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National Legal Cultures in a Globalized World

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Fracking for Shale Gas: Energy Security & Sustainable Water Resources

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Water, water, everywhere,
Nor any drop to drink.

~*The Rime of the Ancient Mariner* by Samuel Taylor Coleridge

I. INTRODUCTION

This presentation focuses on sustainability of water resources, among the most precious of our world's natural resources, and energy independence, development and security. Consistent with the theme of the 24th Biennial Congress on the Law of the World, National Legal Cultures in a Globalized World, we will address the explosive debate taking place in the United States and internationally at the intersection of the human right to safe drinking water and the increased development of unconventional deposits of natural gas through hydraulic fracturing of shale reserves, frequently referred to as "fracking." This debate opens a new chapter in the history of water law, a history of the struggle to control water and manage potential environmental risks associated with water,[1] but it also implicates fundamental goals of energy independence, energy development and global security.

Shale gas exploitation and production have expanded tremendously during the past decade, accounting today for over 30% of all natural gas production in the United States, and reliable estimates indicate that shale gas can comprise 40% to 50% of the United States' total production over the next thirty years.[2] It will continue to play a significant role in both U.S. and international energy development and can potentially contribute to a significant level of energy security through diversification of energy supplies and reduced energy dependence in the context of an unstable global oil market.[3] At the same time, fracking has provoked concerns at the federal, state, local and international level over public health, the environment, adequate supplies of quality water, and pollution.

II. SCOPE OF THIS PRESENTATION

This presentation assesses complex issues that have led to political gridlock and a hardening of positions between the energy industry, scientists, environmentalists and government. At its core is the fundamental need to restore public confidence.

Given the current lack of trust in this post BP oil-spill world, restoring that confidence will require a combination of greater monitoring of water and air pollution, full disclosure of chemical composition, sharing of best practices for recycling waste water, and a corporate willingness to accept greater regulatory oversight.
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In this cauldron fueled by political gridlock, hostile debate, and legitimate concerns over how to handle contaminated water and the risk of overusing water supplies, what kind of warnings and disclosures need to be given and to whom, and collateral harm from trucks, drilling equipment, workers and fracking waste water.[4] First one must understand how matters escalated to this point. Then one must determine how best to reach the goal of a long-term sustainable energy economy by principled management of risk through a regulatory regime that protects the public interest.

The distance between these two points is uncertain, but the need to navigate between them is paramount and will require consideration of several facets of the "fracking" debate:

♦Escalating controversy: We will examine the explosive controversy that has driven at least one state and several local governments in the United States as well as one member of the European Union to impose moratoria on such development, while a growing number of EU members as well as other nations are seriously considering imposing similar bans.

♦Growing environmental concerns: We will scrutinize claims of potential pollution and overuse of water supplies and other environmental risks associated with fracking, the drilling process for capturing natural gas from shale reserves. This process that has revealed potentially vast deposits of natural gas trapped in shale plays, shale gas formations located far below the surface and in some areas a mile or more beneath aquifers serving as a major source of drinking water. The exploration of shale deposits and extraction of gas through the fracking process has spread internationally,[5] as nations have undertaken to evaluate and quantify what promises to be a potential solution to dependence on foreign natural gas.

♦Public confidence shaken: Public confidence in the energy industry is at an all-time low and must be restored. Even securities regulators like the S.E.C., the investor-and-markets watchdog for the U.S. Government, have stepped into the heated environmental debate over fracking.[6] The natural gas industry's credibility has been assailed by an increasingly uneasy and distrustful environmental community, state governments and local governments. Concerns have been raised over the additional demand on water resources attributable to the use of millions of gallons of water at each well site, the potential release of fracking wastewater into the environment at a time when the industry has refused to disclose the chemical composition of hydraulic fracturing fluids used, lack of transparency concerning the industry's operations, reports of methane leaks, and baseline water quality conditions before drilling starts. In short, the debate over unconventional natural gas development has reached a level of gridlock in the United States that demands greater governmental oversight at the federal and state regulatory level and greater cooperation from the natural gas industry in identifying, quantifying and managing the scientifically ascertainable risks associated with this natural gas extraction process in a transparent, proper and safe manner.[7]

♦International developments: In addition to identifying the chief environmental concerns associated with this controversial method of natural gas extraction, we will survey the relevant legal and governmental developments in the U.S. and European Union, identify recommendations that have been formulated by different agencies, including the U.S. Department of Energy's recommendation to create a national database of publicly available information on shale gas operations, and call for aggressive efforts to restore trust and credibility in response to the many concerns voiced over the fracking process. These efforts will include establishing strong and effective governmental oversight, creating a national entity dedicated to the continuous improvement of best practices for extracting shale gas and requiring genuine transparency by the natural gas industry.

♦Recommendations for International Protocols: We will conclude by challenging the international community to augment these efforts with a coordinated and more comprehensive international oversight and risk management mechanism based upon existing treaties and protocols, patterned in part after key recommendations contained in a recently released report from the United States Department of Energy. The centerpiece for this recommendation is the development of an international oversight mechanism and international protocols that address:

1. Fracking waste fluid,
2. Identification of chemical ingredients used in fracking fluids injected at well sites,
3. Public input and participation in permitting processes,
4. Monitoring of contaminants,
5. Shared technology and understanding of impacts of fracking process on domestic and transboundary water resources and water quality, and
6. Remediation protocols by the industry.[8]

The development and implementation of these recommendations will require coordinated work and commitment at the national and international levels leading to regulatory certainty, sound environmental oversight, and energy security. To do this, a balance can and indeed must be struck between the two forces contributing to the current state of gridlock: (1) the demand for public safety through enhanced regulatory oversight, common sense disclosure and transparency measures, and meaningful efforts to minimize environmental risk, and (2) the need for development of shale gas as a predictable and growing energy resource for decades to come.

A. The Human Right to Clean Water

A debate is underway over the competing goals of sustainable energy resources and sustainable water resources, the underpinning of the basic human right to safe drinking water. Beginning with the 2000 adoption of the Millennium Declaration by the U. N. General Assembly, nations of the world adopted the goal of cutting in half by the year 2015 the proportion of the world's population unable to reach or afford safe drinking water, while stopping unsustainable exploitation of water resources.[9]

The 2002 World Summit on Sustainable Development in Johannesburg pledged to cut in half by 2015 the proportion of people without access to basic sanitation. The General Assembly's Declaration of 2003 as the International Year of Freshwater, and its "Water for Life" Declaration of 2005 to 2015 as the International Decade for Action kept the focus on water issues and global freshwater problems.[10] In the summer of 2010, the United Nations General Assembly, citing the fact that approximately 884 million people "lack access to safe drinking water" and more than 2.6 billion "do not have access to basic sanitation" services, approved a landmark resolution that broadly declared: the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights.[11]

Member states and international organizations were urged to help developing countries by providing "financial resources, capacity-building and technology transfer" to augment efforts to provide " safe, clean, accessible and affordable drinking water and sanitation for all."[12]

This action by the United Nations was barely noticed. While the resolution passed by a vote of 122 to zero, 41 nations abstained, including the United States, which nonetheless supported "the goal of universal access to safe drinking water."[13]

Proponents for a sustainable energy policy and proponents for a sustainable water policy in the United States, Europe and other parts of the world are on a collision course. As late as 2007, before the impact of the shale gas revolution was as obvious as it is today, it was assumed that the United States would be importing large amounts of liquefied natural gas from the Middle East and other areas. Today, the United States is essentially self-sufficient in natural gas, with the only notable imports being from Canada, and is expected to remain so for many decades.

Developed countries of the world need a sustainable energy policy, the linchpin of economic stability. At the same time, no one can deny that water is critical for sustainable development and is an essential component of environmental integrity and indispensable for human health.[14]

Given the international community's recognition of the human right to safe drinking water, the escalating concerns over the fracking process expressed by a number of nations and subnational governments through moratoria discussed *infra*, and the willingness of the natural gas industry to join in a collaborative process with government regulatory agencies, how can we best define the problem with fracking? It is submitted that <u>the problem with fracking can most accurately be defined as the management of risk through a transparent regulatory regime that is international in scale.</u>

Such a regulatory regime must be built on the cornerstones of safety and responsibility. It is time to address the creation of a regulatory regime through which the risks associated with the fracking process - including potential surface pollution from fracking fluids, excessive water use, and groundwater contamination - can be assessed on the basis of good science and quantified on the basis of reliable data. Through such a regulatory regime the U.S., the E.U. and other nations currently embroiled in controversies pitting the natural gas industry against the environmental community can open and maintain a constructive dialogue that may enable them to find a safe and responsible way to free themselves from escalating fuel prices by increasing reliance on non-traditional energy sources.

1. Natural Gas as Transitional Energy Source

Increasing pressures have come to bear on nations to identify and secure domestic energy sources. When world market oil prices skyrocketed in 2005, the development of shale gas extraction through fracking received a major boost as the United States, faced with high gas prices, began investing billions of dollars in what promised to be a means of bringing cheap energy to consumers.[15] Members of the EU also began looking at potential shale gas resources on the European continent. In both the United States and the EU, natural gas extracted from shale provides the promise of a reliable transitional energy source. While it is an ultimately non-renewable source of energy, it can nonetheless serve as a critical bridge fuel on a path to energy independence, a common goal shared by the United States and the EU.

2. Dependence on Natural Gas from Russia

Another potential plus of shale, of course, is reducing countries' reliance on Russia, which supplies most of Central and Eastern Europe with natural gas. Many are already saying that if shale deposits are found in Europe, Moscow will lose the benefit of selling resources to other countries. However, the inhabitants of the Gazprom tower do not seem to be losing any sleep over this supposedly miraculous fuel. [16] Others have challenged the optimistic hype and predictions about the tremendous size of shale gas reserves in Europe.[17]

One commentator has noted three key problems with the predicted fracking bonanza in Europe:

a. Even as the United States is beginning to face bottlenecks in locating experienced drilling workforces and equipment, the European Union lacks both the experienced workforces and the pressure pumping; therefore, he queries, if the U.S. is already facing such restrictions, how will Europe fare, where shale gas developments are still in their infancy?

b. Major energy companies are already expressing reservations in light of the highly uncertain economics of shale gas in the EU in the context of a current gas glut that has depressed prices.

c. Compared to the U.S., local opposition is much more likely in the more densely populated Europe, where citizen-organized initiatives opposing shale gas development are mushrooming, particularly in Sweden, France and Germany's most populous state of North Rhine-Westphalia. Fourth, there are environmental challenges associated with the fracking process.[18] In this regard, U.S. companies are not presently required to disclose the identity of such chemicals to the E.P.A. due to the Halliburton Loophole. The extent to which these companies are beyond E.P.A.'s reach or other federal or state regulatory authority is open to debate.

B. Environmental Impacts Associated with Gas Well Drilling and Fracking

1. The Marcellus Shale "Gas Rush"

The natural gas Industry and proponents of hydraulic fracturing cannot afford to concede the validity or even plausibility of the environmental risks identified as legitimate concerns. In a November 25, 2008 online article on fracking entitled "Marcellus Shale: Material Drinking Water Risks?"[19], practitioners in the field of energy, environment and resources discussed several environmental issues believed to be associated with Marcellus Shale drilling. They concluded that "[m]ost signs point to the readiness, if not willingness, of environmental regulatory bodies to permit gas extraction wells in the Marcellus formation." [20]

2. Water Quality Impacts Linked to Gas Well Drilling Brine

The fracking process raises three distinct concerns relating to water quality and quantity:

a. Groundwater as potentially subject to contamination[21];
b. Waste disposal potentially affecting surface water[22]; and
c. The potential impact on other important uses of large amounts of water used in the fracking process.[23]

One of these environmental issues was the subject of an October 10, 2008 report that brine from gas well drilling in Pennsylvania led to excessive dissolved salts being discharged from a wastewater treatment plant into the Monongahela River. It is very common for brine to contaminate groundwater when brine injection wells fail. The fracking process has apparently led to impairment of water quality in that river and prompted the Pennsylvania Department of Environmental Protection to order nine wastewater treatment plants on the river to curtail treatment of gas well drilling brine until further notice. The author of "Marcellus Shale: Material Drinking Water Risks?"[24] noted that "[t]he extent to which opponents of drilling projects will obtain "traction" will likely be a function of the frequency and severity of the occasions when adverse environmental impact is tied to some aspect of a drilling operation," and that a damper could be put on the Marcellus "gas rush" with the occurrence of a few more issues like this one.

