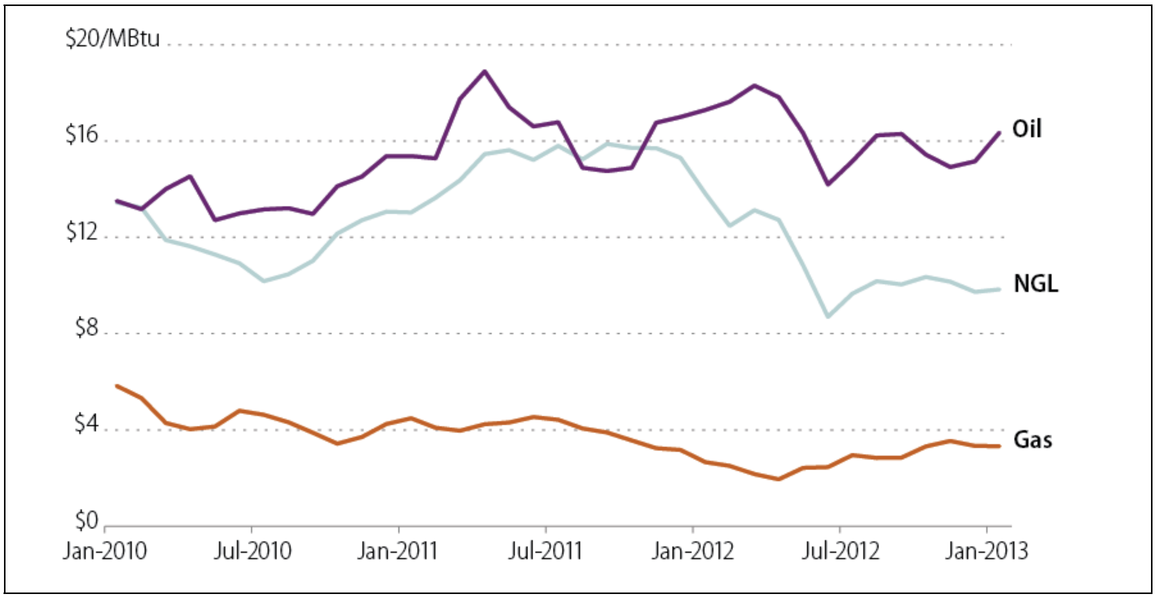
Natural Gas Liquids: A Production Driver

Natural gas liquids (NGLs) have taken on a new prominence as shale gas production has increased and prices have fallen. As natural gas prices have stayed low, company interests have shifted away from dry natural gas production to more liquids-based production. NGL is a general term for all liquid products separated from natural gas at a gas processing plant, and includes ethane, propane, butane, and pentanes. When NGLs are present with methane, which is the primary component of natural gas, the natural gas is referred to as either "hot" or "wet" gas. Once the NGLs are removed from the methane, the natural gas is referred to as "dry" gas, which is what most consumers use.

Each NGL has its own market and its own value. As the price for dry gas has dropped because of the increase in supply and other reasons, such as the warm winter of 2011, the natural gas industry has turned its attention to producing in areas with more wet gas in order to bolster the value it receives (see **Figure 4**). Some companies have shifted their production portfolios to tight oil formations, such as the Bakken in North Dakota and Montana, to capitalize on the experience they gained in shale gas development. Historically, the individual NGL products have been priced against oil, except for ethane. As oil prices have remained higher since 2008 relative to natural gas, they have driven an increase of wet gas production. Because of its low price, dry gas is often treated as a "by-product" of wet gas and oil production, despite its low price.

Figure 4. Natural Gas, Oil, and NGL Prices

2010-2012



Source: U.S. Energy Information Administration.

Notes: According to EIA, the NGL composite price is derived from daily Bloomberg spot price data for natural gas liquids at Mont Belvieu, TX, weighted by gas processing plant production volumes of each product as reported on Form EIA-816, "Monthly Natural Gas Liquids Report." The mix of NGLs will vary by source, and the price will vary by the actual market for the product. The natural gas price is at Henry Hub, and the oil price is West Texas Intermediate (WTI). Units = nominal dollars per million British thermal units (MBtu).

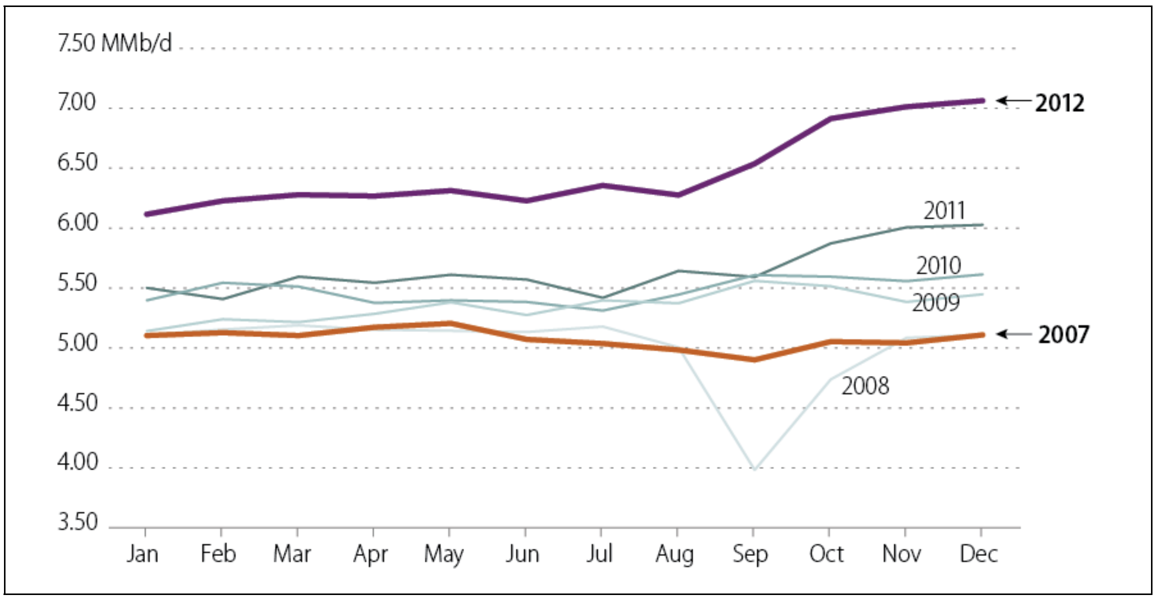
Increased Tight Oil Production Raises Independence Possibility

The prospect of U.S. energy independence is grounded in the production growth from tight oil formations such as the Bakken Formation in North Dakota and Montana, and the Eagle Ford

Formation in Texas.[6] Relative to other fuels, the United States is more dependent upon imports for its oil requirements, still accounting for almost 40% of consumption.[7] Canada is the largest supplier of U.S. oil imports, which is why energy independence is usually mentioned as North American energy independence.[8] The United States added a total of more than 850,000 barrels per day (b/d) of oil production between 2011 and 2012 (see **Figure 5**), and production in February 2013 was up almost 1 million b/d over 2012. U.S. oil production has reached levels not seen in more than a decade, but is almost 2.5 million b/d short of the highs in the 1970s. Since 2005, when imports reached a peak, they have dropped more than 3 million b/d, or 23%, through 2012.[9] Also since 2005, U.S. consumption of crude oil and petroleum products has been trending downward, contributing to the decrease in imports.

Figure 5. Monthly U.S. Oil Production

2007-2012



Source: U.S. Energy Information Administration.

Note: Units = nominal dollars per million barrels per day (MMb/d).

The continued shift of industry resources toward oil-rich production has prompted forecasts of continued growth. Domestic crude oil production is projected to rise through the end of the decade. The tremendous increases are primarily due to dramatic increases in production from the

6 For additional information on the Bakken Formation, see CRS Report R42032, *The Bakken Formation: Leading Unconventional Oil Development*, by Michael Ratner et al.

7 For additional information on U.S. oil imports, see CRS Report R42465, *U.S. Oil Imports and Exports*, by Robert Pirog.

8 CRS Report R41875, *The U.S.-Canada Energy Relationship: Joined at the Well*, by Paul W. Parfomak and Michael Ratner. Mexico is the third-largest source of U.S. oil imports, but is not always included in discussions of North American energy independence, as its oil sector is not as integrated with the United States as is Canada's.

