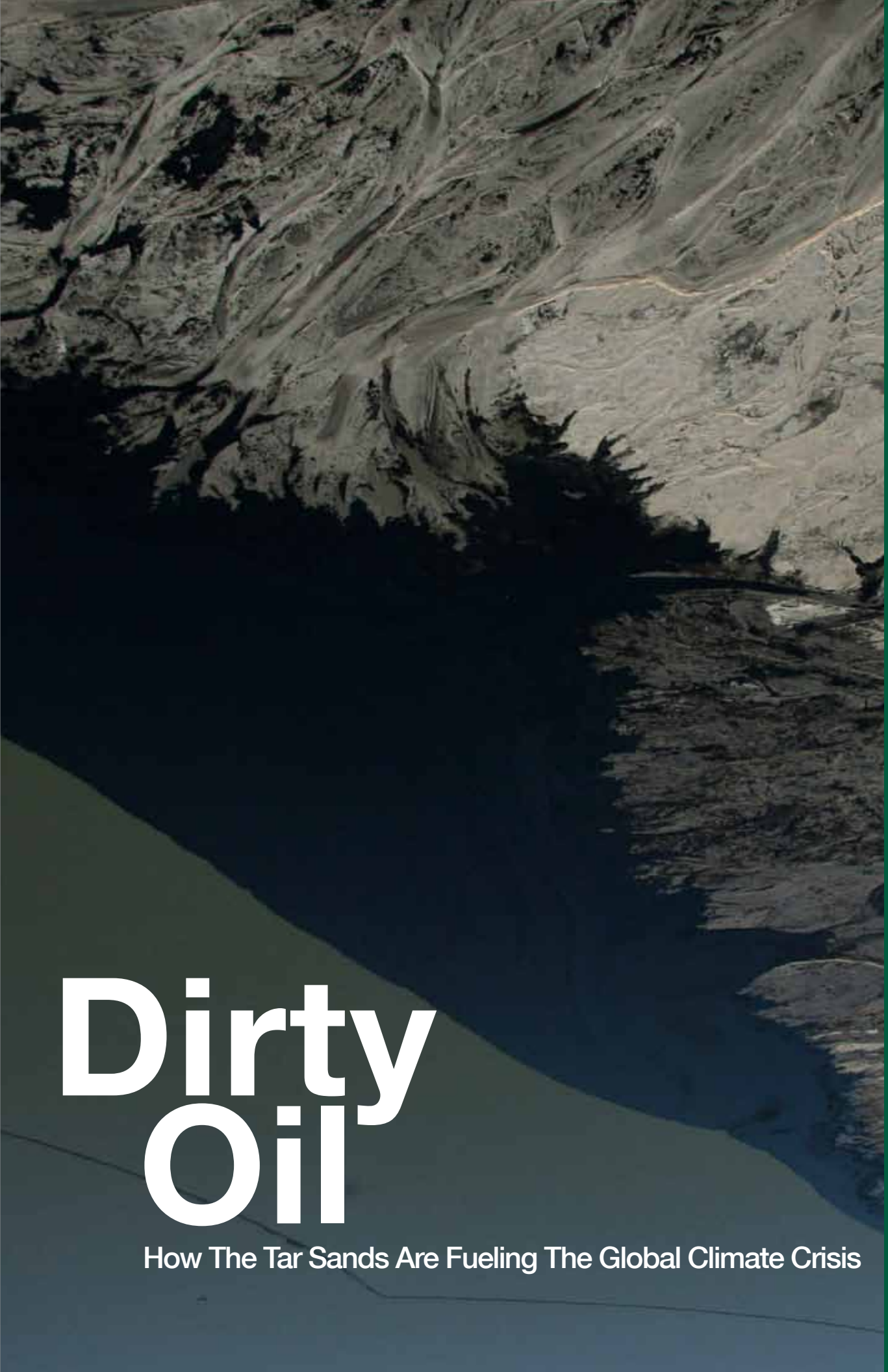


Dirty Oil

How The Tar Sands Are Fueling The Global Climate Crisis

GREENPEACE

www.greenpeace.ca

Dirty Oil:

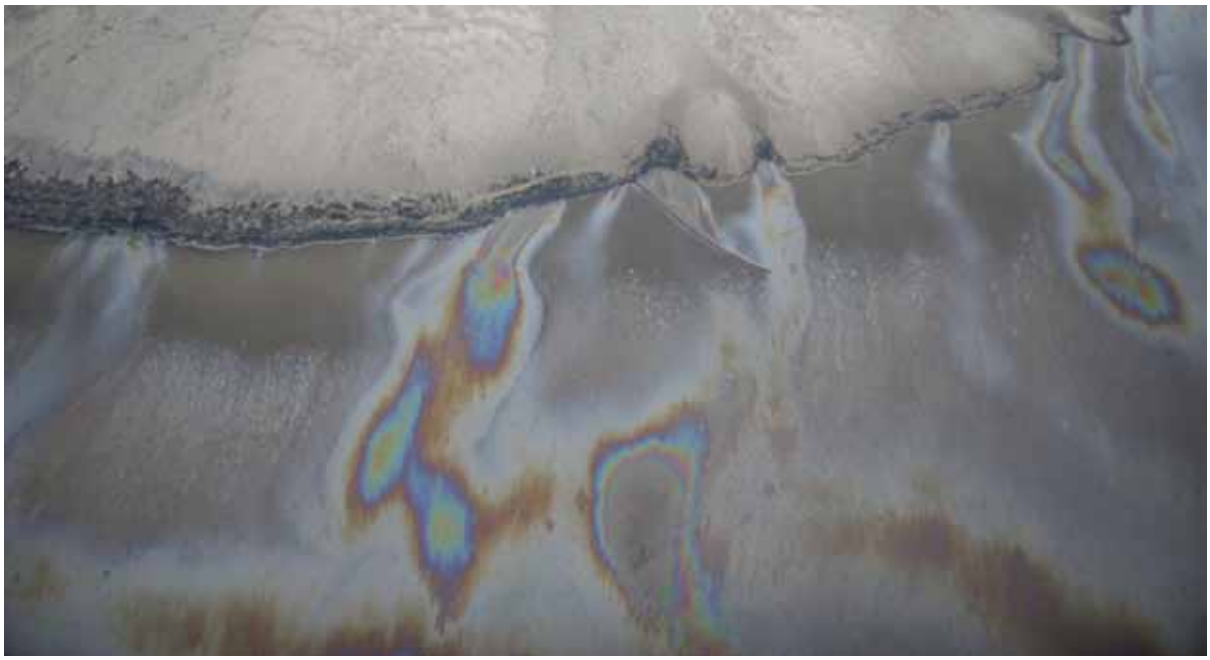
How the tar sands are fueling the global climate crisis

Andrew Nikiforuk

Greenpeace
September 2009

Contents

List of Figures



Introduction

The unrestrained release of greenhouse gases (GHGs) from the burning of fossil fuels now threatens the political stability of human civilization. Every year, climate change kills approximately 300,000 people and costs the global economy more than $100 billion.[1] Even the most conservative of predictions for the future anticipates that extreme weather events combined with food and water shortages and increased diseases could unravel many nation states by 2040.[2] While most scientific experts now call for radical reductions in GHGs (by 80 per cent) by 2050, many nations remain reluctant to change course. The favourable outcome of United Nations Climate Change Conference talks aimed at establishing a new global carbon treaty, to be held in Copenhagen this December, is in doubt. The greatest threat to our future, argues famed Canadian political scientist Thomas Homer Dixon, is not that our fossil fuel economy will disappear but that it will endure. [3]

With plans to expand the production of oil from the tar sands by three- to five-fold, Canada

1 Global Humanitarian Forum, Human Impact Report: Climate Change: The Anatomy of a Silent Crisis, Geneva, 2009

2 Kurt M. Campbell et al., The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change, Center for Strategic and International Studies, and Center for a New American Security, November 2007.

3 Thomas Homer Dixon, ed., Carbon Shift, Random House Canada, 2009, p. 15.

now epitomizes this global threat. Alberta s vast deposits of bitumen, an unconventional hydrocarbon trapped under the Boreal forest, is the source of one of the world s most energy- and carbon-intensive fossil fuels. It has made Canada the Saudi Arabia of the western world.

Global oil addiction and an international failure to establish a price on carbon have created an explosive boom in the tar sands. Despite the current financial crisis, every major multinational and state-owned oil company continues to invest in the Alberta tar sands, now the world s biggest energy project and Canada s largest source of industrial greenhouse gas (GHG) emissions. Canadian Prime Minister Stephen Harper has called the project larger than the Great Wall of China, while Alberta Premier Ed Stelmach has pegged the value of the development at $90 billion since 2000, with an additional $130 billion in development underway or planned.

Exploitation of the tar sands dramatically signals the end of cheap oil. Even large oil companies such as Total S.A. and StatoilHydro describe the resource as extreme or "difficult."

By transforming Canada into a hinterland for unconventional oil production, and making it one of the most carbon-intensive nations on earth, global investors and European oil companies have exercised what they believe is their God-given right to produce more hydrocarbons.[4]

In 2008, Royal Dutch Shell examined two possible energy scenarios for an oil-dependent civilization. One (Blueprint) envisioned radical reductions in GHGs, conservation and clean energy. The other (Scramble) explored what would happen if companies and countries exploited unconventional fuels without clear conservation goals or effective climate change action.

Shell s Scramble scenario painted a bleak global future: . . . international discussion on climate change becomes bogged down in an ideological dialogue of the deaf, and CO_2 [carbon dioxide] emissions grow relentlessly. Civil societies experience both climate and energy insecurity, and face expensive consequences beyond 2050. Powerful water and carbon lobbies protest unconventional fuel development. Canada s rapid development of the tar sands has primed the global community for a volatile scramble on energy and climate.[5]

In turn, the Canadian government, the No. 1 financial benefactor of tar sands development, has obstructed energy conservation at home and effective international climate change action.[6]

---

4 James Hansen, Climate Threat to Creation: Implications for Intergenerational Equity and Justice, Columbia University, New York, May 3, 2009.

5 Shell International, Shell Energy Scenarios to 2050, 2008.

6 According to the Canadian Energy Research Institute (CERI) the project will generate $123-billion worth revenue between 2000 and 2020. Due largely to corporate taxes the federal government will reap 41 percent or $51 billion while the Alberta government will get but 36 per cent or $44 billion. The remainder will go to local municipal government. Govinda R. Timilsina,et al, Economic Impacts of Alberta s Oil Sands, Canadian Energy Research Institute, October 2005, p.98

Key Findings

1 - The rapid development of the tar sands, the world's largest capital project, signals the end of cheap oil. To escalate the production of high-cost and high-carbon unconventional fuels will destabilize the climate and the global economy.

2 - The tar sands now produce 1.3 million barrels of heavy oil a day and supply the US, the world's largest oil consumer, with 13 per cent of its crude imports. That share could grow to 37 per cent. China, the world's second-largest oil consumer, has proposed a strategic alliance with Canada to transport dirty oil by supertanker to Asian refineries.

3 - If exploitation of the tar sands continues unabated, by 2020 it could produce more GHGs than either Austria, Portugal, Ireland or Denmark. The project's CO_2 output could even rival or exceed that of Belgium, a nation of 10 million people. Emissions from the tar sands currently exceed those of several European nations including Estonia and Lithuania. Climate changing gases from two major mining operations now dwarf the emissions of Cyprus and Malta.

4 - Energy exports to the US and tar sands production have made Canada one of the most energy- and carbon-intensive nations in the industrial world. Canada is one of the world's highest per capita GHG emitters.

5 - Canada does not report life-cycle emissions from the tar sands in a transparent way. Data are incomplete and inaccessible. Most life-cycle carbon studies do not include the effects of destruction of carbon sinks in peatlands or of land disturbance caused by drilling for natural gas, the key fuel for tar sands production.

6 - Due to their extreme energy intensity, the tar sands have a higher carbon footprint than any other commercial oil product on the planet. The dirtiest projects burn extreme volumes of natural gas to create steam to melt oil out the ground. These in situ, or steam plants, now use four times more natural gas than mining operations. Some projects are now 10 times dirtier than production of oil in the North Sea.

7 - The tar sands now cannibalize Canada's natural gas supply and represent approximately 20 per cent of Canadian demand. To replace the unsustainable consumption of natural gas as a fuel stock for inferior oil production, some organizations have proposed the construction of 25 nuclear reactors in the tar sands by 2025.