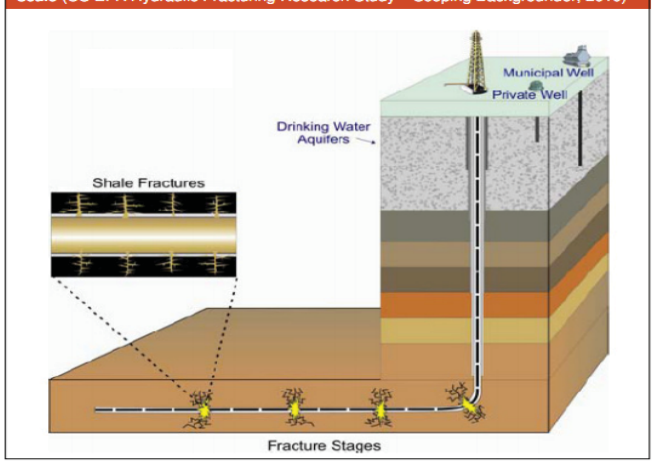
In addition to assurances from the American Petroleum Institute, practitioners in this field suggested that the concerns and public opposition to fracking were being overstated, one noting as recently as November 2008 that "while guarantees cannot be provided, [fracking] in the Marcellus deposit occurs well below the depths at which drinking water aquifers are located" and that the regulatory focus on drinking water protection is "ahead of the fact, not after the fact." Such assurances do not take into account the fact that wells must still be drilled through and pass through these water-bearing units.[25]

III. What is Fracking?

Hydraulic fracturing, or fracking, entails injecting large volumes of water, hydrofrac fluids, and propping agents, usually sand, into porous shale rock under high pressure, creating fissures – or fractures – that allow natural gas trapped inside the shale to flow out while the fracture is propped open after the pressure is released. Coupled with improvements in horizontal drilling, fracking gives natural gas companies the means to access

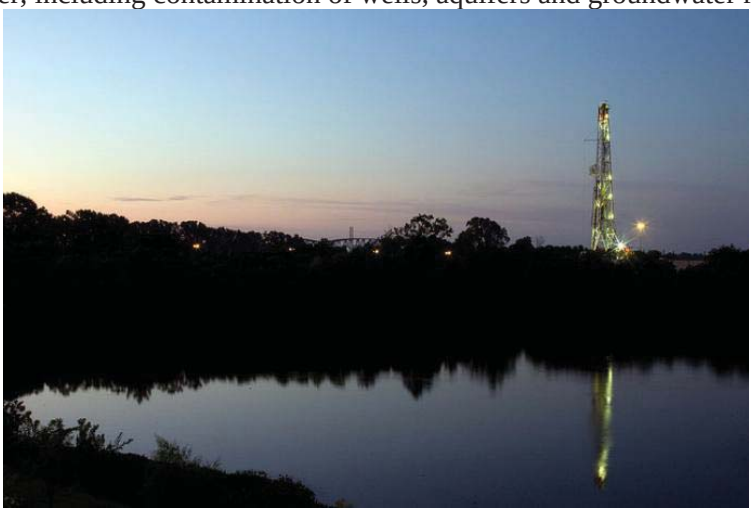
unconventional sources of natural gas in an economical way.[26] The following schematic diagram depicts a typical hydraulically fractured horizontal well and various stages of the fracking process.

Figure 2.1: Schematic diagram of hydraulically fractured horizontal well – not to scale (US EPA Hydraulic Fracturing Research Study – Scoping Backgrounder, 2010)



The fracking process has generated controversy in part because of concerns that it may contaminate groundwater and cause gas to leak from household taps.[27] Along with the various proprietary additives and chemicals in fracking fluids, hydrofrac water is in close contact with the rock during the course of the stimulation treatment, and when it is recovered may contain various formation materials, brines, heavy metals, radionuclides, and organic chemicals that can make wastewater treatment difficult and expensive, not to mention the fact that a substantial amount of wastewater is generated at each well site during the fracking process. The formation brines can also contain high concentrations of sodium, chloride, bromide, and other inorganic constituents such as arsenic, barium, other heavy metals and radionuclides that far exceed safe drinking water standards.[28]

Sand as a proppant is probably a harmless additive, but other parts of hydrofrac fluids may include chemical constituents of potential concern to human health and the environment. Many communities, states in areas where significant fracking operations are underway, environmental organizations, and elected officials at the state and federal level in the U.S. are now raising concerns about the potential impact the fracking process has on drinking water, including contamination of wells, aquifers and groundwater resources.[29]



We will address in greater detail the concerns voiced in public hearings and official actions taken by states, Congress and the EPA, but first let us take a closer look at the shale formation at the center of this firestorm.

IV. Fracking in the United States

During the past decade, the natural gas industry has witnessed rapid technological developments that allow the recovery of natural gas trapped in shale formations. In North America, there are estimated to be up to 1000 trillion cubic feet (TCF) (28.3168 trillion cubic meters)[30] of technically recoverable shale gas, enough to supply our nation's natural gas needs for the next 45 years.[31]

A. The Marcellus Shale Region

The Marcellus Shale play is one of the largest shale regions in the United States, spanning over six states and now the focal point for much of the controversy over hydraulic fracturing and its potential impact with respect to groundwater resources, surface water affected by waste disposal, and large amounts of water needed in the fracking process. As of November 2008, the estimate of recoverable gas from the Marcellus Shale was projected to be over 363 trillion cubic feet (TCF) (10.2790 trillion cubic meters or TCM). Compare this to the estimate of recoverable shale gas for the entire United States in 2011, placed at 860 TCF (24.3524 trillion cubic meters or TCM) according to Advanced Resources International.[32] The U.S. alone uses about 23 TCF (0.651287 trillion cubic meters or TCM) of natural gas annually, so the Marcellus Shale gas resource could be large enough to supply the needs of the entire nation for about 15 years at current rates of consumption. As a transitional energy source, such a dependable supply of natural gas extracted from shale could provide the time and economic impetus for the United States to achieve an unprecedented level of energy resource sustainability within the foreseeable future.

This sedimentary rock formation was deposited over 350 million years ago in a shallow inland sea located in what would become the eastern United States, and it stretches from the Catskill Mountains of New York across Pennsylvania, eastern Ohio, western Maryland and West Virginia, bearing in mind that the position and shape of the continents were different than they appear today in this depiction of the North American shale plays.

While one of the major stakeholders in this region's fracking controversy has given assurance that in most areas of the Marcellus Shale formation, the induced fractures from the fracking process "should not create a geological pathway to usable quality aquifers," since thousands of feet of rock are often between the usable quality aquifers and the shale, this is with the caveat that "[i]f development with hydraulic fracture treatments occurs where the Marcellus is shallow and in close proximity to usable quality water zones, the potential effects

on aquifers must be addressed."[33] With respect to geological pathways, moreover, these observations seem to ignore the elephant in the room: the well itself is a "geological pathway" to the overlying aquifers, and wells can and do fail. In other words, the assessment of environmental risks associated with fracking must be site-specific.

B. The Fracking Controversy Ignites

A media firestorm is now underway, starting in New York and Pennsylvania and spreading across the pond and beyond. While some have observed that the natural gas industry's refusal to provide alleged proprietary information about fracking fluids was the precipitating factor that led to escalation of the debate, the time for assessing blame has long passed.

C. "Gasland"

This controversy may well have been inevitable. In February 2011, the New York Times launched an investigative series on fracking that highlighted possible radioactivity from fracking affecting streams and waterways in Pennsylvania. About the same time, an Academy-Award winning documentary by independent filmmaker Josh Fox entitled "Gasland," aired as an HBO documental film and then went viral, as television networks, blogs, and environmental organizations picked up on the story. Through interviews with ordinary people who had been living ordinary lives in ordinary communities from the Northeast to the Midwest and Western states, Fox provided a graphic portrayal of the damage that this gas drilling practice had caused across the nation, focusing public attention on hydraulic fracturing, horizontal drilling, and flaming faucets, and also focused attention on the FRAC Act, proposed legislation that would make drilling companies disclose the chemicals injected during the fracking process[34]

More reports began to surface about fracking, with environmental concerns ranging from water contamination to the possibility that the fracking process was contributing to the frequency of earthquakes in the region overlying the New Madrid Fault in Arkansas.[35] Indeed, the fact that fluid injection can trigger earthquakes is well-established.[36]

In February 2011, just as the Senate Environment and Public Works Committee was about to convene a subcommittee hearing on the safeness of hydraulic fracturing in the United States, a Cornell University study[37] was released, explaining how methane gas that escapes during natural gas and fracking production may make natural gas as dirty as coal in terms of carbon emissions. The Cornell University researchers concluded that natural gas pried from shale formations is dirtier than coal in the short term, rather than cleaner, and "comparable" in the long term. Their findings were fiercely disputed by the natural gas industry and severely undermined the widely stated belief that gas is twice as "clean" as coal in terms of greenhouse gas emissions.

V. U.S. Regulatory Structure

A. Safe Drinking Water Act

The SDWA is the primary law that ensures the quality of Americans' drinking water. 42 U.S.C. § 300f et seq.). Under the Energy Policy Act of 2005, Congress quietly amended the Safe Drinking Water Act to exempt gas drilling and fracking from regulations under the SDWA, creating what has become known as the Halliburton Loophole, §1421(d), under which federal regulators "have no authority to limit the types of their substances. Indeed, natural gas companies do not need to report to federal regulators what their fracturing fluids contain or where they are used."[38] In the 1996 amendments to the Act, Congress recognized that "safe drinking water is essential to human health."[39] The proposed legislation known as the FRAC Act, now pending before the U.S. Senate after passage in the House of Representatives, would amend the SDWA and remove the Halliburton Loophole.

B. Clean Water Act

In 1972, Congress enacted the Clean Water Act,[40]which established a new permit program, the National Pollutant Discharge Elimination System, prohibiting the discharge of pollutants into waters of the United States from any point source, unless with a permit issued under the Act's rigorous regulatory and permitting provisions. The CWA also advanced the goals of prohibiting discharge of toxins in toxic amounts and preserving and protecting state responsibilities and state rights to "prevent, reduce, and eliminate pollution, to plan the development and use … of land and water resources."[41] The CWA does not require an NPDES permit for discharges to isolated or tributary groundwater or confined wells.[42] Based on the CWA's legislative history, some courts have held that the CWA does not assert authority over groundwater even if hydrologically connected to surface waters, reasoning that Congress could include groundwater as a category of navigable waters (or "waters of the United States") if it intended to do so, and that Congress evidently intended groundwater to be a category of water distinct from the CWA jurisdictional term "navigable waters".[43] The EPA has noted the potential connection between groundwater and surface water, but has left the regulatory definition alone.[44] When discharges to groundwater have resulted in the migration of pollutants to hydrologically connected surface waters, however, some courts have found that a NPDES permit may be required.[45]

Opponent of shale gas fracking generally take the position that the EPA has the right to regulate water when it is combined with sand and chemicals to make the fracking fluid that is injected into underground shale formations to stimulate production of natural gas, while proponents of shale gas fracking take the position that the CWA does not cover fracking fluid since it enters the earth far beneath the water table has no chance to pollute groundwater.[46] As the above case law indicates, the EPA has the authority to regulate water after it comes out of the ground as wastewater, but not while it is below the surface in the form of groundwater. Water that resurfaces from a fracking well is considered industrial wastewater, but while the "fracking water" is underground, it may be subject to applicable state regulations even if beyond the reach of the CWA, under which state regulations may require permits for discharges to groundwater.[47] One may conclude that regulation of fracking during the various stages of the fracking process comes about through a veritable patchwork of state and federal agencies.[48]

C. Clean Air Act

In areas with air quality issues, fracking opponents have focused on possible air impacts associated with the drilling operations themselves. Fracking requires pressure, pressure requires pumps, and pumps require fuel to burn, with associated air impacts. Concerns have been raised that the fracking process itself may release air pollutants. Emissions from drilling operations have come under fire.[49]

While much the public focus centered on water issues related to fracking, regulators and environmental activists continued less visible efforts to increase the regulation of air emissions from natural gas facilities. In 2008, EPA had promulgated an ozone National Ambient Air Quality Standard (NAAQS). When EPA continued its efforts to strengthen the ozone standard even further as shale gas drilling was skyrocketing, ozone levels at excessive levels were being detected in rural areas of the country, exceeding ozone levels found in the our largest cities.

