UNCONVENTIONAL BRIDGES OVER TROUBLED WATER – LESSONS TO BE LEARNED FROM THE CANADIAN OIL SANDS AS THE UNITED STATES MOVES TO DEVELOP THE NATURAL GAS OF THE MARCELLUS SHALE PLAY

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Synopsis: As North America's energy demands grow in the face of diminishing conventional fossil fuel resources, unconventional oil and gas figures to play an increasingly important role. This article assesses two important unconventional fossil fuel deposits, namely the oil sands located in Alberta, Canada and the Marcellus Shale gas located in America's Appalachian region as well as the importance of properly crafted regulatory regimes that safeguard another critical natural resource – fresh water. Development of unconventional fossil fuels requires considerable quantities of fresh water for extraction and produces substantial quantities of contaminated wastewater as a byproduct. This analysis addresses the importance of unconventional fossil fuels, compares the two resources in terms of extraction and water impact, highlights the weaknesses in the regulatory regimes in Alberta and the Marcellus Shale states, and proposes federal intervention and/or regional management as a possible solution, as justified by traditional theories of regulation (i.e., the externalization of pollution and race to the bottom theory). Commercial oil sands extraction has been ongoing for at least forty years and, above all, the Canadian experience demonstrates the importance of properly considered regulation and regional monitoring prior to accelerated development in the Marcellus Shale gas play.

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I. INTRODUCTION

North American society is fossil fuel dependent. From the suburban lifestyle to lengthy daily commutes, our day-to-day lives depend upon a reliable and readily available supply of hydrocarbon-based energy. In contrast, scientists and politicians are becoming increasingly cognizant of the impact of the fossil fuel lifecycle on the natural and human world, be it in the form of social and environmental costs of fossil fuel development or the climate change debate.

Despite heightened awareness, global energy demand grows.[1] The U.S. Energy Information Administration (EIA) forecasts a 49% growth in world marketed energy consumption by 2035 (compared to a 2007 pre-recession baseline).[2] In short, "[f]ossil fuels are expected to continue supplying much of the energy used worldwide."[3] Strikingly, the EIA also notes that unconventional

1. It is not possible to explain this increase in energy consumption by pointing at a single contributing factor. One explanation is simply population growth and another is the rapid industrialization of the developing world. This article is concerned with *how* increasing demand will be met as conventional resources become less readily available rather than *why* demand is increasing.

2. EIA, DOE, INTERNATIONAL ENERGY OUTLOOK 2010 at 1 (July 2010), *available at* ftp://ftp.eia.doe.gov/forecasting/0484%282010%29.pdf.

3. *Id. See generally*, *What We Do and How*, OECD, http://www.oecd.org/pages/0,3417,en_36734052 _36761681_1_1_1_1_1,00.html (last visited Feb. 6, 2012) (the OCED is an international organization that "uses its wealth of information on a broad range of topics to help governments foster prosperity and fight poverty through economic growth and financial stability"); *See generally*, *Members and Partners*, OECD, http://www.oecd.org/document/25/0,3746,en_36734052_36761800_36999961_1_1_1_1,00.html (last visited

fossil fuel energy resources will grow at approximately 4.9% per annum through to 2035.[4]

Two unconventional fossil fuel sources that are currently garnering considerable attention are the oil sands of northern Alberta, Canada, and the Marcellus Shale natural gas play under the Appalachian Mountain range in New York, Pennsylvania, West Virginia, Ohio, and Maryland.[5] Both sources represent significant fossil fuel deposits in terms of potential energy extraction. For example, the Alberta oil sands are estimated to be the second largest reserve for crude oil in the world, second only to Saudi Arabia.[6] Statistically, the Canadian Association of Petroleum Producers confirmed in June, 2011, that Alberta's oil sands deposits contain an estimated 170 billion barrels of crude oil equivalent, of which "34 billion barrels can be recovered by surface mining" and 130 billion barrels by *in situ* extraction.[7] The oil sands have recently received considerable attention in the United States as the proposed extension to the TransCanada Keystone XL pipeline has been the subject of political and legal attention and closely followed by the media. With respect to the Marcellus Shale gas play, recent estimates by the U.S. Geological Survey indicate that there are 84,198 billion cubic feet of natural gas and 3,379 million barrels of natural gas liquids that will ultimately be recoverable.[8] These considerable reserves are attractive to companies who stand to benefit from their development and governments who stand to gain a measure of energy independence and a new export resource.

These fossil fuel resources are not as easily developed as their conventional counterparts. The oil (technically called bitumen) in the oil sands is chemically bonded to sand grains and the process of separating the bitumen and turning it into a consumable petroleum product requires considerable energy, water, and advanced technological processes.[9] Similarly, the natural gas in the Marcellus

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Feb. 6, 2012) (here, the OECD lists its member nations, which currently number 34 representing most of the developed world).

4. EIA, *supra* note 2, at 2; *See generally* Stephen A. Holditch, *The Increasing Role of Unconventional Reservoirs in the Future of Oil and Gas Business*, 55 J. OF PETROLEUM TECH., No. 11, at 34, 34 (Nov. 2003) (defining conventional reservoirs of oil and gas as "those that can be produced at economic flow rates and that will produce economic volumes of oil and gas without large stimulation treatments or any special recovery process," whereas he defines unconventional reservoirs of oil and gas as those "that cannot be produced at economic flowrates or that does not produce economic volumes of oil and gas without assistance from massive stimulation treatments or special recovery processes and technologies").

5. DANIEL J. SOEDER & WILLIAM M. KAPPEL, USGS FACT SHEET 2009-3032: WATER RESOURCES AND NATURAL GAS PRODUCTION FROM THE MARCELLUS SHALE 1 (2009).

6. DR. PIERRE GOSSELIN ET AL., THE ROYAL SOCIETY OF CANADA EXPERT PANEL: ENVIRONMENTAL AND HEALTH IMPACTS OF CANADA'S OIL SANDS INDUSTRY 1 (2010), *available at* http://www.rsc.ca/documents/RSCreportcompletesecured9Mb_Mar28_11.pdf (the Royal Society of Canada is a National Academy dedicated to excellence in research, science, and the arts. This report was prepared by seven scientists with prominent connections to leading academic institutions in Canada).

7. CANADIAN ASS'N OF PETROLEUM PRODUCERS, CRUDE OIL: FORECASTS, MARKETS & PIPELINES 5 (2011), *available at* http://www.capp.ca/getdoc.aspx?DocId=190838.

8. JAMES L. COLEMAN ET AL., USGS FACT SHEET 2011-3092: ASSESSMENT OF UNDISCOVERED OIL AND GAS RESOURCES OF THE DEVONIAN MARCELLUS SHALE OF THE APPALACHIAN BASIN PROVINCE, 2011 at 2 (2011).

9. DAVID FINCH, PUMPED: EVERYONE'S GUIDE TO THE OIL PATCH 102-103 (2008) (Finch is a Canadian historical consultant specializing in the the history of the petroleum industry in Alberta. He has written several books on this topic).

Shale play is trapped diffusely in tightly compacted shale beds, which must first be fractured through the use of advanced horizontal drilling and the injection of water, chemicals, and sand prior to extraction.[10] The rate at which the oil sands are currently being developed, and at which it is projected the Marcellus Shale play will be developed, has led some to compare these energy booms to the North American gold rushes of the 19th century,[11] which raises concerns about the environmental consequences of accelerated development.

The majority of legal literature addressing the future of energy in North America focuses on the affect of carbon intensive energy on the Earth's climate system. Alternatively, this discussion examines the impact that developing unconventional resources has on water resources. Water is quickly becoming society's most valuable natural resource, and this article will assess the "water footprint" associated with developing unconventional fossil fuels and assess the regulatory framework necessary to protect water, concluding that a regulatory regime that avoids the pitfalls commonly associated with a boom industry is both environmentally desirable and economically sustainable in the long-term.[12]

This article is both descriptive and prescriptive and attempts to provide a balanced perspective on what are often polarizing issues. After introducing the emergence of unconventional resources in Part I, Part II of this article will discuss the energy context within which unconventional fossil fuel resources have emerged, evaluate the role that they are projected to play in supplying North America with fossil fuel energy, discuss energy security and self-sufficiency, and the interaction with water resources. Part III investigates these resources in some detail, including how their development impacts water. Part IV describes the theoretical basis for enhancing federal and regional regulation in both the oil sands and the Marcellus Shale gas play. In Part V, the prescriptive portion of the article, I highlight lessons to be learned from the Canadian oil sands as Marcellus Shale gas extraction continues. I attempt to place these regulatory regimes within the theoretical framework advanced in Part IV.

II. THE EMERGENCE OF UNCONVENTIONAL FOSSIL FUEL SOURCES

A. Present Reliance on Fossil Fuel Energy and Forecasted Energy Needs

Global society, and North America in particular, is highly fossil fuel dependent. The EIA projects that world energy consumption will continue to increase through 2035,[13] and that liquid fuels will be the most important energy source in this period.[14] Domestically, the Department of Energy (DOE) indicates

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10. SOEDER & KAPPEL, *supra* note 5, at 2-3.

11. George A. Bibikos & Jeffrey C. King, *A Primer on Oil and Gas Law in the Marcellus Shale States*, 4 TEX. J. OIL, GAS & ENERGY L. 155, 156 (2009); *see also* ANDREW NIKIFORUK, TAR SANDS: DIRTY OIL AND THE FUTURE OF A CONTINENT 22 (2008) (Nikiforuk is a well-recognized critic of the oil and gas industry in Alberta who has published more than one work in the popular press on governmental accountability and the environmental impact of oil and gas development).

12. Robert H. Abrams & Noah D. Hall, *Framing Water Policy in a Carbon Affected and Carbon Constrained Environment*, 50 NAT. RES. J. 3, 7 (2010).

13. EIA, *supra* note 2, at 11.

14. *Id.* at 1.

that America relies on fossil fuels for approximately 85% of its total energy demand; fossil fuels currently account for almost all transportation fuels and provides 66% of electricity.[15] The DOE states that despite "aggressive development and use of new renewable and nuclear technologies," societal "reliance on fossil fuels will likely increase over the next two decades."[16] In order to meet this demand, the DOE is prioritizing both energy stockpiling and research into new fossil fuel technologies.[17]

Conventional oil production can be modeled based on the observation that "oil is a finite resource."[18] In 1956, geologist M. King Hubbert predicted that production of U.S. oil would peak and then start to decline in the 1970s; this prediction proved true and is called "Hubbert's Peak."[19] Similarly, U.S. natural gas field production peaked in the 1970s.[20] It is estimated that U.S. conventional natural gas production will decrease by 5% by 2025, at which point conventional natural gas will only be able to satisfy 75% of America's natural gas demand.[21] Therefore, increasing demands are being met with declines in both natural gas and conventional crude oil production.[22] Hubbert's Peak has not been unanimously accepted. For example, in 2003, Michael Lynch (then President of Strategic Energy and Economic Research, Inc., and Research Affiliate at the Massachusetts Institute of Technology Center for International Studies) challenged the statistical analysis, assumptions, and assertions involved in the creation of Hubbert' Peak.[23]

The fact is that renewable fuel sources like geothermal, solar, and wind power are not available in many regions of North America, and switching quickly to renewable fuels would require dramatic grid infrastructure alterations that are currently unfeasible.[24] This article focuses on two unconventional fossil fuel sources, namely the Alberta oil sands and Marcellus Shale gas play (as a proxy for shale gas generally). These resources differ by product (synthetic crude oil and natural gas, respectively) and by extraction techniques, but the comparison is appropriate since both may soon be utilized heavily by America to fulfill its energy demand, and both have a considerable impact on water resources.

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15. OFA Consulting Servs., *Non-Renewable Sources*, OFACS, http://www.ofaconsultingservices.com/energy-sources/non-renewable-sources (last visited Feb. 6, 2012) [hereinafter *Non-Renewable Sources*]; *see also* DOE, *Fossil Fuels*, ENERGY.GOV, http://www.energy.gov/energysources/fossilfuels.htm (last visited Feb. 6, 2011).

16. *Non-Renewable Sources*, *supra* note 15.

17. *Id.*; *see also Fossil Energy*, DOE OFFICE OF FOSSIL ENERGY, http://www.fe.doe.gov; *see also* DOE, *supra* note 15.

18. Andrew C. Mergen, *The Mining of the North: A Review of Andrew Nikiforuk's Tar Sands: Dirty Oil and the Future of a Continent*, 21 VILL. ENVTL. L.J. 219, 219 (2010).

19. *Id.*

20. Hannah Wiseman, *Regulatory Adaptation in Fractured Appalachia*, 21 VILL. ENVTL. L.J. 229, 233 (2010).

21. Enerdynamics, *The Rise of Unconventional Gas*, THE ENERGY INSIDER, 1 (Sept. 18, 2007), http://www.enerdynamics.com/documents/Insider91807_000.pdf.

22. ALBERTA CHAMBER OF RES., OIL SANDS TECHNOLOGY ROADMAP: UNLOCKING THE POTENTIAL 7 (2004), *available at* http://www.acr-alberta.com/OSTR_report.pdf.

23. *See generally* Michael C. Lynch, *The New Pessimism About Petroleum Resources: Debunking the Hubbert Model (and Hubbert Modelers)*, 18 MINERALS & ENERGY 21 (2003).

24. *See generally* ALBERTA CHAMBER OF RES., *supra* note 22.

B. *Energy Security and Self-Sufficiency*

Unconventional fuels are particularly attractive because of "energy independence,"[25] which has two components: (i) energy security, meaning a country minimizes the volatility of the energy sources it relies upon (which usually implies "reducing energy dependence on unstable foreign sources")[26]; and (ii) energy self-sufficiency, meaning a country utilizes domestically produced energy to reduce reliance on imports.[27] Both the oil sands and the Marcellus Shale gas play help facilitate energy independence.

The oil sands constitute 20% of America's oil imports,[28] making Canada the number one exporter of oil to America.[29] In fact, the United States is currently the only country to which Canada exports oil sands products.[30] In his recent book *Ethical Oil: The Case for Canada's Oil Sands*, Ezra Levant advocates increasing Canadian exports to the United States on the basis that Canada is a stalwart democracy.[31] Levant compares Alberta to the other oil exporting nations and concludes that Alberta is the most ethical source of oil.[32] Other commentators have taken a pragmatic rather than normative approach to assessing the importance that oil sands to energy security and note the following: (i) Canada is politically and economically stable; (ii) oil sands exploration is not inherently risky; (iii) oil sands development is limited only by the price of oil and refining costs; (iv) the "timeline" for oil sands development is projected to be multi-decadal; and (v) Alberta offers "a favourable royalty and tax regime. . .that recognizes the substantial upfront costs and delays in oil sands development."[33] Further, relying on Canada may help limit OPEC's influence, reduce America's susceptibility to Middle East supply disruptions, and insulate against terrorist activities by utilizing secure infrastructure.[34]

The Marcellus Shale gas play also has tremendous potential to help secure America's energy future. In fact, some commentators suggest that the Marcellus Shale play might be the key to domestic energy development.[35] Compared to the oil sands, the Marcellus Shale gas play has the added benefits of being within the

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25. MICHAEL A. LEVI, THE CANADIAN OIL SANDS: ENERGY SECURITY VS. CLIMATE CHANGE 15 (Council on Foreign Relations, Special Report No. 47, May 2009), *available at* http://i.cfr.org/content/publications/attachments/Oil_Sands_CSR47.pdf.