8 - Given its growing dependence on oil revenue and the influence of fossil fuel lobbies, Canada has actively fought standards to lower the carbon content of fuels, lobbied against US legislation to lower emissions, muzzled federal scientists and obstructed international climate change negotiations.

9 - Like many European oil companies, Royal Dutch Shell has banked its entire future on production of dirty oil from the tar sands. It risks becoming the world's most carbon-intensive company.

10 - Many US agencies and lobbyists cite Canada's low-level regulatory regime as a global model for exploiting high-carbon fuels such as oil shale.

11 - Unproven, band-aid technologies, such as carbon capture and storage (CCS), will not reduce emissions from the tar sands on any significant scale in the near future. Neither peak oil nor the carbon crisis, flip sides of the same coin, can be solved with more energy inputs.[7]

7 Ivan Illich, Energy and Equity, Le Monde, 1973.

An Unconventional Nation

Most Europeans view Canada as a modest democracy (population: 33 million), with a responsible environmental record. They generally assume that Canada s waters run pure, that its winds blow clean and that the federal government prudently manages its vast natural capital. But the rapid development of the tar sands has made Canada the No. 1 supplier of oil for the United States. The unprecedented oil boom has dramatically unsettled the nation s economy, scuttled the nation s Kyoto commitments and altered its international politics.

Bitumen, one of the world s heaviest and densest hydrocarbons, is found in deposits around the world.[8] But the largest formation lies in sandy soil under Canada s Boreal forest and spans an area roughly the size of England, 140,000 square kilometres (sq. km). The nation s magic sand pile contains the world s second-largest oil reserves outside of Saudi Arabia. Although tempered by the global financial crisis, US, Asian and European investors have poured more than $100 billion (Cdn) into the construction of mines, upgraders, pipelines, refineries and steam plants over the past decade. All of the world's major petroleum companies, including France s Total, America s Exxon, Norway s Statoil and The Netherlands Royal Dutch Shell, have purchased leases in the sand pile. The Abu Dhabi National Energy Company plans to invest in the project,[9] while China, already a supplier of cheap labour for the tar sands, has proposed a major energy deal with Canada to supply its economy with crude from the tar sands via supertankers.[10] To this end, PetroChina, one of the world s largest oil companies, purchased a $1.9-billlion-Cdn lease in the tar sands in August 2009.

The exploitation of the tar sands signals the end of cheap oil as a driver of the global economy.[11] As one of world s most expensive hydrocarbons ($60 to 85 per barrel [bbl]), bitumen makes a poor substitute for light oil.[12] It also requires more energy and water (an average of four barrels of water per barrel of bitumen) to produce and upgrade than conventional oil. The project s open-pit mines have created lakes of industrial mining waste (covering 130 sq. km) that are among the world s largest.[13] Tar sands air pollution has also

---

8 Richard Meyer and Emil D.Attanasi, Heavy Oil and Natural Bitumen: Strategic Petroleum Resources, US Geological Survey, Fact Sheet 70-03, August 2003

9 Joe Carroll, Abu Dhabi Hunts More Acquisitions in Oil Sands, Bloomberg.com, March 30, 2009.

10 Claudia Cattaneno, China Seeks Energy Alliance, Financial Post, June 2, 2009.

11 Colin J. Campbell, In For a Shock, Sustainable Ireland, 2005, at: http://www.sustainable.ie. See also: Jeff Rubin, Why Your World Is About to Get a Whole Lot Smaller: Oil and the End of Globalization, Random House, 2009.

12 IHS-Cambridge Energy Research Associates, Growth in the Canadian Oil Sands: Finding a New Balance, 2009, p. ES6.

13 Randy Mikula et al., Water Use in Bitumen Production: Tailings Management in Surface Mined Oil Sands, Petroleum Society paper 2008-097. See also: http://www.ercb.ca/portal/server.pt/gateway/PTARGS_0_0_303_263_0_43/http%3B/ercbContent/publishedcontent/publish/ercb_home/news/news_releases/2008/nr2008_14.aspx.

created an acid rain problem in Western Canada, where none previously existed.[14] A cluster of rare cancers and autoimmune diseases in an aboriginal community downstream from the project remains unexplained.[15] Are the Canadians willing to create an environmental disaster in Alberta in order to provide the world market with oil? asked an incredulous 2006 Swedish study.[16]

To date, the project has largely externalized environmental costs and privatized financial gains. The Organisation for Economic Co-operation and Development (OECD) and the US Council on Foreign Affairs, a powerful think-tank, both report that low royalty and tax rates have driven rapid tar sands development.[17] (Alberta, where carbon emissions are increasing, earns only 47 per cent of net oil revenue, while Norway, where emissions are stabilizing, collects 88 per cent of its share.)[18] Neither Canada nor Alberta operates competent sovereign funds. Canada's failure to exercise fiscal accountability on oil wealth mirrors its failure to manage its national carbon budget.[19] In addition, the US Council on Foreign Affairs observes that the tar sands developing province of Alberta has been a one-party state, skeptical of environmental regulation, for 38 years.[20]

By 2007, investments in the tar sands outpaced investments in Canada s manufacturing sector, distorting the economy.[21] Although the project may contribute $1 trillion to Canada s GDP by 2020, global carbon pricing could turn the project into Canada s most toxic asset. An analysis by the Ottawa-based Centre for the Study of Living Standards calculated that if oil prices remain in the $50-per-barrel range and carbon-pricing policies eventually assign a high additional social cost (perhaps $35 per barrel), the net value of the oil sands quickly becomes negative. In other words, Canadians could face a net cost of $1.30 for each barrel of bitumen extracted from the oil sands. [22]

To date, a powerful fossil fuel lobby has effectively hidden these carbon risks and paralyzed national climate change policy. The federal government has created a national record second to none for ineffectiveness. [23] The government will not honour Canada s Kyoto climate change reduction targets. The self-proclaimed emerging energy superpower has actively lobbied against low-carbon fuel standards and new climate change legislation in the United States. In sum, the chaotic development of the tar sands has become a global metaphor for excess and hubris. It has galvanized international debate about the complexities of energy security, dirty oil and the rising risks of dangerous climate change.

---

14 Michael Moran et al., Predicted Acid Deposition Critical-Load Exceedances across Canada from a One Year Simulation with a Regional Particulate-matter Model, Environment Canada, 2008. See also: Julian Aherne, Calculating Critical Loads of Acid Deposition for Forest Soils in Alberta, Canadian Council of Ministers of Environment, 2008.

15 Alberta Cancer Board, Cancer Incidence in Fort Chipewyan, Alberta, 1995 2006, February 2009.

16 Bengt Soderbergh et al., A Crash Program Scenario for the Canadian Oil Sands Industry, Uppsala University, 2006. Online at: http://www.tsl.uu.se/UHDSG/Publications/Tarsandsarticle.pdf.

17 Michael A. Levi, The Canadian Oil Sands: Energy Security vs. Climate Change, Council Special Report No. 47, Council on Foreign Relations, May 2009, p. 28.

18 Annabelle Mourougane, Achieving Sustainability of the Energy Sector in Canada, Economics Department Working Paper No.618, OECD, 2008.

19 Ibid., pp. 15 16.

20 Michael A. Levi, The Canadian Oil Sands: Energy Security vs. Climate Change, Council Special Report No. 47, Council on Foreign Relations, May 2009, p. 29.

21 Statistics Canada, Human Activity and the Environment: Annual Statistics, 2007/2008, p. 25.

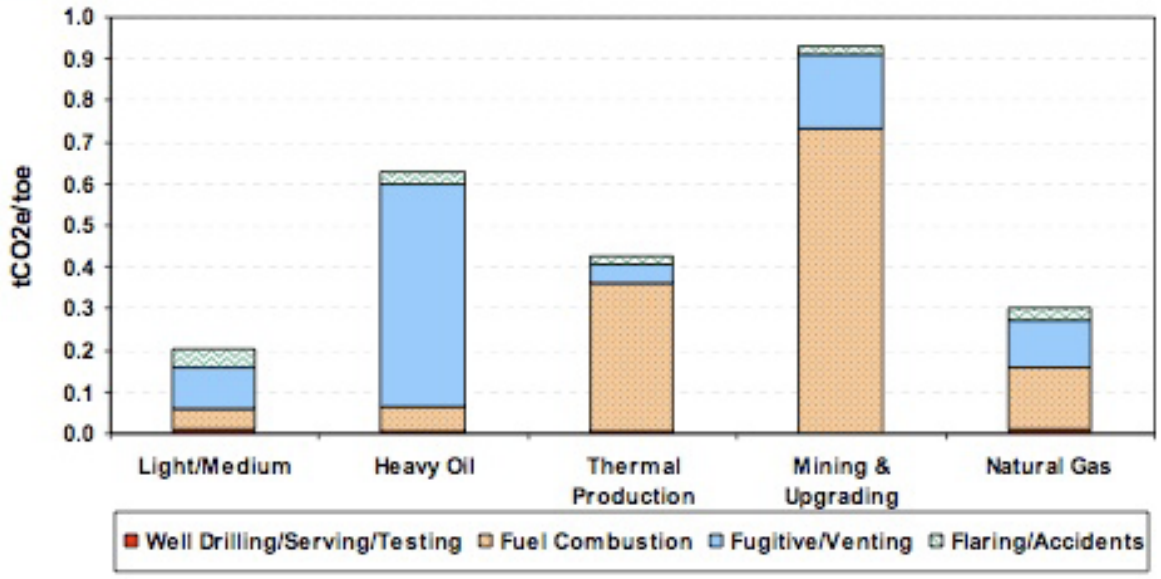
22 Thomas Homer Dixon (ed.), Carbon Shift, Random House Canada, 2009, pp. 177 201.

23 National Centre For Upgrading Technology, Oilsands Bitumen Processability Project, March 2006.

Bitumen: Dirty Crude

Bitumen is an ultra-heavy hydrocarbon of such inferior quality that it was once only used for paving roads. For most of the past century, scientists and politicians referred to Alberta s huge bitumen deposits as the tar sands because of their asphalt-like character. Canada s National Centre for Upgrading Technology notes that Alberta s raw bitumen still consists of more than 50 per cent pitch or asphalt. In the 1990s, in an attempt to sanitize the resource's extreme and difficult character, industry and government started to call it the "oil sands. This moniker gives the impression that the resource is both acceptably clean and readily accessible. The facts contradict this industry spin.

Canada s bitumen deposits, trapped in sand and clay, require extreme amounts of hydrogen, electricity, steam, hot water, diesel fuel and natural gas to extract. The energy intensity of extracting this bitumen, unparalleled among commercially available fossil fuels, generally produces a carbon footprint two to three times greater than that of light oil.



Source: E-STAT table 126-0001, table 131-0001, Clearstone (2004), CAPP (2003), CIEEDAC (2003) and an anonymous industry reference.

Figure 1: GHG Emissions Intensities of Crude Oils and Natural Gas Production in Canada, in 2000

Note: tCO_2e/toe = tons of carbon dioxide equivalent per ton of oil equivalent.
Source: Clearstone 2004, CAPP 2003, CIEEDAC 2003, in: John Nyboer and JianJun Tu, GHG Emissions Trend Analysis in the Fossil Fuel Production Industries 2008 Update, CIEEDAC, 2008, p. 30.

Out of five Canadian petroleum products, synthetic crude oil made from bitumen has the highest GHG intensity.

Source: John Nyboer and JianJun Tu, GHG Emissions Trend Analysis in the Fossil Fuel Production Industries 2008 Update, Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC), 2008

Extracting bitumen generally takes two forms of brute force.