In March 2011, levels of ground-level ozone were triggered by natural gas drilling in western Wyoming's Upper Green River Basin, worse that levels recorded in Los Angeles, one of the nation's smoggiest cities. In the Dallas suburb of Dish, Texas, levels of benzene were detected at levels dangerous to human health, traced to 60 drilling wells, gas production pads and rigs, a treating facility and compressor station. With gases escaping into the air during drilling and from storage tanks and other equipment used in the fracking process, EPA extended its pollution control beyond natural gas processing plants, while states began to ratchet up enforcement on air emissions from well sites.[50] The proposal from the federal Environmental Protection Agency would cut smog-forming pollution -- known as volatile organic compounds or VOCs -- emitted from hydraulically fractured wells when energy companies drill for natural gas, according to a news release from the agency.

Acting in response to a court-imposed deadline in litigation by environmental groups to update its regulations and enforce the Clean Air Act, the EPA in late July 2011 proposed for the first time to control air pollution at natural gas wells, particularly well drilled using hydraulic fracturing. The proposal included cutting volatile organic compounds – smog-forming pollution - emitted from hydraulically fractured wells during the shale gas drilling process. It addressed air pollution problems in Wyoming, Texas, Pennsylvania and Colorado. These were some of the primary sites where shale gas fracking had led to a rush to obtain natural gas that was once considered inaccessible. The proposed CWA regulations were designed to eliminate most releases of smog- and soot-forming pollutants from the approximately 25,000 wells that had been drilled during that rush, and held out the promise that new controls on storage tanks, transmission pipelines and other equipment at drilling sites would reduce by 25% the amounts of toxic air pollution and methane.[51]

D. Underground Injection Control Program

When Congress enacted the SDWA in 1974, Part C of the Act established the Underground Injection Control ("UIC") program that prohibited any "underground injection" (defined as the "subsurface emplacement of fluids by well injection") that endangers underground drinking water sources.[52] Under the UIC, EPA has issued regulations establishing minimum requirements for states to follow, and, if requested, reviews proposed state UIC programs to evaluate compliance with these minimum requirements. If a state chooses not to regulate, EPA runs the program.[53]

Underground injection "endangers drinking water sources if such injection may result in the presence in underground water which supplies or can reasonably be expected to supply any public water system of any contaminant, and if the presence of such contaminant may result in such system's not complying with any national primary drinking water regulation or may otherwise adversely affect the health of persons."[54]

EPA policy into the 1990s was that the UIC program did not apply to hydraulic fracturing because it applied only to operations where the "principal function" of an injection was the placement of fluids, and the principal function of fracking is resource recovery.[55] Given this Orwellian turn of a phrase that allowed injection to continue to take place regardless of the "principal function," states were thus left to regulate fracking under their own laws as they saw fit. This interpretation stood unchallenged until 1995, when Alabama citizens living near a coalbed methane operation that used hydraulic fracturing reported contaminants in their drinking water wells, and petitioned EPA to require Alabama to regulate fracking under the UIC.[56] Over objections from these landowners, EPA approved Alabama's UIC regulations, which did not govern fracking. The residents appealed

EPA's decision and, in 1997, the Eleventh Circuit overruled EPA's interpretation, instructing the agency to begin requiring states to regulate fracking under the SDWA.[57]

Although the Eleventh Circuit limited its ruling in 2001,[58] the seeds of regulatory uncertainty had been sown. According to one commentator[59], different political pressures were quickly brought to bear: "on the one hand, by those concerned with potential environmental impacts of a widespread and largely unregulated industrial practice; on the other, by those concerned that unnecessary government oversight would cripple energy development. The former wanted fracking's environmental impacts studied, the latter wanted the practice exempted from environmental regulation."[60]

In late 2010, EPA posted an announcement in the form of a fracking permit notice on its website that "[a]ny service company that performs hydraulic fracturing" using diesel fuel in the fracking fluid must obtain Underground Injection Control (UIC) program permits as Class II wells. Before this announcement, the UIC program had been operated almost exclusively by individual states, and EPA had not required a federal class II UIC permit prior to drilling despite the fact that fracking operations that used diesel were subject to Safe Drinking Water Act (SDWA) regulation.

On August 21, 2010, the International Petroleum Association of America (IPAA) and the U.S. Natural gas Association filed a petition in the D.C. Circuit alleging that the EPA surreptitiously created new federal regulatory requirements related to fracking in contravention of federal administrative law. Asserting that the EPA's actions "have serious and economic consequences and constitute reviewable final agency action," the IPAA alleged that EPA should have adhered to the Administrative Procedure Act's notice and comment rulemaking requirements when issuing its fracking permitting notice.[61]

At the heart of the dispute was EPA's fracking permit notice, a website statement which, if ruled legal, could mean a wholesale change in how the natural gas industry is regulated in the United States. The legal issue at the core of IPAA's challenge is whether the website posting of the UIC permitting requirements constitutes a "final agency action" under the APA. EPA's agency determination requiring that any service company that performed hydraulic fracturing using diesel fuel must receive prior authorization from the Underground Injection Control ("UIC") is thus being challenged as a change in legal obligations under the UIC, for which EPA did not undertake notice and commend rulemaking procedures required by the APA.

E. State Regulation and Monitoring

In addition to federal authority to regulate the hydraulic fracturing process, several states are reviewing their regulations and considering further environmental safeguards. A major motivation for such increase state-level regulatory activity is the federal Energy Policy Act of 2005, which - through the Halliburton Loophole - specifically exempts fracking from the Safe Water Drinking Act and Clean Water Act. While the results will not be in for another two or three years on the EPA's $1.9 million study of fracking's effects on water resources as it considers whether additional federal protections should be put in place, the states are not sitting back passively. Many have taken administrative action or promulgated additional regulations on fracking and the production of fossil fuels. States with immense reserves of natural gas-rich shale beneath their surface are scrambling to revise their drilling regulations and cleanup requirements, prompted by the boom in natural gas development underway throughout the United States. The state-level rush to regulate reflects broadening recognition of the perceived risk and potential danger to the safety of groundwater that millions of people use in their homes and businesses.

1. Michigan:

The Collingwood Shale formation lies two miles below the surface under the northern part of Michigan, the latest state to confront the deep shale gas trend as gas companies snatched up leases in 2010. In May 2010, a record $178 million was generated in an auction of state mineral leases, almost as much as Michigan had earned in the past 82 years of lease sales. State officials are reviewing regulations for spacing wells and managing freshwater supplies to the wells, each of which will use 5 million gallons of water or more for the deep horizontal well now being drilled, far more than was needed to develop the shallower Antrim Shale wells which were largely developed in the 1990s.

Michigan has a long history with fracking, and most of the gas drilling in the state has involved hydraulic fracturing. According to the Michigan Department of Natural Resources and Environment's mineral and land management division, the state has "very strong casing and sealing standards which have been successful in protecting fresh water resources," and the number of wells drilled will have to be limited to one for every 640 acres, one square mile, rather than the one per 80 acres in effect previously.

Faced with such a large increase in the amount of water required by the fracking process today, the Michigan DNRE does not yet track the cumulative effects of water withdrawals across a given watershed. However, the state is now examining the potential effect of water withdrawals on the immediate surroundings of well sites site, especially if the well is near wetlands or a lake, to make sure drilling activity does not deplete the aquifer.[62]

2. Pennsylvania:

An October 10, 2008 report by the Pennsylvania Department of Environmental Protection revealed that brine from gas well drilling had to excessive dissolved salts being discharged from a wastewater treatment plant into the Monongahela River. The fracking process has apparently led to impairment of water quality in that river and prompted the Pennsylvania Department of Environmental Protection to order nine wastewater treatment plants on the river to curtail treatment of gas well drilling brine until further notice. The author of "Marcellus Shale: Material Drinking Water Risks?" noted that "[t]he extent to which opponents of drilling projects will obtain "traction" will likely be a function of the frequency and severity of the occasions when adverse environmental impact is tied to some aspect of a drilling operation," and that a damper could be put on the Marcellus "gas rush" with the occurrence of a few more issues like this one.[63]

As the birthplace of the American hydrocarbon development industry where over 350,000 natural gas wells have been drilled since the first commercial oil well began production in 1859, Pennsylvania is one of the states that overlies the Marcellus Shale formation. It began regulating drilling in 1956, and its approach to regulate the gas boom reflects a cautious, informed governmental response tempered by experience. As the

former director of the Pennsylvania Department of Environmental Protection's Bureau of Natural gas Management put it, "What do you have to be afraid of? It's only sand and water." The current Bureau director has also noted "There has never been any evidence of fracking ever causing direct contamination of fresh groundwater in Pennsylvania or anywhere else." That nonchalant attitude may be changing. An investigative report by the New York Times from February 2011 revealed Pennsylvania wells have produced more than 1.3 billion gallons of wastewater, most of which was sent to treatment plants incapable of removing many of its toxic elements, and that at least 12 plants in three states discharged the partly treated wastewater into bodies of water such as rivers and lakes.

The secretary of the Pennsylvania Department of Environmental Protection remarked in a June 2010 NPR interview that "gas drilling wastewater is exceptionally polluted. It's nasty, nasty stuff." The Pennsylvania DEP now devotes a web page to news on the Marcellus Shale formation, with answers to frequently asked questions about the area, descriptions of the regulations governing its development, information for landowners considering leasing their mineral rights to natural gas companies, and a list of the hazardous components in various hydraulic fracturing solutions. The state's regulatory enforcement mechanism is fully engaged, as is evident from an August 2010 fine of $97,350 on a Marcellus Shale operator for an incident in which used hydraulic fracturing fluids escaped from a wastewater pit and contaminated a watershed. In an official statement about the pollution incident, the state DEP regional director stated that "[i]t is unacceptable for drilling companies in Pennsylvania to threaten public safety or harm the environment through careless acts, such as this. … The Marcellus Shale offers significant economic opportunities for Pennsylvania, but these companies must adopt operating standards that prevent these sorts of accidents and they must make protecting our water resources a top priority." [64]

Pennsylvania's Environmental Quality Board proposed a series of new rules in May 2010 that "updates existing requirements regarding the drilling, casing, cementing, testing, monitoring and plugging of natural gas wells, and the protection of water supplies." Sierra Club and Earthjustice, a public interest law firm, believe that proposed rules do not go far enough and have commissioned a review of the rule changes by a petroleum and environmental engineer who recommended 47 ways to strengthen the regulations, including setting stronger standards for the surface casing used to protect freshwater aquifers, and a 24-hour deadline to respond to contamination complaints.