26. Abrams & Hall, *supra* note 12, at 6.

27. LEVI, *supra* note 25, at 15.

28. NIKIFORUK, *supra* note 11, at 2.

29. EZRA LEVANT, ETHICAL OIL: THE CASE FOR CANADA'S OIL SANDS 9 (2010) (Levant is a Canadian lawyer, author, columnist, and former parliamentary assistant who is recognized for expressing his political beliefs in the media. His opinions in this book present an alternative perspective to those expressed by authors such as Andrew Nikiforuk and are useful for this paper in identifying the spectrum of competing opinions that exist).

30. *Id.* at 48.

31. *Id.* at 32.

32. *Id.* at 13-14.

33. R.J. (Jack) Thrasher, *Canadian Oil Sands Development and Cross-Border Ventures*, 53 ROCKY MT. MIN. L. INST. 2-1, § 2.02 (2007).

34. LEVI, *supra* note 25, at 18-20.

35. Wes Deweese, *Fracturing Misconceptions: A History of Effective State Regulation, Groundwater Protection, and the Ill-Conceived FRAC Act*, 6 OKLA. J. L. & TECH., No. 49, 2010 at 2, http://www.okjolt.org/images/pdf/2010okjoltrev49.pdf.

United States and containing a cleaner, less carbon-intensive fossil fuel in natural gas,[36] and it is located close to the energy thirsty East Coast.[37]

As attractive as these resources may seem, one must be cognizant of environmental and social costs of development, and this analysis will assess the affects on our most valuable natural resource - fresh water.

C. Interaction with Water Resources

Considerable discussion about the "carbon footprint" of unconventional fossil fuels exists.[38] While less is written on fresh water management, it is equally critical. Most North Americans take water for granted, since today we have "the technological ability to pump water from great depths, and to build dams, reservoirs, aqueducts, pipelines, and water tunnels through mountains, and to desalinate seawater, [and] it is possible to bring the water to the people wherever they might congregate and settle."[39]

Water may be "the next oil, a scarce resource that must be . . . protected and managed," that "societies and governments value, protect, use, depend upon, litigate, and even go to war over."[40] Water and fossil fuels have become intricately connected because the extraction, treatment, and distribution of fresh water requires considerable energy while the production of fossil fuel energy requires fresh water; "water consumption and oil consumption are on a precariously parallel course."[41] The major water concerns of developing unconventional fossil fuel are the considerable quantity of water required for extraction and the production of large quantities of polluted waste-water. This concern is compounded by the increasing demand from a growing population and the effect of climate change on watersheds and the hydrologic cycle.[42] Additionally, there are no fresh water alternatives, and water cannot be replaced.[43] Given the overlap between energy and water, both law makers and the scientists must account for these interconnections as they model and manage the hydrologic cycle.[44] These issues have been live in Alberta for the last forty years, but many are just now coming to a head. Because these water management issues are similar to the current challenges in the Appalachian Basin and are of the type that "industry has rarely faced before," this comparison is particularly useful.[45]

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36. *See generally* SOEDER & KAPPEL, *supra* note 5, at 1 (describing the nature of this resource and the importance of natural gas).

37. Bibikos & King, *supra* note 11, at 156.

38. Abrams & Hall, *supra* note 12, at 39.

39. *Id.* at 20-21.

40. Paula J. Schauwecker, *Oil and Water: Fueling Questions*, 24 NAT. RESOURCES & ENV'T, No. 1, Summer 2009 at 46, 46.

41. *Id.* at 47.

42. Robert E. Beck, *Current Water Issues in Oil and Gas Development and Production: Will Water Control What Energy We Have?*, 49 WASHBURN L.J. 423, 424 (2009-2010).

43. *Id.*

44. *Id.*

45. R. Timothy Weston, *Development of the Marcellus Shale—Water Resource Challenges* 1 (K & L Gates, White Paper, 2008), *available at* http://www.klgates.com/files/Publication/29f56baa-3f9c-4ff2-b43b-07403bf27c53/Presentation/PublicationAttachment/235fa8f0-a493-468a-811d-0aefa98ba28c/Weston.pdf.

III. UNDERSTANDING UNCONVENTIONAL FUELS

A. *The Canadian Oil Sands*

1. What Are the Oil Sands and How Are They Developed?

Millions of years ago, Alberta was covered by ocean where dead organic matter covered by rock layers was transformed into complex hydrocarbon molecules.[46] The formation of the Rocky Mountain west of this oil deposit pushed the oil eastward onto vast beds of sand.[47] Today, the oil sands include fifteen separate deposits[48] and "lie under about 23% of Alberta."[49]

The oil sands are considered unconventional because the oil is found as bitumen. "Bitumen is a thick semi-solid form of crude oil,"[50] and in the oil sands, it is bonded to sand and clay particles and water molecules.[51] Bitumen is naturally "a "highly dense and viscous tar-like" substance.[52] While people have been aware of the oil-soaked sand in northern Alberta for a long time, it was not until the late 1960s that commercial extraction began in earnest.[53] Currently, oil sands extraction is currently accomplished in two ways. The first method is open-pit strip mining for shallow reserves (the 3.3% of the oil sands less than seventy-five meters deep).[54] The second method of bitumen extraction, called "in situ extraction," is used for deeper deposits.[55] Technological advances remain inextricably connected to every aspect of the oil sands.[56]

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46. OIL SANDS DISCOVERY CTR., GOV'T OF ALBERTA, FACTS ABOUT ALBERTA'S OIL SANDS AND ITS INDUSTRY 3 (2009), *available at* http://history.alberta.ca/oilsands/docs/facts_sheets09.pdf.

47. *Id.*

48. GOSSELIN ET AL., *supra* note 6, at 26.

49. FINCH, *supra* note 9, at 100.

50. Thrasher, *supra* note 33, at § 2.02.

51. FINCH, *supra* note 9, at 102.

52. LEVI, *supra* note 25, at 5.

53. *Id.* at 17-18.

54. GOSSELIN ET AL., *supra* note 6, at 111 (Typical strip mining requires the following steps: (i) overburden (boreal forest vegetation, soil layers and/or muskeg) is removed; (ii) the oil sands are mined in a step-wise process by mechanized shovels and transported by heavy hauling trucks; (iii) the mined sand is mechanically broken into smaller pieces; (iv) the fragmented sand is added to hot water (45-60 degrees Celsius) to form a slurry and chemicals are added to separate the bitumen; and (iv) this slurry is either treated further such that it is capable of being transported by pipeline to receiving refineries as "synthetic crude oil" or alternatively it is diluted by the addition of chemical dilution agents or light crude oil so that it can be piped elsewhere for alteration). *See also* OIL SANDS DISCOVERY CTR., *supra* note 47, at 25-28 (this information sheet describes "upgrading" as the process of creating "synthetic crude oil" that can be piped); *see also* JADAR, *The Oil Sands*, BATO ENG'G (2000), http://www.bato.ca/jadar.htm (last visited Feb. 7, 2012) (further describing upgrading as follows: "coking removes carbon and breaks large bitumen molecules into smaller parts, distillation sorts mixtures of hydrocarbon molecules into their components, catalytic conversions help transform hydrocarbons into more valuable forms and hydrotreating is used to help remove sulphur and nitrogen and add hydrogen to molecules. The end product is synthetic crude oil, which is shipped by underground pipelines to refineries across North America to be refined further into jet fuels, gasoline and other petroleum products.").

55. GOSSELIN ET AL., *supra* note 6, at 135; *see also* JEREMY MOORHOUSE, MARC HUOT & SIMON DYER, DRILLING DEEPER: THE IN SITU OIL SANDS REPORT CARD 18-20 (2010) (describing three in situ extraction methods as follows: (i) Cyclic Steam Stimulation (CSS) is used in deposits more than 400 meters underground. It involves drilling into the bitumen deposit and then injecting steam into the layer for many weeks; the steam injection liquefies the bitumen and allows it to pool. The injection wellbore is then used to extract the pooled liquid bitumen. CCS extracts only 25% of the bitumen in the reserve; (ii) Steam Assisted Gravity Drainage

As of September 2010, Strategy West Inc., an oil sands consulting company estimates that oil sands production produces 1,037,500 barrels of synthetic crude daily and that if all approved and announced projects come to fruition, Alberta will produce 2,874,060 barrels of bitumen per day, corresponding to 2,481,900 barrels of synthetic crude oil.[57] So long as world crude oil prices remain in the US$60-70 range (the estimated threshold for profitability), new development in the oil sands will continue.[58]

Canada currently constitutes 19% to 20% of American foreign energy supply, and roughly 50% of this energy is from the oil sands; by 2037, 37% of American foreign oil supplies will come from the oil sands.[59] One hurdle that hinders oil sands import expansion is section 526 of the U.S. Energy Independence and Security Act of 2007.[60] This section reads as follows:

> No Federal agency shall enter into a contract for procurement of an alternative or synthetic fuel, including a fuel produced from nonconventional petroleum sources, for any mobility-related use, other than for research or testing, unless the contract specifies that the lifecycle greenhouse gas emissions associated with the production and combustion of the fuel supplied under the contract must, on an ongoing basis, be less than or equal to such emissions from the equivalent conventional fuel produced from conventional petroleum sources.[61]

In essence, this section "prohibits "[f]ederal agencies from buying an alternative or synthetic transportation fuel produced from non-conventional petroleum sources if the lifecycle greenhouse gas emissions associated with that fuel (from production to refining to consumption) are greater than such emissions from fuel produced from conventional petroleum sources,"[62] and likely includes oil sands products. A second limitation is that not all American refineries are capable of utilizing the heavier synthetic crude oil piped from Canada.[63]

The oil sands have received considerable media attention due to the recently rejected TransCanada Keystone XL Pipeline extension. Current pipeline infrastructure from Alberta enables 3.5 million barrels per day of crude oil to

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(SAGD) is the primary method for deposits 100-400 meters deep. SAGD requires the drilling of multiple well holes, one for steam injection and one drilled deeper to extract sinking liquid bitumen. SAGD can extract 60% of the bitumen from the oil sands deposit; and (iii) Vapour Recovery Extraction (VAPEX) differs from CCS and SAGD as it uses the injection of chemical solvents or carbon dioxide (in addition to, or sometimes in the absence of steam) to draw oil to the extraction pipe); *see also* Kurt Cobb, *Will Toe-to-Heel Air Injection Extend the Oil Age*, SCITIZEN (Apr. 21, 2010, 12:38 PM), http://scitizen.com/future-energies/will-toe-to-heel-air-injection-extend-the-oil-age-_a-14-3449.html (describing a fourth in situ extraction technique called Toe-to-Heel Air Injection (THAI) or "fire flooding," whereby the bitumen reserve is first heated with steam and then oxygen is injected as an ignition source. Once ignited, the fire burns approximately 10% of the bitumen and liberates the rest. Current estimates suggest that THAI can recover 70-80% of the total bitumen stored in the reserve).

56. FINCH, *supra* note 9, at 119.

57. R.B. (BOB) DUNBAR, STRATEGY WEST, INC., EXISTING AND PROPOSED CANADIAN OIL SANDS PROJECTS 1 (2010), *available at* http://www.strategywest.com/downloads/StratWest_OSProjects_201009.pdf.

58. LEVI, *supra* note 25, at 9.

59. Mergen, *supra* note 18, at 219.

60. 42 U.S.C. § 17,142 (2007).

61. *Id.*

62. Gerald Karey, *Section 526 Remains a Potential Impediment for US Purchases of Oil Sands Fuel*, THE BARREL BLOG (Feb. 27, 2009, 5:35PM), http://www.platts.com/weblog/oilblog/2009/02/27/section_526_remains_a_potential_impediment_for_us_purchases_of_oil_sands_fuel.html.

63. Thrasher, *supra* note 33, at § 2.04[6].

enter the United States.[64] The Keystone XL Pipeline that connects Hardisty, Alberta to Kansas (Steele City), Illinois (Pakota, and Wood River), and Oklahoma (Cushing) is currently operational with a capacity of 591,000 barrels per day.[65] The proposed addition to this pipeline connecting Hardisty, Alberta to Steele City, Kansas, and then from Cushing, Oklahoma, to Port Arthur, Texas and Houston, Texas would have increased the capacity of the pipeline to 1.3 million barrels per day.[66] In theory, the expansion would have increased the capacity to supply the mid-west and refineries in Texas that are currently supplied by dwindling Mexican and Venezuelan sources.[67]

On January 18, 2012 President Obama announced that rapid approval of the Keystone XL Pipeline was denied.[68] The State Department indicated that the sixty-day deadline for approval that Congress imposed in December, 2011 did not allow for sufficient time to assess whether or not proceeding with the pipeline was in the national interest.[69] President Obama suggested that this decision was not based on the merits of the Keystone XL Pipeline, and TransCanada's president has already indicated that another application will be submitted with the hope of having the pipeline expansion functioning by 2014.[70] The reality is that Canada is producing more oil than it needs and is actively pursuing export opportunities, be it the Keystone XL Pipeline, pipeline opportunities in California, and pipelines to Canada's west coast to facilitate trade to Asia.[71]

2. Regulation in the Oil Sands

Alberta's oil sands are governed by "federal, provincial, and municipal governments, international agreements, and domestic laws, treaties, [and] regulations."[72] For the purposes of this discussion, I will highlight only key regulatory mechanisms.

According to the Canadian Constitution,

> the regulation of the exploration, development, conservation, and management of non-renewable natural resources in Canada is a provincial responsibility, the federal government has authority to enact laws in relation to non-renewable resources when there are inter-provincial or international characteristics to their development. Areas of shared responsibility also exist, such as environmental regulation, in which both federal and provincial laws apply.[73]

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64. CANADIAN ASS'N OF PETROLEUM PRODUCERS, *supra* note 7, at 19.

65. *Id.* at iii.

66. *Id.*

67. *Id.* at 17.

68. *Keystone Not in National Interest, Feds Say,* HOUS. BUS. J., Jan. 18 2012, http://www.bizjournals.com/houston/news/2012/01/18/keystone-not-in-national-interest.html.

69. *Id.*

70. Aamer Madhani & Susan Davis, *Obama Rejects Keystone Pipeline from Canada to Texas*, USA TODAY, Jan. 18, 2012, http://www.usatoday.com/news/washington/story/2012-01-18/obama-rejects-keystone-pipeline/52655762/1.