9 U.S. Energy Information Administration, *U.S. Imports of Crude Oil and Petroleum Products*, March 15, 2013, http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MTTIMUS2&f=A.

previously mentioned Bakken Formation in North Dakota and the Eagle Ford play in Texas, both tight oil formations.[10]

Environmental Concerns and Responses

As with other energy sources or fuel production, the development of unconventional oil and gas resources can pose environmental risks, many of which potentially may be mitigated with appropriate safeguards and existing technology. The recent large-scale increase in unconventional oil and gas production may result in both negative and positive environmental impacts, comparatively speaking. For example, increased unconventional oil and gas production activity has in some cases placed a strain on water resources, and on wastewater treatment plants that were not designed to remove chemicals, salts, and other contaminants from hydraulic fracturing flowback and produced water. On the other hand, natural gas is seen by many as a "bridge" fuel that provides more energy per unit of greenhouse gas produced than some alternatives (e.g., coal), and has only recently been produced in sufficient quantity and at low enough prices to provide a viable alternative fuel that is widely regarded as relatively cleaner-burning.

Nonetheless, the rapid expansion of oil and natural gas extraction using high-volume hydraulic fracturing—both in rural and more densely populated areas—has generated controversy due to its potential scale and impacts on land and water resources, air quality, communities, and landowners.[11]

Water quality issues have received the most attention, and of these, the potential risks associated with well stimulation by hydraulic fracturing have been at the forefront. Complaints of contaminated well water have emerged in various areas where unconventional oil and gas development is occurring,[12] although regulators have not reported a direct connection between hydraulic fracturing of shale formations and groundwater contamination. In shale formations, the vertical distance separating the target zone from usable aquifers generally is much greater than the length of the fractures induced during hydraulic fracturing. Thousands of feet of rock layers typically overlay the produced portion of shale, and these layers serve as barriers to flow. In these circumstances, geologists and state regulators generally view as remote the possibility of creating a fracture that could reach a potable aquifer. If the shallow portions of shale formations were developed, then the thickness of the overlying rocks would be less and the distance from the shale to potable aquifers would be shorter, posing more of a risk to groundwater. In contrast to shale, coalbed methane (CBM) basins often qualify as underground sources of drinking water. Injection of fracturing fluids directly into or adjacent to such formations would be more likely to present a risk of contamination, and this is where initial regulatory attention and study was focused.[13]

[10] Adam Sieminski, *Outlook for Shale Gas and Tight Oil Development in the U.S.*, U.S. Energy Information Administration, Presentation for the American Petroleum Institute, Washington, DC, April 4, 2013, p. 12.

[11] For a detailed discussion of environmental issues, see, for example, New York Department of Environmental Conservation, Revised Draft SGEIS on the Oil, Gas and Solution Mining Regulatory Program (September 2011): Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing in the Marcellus Shale and Other Low-Permeability Gas Reservoirs, September 7, 2011, http://www.dec.ny.gov/energy/75370.html.

[12] See, for example, Amy Mall, *Incidents Where Hydraulic Fracturing is a Suspected Cause of Drinking Water Contamination*, Natural Resources Defense Council, Switchboard, updated June 17, 2013, http://switchboard.nrdc.org/blogs/amall/incidents_where_hydraulic_frac.html.

[13] U.S. Environmental Protection Agency, *Evaluation of Impacts to Underground Sources of Drinking Water by*
(continued...)

State regulators have expressed more concern about the groundwater contamination risks associated with developing a natural gas or oil well (drilling through an overlying aquifer and casing, cementing, and completing the well), as opposed to hydraulic fracturing per se. The challenges of sealing off the groundwater and isolating it from possible contamination are common to the development of any oil or gas well, and are not unique to hydraulic fracturing.

Identifying the source or cause of groundwater contamination can be difficult for various reasons, including the complexity of hydrogeologic processes and investigations, a lack of baseline testing of nearby water wells prior to drilling and fracturing, and the confidential business information status traditionally provided for fracturing compounds. In cases that have been investigated, regulators generally have determined that groundwater contamination was caused by failure of well-bore casing and cementing, well operation problems, or surface activities, rather than the hydraulic fracturing process.[14]

The debate over the groundwater contamination risks associated with hydraulic fracturing operations has been fueled in part by the lack of scientific studies to assess more thoroughly the current practices and related complaints and uncertainties. To address this issue, Congress has directed the Environmental Protection Agency (EPA) to conduct a study on the relationship between hydraulic fracturing and drinking water.[15] The "hydraulic fracturing" debate also has been complicated by terminology. Many who express concern over the potential environmental impacts associated with hydraulic fracturing do not differentiate the well stimulation process of "fracing" or "fracking" from the full range of activities associated with unconventional oil and gas exploration and production.[16]

The management of the large volumes of wastewater produced during natural gas production (including flowback from hydraulic fracturing operations and water produced from source formations) has emerged as a significant water quality issue. In some areas, such as portions of the Marcellus Shale region,[17] capacity is limited for wastewater disposal using underground injection wells (historically, the most common produced-water disposal practice in oil and natural

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(...continued)

*Hydraulic Fracturing of Coalbed Methane Reservoir*s, Final Report, EPA-816-04-003, Washington, DC, June 2004, p. 4-1. (EPA reviewed 11 major coalbed methane formations to determine whether coal seams lay within underground sources of drinking water (USDWs). EPA determined that 10 of the 11 producing coal basins "definitely or likely lie entirely or partially within USDWs.")

[14] See, for example, New York State Department of Environmental Conservation, *Fact Sheet: What We Learned from Pennsylvania*, NYS DEC NEWS, http://www.dec.ny.gov/energy/75410.html.

[15] Department of the Interior, Environment, and Related Agencies Appropriations Act, 2010, P.L. 111-88, H.Rept. 111-316. Drilling and fracturing methods and technologies have changed significantly over time as they have been applied to more challenging formations, greatly increasing the amount of water, fracturing fluids, and well pressures involved in oil and gas production operations. The EPA study includes five case studies that involve drinking water contamination incidents in areas where unconventional oil and gas development is occurring.

[16] A 2012 Pacific Institute study found that many individuals interviewed for the study defined "hydraulic fracturing" much more broadly than the industry meaning of the term (i.e., injection of fluids into a production well). These individuals used the term broadly to include well construction, completion, and other associated activities. Noting the differences, the authors concluded that "additional work is needed to clarify terms and definitions associated with hydraulic fracturing to support more fruitful and informed dialog and to develop appropriate energy, water, and environmental policy." See *Hydraulic Fracturing and Water Resources: Separating the Frack from the Fiction*, p. 29, http://www.pacinst.org/reports/fracking/.

[17] The Marcellus Shale formation potentially represents one of the largest unconventional natural gas resources in the United States, underlying much of West Virginia and Pennsylvania, southern New York, eastern Ohio, western Maryland, and western Virginia.

gas fields), and surface discharge of wastewater is an increasingly restricted option. Additionally, the injection of large volumes of wastewater into disposal wells has been associated with some instances of induced seismicity.[18]

Other water quality concerns—associated with both conventional and unconventional oil and natural gas extraction—include the risks of contaminating ground and surface water from surface spills, migration of methane gas and contaminants into residential water wells from faulty well construction, and siltation of streams from drilling and pad construction activities.[19] Because of the large volumes of water needed to extract shale gas and tight oil, water consumption issues have emerged as well. Water use issues include the impacts that large water withdrawals might have on groundwater resources, streams and aquatic life, and other competing uses (e.g., municipal or agricultural uses).