The Pennsylvania Governor's Marcellus Shale Advisory Commission (MSAC) recently submitted its report and recommendations concerning the development of natural gas in the Marcellus Shale. Among the Commission's 93 recommendations is to oblige well operators to track and report the treatment and disposal of waste water.[65]

3. New York:

New York State has taken a consistent hard line against fracking since 2008, holding up gas drilling permits in New York's portion of the Marcellus Shale formation as the New York Department of Environmental Conservation (DEC) conducts a review of the shale gas fracking practice. On August 3, 2010, the New York Senate enacted a moratorium on new wells until May 15, 2011, in order to give the state DEC more time to complete its review of the fracking practice and issue new permitting guidelines. The proposed moratorium was ultimately passed by the state Assembly and signed into law by Governor David Paterson. In June 2011 the Democratic-led New York State Assembly voted to extend the moratorium for another year, but the Republican-led Senate never passed the measure, leaving in place the July 1, 2011deadline for the state's Department of Environmental Conservation (DEC) to issue a report on the examining the impacts of fracking.[66] The DEC then issued an update to its environmental review and proposed rules for fracking, recommending that hydraulic fracturing be prohibited in the New York City and Syracuse watersheds, as well as around primary aquifers and within 500 feet of their boundaries. Surface drilling would also be banned "on state-owned land including parks, forest areas and wildlife management areas," according to the agency's announcement. According to DEC officials, "High-volume fracturing will be permitted on privately held lands under rigorous and effective controls, and DEC will issue regulations to codify these recommendations into state law."[67]

4. Wyoming:

In the western states, with their a longer history with the combination of hydraulic fracturing and horizontal drilling, the industry-friendly state of Wyoming introduced what was heralded as “some of the nation’s toughest rules governing fracturing” in June 2010, including requirements that companies disclose the ingredients in their fracking fluids to state regulators. The disclosure requirement was the first in the nation, although the new rules to not require that those ingredients be disclosed to the public.[68]

5. Colorado:

In 2007 the state of Colorado revamped its natural gas laws to require that companies maintain an inventory of the chemicals used at each well. The inventory is required to be maintained for the life of the well plus an additional five years. While the companies do not have to file the list with state regulators, they are required to provide it to the Colorado Natural gas Conservation Commission on request, and the agency can then share the information with health officials or a treating physician under a confidentiality agreement.

6. Delaware River Basin Commission:

In addition to state regulators weighing in on fracking, multistate entities like the Delaware River Basin Commission are stepping up their regulatory oversight. The Commission oversees the 330-mile Delaware River flowing through New York, Pennsylvania, New Jersey and Delaware, with over 15 million people depending on the basin for their drinking water, farming and industrial needs. In May 2009, it took a tough stance in requiring commission approval of any natural gas drilling in the Delaware River Basin, citing concerns that the massive amounts of water required for hydraulic fracturing would deplete the aquifers, that drilling operations could pollute groundwater or surface water, and that the recovered fracking fluids would not be treated and disposed of properly.

7. Local Government Anti-Fracking Ordinances:

Buffalo, New York: In February 2011, the City of Buffalo, New York, banned the natural gas drilling technique of hydraulic fracturing by adopting a municipal ordinance that also banned storing, transferring, treating or disposing of fracking waste within the city.[69]

Appalachia: Municipalities in the Appalachian region, apparently convinced that shale gas exploration was not adequately regulated at the federal and state level, have adopted municipal ordinances outlawing fracking within city limits. The first major U.S. city to enact an anti-fracking ordinance was Pittsburgh, which enacted the Community Protection from Natural Gas Extraction Ordinance in November 2010, followed a similar ordinance adopted by Buffalo, New York in February 2011, and then by Morgantown, West Virginia. Water pollution appeared to be the primary concern of these municipalities. Buffalo’s ordinance was rendered moot by the one-year extension of a statewide moratorium on fracking in New York. Pittsburgh based its authority to regulate natural gas extraction on the inherent right to self-governance established by the Declaration of Independence and on Article 1, Section 2, of the Pennsylvania Constitution, which provides "[a]ll power is inherent in the people."

Critics speaking from the perspective of the natural gas industry have complained that the Pittsburgh anti-fracking ordinance is "breathtaking in its audacity (and its unconstitutionality)" and that Pittsburgh "is blatantly violating Pennsylvania's Certain Remedy Clause," Article 1, Section 11 of the state Constitution, by prohibiting corporations from challenging the ordinance. One commentator has noted that, in light of the presumption of validity accorded municipal ordinances in home rule states like Pennsylvania, coupled with the presumption of constitutionality accorded legislative enactments,

> Pittsburgh's ordinance puts potential challengers in a bind. … Any challenge will result in a show trial, and even where Pittsburgh loses (and it will lose), the forces behind the ordinance win (and the taxpayers footing the legal bills lose). Pittsburgh will be able to challenge the rights of corporations and the idea of corporate personhood, and testimony about the safety of hydraulic fracturing will allow the city to call doomsday experts. This is just in the courts of law. The court of public opinion will likely have even less relation to fact, with confusion about preemption doctrine devolving into a personification of the evil corporation exploiting state laws and connections to deny the will of local voters. With all of the potential negatives and the relative lack of Marcellus exploration in Pittsburgh's Allegheny County, it is not surprising that no one has challenged Pittsburgh's ordinance. If and when the challenge does come, however, it could set the stage for a fascinating and protracted legal battle."[70]

New Jersey Highlands: Following discovery of new shale deposits in New Jersey, major pipeline expansions were proposed in the New Jersey Highlands as part of the state's master energy plan. Opposition to the expansion of the pipelines grew, ultimately leading 12 New Jersey municipalities to adopt resolutions opposing hydro-fracking: Holland, Bethlehem, Byram Township, Stillwater, Highland Park, Princeton Township, Closter, Franklin (Somerset), Trenton, Secaucus, and the Clintons.[71]

In summary, the actions and responses of states and local governments described above have been diverse and episodic, leading some to call for national regulation of fracking. From the natural gas industry's perspective, however, passing nationwide regulations governing hydraulic fracturing may be problematic, in light of the geological variations between regions and the complexity of the industry itself, and the industry should be allowed to evolve and experiment within the free enterprise system without "writing reports". From the perspective of environmentalists, moreover, a more comprehensive regulatory approach is crucial to provide adequate protection to the environment, and fracking and its effects are long overdue for tighter regulation. While any one fracking accident might not be on the scale of the Deepwater Horizon disaster, accidents "are happening all the time, and there's no regime in place that broadly protects the health of communities and the surrounding environment where drilling is being done."[72]

VI. Fracking Comes to Europe

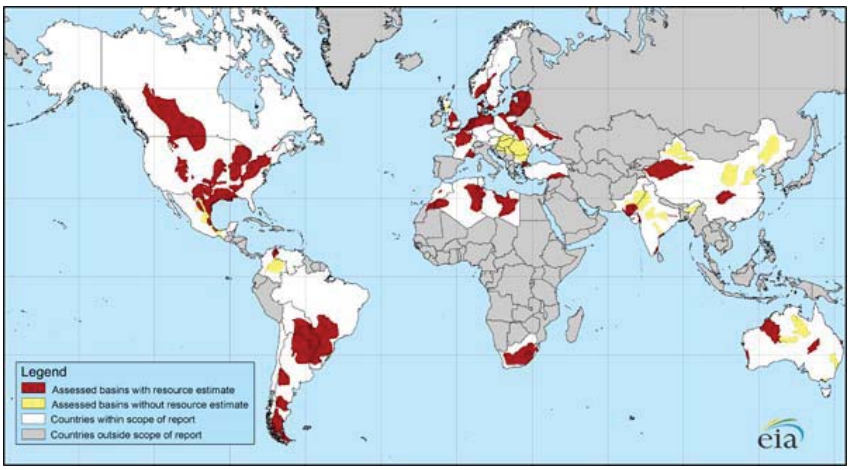
Shale gas resource potential in Europe has been the subject of studies by Advanced Resources International and the Energy Information Administration, and preliminary estimates are being assessed in Austria, Sweden, Poland, Romania, Germany, Croatia, Denmark, France, Hungary, the Netherlands, Ukraine, and the United Kingdom, among others. A technically recoverable assessment of approximately 220 TCF (6.22970 trillion cubic meters or TCM) between Poland, Sweden, Austria and Germany has been estimated, with 55% of that amount being in Poland.[73] Shale gas drilling practices that began in the United States have spread to Canada,[74] the Czech Republic[75], and elsewhere on an international scale,[76] and a number of these other nations are having second thoughts about about the controversial method of natural gas extraction known as "fracking."

The U.S. Department of Energy has noted that the phenomenal increase in the domestic supply of natural gas through shale gas production may have significant, long-lasting effects on energy independence and national security, and may lead to "a lessening of both supply and leverage from countries such as Russia and Iran, in part through the strengthening of European consumer markets."[77]

The direct economic benefits and production potentials predicted for nations and subnational units of government are huge. One London-based research firm recently reported that Europe's recoverable reserves of shale gas, sometimes referred to as unconventional gas, would be enough to meet its gas demand "for at least another 60 years."[78] While others have challenged such growth projections as overly optimistic,[79] environmental resistance and the level of governmental concerns over some of the consequences of shale gas fracking continue to escalate.

A. Europe's Shale Gas Reserves

The International Energy Agency estimates Europe may hold 35 trillion cubic meters (1236.013 TCF)[80] of natural gas dispersed in shale formations, more than enough to meet its foreseeable needs based on current annual demand of about .58 trillion cubic meters. This is significant in light of Europe's relative position with the rest of the world in Global Shale Gas Reserves, as shown below.[81]



The EU is one of the world's largest importers of natural gas and a major player in the international gas market, with Norway being one of the world's largest suppliers of natural gas as part of the extended European Economic Area, followed by the number two supplier, the Russian Federation. One of the key objectives of the EU is a single European energy market, which should level the prices of gas in all EU member states. According to Energy 2020, *A Strategy for Competitive, Sustainable and Secure Energy*, a common EU energy policy

> has evolved around the common objective to ensure the uninterrupted physical availability of energy products and services on the market, at a price which is affordable for all consumers (private and industrial), while contributing to the EU's wider social and climate goals. The central goals for energy policy (security of supply, competitiveness, and sustainability) are now laid down in the Lisbon Treaty.[82]

The technological availability of fracking in the United States for many decades stands in stark contrast to Europe, where the process is still relatively unknown. As in the U.S., its proponents in the EU say that the risks involved with the fracking process are low, and that the benefits of extracting this natural gas make it necessary to continue supplying Europe's energy needs. It opponents have raised red flags about potential contamination of water supplies, attributable in part to unknown chemical additives used in the process.[83]

One commentator recently observed that a host of energy companies are engaging in exploratory drilling for shale gas deposits across Europe in an effort that is comparable to

the great natural gas rushes of the past. Exxon Mobil has bought up concessions in Germany and Poland. Shell is active in Sweden and Ukraine. Chevron is in Poland. Total is in Denmark and France. And Cuadrilla is also exploring in the Netherlands and the Czech Republic.[84]

Against this backdrop of potential shale gas reserves that underlie most of the EU's 27 states, environmental organizations and other critics of fracking are raising the alarm about potential groundwater contamination and other environmental ramifications of large-scale shale gas development.[85]

B. Reactions Within the E.U. and in Other Nations

Concerns over possible groundwater contamination from fracking along with other environmental issues have been raised by citizen groups and environmental organizations in France[86], where the French government recently imposed a moratorium halting shale gas exploration because of environmental concerns. Most recently this issue has arisen in Poland[87], South Africa[88], and Nova Scotia.[89] We will examine how this debate is unfolding in other nations.