71. CANADIAN ASS'N OF PETROLEUM PRODUCERS, *supra* note 7, at 17.

72. Thrasher, *supra* note 33, at § 2.03.

73. *Id.* at § 2.03[1][a]; *see also* Natural Resources Transfer Agreement, Constitution Act, 1930, 20 & 21 Geo. 4, c. 26, scheds. (U.K.), *reprinted in* R.S.C. 1985, app. II, no. 26 (prior to this piece of legislation the regulation of natural resources was a matter of provincial concern but not for the prairie provinces of Alberta,

As a practical matter, oil sands operators must secure resource rights, requiring them to obtain a natural resource lease from the provincial government.[74]

Provincially, Alberta utilizes the Energy Resources Conservation Board (ERCB) to administer and implement the regulatory scheme created by the Oil Sands Conservation Act.[75] In this respect, the ERCB functions as "an independent, quasi-judicial agency of the Government of Alberta . . . [t]o ensure that the discovery, development and delivery of Alberta's energy resources take place in a manner that is fair, responsible and in the public interest."[76] Environmental regulation falls primarily to the Alberta Ministry of Environment and Water, the government department "responsible for ensuring that oil sands operations undergo the appropriate environmental assessment under the Environmental Protection and Enforcement Act (EPEA) [which is analogous to the assessment process in the U.S. National Environmental Policy Act] and the Water Act."[77]

Canadian water regulation is also apportioned between the provinces and the federal government. Specifically, the federal government has regulatory authority over: (i) water on federal lands; (ii) water that is in Canadian territories (being the other functional division of land in Canada besides provinces); (iii) water within national parks; (iv) water on Indian reserve land; (v) water that is commercially navigable, water that is inter-jurisdictional (flowing over or spanning provincial boundaries or between boundaries between provinces and the United States), and both ocean and freshwater fisheries.[78] The most common trigger for federal jurisdiction is contained in section 36(3) of Canada's Fisheries Act, whereby the deposition of any "deleterious substance" in waters "frequented by fish" (or location where it is likely that a "deleterious substance" will intrude upon fish bearing waters) is prohibited by federal law.[79] The Fisheries Act defines "deleterious substance" broadly as

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Manitoba, and Saskatchewan); *see also* Robert Wardhaugh, *Natural Resource Transfer Agreement*, NET INDUSTRIES, *available at* http://www.jrank.org/history/pages/7737/Natural-Resource-Transfer-Agreement.html (last visited Feb. 6, 2012) (the struggle to control natural resources was a matter of constant debate between the provincial governments and the federal government; negotiations of 1929 led to the agreement to finally transfer natural resource control to the prairie provinces).

74. Thrasher, *supra* note 33, at § 2.03[2][a].

75. *See generally* Oil Sands Conservation Act, R.S.A. 2000, c. O-7 (Can.), *available at* http://www.qp.alberta.ca/574.cfm?page=O07.cfm&leg_type=Acts&isbncln=9780779723966.

76. *About the ERCB*, ERCB (Jan. 24, 2008), http://www.ercb.ca/portal/server.pt?open=512&objID=260&PageID=0&cached=true&mode=2.

77. Thrasher, *supra* note 33, at § 2.03[3].

78. *See generally* ENVIRONMENTAL DEFENCE ET. AL., DUTY CALLS: FEDERAL RESPONSIBILITY IN CANADA'S OIL SANDS (2010) [hereinafter DUTY CALLS], *available at* http://environmentaldefence.ca/sites/default/files/report_files/Duty%20Calls%20ENG%20FINAL%20web2.pdf; *see generally About Pembina*, THE PEMBINA INST., http://www.pembina.org/about/about-pembina (last visited Feb. 6, 2012) (here The Pembina Institute describes itself as "a Canadian non-profit think tank that advances sustainable energy solutions through research, education, consulting and advocacy. We promote environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance.").

79. Fisheries Act, R.S.C. 1985, c. F-14, § 36(3) (Can.).

> any substance that, if added to any water, would degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water."[80]

Alberta has regulatory control over the water within her boundaries that is not excluded by federal control. Alberta utilizes a prior allocation of rights water regulatory regime, otherwise known as first in time, first in right (FITFIR),[81] whereby access to water "is acquired by licence or other authorization from the Crown."[82] Priority of water use is established by the seniority of license (based solely on the date of issue), which in times of drought or high water usage may limit junior water usage.[83] The Alberta Ministry of Environment and Water also operates the Water for Life Strategy, which is designed to ensure safe drinking water, productive and healthy aquatic ecosystems, and to secure the water needed to sustain Alberta's economy.[84] This water regime enables the creation of Water Management Plans that can close whole basins to further allocation and prohibit/facilitate the transfer of water rights based on need.[85]

Alberta's oil sand deposits are located within the Mackenzie River Basin, the world's third largest watershed.[86] The Mackenzie Basin encompasses four Canadian provinces and two territories, contains major rivers which empty into the Mackenzie River, and all told contains more than 50% of the total freshwater from Canada that deposits into the Arctic Ocean.[87] Those opposed to oil sands development take issue with: (i) the amount of freshwater water consumed during the oil sand extraction processes; and (ii) the toxicity of the water produced during extraction and the potential for contamination of the natural ecosystem and of humans.[88]

3. Impact on Water

a. Water Consumption Issues

The Royal Society of Canada observes that "[a]ll aspects of the oil sands development[] including surface mining, in situ extraction, and bitumen upgrading are dependent on water."[89] The rivers that flow through the oil sands provide the water needed to develop the bitumen, and the amount of water used

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80. *Id.* § 34(1)(a).

81. *Legislative History of Water Management in Alberta*, ALBERTA MINISTRY OF ENV'T & WATER, http://environment.alberta.ca/02265.html (last visited Feb. 7, 2012).

82. Nigel Banks, *Policy Proposals for Reviewing Alberta's Water (Re)Allocation System*, 20 J. ENVTL. L. & PRAC. 81, 81 (2010).

83. *Id.* at 81-82.

84. GOVERNMENT OF ALBERTA, WATER FOR LIFE: ACTION PLAN 3 (2009), *available at* http://environment.gov.ab.ca/info/library/8236.pdf.

85. *Id.* at 20.

86. NIKIFORUK, *supra* note 11, at 60.

87. JENNIFER GRANT ET AL., PEMBINA INST., NORTHERN LIFEBLOOD: EMPOWERING NORTHERN LEADERS TO PROTECT THE MACKENZIE RIVER BASIN FROM OIL SANDS RISKS 7 (2010), *available at* pubs.pembina.org/reports/northern-lifeblood-report.pdf.

88. *Id.*

89. GOSSELIN ET AL., *supra* note 6, at 111.

in the oil sands is comparable to the water use of a city with 3 million people.[90] Both surface mining and in situ extraction require considerable volumes of water, but of the two, surface mining requires more water.[91] In both cases, industry has presently not found meaningful solutions to reduce the amount of water required.[92]

In terms of open-pit mining, an estimated twelve barrels of water are needed to produce one barrel of bitumen.[93] Most of this water is used during the hot water treatment process by which bitumen is separated from sand and clay.[94] 50-75% of this water is drawn from the Athabasca River, accounting for 70% of the total water allocation for the River.[95] Because withdrawing such considerable quantities of water can seriously affect aquatic ecosystems, the Alberta Ministry of Environment and Water and the federal Department of Fisheries has created a water management framework for the Athabasca River that uses instantaneous monitoring of flow conditions to designate the state of the River and to react accordingly.[96]

In situ bitumen extraction is less water intensive, but still requires considerable quantities of water. The Royal Society of Canada has determined that in situ production of one cubic meter of synthetic crude oil requires one-half cubic meter of water.[97] Unlike surface extraction, the primary impact is on groundwater. As explained earlier, SAGD utilizes steam to liquefy and extract bitumen.[98] The source of water used to generate steam is most often groundwater that can be easily pumped from underground aquifers near the proposed extraction site.[99] Even though 90-95% of the water used for SAGD can be used again, the concern is that removal of large quantities of groundwater alters the hydrostatic pressure within the aquifers and affects the flow patterns of groundwater in the region.[100] Guidelines have been set for groundwater extraction and studies assessing the impact of groundwater extraction are ongoing.[101]

Both of these consumptive uses are compounded by changes occurring in the Mackenzie Basin. Scientists are currently studying the Athabasca River and historical records in an effort to determine the extent to which human use in addition to natural fluctuations and perhaps climate change is affecting flow conditions.[102] To date, evidence suggests that flow rates in this region of Alberta

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90. PEGGY HOLROYD & TERRA SIMIERITSCH, THE WATERS THAT BIND US: TRANSBOUNDARY IMPLICATIONS OF OIL SANDS DEVELOPMENT 15 (2009), *available at* http://pubs.pembina.org/reports/watersthatbindus-report.pdf.

91. *See generally* LEVI, *supra* note 25, at 11-12.

92. FINCH, *supra* note 9, at 113.

93. NIKIFORUK, *supra* note 11, at 63.

94. *Id.*

95. GOSSELIN ET AL., *supra* note 6, at 113, 115.

96. *Id.* at 114.

97. *Id.* at 111.

98. *See supra* note 55 and accompanying text.

99. GOSSELIN ET AL., *supra* note 6, at 135.

100. *Id.* at 135-136.

101. *Id.* at 136.

102. *Id.* at 115-116.

have declined since 1970, and this decline may be significant.[103] Presently, the most serious risk associated with oil sands development is the potential for contamination of both surface and groundwater.

b. Water Contamination Issues

The liquid waste produced during surface mining bitumen extraction and the water used to treat the extracted bitumen is deposited in tailings ponds.[104] "Of the twelve barrels of water needed to [produce] one barrel of bitumen" through surface mining, the equivalent of three barrels of water becomes tailings waste that cannot be recycled or used again in the extraction process.[105] Industry defines this waste as "oil sands process materials" (OSPM).[106] OSPM has been accumulating since the 1970s, and OSPM accumulation remains the most problematic aspect of surface mining.[107] Tailings ponds are a combination of liquid, suspended coarse solids, and suspended fine solids (both of which eventually settle out from the liquid).[108] In addition, tailings liquid contains a variety of toxic and carcinogenic substances, "including naphthenic acids, polycyclic aromatic hydrocarbons, phenolic[s]," mercury and various other heavy metals, ammonia, as well as the liquefied bitumen that was not captured during extraction.[109] Tailings ponds cover 130 square kilometers of Alberta and contain some 720 cubic meters of liquid waste;[110] 400 million gallons of liquid are added daily.[111]

Tailings ponds are constructed from the overburden removed during the initial stages of surface mining extraction. On average, they rise 270 feet above ground level and are often located in close proximity to water sources.[112] Risks associated with the tailings ponds include: (i) the toxicity of the liquid waste; (ii) seepage from the ponds (which may be happening at a rate of 11 million gallons daily);[113] (iii) uncontrolled expansion (since no reclamation strategy exists for tailings ponds);[114] (iv) the possibility of dam failure; (v) impacts on local wildlife that mistake tailings ponds for lakes;[115] and (vi) the fact that no effective reclamation option exists.[116]

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103. *Id.*

104. *Id.* at 39.

105. *See generally* NIKIFORUK, *supra* note 11, at 83-84.

106. *Id.* at 83.

107. *Id.*

108. GOSSELIN ET AL., *supra* note 6, at 39.

109. DUTY CALLS, *supra* note 78, at 10.

110. GOSSELIN ET AL., *supra* note 6, at 39.

111. NIKIFORUK, *supra* note 11, at 83.

112. *Id.*

113. *See generally* GOSSELIN ET AL., *supra* note 6, at 123.

114. *Id.* at 121.

115. *Id.* at 129; *see also* Diane Saxe, *Syncrude Pays $3 Million for Dead Ducks*, ENVTL. L. AND LITIG. BLOG (Oct. 25, 2010), http://envirolaw.com/syncrude-pays-3m-dead-ducks/ (the Syncrude company has experienced two recent events that demonstrate this. In April of 2008, a flock of ducks migrating through the Mackenzie River Basin region landed on the Syncrude tailings pond after Syncrude failed to deploy/properly maintain the deterrence mechanisms that are supposed to keep birds from landing. These birds were quickly covered by the bitumen floating on the surface of the ponds, and 1,600 ducks died. Syncrude was charged provincially and federally, was found guilty, and received a CAN$3 million fine, the largest fine for an

In situ extraction also presents water quality dangers to the oil sands region. The first concern is that the use of significant quantities of groundwater for SAGD will degrade this region's groundwater supply in a number of ways. First, the removal of freshwater promotes the migration of saltwater into previously exclusively freshwater aquifers as a result of pressure changes.[117] This mixing can render such water unfit for human consumption. Second, in areas of groundwater removal, oxygen entrainment can occur whereby oxygen interacts with otherwise stable molecular substances to release toxic substances.[118] Third, steam injection into bitumen reserves may also increase the temperature of aquifers, thereby altering the properties of the groundwater. Some suggest that increased temperature will accelerate the release of arsenic.[119] Finally, in areas where large amounts of bitumen are being removed through SAGD, the space created, or the "vacuum effect," will be filled with migrating water that will then become contaminated within the hydrocarbon reserve.[120]

4. Alberta's Response

Inhabitants of Alberta's oil sands region are concerned that the effects of oil sands development on local surface water and groundwater supplies are unacceptable and that Alberta has not properly positioned itself to monitor and respond to threats to water quality and quantity. The two established organizations tasked with reporting on the impact of oil sands development on water are the Cumulative Environmental Management Association (CEMA) (a public multi-stakeholder association created in 1999) and the Regional Aquatics Monitoring Program (RAMP) (a "quasi-private stakeholders group" created in 1997).[121]

CEMA once attempted a comprehensive river health study but failed to complete a formal report, concluding they lacked the ability to complete a proper review or to assess the problem in light of prevailing environmental regulations.[122] RAMP produces annual reports, which indicate that oil sands development is not harming the environment, polluting water, acidifying lakes, or negatively affecting fish health.[123]

RAMP, which is funded in part by oil sands operators, has been criticized for inappropriate sampling sizes, assessment scope, and for not properly weighting the impact on local fish populations.[124] In response to these perceived

environmental offense ever imposed by a Canadian court. Ironically, one week after Syncrude received this sentence, 400 birds affected by inclement weather landed on the Syncrude tailings pond and perished. The air cannons, mechanical scarecrows, and simulated predators do not appear to be effective deterrence, and research is ongoing as to how duck mortality can be avoided in the future).

116. GRANT ET AL., *supra* note 87, at 9.

117. GOSSELIN ET AL., *supra* note 6, at 141.

118. *Id.*

119. *Id.*; *see also* NIKIFORUK, *supra* note 11, at 69.

120. NIKIFORUK, *supra* note 11, at 69-70.

121. *Id.* at 62-63, 70-71.

122. *Id.* at 63.

123. *Id.* at 71.

124. *Id.*

shortcomings, the lab of Dr. David Schindler, a prominent aquatic ecologist,[125] released peer-reviewed studies refuting RAMP's conclusions that oil sand development has had a negligible impact on water quality; these published findings showed that both heavy metals and polycyclic aromatic compounds are found in elevated levels downstream from oil sands development.[126] These studies add credibility to the claims made by downstream Aboriginal communities in Fort Chipewyan that river toxicity is contributing to fish abnormalities and increased cancer rates.[127] In response to this controversy, the federal Minister of the Environment created the Oil Sands Advisory Panel in September, 2010, to review these discrepancies and to propose a new approach to monitoring water quality in the oil sands region.[128] This report observed that existing monitoring programs in Alberta lacked scientific leadership, integrated data collection and management, and coordination.[129] In response, the panel recommended a new monitoring approach that shares responsibility between the federal and provincial governments,[130] is "holistic and integrated,"[131] adaptive,[132] scientifically credible,[133] and transparent.[134] Environment Canada (in

125. *See generally*, *The Alberta Order of Excellence: Dr. David W. Schindler, OC, D.Phil., FRSC, FRS*, LIEUTENANTGOVERNOR.AB.CA, http://www.lieutenantgovernor.ab.ca/AOE/EDUCATION/DAVID-SCHINDLER/INDEX.HTML (last visited Feb. 1, 2012) (noting that Dr. Schindler was inducted into The Alberta Order of Excellence in 2008. The biographical information provided notes explains that he "is an internationally celebrated scientist who has led efforts to protect fresh water resources in Canada and around the world. His groundbreaking research has served as a clarion call alerting authorities and the public to the effects of pollutants and climate change on the environment." Further, "[a]s founding director of the Canadian Department of Fisheries and Oceans Experimental Lakes Project, Dr. Schindler began innovative large-scale experiments that would reveal serious changes taking place in Canada's lakes. The studies produced sobering proof of the destruction to the Great Lakes and other fresh water resources in Canada and the United States due to pollutants such as phosphate-based detergents and fertilizers. Although the results provoked strong resistance from some quarters, Dr. Schindler's work eventually led to much needed North American controls to mitigate the effects of phosphates on fresh water systems. He then went on to conduct ground-breaking and equally important research into the effects of acid rain and climate change on the health and biodiversity of the environment.").

