Juliana Williams
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American Tar: Learning from the Canadian Tar Sands Experience

Nearly a year after the United States House of Representatives passed the American Clean Energy and Security Act (H.R. 2454), the U.S. still lacks a federal climate policy. In the absence of regulatory certainty and exposure to highly volatile oil prices in the past two years, the expansion and development of fossil fuel resources has been erratic. High oil prices and declining production from conventional sources make unconventional fuels more economically attractive, whereas pending climate regulations increase the risk of investing in such technologies. The tension between energy security and low carbon energy make it likely that federal climate policy will include exemptions for domestic fuel production.

Against this background, the future of tar sands development in the United States is uncertain at best. The first permits for commercial production of tar sands have been granted to a Canadian-based company to extract fuel from the Uintah Basin in Utah on state trust land. The State of Utah's desire for economic development could pose a challenge to the Obama Administration's commitment to reduce the country's contribution to climate change. With resolution of domestic climate policy anywhere from months to years away, it is prudent to draw lessons from the Canadian tar sands experience. This paper provides an overview of tar sands production and environmental impacts, Canadian tar sands development, potential tar sands development in Utah, as

well as discussion of the implications of tar sands development on domestic and international climate policy.

Tar Sands

Distribution

Tar sands produce an unconventional fossil fuel that is derived from the extraction of bitumen, a "thick tar-like substance" that is the lowest grade of crude oil.[1] According to the Alberta Energy and Utility Board, approximately 80 percent of the world's recoverable tar sands deposits are located in North America. [2] Alberta, Canada has an estimated 1.6 trillion barrels of tar sands reserves, of which 175 billion barrels are recoverable tar sands under current economic conditions. Over 54,000 square miles are being developed for tar sands extraction in Alberta, an area that is nearly a quarter of the landmass of the province and equivalent in size to the entire state of Florida.[3]

In 1984, United States Geological Survey estimated that the United States has a total of 53.7 billion barrels of tar sands, of which 11 billion barrels were considered recoverable at the time. The largest tar sands deposits are located in Utah and Texas, but smaller deposits are also found in Alabama, Kentucky and California. More recent estimates indicate that Utah holds approximately 93 percent of total United States tar sands resources and could yield 12-19 billion barrels of tar sands.[4]

Extraction

Also known as 'oil sands' in Canada, tar sands contain approximately 3-18 percent bitumen, 2-10 percent water and 80-85 percent sand or clay.[5] The extraction of bitumen from tar sands is accomplished through two dominant methods: surface mining and in-situ production. Surface mining is typically used for deposits with less than 75

meters of overburden – the plant life, soil, and bedrock between the tar sands deposits and the ground surface. The sands are washed to separate the bitumen from the sand, and typically returned to the mine site for reclamation. In-situ production extracts the bitumen through direct pumping (cold flow), steam-assisted gravity drainage (SAGD), and vapor extraction (VAPEX) processes.[6] SAGD, the most common in-situ production method, pumps steam through horizontal wells drilled into the deposit. The steam liquefies the bitumen, which drains into a second horizontal well beneath the steam well. VAPEX is a new process similar to SAGD, but uses hydrocarbon solvents instead of steam to separate the bitumen from the sand. In 2005, surface mining accounted for about 52 percent of Canadian tar sands production. While in-situ production accounted for the other 48 percent, this proportion is expected to grow due to efficiency improvements and access to deeper tar sands deposits.[7]

Tar sands are frequently classified as "water-wet sands" or "oil-wet sands," depending on whether there is a layer of water surrounding the grains of sand or if the oil is in direct contact with the sand.[8] Oil-wet sands extracted through surface mining require additional washing to recover the bitumen. In open pit mining, extraction of one barrel of bitumen requires twelve barrels of water and, despite water recycling, consumes three barrels of potable water.[9] The wastewater is stored in massive tailings ponds to, in theory, allow the pollutants to settle out.[10]

The SAGD process separates bitumen from the sands during the initial extraction, which requires less water for washing, but consumes significant volumes of water for steam generation. Early industry estimates predicted that only two barrels worth of steam

were needed to melt one barrel of bitumen, but some projects require seven to eight barrels of water per barrel of bitumen.[11] The production of steam for SAGD extraction requires between 750 and 1,500 cubic feet of natural gas per barrel of bitumen.[12] This amount of natural gas is equivalent to the energy content of one-eighth to one-quarter of a barrel of oil. Natural gas costs account for over 60 percent of the operating costs for SAGD projects, but only 15 percent of the surface mining costs.[13] VAPEX, on the other hand, requires no water for washing or steam and has operating costs about half those of SAGD projects because it is not necessary to burn natural gas to make steam.