1. Poland

Shale gas fracking enjoyed a relatively quiet arrival in Poland during the last few months. The new type of natural gas and oil extraction known as hydraulic fracturing was already producing increasing amounts of natural gas — and controversy — in the USA, and is now starting to generate opposition elsewhere as it spreads around the world. So far in Poland, though, the opposition is coming mostly from neighbors of drilling wells, while environmental groups like Greenpeace Poland are reserving judgment. To complicate matters, the Polish government is understandably eager to develop domestic gas supplies that could help free the country from reliance on Russian gas.

a. The Push for Shale Gas in Poland

Millions of Poles already use gas for cooking and heating, but until now virtually all of it came from Russia. And after centuries of domination by their giant neighbor to the east, it is a big problem for many Poles. That is part of the reason why Polish government is pushing shale gas drilling and is "determined to make shale gas in Poland become a reality."[90] Tapping Poland's large shale gas reserves, moreover, could change the regional balance of power.

b. Environmental Impact Assessments

While there may be no concerted environmental campaign against shale gas in Poland at the present time, there are legal obstacles. According to the Polish Environment ministry, there is no special environmental law concerning shale gas, and that the country does not need one. Poland already requires every big new project to have an environmental impact assessment, and the government will consider fracking proposals on a case by case basis.[91]

c. San Leon Energy's Response

Echoing shale gas drillers in the U.S.A. who reject concerns about ground water contamination, the response of one of the major energy companies in Poland is that there is no risk of water pollution from fracking: "You've got shallow water and deep gas,… [and][i]f the groundwater aquifer's at 200 meters or even 1000 meters, the shale gas here in Poland is between 2500 and over 4000 meters.[92]

d. Poland's 21st Century Rush

A major impetus from shale gas fracking is Poland's dependence on Russian gas supplies, which currently account for two-thirds of its demand. According to Poland's Ministry of the Environment, Polish shale gas is "the gold rush of the 21st century," and Poland is a future "energy super-power" with estimated reserves of 1.4 trillion to 3 trillion cubic meters.[93] On the negative side, while shale gas could help reduce Poland's need for coal-derived electricity (currently 92 % of production) and serve as a "transition" energy source on the way to a more renewable future, critics have noted that shale gas drilling could spoil the landscape and exacerbate water shortages in some areas.[94]

As energy-poor Poland begins to move forward with its plans to use hydraulic fracturing, or fracking, to develop the country's natural gas reserves, little controversy has emerged regarding the controversial nature of the fracking process. The Polish experience to date does not appear to address some of the most problematic environmental concerns associated with massive amounts of water required during the fracking process and the potential for surface water contamination.

A more cautious official stance may be in the works. As Poland's Deputy Environment Minister Jacek Jezierski recently observed, "We will be able to say whether amendments to provisions regulating shale gas extraction are needed once we perform a professional assessment of its environmental impact, not an emotional one. Poland intends to control this process, not to ban it." According to Marek Kryda of the Institute of Civil Affairs, "It is necessary to look after issues related to property expropriation and lease. We can already see irregularities at the stage of test drilling."[95]

A number of Polish geologists and experts as recently as July 2011, have rejected as unfounded the arguments of scientists in neighboring Germany that fracking poses environmental dangers. In mid-July 2011, European Union officials received a critical report on the consequences of shale gas exploration and extraction, prepared by a German think tank, Ludwig-Bölkow Systemtechnik, and commissioned by the Environmental Committee of the European Parliament. In the report, scientists demand that the European Commission should not only strictly control the process of exploration, but also that it should prepare regulations to govern the extraction of shale gas. The report's authors argue that existing laws are too loose and that the fracking process is dangerous for the environment because it requires the use of toxic substances that are pumped into the ground in a solution with water, and the fracking fluids which eventually rises to the surface are contaminated with heavy metals and radioactive material.[96]

2. Germany: Gegen-Gasbohren

The controversy over fracking came to Germany when ExxonMobile Germany proposed to begin test drilling in northern Germany in October 2010, shortly after which several hundred people organized an anti-fracking organization, Gegen-Gasbohren, and through their website at www.gegen-gasbohren.de and through an effective outreach facilitated by the media, newspapers and television, provided information about fracking on shaleshock.org, including scenes from the indy movie "Gasland."[97] Gegen Gasbohren was founded in September 2010, with groups in several German towns where shale gas fracking was planned, each drawing up to 300 people. As media coverage increased, after only three months every major party in the state of North Rhine-Westfalia is calling for a moratorium on fracking. Some are even calling for a moratorium on test drillings, until it is clear that the drilling technology is safe.[98] .

3. France: No to "le Fracking"

As the fracking fight has gone international, citizen groups and environmental organizations raised the alarm in France, the first country to enact a moratorium. The site of what was to be a mad rush to conduct exploration for shale gas in France is the Paris Basin, which is under France's most fertile farmland. The geology of the Paris Basin shale formation, a saucer-shaped rock formation that extends over 140,000 kilometers, is similar to the Bakken Shale formation in North America, where oil production has surged with the increased use

of fracking. It is unclear how much of the Paris Basin's estimated 100 to 300 billion barrels will be recoverable using the hydraulic fracturing techniques, but industry executives have noted that "[i]f the geological potential is there, it would be a shame for France to pass up this source of energy."

Opponents to "le Fracking" cited public shock over learning that the French government had pushed though drilling permits without any debate, showing disdain for the population and elected representatives. Fracking opponents have also pushed for modifications of rules that will allow public consultation when awarding permits for natural gas exploration. Opponents expressed fear that harmful chemicals could seep into groundwater through a process that entails shooting water, sand, and chemicals into the ground to extract oil or natural gas.

The French government became increasingly aware of and concerned over the potential impact of fracking on the local environment. Its concerns were threefold: (1) excessive use of existing water supply, insofar the average amount of water used for each hydraulic fracturing well was as much as the amount 100,000 French people use in one day; (2) potential contamination of both the soil and groundwater; and (3) the large number of wells needed to extract shale gas is 10 to 20 times as many as are used in conventional drilling.

As concerns mounted in the United States and Europe over the environmental impact of shale gas fracking, José Bové, a French environmentalist, farmer, former Presidential candidate, and Green party deputy with the European Parliament, brought the search for shale gas to a halt in France. As energy companies began to ready their rigs outside Paris and started to plan for drilling in southern France, local environmental groups began raising concerns about damage to water tables from the hunt for hydrocarbons locked in shale rock. On Jan. 22, 2011, Bové started a petition drive that led to the French government ordering an exploration moratorium. On Mar. 11, 2011, French Prime Minister François Fillon extended the ban until June 2011, when parliamentary and ministry reports on the environmental and economic effects were due.[99]

The National Assembly, France's lower chamber, passed the moratorium bill on June 21, 2011, after which the French Parliament voted on June 30, 2011 to impose a moratorium on fracking. Critics had argued that fracking raised environmental concerns and could contaminate groundwater. Ironically, just as France was making headlines as the first country to enact such a ban, New York State was preparing to lift its moratorium on fracking.

In the meantime, Bové took his anti-fracking battle to the European Parliament and will seek an EU-side ban on exploration by the producer who have already snapped up drilling permits and are now riding out the political storm and waiting until the French government studies are completed.[100]

In a study requested by The European Parliament's Committee on Environment, Public Health and Food Safety, scientists concluded that "at a time when sustainability is key to future operations it can be questioned whether the injection of toxic chemicals in the underground should be allowed, or whether it should be banned as such a practice would restrict or exclude any later use of the contaminated layer… And as long-term effects are not investigated."[101]

Environmental groups complain that in addition to toxic chemical input from fracking, many other problems of natural gas exploration and production are being minimized by the industry, including such problems as "leaks or failures of steel and cement drill casings, deep-well injection of toxic waste which may also increase seismic activity, the storage of explosives on farms and in communities during seismic surveying, increased green house gas emissions, offshore and onshore oil spills that damage fisheries, and waste product contamination of air, water and soils."[102] According to French environment minister Nathalie Kosciusko-Morizet, an outspoken opponent of fracking, permits given to gas exploration companies the year before should never have been granted: "We have seen the results in the U.S. There are risks for the water tables and these are risks we don't want to take. It was an error. ... An environmental evaluation should have been done before giving out the permits and not after.

…There is only one technology that can be used today to produce shale gas and that's hydraulic fracturing and we don't want it."[103]

In France, the shale gas industries ambitious plans have met stiff resistance among environmentalists and ordinary citizens who do not want to see their countryside transformed into fields of oil derricks. In light of a water shortage in this region, moreover, these same opponents of fracking fear the water shortage may become even worse if shale gas fracking proceeds unabated. One can anticipate that the French government will likely condition relaxation of this moratorium, if ever, on an industry-wide commitment to reduce the amount of water needed for the fracking process, placing strict limits on the number and spacing of wells, and other verifiable measures that will reliably protect the environment

4. United Kingdom

In Great Britain, the Energy and Climate Change Secretary gave fracking a clean bill of health and insisted it was subject to robust controls, and the House of Commons Energy Select Committee also supported the fracking procedure, arguing that Great Britain could have considerable reserves of shale gas that should be exploited in order to reduce the country's reliance on imported energy. That all seemed to take a turn for the worse in June 2011, when two earthquakes were recorded in Lancashire, England, leading members of Parliament to call for an investigation into the safety and environmental impacts of drilling for shale gas, based on concerns that fracking could have triggered the the seismic activity, in addition to contaminating local water supplies.[104] Cuadrilla Resources, the British company that was exploring for gas in shale formations deep underground, promptly announced that was temporarily halting fracking operations near Blackpool in Lancashire after indications that it might have set off the two earthquakes.[105] Similar earthquake activity was reported in the state of Arkansas in February 2011, where the Center for Earthquake Research and Information recorded about 100 earthquakes over a seven day period before two injection wells were shut down at the request of the Arkansas Natural gas Commission. One of the earthquakes measured 4.7 on the Richter scale, the largest to hit the state in 35 years.[106]

5. South Africa

In mid-April 2011, South Africa's cabinet placed a moratorium on on natural gas exploration licenses in the semi-arid Karoo region, a vast and ecologically sensitive region where the controversial shale extraction technique of "fracking" was about to be deployed. This region had been high on the radar screen of conservationists and Karoo farmers. A statement issued by the South African government noted that the "Cabinet has endorsed the decision by the department of minerals to invoke a moratorium on licenses in the Karoo, where fracking is proposed." [107]

6. Quebec, Canada

As of March 2011, Quebec will no longer authorize fracking for natural gas, according to Nathalie Normandeau, Quebec's natural resources minister, who announced that the Quebec government would no longer authorize any hydraulic fracturing operations in the province. Gas leaks at wells that have already been fracking in Quebec led government officials to question whether the industry was in control of the situation.[108]

7. Arrival of Shale Gas in the Mainstream

Natural gas multinationals are "now scouring the EU for shale-gas structures. Poland, Hungary, Germany, Austria and other countries in—coincidentally—the region of Europe most exposed to Russian gas, show promise," with projections by the IEA indicating up to 35 trillion cubic meters (1236.013 TCF) of natural gas reserves, six times the size of conventional existing reserves, but that

> [t]here are obstacles. Some environmentalists—and Gazprom—say the drilling process threatens water sources. For that reason, New York has prevented shale-gas exploitation in its share of the Marcellus shale (while Pennsylvania, which shares the field, has allowed it). Inhabitants of densely populated Europe, unaccustomed to disruption by the oil industry, might not like the rapid rate at which multiple shale wells must be drilled to sustain output.[109]

The arrival of shale gas in the mainstream may be problematic for Gazprom's business model, which is based on the development of huge, expensive conventional gas fields in inhospitable regions of Russia. Some of these projects are already being mothballed.

VII. The Scientific Debate

Up until recently, most of the debate over environmental risks associated with fracking was not driven by good science, but by anecdotal evidence.[110] Calls have been made for hydraulic fracturing to receive the highest regulatory priority through instigation of a federal, scientifically rigorous report prepared by the National Academy of Sciences or a similar "neutral" body and a simultaneous regulatory risk-limiting mechanism.

Scientific and government-sponsored studies have been cited in recent years as reassurance that some of these groundwater contamination concerns were "being actively addressed in those states and water basins subject to the jurisdiction of regulatory bodies governing water withdrawal" and that "concern about groundwater contamination has received little substantive support from either regulators or the scientific community."[111] Sources for this reassurance included two public statements, one from the New York Department of Environmental Conservation and the other from the Natural Gas Compact Commission:

First, the Commissioner of the New York State Department of Environmental Conservation's testimony that "no realistic risk of groundwater contamination from the fracking process exists," and that "[t]he same geology that has sealed natural gas in the rock for millions of years - together with our strict well casing and cementing requirements - prevents any risk of groundwater contamination from the drilling and fracking operation. As a result, the only likely vector for possible threats to groundwater comes from the surface management of the water used in the drilling and fracking operations."[112] Granted that this latter observation is a bold, categorical statement that discounts the likelihood of well failure, if these requirements were as effective as the New York DEC indicated, they could be the starting point for an accurate and reliable means of reducing the chances of failure. If enforced by external governmental regulatory controls, as opposed to the kind of industry self-policing evident when the Deep Horizon blowout in the Gulf of Mexico took place in 2010, such regulatory oversight could go a long way toward restoring public confidence in the ability of energy exploration and development to coexist with and not threaten environmental safety.