Air pollution associated with unconventional oil and natural gas production has also raised public health concerns and has drawn regulatory scrutiny. Air pollutants can be released during various stages of oil and natural gas production, not just hydraulic fracturing. Emission sources include pad, road, and pipeline construction; well drilling and completion, and flowback activities; and natural gas processing, storage, and transmission equipment. Key pollutants include methane (the main component of natural gas and a potent greenhouse gas), volatile organic compounds (VOCs), nitrogen oxides, sulfur dioxide, particulate matter, and various hazardous air pollutants.[20] According to EPA, the oil and gas industry is a significant source of VOCs, which react with nitrogen oxides to form ozone (smog). EPA has identified hydraulically fractured gas wells during flowback as an additional source of VOC emissions in the natural gas industry.[21]

In addition to hydraulically fractured gas wells, releases of methane and other pollutants can occur where natural gas is produced in association with oil, and natural gas gathering pipelines and other infrastructure are lacking. In such cases, the natural gas generally must be flared or vented. Flaring reduces VOC emissions compared to venting, but like venting, it contributes to greenhouse gas emissions without producing an economic value or displacing other fuel consumption.[22] Natural gas flaring has become an issue with the rapid and intense development of tight oil from the Bakken Formation in North Dakota, which has significant amounts of associated gas.[23] Other areas that have experienced large increases in tight oil production also have had increases in the amount of natural gas being flared.

[18] Katie M. Keranen, Heather M. Savage, and Geoffrey A. Abers et al., "Potentially Induced Earthquakes in Oklahoma, USA: Links between Wastewater Injection and the 2011 M_w 5.7 Earthquake Sequence," *Geology*, vol. 41, no. 3 (March 26, 2013).

[19] Such impacts may be regional or localized, and can vary seasonally or with longer-term variations in precipitation. For a discussion of water quality and supply issues associated with shale gas development, see CRS Report R42333, *Marcellus Shale Gas: Development Potential and Water Management Issues and Laws*, by Mary Tiemann et al.

[20] For a detailed discussion of air pollution issues associated with oil and gas exploration and development and recent EPA regulations, see CRS Report R42833, *Air Quality Issues in Natural Gas Systems*, by Richard K. Lattanzio.

[21] U.S. Environmental Protection Agency, *Overview of Final Amendments to Air Regulations for the Oil and Natural Gas Industry: Fact Sheet*, EPA, October 2012, http://www.epa.gov/airquality/oilandgas/pdfs/20120417fs.pdf.

[22] When vented, natural gas (largely methane) is released to the air without being burned. In contrast, when natural gas is flared (burned), the main by-product is carbon dioxide. Flaring is preferred to venting, as the latter is a major environmental concern because methane is several times more potent than carbon dioxide as a greenhouse gas, although more short-lived in the atmosphere. During drilling, natural gas is flared for safety reasons.

[23] See CRS Report R42032, *The Bakken Formation: Leading Unconventional Oil Development*, by Michael Ratner et al.

State Regulation of Oil and Gas Development

Oil and natural gas development is occurring in at least 32 states.[24] Shale gas, tight oil, or other unconventional resources are found in many of these states; primarily on non-federal lands (see **Figure 6**). States are the principal regulators of oil and gas exploration and production activities on state and private lands.[25] Additionally, some states require operators on federal public lands within state boundaries to comply with the state's oil and gas rules.[26]

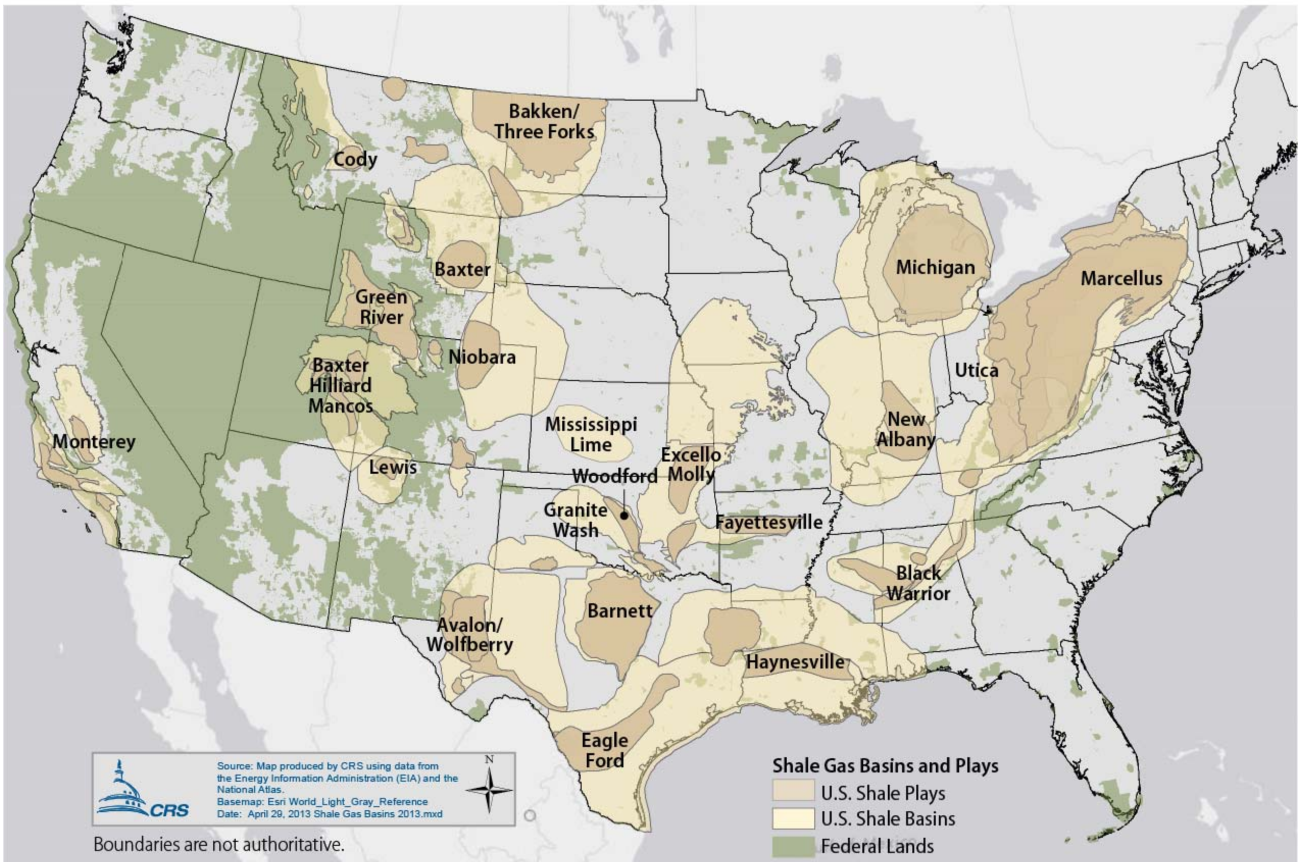
[24] U.S. Energy Information Administration, *Rankings: Natural Gas Marketed Production, 2011*, 2012, http://www.eia.gov/state/rankings/. EIA reports gas production in 32 states and oil production in 31 states. Five states (Texas, Alaska, California, North Dakota, and Oklahoma) accounted for 56% of crude oil production in 2011, and the biggest gains were in North Dakota and Texas, due in large part to increased horizontal drilling and hydraulic fracturing activity. EIA, *Petroleum & Other Liquids*, http://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_m.htm.

[25] The federal government, through the Bureau of Land Management (BLM), within the Department of the Interior, has responsibility for overseeing oil and gas development on federally managed lands. For a discussion of federal responsibilities for oil and gas production, see CRS Report R40806, *Energy Projects on Federal Lands: Leasing and Authorization*, by Adam Vann.

[26] States often enter into memoranda of understanding with BLM to coordinate administration and enforcement various regulatory requirements on public lands within the state.

Figure 6. Unconventional Shale Plays in the Lower 48 States

(with federal lands shown)



Source: CRS, compiled from U.S. Energy Information Administration sources.

Notes: No information reported on active shale plays in Alaska at the time of this report. Hawaii's volcanic origin does not support the geologic process leading to the deposition of shale.

Hydraulic fracturing has been used for decades to stimulate increased production from existing oil or gas wells. This technique, along with other well stimulation techniques, has been regulated to varying degrees through state oil and gas codes. The detail and scope of applicable regulations vary across the states, and some states have regulated "well stimulation" broadly without addressing hydraulic "fracturing" explicitly.[27] State regulators note that hydraulic fracturing operations are regulated through provisions that address a variety of production activities, including requirements regarding well construction (e.g., casing and cementing), well stimulation (e.g., hydraulic fracturing), and well operation (e.g., pressure testing and blowout prevention).[28]

Nonetheless, state groundwater protection officials also have reported that development of shale gas and tight oil using high-volume hydraulic fracturing, in combination with directional drilling, has posed new challenges for the management and protection of water resources.[29] Consequently, many of the major producing states have revised or are reviewing and considering revising their oil and gas laws and regulations to respond to these advances in oil and natural gas production technologies and related changes in the industry.

