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The environmental, health, and safety impacts of the energy industry have been a fundamental aspect of, and will continue to be a challenge for, the business. At one time, many of these challenges had limited, localized effects. Now, however, industry-related impacts, which are present during all phases of the business, including exploration, production, transportation/distribution, and consumption, often have a far broader, even global, scope. Regionally, the results of the 2010 catastrophic explosion of the Deepwater Horizon drilling rig in the Gulf of Mexico are stark reminders of the significance of environmental protection to the industry. Referred to by U.S. president Obama as "the worst environmental disaster America has ever faced," the Deepwater disaster resulted in the death of 11 men and pumped an estimated 4.9 million barrels of crude oil over a 25,000–68,000 square mile area. The international scale of energy-related impacts can be seen in the reported data pertaining to climate change.

This chapter surveys a number of challenges related to the environment and to health and safety matters that are attendant to the energy business. Relevant examples shall be utilized as illustrations. Also discussed are industry opportunities pertaining to public environmental awareness.

THE CHALLENGE OF RESPONDING TO ENVIRONMENTAL DISASTERS

The Deepwater Horizon catastrophe is not the only environmental disaster to which the energy industry has responded; all sources of energy are subject to disastrous environmental events. Companies associated with

virtually every energy source have experienced some sort of calamitous event, some of which were the result of human involvement or accident, while some were the result of natural causes.

Problems with the production, transpiration, distribution, and consumption of petroleum often grab headlines, as did the release of oil from the Deepwater Horizon explosion. Oil spills of that magnitude are not as rare as many believe. While the Deepwater disaster released more than 4,000 barrels of oil into the Gulf of Mexico, spills or releases of this magnitude are not singular occurrences. For example, in 1991, Iraqi military forces deliberately set fire to oil wells in Kuwait, resulting in the release of as many as 1 billion barrels of oil into the environment.

Oil pipelines and refineries are also vulnerable to explosions that are a health and safety risk to local communities. The 2006 Abule Egba pipeline explosion in Lagos, Nigeria, killed hundreds, and the explosion of BP's Texas City refinery killed 15 people and injured another 180, resulting in financial losses that exceeded $1.5 billion.

Other fossil fuel processes have experienced events that have resulted in similar adverse environmental, health, and safety consequences. For example, since 1992, serious natural gas transmission and distribution pipeline incidences have resulted in 332 fatalities, over 1,300 injuries, and over $500 million in property damage. Other stages in the gas have suffered catastrophic accidents; a natural gas liquefaction plant in Skikda, Algeria, exploded in early 2004, killing 27 and injuring 74.

Coal mining tragedies have also captured the public's attention. Thousands have died in coal mining accidents, the causes of which can be numerous, including flooding, leaks of gases such as hydrogen sulfide or explosive natural gases, dust explosions, mine slope collapses, mining-induced seismicity, or mechanical errors of mining. In 2010, the nation watched rescuers search for survivors of the explosion of the Upper Big Branch mine in West Virginia. The explosion killed 29 of the 31 miners at that site.

The coal segment of the energy business has also been associated with significant spills of coal fly ash slurry, a sludge comprising a number of toxic metals such as arsenic, copper, barium, cadmium, chromium, lead, mercury, nickel, and thallium. The Tennessee Valley Authority's Kingston Fossil Plant collapse in 2008 released an estimated 5.4 million cubic yards of coal fly ash slurry into local communities and waterways. It was the largest fly ash release in U.S. history.

Nonfossil fuel energy sources have also significant environmentally related incidents. Nuclear power crises are rare but are disastrous. Consider, for example, the accident that occurred in 2011 at Japan's Fukushima Daiichi 1 Nuclear Power Plant in the wake of the Tōhoku earthquake and tsunami. The huge earthquake and tsunami knocked out essential backup power systems at the plant, resulting in the release of radioactive material that produced extremely high radiation dose rates near the plant, left large

areas of land uninhabitable, and discharged contaminated water into the sea. The accident was rated a 7 on the International Nuclear Event Scale, one of only two such events ever to occur. This rating indicates a nuclear accident that causes widespread contamination with serious health and environmental effects. The accident at the Chernobyl nuclear power plant in the Ukraine was the other such level 7 accident—an event that most believe to be the worst accident in the history of nuclear power. Unlike the weather-related accident in Japan, Chernobyl was attributed to human error and design issues.