Roughly 75-90 percent of the bitumen can be extracted from the sand and must be upgraded to a lighter grade of crude before it can be refined into gasoline.[14] The bitumen is upgraded by the removal of carbon and the addition of hydrogen through coking, catalytic conversion and hydroprocessing. This process produces a synthetic crude oil so viscous that it must be diluted with natural gas in order to pipe it to refineries. Finally, upon arrival at oil refineries the synthetic crude oil is refined into gasoline or diesel that can be used in vehicles or for electricity production.

Environmental Impacts

Until recently, tar sands were not a major fuel source for two primary reasons: they produce heavy crude with high levels of impurities and they are expensive to extract. As the economic barriers decline from increasing production efficiencies and the high price of oil, the quality of fuel derived from the tar sands and the waste associated with it has become a global environmental issue. Tar sands generate pollution throughout virtually every step of extraction: leaks from pipelines; major spills of bitumen; oil and wastewater; evaporation from tailings ponds; seepage from tailings ponds; stack

emissions; coke dust; dry tailings; outgassing from mines; and construction of mining facilities.[15]

The toxic slurry that is stored in the tailings ponds poses a significant risk of groundwater contamination. As of 2008, the tailings ponds in Alberta occupied an area of nearly 50 square miles.[16] Environmental Defence, a Canadian organization, estimates that 11 million liters of contaminated wastewater escape from the tailing ponds each day.[17] In 2008, a highly publicized incident where hundreds of migratory birds died after landing in a tailings pond highlighted the impact of storing such massive volumes of toxic wastewater. In addition to the immediate pollution impacts on groundwater and ecosystems, the development of the tar sands over such a large area compounds the industry's contribution to climate change: destruction of the boreal forest in Alberta (one of the world's largest carbon sinks) and production of carbon intensive fuel.

Beyond extraction, the processing of bitumen must remove contaminants such as arsenic, cyanide, benzene, salt, lead, mercury, nickel, and phenols to process the fuel into gasoline. Removing these substances and upgrading the fuel by adding hydrogen to the bitumen generate two to three times more nitrogen dioxides, sulfur dioxide, volatile organic compounds and particulate matter than the process of refining conventional oil.[18] On average, the production of oil from tar sands generates 85.5 kg CO_2 equivalent per barrel compared to 28.6 kg CO_2 equivalent per barrel for conventional oil production.[19] Most of the increase in greenhouse gas emissions of oil from tar sands comes from the amount of natural gas required for extraction. Approximately 10 percent of Canada's

natural gas consumption, 800 million cubic feet, is used for extracting and upgrading bitumen from the tar sands.[20]

Canadian Tar Sands

Commercial exploitation of the Canadian tar sands stretches back to the 1970s, but has only experienced rapid expansion since 1996. That year the government released the "Declaration of Opportunity," a roadmap for rapid development of tar sands as a route to self-sufficiency and economic growth. Government incentives and streamlined permitting processes spurred massive private investment in developing the tar sands. In particular, Alberta collects royalties at 1 percent of gross revenue, until all project construction costs are recovered; at that time the royalty rate increases to 25 percent.[21] By 2008, the Energy Resources Conservation Board, Alberta's oil and gas regulator, had approved 1,000 tar sands projects. [22]

Canadian production of oil from tar sands approximately doubled in the ten years after the Declaration of Opportunity was released, and was producing 1.2 million barrels per day (mbd) in 2008. Continued expansions are expected to increase production capacity to 2.8 mbd by 2012.[23] The current level accounts for approximately 42 percent of Canada's total crude oil production, a proportion that will increase as conventional oil production declines.[24] However, total world oil demand is around 85 million barrels per day, and oil from the tar sands makes up 1.5 percent of world oil demand. Even with continued rapid expansion, tar sands are only expected to produce 4.1 percent of global crude by 2025.[25]

The tar sands are Canada's single largest source of greenhouse gas emissions, generating approximately 8 percent of the country's total.[26] Greenhouse gas emissions from the tar sands are expected to reach between 108 and 126 megatons of CO_2e by the year 2015. While the industry has reduced its emissions intensity by 29 percent between 1995 and 2004, overall emissions have increased due to massive increases in production.