126. NIKIFORUK, *supra* note 11, at 78.

127. *See generally* GOSSELIN ET AL., *supra* note 6, at 143-151; *see also* Erin N. Kelly et al., *Oil Sands Development Contributes Elements Toxic at Low Concentrations to the Athabasca River and Its Tributaries*, 107 PNAS 16,178, 16,781 (Sept. 14, 2010), *available at* http://www.pnas.org/content/107/37/16178.full.pdf+html (describing how certain chemicals that are carcinogenic to humans and otherwise toxic are found downstream from oil sands development in greater quantities than would be expected naturally); *see also* Erin N. Kelly et al., *Oil Sands Development Contributes Polycyclic Aromatic Compounds to the Athabasca River and Its Tributaries*, 106 PNAS 22,346, 22,346 (Dec. 29, 2009), *available at* http://www.pnas.org/content/106/52/22346.full.pdf+html (the first study advocating the need for further review to determine whether different monitoring should be used in Alberta to ensure that communities downstream from the oil sands operations in Alberta are not being compromised).

128. *See generally* LIZ DOWDESWELL ET. AL., OILSANDS ADVISORY PANEL, A FOUNDATION FOR THE FUTURE: BUILDING AN ENVIRONMENTAL MONITORING SYSTEM FOR THE OIL SANDS at 4 (2010), *available at* http://www.ec.gc.ca/pollution/E9ABC93B-A2F4-4D4B-A06D-BF5E0315C7A8/1359_Oilsands_Advisory_Panel_report_09.pdf.

129. *Id.* at 33.

130. *Id.* at 37.

131. *Id.* at 38.

132. *Id.* at 39.

133. *Id.* at 40.

134. *Id.*

collaboration with Alberta) subsequently created the Lower Athabasca Water Quality Monitoring Program, which appears to embody the panel's recommendations.[135] It is too soon to comment on the efficacy of this new approach.

In response to heightened concerns over tailings ponds, the ERCB released Directive 074, titled *"Tailings Performance Criteria and Requirements for Oil Sands Mining Schemes"* in February 2009.[136] Directive 074 heightens regulatory control over tailings ponds, aims to reduce the amount of liquid accumulating in tailings ponds, and to promote tailings pond reclamation.[137] Further, Directive 074 calls for the creation of Dedicated Disposal Areas (DDAs) where fine suspended particulate matter (usually the most toxic portion of tailings) is separated from the liquid waste, deposited, and then reclaimed.[138] Pursuant to Directive 074, operators are required to submit plans detailing their use of tailings ponds and to report regularly about how operations compare to their planned waste production.[139] The ERCB contemplates undertaking assessment reviews to check for compliance and also the use of enforcement mechanisms contained within other directives to ensure compliance.[140] Uncertainty remains as to the extent to which oil sand operators have come into compliance with Directive 074. According to some, perhaps as few as two of the nine major operators are in compliance with this initiative.[141]

On April 5, 2011, the Government of Alberta announced the release of the draft Lower Athabasca Regional Plan (the LARP).[142] Superficially, LARP appears to be a response to increased concerns from the international community, but to industry, it appears quite different.[143]

The most controversial proposal in the LARP is for the creation of a two million hectare conservation reserve that would cover 20% of Alberta's oil sands region, including land already leased to oil companies for exploration and development.[144] The LARP, as proposed, will revoke leases from several major operators, and otherwise affect assets held by fourteen energy companies and ten

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135. News Release, Env't Canada, Canada's Environment Minister Responds to Oil Sands Recommendations with Water Monitoring Plan (Mar. 24, 2011), *available at* http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=8A1AB11A-1AA6-4E12-9373-60CF8CF98C76.

136. ERCB, DIRECTIVE 074: TAILINGS PERFORMANCE CRITERIA AND REQUIREMENTS FOR OIL SANDS MINING SCHEMES 1 (Feb. 3, 2009), *available at* http://www.ercb.ca/docs/Documents/directives/Directive074.pdf.

137. *Id.*

138. *Id.* at 4.

139. *Id.*

140. *Id.*

141. GRANT ET AL., *supra* note 87, at 18.

142. *See generally* News Release, Government of Alberta, Regional Plan Supports Conservation and Economic Growth: Albertans Asked for Input on First Draft Regional Plan (Apr. 5, 2011), *available at* http://alberta.ca/home/NewsFrame.cfm?ReleaseID=/acn/201104/30180270F6D1C-EEF6-91B3-39A09CEC9E3E0DD8.html.

143. *See generally* Carrie Tait, Nathan VanderKlippe & Josh Windgrove, *Alberta Conservation Plan Stuns Oil Patch*, GLOBE & MAIL, Apr. 5, 2011, http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/alberta-conservation-plan-stuns-oil-patch/article1971930/.

144. *Id.*

mineral companies.[145] Consequently, the announcement of the Plan and "[t]he prospect of having parts of it[, the leased lands,] ripped away prompted one executive to compare Alberta to Venezuela, and to warn that any expropriation of land may frighten away investment crucial to developing one of Alberta's most important economic resources."[146]

5. Future Efforts Needed

One commentator asserts that "[o]nly a nation without a water policy could allow such rapid development of the tar sands in the world's third-largest water basin" and have such ineffective surface and groundwater monitoring regimes.[147] Future initiatives should emphasize three main areas.

a. Monitoring, Scientific Understanding, and Transparency

The Lower Athabasca Water Quality Monitoring Program is a positive step for water monitoring in the oil sands region. The recent studies conducted by Dr. Schindler and Dr. Kelly, as reviewed by an independent panel, tend to confirm the Pembina Institute's assertion that CEMA and RAMP are "inefficient, biased and ineffective."[148] Still, the ideal remains an approach that is a "consistent, transparent and integrated monitoring system, at arms length from industry . . . [on] water quality and quantity and protect[s] aquatic ecosystems in the Athabasca River, the Peace-Athabasca Delta, Lake Athabasca and the Slave River."[149] This should be coupled with increased efforts to understand the hydrological cycling of groundwater in this region and to monitor the effects that SAGD is having as water is removed from fresh water aquifers and injected into bitumen reserves.[150] A groundwater monitoring regime must monitor for pollution migration and contamination for many decades because groundwater moves much slower than surface water, and consequently, "the timescale for groundwater pollution is much longer."[151] While a framework for the extraction of water from the Athabasca River has been proposed,[152] the Alberta Government should endeavor to produce a similar plan for groundwater extraction. For both plans, the scope should be regional because one alteration to the hydrological cycle within the Mackenzie Delta may affect other aspects.[153]

The Government of Alberta should also consider reform that involves disclosure of data regarding leakage and seepage from tailings ponds. Currently,

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145. *Id.*

146. *Id.* (noting that new leases for oil sands development will not be issued for the conservation area, while limited conventional oil and gas exploration will be allowed. Compensation will be paid for the expropriation, and LARP proposes a negotiation process for determining the appropriate value for affected leaseholders).

147. NIKIFORUK, *supra* note 11, at 74.

148. HOLROYD & SIMIERITSCH, *supra* note 90, at 2; *see also* GOSSELIN ET AL., *supra* note 6, at 120.

149. HOLROYD & SIMIERITSCH, *supra* note 90, at 2.

150. *See generally* MOORHOUSE, HUOT & DYER, *supra* note 55, at 49.

151. GOSSELIN ET AL., *supra* note 6, at 117.

152. Vic Adamowicz, *Water Use and Alberta Oil Sands Development – Science and Solutions: An Analysis of Options*, *in* RUNNING OUT OF STEAM? OIL SANDS DEVELOPMENT AND WATER USE IN THE ATHABASCA RIVER-WATERSHED: SCIENCE AND MARKET BASED SOLUTIONS 40, 40 (Debra J. Davidson & Adele M. Hurley eds., 2007), *available at* http://www.ualberta.ca/~ersc/water.pdf.

153. GOSSELIN ET AL., *supra* note 6, at 153-154.

there is a lack of transparency for tailings pond "dam status and performance" because industry is not required to publish data publically that indicates how effective these dams are at preventing seepage and leaks into surrounding surface water or groundwater.[154]

RAMP has conducted fish health studies downstream from major tailings ponds in which fish growth, survival, and reproductive rates have been measured in addition to fish characteristics such as general physical condition, size, and age.[155] In 2009, RAMP concluded that "statistically significant differences were observed among years for condition and length-frequency distribution for many of the key indicator species," but that such variation could likely be attributed to natural variability in fish populations.[156] Because fish are consumed locally and also serve as an important indicator of ecosystem health and exposure to toxic substances, it is important to continue to monitor and report on fish health.[157] The Royal Society of Canada points out that while the acute toxicity of leaking tailings liquid may dissipate quickly, some of the chemicals and noxious substances can have effects in fish populations from ecosystem exposure from up to fifteen years prior, which makes continued testing imperative.[158]

The LARP contemplates regional scientific assessment for air and water quality.[159] The Government of Alberta has stated that "[t]hrough regional planning, . . . Alberta is moving towards managing the cumulative effects of all development on the air, water and landscape" and that "with science-based limits, and triggers to signal where proactive efforts may be needed to avoid reaching limits," it will be possible to meet the goals of this plan.[160] Considerable improvement is needed in this area. It may not be possible for the Government of Alberta to accomplish this goal on its own. For this reason, it may be appropriate to investigate the possibility of increasing the role of the federal government in regulating the impact that oil sands development has on Alberta's water supply.

b. Increased Federal/Regional Participation

One of the proposed solutions to perceived water mismanagement by Alberta is for the federal government to act where it has "authority to implement policies . . . and a legal obligation to do so."[161] The release of the Lower Athabasca Water Quality Monitoring Program may indicate a new willingness for Environment Canada to engage in oil sands regulation.[162] Additionally, the

154. GRANT ET AL., *supra* note 87, at 9.

155. GOSSELIN ET AL., *supra* note 6, at 151.

156. *Id.*

157. *Id.*

158. *Id.* at 154.

159. GOVERNMENT OF ALBERTA, DRAFT LOWER ATHABASCA INTEGRATED REGIONAL PLAN 2011-2021 at 30-32 (2011), *available at* https://landuse.alberta.ca/Documents/LARP_Phase_3_Draft_Lower_Athabasca_Integrated_Regional_Plan-Strategic_Plan_and_Implementation_Plan-P3-2011-03.pdf.

160. News Release, Government of Alberta, *supra* note 142.

161. DUTY CALLS, *supra* note 78, at 3.

162. ENV'T CANADA, AN INTEGRATED OIL SANDS ENVIRONMENT MONITORING PROGRAM 1 (2011), *available at* http://www.ec.gc.ca/pollution/EACB8951-1ED0-4CBB-A6C9-84EE3467B211/Integrated%20Oil%20Sands_low_e.pdf.

federal government clearly has authority to act in fishery management, and any of the water quality or quantity issues, described previously, that affect fish-bearing waters would potentially trigger Fisheries Act federal regulatory authority, including enforcement jurisdiction.[163] Further, if Alberta fails to create a robust monitoring agency capable of investigating the environmental uncertainties that persist in the Mackenzie River Basin region, arguably, there is no legal barrier preventing the federal government from responding with the creation of its own agency.[164] Because the Mackenzie River Basin encompasses parts of Saskatchewan, British Columbia, the Yukon, and the Northwest Territories, some have urged that it might make sense for the federal government to get involved in any case.[165]

The second way in which the federal government could engage in the regulation of pollution of waters in the oil sands region is through its legal duty toward Aboriginal populations.[166] Section 35 of Canada's Constitution establishes that the federal government owes Canada's Aboriginal populations a fiduciary obligation when their constitutionally protected rights are affected.[167] The majority of communities downstream from oil sands development are Aboriginal, either First Nations or Metis (of mixed Aboriginal and European ancestry).[168] This obligation to consult and accommodate Aboriginal peoples in Canada is owed by both the federal and provincial Crown.[169] It has been suggested that by delegating consultation procedures to industry and by failing to develop a consultation strategy that has been accepted by Aboriginal groups, the Alberta government has failed to discharge its duty, thereby opening the door to federal intervention.[170] One requirement of properly designed "free, prior, and informed consent" in this region could be ensuring that Aboriginal communities are capable of monitoring (and responding to) the public health consequences from the ways in which oil sands development is altering the water supply that they use for drinking and fishing and rely on for everyday purposes.[171] The LARP sets as a goal the "[i]nclusion of [A]boriginal peoples in land-use planning," but that goal cannot be met until further planning has been initiated and the Aboriginal communities agree to participate within the framework that Alberta proposes.[172]

c. Minimization of Further Jeopardy

A moratorium on future development or leasing of oil sands is unlikely and would be detrimental to Alberta (and Canada as a whole) and the United States.

163. DUTY CALLS, *supra* note 78, at 10 (recall, to accomplish this, the federal government simply has to find that the chemicals potentially seeping and leaking into the waters surrounding tailings ponds are deleterious in nature, and from that, the regulatory and enforcement powers contained within the Fisheries Act become engaged).

164. *Id.* at 11.

165. GRANT ET AL., *supra* note 87, at 7.

166. DUTY CALLS, *supra* note 78, at 5.

167. *Id.*

168. *Id.*

169. *Id.*

170. *Id.*

171. *Id.* at 5-6.

172. News Release, Government of Alberta, *supra* note 142.

Alternatively, the Government of Alberta has increased efforts to find alternatives to exposed tailings.[173]

At this point, the most controversial proposal is for a "wet landscape option" alternative.[174] The "End Pit Lakes" option involves depositing tailings waste and other extraction substances onto the bottom of depleted mine pits, which would then be "capped with surface and groundwater from surrounding reclaimed and undisturbed landscapes."[175] Theoretically, End Pit Lakes would become "permanent features in the . . . landscape, and ideally, they would be able to support life (both aquatic and land-based) and return naturally filtered water back to the environment.[176] To aid in this process, the proposal involves stocking the End Pit Lakes with fish and native vegetation.[177] Alberta plans to create twenty-seven such artificial lakes.[178]

Scientifically, these lakes would have to be treated with microbes to help reduce surface toxicity with the expectation that over time normal decay through organic decomposition will deposit a natural barrier of sediment on top of the tailings waste.[179] What sounds viable in theory might prove to be difficult to implement in practice: there are persistent concerns over the physical, biological, chemical, and sociological aspects of End Pit Lake construction and operation.[180] Until small-scale trials prove successful, End Pit Lakes might simply represent a risk-laden out-of-sight, out-of-mind alternative that distracts from the real technological issue at hand, which is developing extraction techniques that maximize water efficiency and water recycling and reduce the amount of tailings created in the first place.[181]

B. The Marcellus Shale Natural Gas Deposit

1. What Is the Marcellus Shale Gas Deposit and How Is It Developed?

Shale gas deposits exist throughout North America in two deposit belts.[182] The first belt runs through the western Canadian provinces of Alberta, Saskatchewan and Manitoba and into the United States in North Dakota.[183] The second belt stretches from northeastern United States to Texas.[184] Generally, shale gas is "formed in fine-grained shale rock (called gas shales) with low permeability in which gas has been absorbed by clay particles or is held within

173. Fact Sheet, Government of Alberta, Facts About Alberta's Oil Sands: Energy Research and Technology (Aug. 2010), http://www.oilsands.alberta.ca/FactSheets/FS-EnergyResearchAndTechnology.pdf.

