July 21, 2014

Via Electronic Filing - Online Comment Submission Form, http://energy.gov/fe/Procedures

RE: Proposed Procedures for Liquefied Natural Gas Export Decisions

Dear Department of Energy:

I am licensed to practice law in California and am a Visiting Assistant Law Professor at the University of Houston Law Center where I teach a seminar on the legal, policy and environmental aspects of global shale gas development and the role of liquefied natural gas (LNG) in global gas markets.

I have a LL.M. from Georgetown Law in International Trade and also teach a seminar on the WTO as an adjunct law professor at the University of San Francisco School of Law and am familiar with the international trade and WTO issues raised in the context of U.S. LNG exports. Prior to teaching, I was a commercial litigator in San Francisco and remain a member (inactive status) of the California Bar.

I am also the author of the most recent book on LNG entitled ENERGY FOR THE 21ST CENTURY: OPPORTUNITIES AND CHALLENGES FOR LIQUEFIED NATURAL GAS (LNG), which discusses the globalization of gas markets and the prospects for U.S. LNG exports in detail.[1]

I have previously expressed some of my views on U.S. LNG exports in a brief submitted to the U.S. Department of Energy (DOE), Office of Fossil Energy, in response to the NERA LNG Study.[2] In that brief, I analyzed the various arguments that had been raised by all parties and made a number of recommendations which I believed would allow DOE to fulfill its mandate to protect the "public's interest" while processing additional LNG export applications in a reasonable and prompt manner.

The primary recommendation I made in my earlier brief and the recommendation that I now re-iterate in response to the DOE's May 29, 2014 announcement and **Notice of Proposed Procedures for Liquefied Natural Gas Export Decisions** is that DOE should establish detailed procedures that address the unique and complex public interest concerns associated with LNG exports. A transparent and comprehensive procedure will ensure DOE fulfills its legal duty to "monitor the cumulative impacts" of each approved LNG export project. At the same time, a comprehensive procedure would provide greater regulatory certainty for the market and ensure that America is taking advantage of its newfound abundance of shale gas in the most beneficial manner.

DOE has proposed to suspend its current practice of issuing conditional authorizations for non-FTA applications and will instead make final public interest determinations only after a project has completed the environmental review process under the National Environmental Policy Act (NEPA). By removing the intermediate step of conditional decisions and setting the order of DOE decision-making based on readiness for final action, DOE will prioritize resources on more commercially advanced projects.

---

[1] Susan L. Sakmar, ENERGY FOR THE 21ST CENTURY: OPPORTUNITIES AND CHALLENGES FOR LIQUEFIED NATURAL GAS (LNG) (2013), Edward Elgar (Pub.),http://www.amazon.com/Energy-21st-Century-Opportunities-Environmental/dp/1849804214/ref=sr_1_1?ie=UTF8&qid=1397033918&sr=8-1&keywords=susan+sakmar

[2] U.S. Dept. of Energy, Office of Fossil Energy, LNG EXPORT STUDY - RELATED DOCUMENTS, http://energy.gov/fe/downloads/lng-export-study-related-documents.

DOE states the procedural change will improve the quality of information on which DOE makes its public interest determinations and will be better positioned to judge the cumulative market impacts of its authorizations in its public interest review.

While the proposed change offers some advantages over the existing procedure which was based on an "order of precedence" set by the DOE, the proposed procedural change also creates a new set of questions and concerns that must be addressed. For example, the proposed change will give priority to more commercially advanced projects. But commercial viability does not necessary mean approving the project is in the public's interest. Theoretically, all of the proposed LNG projects could be commercially viable and the majority of America's natural gas could be exported. It is doubtful that exporting most or all of America's natural gas is in the public's interest since this would foreclose other important opportunities to use more natural gas at home in manufacturing, transportation and power generation. It would also mean much higher energy costs for average American's. In this regard, I urge DOE to consider commercial viability as BUT one potential factor in the public interest analysis.

There are many other factors that DOE should also consider and the comments that this current process will solicit will no doubt raise many issues for consideration. Presumably, DOE intends to take all comments and develop a comprehensive approach for how it will decide the remaining LNG export applications consistent with its duty to monitor the cumulative impact of large scale LNG exports on the public's interest.

I especially commend DOE for stepping back to further analyze the impact large scale LNG exports will have on the public's interest now that over half of America's natural gas has been approved for export. Even if the DOE decided not to approve another LNG export project, with the volumes already approved and under contract, the U.S. will be one of the largest, if not THE largest, LNG exporter in the world. This is a remarkable turn of events from just a few years ago when the U.S. was expected to become one of the world's largest LNG importers. This demonstrates how quickly the market can change and for this reason, along with the reasons detailed below, I urge DOE to continue to conduct a thorough public interest determination for each successive export application to ensure that the legal requirements of the Natural Gas Act are met.

I. There Is No Need to Expedite LNG Exports Since the DOE Has Already Approved Over Half of Current U.S. Gas Production for Export

A. Free Trade Agreement (FTA) v. Non-FTA Countries

At the outset, it is important to note that under existing U.S. law, export applications to export to most free trade agreement (FTA) countries are deemed to be in the public interest and such applications are quickly authorized by the Department of Energy, Office of Fossil Energy (DOE/FE).[3]

Most, though not all, countries that have an FTA with the U.S. require national treatment for trade in natural gas, including Australia, Bahrain, Canada, Chile, Colombia, Dominican Republic, El Salvador, Guatemala, Honduras, Jordan, Mexico, Morocco, Nicaragua, Oman, Peru, Republic of Korea, Singapore and Panama.[4]

With the exception of the Republic of Korea, Chile, and Singapore, which is trying to establish an LNG trading hub, most of the FTA countries are not likely to be significant importers of LNG so the real prize for a company is the authorization to export LNG to any country, which the DOE refers to as "non-FTA"

[3] 15 U.S.C. § 717b (2006).