Energy production from hydroelectric facilities may also confront its own environmental crises. One such crisis occurred in 1975 when two dams in China's Henan Province, Banqiao Reservoir Dam and Shimantan Reservoir Dam, suffered catastrophic failure or were intentionally destroyed during a typhoon. Reports indicate that approximately 26,000 people died from flooding, an additional 145,000 died during subsequent epidemics and famine, and 11 million residents were impacted. Some 5,960,000 buildings collapsed as a result of the floods.

REGULATORY CHALLENGES

While calamities are risks for the energy sector, they certainly are not the only environment, safety, and health concerns for businesses. Regulation of environmental aspects of the energy business poses a continuing challenge for industry professionals.

Aging Infrastructure

Many segments of the energy business are confronting the prospect of making large investments to upgrade aging infrastructure. Many of these upgrades are attributable to regulatory measures pertaining to environmental compliance, just a few of which are discussed below.

Coal-Fired Power Plants

It is expected that a number of older coal-fired power will require significant upgrades or will be retired in the next few years. Many utilities must install pollution-control technology in order to cut emissions from its coal plants to comply with new and pending federal and state regulatory limits. Environmental concerns such as the development of sulfur dioxide, mercury, and air toxics regulations have been cited as significant factors for the required "improvements" and retirements, as have issues regarding the regulatory treatment of coal handling and ash disposal. Several companies have canceled plans for low-carbon, "clean" coal plants due to lower natural gas prices and reduced customer demand.

Nuclear Facilities

Thirty-two percent (32%) of the world's 435 nuclear power plants had been in operation for more than 30 years at the end of 2011; 5 percent were more than 40 years old. In the United States, the Nuclear Regulatory Commission has reported that one-half the 104 nuclear reactors in the nation are over 30 years old. Most of the nuclear reactors in the United States were granted licenses to operate for 40 years, and many have applied for, and have been granted, 20-year extensions.

Environmental issues are important factors in determining the future of these aging facilitates. There are a number of environmental concerns associated with ongoing nuclear power generation. These include the safe storage, transport, and disposal of nuclear wastes as well as the potential for a catastrophic nuclear accident, despite the low probability of such an accident. Regarding waste management, the development of a national geological storage facility for spent nuclear reactor fuel and other high-level radioactive material has been the subject of a spirited national dialogue. A proposed facility at Yucca Mountain in Nevada has suffered funding issues, and public concerns over stored waste at operating nuclear generation facilities have mounted. Yet, as with continued operation, the decommissioning of retired, potentially contaminated facility sites also entails potential environmental and financial liability.

With regard to catastrophic accidents, Japan's Fukushima disaster certainly has impacted public attitudes toward nuclear power. Such accidents have also caused regulators and operators to more carefully consider nuclear energy programs. In the wake of Fukushima, some countries, such as Germany and Italy, may phase out the use of nuclear power; other countries, including Austria, Denmark, and New Zealand, are opposed to nuclear power. However, a number of countries will continue (China, India, and the Republic of Korea) or even accelerate their nuclear programs (the United Kingdom, France, and the Russian Federation).

Regulatory Uncertainty

The regulation of the energy business' environmental impacts is expansive, both volumetrically and substantively. The importance of the regulatory system to the industry's business planning process cannot be overestimated, yet the system is complicated in a number of respects. First, in many nations, including the United States, environmental impacts are regulated at multiple governmental levels, that is, local, state, and/or federal levels. This is further complicated by the potential for jurisdictional inconsistency, fragmentation, and duplication for energy businesses operating internationally. Further, inconsistent interpretation and enforcement of existing regulations also adds to the complexity of the industry's

regulatory burdens. Another complication involves a lack of clarity over future regulation, a factor which is often cited by industry as a barrier to efficient operations and to future investment.

With regard to multijurisdictional requirements, the energy business confronts enormous compliance challenges and will continue to do so. Conformity with different policies and regulations both internationally and domestically consumes enormous financial and human resources. For example, a company seeking to construct an interstate natural gas pipeline in the United States must comply with a plethora of federal laws, including the Clean Water Act; the Clean Air Act (CAA); the Endangered Species Act; the Wild and Scenic Rivers Act; the Wilderness Act; the National Parks and Recreation Act; the Toxic Substances Control Act; the National Historic Preservation Act; the Coastal Zone Management Act; and Executive Orders No. 11,988 and No. 11,990. Navigating these many relevant multilayered regulatory regimes complicates industry compliance efforts.