Second, a statement by the Interstate Natural Gas Compact Commission on its website that "In 2004, the U.S. Environmental Protection Agency completed a study of the environmental risks associated with the hydraulic fracturing of coal bed methane wells. The EPA concluded that the injection of hydraulic fracturing fluids poses little or no threat to underground sources of drinking water. Although thousands of wells are fractured annually, the EPA did not find a single incident of the contamination of drinking water wells by hydraulic fracturing fluid injection. Effective state regulation has made hydraulic fracturing a safe and environmentally-sound way to maximize and conserve our nation's natural resources."[113]The same authors also noted that The Catskill Riverkeeper organization and others in the environmentalist community have charged that hydraulic fracturing may result in groundwater contamination, but the cases cited by these organizations where hydraulic fracturing is the suspected source of impaired or polluted drinking water do not involve fracking at the depths involved with the Marcellus region.[114] It should be noted that such "geology will keep us safe" arguments may often be true, but not always. The environmental risks incident to the fracking process are indeed site-specific, but concerns *accurate site characterization* still remain, that is, over whether the natural gas industry can

and will adequately and accurately characterize exploratory holes, core samples and geophysical exploration to determine lithology and any potential fast paths prior to commencing fracking operations. More substantial and encompassing regulation may be the only reasonable and appropriate alternative.

A. Cornell University Study

In the second week of February 2011, just as the Senate Environment and Public Works Committee was about to convene a subcommittee hearing on the safeness of hydraulic fracturing in the United States, a Cornell University study[115] was released, explaining how methane gas that escapes during natural gas and fracking production may make natural gas as dirty as coal in terms of carbon emissions. The Cornell University researchers concluded that natural gas pried from shale formations is dirtier than coal in the short term, rather than cleaner, and "comparable" in the long term. Their findings were fiercely disputed by the natural gas industry and severely undermined the widely stated belief that gas is twice as "clean" as coal in terms of greenhouse gas emissions.

B. Duke University Study on Methane Contamination of Groundwater

The Duke University study[116]was one of the first scientific reports connecting methane contamination of groundwater to fracking, but it came under sharp criticism from the moment it was released in April 2011. It did not note that researchers sampled 68 wells across Pennsylvania and New York, where more than 20,000 water wells are drilled annually, nor did it reflect any baseline data and provide any valid basis for determining if methane concentrations were high prior to drilling. The study did acknowledge that methane was detected in 85% of the wells tested, regardless of drilling operations, and no trace of fracking fluids were found in any wells.[117] The Duke study also noted the possibility of leaky well casings at the top of a drilling site, from which methane could migrate to water supplies. Risks incident to proper well construction and maintenance are not unique to fracking, are encountered in any type of drilling, and along with adequate site characterization prior to beginning operations should be the focus of industry standards and attention.[118]

VIII. A Decade of Progress and Recent Developments

A. 2001 Energy Task Force

A decade ago, efforts to study the environmental impact of fracking and whether it posed risks to drinking water were undertaken by President George W. Bush's National Energy Policy Development Group, led by former Halliburton CEO and now Vice President Dick Cheney. This "Energy Task Force" issued its May 2001 final report in which it briefly discussed fracking, stressing the importance of the technique and mentioning the possibility of increased environmental regulation, but was silent about the fact that fracking had been the subject of debate among its authors and EPA, nor did it refer to EPA's ongoing investigation. Initial drafts of the report contained a legislative recommendation that fracking be exempted from the SDWA, but at the request of EPA the recommendation was dropped.[119]

In 2003, a voluntary Memorandum of Agreement was entered into between EPA and three of the largest hydraulic fracturing companies, Halliburton, BJ Services and Schlumberger, to eliminate diesel fuel from fracking fluids injected into certain wells located in the vicinity of underground sources of drinking water.

In July 2004, EPA released its final report on fracking, concluding that "injection of hydraulic fracturing fluids into coalbed methane wells poses little or no threat to [underground sources of drinking water] and does not justify additional study at this time . . .." Aside from the 2003 MOA, there was virtually no federal regulation of fracking during this period of time. The EPA's 2004 report was criticized as "scientifically unsound," members of the report's peer review panel were accused of conflicts of interest, and many in the environmental community rejected it as unreliable.[120] Among the conclusions from the EPA's 2004 report on the safety of hydraulic

fracturing (fracking) was the finding that hydraulic fracturing was safe for drinking water. Those findings were used to bolster the case for slipping the Halliburton Loophole into the Safe Drinking Water Act. Five years later, Benjamin Grumbles, who was assistant administrator for water at EPA and oversaw the release of the 2004 EPA report, formerly served as director of the Arizona Department of Environmental Quality and now serves on the board of the Clean Water America Alliance, a group that focuses on water sustainability issues, complained that the report had been exaggerated for years and that it was time for Congress and the EPA to take another look at hydraulic fracturing.[121]

B. 2010-11 Fracking Studies and Research by EPA and DOE

More than one federal agency has been involved in the 2010-2011 public hearings, studies and research into the fracking process and its potential environmental risks and impact on the future of shale gas production. Initially, EPA took the lead, but the Department of Energy was not far behind and has now leaped out front.

1. EPA Hydraulic Fracturing Study Plan

In March 2010, EPA announced that it would conduct a research study to investigate the potential impacts of hydraulic fracturing on drinking water resources. On March 7, 2011, a draft study plan was submitted to EPA's Science Advisory Board (SAB) for review, and both stakeholders and the public were asked to provide comments. Initial study results were expected by the end of 2012, but additional reports based on study findings from long-term projects would not be published until 2014.[122] Some question whether the EPA study is duplicative of other federal efforts to study the fracking issue and whether the study will indeed provide meaningful guidance insofar as it is not a risk assessment, nor does it purport to assess the degree or probability of any potential risk to drinking water posed by fracking.[123] On March 30, 2011, President Obama unveiled a "Blueprint for a Secure Energy Future"[124] setting forth his energy "blueprint" to make sure the nation is "extracting natural gas safely, without polluting our water supply."[125]

2. SEAB Shale Gas Subcommittee Fracking Study authorized

The week after the President's Blueprint was released, Energy Secretary Steven Chu announced that The Secretary of Energy Advisory Board (SEAB), an independent advisory committee, had been given the responsibility of forming a subcommittee to study the issue. The subcommittee was to be supported by the Department of Energy, EPA and the Interior Department, with its members extending beyond SEAB membership to include industry, environmental experts and states.[126]

3. EPA Expansion of Fracking Study to Seven Sites Nationwide

On June 23, 2011, under pressure and facing growing concerns raised by citizens, politicians, and interest groups about the potential impact of hydraulic fracturing on drinking water, EPA announced plans to conduct a study of the impact of fracking on drinking water by conducting case studies in seven U.S. sites. The scope of the EPA fracking study was to involve analyzing the full process of hydraulic fracturing from the acquisition of water to the mixing of chemicals, through the ultimate treatment and disposal of produced water. The sites were identified, prioritized, and selected based on factors such as the site's proximity to human population and drinking water supplies, evidence of impaired water quality, health and environmental concerns, and unique geological or hydrological features.

While the EPA fracking study was getting underway, EPA has met with representatives of the Department of Energy and other agencies to learn about research that those agencies were involved in and to identify opportunities for collaboration and leveraging of resources. It planned to coordinate particularly with the Department of Energy to share research on fracking and exchange information among experts.

4. SEAB Shale Gas Subcommittee Report

On August 11, 2011, The Shale Gas Subcommittee of the Secretary of Energy Advisory Board, charged with identifying measures that could be taken to reduce the environmental impact and improve the safety of shale gas production, issued its 90-day report with "recommendations that if implemented will reduce the environmental impacts from shale gas production."[127]

5. Congressional Directive for EPA Study

In the Appropriations Committee Conference Report for Fiscal Year 2010, Congress directed the EPA to study the relationship between fracking and drinking water. EPA is now undertaking a study to of the potential impacts of hydraulic fracturing on drinking water resources, and vows to use the best available science and independent sources of information using a transparent, peer-reviewed process and engaging in consultation with stakeholders throughout the study. Among those stakeholders are representatives from 21 states, the Association of State Drinking Water Administrators, the Association of State and Interstate Water Pollution Control Administrators, the Ground Water Protection Council, the Interstate Natural gas Compact Commission, and representatives from industry and from non-governmental organizations.[128]

6. EPA Hydraulic Fracturing Study Plan

On February 7, 2011, the EPA presented its plan for the study, the purpose of which was to "understand the relationship between hydraulic fracturing and drinking water resources."[129] According to the EPA, this study is designed to "examine the conditions that may be associated with the potential contamination of drinking water resources, and to identify the factors that may lead to human exposure and risks," and the scope of EPA's proposed research included "the full lifespan of water in hydraulic fracturing, from acquisition of the water, through the mixing of chemicals and actual fracturing, to the post-fracturing stage, including the management of flowback and produced water and its ultimate treatment and disposal."[130] In its preliminary remarks about the plan, EPA noted that many public concerns about hydraulic fracturing centered on potential risks to drinking water resources and impacts of the fracking process used during natural gas production from shale and coalbed methane formations. It also expressed awareness of the "potential risks to surface and underground sources of drinking water [that] might occur at various points in the hydraulic fracturing process" as well as "[t]he likelihood of those risks causing drinking water contamination. …"[131]

7. Criticism of EPA's Hydraulic Fracturing Study

Concerns have been expressed with increasing frequency and volume over whether EPA's study will ultimately raise more questions than it answers. According to one commentator, policymakers are looking to the EPA's study of the potential impacts of fracking on drinking water resources for guidance that will enable them to balance the potential environmental risks against the benefits of this form of increased domestic production of natural gas, and "the agency has to get it right."[132] As one commentator noted:

> [T]hose with a stake in a credible, authoritative analysis of the potential environmental impacts of hydraulic fracturing on drinking water are concerned about EPA's effort. Given the lack of any threshold for degree or probability, EPA's study seems likely to identify potential risks to drinking water. However, industry, environmental groups, and regulatory agencies will be left to debate how those risks should be characterized and whether they are adequately addressed by existing law.[133]

C. SEAB Shale Gas Production Subcommittee Recommendations

While the EPA fracking study was underway, and well before the 2014 publication of its final study, The SEAB Shale Gas Production Subcommittee in the Department of Energy generated its own interim report on

August 11, 2011. The report included recommendations calling for disclosure of all chemicals used for fracking at each well, use of a life-cycle approach to managing and tracking water and wastewater, extensive testing, monitoring, and disclosure of air pollution associated with gas development, reduction in use of diesel fuel, improving communication among state and federal regulators, and further study of the climate change impacts posed by natural gas development.[134] It also identified significant gaps in how state and federal regulators manage shale gas development and pointed out the need for major improvements in the natural gas industry's drilling practices in a manner that protects public health and the environment. Unlike the EPA study, the SEAB Subcommittee looked beyond the fracking process and took note of the need for make changes in the management of water use and disposal, well design, drilling, cementing and well integrity practices. While these same concerns have been raised with EPA, the SEAB Subcommittee has taken the lead in focusing attention on much needed improvements in these areas.