174. GOSSELIN ET AL., *supra* note 6, at 130.

175. DUTY CALLS, *supra* note 78, at 9; *see also* GOSSELIN ET AL., *supra* note 6, at 130.

176. GOSSELIN ET AL., *supra* note 6, at 130.

177. *Id.*

178. *Id.*

179. *Id.* at 131-132.

180. *Id.* at 131.

181. *See generally* ERCB, ERCB BACKGROUNDER ON DRAFT DIRECTIVE: TAILINGS PERFORMANCE CRITERIA AND REQUIREMENTS FOR OIL SANDS MINING SCHEMES 1 (2008), *available at* http://www.ercb.ca/docs/documents/directives/Backgrounder_DraftDirective_Tailings.pdf.

182. Press Release, Ziff Energy Grp., Shale Gas Outlook to 2020, at 2 (Apr. 8, 2009), *available at* http://www.ziffenergy.com/download/pressrelease/PR20090408-02.pdf.

183. *Id.*

184. *Id.*

minute pores and microfractures."[185] The Marcellus Shale natural gas play exists under the Appalachian mountain range from southern New York through Pennsylvania, the western portion of Maryland, West Virginia, and into the eastern portion of Ohio.[186] Geologically, the Marcellus Shale sedimentary rock formation formed over 350 million years ago.[187] Rather than pooling in formations,[188] Marcellus Shale gas exists in "fractures, in the pore spaces between individual mineral grains, and is chemically absorbed onto organic matter within the shale."[189]

American interest in developing eastern shale gas began in the 1970s when the United States Department of Energy began funding the Eastern Gas Shales Project (EGSP).[190] In terms of total quantities of natural gas in the Marcellus Shale gas play, as of August 2011 the U.S. Geological Survey estimates that the technically recoverable, undiscovered continuous (unconventional) gas within the Marcellus Shale is a mean of 84,198 billion cubic feet of gas and a mean of 3,379 million barrels of total natural gas liquids.[191] The Institute of Gas Technology (IGT) suggests the Marcellus Shale may contain upwards of 26.5 standard cubic feet of gas in each cubic foot of rock.[192]

Shale gas extraction did not become commercially viable until the 1990s.[193] Because the gas is distributed diffusely throughout the shale, industry had to innovate to create "higher permeability flowpaths" within shale formations.[194] The process for gas extraction from shale plays utilizes horizontal drilling and hydraulic fracturing, which together accomplish "stimulation" of shale gas plays.[195]

The horizontal drilling process is initiated similarly to vertical drilling operations. But once the shale is sufficiently penetrated, the borehole is turned at a ninety-degree angle,[196] a maneuver called "deviat[ing]" the drill bit.[197] Horizontal drilling is useful because: (a) the natural gas within a shale gas play exists within a horizontal plane; (b) drilling horizontally allows the borehole to contact an increased number of naturally occurring fractures within the shale; and (c) horizontal drilling enables extraction to occur beneath areas where gas extraction would not be possible otherwise (i.e. population centers).[198]

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185. Enerdynamics, *supra* note 21, at 2.

186. SOEDER & KAPPEL, *supra* note 5, at 1.

187. *Id.*

188. CLINTON CNTY. NATURAL GAS TASK FORCE, CLINTON CNTY. GOV'T, WHY DOES MARCELLUS SHALE HOLD SO MUCH NATURAL GAS? at 1, *available at* http://www.clintoncountypa.com/resources/CCNGTF/pdfs/articles/12.23.10%20-%20Why%20does%20Marcellus%20Shale%20Hold%20so%20much%20Natural%20Gas.pdf.

189. SOEDER & KAPPELL, *supra* note 5, at 1-2.

190. *Id.* at 2.

191. COLEMAN ET AL., *supra* note 8, at 1.

192. SOEDER & KAPPEL, *supra* note 5, at 3.

193. Wiseman, *supra* note 20, at 233-234.

194. SOEDER AND KAPPEL, *supra* note 5, at 2.

195. *Id.*

196. *Id.* at 3.

197. Wiseman, *supra* note 20, at 237.

198. Laura C. Reeder, *Creating a Legal Framework for Regulation of Natural Gas Extraction from the Marcellus Shale Formation*, 34 WM. & MARY ENVTL. L. & POL'Y REV. 999, 1004 (2009-2010).

The hydraulic fracturing process involves pumping large volumes of fluids and sand (or "a similar granular substance" called the "proppant") into the shale through the horizontal borehole.[199] The goal of hydraulic fracturing is to increase the surface area of the borehole and natural fractures within the shale to facilitate migration of natural gas to the borehole for extraction.[200] It is accomplished by: (a) high pressure fluid injection which creates new shale fractures and generally makes the shale "more porous and permeable;" and (b) the granular substance suspended in the injected fluid become lodged within existing fractures and newly created ones and keeps them open.[201]

In contrast to the decades of development in Alberta's oil sands, the first gas Marcellus Shale gas play well was drilled in 2003, and the play has only been productive since 2005.[202] This is not to say that shale gas development is not rapidly increasing in the United States, where similar extraction techniques have been employed and extraction has been occurring since the 1990s.[203] Similarly, throughout the United States, hydraulic fracturing has been used to create one million oil and gas wells and 35,000 new wells annually.[204]

Each Marcellus Shale well may be capable of producing nearly four million cubic feet of natural gas daily and producing 2.5 billion cubic feet of gas during its lifetime (at a production cost of only $1.00 per million cubic feet).[205] Analysts use estimates like this to predict the future of domestic energy relying heavily on gas play development. They project that the amount of natural gas produced will result in a dramatic increase between 2008 and 2018 of 15 billion cubic feet of production daily.[206] The Marcellus Shale gas play is favorably located as it is in close proximity to major population centers in the states of New York and New England. Therefore, there is a great incentive to utilize Marcellus Shale to stabilize the natural gas energy demand in this region.[207]

The fact that the rush to develop the gas of the Marcellus Shale gas play has just begun poses an interesting conundrum. On one hand, state and federal regulators have the opportunity to address the impact that hydraulic fracturing and horizontal drilling have on water resources before widespread extraction operations are initiated. On the other hand, for regions where extraction is already underway, it is necessary to act quickly to mend any existing regulatory shortfalls before local and regional water resources are seriously compromised.

2. Regulatory Regime

Regulation within the Marcellus Shale gas play is complicated by the fact that each state with Marcellus Shale resources has adopted a different approach to natural gas extraction and water regulation within the confines of a federal

199. *Id.*

200. *Id.*

201. *Id.*

202. Wiseman, *supra* note 20, at 240.

203. Reeder, *supra* note 198, at 1005.

204. Deweese, *supra* note 35, at 1.

205. SOEDER & KAPPEL, *supra* note 5, at 3.

206. Deweese, *supra* note 35, at 4.

207. *Marcellus Shale - Appalachian Basin Natural Gas Play*, GEOLOGY.COM, http://geology.com/articles/marcellus-shale.shtml (last visited Feb. 8, 2012).

framework (as far as a discernible federal framework currently exists). This section provides a description of the pertinent regulatory scheme throughout the Marcellus Shale gas play, focusing on fundamental principles, common characteristics, and salient differences.

a. A Federal Framework?

Federal law establishes certain minimum requirements applicable to hydraulic fracturing. First, the Clean Water Act prohibits the discharge of pollution into a waterway absent a proper permit.[208] Secondly, federal law establishes liability for the contamination of well sites pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Superfund).[209] Federal transportation laws are applicable to hazardous waste and toxic chemical transport.[210]

Despite potential sources of regulation, federal regulatory authority is most notable for what has been exempted or not regulated. Congress passed the Safe Water Drinking Act (SDWA) in 1974 "to protect public health by regulating the nation's public drinking water supply."[211] Pursuant to the SDWA, the Environmental Protection Agency (EPA) is required to promulgate regulations addressing underground fluid injection to protect groundwater drinking supplies.[212] Until 1997, the EPA operated according to the principle that the definition of "underground injection" in Section 300h of the SDWA was designed to address subterranean fluid storage and not oil and gas extraction techniques such as hydraulic fracturing.[213] The EPA's exclusion of hydraulic fracturing was challenged by the Legal Environmental Assistance Foundation. In *Legal Environmental Assistance Foundation v. EPA*, the Court of Appeals for the 11th Circuit held that the EPA's interpretation of the SDWA was incorrect, and consequently, hydraulic fracturing qualified as "underground injection" and was subject to regulation.[214] In 2005, Congress reacted to this decision in the Energy Policy Act of 2005 and amended section 300h(d) of the SDWA to exclude expressly the hydraulic fracturing process.[215]

The federal regulatory scheme touching on the Marcellus play has two other notable exemptions. First, oil and gas operators are not required to report publically on toxic chemical releases that occur during hydraulic fracturing operations, unlike other industries which must report such releases pursuant to

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208. Clean Water Act § 301, 33 U.S.C. § 1311 (2006).

209. CERCLA § 107, 42 U.S.C. § 9607 (2006).

210. *See generally* Wiseman, *supra* note 20, at 242-43.

211. *Safe Drinking Water Act (SDWA)*, EPA.GOV (Oct. 28, 2011), http://water.epa.gov/lawsregs/rulesregs/sdwa/.

212. Deweese, *supra* note 35, at 9 (this article makes the point that this regime allows for states to develop programs that meet all of the requirements set by the SDWA); 42 U.S.C. § 300h (2010).

213. 42 U.S.C. § 300h(d); Angela C. Cupas, *The Not-So-Safe Drinking Water Act: Why We Must Regulate Hydraulic Fracturing at the Federal Level*, 33 WM. & MARY ENVTL. L. & POL'Y REV 605, 605-606 (2009).

214. Legal Envtl. Assistance Fund v. EPA, 276 F.3d 1253, 1256 (11th Cir. 2001); Deweese, *supra* note 35, at 10.

215. *See generally* Wiseman, *supra* note 20, at 243.

the Emergency Planning and Community Right to Know Act.[216] Second, Subtitle C of the Resource Conservation and Recovery Act is generally designed to regulate the lifecycle of waste, from creation to ultimate disposal.[217] Since 1980, however, "exploration and production" (E&P) waste from the oil and gas industry has been exempted from this requirement, despite the fact that in 1988 the EPA concluded that this exemption was "unwarranted."[218] This exemption covers waste "'intrinsic to and uniquely associated with primary E&P operations,'" meaning the "down-hole" waste and the waste "'otherwise . . . generated by contact with the oil and gas production stream during the removal of produced water of contaminants from the product.'"[219] These exemptions and the minimum requirements created by the CWA have led professor Hanna Wiseman to conclude that there is a "federal gap" of regulation in this area, within which "the Marcellus [Shale] states have begun to address environmental concerns associated with hydraulic fracturing."[220]

b. The Marcellus Shale States

The Marcellus Shale states have considerable leeway in terms of their regulatory approach to shale gas development. Specifically, states have control over: (i) how mine sites are developed; (ii) how "flowback water" (the hydraulic fracturing fluid that returns to the surface during gas production) is captured and disposed; (iii) how the impact on surface water and groundwater at well-sites is controlled; (iv) data collection and reporting; (v) the prevention of spills and leakage of fracking fluid (both before and after it is used); and (vi) the ways in which fracking fluid is recovered and disposed of.[221] The extent to which individual states have acted to fill this void varies greatly. New York has opted for a precautionary approach towards the use of hydraulic fracturing.[222] Pennsylvania initially encouraged shale gas development and has since employed a "reactionary mode[l]" as development initially outpaced regulatory capacity.[223] Ohio and West Virginia have adopted a hands-off approach and currently encourage development with minimal regulatory burdens.[224]

3. Water Regulation

Water regulation also differs significantly between the Marcellus Shale states and western Canada. In contrast to prior appropriation and FITFIR, water regulation in the northeastern United States is derived from English "riparian

216. Emergency Planning and Community Right to Know Act § 313, 42 U.S.C. § 11023(a) (2006); *see generally* Wiseman, *supra* note 20, at 243.

217. Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901-6992k (2010); *see generally* Wiseman, *supra* note 20, at 243-244.

218. Wiseman, *supra* note 20, at 243-244.

219. *Id.* at 244-245 (quoting Clarification of the Regulatory Determination for Wastes from the Exploration, Development and Production of Crude Oil, Natrual Gas and Geothermal Energy, 58 Fed. Reg. 15,284, 15,284-85 (1993)).

220. *Id.* at 251.

221. *Id.* at 253.

222. *Id.* at 251.

223. *Id.*

224. *Id.*

rights law" but has taken on its own distinct form over the last 250 years of use.[225]

Within a riparian rights regime, landowners adjacent to waterways gain water rights to that waterway as an appurtenant feature of land ownership.[226] The specific rights that landowners gain depend on the type of water in question. The rights are designed to address the following water resources: (i) "diffused surface water" (such as rainwater); (ii) traditional stream, river, and lake surface water; (iii) groundwater that flows in "well-defined subterranean streams;" and (iv) "percolating groundwater."[227]

A mineral lease in favor of an operator will generally contain the specifics of what uses the operator can make of water on the surface of the property, and the "specific lease terms will govern the relationship between the surface fee owner and mineral rights holder."[228] Usually these leases allow water to be used "for operating on the premises."[229] For surface water and flowing groundwater, the usual use allowed comes from the "American Rule", which states that the owner or operator can use a reasonable amount of water so long as other riparian rights holders are not prejudiced in their use.[230] A similar reasonable use regime exists for percolating groundwater.[231] In practice, the reasonable use doctrine renders "virtually all uses of water made upon the land from which it is extracted . . . 'reasonable,' even if they more or less deplete the supply to the harm of neighbors, unless the purpose is malicious or the water is simply wasted."[232] Certain Marcellus Shale states, namely New York and Ohio, have adopted a "regulated riparian" scheme to deal with these uncertainties.[233] Others, like Pennsylvania and West Virginia, rely heavily on the common law and have yet to adopt permitting procedures.[234]

3. Impact on Water

Generally speaking, shale gas production consumes large quantities of water during the fracking process and produces water contaminated with chemicals that can migrate through groundwater and surface water.[235] These problems are compounded by the difficulties of water disposal used in the fracking process.[236]

a. Water Consumption Issues

Water has always been a critical component of mining operations. Law professor Robert E. Beck notes that "[i]n the context of frac[k]ing, the growing

225. Weston, *supra* note 45, at 4.
226. *Id.* at 6-7.
227. *Id.* at 4.
228. *Id.* at 3.
229. *Id.*
230. *Id.* at 6.
231. *Id.* at 7.
232. *Id.*
233. *Id.* at 10-11.
234. *Id.* at 11-14.
235. Beck, *supra* note 42, at 423-425.
236. *Id.*

scarcity of water suggests that an extra level of care for existing water resources is in order, particularly for those water resources that presently are used or usable for sustenance of life."[237]

Water is used during the horizontal well drilling stage to cool the drill bit and to remove debris from the borehole.[238] The fracking process itself can use "[three] million gallons of water per treatment," and multiple treatments may be required for each borehole before gas extraction can begin.[239] There are three potential fates for the water used during fracking: (i) it can be extracted, recycled, and used again; (ii) it can be left inside of the shale deposit; or (iii) it can be extracted and disposed of (meaning stored on or off site or treated for other uses).[240] Normally, 30-70% of the water that is injected during the fracking process will be returned to the surface[241] as either "produced water" from the well as gas is being produced, "flowback water" that returns to the surface during fracking,[242] or water that is actively extracted to promote natural gas extraction.[243] According to Reeder, gas drillers are starting to experiment with new technologies and processes that enable them to be more effective at recycling fracking water.[244]

The Appalachian Basin has increasingly encountered drought conditions in recent years, making consumptive uses of water a considerable concern.[245] According to Weston, "[w]hile supplies are relatively plentiful in 'normal' years, the fact is that recurrent droughts have resulted in sometimes painful shortage conditions affecting, to various degrees, the region's streams and groundwater aquifers, leading to sometimes heated controversy, conflict and litigation."[246] Currently, if a well site in this region does not contain sufficient access to, or quantities of, surface or groundwater for drilling and extraction, operators will truck this water in from nearby sites.[247] It is with these sorts of concerns in mind that the issue of deep-injection of wastewater has become relevant to the discussion of developing the Marcellus Shale gas play.[248] Deep water injection is a purely consumptive process whereby waste water is placed deep underground in stable geological formations where it is isolated from the rest of the hydrological cycle and was frequently employed during development of the Barnett Shale gas play in Texas.[249] Despite these concerns, the most pressing issue surrounding shale gas is water contamination.[250]

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237. *Id.* at 438.