[4] For example, Costa Rica and Israel do not require national treatment for trade in natural gas. U.S. Dep't of Energy, *How to Obtain Authorization to Import and/or Export Natural Gas and LNG* (Sept. 26, 2012), http://www.fossil.energy.gov/programs/gasregulation/How_to_Obtain_Authorization_to_Import_an.html.

countries. Applications for export authorization to non-FTA countries involve greater scrutiny and under Section 3(a) of the Natural Gas Act (NGA), 15 U.S.C. § 717b, DOE performs a thorough public interest analysis before acting and is authorized to attach terms or conditions to orders that are necessary or appropriate to protect the public interest.

B. The DOE Has Already Approved A Significant Amount of Exports After Making A "Public Interest" Determination

Subsequent to the release of the NERA LNG Study, the DOE resumed its approval of LNG export applications to non-FTA countries (the applications for FTA approval had not been delayed by the NERA study). Consistent with the public interest requirement, the DOE continued to process the pending non-FTA application on a case-by-case basis, following the order of precedence previously established. While the DOE's case-by-case process has resulted in slower approvals than the industry would like and many have called for "expediting" even more exports,[5] **the DOE has in fact already approved over half of current U.S. natural gas production for export.**

As of June 11, 2014, the DOE has approved long-term applications to export over 37 Bcf/d of natural gas to FTA countries. To put this in perspective, 37 Bcf/d is 290 million metric tonnes per annum (MTPA) of LNG (using the DoE's conversion factor of 1 Bcf/d = 7.82 mtpa). This is around 50 MTPA more than was produced worldwide in 2012. **Perhaps most significant is the fact that 37 Bcf/d represents over half of current U.S. production of natural gas of approximately 70 Bcf/d.**

In terms of non-FTA approvals, the DOE crossed the psychologically significant 6 Bcf/d threshold when it approved Dominion's Cove Point Project, thereby cumulatively authorizing non-FTA exports totaling 6.4 Bcf/d. The 6 Bcf/d of non-FTA approvals was significant because most of the economic studies analyzing the impact of exports on the domestic price of natural gas have used a 6 Bcf/d minimum and 12 Bcf/d maximum.[6] In addition to Dominion (.77 Bcf/d), the non-FTA approvals are Cheniere's Sabine Pass (2.2 Bcf/d), Freeport's first application (1.4 Bcf/d), Lake Charles Exports (2.0 Bcf/d), Freeport's second application, (0.4 Bcf/d), Cameron (1.7 Bcf/d) and most recently, Jordan Cove (0.8 Buff/d).[7]

As of June 11, 2014, the amount of non-FTA export approval is 9.27 Bcf/d or approximately 72 MTPA, which is a massive amount of LNG.[8] To put this in perspective, the world's largest LNG exporter is Qatar, with current export capacity of 77 MTPA. Australia has numerous LNG export projects under construction and is expected to meet or exceed Qatar's LNG export capacity by the end of the decade. Even if just a fraction of the proposed U.S. LNG export capacity came to fruition, the U.S. will rival both Qatar and Australia in terms of exports.

---

[5] There is no dispute that the current process is less than ideal which has led to some, including myself, to suggest that a rulemaking would be appropriate. Susan L. Sakmar, What's Next for US LNG Exports – A Rulemaking?, Gastech News, http://www.gastechnews.com/lng/whats-next-for-us-lng-exports-a-rulemaking/.

[6] See, U.S. Energy Info. Admin., Effect of Increased Natural Gas Exports on Domestic Energy Markets (Jan. 2012), *available at* http://www.eia.gov/analysis/requests/fe/pdf/fe_lng.pdf, Deloitte MarketPoint LLC and the Deloitte Ctr. for Energy Solutions, *Made in America: The economic impact of LNG exports from the United States* (Dec. 2011), *available at* http://www.deloitte.com/assets/DcomUnitedStates/Local%20Assets/Documents/Energy_us_er/us_er_MadeinAmerica_LNGPaper_122011.pdf, Charles Ebinger et al., Brookings Institution Energy Security Initiative, *Liquid Markets: Assessing the Case for U.S. Exports of Liquefied Natural Gas* (May, 2012), *available at* http://www.brookings.edu/research/reports/2012/05/02-lng-exports-ebinger.

[7] Summary of LNG Export Applications, http://energy.gov/fe/downloads/summary-lng-export-applications.

[8] Most of the applicants seeking authorization to export LNG from proposed facilities to FTA countries have also filed to export LNG to non-FTA countries in the same volume from the same facility to provide optionality on the final destination country. The volumes of the application to export to FTA countries and non-FTA countries are therefore not additive.

Under DOE's prior policy framework, DOE had signaled and the market had largely accepted there would be a "soft cap" of 12 Bcf/d of non-FTA approvals, after which a pause might take place. While DOE has never announced a cap of any kind, the NERA study focused on exports of 12 Bcf/d maximum, which gives rise to the assumption that once this threshold is reached, new studies are warranted. DOE's current announcement that it planes to undertake an economic study to assess the impact of exports between 12 and 20 Bcf/d is therefore a positive development. The DOE has also indicated it will use more recent data from the EIA.