1.) Open-pit mines employ giant electric shovels to dig up shallow deposits and 400 tonne trucks to transport the low-grade ore. It takes four tonnes of earth to produce two tonnes of sand in order to create one barrel of bitumen.[24] Imperial s Kearl Mine, for example, will cover 200 sq. km (an area larger than Washington, DC) and produce nearly four megatonnes of carbon dioxide (CO_2) a year.[25] That s the same as 800,000 passenger vehicles on the road.[26]

2.) To access deeper formations, industry employs steam plants. Through a process called steam-assisted gravity drainage (SAGD), pressurized steam at 240 C is injected deep into the ground to "melt" the bitumen formations. A steam plant's efficiency (and energy intensity) is gauged by the volume of steam used, or what industry calls a steam-to-oil ratio (SOR). Most projects have underestimated their steam volumes, and their SORs are climbing.[27] Some projects use 2.5 barrels of steam, while others require up to 20 barrels.[28] The majority of steam actually ends up heating rock, as opposed to bitumen, or escaping into other formations.[29] Due to steam leaks, low productivity and poor-quality bitumen formations, CO_2 emissions from the steam plants can range from 20 to 400 kg per barrel.[30] Emissions from Opti-Nexen s Long Lake project, for example, are conservatively estimated to range from 174 to 374 kg per barrel.[31] In contrast, StatoilHydro says CO_2 emissions from North Sea oil production range from 8 to 19 kg.[32] Steam plants have showed such unexpectedly low performances and high carbon levels that the Japan Oil, Gas and Metals National Corporation requested industry proposals to study SAGD problems in 2009.[33]

According to the Petroleum Technology Alliance Canada, steam-based operations in the tar sands consume approximately one unit of energy for each four units produced for sale, which is two to three times the energy intensity of conventional light and heavy production. In other words, the steam plants burn one barrel of oil or oil equivalent to produce four barrels of bitumen. As bitumen production moves from high- to lower-quality deposits, tar sands projects will increasingly use more energy and create more CO_2 emissions.[34]

24 Christopher Holly, The Oilsands Resource, presentation, Alberta Energy, August 21, 2008. Online at: http://www.uofaweb.ualberta.ca/iusps2/pdfs/Sept_4_-_08_Oil_Sands_Chris_Holly_.ppt.

25 The US capital occupies 177 sq km. Note: Emissions of GHGs are quantified as a metric measure based on their global warming potential compared to carbon dioxide. The emission weights given in this document refer to carbon dioxide equivalent.

26 Energy Utility Board, Joint Panel Review Addendum to EUB Decision 2007-013, May 6, 2008. Online at: http://www.imperialoil.ca/Canada-English/Files/ThisIs/EUB_Kearl_Addendum_May_008-06.pdf.

27 See: Energy Resources Conservation Board, In Situ Progress Reports, Performance Presentations, online at: http://www.ercb.ca/portal/server.pt/gateway/PTARGS_0_0_303_263_0_43/http%3B/ercbContent/published-content/publish/ercb_home/industry_zone/industry_activity_and_data/in_situ_progress_reports/2009/default.aspx.

28 Pat Roche, SAGD Report Card, New Technology Magazine, October 2008.

29 Petroleum Technology Alliance Caanada, Expanding Heavy Oil and Bitumen Resources while Mitigating GHG Emissions and Increasing Sustainability A Technology Roadmap, March 31, 2006.

30 Based on oil production data and reported project emissions to Environment Canada, available at: http://www.ec.gc.ca/pdb/ghg/onlinedata/table_e.cfm?year=2007&gasorcas=gas&gas=A&cas=A&fac_name=&npri_id=&c_local=P&prov=A&city=169&postal=&naics=2111&submitinfo=Submit.

31 Katherine Elliot, Examination of Oil Sands Projects: Gasification, CO_2 Emissions and Supply Costs, SPE/PS/CHOA 117524, October 2008, p. 7.

32 Statoilhydro, 2008 Offshore Environmental Statement, March 23, 2009, p. 6.

33 Japan Oil,Gas and Metals National Corporation, Request for Proposals-Study Report of SAGD Method Performance, April 30, 2009

34 Bruce Peachey et al., Low Carbon Futures: Carbonate Triangle and Conventional Heavy Oil Lowest GHG

Bitumen is much heavier and stickier than conventional oil. Brent Blend, a mix of light oils from the North Sea, has an API gravity (American Petroleum Institute measure of density) of 38 degrees. In contrast, Athabasca bitumen claims one of the lowest gravities, with an API of 7.9 degrees.[35] (Every deposit in Alberta shares unique characteristics, in terms of density and sulfur content.) Due to its stickiness, bitumen can t move through a pipeline without being diluted with natural gas condensate or light oil. Canada now imports diluent from Russia and Indonesia, and transports these lighter hydrocarbons by train across the Rocky Mountains to tar sands in Fort McMurray, Alta.[36]

Millions of years of bacterial degradation make bitumen notoriously carbon rich and hydrogen poor. As a consequence, industry must reverse geological time with energy-intensive upgrading in order to improve the product.[37] Upgrading takes out carbon (as coke) and adds hydrogen to make a product called synthetic crude.[38] Upgrading can add anywhere from 50 to 90 kg of CO_2 per barrel to bitumen s footprint.

Unlike light oil, bitumen contains a host of contaminants, including sulfur, salts, nitrogen, clays, asphaltenes, resins and heavy metals. (Western Canadian Select, a blend of bitumen and synthetic crude, has eight times more sulfur than West Texas crude.[39]) North American refineries, which were built to handle light oils, have raised numerous concerns about their ability to clean and process diluted bitumen. [40] The federal government adds that the qualities of bitumen sometimes lead to fouling and corrosion of equipment, causing energy inefficiencies" and refinery shutdowns.[41] Lower-quality oil from the tar sands has increased energy consumption at US refineries by 47 per cent between 2003 and 2007, resulting in larger GHG emissions.[42] Bitumen proves the industry maxim that as crude prices increase, crude quality decreases. [43]

The Canadian Industrial End-use Energy Data and Analysis Centre (CIEEDAC) concluded in 2008 that synthetic crude oil made from bitumen had the highest combustion emission intensity" of five domestic petroleum products and was "the most energy intensive one to process in Canada. [44]

Production Scenarios, Petroleum Technology Alliance Canada, March 31, 2007.

35 Energy Information Administration, United States Government, online at: http://tonto.eia.doe.gov/ask/crude_types1.html.

36 Canadian Heavy Oil Association, online at: http://www.choa.ab.ca/pdf/090430BC-SlidesCN.pdf.

37 Robert Skinner, Difficult Oil, Centre for Global Energy Studies, Pennyhill, UK, September 2005.

38 Total SA, Extra Heavy Oils and Bitumen: Reserves for the Future, 2006.

39 UOP LLC, A Honeywell Company, The Impact of Bitumen-Derived Feeds On the FCC Unit, O&G Next Generation, 2009

40 National Centre for Upgrading Technology, Oilsands Bitumen Processability Project, March 2006.

41 Natural Resources Canada (NRCan), Roadmap Workshop on Nonpetroleum-based Fuels and Advanced Combustion Research, 2007. p.B21

42 Greg Karras, Refinery GHG Emissions From Dirty Crude, Communities for a Better Environment, April 20, 2009. Available at: http://www.cbecal.org.

43 Ibid.

44 John Nyboer and JianJun Tu, GHG Emissions Trend Analysis in the Fossil Fuel Production Industries 2008 Update, CIEEDAC, 2008, p. 30. Online at: http://www.cieedac.sfu.ca/CIEEDACweb/pubarticles/GHG%20Analysis%20Publications/Fossil%20Fuel%20Industry%20Trend%20Report%202008%20Update.pdf.

The Carbon Canadian

Canada s rapid development of the tar sands has given the nation one of the largest carbon footprints in the world. According to the government s own statistics, emissions have increased by 27 per cent between 1990 and 2004, from 599 MT to approximately 758 MT.[45] This dramatic rise in climate-changing gases even outpaced Canada s 15-per-cent growth in population. While the European Union, France, the United Kingdom and Germany decreased their emissions between 1990 and 2004, Canada became the eighth-largest GHG emitter in the world, and even outpaced the US in GHG growth.[46]

Of 38 countries that pledged to cut GHG pollution under the Kyoto Protocol, the 1997 international treaty to reduce emissions, Canada ranks as the world s third-worst offender for failing to honour promised reductions. It ranks just behind Sweden and Turkey. (These four-year-old data also include emissions from land use and forestry changes, and probably underestimate Canada s position as a treaty breaker and careless carbon producer.)[47]

Canada ranks as the world's third-worst performer in honouring its Kyoto protocol pledge after failing to control GHG emissions at 1990 levels.

Source: United Nations Framework Convention on Climate Change (UNFCCC), National Greenhouse Gas Inventory Data for the Period 1990–2006, FCCC/SBI/2008/12, November 17, 2008, p.10

45 Government of Canada, Energy Sector Sustainability Tables, Environmental Scan of Canada s Energy Sector, 2008, chapter 1. Online at: http://www.sst.gc.ca/179F880B-3AC0-48D3-A001-EE5789DBCA04/EnvScan%20E%20Ch%201.pdf.

46 Ibid. Also available at: http://www.sst.gc.ca/default.asp?lang=En&n=4C800B38-1&offset=2&toc=show.

47 United Nations Framework Convention on Climate Change (UNFCCC), Fact Sheet: The Need for Mitigation, 2009. Online at: http://unfccc.int/files/press/backgrounders/application/pdf/press_factsh_mitigation.pdf.

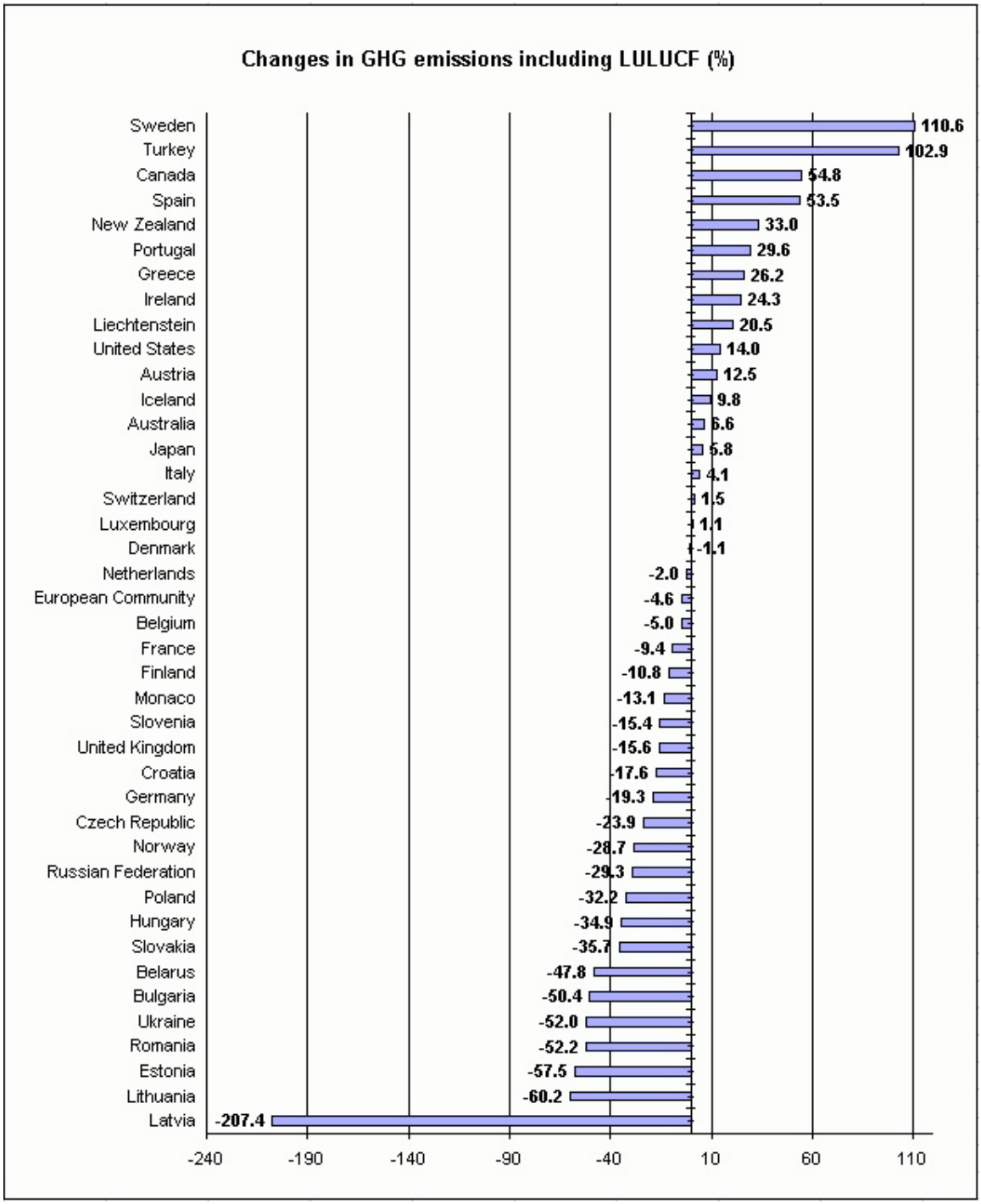
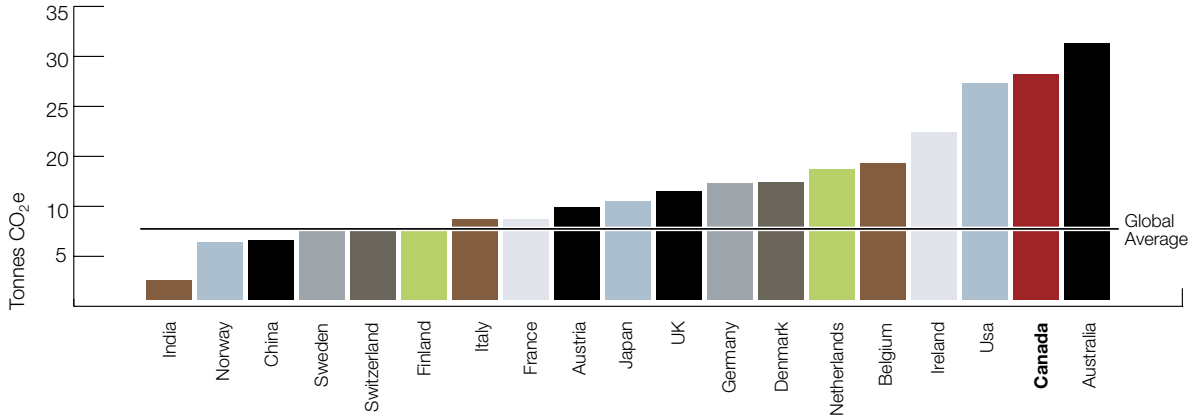


Figure 2: Changes (as %) in GHG Emissions, including LULUCF, by country, 1990–2004

Note: LULUCF = land use, land-use change, and forestry.
Source: Government of Canada, Energy Sector Sustainability Table, Environmental Scan of Canada s Energy Sector, 2008, chapter 1: Greenhouse Gas Emissions.