The massive expansion of the tar sands has brought substantial economic growth to Alberta and the country as a whole, but this development is at odds with the country's professed commitment to dealing with climate change. In 2002, Canada ratified the Kyoto Protocol and committed to reducing its greenhouse gas emissions to 6 percent below 1990 levels by 2012. As of late 2009, Canadian emissions were 26 percent higher than 1990 levels.[27] Canada's Federal Environment Minister, Jim Prentice, stated in 2008 that Canada would not risk harm to its weakened economy for the sake of environmental protection related to the tar sands.[28]

This blatant disregard for Kyoto commitments has drawn criticism from the international community and positioned Canada as an obstructionist country in the post-Kyoto climate negotiations. At the United Nations Framework Convention on Climate Change intersessional meeting in Bangkok in October 2009, delegates from the G-77 walked out during Canada's speech.[29] Frustrated in efforts to make progress with the Canadian government, Members of the European Parliament sent an open letter to CEOs of Shell, BP, StatOil and Total last year urging them to stop investing in the tar sands. In her appeal, Corrine Lepage, Vice-Chairwoman of the Environment Committee of the European Parliament said, "Tar sands are one of the reasons why Canada has failed to

live up to its commitments under the Kyoto Protocol, they should not be a cause for Canada to undermine the possibility to get an ambitious agreement in Copenhagen."[30] After a coalition of Shell shareholders forced a resolution onto the agenda of the annual meeting, the company announced the postponement of decision-making regarding expansion of its Athabasca Oil Sands Project until the second half of this decade and instead, will increase production from its other facilities.[31]

Utah Tar Sands

Similar to efforts in Canada, efforts to extract tar sands from Utah began in the 1960s and 1970s. Government collaboration with major oil companies, including Shell, Conoco, Mobil, Exxon, and Chevron, led to 52 pilot projects around the United States, involving both surface mining and in-situ extraction. However, none of these facilities managed commercial production of oil and most were abandoned.[32] Some of these facilities, most notably Asphalt Ridge in Utah, simply mined the tar for use in road construction instead of refining it into oil.

Through the Combined Hydrocarbon Act of 1981, Congress established Special Tar Sands Areas (STSAs), in which companies and private landowners were allowed to add tar sands extraction in existing oil and gas leases.[33] It also directed the Bureau of Land Management (BLM) to establish the boundaries of STSAs and draft a Combined Hydrocarbon Environmental Impact Statement for Utah. In 1984, the EIS was completed and identified eleven STSAs available for tar sands development in Utah.[34] The Act was intended to help spur development of tar sands for crude oil, but was not enough to make tar sands extraction economically viable.

Activity around domestic tar sands waned in the 1980s due to low oil prices, but was revived when Congress passed the Energy Policy Act of 2005 (EPAct). Section 369 of the Act, also called the Oil Shale, Tar Sands and Other Unconventional Fuels Act of 2005, stated that, "…oil shale, tar sands and other unconventional fuels are strategically important domestic resources that should be developed to reduce growing dependence of the United States on politically and economically unstable sources of foreign oil imports."[35] The EPAct directed the Interior Secretary to develop a programmatic environmental impact statement (PEIS) for commercial leasing for tar sands and oil shale in Utah, Colorado and Wyoming. The PEIS was completed in September 2008, at which point commercial leasing became available on federal land.[36] Although the STSAs are approved for leasing, the Obama Administration has been reluctant to put any of the leasing rights up for auction.

The development of tar sands on federal land must meet stricter regulatory requirements and approval guidelines than activities proposed on state-owned land in Utah. The State of Utah School and Institutional Land Trust Administration (SITLA) manages land granted to the State by the Federal Government in the Utah Enabling Act of 1896. For nearly a century, the nature of that management lacked clarity, until the Utah Legislature passed the School and Institutional Lands Management Act of 1994, which specified that the primary goal of state land management was to "manage the lands and revenues generated from the lands in the most prudent and profitable manner possible, and not for any purpose inconsistent with the best interests of the trust beneficiaries."[37] SITLA has determined that mining is not a violation of the trust and has encouraged

extractive activities on SITLA land across the state. Environmental advocates argue that tourism generates greater revenue and does not diminish the quality of the land with use compared to mining, but these arguments have had relatively little sway with SITLA and the Utah Department of Oil, Gas and Mining, the agency responsible for approving mining permits.