When revising measures, states have added provisions that address hydraulic fracturing specifically, such as requirements for disclosure of chemicals used in hydraulic fracturing.[30] Other common revisions include stricter requirements for well construction and operation (e.g., cementing, casing, and pressure testing) and wastewater storage and disposal.[31] New York State has imposed a de facto moratorium on high-volume hydraulic fracturing pending completion of environmental and public health reviews and development of new rules. Similarly, Maryland regulators, pursuant to executive order, are studying the risks associated with deep drilling and hydraulic fracturing to identify new safeguards that may be needed in permits. North Carolina has enacted legislation to permit hydraulic fracturing and horizontal drilling once rules are in place.[32]

The National Conference of State Legislatures (NCSL) reports that "state legislatures are actively working to address public health and environmental concerns, while also taking advantage of the economic potential offered by shale gas development."[33] During the 2011-2012 legislative

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[27] For state-specific information, see the Interstate Oil and Gas Compact Commission, *Summary of State Statutes and Regulations*, available at http://www.iogcc.state.ok.us/state-statutes.

[28] The state of California notes, for example, that requirements for protecting underground resources and well construction standards "provide a first line of protection from potential damage caused by hydraulic fracturing." However, the state notes that "There is a gap between the requirements placed on oil and gas operators to safely construct and maintain their wells, and the information they provide to the Division about hydraulic fracturing operations and steps taken to protect resources and the environment. The Department's pending regulatory process is intended to close that gap." California Department of Conservation, *Hydraulic Fracturing in California*, http://www.conservation.ca.gov/dog/general_information/Pages/HydraulicFracturing.aspx.

[29] See, for example, Ground Water Protection Council, U.S. Department of Energy, Office of Fossil Energy, National Energy Technology Laboratory, *State Oil and Natural Gas Regulations Designed to Protect Water Resources*, 2009, p. 24, http://www.gwpc.org/sites/default/files/state_oil_and_gas_regulations_designed_to_protect_water_resources_0.pdf.

[30] Alabama, Arkansas, Colorado, Montana, North Dakota, New Mexico, Ohio, Pennsylvania, Texas, Utah, West Virginia, and Wyoming are among the states that have revised oil and gas rules in recent years.

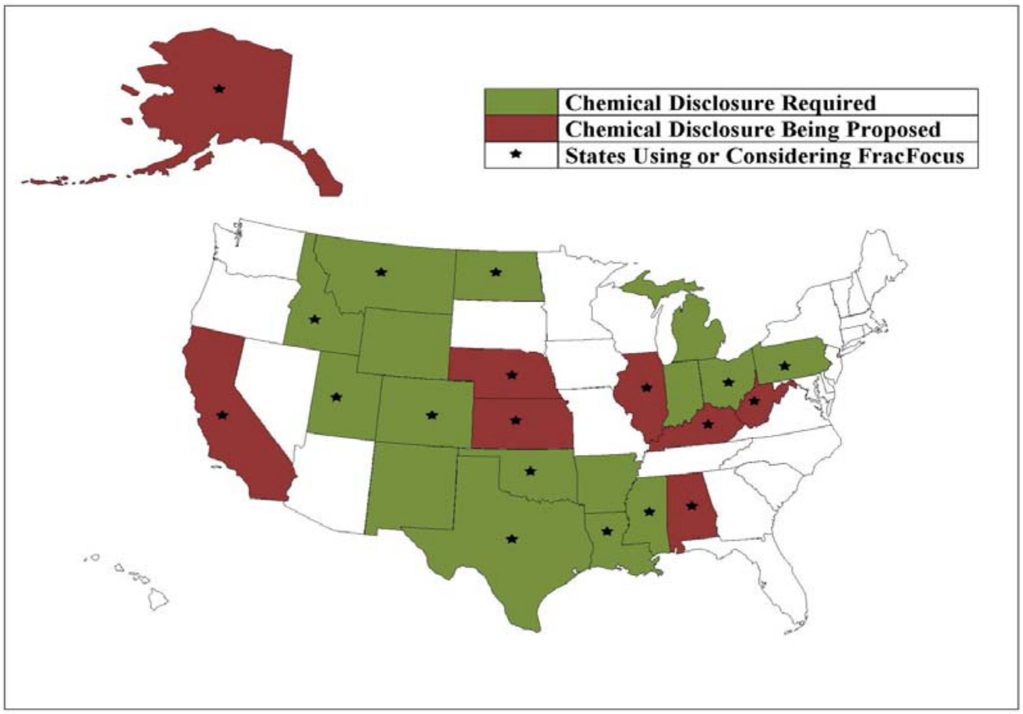
[31] For a comparison of state requirements for specific activities (e.g., wastewater disposal, chemical disclosure, and cementing) see Resources for the Future, *A Review of Shale Gas Regulations by State*, Center for Energy Economics and Policy, July 2012, http://www.rff.org/centers/energy_economics_and_policy/Pages/Shale_Maps.aspx.

[32] Vermont banned hydraulic fracturing; currently, EIA does not list Vermont as an oil or gas producing state. The New Jersey legislature passed a ban on shale gas drilling; however, the governor vetoed the bill and imposed a one-year ban, which has expired.

[33] Jacquelyn Pless, *Natural Gas Development and Hydraulic Fracturing: a Policymaker's Guide*, National Conference (continued...)

session, more than 170 bills were introduced in 29 states, and 14 of the states enacted legislation related to natural gas development.[34] The proposals covered a broad range of issues, and included measures on (1) water resources protection (including casing, well spacing, setbacks, water withdrawal, flowback, waste management requirements); (2) disclosure of hydraulic fracturing fluids; (3) severance taxes; (4) hydraulic fracturing suspensions, moratoria, or studies to investigate impacts; and (5) resolutions addressing hydraulic fracturing.[35] Regarding disclosure of chemicals used in hydraulic fracturing fluids, at least 35 bills were introduced in 14 states, and legislation was enacted in three states (Indiana, Louisiana, and Pennsylvania). Through 2012, 16 states had adopted chemical disclosure requirements (see **Figure 7**).[36]

Figure 7. Hydraulic Fracturing Chemical Disclosure by State



Source: Ground Water Protection Council, Groundwater Communique, p. 2, January 2013.

Notes: FracFocus was established in 2011 by the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission (IOGCC). FracFocus is a public registry where oil and gas companies may voluntarily identify chemicals used in hydraulic fracturing operations at specific wells. Various states allow or require operators to meet state disclosure requirements by posting information on the FracFocus website (http://www.fracfocus.org).

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of State Legislatures, June 2012, p. 5.

[34] Jacquelyn Pless, *States Take the Lead on Regulating Hydraulic Fracturing: Overview of 2012 State Legislation*, National Conference of State Legislatures, March 2013, p. 1.

[35] Ibid., pp. 2-3. North Dakota adopted a resolution urging Congress to limit EPA regulation of hydraulic fracturing. South Dakota and Utah resolutions urge Congress to clearly delegate hydraulic fracturing responsibility to the states.

[36] State requirements regarding disclosure of chemicals used in hydraulic fracturing are discussed in CRS Report R42461, *Hydraulic Fracturing: Chemical Disclosure Requirements*, by Brandon J. Murrill and Adam Vann.

Debate over the Federal Role

While states continue to adopt and implement varying frameworks and degrees of oversight and regulation of unconventional gas and oil development, citizen and environmental groups, and some Members of Congress, have pressed for greater environmental oversight of this industry sector at the federal level. Some advocates of a larger federal role point to a wide range of differences in substance, scope, and enforcement among state regulatory regimes, and assert that a national framework is needed to ensure a consistent baseline level of environmental and human health protection and transparency.[37] Such advocates further argue that greater regulatory uniformity would reduce risks and uncertainties to both the industry and the public.[38] Others argue against greater federal involvement, and point to established state oil and gas programs and regulatory structures (which include a range of structures involving commissions, boards, or divisions within natural resource agencies working to varying degrees with, or within, state environmental agencies). In this view, experience lies with the states, and in addition to the relative nimbleness of states to review and revise laws and rules, the states are better able to consider regional differences in geology, topography, climate, and water resources.