As with the EPA study committee, the composition of the SEAB Subcommittee panel was severely criticized by the right and left, with the natural gas industry and congressional Republicans complaining the panel was "stacked with former Democratic appointees hostile to drilling," while environmentalists and congressional Democrats complained up to seven panel members had financial ties to the natural gas industry. Panels so balanced are hard to come by, and this one takes the prize as an equal opportunity offender. The panel has provided a series of recommendations for amassing more information on the effects of drilling and sharing that information with the public. It makes no policy recommendations and suggests no changes in specific laws, regulations or enforcement. These are its recommendations:

(1) Improve public information about shale gas operations[135]

(2) Improve communication among state and federal regulators[136]

(3) Improve air quality[137]

(4) Protection of water quality[138]

(5) Disclosure of fracturing fluid composition[139]

(6) Reduction in the use of diesel fuel[140]

(7) Managing short-term and cumulative impacts on communities, land use, wildlife, and ecologies[141]

(8) Organizing for best practice[142]

(9) Research and Development needs[143]

D. State Monitoring

New York: In July 2011, the New York Department of Environmental Conservation (DEC) released Supplemental Generic Environmental Impact Statement (SGEIS) addressing permit conditions required for gas drilling in Marcellus Shale. The SGEIS applies statewide, except in areas that the Department proposes should be off-limits to surface drilling for natural gas using HVHF [high-volume hydraulic fracturing] technology. These areas include the watersheds associated with unfiltered water supplied to the New York City and Syracuse areas pursuant to Filtration Avoidance Determinations issued by EPA, reforestation areas, wildlife management areas, state parks, and 'primary' aquifers as defined by State regulations, and additional setback and buffer areas. Forest Preserve land in the Adirondacks and Catskills are already off-limits to natural gas development pursuant to the New York State Constitution. Coupled with tighter monitoring of wastewater disposal and other process streams, disclosure of chemicals used to the DEC, and other environmental controls, the new SGEIS is expected to tighten

environmental protection while allowing the state to maximize the benefits of shale gas development. The Statement is deemed "preliminary" because, the DEC said, "it omits a number of areas of analysis that are still ongoing and will be finalized later in 2011 and incorporated into this draft."

New Jersey: New Jersey's Legislature passed legislation that affirmed the state's involvement in the Regional Greenhouse Gas Initiative (RGGI), by a vote of 32 to 1 in the Senate and 56 to 11 in the House, banning the natural gas drilling technique known as hydraulic fracturing, or fracking. If the New Jersey anti-fracking bill is signed by Governor Christie, "it will be the first statewide ban on fracking in the U.S." [144]

Texas: In June 2011, Texas Governor Rick Perry signed into law the United States' first bill which will require natural gas operators to publicly disclose the chemicals they use in all hydraulic fracturing projects in the state.[145]

E. The FRAC Act

A report several years ago from the House Committee on Energy and Commerce disclosed that that natural gas service companies conducting fracking operations had used over 2500 fracturing products containing 750 chemicals, toxic and carcinogenic. The House Committee report lists every chemical disclosed by the natural gas industry, revealing that some of the chemicals are proprietary and cannot be identified. As the report notes:

> Up until 2005, much of the discussion and debate over fracking took place outside the mainstream public's perception. Concerns grew over the environmental and public health impacts of hydraulic fracturing fluids used to fracture rock formations, fluids that contained numerous chemicals that could harm human health and the environment, especially if they enter drinking water supplies. The opposition of many natural gas companies to public disclosure of the chemicals they use in the fracking process only compounded this concern. As the volume and intensity of demands continued to escalate for the natural gas industry to provide detailed disclosure of the chemicals used in fracking, the industry was nearing the end of a time when it could simply assure regulators that fracking fluids were basically benign and in any event could be contained underground or handled carefully on the surface. While resisting disclosure of the precise chemical makeup of these chemicals based on claims that their formulas are proprietary intellectual property, opposing environmental concerns increasingly emphasized that some chemicals used in fracking operations were known to be toxic, that increased use led to increased risk of spills, and that regulators would not know what to test for and medical professionals would not know what to look for if the chemicals remained secret.[146]

Disclosure bills began to surface at the local, state and federal level, and disclosure language was attached to the Senate's legislative response to the Gulf Oil Spill.[147] The Fracturing Responsibility and Awareness of Chemicals Act, H.R. 2766 and S. 1215, known as the FRAC Act, was introduced to both houses of the 111th United States Congress on June 9, 2009. Its aim was to close the Halliburton Loophole and repeal the exemption for hydraulic fracturing in the Safe Drinking Water Act. The FRAC Act would require the energy industry to disclose the chemicals it mixes with the water and sand it pumps underground in the fracking process, information that has largely been protected as trade secrets. The energy and gas industry opposed the legislation, and it did not become law. On March 24, 2011, however, the FRAC Act was re-introduced in the 112th United States Congress, was passed by the House of Representatives, and is now before the U.S. Senate, where it was initially referred to the Senate Committee on Environment and Public Works, and the last bill status report of April 12, 2011 reflects that hearings will be held by that committee jointly with the Subcommittee on Water and Wildlife.[148]

Sponsors of the 2011 bill noted that there was a "growing discrepancy between the natural gas industry's claim that nothing ever goes wrong and the drumbeat of investigations and personal tragedies which demonstrate a very different reality."[149] They characterized the FRAC Act as "a simple, common sense way to answer the serious concerns that accompany the rapid growth of drilling across the country," restoring "a basic, national

safety-net that will ensure transparency within the industry and safeguard our communities. If there is truly nothing to worry about, then this bill will lay the public's concern to rest through science and sunlight."[150]

F. International Treaties and Protocols

1. The Bellagio Draft Treaty

Professor Albert Utton, a leading international groundwater scholar, has proposed a draft international groundwater treaty[151] that would establish transboundary commissions with power to establish conservation areas and adopt comprehensive management plans based on equitable apportionment. The Bellagio Draft Treaty on Transboundary Groundwaters provides an international mechanism to deal with transboundary groundwater pollution.[152]

2. Berlin Rules

The 2004 International Law Association's Berlin Rules apply to all aquifers, confined and connected to surface waters, regardless of whether they receive surface recharge. The Berlin Rules adopt the principle of equitable apportionment augmented by the precautionary principle and call for the adoption of sustainable management regimes that are integrated into surface water allocation and management systems.[153]

3. NAFTA

Greater conservation of border groundwater resources shared by the United States and Mexico may be hastened by the North American Free Trade Agreement. For example, the Integrated Environmental Plan for the Mexico-United States Border Area makes potential groundwater contamination a more visible issue, and the Plan's groundwater quality monitoring proposals should promote the greater exchange of groundwater information. Such international collaborative efforts can lead to a more coherent, mutually beneficial and enforceable regime for addressing pollution of internationally shared aquifers and transboundary groundwaters.[154]

4. Montreal Rules and Helsinki Rules

An important objective of international water law is pollution prevention, and that objective has been the focal point of several international treaties and standards. Under the 1982 Montreal Rules on Water Pollution in an International Drainage Basin declare that the right to equitable utilization includes the correlative duty to prevent new or increased water pollution that causes substantial injury to the territory of another state and to take all reasonable measures to abate the pollution. Under the Montreal Rules, basin states are required to cooperate to ensure an effective system of pollution prevention and abatement. The Helsinki Rules and the 1991 ILC Draft Rules integrate water quantity and quality considerations. This is done by the Helsinki Rules by making states liable for transboundary pollution, while the 1991 Draft ILC Rules extend state liability, making them liable for activities that caused appreciable harm to other states.[155]

IX.CONCLUSION: The Case for International Oversight

Stepping back from the emotional frenzy and hyperbole that has characterized much of the debate and controversy over fracking and its impact on the environment, human health and safety, particularly as they related to water resources, we must consider two issues.

One is the fundamental issue of how best to achieve energy independence and to secure alternative sources of energy on a sustainable basis to power the nations and economies of our world. In achieving that independence, natural gas must be considered an important economic driver and a critical bridge fuel.

The other is the fundamental issue of how best to achieve sustainability of water resources and protect the fundamental human right to safe drinking water.

A strong argument can be made for federal oversight in this field, particularly since waterways and water supplies do cross state boundaries. It is unacceptable, moreover, to trade human health for fuel.[156] A similar argument can and should be made for international oversight in a collaborative role with member states under applicable provisions of existing U.N. treaties and protocols.

On an international scale, creation of an international mechanism similar to the FRAC Act of 2011 may provide the communication and information network that is an essential element of ensuring that our global water resources are protected, public health is not compromised, and states and communities are not exposed to unknown environmental risks. Such an international mechanism is within reach and could develop international protocols for

(1) treatment, disposal or recycling of fracking waste fluid, which cannot be treated like oil field brines and reinjected into the ground, since the water did not come from that source to begin with;
(2) a transparent and effective process for disclosing the identity of all chemical ingredients, components and additives using in cracking fluids and propping material;
(3) expanded public input and participation in the permitting process when dealing with transboundary aquifers and water resources;
(4) coordinated monitoring of monitoring for contaminants such as radium, barium, strontium and other heavy metals, radioactivity, and other environmental risks associated with hydrofracking fluid waste; and
(5) increased public-private collaboration and sharing of technology to increase level of understanding of the impacts of drilling and extraction processes on the management and protection of transboundary water resources and water supplies.
(6) remediation protocols by the industry – provisions to authorize and facilitate payment of monetary damages to landowners and others determined to have suffered injuries or losses as a result of failures during the fracking process, accidental spills or contamination attributable to spillage, leakage or other contamination above or below the surface at or near hydraulic fracturing sites.

A monitoring and management mechanism could be crafted by using the framework of existing international water law, treaties and protocols designed to address transboundary groundwater pollution, water quality monitoring and comprehensive management of internationally shared groundwater and surface water resources, including fundamental tenets of the Bellagio Draft Treaty, the Berlin, Montreal and Helsinki Rules, and NAFTA. Creation of such a monitoring and management mechanism would provide states and the international community as a whole with the means to share critical risk-related information and develop as well as implement environmental safeguards while preserving the rights of sovereign states to control their own resources.

We challenge the international community to augment the recommendations and proactive efforts that have been identified in the recent report from the Department of Energy's SEAB subcommittee, with a coordinated, comprehensive mechanism for oversight and risk management. Such a mechanism based upon the above treaties and protocols can include components that parallel the key recommendations enumerated in the SEAB report. Coordinated work on the national and international levels can help strike a balance between public safety and the development of shale gas as a growing energy resource for the future. This requires commitment at every level, national, international, subnational and private sector, and will not be a panacea. It can nonetheless lead us away from the political gridlock and acrimonious debate over natural gas development and provide a pathway for states and communities to realize the economic benefits of natural gas as a reliable, transitional energy source, a critical bridge fuel on a path to energy independence for our nation and for the world.

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ENDNOTES

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[4] Juliette Kayyem, *Rethinking the Fracking Debate*, The Boston Globe, August 22, 2011, http://www.statesman.com/opinion/rethink-the-fracking-debate-1775276.html?printArticle=y

[5] Using decades-old technology from horizontal drilling and high-pressure fracturing, deployment of the fracking process began increasing in the United States about a decade ago when shale gas made up 1% of our nation's natural gas supply. As the world market price for gas skyrocketed in 2005, this form of exploration of unconventional natural gas skyrocketed as well, and today, shale gas accounts for 25% of the United States' natural gas supply. *The rise of unconventional gas*, Industrial Fuels and Power, March 26, 2010, http://www.ifandp.com/article/003225.html ("The WEO indicates that North America is currently the leading producing region for all types of unconventional gas and that these account for over half of US output and more than a third of Canada's production."). Major energy firms are poised to commence exploratory operations to determine the extent of what many believe to be substantial unconventional deposits of shale beneath the surface of many countries in Europe in what has been compared to the great natural gas rushes of the past, with concessions purchased or applied for in Germany, Poland, Sweden, Ukraine, Denmark, France, the Netherlands and the Czech Republic.
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'Fracking' Comes to Europe, *Sparking Rising Controversy*, February 28, 2011, Environment 360, http://e360.yale.edu/feature/fracking_comes_to_europe_sparking_rising_controversy/2374/; *Shale gas in eastern Europe: Gas or hot air*, The Economist, June 14, 2010, accessible online at http://www.economist.com/node/21007490 ("Only now, with the shale gas boom in full swing, are environmental concerns mounting in the US. In Europe, by contrast, exploration starts with these concerns already being widely discussed. UG production needs huge amounts of water and, more importantly, uses chemicals that seep into the ground (usually at a depth of several thousand metres but that could store up problems in later years)").