In 2006, Earth Energy Resources, a Canadian company, acquired the leasing rights to 5,930 acres of SITLA land in PR Spring, Utah for tar sands development. The PR Spring area is estimated to have tar sands deposits between 3.3 to 4.5 billion barrels over approximately 225 square miles (144,000 acres).[38] In November 2009, the company received regulatory approval to begin commercial operation and declared, "This is the first oil sands production permit to be granted in the United States and represents a very significant milestone for the Company and the US domestic oil sands and oil shale industry."[39]

The company intends to use VAPEX, which minimizes water consumption, to reach the deposits. VAPEX substantially reduce natural gas and water consumption, has operating costs half that of SAGD, but faces the challenge of safe chemical disposal. D. Glen Snarr, President and CFO of Earth Energy Resources claims that the company will use only 1.5 barrels of water per barrel of oil, and that the water will come from deep groundwater sources.[40] Local environmental organizations are urging the Environmental Protection Agency to require further air and water quality permits in attempt to delay construction. Although Earth Energy Resources currently has regulatory approval, they must still raise $35 million before construction can begin.[41] The sluggish pace of

domestic tar sands development is well characterized by a 2008 report by the Congressional Research Service, which concludes that,

> "In light of the environmental and social problems associated with oil sands development, e.g. water requirements, toxic tailings, carbon dioxide emissions, and skilled labor shortages, and given the fact that Canada has 175 billion barrels of reserves…the smaller U.S. oil sands base may not be a very attractive investment in the near-term."[42]

United States Energy and Climate Policy

Canada is now the largest supplier of oil to the United States, representing 18 percent of U.S. oil imports and 12 percent of total American oil consumption. Of the 1.82 million barrels per day produced in Canada in 2006, 1.8 mbd, or 99 percent, were exported to the United States for refinement or consumption.[43] Due to the high degree of economic integration between the two countries, about 70 percent of the current refinery expansion in the United States is intended to accommodate higher imports of Canadian bitumen.[44]

Building on the efforts of the North American Free Trade Agreement (NAFTA) to integrate Canadian, Mexican and American markets, leaders of the three countries launched the Security and Prosperity Partnership of North America (SPP) in 2005. One of the efforts first priorities was to create an Oil Sands Working Group, which recommended further rapid development of the tar sands as a means to displace Middle Eastern oil and improve energy security.[45] In order to replace all Middle Eastern oil, the United States would need to import 3.8 mbd of tar sands oil by 2016. While such a move would reduce the amount of revenue the United States sends to adversarial governments overseas, which was $440 billion in 2008. However, the Council on Foreign Relations

asserts that replacing Middle Eastern oil with tar sands would do little to change global energy dynamics because tar sands represent such a small percentage of global production.[46]

Tensions between environmental groups and the State Department over refining capacity have markedly risen in the last three years. In 2008, the Natural Resources Defense Council sued the U.S. State Department, arguing that that the State Department's Environmental Impact Statement produced by the Bush administration for TransCanada's Keystone XL Pipeline fails to take into account the greenhouse gas emissions from extraction and refinement, even though the source of the emissions is outside the U.S. borders. The State Department responded that only the environmental impacts of the pipeline and transportation of the crude should be considered.[47] The Sierra Club asserts that the construction of the Keystone Pipeline would result in about 38 million metric tons of additional greenhouse gas emissions per year.[48] In November 2009, four environmental and Native American groups sued the State Department for its approval of Enbridge Energy's proposal to build the Alberta Clipper tar sands pipeline.[49] The pipeline would transport 450,000 barrels per day of tar sands crude from Alberta to Wisconsin for refining. The groups argued that the U.S. Army Corps of Engineers failed to adequately analyze the indirect and cumulative impacts of the proposed pipeline. Legal challenges to approval of the expansion of tar sands import infrastructure are expected to continue.

Further dependence on tar sands oil is not likely to reduce American exposure to price volatility. Technological improvements have reduced operating costs from over $20 per barrel in the 1970s to $8-12 per barrel in 2000.[50] While further technological

improvements have been made, the dependence of SAGD extraction on natural gas leaves the industry vulnerable to rising gas prices. The fact that in-situ operations require less capital investment than surface mining operations presents a trade-off between capital and operating costs for the two primary methods of extraction.