In the 113th Congress, as in recent Congresses, the federal role in regulating oil and gas production generally, and hydraulic fracturing specifically, has been the subject of hearings and legislation.[39] Some bills have proposed to broaden the federal role, while others have proposed to further limit federal involvement in regulating oil and gas development.[40] Such proposals have been contentious, and Congress has not enacted such legislation since amending the Safe Drinking Water Act (SDWA) in the Energy Policy Act (EPAct) of 2005 (P.L. 109-58) to explicitly exclude from the SDWA definition of underground injection the injection of fluids (other than diesel fuels) related to hydraulic fracturing operations.

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[37] See, for example, Matthew McFeeley, *State Hydraulic Fracturing Disclosure Rules and Enforcement: A Comparison*, Natural Resources Defense Council, NRDC Issue Brief IB: 12-06-A, July 2012.

[38] For further discussion, see Jeffrey Logan, Garvin Heath, and Elizabeth Paranhos et al., *Natural Gas and the Transformation of the U.S. Energy Sector: Electricity*, Joint Institute for Strategic Energy Analysis, NREL/TP-6A50-57702, Golden, CO, January 2013, http://www.nrel.gov/docs/fy13osti/55538.pdf.

[39] The 113th Congress has explored the role of states and the federal government in oil and gas production, specifically, and in environmental protection broadly. In February 2013, the House Committee on Energy and Commerce, Subcommittee on Environment and the Economy, held a hearing, *The Role of the States in Protecting the Environment Under Current Law.* The Senate Committee on Energy and Natural Resources has held a series of Natural Gas Roundtables, including a May 2013 forum on *Shale Development: Best Practices and Environmental Concerns.*

[40] Several relevant bills were offered in the 112th Congress, but none was enacted. H.R. 1084/S. 587 proposed repealing the hydraulic fracturing exemption established in the Energy Policy Act (EPAct) of 2005, and amending the term "underground injection" to include the injection of fluids used in hydraulic fracturing operations, thus authorizing EPA to regulate this process under the SDWA. The bills also would have required disclosure of the chemicals used in the fracturing process. In response to rules proposed by BLM in 2012, S. 2248/H.R. 4322 proposed that a state would have sole authority to regulate hydraulic fracturing on federal lands within state boundaries; H.R. 3973 would have prohibited the rule from having any effect on Indian lands; and H.R. 6235 would have barred a final rule for 10 years, pending an impact study.

In the 113th Congress, hydraulic fracturing legislation has been introduced again. H.R. 1921, S. 1135, and Section 301 of S. 332 would (1) require disclosure of the chemicals used in the fracturing process, and (2) repeal the hydraulic fracturing exemption established in EPAct 2005, and amend the term "underground injection" to include the injection of fluids used in hydraulic fracturing operations, thus authorizing EPA to regulate this process under the SDWA. H.R. 2513/S. 1234 would grant states sole authority to regulate hydraulic fracturing on federal lands within the state, and specify that hydraulic fracturing on federal land shall be subject to the law of the state in which the land is located. For further discussion, see CRS Report R41760, *Hydraulic Fracturing and Safe Drinking Water Act Regulatory Issues*, by Mary Tiemann and Adam Vann.

Selected Federal Responses to Unconventional Resource Extraction

Provisions of several federal environmental laws and related regulations currently apply to certain activities associated with oil and natural gas production. The Clean Water Act (CWA), for example, prohibits the discharge of pollutants from point sources into surface waters without a permit,[41] and the Safe Drinking Water Act (SDWA) requires an Underground Injection Control (UIC) permit for wastewater disposal through deep well injection.[42] Additionally, a SDWA UIC permit is required for the underground injection of fluids or propping agents pursuant to hydraulic fracturing if the injected fracturing fluids contain diesel fuels.[43] In 2012, EPA promulgated regulations under the authority of the Clean Air Act that require reductions in emissions related to oil and natural gas production, including emissions of volatile organic compounds (VOCs) from hydraulically fractured natural gas wells.[44]

While congressional debate has continued over possible legislation, the Administration has been pursuing additional initiatives to regulate or otherwise manage activities related to unconventional oil and natural gas production, and hydraulic fracturing specifically. EPA has been most active, and is considering actions under several pollution control statutes. Among these efforts, EPA is working to (1) establish technology-based limits to control discharges of wastewater from shale gas and coalbed methane extraction; (2) revise water quality criteria to protect aquatic life from discharges of brine produced during oil and gas extraction; (3) subject hydraulic fracturing chemicals to toxic substance reporting requirements, and (4) finalize permitting guidance for the use of diesel in hydraulic fracturing operations. The **Appendix** of this report provides a brief overview of selected federal environmental research and regulatory activities related to the production of tight oil and gas resources. Several of these initiatives are reviewed below.

EPA Study on Hydraulic Fracturing and Drinking Water

The 111th Congress, in 2009, urged EPA to conduct a study on the relationship between hydraulic fracturing and drinking water to gain a better understanding of potential contamination risks.[45] In

[41] CWA Section 301 prohibits the discharge of pollutants into the nation's waters except in compliance with the provisions of the law, which include obtaining a discharge permit. 33 U.S.C. §1311. For information on applicable CWA requirements, see Environmental Protection Agency, "Natural Gas Drilling in the Marcellus Shale, NPDES Program Frequently Asked Questions," March 16, 2011, http://www.epa.gov/npdes/pubs/hydrofracturing_faq.pdf.

[42] The Safe Drinking Water Act of 1974 (P.L. 93-523) authorized the Underground Injection Control (UIC) program at EPA. UIC provisions, as amended, are contained in SDWA Part C, §§1421-1426; 42 U.S.C. §§300h-300h-5.

[43] EPAct 2005 (P.L. 109-58, §322), amended SDWA to exempt from the definition of underground injection the injection of fluids or propping agents (other than diesel fuel) for hydraulic fracturing purposes.

[44] The rules regulate VOC emissions from hydraulically fractured natural gas wells, compressors, pneumatic controllers, storage vessels, and leaking components at onshore natural gas processing plants, as well as sulfur dioxide emissions from onshore natural gas processing plants. The new standards require producers to capture about 90% of the natural gas that escapes into the atmosphere as a result of production using hydraulic fracturing. For further discussion, see CRS Report R42986, *Air Quality Issues in Natural Gas Systems: In Brief*, by Richard K. Lattanzio.

[45] The Department of the Interior, Environment, and Related Agencies Appropriations Act, 2010 (P.L. 111-88, H.Rept. 111-316):

> Hydraulic Fracturing Study.—The conferees urge the Agency to carry out a study on the relationship between hydraulic fracturing and drinking water, using a credible approach that relies on the best available science, as well as independent sources of information. The conferees expect the study to be conducted through a transparent, peer-reviewed process that will ensure the validity and accuracy of the data. The Agency shall consult with other Federal agencies as well as

(continued...)

2011, EPA published a final study plan that identified research projects that would address the full life cycle of water in hydraulic fracturing, from water acquisition to chemical mixing and injection through wastewater treatment and/or disposal. The study is intended to (1) examine conditions that may be associated with potential contamination of drinking water sources, and (2) identify factors that may lead to human exposure and risks.[46] As part of the study, EPA is investigating five reported incidents of drinking water contamination in areas where hydraulic fracturing has occurred. The purpose of the retrospective case studies is to determine the potential relationship between reported impacts and hydraulic fracturing activities.[47]

In December 2012, EPA released a status report presenting the agency's efforts through FY2012 on 18 research projects being conducted for the study.[48] No data or findings were included. EPA plans to issue individual reports and papers during 2013 and 2014, and to synthesize the results from the research projects in a draft "report of results" by the end of 2014. EPA has designated the report of results as a "highly influential scientific assessment" (HISA),[49] which will undergo peer review by EPA's Science Advisory Board.[50] In June 2013, the agency announced that the final report will not be completed before 2016.