While these studies are underway, the DOE has indicated it will continue to act on applications. **Since the new studies are critical to the public interest analysis, the proper course of action would be for DOE to suspend review of all remaining pending applications subject to the release of the new studies.** DOE has already conditionally approved 9.27 Bcf/d but has issued final approval for just one project - Cheniere's Sabine Pass Liquefaction project (2.2 Bcf/d). Suspending review of the remaining projects would ensure that the 12 Bcf/d threshold is not exceeded pending the outcome of the new studies. Alternatively, DOE should clarify exactly how it intends to proceed on the conditionally approved and pending applications while awaiting the release of the new economic studies. DOE should also provide a time frame for the studies.

C. The Market Has Responded and a Significant Amount of LNG Exports is Under Contract

It is my understanding that most, if not all, of the volumes authorized for the non-FTA projects have already been contracted out to buyers, or "off takers" although Cheniere's Sabine Pass project is the only project currently under construction. The significance of committed off takers should not be overlooked since this means it is likely that **ALL** of the approved non-FTA projects will take final-investment-decision (FID) and move forward. The fact that all of the current non-FTA projects, with the exception of Jordan Cove, are already existing import terminals also makes it more likely that the project will move forward since these projects will be less expensive than new Greenfield projects.

A deeper understanding of the amount of supply under contract for non-FTA projects should be obtained before more exports are approved. While the larger non-FTA projects have garnered the most attention in the media, a deeper understanding of whether the numerous FTA only projects are likely to be viable should also be obtained. Many of these FTA only projects are seeking to ship LNG via ISO container and as a result, do not require the massive infrastructure and capital expenditures as the larger non-FTA projects. While the volumes for the FTA only projects are small on an individual basis, the cumulative volume is significant and could be a surprise to the upside in terms of exports if more go forward than realized.

D. The "Public Interest" Test Must Be Maintained to Achieve the Primary Purpose of the Natural Gas Act – To Protect Consumers

With a large volume of LNG exports already approved and under contract, I commend DOE for now taking the time to focus on the potential impacts of exporting a much greater volume of LNG exports than previously contemplated and analyzed. There is no doubt that regulation of natural gas in the United States has experienced many years of regulatory evolution. But the primary purpose of the Natural Gas Act (NGA) has essentially remained the same for decades – "protection of consumers against exploitation at the hands of natural-gas companies."[9]

In the context of U.S. LNG exports, the protection of consumers is delegated to the DOE who has

[9] Robert R. Nordhaus, *Producer Regulations and the Natural Gas Policy Act of 1978*, Natural Resources Journal (1979), citing Phillips Petroleum Co. v. Wisconsin, 347 U.S. 672, 689 (1954).

indicated that it will continue to take a "measured approach" in reviewing the pending export applications and will continue to assess the cumulative impacts of each succeeding request for export authorization on the public interest with due regard to the effect on domestic natural gas supply and demand fundamentals. Going forward, the DOE should continue to proceed with caution in approving additional export projects for several valid reasons that the DOE has articulated:

1. The LNG Export Study, like any study based on assumptions and economic projections, is inherently limited in its predictive accuracy,

2. Applications to export significant quantities of domestically produced LNG are a new phenomena with uncertain impacts, and

3. The market for natural gas has experienced rapid reversals in the past and is again changing rapidly due to economic, technological, and regulatory developments.

In short, the DOE has correctly recognized that ***"The market of the future very likely will not resemble the market of today."***[10] As such, it is paramount that DOE maintain the current public interest determination since this is the best way to ensure vigilant protection of the public's interest in times of significant market fluctuations, which seems to characterize the U.S. natural gas markets

Numerous parties have already raised concerns about allowing unlimited LNG exports, including industrial users of natural gas and consumer focused trade associations such as APGA and America's Energy Advantage (AEA). With such significant volumes of gas now approved for exports, these concerns should be prioritized since the overarching policy goal is to harness America's new found abundance of shale gas not JUST for export, but for other opportunities in manufacturing, transportation and domestic consumption.

II. Environmental Impacts of Large Scale LNG Exports

To better inform the Department and the public of the environmental impacts of increased LNG exports, DOE elected to prepare two additional reports of environmental issues beyond what is required for NEPA. The Department released the *Draft Addendum To Environmental Review Documents Concerning Exports Of Natural Gas From The United States*.

A. Draft Addendum - Environmental Impacts of Shale Gas Development

The DOE has indicated that comments on the Draft Addendum will be considered in preparation of the Final Addendum. Once final, the Addendum, along with other environmental information, will be considered by the Department in its public interest determinations in connection with applications to export LNG to non-FTA countries.

At the outset, I note that this appears to be an expansion of what DOE has considered in approving LNG exports thus far and it is not clear how DOE will use the environmental information in its public interest determination. The devil will be in the details of the procedures DOE develops to incorporate the myriad of environmental issues raised by shale gas development into its public interest determination. Since these details are not yet known, my comments are more generally focused on the environmental issues DOE should consider – most of which were raised in the Draft Addendum. Many environmental groups will no doubt provide more expert analysis on the environmental issues with particular focus most likely

[10] Order No. 3324 Conditionally Granting Long-Term Multi-Contract Authorization To Export Liquefied Natural Gas By Vessel From The Lake Charles Terminal To Non-Free Trade Agreement Nations, http://energy.gov/fe/downloads/fe-docket-no-11-59-lng.

to be on the complicated issue of how to measure and account for methane emissions.

By most accounts, the vast shale gas reserves found throughout the world offer an unprecedented opportunity to meet growing energy demand in a cleaner and more sustainable manner. While the economic and energy security benefits of shale gas development could be substantial for many areas, the evolving environmental, social and regulatory responses to shale gas development continue to challenge the industry.