With just half a per cent of the world s population, Canada has become one of the world s highest per capita GHG polluters. Among industrial nations, it ranks just below coal-powered Australia (28.1 tonnes per person) and four Middle Eastern states.[48] Because energy production outstripped energy use in Canada, emissions per capita rose 10 per cent from 1990 to 2004, to reach 24 tonnes per person.[49] The average Swede, living in a cold climate, generates but seven tonnes. In contrast, the average citizen of Alberta, home to Canada s fossil fuel production and a third of the nation s emissions, is responsible for approximately 70 tonnes per capita. Only Qatar, a natural gas exporter, claims a higher rate.[50]



Sources: OECD, Congressional Research Service and Environment Canada

Figure 3: GHG Emissions per Capita, by Country, 2005

Note: CO2e = carbon dioxide equivalent.
Source: National Round Table on the Environment and the Economy (NRTEE), Carbon Pricing Fact Sheet 1, 2008. Online at: http://www.nrtee-trnee.com/eng/publications/carbon-pricing/Carbon-Pricing-Fact-Sheet-1-Canadian-GHG-Emissions-eng.pdf.

In 2008 the Conference Board of Canada, a conservative national business group, compared Canada s GHG record with 17 peer nations that belong to the OECD. Canada ranked 16th on emissions per capita. The nation s per capita atmospheric pollution is double the OECD country average (12 tonnes) and is almost four times greater than Norway s, the No. 1 performer. The Board awarded Canada a D for its poor performance on GHG emissions.[51] The World Wildlife Fund and Allianz gave Canada the lowest ranking for climate change action among G8 nations in 2009.[52]

48 Ross Garnaut, The Garnaut Climate Change Review Final Report, chapter 7: Australia s Emissions in a Global Context, Cambridge University Press, 2008.

49 Environment Canada, and NRCan, Environmental Scan of Canada s Energy Sector, chapter 1: Greenhouse Gas Emissions, 2008. Available at: http://www.tdds.ca/default.asp?lang=en&n=179F880B-1.

50 Peter Lee et al., The Last Great Intact Forests of Canada: Atlas of Alberta, Global Forest Watch, 2009, p. 72.

51 The Conference Board of Canada, Environment Report Card, October 2008. Online at: http://www.conferenceboard.ca/hcp/details/environment/greenhouse-gas-emissions.aspx.

52 Allianz, Germany Leads G8 Climate Ranking, July 1, 2009. Online at: http://knowledge.allianz.com/en/globalissues/climate_change/top_climate_stories/climate_scorecards_09.html?g8_climatescorecards_2009_flash/.

The energy sector, which includes fossil fuel industries, electricity generation, and energy end use, accounts for the largest share of Canada s emissions (82 per cent). In fact, fossil fuel production, primarily from the tar sands, accounted for 30 per cent of Canada s total emission growth between 1990 and 2004. Any advances in controlling emissions intensity have been erased by accelerated oil production. (One recent estimate says emissions from tar sands operations alone increased by 20 per cent between 2005 and 2006.)[53]

According to government statistics, half of the emission growth in the oil and gas industry has come from the export of fossil fuels, mainly to the United States. In both 1990 and 2002, the production of these fuels for export emitted more GHGs than the production of any other exported commodity. [54] The US Energy Information Administration (EIA) calculates that Canada s total energy production increased by 87 per cent, while energy consumption rose by only 44 per cent since 1980.[55] Environment Canada expects that energy consumption in the tar sands will triple by 2020, and account for one-fifth of energy use in the nation s energy sector. As a result, GHG emissions will also triple, making it the largest single contributor to Canada s medium term emissions growth. [56]

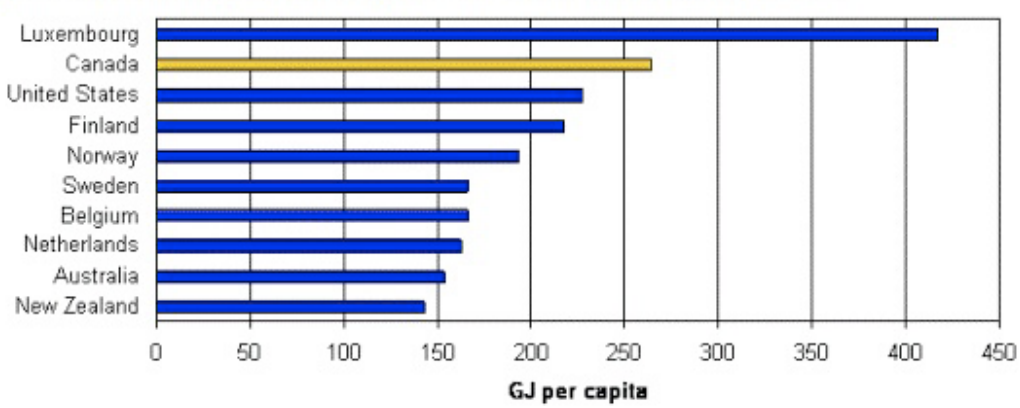


Figure 4: Energy Intensity for Selected IEA Countries, 2004

Note: GJ = gigajoules.
Source: International Energy Agency (IEA), Energy Balances of OECD Countries (2007), in: Energy Canada (NRCan), Economic Scan of Canada s Energy Sector, section 1.4, Energy Sector Sustainability Table, 2008. Online at: http://www.sst.gc.ca/default.asp?lang=En&n=98583627-1&offset=3&toc=show.

The nation's extreme carbon footprint directly reflects the fact that the average Canadian

53 CIEEDAC, GHG Emissions Trend Analysis in the Fossil Fuel Production Industries, 2008 Update, February 2008.

54 Joe St. Lawrence, A Demand Perspective on Greenhouse Gas Emissions, Envirostats Fall 2007, Statistics Canada. Available at: http://www.statcan.gc.ca/pub/16-002-x/16-002-x2007002-eng.htm. See also: Government of Canada, Sustainability Tables, Greenhouse Gas Emissions, section 1.3: Energy Sector Contribution, 2008. Half of the growth in emissions in Canada s oil patch (1990 to 2004) comes from energy exports to the United States.

55 US Energy Information Administration (EIA), Country Analysis Briefs: Canada, July 2009. Online at: http://www.eia.doe.gov/cabs/Canada/Background.html.

56 Environment Canada, Turning the Corner: Detailed Emissions and Economic Modelling, Annex 4, online at: http://www.ec.gc.ca/doc/virage-corner/2008-03/571/Annex4_eng.htm.

uses more energy per capita than almost any other people in the world. Each Canadian consumes about 6.5 times as much energy as the average Chinese.[57] Rapid tar sands development and energy exports combined with geography, climate and high carbon standard of living have made Canada one of the world s most wasteful consumers of energy.[58]

57 Alastair Bonnett, Green Agendas and Grey Dawns, New Statesman, March 5, 2009

58 Government of Canada, Energy Sector Sustainability Table, Economic Scan of Canada s Energy Sector, 2008. Online at: http://www.sst.gc.ca/default.asp?lang=En&n=98583627-1&offset=3&toc=show.

Tar Sand Emissions: A Lack of Transparency

The mines and steam plants in the tar sands have an unconventional carbon footprint, but to date their life cycles have been poorly quantified. Approximately 60 to 85 per cent of fuel GHG emissions comes from the tail pipe exhaust of vehicles that is, consumption. The remainder comes from the direct production of the fuel — the drilling and refining of hydrocarbons.[59] Studies that measure emissions from the production cycle are called well-to-tank and those that add up GHG pollution from both production and consumption are called well-to-wheel.

Controversial well-to-wheel industry studies suggest that GHG emissions from the tar sands are only marginally higher (15 per cent) than conventional oil sources. The Canadian Association of Petroleum Producers (CAPP) also argues that oil supplies are getting heavier (and dirtier), due to depletion of light oil.[60]

The Alberta government, a promoter of tar sands development, now claims that tar sands emissions are only 10 per cent worse than conventional oil, based on two commissioned, non peer reviewed studies.[61] But Canada s most respected climate change experts (including University of Calgary s David Keith) challenge the credibility and accuracy of these studies. The Alberta reports didn t use real industry data, omitted critical information and failed to supply "sufficient documentation of assumptions, methods and treatment of uncertainty. [62]

Overall, industry claims about bitumen GHG intensity are misleading or highly suspect for several reasons. For starters, bitumen is not equivalent to oil: it takes 1.2 barrels of bitumen to make one barrel of synthetic crude. Moreover, most companies don t report GHG data verified by independent third parties on a project-per-project basis. According to the CIEEDAC, a university group dedicated to unbiased information on energy use, GHG data reporting from Environment Canada, CAPP and industry do not appear to be congruent. (The federal government s online life-cycle analysis tool for transportation fuels, GHGenius[63] consistently reports higher GHG rates than industry.) To date, Canada has yet to produce a comprehensive report with real, up-to-date bitumen production data from various mining and steam projects. The Centre for the Study of Living Standards has also concluded that, "publicly-available scientific estimates of future GHG emissions from the oil sands are limited. [64]

A 2009 University of Toronto review of more than 13 life-cycle tar sands studies found huge gaps in emissions data, limited company information, and startling inconsistencies.

59 Joule Bergerson and David Keith, Life Cycle Assessment of Oil Sands Technologies, Paper No.11 of the Alberta Energy Futures Project, Institute for Sustainable Energy, Environment and Economy, University of Calgary, November 2006, p. 3.

60 David Collyer, Energy, Environment, Economy: The Outlook for Canada s Oil and Gas Sector, Canadian Association of Petroleum Producers, June 18, 2009. Online at: http://www.capp.ca/GetDoc.aspx?dt=PDF&docID=152454.

61 Alberta Energy Research Institute, Emissions from Oil Sands Comparable to Other Crude Oils, news release, July 23, 2009. Online at: http://eipa.alberta.ca/media/39698/lca%20news%20release%20and%20backgrounder.pdf.

62 Memorandum to Eddy Isaacs, Alberta Energy Research Institute, from Joule Bergerson, University of Calgary, David Keith, University of Calgary, and Heather L. MacLean, University of Toronto, July 16, 2009. Online at: http://eipa.alberta.ca/media/39674/post%20workshop%20stakeholder%20input.pdf.

63 Online at: http://www.ghgenius.ca/.

64 Andrew Sharpe et al., The Valuation of the Alberta Oil Sands, Centre for the Study of Living Standards, November 2008, p. 27.