There are also many examples of the challenges presented by inconsistent laws and regulations, including their interpretation and enforcement. In many industrializing economies, such as in India and China, polluting industries are sometimes subjected to harsh sanctions for violations of environmental regulations; yet these same governments also have unpredictable enforcement histories. For example, the Indian Air Prevention and Control of Pollution Act imposes a source-by-source "command and control" system of regulation, yet the most publicized enforcement actions have been imposed by the Supreme Court of India. In the 1997 case of *M. C. Mehta v. Union of India,* the Supreme Court of India ordered the relocation of hundreds of industries with emissions alleged to be causing damage to the Taj Mahal. It further ordered a number of other industries to switch its operations from coke and coal to natural gas or to cease operations completely. The affected industries included foundries, chemical facilities, a refinery, and diesel generators. China too has a record of using forced facility relocations and construction/traffic restrictions to address environmental issues.

Inconsistency in interpretation and enforcement is a regulatory challenge in the United States, too. The case of *Environmental Defense v. Duke Energy Corporation* is illustrative. In this case, the Supreme Court of the United States addressed definitional inconsistencies between the Prevention of Significant Deterioration (PSD) and New Source Performance Standard (NSPS) air pollution control schemes of the CAA. The PSD standards pertain to annual emissions; and NSPS regulate hourly emissions. Both schemes cover modified, as well as new, stationary sources of air pollution, and both define the term "modification" differently. The NSPS provisions define "modification" of a source as a physical change, or a change in the method of operation, that increases the amount of a pollutant discharged or emits a new one. Under the PSD scheme, a permit is required

to "construct" a "major emitting facility," with "construction" defined as including a "modification" as defined in NSPS.

Based upon its interpretation of the regulations, the United States filed an enforcement action against Duke Energy for making unpermitted changes to several of its coal-fired electric-generating units. These changes allowed the company to operate longer hours, which increased annual net emissions. Duke Energy responded that none of its projects was a "major modification" requiring a PSD permit under the CAA because none increased hourly emissions rates. The Supreme Court ruled in favor of the United States, declining to require regulatory uniformity.

Uncertainty regarding future regulations may be one of the most daunting environmental challenges with which the energy business must cope. One prime example of this in the United States is the potential for carbon emission legislation, a significant concern to power generators. These industry participants are experiencing a high level of uncertainty regarding the regulation of carbon dioxide emissions. Confronted with this uncertainty, firms are cautious about making significant investments in retrofits or particular replacement technologies, given the lack of direction of future regulatory interventions.

Congressional inaction regarding carbon legislation in the United States has driven interested parties to the courts, where costly and lengthy litigation has resulted in a number of regulations at the federal level. In one opinion of immense importance, *Massachusetts v. Environmental Protection Agency* (EPA), the U.S. Supreme Court determined that the federal EPA had the authority to regulate greenhouse gas emissions under the CAA and that the agency had abused its discretion in failing to exercise that authority. Based upon this ruling, the EPA has begun to regulate emissions from motor vehicles and power plants based upon existing legislative authority.

Further exacerbating the energy industry's regularity uncertainty concerning carbon emissions are state and local governmental responses to climate change in the United States as well as legal activity at the international level. At least 10 U.S. states and a number of countries have implemented cap-and-trade systems for carbon. Taking the initiative on climate legislation, some industry members, including some of the largest energy companies in the world, such as Shell and Duke Energy, have engaged in discussions with environmental groups regarding federal actions that would be sensitive to the needs of business and would preempt a patchwork of differing and possibly inconsistent state standards. In a 2007 earnings call, the CEO of ConocoPhillips, noted that, "We don't want to see 50 different states coming up with their own program on addressing climate change."As one can see, industry members continue to be challenged by the lack of clarity and consistency of regulatory regimes governing the environmental aspects of their operations.