While there is a widely held view within the industry that shale gas resources can be developed in a safe and environmentally sound manner, the public and policy leaders in many areas remain sceptical. Since shale gas development is a global opportunity, there is a growing need to coordinate and share lessons learned and best practices on a global scale to ensure that the opportunity is not just limited to some areas of the world. **In this regard, I urge DOE to consider lessons learned and environmental studies from not just the United States but from around the world**. For example, there are lessons to be learned from the two fracking related earthquakes in England as well as other incidents in other countries such as Canada and Australia.

Thus far, the most serious risks related to shale gas development center around the following:

1. The water lifecycle - from water acquisition to disposal;
2. The risk of water contamination and well integrity issues;
3. Disclosure of chemicals used in hydraulic fracturing fluids;
4. Induced seismicity (earthquakes);
5. Methane emissions from shale gas production, and
6. Public health issues.

1. The Water Lifecycle For Shale Gas Development

By far one of the most critical issues related to shale gas development pertains to what the US Environmental Protection Agency (EPA) has called the water lifecycle. At the request of the US Congress, the US EPA is conducting a study to better understand any potential impacts of hydraulic fracturing on drinking water and ground water.[11]

The scope of the EPA's research includes the full lifecycle of water use 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.

This study is significant because to date, it is the most comprehensive study being undertaken on the impact of hydraulic fracturing on water and the findings may be useful to inform decisions around the world. The EPA's first progress report was released in December 2012.[12] A final draft report is expected to be released for public comment and peer review in 2014. In the meantime, a number of issues have been raised and are in the process of being studied.

Water Acquisition Issues

With many countries facing acute water shortages, concerns have been raised pertaining to the large volumes of water needed during the hydraulic fracturing process. According to a report issued by the U.S. Geological Survey (USGS) pertaining to water resources and gas production in the Marcellus Shale,

[11] US Environmental Protection Agency (US EPA), *EPA's Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources* ***http://www.epa.gov/hydraulicfracturing*****.**
[12] US EPA, http://www2.epa.gov/hydraulicfracturing

"many regional and local water management agencies [in the Marcellus shale region] are concerned about where such large volumes of water will be obtained, and what the possible consequences might be for local water supplies."[13]

Chesapeake Energy Corp., one of the most active drillers in the Marcellus shale,[14] candidly admits water is an essential component of its deep shale gas development. According to the company, "fracturing a typical Chesapeake Marcellus horizontal deep shale gas well requires an average of five and a half million gallons per well." Industry generally maintains that water resources are protected through stringent state, regional and local permitting processes and in comparison to other uses, deep shale gas drilling and fracturing uses a small amount of water. According to Chesapeake, 5.6 million gallons of water is equivalent to the amount of water consumed by New York City in eight minutes, a 1,000 mega-watt coal-fired power plant in 13 hours, a golf course in 28 days, or nine acres of corn in a season.[15] Nonetheless, whether or not a particular location has the water resources to support shale gas development is a critical issue and consultation with the appropriate water management agencies is essential.

Water Disposal Issues – Flowback Water

Related to the issue of how much water is needed for shale gas development is the issue of how to dispose of the water that is returned to the surface as "flowback" water. While some of the injected hydraulic fracturing fluids remain trapped underground, the majority—sixty to eighty percent returns to the surface as "flowback." The USGS has noted that because the quantity of fluids is so large, the additives in a 3-million gallon frac job would yield about 15,000 gallons of chemicals in the flowback water, making wastewater disposal a significant challenge for many regions.

The US EPA has noted that wastewater associated with shale gas extraction can contain high levels of total dissolved solids (TDS), fracturing fluid additives, metals, and naturally occurring radioactive materials. The EPA is currently examining the different disposal methods used by the industry to ensure that there are regulatory and permitting frameworks in place to provide for the safe disposal of flowback and produced water. In general, wastewater in the US is disposed of in one of several ways:[16]

> **Underground injection**: In many regions of the US, underground injection is the most common method of disposing of fluids or other substances from shale gas extraction operations. Disposal of flowback and produced water via underground injection is regulated under the Safe Drinking Water Act's Underground Injection Control (UIC) Program.[17]
>
> **Wastewater discharges to treatment facilities**: Shale gas wastewater is often transported to treatment plants or private centralized waste treatment facilities for disposal. In the US, a number of concerns have been raised that many treatment facilities may not be equipped to properly treat such wastewater. As a result, the EPA is currently developing national standards for wastewater treatment with plans to solicit public comment for a proposed rule for shale gas in 2014.

---

[13] DANIEL J. SOEDER & WILLIAM M. KAPPEL, WATER RESOURCES AND NATURAL GAS PRODUCTION FROM THE MARCELLUS SHALE 3–4 (2009) http://pubs.usgs.gov/fs/2009/3032/pdf/FS2009-3032.pdf.

[14] Press Release, *Chesapeake Energy, Chesapeake Energy Corporation Confirms Decision Not to Drill for Natural Gas in the New York City Watershed* (Oct. 28, 2009) *available at* http://www.chk.com/news/articles/pages/1347788.aspx.

[15] *Fact Sheet: Water Use in Marcellus Deep Shale Gas Exploration*, CHESAPEAKE ENERGY (2010), http://www.chk.com/media/marcellusmediakits/marcellus_water_use_fact_sheet.pdf [hereinafter CHESAPEAKE ENERGY, *Water Use*].

[16] US EPA, http://www2.epa.gov/hydraulicfracturing.

[17] Safe Drinking Water Act, 42. U.S.C. § 300f (2005). The SDWA is the primary US federal law for protecting public water supplies from harmful contaminants.