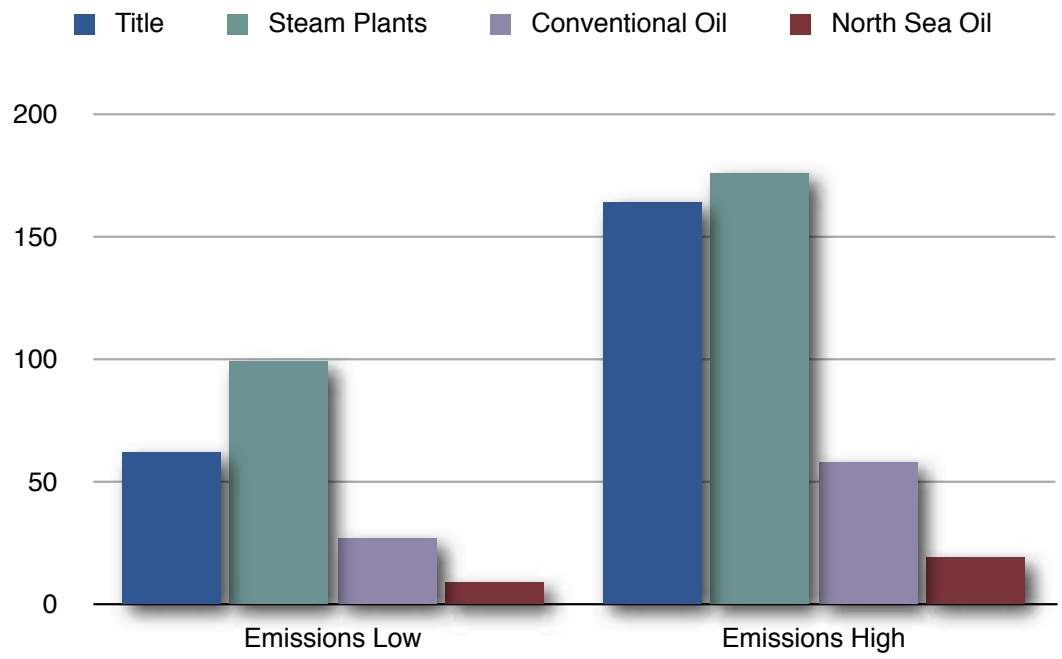


Figure 5: Range of Emissions from Compared Oil Production Methods

Source: Compiled from data from Alex D. Charpentier et al., Understanding the Canadian Oil Sands Industry s Greenhouse Gas Emissions, Environmental Research Letters, January March 2009; and Statoil (UK) Limited, 2008 Offshore Environmental Statement, March 23, 2009.

While some studies excluded CO_2 emissions from tailing ponds, flaring, venting, and fugitive emissions (leaks), others didn t recognize extreme variance in the quality of bitumen deposits. Many excluded vital steam-to-oil ratios, a signature of energy intensity. Most did not directly compare the emissions associated with bitumen, synthetic crude and conventional oil or compare the results from a well-to-wheel analysis. None included CO_2 emissions from the construction or decommissioning of facilities. Nevertheless, all the analyses concluded that the tar sands were indeed dirtier than conventional oil. In addition, the review found an alarming range of emissions from project to project.[65] (A 2008 industry presentation on GHG emissions from steam plant production, for example, showed emissions ranging from 71 to 276 kg of CO_2 per barrel, depending on fuel type and other factors.)[66]

Given that Canada contributes the largest amount of foreign crude to US refineries, the US National Energy Technology Laboratory (NETL) recently analyzed GHG emissions from bitumen and synthetic crude (well-to-wheel) using real 2006 data from Imperial Oil and

65 Alex D Charpentier et al., Understanding the Canadian Oil Sand Industry s Greenhouse Gas Emissions, Environ. Res. Lett 2009. Available at: http://www.iop.org/EJ/abstract/1748-9326/4/1/014005.

66 John Nenniger, N-Solve: The Profits of Energy Efficiency vs. the High Costs of Carbon Capture, presentation to PTAC Towards Clean Energy Production Forum, Calgary, Alberta, October 2008.

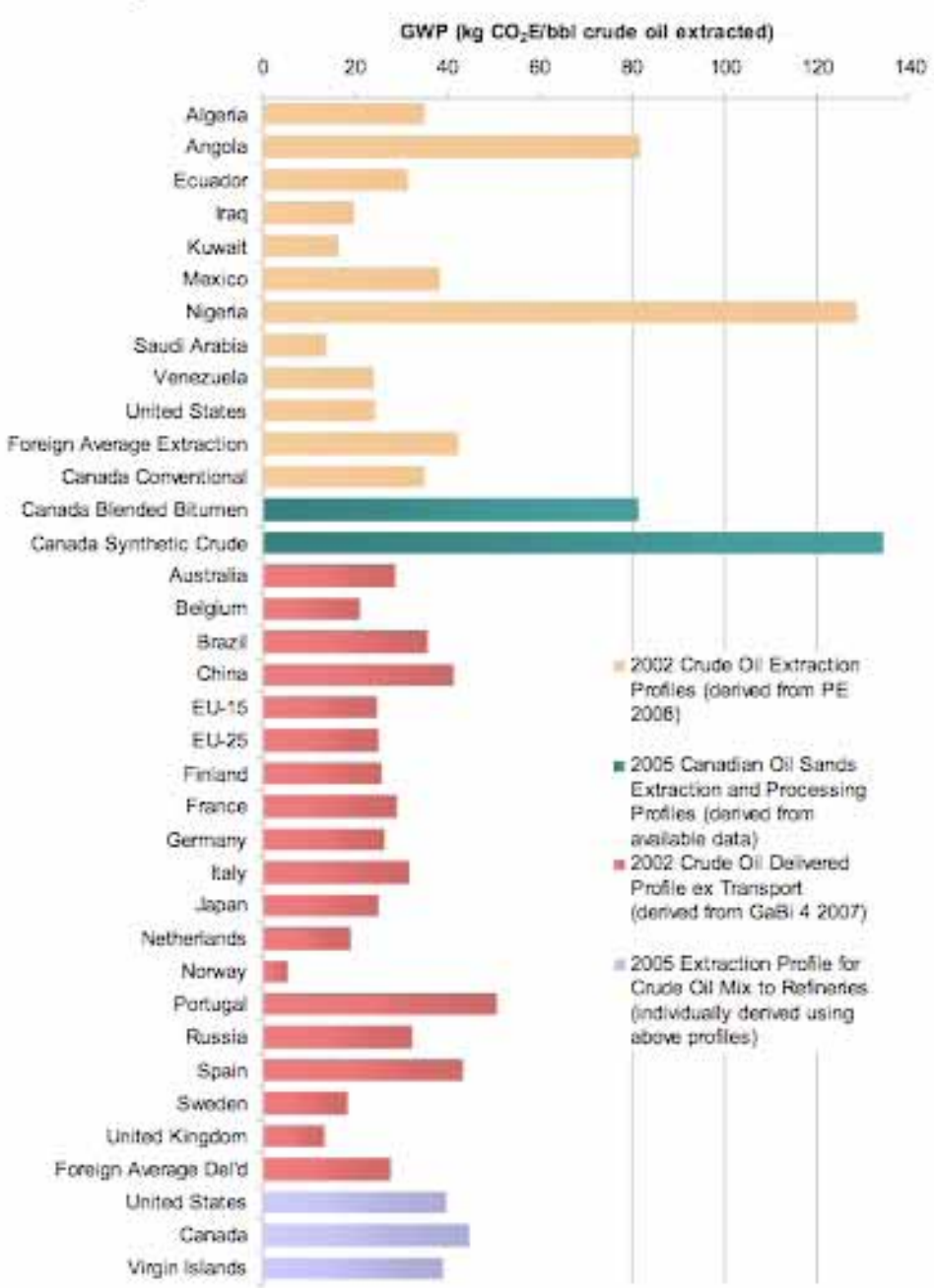


Figure 6: GHG Emissions Consistent with Crude Oil Extraction

Note: GWP = global warming potential; kg CO2E/bbl = kilograms of carbon dioxide equivalent per barrel.
Source: Alex D. Charpentier et al., Understanding the Canadian Oil Sands Industry s Greenhouse Gas Emissions, Environmental Research Letters, January March 2009, p. 1; and Statoil (UK) Limited, 2008 Offshore Environmental Statement, March 23, 2009, p. 6.

Syncrude. Due to energy intensive extraction processes and pre-processing, the NETL concluded that bitumen had GHG emissions several times greater than that for extraction of conventional crude oil. [67] The NETL also revealed that emissions from the extraction of bitumen and synthetic crude easily trumped the footprint of most major US imports.[68]

Production of Canadian synthetic crude oil results in GHG emissions that are among the highest in the world.

Source: Timothy J. Skone and Kristin Gerdes, Development of Baseline Data and Analysis of Life Cycle Greenhouse Gas Emissions of Petroleum-Based Fuels, US National Energy Technology Laboratory (NETL), DOE/NETL-2009/1346, November 26, 2008, p. 55.

Comprehensive NETL studies also show that well-to-tank emissions for jet fuel made from bitumen were three times greater than those from US domestic crude. Diesel fuel refined from Canadian bitumen also had the highest well-to-tank emissions of any imported fuel, or 144 per cent greater than those of domestic crude. As a consequence, the NETL concluded that $19 billion worth of imported Canadian bitumen used for diesel fuel created twice as many as emissions as domestic crude oil.[69] An unpublished 2009 Carnegie Mellon study on life-cycle emissions of unconventional fuels concluded that if the US has a goal to enhance energy security while seeking to reduce the environmental impacts of petroleum, coal to liquid, oil shale, and oil sands are not the right path. [70]

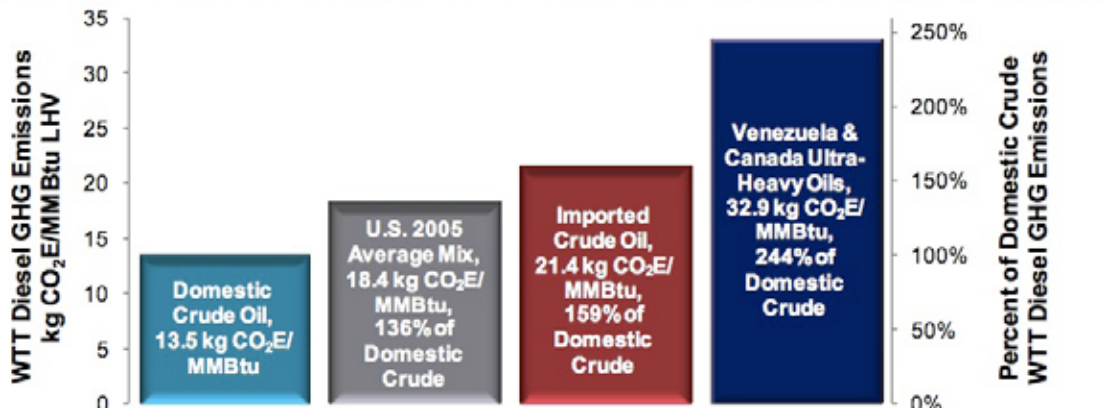


Figure 7: Diesel Fuel WTT GHG Emission Profiles for Crude Oil–Specific Sources, 2005

Note: WTT = well-to-tank; kg CO_2E/MMBtu = kilograms of carbon dioxide equivalent per million British thermal units; LHV = lower heat value.
Source: Kristin J. Gerdes et al., Consideration of Crude Oil Source in Evaluating Transportation Fuel GHG Emissions, US Department of Energy, National Energy Technology Laboratory, DOE/NETL-2009/1360.

67 Kristin J. Gerdes et al., Consideration of Crude Oil Source in Evaluating Transportation Fuel GHG Emissions, US Department of Energy, National Energy Technology Laboratory, DOE/NETL-2009/1360.

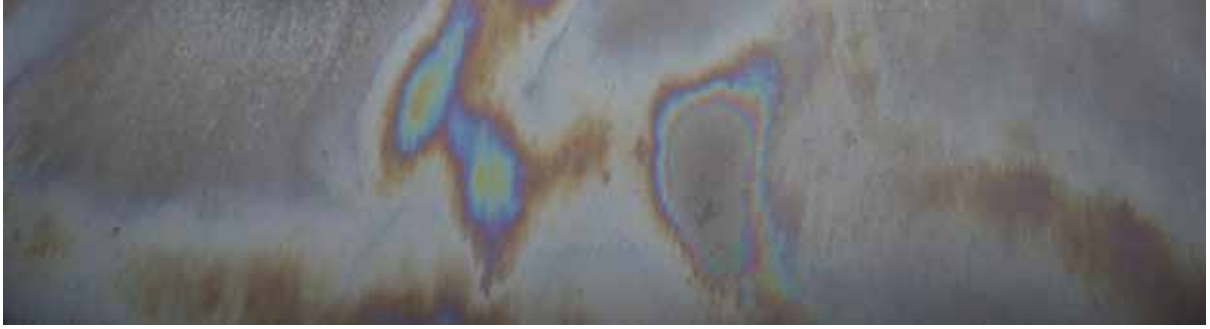
68 Timonthy J. Skone et al., Development of Baseline Data and Analysis of Life Cycle Greenhouse Gas Emissions of Petroleum-Based Fuels, US Department of Energy, National Energy Technology Laboratory, DOE/NETL-2009/1346.