Industry Structuring

The energy industry continues to restructure, both externally and internally, and environmental considerations factor into this activity. Externally, gas and electricity markets have transitioned from monopolistic, highly regulated markets to more competitive market environments. In the United Kingdom, for example, state-owned gas and electric firms were privatized, with the unbundling of production and distribution. In the United States, the Federal Energy Regulatory Commission (FERC) mandated the unbundling of natural gas production and wholesale sales from its distribution, requiring pipelines to provide delivery to all users on a nondiscriminatory basis. The wholesale electricity market was similarly unbundled in the United States, separating the generation, transmission, and distribution functions.

A number of U.S. states also introduced competition into their electricity markets by unbundling production and retail electric sales from local distribution. Many have been disappointed with some of the outcomes of this transition, including wholesale price volatility and higher-than-expected prices. Restructuring has not resulted in the anticipated reduction in energy prices, and it apparently did not eliminate large price disparities across regions.

Indeed, at least one U.S. state suffered a crisis in its electricity market after regulatory restructuring. The California energy crisis in the early 2000s caused many to question the wisdom of unregulated markets for such important products. The price of wholesale electricity escalated to unprecedented levels in the state, with increased daily averages some 500 times higher than historical norms. The crisis resulted in large-scale rolling blackouts and was attributed in part to manipulations of the market and to capped retail electricity prices. Many regulators and consumers remain concerned about abuses of market power in these restructured environments; their concerns include considerations of environmental factors pertaining to the market restructuring debate.

Internally, there has been significant merger and acquisition (M&A) activity among energy businesses. Some of this activity has been driven by financial considerations rather than by considerations of operating synergies. Natural gas and electric utilities have been very active in the M&A arena. Confronted with prospects of substantial capital investments to fund new generating plants; to address environmental compliance issues such as emission retrofits, natural gas conversions or retirements; and to upgrade aging infrastructure, many companies are seeking opportunities to scale up and strengthen balance sheets and manage risk more effectively.

Oil and gas businesses also remain active in the M&A business sector. There, of course, are the much-publicized megamergers in the industry

such as the Exxon/Mobil, BP/Amoco, Chevron Texaco, Royal Dutch Shell, and TotalFinaElf, but oil and gas mergers and acquisitions saw transaction values over $US 4 billion in 2012. According to industry observers, demand for energy and for business capital drove activity in 2012, but future M&A transactions could be influenced by several legal and regulatory factors, including those related to environmental considerations. Consider, for example, reports suggesting that Shell and Exxon both considered bids on BP following the Deepwater Horizon disaster.

When regulatory approval is required for utility restructuring activity, whether the restructuring is in response to regulatory requirements or whether restructuring must take regulatory requirements into account, some have proposed that environmental effects be evaluated and disclosed as part of the restructuring process. With regard to utility restructuring, at least one state has called upon the U.S. Congress to amend the Federal Power Act "to make it clear that FERC has both the authority and the responsibility to consider the environmental impacts of broad industry restructuring decisions." Even without regulatory scrutiny, claims related to environmental liability and site remediation issues factor into energy industry M&A transactions.

SUPPLY AND DEMAND CHALLENGES

Environmental concerns are impacting and shifting the supply and demand profile of the energy business. These concerns arise from a variety of factors, including shifts in consumer demand or the political climate, catastrophic events, and new energy supply sources/technologies.

Consumer Behavior

Consumer behavior and public pressure in response to concern for the environment is impacting the energy industry. Data reveal a clear increase in consumer demand for sustainable products and practices, and the industry is beginning to respond and incorporate sustainability into their business plans. For example, the increased use of natural gas for power generation is forcing the pipeline companies to evaluate whether its infrastructure is adequate to deliver sufficient supplies reliably.

Increased sales of electric and hybrid vehicles that are capable of being charged from main power grids will also increase the demand for baseload power generated from all sources. This will tax aging grid systems, many of which are barely able to keep up with current demand levels. Widespread outages support former U.S. Energy Secretary Bill Richardson contention that the "[United States is] a superpower with a Third World grid." In addition to general citizen NIMBY (Not In My Backyard) objections, the construction of transmission lines raises a number

of environmental concerns, including overall aesthetic effects, noise and light disturbances, surface erosion, other water source impacts, wetland destruction, health concerns about overexposure to electromagnetic fields, and the spread of invasive species.