Recycling of wastewater: Some drilling operators are electing to re-use a portion of the wastewater for a future well or to re-fracture the same well. The ability to re-use waste water is in part dependent on the levels of pollutants in the wastewater and the proximity of other fracturing sites that might re-use the water.

Surface impoundments (pits or ponds): In some cases, operators use surface storage tanks and/or pits to temporarily store hydraulic fracturing fluids for re-use. The US EPA is currently evaluating industry practices and is considering the need for technical guidance on the design, operation, maintenance, and closure of pits to minimize potential environmental impacts. Some states now require that all surface pits be lined with some sort of protective barrier.

2. The risk of water contamination and well integrity issues

In the United States and elsewhere, much of the public debate surrounding hydraulic fracturing has centered on whether "fracking" can lead to water contamination. In many cases, the concerns raised are whether the fracturing process could create or extend fractures linking the producing zone to an overlying aquifer and, thus, provide a pathway for gas or fracturing fluids to migrate. However, in most shale formations, the vertical distance separating the target zone from usable aquifers is usually much greater than the length of the fractures induced during hydraulic fracturing. Thousands of feet of rock layers typically overly the produced portion of the shale, and these layers serve as barriers to flow.

Consequently, most regulators and geologists generally consider there to be only a remote possibility that a fracture could extend to a potable aquifer. However, if the shallow portions of shale formations were developed, then the thickness of the overlying rocks would be less and the distance from the shale to potable aquifers would be shorter, posing more of a risk to groundwater.[18]

To date there is no confirmed case that the hydraulic fracturing process itself has led to water contamination although a possible link has been raised in one case that is still under review in Pavillion, Wyoming. On December 8, 2011, the U.S. Environmental Protection Agency (EPA) issued a draft report on its investigation of groundwater contamination near the town of Pavillion, Wyoming after residents of Pavillion petitioned EPA, asking the agency to investigate whether groundwater contamination exists, its extent, and possible sources.[19] The draft report indicated that EPA had identified certain constituents in groundwater above the production zone of the Pavillion natural gas wells that are consistent with some of the constituents used in natural gas well operations, including the process of hydraulic fracturing.

Because the EPA's draft report linked groundwater contamination in the deeper portions of the aquifer to activities related to hydraulic fracturing, it raised concerns about hydraulic fracturing practices in general and attracted a lot of attention in the US. As a result, numerous organizations representing the oil and gas industry and other stakeholders took issue with some of the findings in the draft report, and questioned the scientific validity of EPA's contention.[20]

---

[18] Mary Tiemann and Adam Vann, Congressional Research Service (CRS) Report for Congress, "Hydraulic Fracturing and Safe Drinking Water Act Issues," R41760, July 12, 2012, www.crs.gov.

[19] U.S. Environmental Protection Agency, Region 8 and Office of Research and Development, National Risk Management Research Laboratory, (Draft) Investigation of Ground Water Contamination near Pavillion, Wyoming, EPA 600/R-00/000, December 2011, http://www.epa.gov/region8/superfund/wy/pavillion/EPA_ReportOnPavillion_Dec-8-2011.pdf.

[20] Peter Folger, Mary Tiemann and David M. Bearden, Congressional Research Service (CRS) Report for Congress, "The EPA Draft Report of Groundwater Contamination Near Pavillion, Wyoming: Main Findings and Stakeholder Responses," R42327, Jan. 25, 2012, www.crs.gov.

As a result of the intense scrutiny of the Pavillion investigation, EPA initially decided to extend the public comment period for the draft research report on Pavillion until September 30, 2013.[21] However, in June 2013, EPA announced that it would be supporting the State of Wyoming in its further investigation of drinking water quality in the rural area east of Pavillion, Wyoming. While EPA indicated that it stood behind its work and data, EPA also indicated that does not plan to finalize or seek peer review of its draft Pavillion groundwater report released in December 2011.[22]

The sampling data obtained throughout EPA's groundwater investigation will be considered in Wyoming's further investigation, and EPA will have the opportunity to provide input to the State of Wyoming and recommend third-party experts for the State's consideration. The State intends to conclude its investigation and release a final report by September 30, 2014.

While the Pavillion case remains under review by the state of Wyoming, the general consensus that seems to have emerged is the greater risk for groundwater contamination is related to the process of developing a natural gas or oil well (drilling through an overlying aquifer, and casing, cementing and completing the well). Incidents of well water contamination attributed to hydraulic fracturing, typically have been found to be caused by problems with the well casing or cementing. In some states, such as Pennsylvania, regulators have confirmed that methane had migrated to water wells and that the gas migration was caused by improperly cased and cemented wells, as well as excessive pressures in some cases. The challenge of sealing off the groundwater and isolating it from possible contamination is common to the development of any oil or gas well, not only those that rely on hydraulic fracturing. Nonetheless, given the higher pressures and large volumes of water used in hydraulic fracturing, a number of states have revised well casing, cementing, pressure testing and other requirements to protect water resources.[23]

Another primary concern involves the potential contamination of ground water from surface activities such as accidental or careless surface disposal of drilling fluids. Other potential water quality issues involve the management (storage, treatment and disposal) of water produced in the fracturing process.