238. SOEDER & KAPPEL, *supra* note 5, at 4.

239. *Id.*

240. Deweese, *supra* note 35, at 19.

241. *Id.*

242. Wiseman, *supra* note 20, at 260.

243. Schauwecker, *supra* note 40, at 47.

244. Reeder, *supra* note 198, at 1013 (Reeder describes the use of "mobile heated distillation units" by Devon Energy Corporation as an example of emerging efficiencies).

245. Weston, *supra* note 45, at 1.

246. *Id.*

247. SOEDER & KAPPEL, *supra* note 5, at 4.

248. Reeder, *supra* note 198, at 1001.

249. *Id.*

250. *Id.* at 1012.

b. Water Contamination Issues

This concern arises from the addition of chemicals to the water used and the possible contamination of surrounding water sources. As Laura Reeder suggests, the main environmental concern associated with fracking and "arising from the extraction of natural gas from the Marcellus Shale formation is connected to the amount of wastewater that frac[k]ing generates."[251]

The first aspect of this issue is the type of water that gets produced. As mentioned previously, the creation of fracking fluid requires mixing of millions of gallons of fresh water with thousands of gallons of chemicals.[252] Many of the chemicals utilized in the fracking process are the type that humans encounter on a daily basis in household cleaning supplies and cosmetic products and should be "relatively safe given their diluted nature, when used in conjunction with sand and water."[253] The potential damages from these chemicals cannot be completely ignored, however, given the quantity of chemicals required and the use of certain substances like hydrochloric acid, which can be quite harmful.[254] In addition to chemical additives, wastewater comes into contact with a variety of naturally occurring substances within the shale deposits during the fracking process, such as "brines [which makes fresh water salty], heavy metals, radionucleotides, and organics that can make wastewater treatment difficult and expensive."[255] Recovered water that contains salts, bromides, inorganic substances like arsenic and barium, heavy metals, radionucleotides, and hydrocarbons will often exceed levels that states have set as safe concentrations for human consumption.[256]

Not all of the water that is injected into wells will be recovered. Once in the shale formation, injected fracking fluid can migrate and contaminate groundwater supplies that local populations use for drinking.[257] Another issue exists concerning what to do with wastewater that returns to the surface. Industry in West Virginia has previously diluted the brine water and returned it to nearby rivers.[258] This is problematic because this introduces chemicals and sediment to rivers which can accumulate and spread into other regions.[259] For example, industrial dumping into the Monongahela River in West Virginia has led to levels of total dissolved solids that exceeded standards in Pennsylvania.[260] Water that returns to the surface has to be stored on site in pits or in steel containers, at least initially, and some have wondered if this should be a more permanent option.[261] However, in reality this is more suitable as a temporary

251. *Id.*

252. Wiseman, *supra* note 20, at 238-239.

253. Deweese, *supra* note 35, at 18.

254. *Id.* at 19.

255. Comment from Pa. Sierra Club on Pa Dep't of Envtl. Resources' Proposed Chapter 95 Regulations (Dec. 2009), *available at* http://pennsylvania.sierraclub.org/PA_Chapter_2008/Take%20Action/Marcellus%20 Wastewater%20Comments.pdf.

256. *Id.*; *see also* Reeder, *supra* note 198, at 1012.

257. Reeder, *supra* note 198, at 1011-12.

258. *Id.* at 1012-13.

259. *Id.*

260. *Id.* at 1013.

261. Wiseman, *supra* note 20, at 262-264.

option, because the longer that it remains on site, the greater the risks that the storage mechanism will fail or that it will be tampered with in some way.[262]

The final issue with wastewater is disposal. The options for final disposal include treatment at public or private waste treatment facilities or deep/shallow injection for underground storage.[263] Currently, Marcellus Shale states allow for a differing mixture of disposal techniques. In Pennsylvania, wastewater disposal must occur through public or private waste treatment facilities or deep water injection.[264] In New York, disposal is permitted at public treatment plants and "out-of-state industrial treatment plants" or by deep water injection.[265] Ohio does not require a particular type of disposal, but most disposal occurs by way of deep water injection.[266] Maryland allows disposal in pits and in water treatment facilities.[267] West Virginia allows for land disposal, treatment facility processing, and also injection.[268]

It is difficult to comment on or compare the effectiveness of these disposal options with much certainty given considerable knowledge gaps. For example, the U.S. Geological Survey has noted that "the effectiveness of standard wastewater treatment on these [fracking and produced] fluids is not well understood."[269] It is generally acknowledged that constituent brine elements are not effectively removed through standard treatment processes.[270] Similarly, the efficacy of relying on deep or shallow underground injection is entirely dependent on the geological features of each region of the Appalachian Region.[271] What might have worked well in the Texas Barnett Shale Gas play may not translate effectively to other producing regions and geological formations.[272] The other method that has been suggested - leaving the waste water exposed to the atmosphere to evaporate and then collecting the solid waste left behind - is not suitable for the Appalachian Basin as it is located within a mountainous landscape and the climate is not conducive to this recovery method.[273] Given the rate at which gas extraction is projected to occur within the

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262. *Id.* at 264. For this reason, the Marcellus Shale states have developed requirements for both storage techniques and the timing of storage. For example, Pennsylvania requires the use of pit liners for temporary storage, and New York has proposed regulations that require the use of stainless steel containment. Other states are lagging in this respect, such as West Virginia, Ohio, and Maryland that do not require pit liners (West Virginia does if the soil is porous). *Id.* at 263. With respect to the timing of storage, New York generally requires removal of wastewater forty-five days after drilling finishes; Pennsylvania requires removal by nine months after drilling is finished unless the permit states otherwise. In Ohio, operators have three months to remove brine water, and in West Virginia, the storage sites cannot pose a "hazard" or prevent farming activities six months after drilling is completed. *Id.* at 264. All Marcellus Shale states require waste liquid to be no less than two feet below the lip of a wastewater storage pit. *Id.* at 262.

263. *Id.* at 264-265 (note that a basic restriction common to all Marcellus Shale states is that wastewater can not be dumped into water that qualifies as "waters of the United States" pursuant to the Clean Water Act).

264. *Id.*

265. *Id.* at 265.

266. *Id.* at 265 n.231.

267. *Id.* at 265.

268. *Id.* at 265-266.

269. SOEDER & KAPPEL, *supra* note 5, at 5.

270. *Id.* at 4.

271. *Id.*

272. *Id.*

273. *Id.*

Marcellus Shale region, it is not likely that injection wells can be created quickly enough to dispose of the amount of waste water that will be produced.[274]

The final issue in terms of water quality involves the chemicals that are used in the fracking process within the so-called Halliburton Loophole of the Safe Drinking Water Act.[275] A Congressional Investigation by the Democratic Committee on Energy & Resources released January 31, 2011, indicated that "32.2 million gallons of diesel fuel" were used by the oil and gas industry in nineteen states in hydraulic fracturing operations between 2005-2009, in contravention of the SDWA.[276] Diesel fuel, a known carcinogen, may seep into surrounding groundwater and was excluded from the so-called Halliburton Loophole.[277] Diesel could still be used with approval of the EPA, but in all instances described by the Congressional Investigation "no oil and gas service companies have sought—and no state and federal regulators have issued—permits for diesel fuel use in hydraulic fracturing."[278] For some, this questions how honestly industry reports the chemicals they use during fracturing and supports the argument that mandated transparency is needed to ensure corporate accountability.[279]

4. Future Efforts Needed

As shown, the lack of comprehensive federal regulations in this area has led to a variety of state regulations. In response, the U.S. Department of Energy Secretary of Energy Advisory Board Shale Gas Production Subcommittee (Shale Gas Subcommittee) has been "charged with identifying measures that can be taken to reduce the environmental impact and improve the safety of shale gas production."[280]

a. Chemical Disclosure and Transparency

The use of chemicals during the hydraulic fracturing process is an important open issue that should be addressed. The case against mandating the disclosure of hydraulic fracturing chemicals is that "[t]he specific make-up of the chemicals used in fracturing in particular is considered proprietary information and should be protected."[281] The most persuasive counter-argument is that considerable knowledge gaps about the short-term and long-term impacts of hydraulic

274. Wiseman, *supra* note 20, at 266.

275. *Id.* at 243.

276. Letter from the H.R. Comm. on Energy & Commerce, to Lisa Jackson, Adm'r of the EPA (Jan. 31, 2011) [hereinafter House Committee Letter], *available at* http://democrats.energycommerce.house.gov/index.php?q=news/waxman-markey-and-degette-investigation-finds-continued-use-of-diesel-in-hydraulic-fracturing-f.

277. Tom Pelton, *Investigation: "Fracking" Companies Illegally Injected Diesel Fuel into Ground*, BAY DAILY: CHESAPEAKE BAY FOUND., Feb. 2, 2011, http://cbf.typepad.com/bay_daily/2011/02/long-after-the-natural-drilling-industry-asserted-that-it-had-stopped-used-diesel-fuel-in-hydraulic-fracturing-drillers-inje.html.

278. *Id.*

279. *Id.*

280. SEC'Y OF ENERGY ADVISORY BD. SHALE GAS PROD. SUBCOMM., DOE, 90-DAY REPORT 1 (Aug. 18, 2011) [hereinafter 90-DAY REPORT], *available at* http://www.shalegas.energy.gov/resources/081111_90_day_report.pdf; *see also* SEC'Y OF ENERGY ADVISORY BD. SHALE GAS PROD. SUBCOMM., DOE, SECOND NINETY DAY REPORT (Nov. 18, 2011) [hereinafter SECOND NINETY DAY REPORT], *available at* http://www.shalegas.energy.gov/resources/111811_final_report.pdf.

281. Deweese, *supra* note 35, at 11.

fracturing on water and consequently public health still exist. The EPA announced in March, 2010 that it is committed to investigating this question further.[282]

One emerging trend is that operators are starting to publish voluntarily the chemicals used in their hydraulic fracturing processes. For example, both Aubrey McClendon (President and Chief Executive Officer of Chesapeake Energy) and John Pinkerton (Chairman and Chief Executive Officer of Range Resources Inc.) have indicated that their companies will make the list of chemicals used publicly available, and Schlumberger is following suit.[283] The Fracturing Responsibility and Awareness of Chemicals Act (FRAC Act) is proposed federal legislation that would close the so-called Halliburton Loophole and would not allow operators to keep chemical formulas secret.[284] The FRAC Act was unsuccessfully introduced in 2009, and on March 15, 2011, United States Representatives Diana DeGette and Jared Polis (both Democrats from Colorado) reintroduced it to Congress.[285] The Shale Gas Subcommittee tends to agree with continued voluntary disclosure, accelerated if necessary, as "there is no economic or technical reason to prevent public disclosure of all chemicals in fracturing fluids, with an exception for genuinely proprietary information."[286] In its second 90-day report, the Shale Gas Subcommittee recommends that the U.S. Department of Interior follow through on its proposal to require disclosure of fracking fluid composition used on federal lands.[287]

The third option is a measured state response that requires lease-holding operators to disclose the chemicals used. Currently New York and Pennsylvania, and to a lesser extent Maryland, require disclosure, whereas Ohio and West Virginia do not.[288] On December 3, 2010, the state of New York took a different approach when the House Assembly voted 93 to 43 to prohibit the practice of hydraulic fracturing statewide for an 11-month period due to concerns about drinking water contamination.[289] Similarly, on March 25, 2011,

282. Wiseman, *supra* note 20, at 253.

283. Deweese, *supra* note 35, at 12-13; *see also* Timothy Gardner & Sarah N. Lynch, *Despite Probe, SEC Says Not Regulating Fracking*, REUTERS, Sept. 15, 2011, http://www.reuters.com/article/2011/09/15/us-usa-sec-fracking-idUSTRE78E5NK20110915 (an interesting recent development has the Security and Exchange Commission (SEC) inquiring about the fracking fluids used by certain companies. At the end of August, 2011 the SEC subpoenaed ExCo Resources Inc. and Quicksilver Resources Inc. as part of a probe to ensure these companies are accurately representing their natural gas reserves to their investors. As part of this process the SEC has asked these companies to disclose the chemicals used in their fracking process, with the intention of publicly disclosing the results. Despite concerns from industry that this is a veiled attempt to regulate fracking, the SEC insists it is simply part of the process to verify natural gas reserves).

284. Deweese, *supra* note 35, at 6.

285. David O. Williams, *DeGette, Polis Once Again Introduce FRAC Act to Bring Federal Oversight to Gas Fracking*, THE COLO. INDEP., Mar. 15, 2011 5:47 pm, http://coloradoindependent.com/79273/degette-polis-once-again-introduce-frac-act-to-bring-federal-oversight-to-gas-fracking.

286. SECOND NINETY DAY REPORT, *supra* note 280, at 17.

287. *Id.* at 5-6.