CONVENTIONAL SOURCES: SUPPLY DISRUPTION FROM TERRORISM, PIRACY, ACCIDENTS, SEVERE WEATHER, POLITICAL TENSIONS, OR WAR

Energy security has become a global issue. The term "resource nationalism" has become part of the public discourse on energy policy. In the United States, government will continue to discuss energy independence in order to limit the nation's exposure to supply disruptions due to political factors, terrorist threats and/or attacks, acts of piracy, weather-related disasters, and other force majeure events. Fuel and generation portfolio diversity is one response to energy security in the power sector, with a focus on indigenous resources such as coal and natural gas; nuclear power; and wind, solar, hydroelectric, and other renewables. It is likely that examination of the relative environmental impacts of the fuel source for electricity production will influence decisions about national energy portfolios.

Another security issues pertains to the pervasiveness of systems that rely upon interdependent central energy production and delivery. Research into the networking of more independent distributed energy systems is underway. Creation of these sorts of distributed networks could increase energy security.

Political Considerations

Politics plays a significant role in the energy business. Market participants are often frustrated by the uncertainty inherent in this aspect of their work. However, environmental issues are a permanent feature of the political landscape and must be taken into account in industry-wide or company-specific planning.

Unpopular Sources—Nuclear and Coal

While industry insiders tout the cost and efficiency advantages of using coal as a fuel source for electric production, it has become a political hot potato, largely due to environmental concerns. Coal is a major producer of carbon dioxide emissions and has been under siege in the United States as part of the focus on climate change. Emissions from coal-burning industries have also been linked with respiratory illnesses and developmental disabilities in children. As discussed herein, coal mining involves health and safety risks to workers, that is, mining accidents, black lung disease,

and direct environmental consequences from mining techniques such as mountain top removal from strip mining.

These factors have caused a decline in the use of coal in the United States. Recent environmental regulations, discussed herein, have forced utilities to retrofit coal-burning plants or to shut them down to be replaced by natural gas equipment. However, coal exports are increasing as global demand for coal rises. Coal-fired power generation facilities are still being built internationally, particularly in China, where over 200 gigawatts of coal-fired generation is anticipated to come online in the near future, and in India, with an additional 70 gigawatts.

As coal-fired generation declines, nuclear energy is often cited as a more environmentally sound alternative. However, nuclear energy also comes under heavy political fire and has a largely negative public perception vis-à-vis the environment. Even considering the effects, both environmental and economic, of a large-scale nuclear accident, proponents argue that nuclear power production has low environmental impacts when compared to coal as it could alleviate global climate change, reduce local pollution, and improve sustainable energy supply portfolios. Opponents, however, appear to have convinced the public that the risks of this supply source far outweigh any possible benefits. Public concerns about emergency planning and the routine or accidental release of radioactivity; waste management and disposal; and nuclear weapons proliferation have been criticized by some as being irrational. However, accidents such as those occurring in Fukushima and Chernobyl, and the continuing international tensions arising from the development of nuclear programs by unpopular regimes in nations such as North Korea and Iran have had a profound effect on public perceptions of the environmental, health, and safety impacts of nuclear energy.

Regardless of one's views of the factual debates or industry position, public perception cannot be ignored, given its influence on politics and, ultimately, on policy choices.

Extraction in "Sensitive" Environments

As energy consumption increases across the world, industry perseveres with its exploration efforts. When these efforts reach into fragile or sensitive ecosystems, there often are protests or political repercussions based upon concerns about the potential damage to the environment. The Keystone pipeline project is emblematic of the kind of public scrutiny that projects of this sort can attract. The proposed pipeline would run from the tar sands of Alberta, Canada, a large reserve of bitumen, a form of crude petroleum, to refineries in Texas. Along its way, the pipeline could be routed through environmentally sensitive areas, such as the Sand Hill region of Nebraska and the Ogallala Aquifer, a major water source in the

Western United States. Concerns over this routing, along with concerns that the carbon-intensive development of the oil sands will increase greenhouse gas emissions, have delayed the project since 2011.