3. Disclosure of chemicals used in hydraulic fracturing fluids

A key component to hydraulic fracturing is the high-pressure injection of hydraulic fracturing fluids that increases the permeability of the rock by "propping up" or holding open the fractures. According to the industry, fracturing fluid is a mixture of about 90% water, 9.5% sand, and 0.5% other chemicals.[24]

Although water is the main component of hydraulic fracturing fluids, a number of additives and chemicals are also used, the number varying based on the conditions of the specific well being fractured and thus no "one-size fits all formula for the volumes for each additive." The chemical additives used include "common chemicals which people regularly encounter in everyday life" as well as "chemical additives that could be hazardous, but are safe when properly handled." The service companies that provide these additives have developed a number of different combinations to be used depending on the well characteristics.[25]

---

[21] EPA Pavillion Groundwater Investigation, http://www.epa.gov/region8/superfund/wy/pavillion/
[22] EPA Pavillion Groundwater Investigation, http://www2.epa.gov/region8/pavillion.
[23] Mary Tiemann and Adam Vann, Congressional Research Service (CRS) Report for Congress, "Hydraulic Fracturing and Safe Drinking Water Act Issues," R41760, July 12, 2012, www.crs.gov.
[24] AM. PETROLEUM INST., FREEING UP ENERGY, HYDRAULIC FRACTURING: UNLOCKING AMERICA'S NATURAL GAS RESOURCES 5 (2010), http://www.api.org/~/media/Files/Policy/Exploration/HYDRAULIC_FRACTURING_PRIMER.ashx [hereinafter API FREEING UP ENERGY].
[25] Id. At 61-62.

As shale gas development increased in the United States, there were growing calls for the industry to disclose the chemicals used in hydraulic fracturing fluids. In addition to public calls for disclosure, various members of the US Congress through the US Subcommittee on Energy and Environment also requested this information from oil and gas companies with companies ultimately complying.[26]

More recently, there is a growing trend in the US towards requiring companies to disclose the chemicals used in hydraulic fracturing with a number of states now requiring disclosure and more states likely to follow this trend. Some states require or allow for the disclosure via FracFocus, which is a web-based national registry where companies can disclose the chemical additives used in the hydraulic fracturing process on a well-by-well basis.[27] Canada has a similar website and other countries are considering something similar for disclosure which is likely to be required in most countries.

4. **Induced Seismicity – Earthquakes**

To date, the most significant research pertaining to hydraulic fracturing and induced seismicity comes from the experiences of the United Kingdom (UK) and United States. In April and May of 2011, two earthquakes with magnitudes 2.3 and 1.5 occurred in the UK in an area where Cuadrilla Resources was hydraulically fracturing for shale gas at their Preese Hall site in Lancashire. Operations were suspended and Cuadrilla submitted a geotechnical report, which concluded that the tremors were caused by fracking. The UK suspended all shale gas activity pending review of the incident.[28]

Following a detailed study and further analysis by an independent panel of experts commissioned by the DECC, along with public feedback and the benefit of a report by the Royal Society and Royal Academy of Engineering,[29] the UK Government ultimately concluded that the seismic risks associated with fracking can be managed effectively with proper controls in place.[30] These controls include:

- A prior review before fracking begins must be carried out to assess seismic risk and the existence of faults;
- A fracking plan must be submitted to DECC showing how seismic risks will be addressed;
- Seismic monitoring must be carried out before, during and after fracking; and
- A new traffic light system to categorize seismic activity and direct appropriate responses, including a trigger mechanism, which will stop fracking operations in certain conditions.

Induced Seismicity Caused By Disposal

[26] Letter from Rep. Henry A. Waxman, Chairman, Comm. on Energy and Commerce, to 10 Oil and Gas Companies (July 19, 2010), *available at* http://energycommerce.house.gov/documents/20100719/Letters.Hydraulic.Fracturing.07.19.2010.pdf

[27] FracFocus, www.fracfocus.org.

[28] UK DEEC, "New controls announced fro shale gas exploration," Dec. 13, 2012, https://www.gov.uk/government/organisations/department-of-energy-climate-change.

[29] The leading engineering and science bodies in the UK, the Royal Academy of Engineering and the Royal Society carried out an independent review of the health, safety and environmental risks associated with hydraulic fracturing for shale gas. Their central conclusion is that the risks can be managed effectively in the UK so long as operational best practices are implemented, and enforced through regulation. The Royal Society, Shale Gas Extraction Report, June 2012, http://royalsociety.org/policy/projects/shale-gas-extraction/report.

[30] UK DEEC, "New controls announced fro shale gas exploration," Dec. 13, 2012, https://www.gov.uk/government/organisations/department-of-energy-climate-change.

In the United States, a recent report by the National Research Council (NRC) noted that induced seismicity can be caused by a range of activities that involve disposal or storage by injection deep into the ground and that this has been known since the 1920s with respect to geothermal energy and carbon capture and storage. That report concluded that the process of hydraulic fracturing poses a low risk for inducing earthquakes and notes that over 35,000 wells have been hydraulically fractured for shale gas in the US.[31]

The NRC report, as well as some recent work done by the US Geological Survey, concluded that there is a greater risk of earthquakes from the use of injection wells used for the disposal of wastewater in oil and gas development. In the US, there are approximately 150,000 Class II injection wells, which include about 40,000 waste fluid disposal wells for oil and gas operations. A small number of these disposal wells have induced earthquakes that are large enough to be felt and could cause damage – these are generally earthquakes of magnitude 4.0 or higher. There has also been an uptick in seismic activity in the US in areas with significant shale gas development, such as Oklahoma, and additional research is being undertaken.[32]

5. Methane Emissions

It is generally recognized that natural gas has about half of the CO_2 emissions of coal. But, as noted in the IEA's Golden Rules report, shale gas has higher production related greenhouse gas emissions than conventional gas due to more wells being needed per cubic meter of gas production and more venting or flaring during well completion.