Multiagency Collaboration on Unconventional Oil and Gas Research

In March 2011, the White House issued a broad *Blueprint for a Secure Energy Future*, which identifies the need to "expand safe and responsible domestic oil and gas development and production." Additionally, the President directed the Secretary of the Department of Energy (DOE) to identify steps that could be taken to improve the safety and environmental performance of shale gas production, and to develop consensus recommendations on practices to ensure the protection of public health and the environment. [51]

In response, the Secretary of Energy's Advisory Board (SEAB) convened the Shale Gas Production Subcommittee to evaluate hydraulic fracturing issues and make recommendations to mitigate possible impacts of shale gas development. The final report included recommendations

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> appropriate State and interstate regulatory agencies in carrying out the study, which should be prepared in accordance with the Agency's quality assurance principles.

[46] U.S. Environmental Protection Agency, *Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Sources*, Office of Research and Development, EPA/600/R-11/122, November 2011.

[47] EPA is conducting retrospective case studies at five sites to develop information about the potential impacts of hydraulic fracturing on drinking water resources under different circumstances. The case studies include (1) the Bakken Shale in Dunn County, ND; (2) the Barnett Shale in Wise County, TX; (3) the Marcellus Shale in Bradford County, PA; (4) the Marcellus Shale in Washington County, PA; and (5) coalbed methane in the Raton Basin, CO.

[48] U.S. Environmental Protection Agency, *Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources: Progress Report*, Office of Research and Development, EPA 601/R-12/011, December 2012, http://www2.epa.gov/hfstudy/study.

[49] Ibid., p. 6.

[50] Because EPA has designated the "report of results" as a "highly influential scientific assessment," the agency is to follow the peer review planning requirements described in the Office of Management and Budget's *Information Quality Bulletin for Peer Review*, 2004. The Bulletin states that important scientific information must be peer reviewed by qualified specialists before being disseminated by the federal government. The EPA Science Advisory Board is an external federal advisory committee that conducts peer reviews of significant EPA research products and activities.

[51] The White House, "Blueprint for a Secure Energy Future," March 30, 2011, p. 13, http://www.whitehouse.gov/sites/default/files/blueprint_secure_energy_future.pdf.

for the states, federal government, and industry. The subcommittee recommended, among other actions, that companies and regulators—to the extent that such actions had not been undertaken—adopt further measures to protect water quality and to manage water use and wastewater disposal, publicly report the composition of water and flow throughout the fracturing and cleanup process, disclose fracturing fluid composition, and adopt best practices for well development and construction (especially casing, cementing, and pressure management).[52]

In 2012, the President issued Executive Order (E.O.) 13605, *Supporting Safe and Responsible Development of Unconventional Domestic Natural Gas Resources*, to coordinate the efforts of federal agencies overseeing the development of unconventional domestic natural gas resources and associated infrastructure. The order states that "Because efforts to promote safe, responsible, and efficient development of unconventional domestic natural gas resources are underway at a number of executive departments and agencies, close interagency coordination is important for effective implementation of these programs and activities."[53]

E.O. 13605 established an interagency working group to coordinate agency activities and to engage in long-term planning and ensure coordination on research, resource assessment, and infrastructure development. In April 2012, the lead agencies—DOE, EPA, and the Department of the Interior (DOI/U.S. Geological Survey)—signed a Memorandum of Agreement to develop a multiagency research plan "to address the highest priority research questions associated with safely and prudently developing unconventional shale gas and tight oil reserves."[54]

BLM Proposed Rule on Hydraulic Fracturing

While states have predominant regulatory authority for oil and gas development on state and private lands, the federal government is responsible for managing oil and gas resources on federal lands. However, some states require oil and gas operators on federal lands within their state to comply with state rules, and consequently, the debate over the federal role in regulating unconventional oil and gas production has extended to activities on federal lands.

The Bureau of Land Management (BLM), within the Department of the Interior, is the federal agency responsible for overseeing oil, natural gas, and coal leasing and production on federal and Indian lands, including split estate where the federal government owns the subsurface mineral estate.[55] BLM is tasked with leasing subsurface mineral rights not only on BLM-administered land, but also for lands managed by other federal agencies, including the U.S. Forest Service.[56] BLM oversees roughly 700 million subsurface acres of federal mineral estate and 56 million subsurface acres of Indian mineral estate nationwide. BLM estimates that approximately 3,400

[52] U.S. Department of Energy, the Secretary of Energy Advisory Board, Shale Gas Production Subcommittee, *Second Ninety Day Report*, November 18, 2011, http://www.shalegas.energy.gov/.

[53] Executive Order 13605, "Supporting Safe and Responsible Development of Unconventional Domestic Natural Gas Resources," (Washington: GPO, 2012), http://www.gpo.gov/fdsys/pkg/DCPD-201200269/pdf/DCPD-201200269.pdf.

[54] The Memorandum of Agreement is available at the Administration website, Multi-Agency Collaboration on Unconventional Oil and Gas Research, http://unconventional.energy.gov/.

[55] Mineral Leasing Act of 1920, 30 U.S.C. §181.

[56] For a discussion of federal lands leasing authorities and activities, see CRS Report R40806, *Energy Projects on Federal Lands: Leasing and Authorization*, by Adam Vann.

wells have been drilled annually in recent years on federal and Indian lands, and that hydraulic fracturing is used to stimulate roughly 90% of these wells.[57]

In May 2012, BLM proposed revisions to its oil and natural gas development rules in response to the increased use of hydraulic fracturing on federal and Indian lands.[58] The proposed rule broadly addressed "well stimulation, including hydraulic fracturing," and would revise BLM oil and gas production regulations that were promulgated in 1982 and last revised in 1988.[59] In the 2012 *Federal Register* notice, BLM noted that the rule would modernize its management of well stimulation activities, and stated that the "rule is necessary to provide useful information to the public and to assure that hydraulic fracturing is conducted in a way that adequately protects the environment."[60] The preamble further noted that the proposed changes were partly in response to recommendations made by the aforementioned SEAB Shale Gas Subcommittee.

BLM received more than 177,000 comments on the proposed rule, and in May 2013, BLM published a Supplemental Notice of Proposed Rulemaking (SNPR) and Request for Comment. BLM has requested comments on the multiple changes in the proposed rule, and provided 30 days for public comment. (The comment period was extended for 60 days.)[61]

Despite changes, the 2012 proposed rule and the 2013 SNPR share overarching features that reflect recommendations of the SEAB subcommittee report. Both proposals would (1) add reporting and management requirements for water and other fluids used and produced in hydraulic fracturing operations, with emphasis on managing fluids that flow back to the surface, (2) require public disclosure of hydraulic fracturing chemicals, and (3) tighten well construction and operation requirements to help ensure that wellbore integrity is maintained throughout the hydraulic fracturing process. Among the changes to the 2012 proposed rule, the BLM 2013 Supplemental Notice would

- narrow the scope of the rule to apply only to hydraulic fracturing and refracturing (the 2012 proposed rule would have applied to "well stimulation" activities broadly);[62]
- provide opportunities for individual states or tribes to work with BLM to craft variances for specific regulatory provisions that would allow compliance with state or tribal requirements to be accepted as compliance with the BLM rule (if the variance would meet or exceed the effectiveness of the rule provision it would replace);[63]

[57] 77 *Federal Register* 27691-27693.

[58] Department of the Interior, Bureau of Land Management, "Oil and Gas; Well Stimulation, Including Hydraulic Fracturing, on Federal and Indian Lands," 77 *Federal Register* 27691, May 11, 2012.

[59] The proposed rule would amend existing BLM regulations at 43 C.F.R. Section 316.3-2.

[60] 77 *Federal Register* 27692-27693.

[61] Department of the Interior, Bureau of Land Management, "Oil and Gas; Hydraulic Fracturing on Federal and Indian Lands: Supplemental Notice of Proposed Rulemaking," 78 *Federal Register* 31636, May 24, 2013.

[62] SNPR, §3162.3-3(a) and §3160.0-5. This revision excludes acidizing, enhanced secondary and tertiary recovery so that the rule would apply only to hydraulic fracturing and not to other "well stimulation" activities.