This political and public scrutiny is not just a U.S. phenomenon nor is it limited to the oil segment of the energy sector. Protests have been held in Inner Mongolia over the grassland destruction by the coal and mining industries. Despite the increasing energy demands in rapidly developing India, opposition has arisen to the country's ambitious plans for the construction of hundreds of thermal power plants, including criticisms pertaining to environmental consequences in areas of great ecological sensitivity and rich agricultural biodiversity such as the Konkan coastal region of the state of Maharashtra. Alarm has also been expressed about the environmental consequences of Jordan's nuclear power ambitions. Reports have claimed that the Kingdom's discovery of large uranium deposits and its intentions to mine and use these deposits in a planned nuclear facility could endanger the fragile marine habitat in an area south of the Red Sea port of Aqaba as well as threaten the region's already serious water shortages. Controversies such as these are a challenge to all industry segments the world over.

Unconventional Sources/Technologies

Higher oil and gas prices and increased demand have spurred the growth of energy business projects that explore and extract unconventional hydrocarbon using unconventional technologies. There are various unconventional hydrocarbons, including shale gas, shale oil, coal bed methane, tight gas sands, and heavy oil such as that found in the Orinoco Oil Belt in Venezuela from which the Orimulsion fuel is derived. Recovery of these hydrocarbons often involves unconventional technologies such as hydraulic fracturing ("fracking") and horizontal drilling.

The environmental implications of these projects have not escaped public scrutiny or political controversy. Critics have identified a number of negative environmental consequences associated with the exploration and exploitation of these resources:

- The increase of greenhouse gas emissions
- The risk of groundwater contamination due to accidental blowouts or spills, leaking fracturing fluid, waste water discharge, or water pollution from methane
- The use of fracturing fluids that contain hazardous substances and effluent containing heavy metals and radioactive materials from the hydrocarbon deposit
- The risk of salinization of, or other impacts on, drinking water
- The production of hazardous waste from the extraction processes
- The use of large volumes of water during the production process

These concerns and other highly publicized risks such as induced seismic events associated with fracking have captured the attention of the public, policymakers, and regulators. These resources are distributed globally and pose a challenge to the energy business internationally.

Fracking (Hydraulic Fracturing) for Natural Gas

While this method of mining for natural gas is not new, it has become more commercially viable. Natural gas must be pressurized to transport it and this usually requires pipelines and other infrastructure. Pipelines of any kind are controversial in the United States. Nations that rely on natural gas have extensive pipeline infrastructure. Natural gas can come from oil drilling and can be independently mined. When it is mined from underground sources, controversies ensue all over the world and throughout the United States, Australia, France, and Canada. New York State, Pennsylvania, Texas, and Colorado all have large fracking controversies. For example, New York State declared a moratorium against any fracking in March 2013. This was one year after they planned to give drilling companies access to 85 percent of the states' portion of the large Marcellus and Utica shale reserves. Fracking in New York City and Syracuse watersheds would not be allowed because the drinking water is not filtered before it reaches the public. Other states and countries face similar policy challenges. Pennsylvania fined a drilling company about $1 million for releasing methane with improper drilling methods and destroying the water for 16 families in 2010. The U.S. Environmental Protection Agency is studying new rules about fracking and environmental protection. Because of the large amount of natural gas, its lower environmental impacts, and rapid advancements in the power and scale of mining technology, these challenges will continue in energy policy development.

What Is Fracking?

Fracking is a term used to describe processes used to get natural gas from the ground. It can be defined as a single fracture of rocks, usually shale, to loosen underground deposits of natural gas. However, fracking is more than this one act. Industrial fracking often requires multiple fracking. It raises controversial issues of groundwater contamination, wastewater storage, transportation impacts, and other environmental impacts, if there are leaks or explosions.

To mine natural gas, a vertical well shaft is drilled until it hits a layer of shale. The shale is found by applying a collection of techniques

and knowledge of geology. Drills bore to the shale layer, sometimes as much as 5,000 feet. Recently, the drilling has expanded from up and down drilling to horizontal or directional drilling. The drills can bore another 5,000 feet horizontally. Large volumes of chemical solvent, sand, and water are forced through high pressure into the rock to fracture or break the shale. The exact chemical composition of the pressurized fracturing material may differ from place to place because of differing underground conditions and costs of extraction. At present, benzene is commonly used. Many companies claim that the chemical composition they use for fracking is confidential business information. A company with a highly effective chemical solvent will have a technological business advantage, and one they may have invested in and protected with patents as intellectual property. They do not want to disclose this because a competitor could use it without the costs of research and development.