69 National Energy Technology Laboratory (NETL), An Evaluation of the Extraction, Transport and Refining of Imported Crude Oils and the Impact of Life Cycle Greenhouse Gas Emissions, DOE/NETL-2009/1362, March 27, 2009.

70 Aweewan Mangmeechai et al., Life Cycle Consumptive Water Use and Greenhouse Gas Implications of Unconventional Oil, abstract, Carnegie Melon University, http://www.lcacenter.org/LCA9/abstracts/115.html.

US diesel fuel made from Canadian bitumen has a carbon footprint 144 per cent greater than that of domestic crude.

Source: Kristin J. Gerdes et al., Consideration of Crude Oil Source in Evaluating Transportation Fuel GHG Emissions, US Department of Energy, National Energy Technology Laboratory, DOE/NETL-2009/1360.



A Significant Global Polluter

If tar sands production grows from 1.3 million barrels a day to three or five million by 2030, the project will emit more CO_2 on an annual basis than all the world s volcanoes (130 MT).[71] It will foul the atmosphere at a pollution rate greater than that of many medium-sized European nations and of most African nations. And it will outpace emissions from Canada s two largest sectors of carbon producers: transportation, and electricity and heating.[72]

Between 1990 and 2001, the project s emissions grew from 10 MT to 15 MT per year, but then exploded to 36 MT by 2006. (According to Natural Resources Canada, that s enough CO_2 to fill 76 million average-sized homes.) [73] By 2020, annual emissions from the project could range anywhere from 127 to 140 MT.[74]

Both industry lobbyists and government leaders downplay the significance of these emissions. The Oil Sands Developers Group, for example, says carbon waste from the tar sands amounts to only five per cent of Canada's total GHG emissions today, and could grow to eight per cent by 2015.[75] Alberta Premier Ed Stelmach describes the province s energy emissions as a tiny contributor. [76]

But in real terms, the tar sands emissions are neither tiny nor insignificant. In fact, the energy-intensive project has become a formidable carbon-making nation within the nation. Emissions from the world s largest energy project (36 MT) now exceed those of several European nations, such as Estonia (22 MT) and Lithuania (24 MT). Total annual emissions from two major tar sands producers, Suncor (11 MT) and Syncrude (15 MT) easily dwarf the emissions of entire nation states, including Cyprus (10 MT) and Malta (3 MT).[77]

By 2020, project emissions could range anywhere between 127 MT and 140 MT if

71 US Geological Survey, Volcano Hazards Program: Volcanic Bases and Their Effects. Online at http://volcanoes.usgs.gov/hazards/gas/index.php.

72 Alex D. Charpentier et al., Understanding the Canadian Oil Sands Industry s Greenhouse Gas Emissions, Environ. Res. Lett. 4 014005, 2009, p. 2.

73 According to NRCan, the emissions of one tonne of CO_2 would fill the volume of approximately two averaged-sized houses in Canada. One megatonne would fill about 2 million average-sized houses. See: http://oee.nrcan.gc.ca/Publications/statistics/trends06/chapter2.cfm?attr=0.

74 Katherine Elliot, Examination of Oil Sands Projects: Gasification, CO_2 Emissions and Supply Costs, Energy Resources Conservation Board, 2008. See also: David McColl, Green Bitumen:The Role of Nuclear, Gasification and CCS in Alberta s Oil Sands, Canadian Energy Research Institue, February 2008.

75 The Oil Sands Developers Group, Oil Sands: Forecast Update, March 2009.

76 Darcy Henton, CO_2 output tiny says Stelmach, Edmonton Journal, July 25, 2009. Online at: http://www.calgaryherald.com/business/Alberta+output+tiny+says+Stelmach/1828456/story.html.

77 European Environment Agency (EEA), Summary of Annual European Community Greenhouse Gas Inventory 1990 2007 and Inventory Report 2009, EEA Technical Report No. 4/2009, Submission to the UNFCCC Secretariat, p. 11.

production reaches 3.4 million barrels a day. At that point, the project will exceed the 2009 emissions of many European countries, including Austria (88 MT), Portugal (81), Ireland (69), Finland (78), Bulgaria (75), Hungary (75) and Denmark (66). In fact, the project s CO_2 output could rival or even exceed that of Belgium (131 MT), a nation of 10 million people. It will also amount to the addition of two oil-exporting nations the size of Norway (53 MT) to the planet s atmosphere.[78]

A 2009 report on the viability of non-conventional fuels warned investors that the emissions and impacts from the tar sands projects are so large that they will in and of themselves have massive global impacts." As a consequence, tar sand companies "by definition are likely to lose their licence to operate and this will mean they would be stopped from realizing these projects by regulators and stakeholders as the impacts of the externality costs are calculated and more widely understood. [79]

78 Statistics Norway, Emissions of Greenhouse Gases, 1990 2008, May 19, 2009.

79 Marc Brammer and Yulia Reuter, The Viability of Non-Conventional Oil Development, Innovest Strategic Value Advisors, March 2009.

By 2020, GHG emissions from the tar sands will rival those of many large European nations.

Source: European Environment Agency, Summary of Annual European Community Greenhouse Gas Inventory 1990–2007 and Inventory Report 2009, submission to the UNFCCC Secretariat, EEA Technical Report No 4/2009, p. 11. Katherine Elliot, Examination of Oil Sands Projects: Gasification, CO2 Emissions and Supply Costs, SPE/PS/CHOA, presentation to International Thermal Operations and Heavy Oil Symposium, October 20–23, 2008 pp. 9–10.

Energy Cannibalism and Nuclear Reactors

The tar sands project consumes more natural gas than almost any other industrial sector and relentlessly cannibalizes Canada s natural gas supplies.[80] In 2007, the tar sands accounted for 13 per cent of Canada s natural gas demand. Since 2000, consumption of natural gas in the tar sands has nearly tripled to 1.1 billion cubic feet (bcf) a day.[81] That s enough fuel to heat six million average-sized homes every day.[82]

The industry uses natural gas in all forms of bitumen production. It burns gas to make electricity to run industrial facilities. It also cracks natural gas to produce hydrogen for enriching bitumen into refinable synthetic crude. Upgraders use as much as 500 cubic feet of natural gas to produce synthetic crude, while steam plants consume 1.5 thousand cubic feet of natural gas to boil steam to melt bitumen. Natural Resources Canada recently calculated that without new upgrading technologies, by 2030 the tar sands could consume 60 per cent of Canada s natural gas supply, an impossible scenario. [83]

Cambridge Energy Research Associates, a private US energy consulting firm, now estimates that the tar sands cannibalize 20 per cent of Canadian natural gas demand. By 2035, the project could consume between 25 and 40 per cent of total national demand, or 6.5 billion cubic feet a day.[84] Such a scenario would consume most of the natural gas supplies contained in the Arctic: Canada s Mackenzie Delta as well as the Alaska s North Slope.[85] In 2007, the Canadian Parliament reported that it would take 20 nuclear reactors to replace natural gas consumption and meet forecast oil production by 2015.[86] The Canadian Energy Research Institute (CERI), a Calgary think-tank, envisions as many as 25 nuclear reactors providing steam and electricity for bitumen production by 2025.[87] Several companies, including French nuclear giant Areva, have expressed interest in building several nuclear reactors near tar sands projects.[88] To produce 200,000 barrels a day from a steam plant, Total S.A. estimates it would need 3,300 metric tonnes of steam per hour, or the equivalent of a 2,600-megawatts power plant. A typical nuclear power plant produces 3,000 megawatts. [89]

---

80 Energy cannibalism, a term coined by J.M. Pearce at Canada s Queen s University, occurs when the rapid growth of one energy system creates a need for energy that uses or cannibalizes the energy of existing power plants or devices. See: http://me.queensu.ca/people/pearce/publications/documents/asp3.pdf.

81 Energy Canada (NRCan), Canadian Natural Gas: Review of 2007/08 and Outlook to 2020, December 2008. Available at: http://www.nrcan.gc.ca/eneene/sources/natnat/revrev-eng.php.

82 J. Marriott et al., BP and Shell: Rising Risks in Tar Sands Investments, Greenpeace, 2008, p 9.

83 NRCan, Roadmap Workshop on Non-petroleum-based Fuels and Advanced Combustion Research, Eco-tourism and Sustainable Tourism Conference (ESTC), Portland, Oregon, November 27 28, 2007.

84 IHS Cambridge Energy Research Associates (CERA), Growth in the Canadian Oil Sands: Finding the New Balance, 2009. Available at: http://www.cera.com/aspx/cda/client/knowledgeArea/serviceDescription.aspx?KID=228.

85 IHS Cambridge Energy Research Associates, Growth in the Canadian Oil Sands: Finding a Balance: An IHS Special Report, 2009, p. ES6.

86 Lee Richardson (Chair), The Oil Sands: Toward Sustainable Development, Report of the Standing Committee on Natural Resources, 39th Parliament of Canada, 1st Session, March 2007, p. 31. Online at: http://cmte.parl.gc.ca/Content/HOC/committee/391/rnnr/reports/rp2614277/rnnrrp04/10_Chap_5_ENG.htm.

87 David McColl, Green Bitumen: The Role of Nuclear, Gasification and CCS in Alberta's Oil Sands, Summary Report, Canadian Energy Research Institute, Study No. 119, February, 2009

88 Geoffrey Scotton, Global Nuclear Firms Eye Province, Calgary Herald, March 29, 2008.

89 Total SA, Extra-Heavy Oils and Bitumen: Reserves for the Future, 2006, p. 24.

Accelerated tar sands production could increase electricity use by the region s industrial sector by 91 per cent and thereby drive the highly contentious demand for nuclear power in the region.[90]

Canada could well become the first country in the world to use nuclear power to accelerate the exploitation of fossil fuels. Sweden s Uppsala Hydrocarbon Depletion Group calculates that Canada can t expand tar sands production without either reducing natural gas exports to the US or building nuclear power plants to fuel steam plants and carbon capture and storage projects.[91]

A variety of corporations and agencies have championed nuclear power as a way to accelerate the development of Canada s tar sands and ostensibly reduce GHG emissions. In particular, Ontario-based Bruce Power has sparked much public outcry with proposals to build several nuclear reactors near tar sand deposits.[92] Areva has even described Canada s tar sands boom as a boost for nuclear power. [93] The governments of Alberta and Saskatchewan have both signed memorandums with the Idaho National Laboratory, the US government nuclear research lab, to explore the use of nuclear reactors for unconventional oil development. The Idaho National Laboratory says, there is growing interest in applying nuclear energy (heat) to the recovery and upgrading/conversion of critical unconventional fossil energy resources. [94] In addition, CERI has argued that nuclear power combined with CCS could green bitumen, creating the cleanest sources of produced crude oil on the planet. [95] But this renaissance of nuclear rhetoric in the tar sands generally ignores five critical realities:

1.) An Economic Liability: Once billed as too cheap to meter, nuclear power remains too expensive to build. Since 2003, the cost of constructing a nuclear plant has increased by a rate of 15 per cent a year.[96] A 2009 study by the Vermont Law School found that recent cost projections are four times as high as those made a decade ago.[97] Moreover, numerous studies have concluded that renewable energy and efficiency improvements cost but six cents per kilowatt-hour while electricity from nuclear power ranges between 12 and 20 cents. Nuclear remains the most capital-intensive and riskiest form of energy on the planet.

2.) The Waste Legacy: Disposing of hazardous radioactive nuclear waste for up to 10,000 years remains an unsolved global problem. Canada has no permanent home for two million nuclear fuel bundles, and storing the waste deep underground could cost taxpayers up to $24 billion.[98] To date, nuclear waste has no permanent storage site in the US and even the

90 Government of Alberta, Report On Nuclear Power and Alberta, Nuclear power expert panel report, Alberta Energy, February 2009. Online at: www.energy.alberta.ca/Electricity/pdfs/NuclearPowerReport.pdf.

91 B. S derbergh et al., A Crash Program Scenario for the Canadian Oil Sands Industry, Uppsala Hydrocarbon Depletion Study Group, Uppsala University, 2006.

92 Jim Macdonald, Bruce Power View to Win Support On the Prairies, Canadian Press, March 15, 2009.

93 Areva, Extreme Oil, Alternatives, 3rd Quarter, 2008. Online at: http://www.areva.com/servlet/BlobProvider?blobcol=urluploadedfile&blobheader=application/pdf&blobkey=id&blobtable=Downloads&blobwhere=1230027582389&filename=8192_AREVA_MAG19_GB,0.pdf.