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[13] Id.
[14] U.N. General Assembly Resolution 58/217, International Decade for Action, "Water for Life", 2005-2015 (58th Session)
[15] Shale Gas: Cheap, Readily Available, Made In USA, Eurasia Review- News and Analysis, April 20, 2011, http://www.eurasiareview.com/shale-gas-cheap-readily-available-made-in-usa-20042011/
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[17] Roderick Kefferpütz, *Europe's shale gas bonanza? Don't believe the hype* , May 9-10, 2011, EurActiv, *http://www.euractiv.com/en/print/energy/europe-shale-gas-bonanza-believe-hype-analysis-504640*. Kefferpütz is an associate research fellow at the Centre for European Policy Studies (CEPS), political advisor to German Green MEP Reinhard Bütikofer in the European Parliament, and an associate at Berlin-based think-tank 'stiftung neue verantwortung'.
[18] Id.
[19] http://www.duanemorris.com/alerts/alert3054.html
[20] Id.
[21]"[C]oncern about groundwater contamination has received little substantive support from either regulators or the scientific community. …[T]he Commissioner of the New York State Department of Environmental Conservation, while expressing the need for study of the impact of water consumption on public water supplies, has publicly testified that no realistic risk of groundwater contamination from the fracking process exists … . '[H]ydraulic fracturing takes places many thousands of feet underground, well below any groundwater zones. Groundwater zones are typically hundreds, not thousands, of feet below the surface. The same geology that has sealed natural gas in the rock for millions of years - together with our strict well casing and cementing requirements - prevents any risk of groundwater contamination from the drilling and fracking operation." Alerts and Updates, *Marcellus Shale: Material Drinking Water Risks*? November 25, 2008, http://www.duanemorris.com/alerts/alert3054.html
[22] Acknowledging that risk exists for contamination at the ground surface resulting from spills, overflows from storage basins, but noting "most of the risks appear to be in line with those associated with the collection, storage, transportation and overall management of wastewater streams generated by numerous other industrial processes. Permitting and regulatory programs already exist to address these risks, which are identifiable and quantifiable." Alerts and Updates, *Marcellus Shale: Material Drinking Water Risks*? November 25, 2008, http://www.duanemorris.com/alerts/alert3054.html
[23] "The amount of groundwater and/or surface water needed to perform hydraulic fracturing is, by all accounts, substantial. But will it lower aquifers and surface water bodies to levels that pose risks? The answers that are offered in response to these questions differ, of course, based on the source. … Ultimately, whether, and to what extent, water resource impairment is a significant concern will likely depend on the specific location of the proposed water withdrawal and the levels of available groundwater or surface water at the time of withdrawal. Areas not clearly subject to water withdrawal regulation and oversight are by definition more likely to see disputes and, perhaps, impacts." Alerts and Updates, *Marcellus Shale: Material Drinking Water Risks*? November 25, 2008, http://www.duanemorris.com/alerts/alert3054.html
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[29] Id.

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[31]Kenneth B. Madlock III, Ph. D., Amy Myers Jaffe, and Peter R. Hartley, Ph. D., Shale Gas and U.S. National Security, James A. Baker III Institute for Public Policy and U.S. Department of Energy, July 2011, http://www.bakerinstitute.org/publications/EF-pub-DOEShaleGas-07192011.pdf

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[33] *Risks and Rewards: The Controversy About Shale Gas Production and Hydraulic Fracturing, Ground Water Pollution, Toxic and Carcinogenic Chemical Dangers, Marcellus Shale, Hydrofrac and Fracking* (U.S. E.P.A., D.O.E., U.S.G.S., Progressive Management Publications 2011).

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[38]The first draft of the Energy Policy Act of 2005 proposed exempting hydraulic fracturing from SDWA regulation, and when the total package of energy reform legislation was nearing passage, the 2004 EPA report "greatly simplified the debate over the fracking issue." When the Senate approved a conference version of the Act on July 29, 2005, it included an amendment to the SDWA, exempting from its scope "the underground injection of fluids or propping agents (other than diesel fuels) pursuant to hydraulic fracturing operations related to oil, gas, or geothermal production activities." Unless it was using diesel fuel, fracking would not be federally regulated, leaving states free to continue to regulate as they saw fit. Adam Orford, *Fractured: The Road to the New EPA "Fracking" Study*, September 17, 2010, http://www.martenlaw.com/newsletter/20100917-new-epa-fracking-study#_ftn20.

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[41]33 U.S.C.§1251(b).

[42]See Exxon Corp. v. Train, 554 F. 2d 1310, 1329 (5th Cir. 1977); Washington Wilderness Coal v. Heckla Mining Co., 870 F. Supp. 983, 989-90 (E.D. Wash. 1994); United States v. GAF Corp., 389 F. Supp. 1379 (S.D. Tex. 1975). Accord, Kelley v. United States, 618 F.Supp. 1103 (W.D.Mich.1985) (groundwaters not part of the CWA jurisdictional term "waters of the United States".)

[43] Village of Oconomowoc Lake v. Dayton Hudson Corp., 24 F. 3rd 962,965 (7th Cir. 1994) ("Neither the Clean Water Act nor the EPA's definition asserts authority over ground waters, just because these may be hydrologically connected with surface waters. … The omission of ground waters from the regulations is not an oversight. Members of Congress have proposed adding ground waters to the scope of the Clean Water Act, but these proposals have been defeated, and the EPA evidently has decided not to wade in on its own. S.Rep. No. 414, 92d Cong., 1st Sess. 73 (1972). See also Exxon Corp. v. Train, 554 F.2d 1310, 1325-29 (5th Cir.1977) (recounting this history).")

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[55] Legal Envtl. Assistance Found., Inc. v. U.S. E.P.A., 118 F.3d 1467, 1471 (11th Cir. 1997).

[56]Id., 118 F.3d at 1478.

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[86] Anita Elash, French farmland tapped for oil, The World, December 24, 2010 http://www.theworld.org/2010/12/french-farmland-tapped-for-oil/
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[91] Id.

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[133] Id. at 14.

[134] http://www.shalegas.energy.gov/resources/081111_90_day_report.pdf

[135] Create a portal for access to a wide range of public information on shale gas development, to include current data available from state and federal regulatory agencies. The portal should be open to the public for use to study and analyze shale gas operations and results.

[136] Provide continuing annual support to STRONGER (the State Review of Oil and Natural Gas Environmental Regulation) and to the Ground Water Protection Council for expansion of the Risk Based Data Management System and similar projects that can be extended to all phases of shale gas development.

[137] Measures should be taken to reduce emissions of air pollutants, ozone precursors, and methane as quickly as practicable. Rigorous standards should be adopted for new and existing sources of methane, air toxics, ozone precursors and other air pollutants from shale gas operations, with these recommended actions:
(1) Enlisting a subset of producers in different basins to design and rapidly implement measurement systems to collect comprehensive methane and other air emissions data from shale gas operations and make these data publically available;
(2) Immediately launching a federal interagency planning effort to acquire data and analyze the overall greenhouse gas footprint of shale gas operations through out the lifecycle of natural gas use in comparison to other fuels; and
(3) Encouraging shale-gas production companies and regulators to expand immediately efforts to reduce air emissions using proven technologies and practices.

[138] A systems approach to water management should be adopted based on consistent measurement and public disclosure of the flow and composition of water at every stage of the shale gas production process. The following actions are

recommended for shale gas companies and regulators – to the extent that such actions have not already been undertaken by particular companies and regulatory agencies:
(1) Measure and publicly report the composition of water stocks and flow throughout the fracturing and clean-up process.
(2) Manifest all transfers of water among different locations.
(3) Adopt best practices in well development and construction, especially casing, cementing, and pressure management. Pressure testing of cemented casing and state-of-the-art cement bond logs should be used to confirm formation isolation. Microseismic surveys should be carried out to assure that hydraulic fracture growth is limited to the gas producing formations. Regulations and inspections are needed to confirm that operators have taken prompt action to repair defective cementing jobs. The regulation of shale gas development should include inspections at safety-critical stages of well construction and hydraulic fracturing.
(4) Additional field studies on possible methane leakage from shale gas wells to water reservoirs.
(5) Adopt requirements for background water quality measurements (e.g., existing methane levels in nearby water wells prior to drilling for gas) and report in advance of shale gas production activity.
(6) Agencies should review field experience and modernize rules and enforcement practices to ensure protection of drinking and surface waters.

[139] The risk of fracturing fluid leakage into drinking water sources through fractures made in deep shale reservoirs is remote. Nevertheless the there is no economic or technical reason to prevent public disclosure of all chemicals in fracturing fluids, with an exception for genuinely proprietary information. While companies and regulators are moving in this direction, progress needs to be accelerated in light of public concern.

[140] There is no technical or economic reason to use diesel in shale gas production and recommends reducing the use of diesel engines for surface power in favor of natural gas engines or electricity where available.

[141] Each relevant jurisdiction should pay greater attention to the combination of impacts from multiple drilling, production and delivery activities and make efforts to plan for shale development impacts on a regional scale. Possible mechanisms include:
(1) Use of multi-well drilling pads to minimize transport traffic and need for new road construction.
(2) Evaluation of water use at the scale of affected watersheds.
(3) Formal notification by regulated entities of anticipated environmental and community impacts.
(4) Preservation of unique and/or sensitive areas as off-limits to drilling and support infrastructure as determined through an appropriate science-based process.
(5) Undertaking science-based characterization of important landscapes, habitats and corridors to inform planning, prevention, mitigation and reclamation of surface impacts.
(6) Establishment of effective field monitoring and enforcement to inform ongoing assessment of cumulative community and land use impacts. Affected communities must have the opportunity to participate in this process and the rights of surface and mineral rights owners must be respected.

[142] Creation of a shale gas industry production organization dedicated to continuous improvement of best practice, defined as improvements in techniques and methods that rely on measurement and field experience, is needed to improve operational and environmental outcomes; a national approach could be used with regional mechanisms that recognize differences in geology, land use, water resources, and regulation, for which several different models are under discussion.
Activities relating to air and water deserve priority attention for developing best practices:
For Air: (a) Reduction of pollutants and methane emissions from all shale gas production/delivery activity.
(b) Establishment of an emission measurement and reporting system at various points in the production chain.
For Water: (a) Well completion – casing and cementing including use of cement bond and other completion logging tools.
(b) Minimizing water use and limiting vertical fracture growth.

[143]The public should expect significant technical advances associated with shale gas production that will significantly improve the efficiency of shale gas production and that will reduce environmental
impact. The move from single well to multiple-well pad drilling is one clear example. Given the economic incentive for technical advances, much of the R&D will be performed by the natural gas industry.

[144] *N.J. and France Ban Fracking While N.Y. Is About to Lift Fracking Moratorium*,
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[145] http://energyboom.com/policy/texas-passes-landmark-hydraulic-fracturing-legislation

[146] The industry's position was that voluntary compliance worked, and one of its chief examples was the website "FracFocus," at http://fracfocus.org, the hydraulic fracturing chemical registry website that was a joint project of the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission. This website was established to allow

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companies to voluntarily report the chemicals they used in the fracking process, thereby enabling the public to see what had been injected. In the recent report of the Department of Energy's SEAB Shale Gas Production Subcommittee, while the effort behind the FracFocus website was noted to be "off to a good start," the site itself was criticized as excluding information relevant to concerns over groundwater contamination and was presented in a way that prevented broad analysis of the chemicals. The SEAB Shale Gas Production Subcommittee Ninety-Day Report – August 11, 2011, http://www.shalegas.energy.gov/resources/081111_90_day_report.pdf;
Frack Panel to Industry: Fix Environmental Problems, August 11, 2011, New York Times, http://www.nytimes.com/gwire/2011/08/11/11greenwire-frack-panel-to-industry-fix-environmental-prob-20662.html?pagewanted=all

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