In its report, the IEA noted that the estimation of greenhouse gas emissions from shale gas production has been the subject of much controversy, which stems primarily from a study by Professor Robert W. Howarth from Cornell University.[33] The Howarth Study evaluated the greenhouse gas footprint of natural gas obtained by high-volume hydraulic fracturing from shale formations, focusing on methane emissions.

That study found that 3.6% to 7.9% of the methane from shale-gas production escapes to the atmosphere in venting and leaks over the life-time of a well and that these methane emissions are at least 30% more than and perhaps more than twice as great as those from conventional gas. The study further found that the higher emissions from shale gas occur at the time wells are hydraulically fractured—as methane escapes from flow-back return fluids—and during drill out following the fracturing.

The study noted that methane is a powerful greenhouse gas with a global warming potential that is far greater than that of carbon dioxide, particularly over the time horizon of the first few decades following emission. As a result, the study found that the greenhouse gas footprint for shale gas is greater than that for conventional gas or oil when viewed on any time horizon, but particularly so over 20 years. Compared to coal, the footprint of shale gas is at least 20% greater and perhaps more than twice as great on the 20-year horizon and is comparable when compared over 100 years.

The IEA Golden Rules report also noted that methane is a more potent greenhouse gas than CO2 but has a shorter lifetime in the atmosphere and as a result there are various ways to compare the effect of methane and CO2 on global warming – including evaluating the Global Warming Potential of methane. While noting that methane emissions from the gas chain come from a number of sources including venting and

[31] National Academies, *Induced Seismicity Potential in Energy Technologies*, www.nationalacademies.org.
[32] Joe Eaton, "Scientists Say Oil Industry Likely Caused Largest Oklahoma Earthquake," National Geographic News, March 29, 2013, http://news.nationalgeographic.com/news/energy/2013/03/130329-wastewater-injection-likely-caused-quake/.
[33] Howarth R, Santoro T, and Ingraffea A *Methane and the greenhouse gas footprint of natural gas from shale formations*. Climatic Change (2011). available at http://www.springerlink.com/content/e384226wr4160653/.

fugitive emissions, the IEA also indicated that these emissions are VERY difficult to quantify. It should be noted that the Howarth study has been refuted by other studies including a commentary that is widely cited by the industry that disagreed with the underlying assumptions in the Howarth study.[34] A number of research activities are underway with various groups conducting a number of emissions related studies.[35]

6. Public Health Issues

Assessment of the health impacts of hydraulic fracturing and shale gas development is at just starting, in part due to the "novelty of the practice at the current scale"[36] and in part due to a scarcity of funding for large-scale studies.[37] While the science is far from settled, there is a growing body of research to consider, especially coming from the United States where the rapid increase in shale gas development during the past decade has brought wells and related infrastructure closer to population centers.

Thus far, the main risks related to public health include air emissions and indirect impacts in terms of potential water pollution, some being recognized as carcinogens. Water contamination can also lead to contamination of live animals, food and feed. Worksite health hazards include silica hazards, handling of chemicals, exposure to diesel particulate and exhaust gases from equipment as well as high noise levels.

Overall, the current literature suggests that there is the potential for a variety of health disorders resulting from gas extraction and that the potential may not be just limited to the immediate vicinity of the well since polluted air can be carried up to 200 miles from its source by prevailing winds.[38] The health effects may be acute and immediate or chronic and not apparent for many years. Young children, the elderly and pregnant women are at greater risks.[39]

At least one study of air sampling has concluded that the greatest potential for health impacts from airborne chemicals occurs during the well completion period, when condensate tanks are vented during filling, and methane flared off. The estimated potential for health risks, based on exposures to air pollutants, was found to be grater for people living closest to the site.[40]

For its part the industry has largely dismissed the studies done to date and considers them to be "largely anecdotal and less than convincing."[41] Departments of Health are involved in two states, New York and Maryland, after regulators responded to the public's insistence on public health and environmental reviews before allowing shale gas development. These two states currently have a moratorium on shale

---

[34] Lawrence M. Cathles III, Larry Brown, Milton Taam, Andrew Hunte, A commentary on "The greenhouse-gas footprint of natural gas in shale formations" by R.W. Howarth, R. Santoro, and Anthony Ingraffea, Climatic Change (2012) available at http://link.springer.com/article/10.1007%2Fs10584-011-0333-0.

[35] Environmental Defense Fund, *Methane Leakage*, http://www.edf.org/methaneleakage.

[36] European Commission, *Communication from the Commission to the Council and the European Parliament on the exploration and production of hydrocarbons (such as shale gas) using high volume hydraulic fracturing in the EU,* Brussels, 22.1.2014, available at http://ec.europa.eu/environment/integration/energy/unconventional_en.htm.

[37] Naveena Sadasivam, Drilling for Certainty: The Latest in Fracking Health Studies, ProPublica, March 5, 2014, available at http://www.propublica.org/article/drilling-for-certainty-the-latest-in-fracking-health-studies.

[38] The League of Women Voters of Pennsylvania, *Shale Gas extraction and Public Health*, 2013 Addendum, http://shale.palwv.org/wp-content/uploads/2013/12/846114-League-of-Women-Voters-Shale-Resource-Guide.pdf.

[39] The League of Women Voters of Pennsylvania, *Shale Gas extraction and Public Health*, 2013 Addendum, http://shale.palwv.org/wp-content/uploads/2013/12/846114-League-of-Women-Voters-Shale-Resource-Guide.pdf.