Water

Many of these solvents are very acidic. If they hit limestone, there is a concern of a greater chance of natural gas migrating to fresh water sources because the acetic solvents can corrode limestone layers. The natural gas comes up with the wastewater. The wastewater is placed in holding ponds or large tanks. About three-fourths of the pressurized material comes back as wastewater. This wastewater contains water, the chemical solvent solution, sand, chemical lubricants, antibacteriological material, and sometimes radioactive material along with high salt contents. New regulations require the holding ponds be lined and that tanks be water tight. However, there is concern that they may leak. Another source of drinking water contamination is the wastewater that leaks or spills on the ground and percolates down through the soil to the groundwater. The 25 percent of the wastewater left in the drill hole is also a potential source of contamination, as it could migrate through the fractures left behind.

The public concern over freshwater contamination from the fracking comes in part from the intensity of drilling on any one particular site. The main goal of drilling is to get to the gas, and this may require multiple drills both vertically and horizontally. It may also require multiple blasts of pressurized solvent, water, and sand. Since this information is kept from the public as "confidential business information," there is concern that they do not know the true extent of environmental impacts. Much of the research on safety of fracking measures the risk from one vertical drill with one solvent blast at one time. It is unknown

how much increased risk comes from high-intensity fracking of one area. An additional risk that could be caused by high-intensity fracking is that the induced fractures combine with natural fractures and other old abandoned mines and create pathways for natural gases, including methane, to contaminate drinking water sources. The U.S. Environmental Protection Agency currently wants companies to give them a map of the gas flow pathways. Industry responds that the risk of gas leaking out upwardly is minimal because they place cement caps in the drill hole. They fill in the space between the gas pipe and the hole wall with cement so that gas cannot rise up and leak into higher-level groundwater reserves. Methane contamination is a primary concern, and recent research indicates that there are greater concentrations of methane migration near fracturing sites. It is a specific type of methane found deep in the ground called thermogenic, not the biogenic kind of methane found closer to the surface.

Hydrofracturing can cause even bigger controversies when it threatens natural resources and when the process gets out of control. Both happened near Yellowstone National Park in Wyoming. Wyoming is a sparsely populated state with powerful gas and oil industries and a distinct indigenous population. Yellowstone National Park is an active geological area, with many steam geysers. The community was concerned with hydrofracturing such a geological sensitive area to mine natural gas. On August 11, 2006, this concern became a reality. Windsor Energy Corporation lost control of a hydrofracturing well causing hydrofracturing chemicals to migrate into the soil and drinking water and sending a toxic plume over the community. The community evacuated itself. There is no estimate of the damage to natural resources.

Normally, wastewater is injected back deep into the ground. However, in the western United States, where water is scarce, these chemicals are left on the surface. This practice affects Native American lands on the Wind River Reservation, shared by the Northern Arapaho and the Eastern Shoshone. Wind River reservation is 150 miles southeast of Yellowstone National Park. Wind River operated around 12 oilfields on their land. These oil companies were allowed to dump wastewater onto the land by the U.S. Environmental Protection Agency. As of this writing, the U.S. Department of Interior proposed new rules requiring the disclosure of fracking chemicals on Indian and public lands. About 90 percent of the 3,400 wells on federal and Indian lands use hydraulic fracturing. Contested areas are whether to require disclosure before or during drilling and what should be disclosed. Full disclosure of the actual mixture of chemicals used may reveal trade secrets. Another contested area whether mechanical integrity testing should be required.

These contested areas become inflamed as localities respond to fracking concerns with land use ordinances. In April 2013, Mora County commissioners in New Mexico made it illegal for corporations to extract gas or oil on both public and private land. Mora County has few water resources and defends the ordinance on environmental grounds. Over 400 towns, villages, and counties have resolved to ban the use of high pressure water and chemicals to release gas and oil. Most of these are in cities where little fracking occurs. Most urban fracking bans are in the form of land use ordinances that ban industrial development. About 125 cities specifically ban fracking. Mora County is the first county to do so. It is also an impoverished community with few employment opportunities and with four-fifths of the community identified as Latino. Other counties in New Mexico are considering similar bans. Currently, many of these ordinances are being challenged in court by energy corporations.