288. Wiseman, *supra* note 20, at 273.

289. Sarah Hoye, *New York Could Be the First State to Ban Controversial Drilling Practice*, CNN, Dec. 2, 2010, http://www.cnn.com/2010/US/12/02/new.york.fracking.moratorium/index.html?hpt=T2 (this proposed moratorium is currently before the Governor); *see also* Parker Waichman Alonso LLP, *Hydraulic Fracturing (Fracking) in New York*, WATER CONTAMINATION FROM SHALE BLOG, http://www.water-contamination-from-shale.com/new-york/hydraulic-fracturing-fracking-in-new-york/ (last visited Feb. 9, 2012).

the House of Representatives of the state of Maryland passed House Bill 852 (called the Maryland Shale Safe Drilling Act of 2011) by a vote of 98-40, which effectively bans hydraulic fracturing in the western portion of the state until 2013.[290] It is uncertain whether other Marcellus Shale states will follow the example set by New York and Maryland, but these moratoriums indicate that certain state legislators are taking concerns about water contamination seriously.

b. Waste Water Disposal

Each Marcellus Shale state has adopted different disposal priorities, including dilution and dumping, deep well underground injection, and treatment of wastewater at public and private treatment facilities. One solution is to rely on technological advances that maximize the ability for operators to recycle fracking fluid by utilizing wastewater in subsequent treatments.[291] Even if we assume that technology will be developed that maximizes recycling (such as the AltelaRain® 4000 water desalination system),[292] the hydraulic fracturing process will continue to produce a significant amount of waste water, making it prudent to consider improved regulation. As the Shale Gas Subcommittee suggests, maintaining water quality requires the adoption of best practices, public disclosure of water use, and increased field testing at well-sites.[293]

There are several watersheds and river basins that overlie the Marcellus Shale gas play and cross state lines.[294] Laura Reeder proposes that one way to approach water management in the Marcellus Shale region is through regional coordination between states.[295] As justification for this approach, Reeder suggests that the environmental and regulatory concerns are common to all the Marcellus Shale states and that there is considerable interconnectedness when it comes to water resources.[296] Basin-wide management strategies have been established for some of major rivers basins, such as the Susquehanna River Basin Commission (SRBC),[297] and there could be utility in coordinating efforts between basins or in expanding this to regional groundwater management as well. Reeder asserts that "[t]he creation of a centralized system for distribution of information for regulation of the specific compliance requirements associated with horizontal drilling [and] hydraulic fracturing" is a prerequisite to such

290. T.J. Scolnick, *Maryland House Votes for Moratorium on Shale Gas Development and Fracking*, DESMOGBLOG (Mar. 25, 2011), http://www.desmogblog.com/maryland-house-votes-moratorium-shale-gas-development-and-fracking.

291. Reeder, *supra* note 198, at 1013.

292. *See generally* Press Release, Office of Fossil Energy, DOE, Fossil Energy Techline: Water Treatment System Cleans Marcellus Shale Wastewater: DOE-Funded Field Demonstration Speeds Commercialization of Mobile Desalination System (Apr. 13, 2011), http://fossil.energy.gov/news/techlines/2011/11020-Water_Treatment_System_Cleans_Marc.html (describing the field testing of "Altela Inc.'s AltelaRain® 4000 water desalination system," a new approach to water reclamation that successfully treated 77% of waste water created over a nine-month trial, which produces distilled water as the final product).

293. 90-DAY REPORT, *supra* note 280, at 2-3.

294. J. DANIEL ARTHUR, MIKE URETSKY & PRESTON WILSON, ALL CONSULTING, LLC, WATER RESOURCES AND USE FOR HYDRAULIC FRACTURING IN THE MARCELLUS SHALE REGION 3 (2010), *available at* http://www.netl.doe.gov/technologies/oil-gas/publications/ENVreports/FE0000797_WaterResourceIssues.pdf.

295. Reeder, *supra* note 198, at 1014.

296. *Id.*

297. *Id.* at 1023.

development.[298] In Reeder's opinion, rather than hindering economic development, regional coordination will promote the maximization of the economic potential of the Marcellus Shale gas play and also minimize the ultimate cost to the environment.[299] Reeder's vision of regional coordination culminates in the creation of the "Marcellus Shale Compact Commission" through which Congress and the Marcellus Shale states standardize the current fragmented regulatory approach to produce a streamlined process that provides operational certainty for industry, protects the environment, and safeguards public health against the unknown consequences of hydraulic fracturing.[300]

IV. THE THEORETICAL FOUNDATION OF AN APPROPRIATE REGULATORY RESPONSE

My discussion in Part III emphasizes that Alberta's regulatory regime has seemingly developed independently from underlying federal obligations and that the Marcellus Shale states are employing a variety of regulatory schemes permissible because of key federal exemptions. Before delving into a discussion of the specific lessons that can be learned from Alberta's experience, and assessing appropriate regulation, it is important to describe arguments and theories that support increasing federal or regional environmental regulation.

In theory, there are two connected rationales justifying regional or federal regulation in situations where pollution is not contained within the borders of one state/province or where multiple states/provinces are interested in developing the same resource. The first theory, known as the "race-to-the-bottom," holds that in situations where both industry and commerce are mobile, states are incented to lower industrial environmental standards below an otherwise optimal level for environmental protection to reduce regulatory burdens and attract industry and prevent companies from migrating to jurisdictions with more favorable standards.[301] This situation may "exist whenever jurisdictions compete to attract or to retain industry by lowering their environmental standards," which, in turn, justifies creating and enforcing federal regulation.[302] The second connected theory engages interstate externalities and holds that federal or regional regulation is required where "a state that sends pollution to another state obtains the labor and fiscal benefits of the economic activity that generates the pollution but does not suffer the full costs of the activity."[303]

Professor Revesz has challenged the foundations of both these theories, questioning whether state competition truly decreases social welfare and asserting in the alternative that it leads to "competition [that] can be expected to produce an efficient allocation of industrial activity among the states," whereas it

298. *Id.* at 1020.

299. *Id.* at 1023.

300. *Id.* at 1024.

301. Richard B. Stewart, *Pyramids of Sacrifice? Problems of Federalism in Mandating State Implementations of National Environmental Policy*, 86 YALE L.J. 1196, 1212 (1976-1977).

302. Joshua D. Sarnoff, *The Continuing Imperative (But Only from a National Perspective) for Federal Environmental Protection*, 7 DUKE ENVTL. L. & POL'Y F. 225, 278 (1996).

303. Richard L. Revesz, *The Race to the Bottom and Federal Environmental Regulation: A Response to Critics*, 82 MINN. L. REV. 535, 538 (1997-1998).

is federal regulation that produces many undesirable consequences.[304] In terms of interstate externalities, Professor Revesz is similarly skeptical and utilizes the air pollution example to illustrate that varying state contributions, shifting membership in interstate pollution problems, and difficulties in pollution measurement render regional cooperation to address this issue unlikely.[305]

There are a few supporting or emerging theories that may also help justify federal or regional regulation in Alberta and in the Marcellus Shale gas play. The first theory of note is "environmental justice." This is the idea that minority and impoverished communities are underrepresented in environmental regulatory schemes, enabling polluters to externalize the costs of pollution in ways that affect the health and welfare of these communities.[306] Succinctly stated, environmental justice seeks the "fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies."[307] In situations where existing regulation facilitates environmental degradation that disproportionately affects certain minorities, environmental justice can serve to support regulatory intervention from a different level of government to address perceived wrongs.[308]

The last theoretical justification for regulating above the state/provincial level is the emerging concept of "sub-national environmental solidarity."[309] Under this approach, "solidarity" means "a principle of focused cooperation among actors to achieve an outcome that benefits all."[310] Environmental solidarity is a theory often associated with international environmental law where many nation states work together to address an environmental problem.[311] Professor Perkins argues that we are seeing the emergence of environmental solidarity at the sub-national level in the United States as states form a "collective force" when they join together as "actors that often generate[]

304. Richard L. Revesz, *Rehabilitating Interstate Competition: Rethinking the "Race to the Bottom" Rationale for Federal Environmental Regulation*, 67 N.Y.U. L. REV. 1210, 1212 (1992) (Revesz argues that one of the reasons that regional regulation is not appropriate is that states are generally non-cooperative, concluding that the race-to-the-bottom remains an interesting theoretical talking point but has yet to be proven in practice); *see contra* Sarnoff, *supra* note 302, at 230 (the author argues that there are a variety of reasons to continue to support federal environmental regulation, including: (1) the fact that federal regulation can be "more efficient than state regulation;" (2) the reality that it is appropriate for the federal government to regulate pollution that moves across state borders; (3) the suggestion that federal regulation will stop state regulation from sacrificing optimal social welfare for the sake of individual competitiveness; (4) federal regulation can account for environmental interests more appropriately than state legislators; and (5) that there is a greater ability at the federal level to codify the moral obligation to protect the environment).

305. Revesz, *supra* note 303, at 540.

306. Richard J. Lazarus, *Pursuing "Environmental Justice": The Distributional Effects of Environmental Protection*, 87 NW. U. L. REV. 787, 788 (1993).

307. OFFICE OF FED. ACTIVITIES, EPA, FINAL GUIDANCE FOR CONSIDERATION OF ENVIRONMENTAL JUSTICE IN CLEAN AIR ACT 309 REVIEWS, AT 7 (1999), *available at* www.epa.gov/compliance/resources/polic ies/nepa/enviro_justice_309review.pdf.

308. *Id.*

309. Nancy D. Perkins, *Form and Norm: The Transformative Potential of Sub-National Environmental Solidarity*, 20 FORDHAM ENVTL. L. REV. 469, 469 (2009-2010).

310. *Id.*

311. *Id.*

uniformity and consistency of action."[312] It is important to distinguish mere regional cooperation from true solidarity, however. Cooperation does not become "solidarity until there is a buy-in by all participants of a common good tied to community-wide well-being combine[s] with focused action that demonstrates acceptance of uniform, consistent response[s]."[313] In the opinion of Perkins, environmental solidarity has applicability in a variety of situations, including instances where a federal regulatory vacuum exists and where supplemental action is required.[314] Creating solidarity can trigger reform to flawed regulation and can be "informative, formative, and reformative."[315]

V. TOWARDS PROPER REGULATION – LESSONS FROM ALBERTA'S OIL SANDS

Learning from the oil sands experience, and through application of the theory justifying federal and/or sub-national regional regulation, it may be possible to develop the Marcellus Shale gas play as the important source of natural gas it has the potential to become.

A. Look Before You Leap (the Value of Scientific Assessment and Transparency)

Professor Hannah Wiseman notes the difficulty in designing and implementing appropriate regulation for the development of unconventional gas and oil.[316] She maintains that the fact that the assessment process is necessarily multi-factorial and contingent on everything from traditional scientific and economic studies to intergenerational and ethical concerns that are more difficult to quantify.[317] Alberta's oil sands experience demonstrates the importance of attempting this investigation prior to permitting a development boom, since once industry is established, it is difficult to undo what has occurred, especially given the long-term consequences of groundwater contamination and toxic waste accumulation. Determining whether optimal regulation occurs at the state, regional, or national level is contingent on being able to assess accurately the risks associated with resource development.

A significant concern in Alberta is the accumulation of toxic tailings that currently cannot be remediated.[318] This issue is compounded by the fact that tailings ponds may be leaking into nearby waterways and potentially contaminating downstream ecosystems and communities.[319] While hydraulic fracturing does not produce tailings *per se*, it does produce considerable quantities of wastewater that has been contaminated by both fracking chemicals and naturally occurring contaminants that the water contacts during fracking. Marcellus Shale states currently employ a variety of disposal techniques ranging from treatment in public water treatment plants to underground deep-water

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312. *Id.* at 487.
313. *Id.* at 488.
314. *Id.*
315. *Id.* at 498-502.
316. Wiseman, *supra* note 20, at 252.
317. *Id.*
318. HOLROYD & SIMIERITSCH, *supra* note 90, at 17-18.
319. *Id.*

injection.[320] Until the efficacy of these different disposal techniques is understood, caution in the face of uncertainty is prudent.

The emerging in situ oil sands extraction process engages a different set of issues than surface extraction. Of paramount concern is the effect that steam injection using groundwater will have on the overall hydrologic cycle of this portion of the Mackenzie Basin.[321] In addition to being a consumptive use of freshwater, there are still considerable knowledge gaps that the scientific community has yet to fill concerning the hydrologic cycle and the long-term consequences that the redistribution of groundwater will have on cycling and hydrologic patterns. As previously mentioned, the main concern from citizens in the Appalachian Basin is that the consumptive fracking process, which uses considerable quantities of chemical additives and also liberates naturally occurring heavy metals and radionucleotides, will contaminate groundwater or surface water that serves as a source of drinking water.[322] Given the slow rate of groundwater flow compared to surface water flow, it could be decades before the true consequences of this practice are known, heightening the need for proper assessment.

A third lesson to be learned from oil sands is the need for legally mandated transparency and separation between the regulator and operator within the monitoring process.[323] The Pembina Institute hopes for a "consistent, transparent and integrated monitoring system, at arms-length from industry, on water quality and quantity and aquatic ecosystems" in the oil sands region.[324] The efficacy of RAMP and CEMA, the two agencies responsible for monitoring water quality, has been called into question, and recent developments indicate that future monitoring of water quality in the oil sands will be significantly different.[325] The key transparency issue in the Marcellus Shale region is public disclosure of the chemicals utilized by industry in the fracking process.[326] Currently, federal regulation provides considerable deference to industry in the so-called Halliburton Loophole.[327] In light of the recent Congressional Investigation that reveals the unauthorized use of diesel fuel, it might be time to reconsider this exemption.[328] The Secretary of Energy Advisory Board also confirms that eliminating the use of diesel fuel is a top priority.[329]

There are signs that the EPA and some state regulators are already aware that these problems require immediate attention. In terms of the scientific research and existing uncertainty, the EPA initiated research into the consequences of hydraulic fracturing in the Marcellus Shale basin in 2010,

320. Weston, *supra* note 45, at 16.

321. *See supra* Section III.A.3 and accompanying text.

322. *See generally* Reeder, *supra* note 198, at 1012.

323. HOLROYD & SIMIERITSCH, *supra* note 90, at 42.

324. *Id.*

325. *Id.* at 1-2.

326. *See generally* Pelton, *supra* note 277.

327. *Id.*

328. House Committee Letter, *supra* note 276.

329. *See generally* SECOND NINETY DAY REPORT, *supra* note 280, at 4.

focusing on environmental impacts and public health effects.[330] Importantly, this study will incorporate industry's perspective, but as Dr. Paul T. Anastas (assistant administrator in the EPA's Office of Research and Development) indicates, "[t]he study will be conducted through a transparent, peer-reviewed process, with significant stakeholder input."[331] Similarly, the Shale Gas Subcommittee has highlighted certain shortfalls in the development of shale gas and recommends everything from disclosure of fracking chemicals to the development of best practices, improved water monitoring, and assessment of cumulative effects of development.[332] The second indication that regulators are taking these issues seriously is the moratoria on hydraulic fracturing passed in New York and Maryland, where the goal is to prevent development until the impact of hydraulic fracturing in this region is understood.[333] It is yet to be seen if the other Marcellus Shale states will move to impose moratoriums or if they are content to risk water contamination in favor of industrial opportunity.

B. The Federal Role Deserves Further Consideration

While the American and Canadian approaches to natural resource and water regulation may vary in many ways, they are similar in the context of unconventional oil and gas extraction in that the federal regulator, in both instances, has the ability to create the basic framework within which states or provinces take the lead in development and regulation. We should not discount the role that the federal regulator could play in both countries as unconventional fossil fuel extraction progresses, especially in instances where the province or state fails to appropriately regulate industrial activity. Water is a matter of national importance, as are the environmental and public health concerns, all of which have an inter-state and inter-provincial component as a result of the network of rivers and underground aquifers within the Mackenzie Basin and the Appalachian region.