[40] Mckenzie, LM., Witter, R.Z., Newman, L.S., and Adgate, J.L., *Human Health Risk Assessment of Air Emissions from Development of Unconventional Natural Gas Resources*, Science of the Total Environment, http://cogcc.state.co.us/library/setbackstakeholdergroup/Presentations/Health%20Risk%20Assessment%20of%20Air%20Emissions%20From%20Unconventional%20Natural%20Gas%20-%20HMcKenzie2012.pdf

[41] Naveena Sadasivam, Drilling for Certainty: The Latest in Fracking Health Studies, ProPublica, March 5, 2014, available at http://www.propublica.org/article/drilling-for-certainty-the-latest-in-fracking-health-studies.

gas development pending public health studies. Other countries are looking into the impact on public health with a recent study from the United Kingdom finding that the risks to public health from emissions caused by hydraulic fracturing are low as long as operations are properly run and regulated.[42]

III. Life Cycle Greenhouse Gas Perspective of LNG Exports

The Department also released the *Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States*. The LCA GHG Report and public comments received in response thereto will be considered by the Department in its public interest determinations in connection with applications to export LNG to non-FTA countries.

The purpose of the LCA GHG is to inform the public and DOE on the life cycle greenhouse gas (GHG) emission of U.S. LNG exports for use in electric power generation. The LCA GHG Report compares the life cycle GHG emission from U.S. LNG exports to regional coal and other imported natural gas for electric power generation in Europe and Asia.

The study is problematic for several reasons. As a preliminary issue, it is not clear how or why the study questions were limited to the following:

1) Does export liquefied natural gas (LNG) from the U.S. to European or Asian markets for power production result in increased global GHG emissions from a life cycle analysis perspective compared to power production from regional coal?
2) How do these results compare with natural gas sourced from Russia and delivered to the same European and Asian markets via pipeline?

There seems to be no basis for the assumption that exported U.S. LNG would necessarily displace coal in Europe or Asia. In fact, in some cases, exported U.S. LNG might actually displace nuclear or renewables, which would certainly make U.S. LNG the higher emissions fuel source. This is precisely what has happened in Japan, the world's largest LNG importer. After the Fukushima tragedy that led to the shut down of virtually all of Japan's nuclear power, Japan imported record amounts of LNG. A more relevant study might be to compare Japan's emissions both before and after Fukushima. Similarly, Germany and other countries have backed away from nuclear power after Fukushima and the impact on emissions from switching to natural gas should be considered.

In addition to the flaw in the study questions, it is far from clear whether emissions should be measured on a global basis or not. In my recently published book on the global LNG industry, *Energy for the 21st Century: Opportunities and Challenges for LNG*, I addressed this question but found there was very little research on this issue. Most of the research pertaining to emissions from LNG is related to the massive LNG project underway in Australia. These projects should be reviewed and emissions data incorporated into DOE's analysis.

My research revealed one study from Worley Parson's referenced in the Wheatstone Draft EIA. The study, entitled, "Greenhouse Gas Emissions Study of Australian LNG, "provides a comparison of Australian LNG versus Australian black coal in terms of lifecycle greenhouse gas emissions, which includes the entire process from extraction and processing in Australia through to an end use of combustion in China for power generation.[43] In general, the study found that the displacement of coal

[42]Kate Kelland, *Shale gas fracking a low risk to public health – UK review*, Reuters, Oct. 31, 2013, http://www.reuters.com/article/2013/10/31/us-britain-health-fracking-idUSBRE99U0KX20131031.

[43] WorleyParsons, WOODSIDE ENERGY LIMITED GREENHOUSE GAS EMISSIONS STUDY OF AUSTRALIAN LNG**,** Originally prepared August 7, 2008, Modified for public release, March 2011, available at

with LNG for use for power generation in China results in substantial reductions globally in greenhouse emissions, albeit at the expense of some additional Australian greenhouse emissions.

While the measurement of emissions on a global basis has some merit, it is far from clear that this is the consensus view. In addition, it is clear from several prominent studies, such as the IEA's Golden Age of Gas Report, that absent additional actions, the world's increased use of natural gas will not result in the globally agreed upon reduction of greenhouse gas emissions.

Conclusion

For the reasons stated above, I urge DOE to continue to apply its public interest determination on a case-by-case basis and to incorporate the comments it receives into its future analysis of the pending LNG export projects. The DOE has already approved half of America's natural gas production for export so there is no compelling reason to expedite even more exports without waiting for the new economic studies and after careful consideration of all of the comments submitted. **Caution is particularly warranted since the export of U.S. LNG is merely an arbitration opportunity for energy companies and energy traders.**

As trading companies have emerged from relative obscurity to become formidable players in global energy markets, there is a growing need for policy makers to understand the full implications of who owns the natural gas production in the U.S., how it will be traded and by whom, and where America's natural gas is likely to go if unfettered LNG exports are permitted.

It should be abundantly clear that energy companies and energy traders have every incentive to export every single drop of America's natural gas to the highest bidder. If this is the outcome, as I believe it could be if LNG exports are expedited and allowed without any limits, then policy makers should be prepared to explain to American voters why this is in the "public's interest" or why they failed to miss the warning signs.[44]

Respectfully submitted,

Susan L. Sakmar

Email: susansakmar@globalgaslaw.com
www.susansakmar.com
Twitter: @SusanSakmar

http://www.woodside.com.au/ourapproach/climatechange/documents/worleyparsons%20(2008)%20greenhouse%20gas%20emissions%20study%20of%20australian%20lng.pdf.

[44] If the financial crisis of 2008 taught us anything, it is that policy makers must not ignore warning signs and must not fail to question, understand and manage evolving risks within a system essential to the well being of the American people. *Conclusions of the Financial Crisis Inquiry Commission*, http://fcic.law.stanford.edu/report.