94 Michael Hagood, Unconventional Fossil Fuels: A Strategic US Energy Resource, presentation to 4th International Topical Meeting on High Temperature Reactor (HTR) Technology, Washington, DC, October 1, 2008.

95 David McColl, Green Bitumen: The Role of Nuclear, Gasification and CCS in Alberta's Oilsands, Study No. 199, Canadian Energy Research Institute (CERI), 2009. Online at: http://www.ceri.ca/documents/CERIOilSands-GHG-SummaryReport.pdf.

96 John M. Deutch et al., Update of the MIT 2003 Future of Nuclear Power, Massachusetts Institute of Technology (MIT), 2009.

97 Mark Cooper, The Economics of Nuclear Reactors: Renaissance or Relapse? Institute for Energy and the Environment, Vermont Law School, June 2009.

98 Canadian Broadcast Corporation, Storing Nuclear Waste a $24-billion Problem, August 18, 2009. Avail-

Massachusetts Institute of Technology, a nuclear proponent, admits "insufficient progress has been made on waste management. [99]

3.) A Carbon Maker: Nuclear power, often billed as a climate change fighter, is not carbon-free. GHG emissions derived from uranium mining, milling, enrichment and fuel manufacture are substantial and increasing due to declining quality of uranium ores. Even the Nuclear Energy Institute admits that both wind and geothermal energy create fewer life-cycle GHG emissions than nuclear power.[100] A 2008 Australian study reported there is very little detailed analysis of the true carbon costs of nuclear energy.

4.) Security: Nuclear power plants pose extreme security risks. A 2007 US report concluded that there is no assurance that reactors can be defended against terrorist attacks and that spent fuel rods are highly vulnerable to attacks.[101]

5.) Political Risk: Employing nuclear power to accelerate the production of one of the world s dirtiest hydrocarbons could well provoke international censure and further diminish Canada's international reputation. The first country or company to use nuclear power to increase fossil fuel production and consumption could well trigger international trade sanctions.

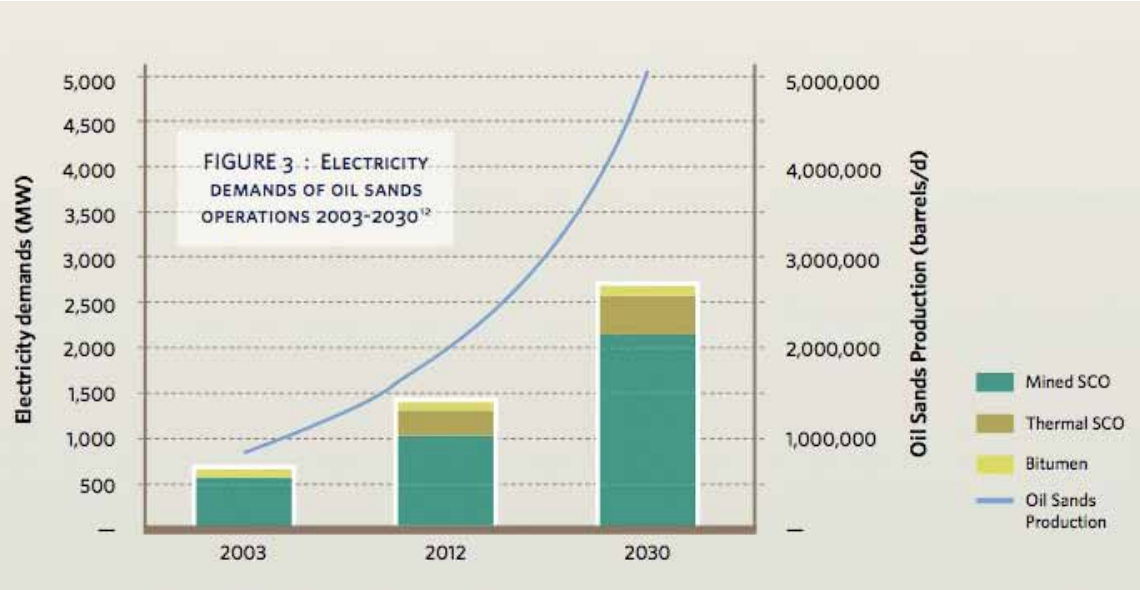


Figure 10: Projected Electricity Demands of Oil Sands Operations, 2003–2030

Note: MW = megawatts; SCO = synthetic crude oil.
Source: Government of Alberta, Report on Nuclear Power and Alberta, Nuclear power expert panel report, Alberta Energy, February 2009, p.15.

able at: http://www.cbc.ca/canada/story/2009/08/18/f-nuclear-waste-storage.html.

99 John M. Deutch et al., Update of the MIT 2003 Future of Nuclear Power, Massachusetts Institute of Technology (MIT), 2009.

100 Nuclear Energy Institute (NEI), Life-cycle Emissions Analysis, at: http://www.nei.org/keyissues/protectingtheenvironment/lifecycleemissionsanalysis/.

101 L. Gronlund, D. Lochbaum and E. Lyman, Nuclear Power in a Warming World, Union of Concerned Scientists, Cambridge, Massachussetts, 2007. Online at: http://www.ucsusa.org/assets/documents/nuclear_power/nuclear-power-in-a-warming-world.pdf.

Tar sands production can t reach three million barrels a day without increasing electricity use and opening the door for nuclear reactors.

Source: Government of Alberta, Report On Nuclear Power and Alberta, Alberta Energy, February 2009. Online at: www.energy.alberta.ca/Electricity/pdfs/NuclearPowerReport.pdf.

The Technology Illusion

Industry and government now argue that new recovery technologies and game changers will radically reduce the energy intensity and carbon footprint of bitumen. CERI, for example, proposes to green bitumen by reducing GHG emissions to a level equal to or below that of conventional crude with innovation. These perceived carbon-saving technologies include using nuclear power for steam and hydrogen production; CCS for upgraders; the gasification of bitumen residues; and solvents or electrodes to melt bitumen underground.[102] CAPP adds that technology is the key lever for sustainable growth. [103]

But the history of technological innovation in the tar sands challenges this official optimism. In fact, industry innovation has perversely increased GHG emissions in the tar sands. Technologies that marginally reduce GHG intensity or energy use often create a rebound effect that simply accelerates total fossil fuel production or consumption.

A short history of Canadian bitumen mining tells this story. At the turn of the century, tar sand pioneers mined bitumen by hand. By the 1960s, engineers graduated to bulldozers, draglines and bucket wheel excavators. After much trial and error, industry eventually converted to truck-and-shovel operations by the 1990s. Although truck-and-shovel mining achieved greater mobility and energy efficiency, the change ultimately sped up extraction and thereby created ever-growing clouds of climate-making gases. In fact, all gains in energy efficiency or decreases in GHG intensity (and industry has reduced its GHG intensity by 38 per cent) have been completely overwhelmed by the growth of oil sands industry. [104]

As a consequence, the governments of Alberta and Canada are now gambling on another technology, carbon capture and storage (CCS), to reduce GHG emissions in the tar sands. Both governments have invested nearly $3 billion worth of taxpayers money to develop several demonstration projects.[105] This largely untested and complex technology, intended primarily for coal-fired power plants, strips CO_2 emissions from smoke stacks, compresses the gas and then transports it to be stored in deep underground formations. This waste must then be monitored for an undetermined time, possibly thousands of years, at an uncalculated cost, to ensure no leaks occur.

---

102 Eddy Isaacs, The Canadian Oil Sands in the Context of the Global Energy Demand, Abstract for 17th Convocation of CAETS, Tokyo, Japan, October 2007. Online at: http://www.aeri.ab.ca/sec/new_res/docs/CDN_oil_sands_Isaacs_071005.pdf.

103 David Collyer, Energy, Environment, Economy: The Outlook for Canada s Oil and Gas Sector, presentation to the Newfoundland and Labrador Oil and Gas Industries Association Conference, Canadian Association of Petroleum Producers, June 18, 2009.

104 John Nyboer and JianJun Tu, GHG Emissions Trend Analysis in the Fossil Fuel Production Industries 2008 Upate, Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC), Simon Fraser University, Burnaby, BC, February 2008. Available at: http://www.cieedac.sfu.ca/CIEEDACweb/pubarticles/GHG%20Analysis%20Publications/Fossil%20Fuel%20Industry%20Trend%20Report%202008%20Update.pdf.

105 Kevin Stringer, Letter to California Air Resources Board (CARB), March 4, 2009. Online at: http://www.canadainternational.gc.ca/washington/events-evenements/LCFS_Stringer.aspx?lang=eng.

The Alberta government plans to meet at least 70 per cent of its planned reductions of 200 megatonnes of CO_2 by 2050 by using CCS to capture CO_2 and dump it in saline formations. The federal government estimates that it might be able to bury 40 per cent of the nation s emissions by 2050. Natural Resources Canada predicts the technology will be affordable and reliable by 2020, while the Alberta government says it s an investment in the environment. [106] Yet researchers and energy experts have identified a daunting array of research gaps and uncertainties. Critical barriers to widespread technological deployment of CSS include the following:

1.) No full-scale integrated CCS system for a coal fired plant or tar sands developer now exists. Commercial availability is still at least 10 to 15 years away.[107]

2.) Concentrating and purifying CO_2 for storage requires extreme amounts of energy, equivalent to nearly a third of the power produced by a coal-fired plant.[108] Because CCS increases coal consumption at power plants, its life cycle has the highest emissions rate of nine well-known electricity-generating technologies.[109]

3.) Organizations as varied as *The Economist* and Greenpeace have challenged the unruly economics of CCS. According to the US government, current CCS technology would cost $150 per ton of carbon and is much too high for carbon emissions reduction applications. [110] The Alberta Carbon Capture and Storage Development Council describes CCS as expensive and currently uneconomic without taxpayer subsidies of one to $3 billion a year over several decades.[111]

4.) The scalability of CCS remains in doubt. Canadian energy expert Vaclav Smil argues that CCS would require an infrastructure base twice the size of the world s crude oil industry just to bury 25 per cent of the world s emissions, an undertaking that would take many decades to accomplish. [112]

5.) The risks of leakage and the need for monitoring at storage sites over several thousand years raise both global and local liability issues.[113] Questions about the potential for significant groundwater contamination remain unanswered.[114]

---

106 Kevin Stringer, CCS as Seen from Canada, presentation at Carbon Capture and Storage Workshop, London, UK, October 2008. See also: Government of Alberta, Talk About Carbon Capture and Storage, April 2009. Online at: www.energy.gov.ab.ca/Org/pdfs/FactSheet_CCS.pdf.

107 Anders Hansson et al., Expert Opinions on Carbon Dioxide Capture and Storage A Framing of Uncertainties and Possibilities, Energy Policy 37, 2009.

108 US Department of Energy, Fossil Energy: Retrofitting the Existing Coal Fleet with Carbon Capture Technology, 2008 http://www.fossil.energy.gov/programs/powersystems/pollutioncontrols/Retrofitting_Existing_Plants.html

109 Mark Jacobson, Review of Solutions to Global Warming, Air Pollution and Energy Security, Energy and Environmental Science, December 2008.

110 US Department of Energy, Carbon Capture Research, http://fossil.energy.gov/programs/sequestration/capture/index.html.

111 Alberta Carbon Capture and Storage Development Council, Accelerating Carbon Capture and Storage Implementation in Alberta, Final Report, March 2009.

112 Vaclav Smil, Letter to the Editor, Nature vol. 453, 8 May 2008. Online at: http://home.cc.umanitoba.ca/~vsmil/pdf_pubs/nature2008.pdf

113 Rose Murphy and Mark Jaccard, Geological Carbon Storage: The Roles of Government and Industry in Risk Management, in Innovation, Science, and Environment: Canadian Policies and Performance, 2008 2009, edited by Glen Toner, McGill-Queens University Press, 2009.

114 Berkeley Lab Earth Sciences Division, CO_2 Geological Storage and Groundwater Resources. Online at: http://esd.lbl.gov/GCS/projects/CO_2/taskBpubs/report_1_NETL_October2007_AnnRep.pdf.