In Alberta, the Pembina Institute suggests that engaging the federal government in oil sands regulation simply requires a rejuvenated mandate to enforce existing applicable legislation.[334] There has always been considerable tension between the Canadian federal government and the prairie provinces regarding natural resources, a tension heightened because the oil sands are wholly situated within one province. Still, it is worth considering whether the United States federal government has this option available to it if development in the Marcellus Shale region proceeds at an inappropriate pace.

When the EPA issued its 1988 determination that the control of oil and gas exploration and production wastes did not have to be covered by Subtitle C regulations of the Resource Conservation and Recovery Act, the states were, in

330. Press Release, EPA, EPA Initiates Hydraulic Fracturing Study: Agency Seeks Input from Science Advisory Board (Mar. 18, 2010), *available at* http://yosemite.epa.gov/opa/admpress.nsf/e77fdd4f5afd88a3852576b3005a604f/ba591ee790c58d30852576ea004ee3ad!opendocument.

331. *Id.*

332. 90-DAY REPORT, *supra* note 280, at 3-6.

333. *See supra* notes 289 and 290 and accompanying text.

334. *See generally* DUTY CALLS, *supra* note 78.

essence, entrusted with primary control.[335] Hannah Wiseman asserts that in hindsight this afforded too much discretion to the states and the result has not been what the EPA would have anticipated.[336] As I have noted in this article, the fragmented state-by-state approach to Marcellus Shale regulation has led to significant discrepancy between states, as some have opted for a precautionary approach in the face of uncertainty whereas others have embraced the boom mentality and are moving forward rapidly. Unlike the situation in Canada, where the federal government can reassert itself in the oil sands by more rigorously enforcing existing laws, the U.S. federal government would have to fill the gap that it has created in this area by further amendments or new legislation specific to hydraulic fracturing.[337] Commentators on both sides of the Marcellus Shale debate recognize that this is a tall order that would be met with considerable resistance.[338] Perhaps by initiating a comprehensive, independent, and peer-reviewed assessment of the environmental and public health consequences, the EPA has already started the process needed to fill a crucial void that the states have yet to address.[339]

The Chesapeake Bay Foundation announced on April 4, 2011, that it has filed a legal petition pursuant to the National Environmental Protection Act, calling for the federal government to conduct "a Programmatic Environmental Impact Statement, of the risks and cumulative impacts of the extraction of natural gas from the Marcellus Shale formation in the Chesapeake Bay states[, Virginia, West Virginia, Pennsylvania, Maryland, Delaware, and New York]," and to take appropriate actions once the comprehensive assessment is complete.[340] In the opinion of the Chesapeake Bay Foundation, "[e]nsuring clean, safe drinking water, healthy aquatic ecosystems, and healthy air across a multi-state ecosystem cannot be done without an unbiased comprehensive assessment of all the impacts."[341] The Secretary of Energy Advisory Board picks up on these concerns and recommends that there should be measurement and public reporting on "the composition of water stocks and flow throughout

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335. Wiseman, *supra* note 20, at 243-244; *see also* EPA, EXEMPTION OF OIL AND GAS EXPLORATION AND PRODUCTION WASTES FROM FEDERAL HAZARDOUS WASTE REGULATIONS 5 (1988), *available at* http://www.epa.gov/osw/nonhaz/industrial/special/oil/oil-gas.pdf.

336. Wiseman, *supra* note 20, at 248.

337. Schauwecker, *supra* note 40, at 47 (this author suggests that the Federal government might be able to be creative in its application of the Produced Water Utilization Act of 2009 to promote more efficient uses of the water that is produced during natural gas extraction after hydraulic fracturing and, also, that the EPA has the obligation pursuant to the Water Use Efficiency and Conservation Research Act to address the concerns associated with hydraulic fracturing, because this legislation "directs the U.S. Environmental Protection Agency to establish a research and development program that promotes water efficiency and conservation").

338. Deweese, *supra* note 35, at 21 (the author makes the point that in his opinion state regulation has proved responsive and appropriate thus far and that Congress acting to bring hydraulic fracturing within the purview of the SDWA will only serve to stifle further development of this necessary resource); *see also* Wiseman, *supra* note 20, at 286 (where the author emphasizes that there are a variety of actions that states could undertake to enhance the regulatory regime, but that if they fail to do so federal intervention becomes necessary. Wiseman indicates that such federal interaction would be met with considerable opposition, as stakeholders and operators do not take kindly to such federal action).

339. Wiseman, *supra* note 20, at 283.

340. Press Release, Chesapeake Bay Foundation, CBF and Partners: Federal Government Must Assess Regional Impacts of Shale Drilling (Apr. 4, 2011), *available at* http://www.cbf.org/Page.aspx?pid=2411.

341. *Id.*

the fracturing and cleanup process" and a "systems approach" to water management in regions of hydraulic fracturing.[342] The level of concern in Alberta has escalated to the point that Albertans may not oppose federal intervention if the Government of Alberta does not act to protect public health and the environment. If the EPA's comprehensive review sheds new light on the consequences of fracking and horizontal drilling, and states still do not act, the time will be right for the EPA to re-consider the 1988 Schedule C exemption, as it is entitled to do if circumstances change.

It is uncertain the extent to which the race-to-the-bottom or interstate externalization theories can explain the current regulatory situation in either Alberta or the Marcellus Shale states, but assessing their applicability is still a useful exercise. In terms of race-to-the-bottom, this theory has application to Alberta (even though oil sands development is currently occurring wholly within Alberta) given that the province is in competition with jurisdictions producing conventional oil as a major exporter to the United States. It is likely not controversial to conclude that the environmental and social impact of oil sands development is sub-optimal, and it is possible that the regulator in Alberta has intentionally kept environmental regulation lax to promote foreign investment and development; if this is the case, enhanced federal regulation is reasonable. Assessing the applicability of a race-to-the-bottom amongst the Marcellus Shale states is more difficult, especially since recent moratoriums on hydraulic fracturing in New York and Maryland suggest that certain states are more interested in public health and environmental issues then development.

Nonetheless, my analysis suggests that there are significant interstate externalities associated with developing both the Marcellus Shale gas play and the oil sands, and in both instances, this may justify federal intervention even if race-to-the-bottom theory does not. Alberta is just now starting to assess the intra-provincial consequences of oil sands water contamination properly and thoroughly. It will likely be some time before the impacts on communities and waterways in other provinces and territories are rigorously examined. It is worth noting that the downstream communities directly impacted by oil sands development are predominately minority Aboriginal communities that still rely on the land for many subsistence purposes.[343] Environmental justice theory suggests that the Alberta regulator has created a regime whereby operators in the oil sands externalize the burdens of pollution upon Aboriginal minority communities that are not as well organized or funded and, consequently, less able to mount legal challenges. This externalization of the harm further justifies increased federal participation in oil sands regulation to ensure proper protection for Aboriginal populations.

The situation is quite different in the Marcellus Shale gas states where interstate contamination and sediment loading has already been reported. The current regulatory variation that exists amongst the Marcellus Shale states means that even if states are not competitively lowering their environmental standards, the current regime is inadequate to protect downstream states from adverse environmental and social impact, and this justifies enhanced federal regulation.

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342. SECOND NINETY DAY REPORT, *supra* note 280, at 16.

343. DUTY CALLS, *supra* note 78, at 4; *see generally* GRANT ET AL., *supra* note 87.

C. Is Regional Management the Appropriate Compromise?

Federal involvement in unconventional fossil fuel management might be the most comprehensive solution. However, this may be hampered by industrial lobbying and political tensions in both Canada and the United States. Regional management is a possible compromise.

Alberta has turned towards regional management in its Water For Life strategy and also the water management frameworks for some of the major rivers in the Mackenzie Basin. Both frameworks utilize a "protective Ecological Base Flow (EFB) below which water withdrawals are prohibited."[344] Some have suggested that regional management should be expanded beyond watersheds and river basins within Alberta to cover downstream provinces and territories, and most importantly the Northwest Territories where the Mackenzie River Basin provides local inhabitants with food and drinking water.[345] The Royal Society of Canada has noticed the importance of regional management and assessment, suggesting that a regional approach should be expanded to groundwater extraction, groundwater impact assessment, and to further understanding of how surface water and groundwater interact in oil sands extraction areas.[346]

The existence of river basin management commissions for both the Susquehanna River and the Delaware River "[which has] authority over entire river basins . . . that are looking at regional, interstate issues" indicate that an additional level on top of state agency control is possible.[347] In light of the progression of regional management in Alberta, the next step for regional management of water in the Marcellus Shale gas play should be turning attention to groundwater concerns rather than just water withdrawals, and also the interplay between surface water and groundwater. Laura Reeder proposes that the obvious progression for regional management in this area is the creation of a "Marcellus Shale Compact Commission" that engages Congress and the Marcellus Shale states and standardizes the permitting and reporting requirements for operators.[348] If regional commissions can be established for the major waterways in the region and their jurisdiction expanded to groundwater issues, it may be unnecessary to engage Congress in this regulation. The Shale Gas Subcommittee has proposed reliance on integrated water management that manages water throughout its life cycle during shale gas extraction, reports to the public at each stage of use, and about any transfer of water between locations.[349] The Shale Gas Subcommittee proposes that such a water management approach should occur at the regional level to account for water impacts.[350] It is possible that focusing on regional coordination to address these issues might pressure the Canadian and American federal governments to re-examine their regulatory role, prompting these reforms.

It might not be possible for Alberta to move towards sub-national environmental solidarity in terms of oil sands regulation given the reality that

344. HOLROYD & SIMIERITSCH, *supra* note 90, at 28, 41.

345. GRANT ET AL., *supra* note 87, at 11.

346. GOSSELIN ET AL., *supra* note 6, at 153-154.

347. ARTHUR ET AL., *supra* note 294, at 18.

348. Reeder, *supra* note 198, at 1024.

349. 90-DAY REPORT, *supra* note 280, at 23.

350. *Id.*

Alberta is, at this point, the only province whose water quality and quantity is dramatically being affected by oil sands activity. Ideally, regional cooperation amongst the Marcellus Shale states could emerge as something more than mere cooperation, helping to create a "collective force" of action in this region capable of responding to the environmental and social concerns of Marcellus Shale gas play development without hindering the proper development of this important natural gas reserve.[351] Professor Perkins has suggested that recent regional action in the United States supports a movement towards environmental solidarity, and she provides numerous examples. The first two are the Regional Greenhouse Gas Initiative and the Western Climate Initiative in which American states (and to some extent Canadian provinces) have voluntarily agreed to address climate change and the absence of a comprehensive federal regulatory response by implementing regional cap and trade.[352] Even more applicable examples of environmental solidarity can be found in the Chesapeake Bay Program (operational since 1983) and more recently in the Great Lakes initiative, both initiated in response to perceived regulatory shortcomings of the Clean Water Act.[353] The Chesapeake Bay Program involves a partnership between states and the District of Columbia and the EPA to create a "legitimate governance structure that unifies government and non-government actors in a collaborative enterprise focused on a common good [being the recovery of the Chesapeake Bay]."[354] In the opinion of Perkins, these initiatives have been extremely successful, and "[i]n addition to addressing the common good through environmental improvement, environmental solidarity yields better informed participants, efficiencies . . . , and . . . experimentation."[355]

In addition to these benefits, it does not appear that regional coordination in the Marcellus Shale gas play would be hampered by the characteristics of air pollution that has rendered regional management inappropriate. The Marcellus Shale states are a defined set of states. Water pollution can be measured and quantified. Water pollution can be traced to a source, and the range of issues affecting this category of states is similar.[356] The fact that the impacts of Marcellus Shale gas play development are being considered at the river basin level is a step in the right direction, and moving forward, it is this author's hope that regional coordination will expand beyond state borders and that the most appropriate form of regulation develops, consisting of comprehensive regional coordination in the form of an agreement between EPA and the Marcellus Shale states in a way that mitigates present and future water concerns without prohibiting the proper development of this important resource.

Both Alberta and the Marcellus Shale states have considerable work to do in developing these important unconventional oil and gas resources in ways that do not compromise valuable water resources. The regulatory transformation

351. Perkins, *supra* note 309, at 487.

352. *Id.* at 488.

353. *Id.* at 491.

354. *Id.* (the Great Lakes initiative involves similar coordination and cooperation).

355. *Id.* at 496.

356. Revesz, *supra* note 303, at 540 (noting that the characteristics of air pollution render it inappropriate for regulation by "interstate compacts").

needed to accomplish this may take many forms, but until it occurs, concern about the consequences of such development will linger.

VI. CONCLUSION

Unconventional oil and gas may very well represent the energy needed to satiate society as our search for sustainable energy continues. Nevertheless, we must be mindful of the novel challenges presented by unconventional oil and gas development. This comparison of the Alberta oil sands and the Marcellus Shale gas play has demonstrated that certain regulatory features are required to facilitate the organized development of unconventional oil and gas.

Both Canada and the United States have significant and legitimate interests in developing the oil sands and the Marcellus Shale gas play, and it is unlikely that development of either will be slowed in the foreseeable future. For this reason, it is crucial that the proper regulatory framework be established before the opportunity passes. There are a variety of environmental issues to be addressed in both regions, but this assessment concludes that water should be the top priority. Freshwater use and scarcity are poised to become the most important environmental and social issues of the 21^{st} century, and it is imprudent to proceed without properly monitoring and regulating the consequences of unconventional fossil fuel development on water.[357]

An application of pertinent legal theory suggests that federal or regional regulation is justified in both Alberta and the Marcellus Shale states, based on race-to-the-bottom theory and interstate pollution externalization, respectively. Alberta's regulatory regime favors development over environmental protection to promote foreign investment option and commodity exports. Only now are these issues being addressed, and federal intervention is justified. The Marcellus Shale states appear to be well-suited to regional cooperation and environmental solidarity because all Marcellus Shale states stand to gain the same economic benefits from developing the gas, the regional hydrologic cycle is interconnected, and each state is faced with similar environmental and social problems if development proceeds unchecked. Regional coordination is currently used to address climate change and inter-state pollution, and the orderly development of the Marcellus Shale gas play could be approached the same way.[358]

Perhaps the most important lesson from Alberta's oil sands experience as the Marcellus Shale states move forward is that it is preferable to assess the impact of resource extraction before industry is entrenched within a boom-time regulatory regime. After forty-four years of commercially viable extraction in the Alberta's oil sands, millions of liters of toxic waste continue to accumulate without a feasible reclamation procedure. Only now is the Government of Alberta seriously considering how to best monitor the human health effects and a possible retraction of oil sands leases issued in an unsustainable manner (a

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357. *See generally* U.N. ENV'T PROGRAMME, WATER POLICY AND STRATEGY OF UNEP (2007), *available at* http://www.unep.org/Themes/freshwater/Documents/Water_Policy_Strategy.pdf (outlining the importance of freshwater management and conservation throughout the world, and highlighting the fact that water is poised to become a major area of concern, if it not already one).

358. Perkins, *supra* note 309, at 488.

reactionary method of regulatory control that should be discouraged within Western democracies).

Unconventional resource development requires an innovative regulation. Water conservation necessitates coordination beyond provincial and state boundary lines in the form of regional and/or federal management to address the water quality and quantity concerns. If this remains the goal, I have no doubt that both Alberta and the Marcellus Shale states, in addition to Canada and the United States as a whole, can reap the benefits of these key unconventional resources.