The economic viability of tar sands is perhaps the most important factor in determining the pace of tar sands expansion, particularly in the United States. The precipitous drop in oil prices in the fall of 2008 prompted many companies to postpone or cancel planned tar sands expansion in Canada. Additionally, lower oil prices mean less revenue available for new tar sands projects.[51] Given the high cost of constructing new extraction, transportation, and refinement capacity in the United States, multiple sources estimate that the Utah tar sands are only economically viable with sustained oil prices above $60 per barrel.[52] The introduction of a price on carbon, through a cap and trade program or carbon tax, should raise the price of oil and should, in theory, also increase the price of carbon intensive fuels such as tar sands oil. Carbon price exemptions for unconventional or domestic fuels could have the perverse effect of making tar sands more economically competitive with conventional oil.

Several policies currently in effect or under consideration impact expansion of domestic tar sands consumption. The Energy Policy Act of 2005 encourages domestic development of unconventional fuels, but the Energy Independence and Security Act of 2007 prevents federal agencies from entering into contracts that purchase unconventional fuels that have higher lifecycle emissions than conventional petroleum. Despite good intentions, the 2007 requirement lacks strength because most oil from tar sands is mixed

with conventional fuel and purchased on commercial markets, rather than by the government.[53]

California is finalizing the rules for implementation of its low-carbon fuel standard (LCFS), which aims to reduce lifecycle emissions from transportation by at least 10 percent per unit of energy by the year 2020.[54] This policy mechanism is designed to provide a flexible economic incentive for the development of low-carbon fuels and a disincentive for high carbon fuels, such as tar sands oil. Concerns about leakage, where fuel producers simple shift the sale of high-carbon fuels to other states rather than decrease their production of high-carbon fuels, can be largely addressed if the policy is adopted in multiple states or on the federal level. Last month, Members of the European Parliament urged the European Fuel Quality Directive to implement an LCFS across the European Union.[55] Another major critique of the LCFS is that it is economically inefficient and that the same emissions reductions could be achieved at a lower cost elsewhere in the economy.[56] A rebuttal to this argument is that innovation is rarely the cheapest option, but that it is essential to long-term emissions reductions.

Looking Forward, Moving Backward?

Given the momentum and incompatibility of both tar sands development and climate policy, the United States needs to decide how it will navigate the competing pressures of industry and climate stability. Bilateral commitments to import tar sands from Canada, the pressure to pursue economic development in the midst of a recession, and the political influence of the fossil fuel industries cannot be circumvented overnight, so if the United States is serious about tackling climate, it will need to act on multiple

fronts to stop the expansion of tar sands. If the United States fails to address tar sands directly or through comprehensive climate policy, like Canada, it is likely to lose what little credibility it has in international climate negotiations.

The Council on Foreign Relations makes the case that expansion of tar sands production is unlikely to significantly change global oil markets, even if Canada (and the United States) incentivize rapid development. Additionally, there is no way to create high-quality fuel out of the lowest grade crude without substantial energy consumption and pollution. Therefore, United States must take action to stop the expansion of tar sands, and can do so through the following options:

- Remove federal subsidies and R&D funding for unconventional fuels and keep them out of proposed climate legislation. (Congress)
- Expand the provision in the Energy Independence and Security Act of 2007 to bar all federal agencies from using fuel with higher lifecycle emissions than conventional petroleum. (Congress, Executive Order)
- Require the disclosure of lifecycle emissions for commercial fuels. If gasoline or diesel is blended with oil from the tar sands, consumers should have access to that information. (EPA)
- Require the consideration of greenhouse gas emissions in environmental impact statements, particularly programmatic environmental impact statements for unconventional fuel leasing. (EPA)

- Implement a nationwide low-carbon fuel standard. If the federal government fails to adopt such a policy individual states can still make progress by passing programs similar to the one in California. (Congress, State Legislatures)
- Include emissions produced from extraction in a carbon pricing system. This could be accomplished through placing the cap on upstream (extraction and production) emissions for fossil fuels, as found in the Carbon Limits and Energy for America's Renewal (CLEAR) Act.[57] (Congress)

Although tar sands are making inroads into the United States economy, they do not yet have the stranglehold here as they do in Canada. These actions, in combination with civic enforcement and litigation of existing environmental regulations, can limit the influence tar sands have on the United States contribution to climate change.

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