Hydraulic fracturing is a controversial, dynamic, and growing area of energy policy and law. To some, it challenges the sanctity of private property, to others, it threatens environmental resources, and still others find that it meets an emerging demand for alternative energy sources. It is an area of intense policy debate and scrutiny by communities, government, and businesses. New methods of mining underground natural gas such as hydrofracking are controversial.

—Robert William Collin

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Renewables

In addition to growing global consensus on climate change and other environmental issues, the dramatic rise in the cost of energy, security issues, and resource access have finally inspired global leaders to explore alternatives to more conventional sources of energy. In the United States, federal stimulus programs and federal tax incentives have been introduced to stimulate the development of renewable energy sources. At the state level, a number of states, including California, have implemented Renewable Portfolio Standards (RPSs) that require utilities to produce a certain percentage of their energy from renewable sources. These subsidies, as well as the decreasing technology costs, have made renewable energy sources more attractive to both politicians and industry.

Germany has been a leader in this regard; its solar capacity is large enough to satisfy 50 percent of that nation's midday energy demand. China and Japan are expanding their renewable asset portfolio. China has announced plans to more than double its solar capacity and to increase its wind capacity by 30 percent. Perhaps in response to the Fukushima disaster, Japan increased its investment in clean energy in 2012 with plans to add nearly 5 gigawatts of solar capacity in 2013. India may, however, have posted one of the largest increases in renewable investment, up 62 percent in 2011.

Consumer activity in this area is also impacting the political acceptability and growth of renewables. Reports indicate that large corporations in some markets are contracting directly with renewable energy generators to secure Power Purchase Agreements (PPAs). These so-called sleeved PPA structures allow the power purchaser to contract with off-site renewable generators and to "sleeve in" the purchased energy into their existing supply contracts/volumes. Both parties benefit: the purchaser can improve its "green" profile, while the supplier secures a market for its generation.

These sleeved PPAs have appeared in a number of countries. For example, Wal-Mart and three Mexican corporations have signed 15-year PPAs with a wind farm in Mexico; UK giants Sainsbury's and Marks & Spencer have also contracted directly with generators for renewable power. The U.S. Military and the U.K. Government Procurement Services apparently have also expressed an interest in these sorts of renewable deals.

In response to these trends, some industry companies are hoping to capitalize on consumer preferences for sustainable products and services. In 2011, investments in renewable energy investments almost matched investments in fossil fuel-fired generation, with many large energy industry participating in renewable investments.

Energy companies, large and small, are entering the "green" market in a variety of ways: by investing or providing financing to generation projects or renewable companies and ventures and by engaging in

technological resource and development. One well-publicized example is BP's push into wind energy. Chevron has created a dedicated venture capital business unit for investment in renewable and other technologies. Total purchased a 60 percent stake in a U.S. solar panel maker, SunPower; and BP bought an 83 percent stake in a Brazilian ethanol producer. Shell also joined the party, announcing plans for a joint venture with a Brazilian biofuels firm, Cosan, to be produce and distribute sugarcane ethanol. And these are simply some examples of the market participants entering the renewable fields.

As is evident by the impact of government subsidies on the increase in renewable power, growth in this sector of the energy business is closely tied to political and policy choices that affect funding mechanisms. However, many conventional energy businesses anticipate growth in the renewables sector of the market and can leverage government financial support to improve their bottom lines and their environmental profiles.

CONCLUSION

To conclude, the energy business must wrestle with a number of pressing environmental, health, and safety challenges, both local and global. In addition to accident and disaster responses, the industry must also contend with the legal regimes that govern the environmental aspects of its operations, including compliance with existing laws, regulations, and rules, the interpretation and enforcement of which may be somewhat inconsistent. Uncertainty regarding future regulatory activity also confounds businesses. Additionally, environmental considerations also impact supply and demand profiles for industry participants.

The industry's environmental challenges are not all negative, however. As energy consumption and demand grows so too do investment opportunities. These opportunities are present in both conventional and unconventional fuel sources and in their attendant "clean" technologies and in source and technologies in the renewable segment of the market. Progressive industry participants are already embracing environmental sustainability as part of their short- and long-term business strategies in order to take advantage of these new opportunities and to improve their environmental performance.

FURTHER READING

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