[63] SNPR, §3162.3-3(k). In 2012, BLM proposed to implement on public lands "whichever rules, state or Federal, are most protective of Federal lands and resources and the environment, consistent with longstanding practice and relevant statutory authorities." 77 *Federal Register* 72694.

- allow operators to report hydraulic fracturing chemical information to BLM either directly or through the FracFocus website or other specified database,[64] and provide more detailed guidance on procedures for handling trade secret claims;[65]
- clarify that mechanical integrity testing would be required for all fracturing and refracturing operations;[66]
- require that all fracturing operations must isolate all usable water formations to protect them from contamination, and allow operators to use an expanded set of cement evaluation tools to help ensure that usable water zones have been isolated and protected;[67]
- allow an advanced Notice of Intent Sundry to be submitted for a single well, or group of wells with the same geological characteristics within a field where hydraulic fracturing operations are likely to be successful using the same design;[68] and
- request comment on whether to require hydraulic fracturing wastewater to be stored in tanks only, rather than in lined pits or tanks as proposed in 2012.

Coast Guard Regulation of Barge Shipments of Shale Gas Wastewater

The disposal of the large volumes of wastewater produced during shale gas extraction has posed challenges for companies, state regulators, and communities—particularly in the Marcellus Shale region. On-site disposal options are limited, and trucking wastewater to distant injection wells is a costly endeavor. In 2012, the Coast Guard received two requests for approval for the bulk shipment of wastewater resulting from shale gas extraction in the Marcellus Shale.

The Coast Guard regulates the shipment of hazardous materials on the nation's rivers, and classifies cargoes for bulk shipment.[69] For a cargo that has not been classified in the regulations or under prior policy, the ship owner must request Coast Guard approval prior to shipping the cargo.[70] The Coast Guard has identified concerns with shipment of shale gas wastewater in barges. A key concern with the wastewater is "its potential for contamination with radioactive isotopes such as radium-226 and -228. Radium is of particular concern because it is chemically similar to calcium and so will easily form surface residues and may lead to radioactive surface contamination of the barges."[71] Because of this concern, the Coast Guard currently does not allow

[64] SNPR, §3162.3-3(i). Operators submitting information through FracFocus would be required to certify that the information is correct and certify that the operator complied with applicable laws governing notice and permits.

[65] SNPR, §3162.3-3(j)1-4. Modeled on Colorado rules, BLM would instruct operators not to disclose trade secret information to BLM or on FracFocus. Operators would submit an affidavit stating that withheld information is entitled to withholding. BLM would retain authority to require operators to submit claimed trade secret information.

[66] SNPR, §3162.3-3(f).

[67] SNPR, §3162.3-3(b) and §3162.3-3(d).

[68] SNPR, §3162.3-3(d).

[69] This action is based on authority in 46 U.S.C. Chapter 37—"Carriage of Liquid Bulk Dangerous Cargoes." Implementing regulations are published in 46 C.F.R. Subchapter O—"Certain Bulk Dangerous Cargoes."

[70] See 46 C.F.R. 153.900(c)-(d) or 46 C.F.R. 151.01-15.

[71] U.S. Coast Guard, *Marine Safety Engineering, Shale Gas Extraction Waste Water*, Commercial Regulations and Standards Directorate, Fall 2012, p. 5, http://www.uscg.mil/hq/cg5/cg52/docs/2012fall.pdf.

barge shipment of shale gas extraction wastewater (SGEWW), and is developing a draft policy to allow SGEWW to be transported for disposal. In March, the Coast Guard submitted to the Office of Management and Budget for review a draft document, "Carriage of Conditionally Permitted Shale Gas Extraction Waste Water in Bulk."

Conclusion: Above- and Below-Ground Issues a Concern

The prospect that by the end of the decade the United States could become a significant exporter of natural gas and the world's leading oil producer is a phenomenal change of circumstances from just a few years ago. The technological advances that drove the changes in the United States have also reversed the global perspective of dwindling oil and natural gas resources, and increased the concern among many about greenhouse gas emissions. Other countries seek to emulate the U.S. success, but have yet to do so. The U.S. oil and gas situation continues to be extremely dynamic, and many questions remain about how the United States will develop its resources.

Many observers, including U.S. government officials, have only recently recognized the tremendous resource size and the benefits that will accrue from developing the resources, as well as the potential risks that may be associated with this development. Even though shale gas development is still considered very new and tight oil production is even newer, the industry has continued to improve its efficiency in extracting the resources, particularly of natural gas. As more industry resources are shifted to tight oil plays, the natural gas sector has had to produce more with less. Some in industry point out that at the beginning of shale gas development about 5% of the resource was able to be extracted; now it is closer to 20%. By comparison, the extraction rate from conventional gas is between 30% and 60% of the resource.

Most concerns surrounding shale gas and tight oil development have involved environmental and human health issues, and particularly concerns over the potential risks to groundwater and surface water resources, and emissions of air pollutants. These concerns have led to calls for greater federal oversight of oil and gas development. Although primary regulatory authority over oil and natural gas exploration and production on state and private lands generally rests with the states, provisions of several federal environmental laws currently apply to certain activities associated with oil and natural gas exploration and production. Moreover, EPA is reviewing other statutory authorities and pursuing new regulatory initiatives, and BLM has proposed revisions to its oil and gas rules to specifically address hydraulic fracturing on federal and Indian lands. A broader concern, particularly from environmental groups, is that the low price of natural gas is having negative consequences for the development and growth in renewable energy sources and nuclear power, potentially resulting in another generation of greenhouse-gas-producing energy sources.

The 113th Congress has held hearings, roundtables, and other discussions on issues associated with unconventional oil and gas development broadly, and on the role of the states specifically. Bills have been introduced to expand and also to constrain federal involvement in oil and gas development involving hydraulic fracturing. In the meantime, the Administration is pursuing actions to broaden federal oversight of this industry sector through administrative means.

Appendix. Selected Federal Initiatives Related to Unconventional Oil and Gas Production

Table A-1. Selected Federal Actions Related to Unconventional Oil and Gas Production

(with emphasis on hydraulic fracturing)

Agency: Statute, as Amended	Regulatory	Research	Status
EPA: Clean Air Act (CAA)	**Air emissions.** In 2012, EPA issued regulations that revised existing rules and promulgated new ones to regulate emissions of volatile organic compounds (VOCs), sulfur dioxide, and hazardous air pollutants (HAPs) from many production and processing activities in the oil and gas sector that had not been subject previously to federal regulation.		Rules were promulgated in August 2012 (77 *Federal Register* 49489); requirements phase in through 2015.
	Particularly pertinent to shale gas production are the New Source Performance Standards (NSPS), which require reductions in emissions of VOCs from hydraulically fractured natural gas wells. The rules require operators to use reduced emissions completions (green completions) for all hydraulically fractured natural gas wells beginning no later than January 2015.		EPA has agreed to revisit elements of the NSPS, and on April 12, 2013, proposed revisions to the NSPS for storage tanks (78 *Federal Register* 22125).
	Applying broadly across the sector, the NSPS require reductions of VOCs from compressors, pneumatic controllers, storage vessels, and other emission sources, and also revise existing standards for sulfur dioxide emissions from onshore natural gas processing plants, and HAPs from dehydrators and storage tanks.[a]		
EPA: Clean Water Act (CWA)	**Wastewater discharge.** Produced water and flowback from hydraulic fracturing have high levels of total dissolved solids (TDS), largely chlorides, which can harm aquatic life and affect receiving water uses (such as fishing or irrigation). EPA is updating its chloride water quality criteria for protection of aquatic life.		Draft criteria document expected in summer 2014.
	CWA Section 304(a)(1) requires EPA to develop criteria for water quality that reflect the latest scientific understanding of the effects of pollutants on aquatic life and human health. States use EPA-recommended criteria to establish state water quality standards, which in turn are used to develop enforceable discharge permits.		
	If reflected in state water quality standards, the revised chloride water quality criteria could affect discharges of produced water from extraction of conventional and unconventional oil and gas.[b]		

Agency: Statute, as Amended	Regulatory	Research	Status
EPA: CWA	**Wastewater discharge.** In 2011, EPA indicated that it was initiating two separate rulemakings to revise the Effluent Limitations Guidelines and Standards (ELGs) for the Oil and Gas Extraction Point Source Category to control discharges of wastewater from coalbed methane (CBM) and shale gas extraction. Under CWA Section 304(m), EPA sets technology-based effluent limitations for industrial wastewater discharges. States incorporate these limits into discharge permits. Shale and CBM wastewaters often contain high levels of total dissolved solids (TDS—i.e., salts), and shale gas wastewater may contain chemical contaminants, naturally occurring radioactive materials (NORM), and metals. Currently, shale gas wastewater may not be discharged directly to surface waters, but CBM wastewater is not subject to national discharge standards. (CBM wastewater discharge permits are based on best professional judgments of state or EPA permit writers.) EPA is developing regulatory options to control direct discharges of CBM wastewaters. Also, current ELGs lack pretreatment standards for discharges of shale gas or CBM wastewaters to publicly owned wastewater treatment works (POTWs), which typically are not designed to treat this wastewater. EPA is developing national pretreatment standards that shale gas and CBM wastewaters must meet before discharge to a POTW to ensure that the facility can treat the wastewater effectively.[c]		Notice of the final Effluent Guidelines Program Pan was published in October 2011 (76 *Federal Register* 66286). Initially, EPA planned to propose the CBM rule in 2013, and the shale gas rule in 2014. EPA has combined the rulemakings, and plans to issue a proposed rule in April 2014 and a final rule in December 2015.
EPA: Emergency Planning and Community Right-to-Know Act (EPCRA)	**Chemical disclosure.** EPA is considering an October 2012 petition by nongovernmental organizations to subject the oil and natural gas extraction industry to Toxics Release Inventory (TRI) reporting under EPCRA. Section 313 of EPCRA requires owners or operators of certain industrial facilities to report on releases of toxic substances to the state and EPA. EPA and states are required to make nonproprietary data publicly available through the TRI website.		Response to petitioners is expected in spring 2014.
EPA: Safe Drinking Water Act (SDWA)	**Diesel fuels.** EPA issued draft *UIC Program Guidance for Permitting Hydraulic Fracturing with Diesel Fuels* in response to the revised SDWA definition of "underground injection" in the Energy Policy Act (EPAct) of 2005 to explicitly exclude the underground injection of fluids (other than diesel fuels) used in hydraulic fracturing. The draft guidance provides recommendations for EPA permit writers to use in writing permits for hydraulic fracturing operations using diesel fuels. The guidance will apply in states where EPA implements the UIC program for oil and natural gas related (Class II) injection wells. States are not required to adopt the guidance, but may do so.[d]		Draft guidance issued in May 2012; final guidance is expected in 2013.

Agency: Statute, as Amended	Regulatory	Research	Status
EPA: SDWA		**Study.** EPA is studying the relationship between hydraulic fracturing and drinking water. Congress requested the study in EPA's FY2010 appropriations act. EPA designated the pending "report of results" as a "highly influential scientific assessment" (HISA), which requires peer review by qualified specialists.	Progress report issued in December 2012. During 2013 and 2014, EPA plans to issue individual reports and papers. A final report of results is expected in 2016 (extended from 2014).
EPA: Toxic Substances Control Act (TSCA)	**Chemical reporting.** EPA is developing an Advance Notice of Proposed Rulemaking (ANPRM) to get input on the design and scope of possible reporting requirements for hydraulic fracturing chemicals; EPA is considering requiring information reporting under TSCA Section 8(a), and health and safety data reporting under Section 8(d).		Initiated in January 2012. Publish ANPRM in *Federal Register*: expected February 2014.
EPA: Resource Conservation and Recovery Act (RCRA) (Also known as the Solid Waste Disposal Act)	**Storage/disposal pits and ponds.** EPA is considering developing guidance to address the design, operation, maintenance, and closure of pits used to store hydraulic fracturing fluids for reuse or pending final disposal. These wastes are exempt from regulation as a hazardous waste under RCRA.		No schedule.
EPA: National Enforcement Initiative	**Oil and gas extraction.** Every three years, EPA selects specific industries or pollution sources to focus enforcement efforts on "serious pollution problems" that EPA believes can best be addressed by a national enforcement team. The 2011-2013 initiatives include *Assuring Energy Extraction Activities Comply with Environmental Laws* focused on natural gas extraction and production activities.		This initiative runs through 2013.
Department of the Interior, Bureau of Land Management: Mineral Leasing Act, Indian Mineral Leasing Act	**Hydraulic fracturing on public lands.** BLM has proposed revisions to rules governing oil and natural gas production on federal and Indian lands. BLM proposes to (1) require public disclosure of chemicals used in hydraulic fracturing, (2) tighten regulations related to well-bore integrity, and (3) add new reporting and management/storage/disposal requirements for water used in hydraulic fracturing.		Proposed in May 2012; following extensive public comment, BLM issued a Supplemental Notice of Proposed Rulemaking in May 2013.
U.S. Coast Guard: 46 U.S.C. Ch. 37	**Wastewater shipment.** The Coast Guard regulates the shipment of hazardous materials on the nation's rivers. Because of the potential for shale gas wastewater in the Marcellus Shale region to contain radioactive materials (especially radium, which can form surface residues and may lead to radioactive surface contamination of the barges), the Coast Guard currently does not allow barge shipment of shale gas extraction wastewater. The Coast Guard's Hazardous Materials Division is developing a policy to allow shale gas extraction wastewater to be transported for disposal.		In March, the Coast Guard submitted to the Office of Management and Budget for review a draft document, "Carriage of Conditionally Permitted Shale Gas Extraction Waste Water in Bulk."

Agency: Statute, as Amended	Regulatory	Research	Status
DOE/EPA/DOI-USGS: E.O. 13605		**Federal research coordination.** In 2012, the agencies agreed, through an MOU, to develop a multiagency research plan "to address the highest priority research questions associated with safely and prudently developing unconventional shale gas and tight oil resources."	Research plan expected to be available mid-2013.

Source: Prepared by the Congressional Research Service.

Notes: This table presents selected Administration activities related to unconventional oil and natural gas extraction. It excludes, for example, regional or site-specific research studies conducted by federal agencies. More information on EPA initiatives to regulate oil and gas production and hydraulic fracturing is available at EPA's website, Natural Gas Extraction—Hydraulic Fracturing, http://www2.epa.gov/hydraulicfracturing.

a. These CAA rules, issued under court order, establish new air emissions standards for the "Crude Oil and Natural Gas Production" and "Natural Gas Transmission and Storage" source categories. For details, see CRS Report R42986, *Air Quality Issues in Natural Gas Systems: In Brief*, by Richard K. Lattanzio.

b. For more information, see the EPA Water Quality Criteria web page, http://water.epa.gov/scitech/swguidance/standards/criteria/.

c. EPA explains that "[f]or direct dischargers of unconventional oil and gas wastewaters from onshore oil and gas facilities—with the exception of coalbed methane—technology-based limitations are based on the Effluent Limitations Guidelines (ELGs) for the Oil and Gas Extraction Category (40 CFR Part 435). Permits for onshore oil and gas facilities must include the requirements in Part 435, including a ban on the discharge of pollutants, except for wastewater that is of good enough quality for use in agricultural and wildlife propagation for those onshore facilities located in the continental United States and west of the 98th meridian.... Part 435 does not currently include categorical pretreatment standards for indirect discharges to publicly owned treatment works (POTWs) for wells located onshore." Source: U.S. Environmental Protection Agency, *Unconventional Extraction in the Oil and Gas Industry*, http://water.epa.gov/scitech/wastetech/guide/oilandgas/unconv.cfm.

d. EPA regulates the underground injection of fluids through SDWA §§1421-1426; 42 U.S.C. §§300h-300h-5. In May 2012, EPA issued draft *UIC Program Guidance for Permitting Hydraulic Fracturing with Diesel Fuels*, which generally follows EPA Class II underground injection well requirements (i.e., well construction standards; mechanical integrity testing; operating, monitoring, and reporting requirements; and public notification and financial responsibility requirements). The draft guidance provides recommendations for EPA permit writers for tailoring requirements for hydraulic fracturing using diesel fuels. The guidance will apply in states where EPA implements the UIC program for Class II wells (including Pennsylvania, New York, Michigan, Kentucky, Tennessee, and Virginia).

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