6.) With the exception of bitumen upgraders, CCS is largely unsuitable for tar sands. Emissions are so diverse from the project that a 2008 government study concluded that only a small portion of the CO_2 streams are currently amenable for CCS due to both the size of the emission streams and the concentration. [115]

7.) Researchers admit that CCS could founder on the shoals of inadequate and incoherent regulatory strategies. [116] An independent Swiss group has concluded vital information needed to create general governance capable of managing wide-scale commercial deployment of CCS is not yet available. [117]

8.) CCS locks the world into more fossil fuel consumption and is not a bridge to renewable energy but a costly detour.[118] Canadian energy analyst Peter Tertzakian calls it an incredibly inefficient, energy-intensive system that is designed to clean up the energy from another very inefficient and wasteful process."[119]

A 2008 report prepared for Environment Canada concludes that innovation won t quell atmospheric pollution but will, instead, increase overall GHG emissions emitted by fossil fuel production. [120] Cambridge Energy Research Associates calculates that technology will not prevent GHG emissions from rising rapidly during an aggressive scale-up of tar sands

---

115 EcoEnergy Carbon Capture and Storage Task Force, Canada s Fossil Energy Future: The Way Forward on Carbon Capture and Storage, Report to the Minister of Alberta Energy and Minister of Natural Resources Canada, January 2008, p. 9.

116 Elizabeth Wilson et al., Regulating the Geological Sequestration of C02, Environmental Science and Technology, April 15, 2008.

117 International Risk Governance Council, Regulation of Carbon Capture and Storage, February 2008. Online at: http://www.irgc.org/IMG/pdf/Policy_Brief_CCS.pdf.

118 Anders Hansson et al., Energy Opinions On Carbon Dioxide Capture and Storage A Framing of Uncertainties and Possibilities, Energy Policy 36, 2009.

119 Patrycja Romanowska. Energy Gluttons, Alberta Oil Magazine, June 2009

120 John Nyboer and JianJun Tu, GHG Emissions Trend Analysis in the Fossil Fuel Production Industries 2008

production.[121] A German study concluded that technological innovations such as CSS might limit some emissions but doubted any real improvement: Current GHG politics do not provide sufficient incentives to apply innovative technologies and to avoid a dramatic increase of GHG emissions of the oil sand sector. [122] Even if largely unproven technologies such as CSS could lower the tar sands footprint, they would still leave unaddressed the CO_2 emissions from final fuel combustion."[123] A 2008 study by the US Rand Corporation concluded that unconventional fossil fuels simply do not offer a path to greatly reduced carbon-dioxide emissions.[124]

Canada's pre-eminent energy economist, Vaclav Smil, doubts technical fixes can resolve the central tar sands problem: unbridled energy consumption. Good public policy must simply encourage reductions in energy use. All economies are just subsystems of the biosphere and the first law of ecology is that no trees grow to heaven. If we are not going to engineer thoughtful, gradual reductions we run a considerable risk that the biosphere may do the scaling down for us in a less desirable (if not catastrophic) manner. [125]

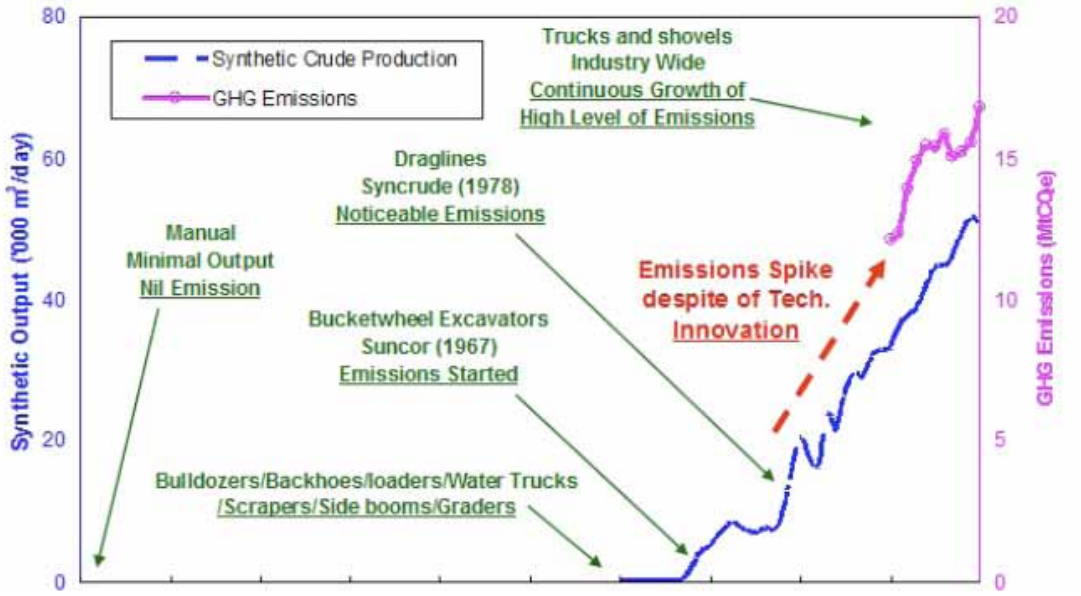


Figure 11: Timeline of GHG Emissions, Oil Sands Mining Technology, and Synthetic Crude Production, in the 20th Century

Note: m3 = cubic metres; MT CO_2e = megatonnes (million tonnes) of carbon dioxide equivalent.
Source: CAPP (various years) and Oil Sands Discovery Centre, 2007, quoted in: John Nyboer and JianJun Tu, GHG Emissions Trend Analysis in the Fossil Fuel Production Industries 2008 Update, Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC), Simon Fraser University, Burnaby, BC, February 2008, p.44.

---

121 IHS Cambridge Energy Research Associates (CERA), Growth in the Canadian Oil Sands: Finding a Balance: An IHS Special Report, p.100.

122 Martin Meyer Renschhausen, Expanding Unconventional Oil Production in a Carbon-Constrained World, University of Applied Sciences, Dresden, 2008. Online at: http://www.tu-dresden.de/wwbwleeg/events/enerday/2008/Paper/MeyerRenschhausen.pdf.

123 Michael Toman et al., Unconventional Fossil-Based Fuels: Economic and Environmental Trade-Offs, Rand Corporation, 2008, p.89. Online at: http://www.rand.org/pubs/technical_reports/2008/RAND_TR580.pdf.

124 Ibid.

125 Vaclav Smil, Energy at the Crossroads, presentation at Global Science Forum Conference on Scientific Challenges for Energy Research, Paris, May 17 18, 2006.

In the tar sands, emissions and technological innovation have climbed the same ladder.

Source: John Nyboer and JianJun Tu, GHG Emissions Trend Analysis in the Fossil Fuel Production Industries 2008 Update, Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC), Simon Fraser University, Burnaby, BC, February 2008, p.44.

Eroding Carbon Storehouses

The exploitation of tar sands deposits in northern Canada has unsettled one of the world s great carbon storehouses: the Boreal forest. This forest, the lungs of the planet, now stores an estimated 186 billion tonnes of carbon across Canada. Peatlands, which occupy 40 per cent of the forest, perform many important ecological services, including water filtration and carbon capture. These mossy lands contain seven times more carbon than normal Boreal forest soils.[126] Even though Boreal and subarctic peatlands cover only three per cent of the world s landmass, they store anywhere from 15 to 30 per cent of the world s soil-based carbon.[127] That makes peatlands the most effective carbon saver of any ecosystem on the planet.

The full development of Canada s tar sands will eventually fragment and erode peatlands and forest over an area the size of England (Sixty per cent of this area has already been leased to oil companies). The mining operations alone will directly destroy a forest the size of two Luxembourgs or four Hong Kongs.[128] Peatlands and wetlands once covered more than half this mining zone. The federal government has yet to quantify how many megatonnes of CO_2 will be released into the atmosphere by the industrialization of these critical carbon storehouses. One University of California study estimates that GHG emissions caused by land disturbance for tar sands production could be two to three times greater than those of conventional fuels, or even yet greater, given the carbon content of peatlands.[129] Scientists estimate that even small changes to the health of peatlands in the region will convert these northern organic soils to a net carbon source to the

126 Dale H. Vitt et al., The Future of the Peatland Soils of Western Canada: Cumulative Effects of Natural and Anthropogenic Disturbance, presentation to the Symposium on Stability of Peatland Soil Carbon Pools and Trace Gas Emissions to Disturbance, 2008 Joint Annual Meeting, Houston, Texas, October 8, 2008.

127 Dale H. Vitt and R.K. Wieder, Boreal Peatland Ecosystems: Our Carbon Heritage, Chapter 18, New York: Springer, 2006.

128 According to the CIA World Factbook, the area of Luxembourg is 2,586 sq. km. while the area of Hong Kong is 1092 sq. km. Alberta's Energy Resources Conservation Board now defines the Surface Mineable Area (SMA) in the tar sands Athabasca deposit as 4750 sq. km. See: Energy Resources Conservation Board, Alberta s Energy Reserves 2008 and Supply/Demand Outlook, 2.1: Reserves of Crude Bitumen, ST98-2009.

129 Sonia Yeh et al., Land Use Greenhouse Gas Emissions for Conventional and Unconventional Oil Production, Institute of Transportation Studies, University of California, Davis, February 26, 2009.

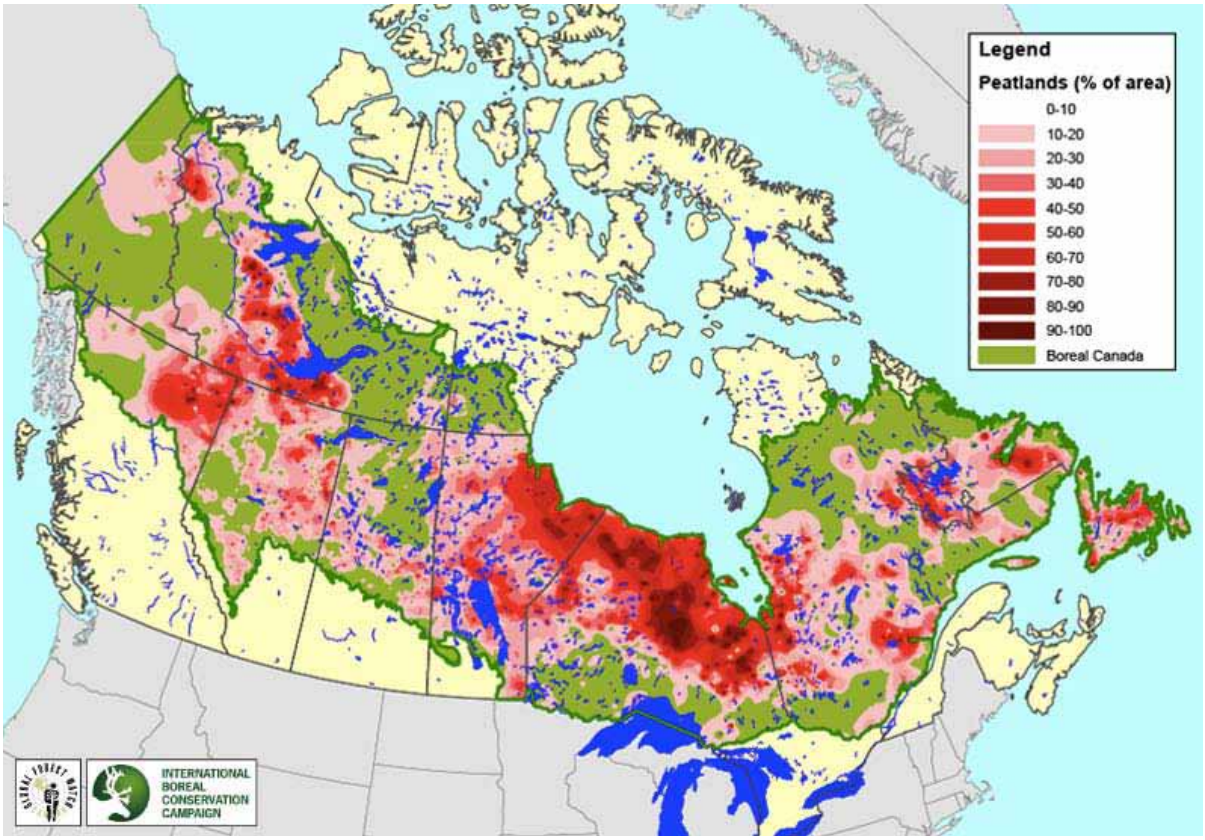


Figure 12: Carbon Storage in Canada's Boreal Forest

Source: International Boreal Conservation Campaign, Carbon Storage in Canada s Boreal Forest: Map of Peatlands Extent in Boreal Canada, 2002.

The rapid development of the tar sands threatens to unravel critical carbon storehouses.

Source: International Boreal Conservation Campaign, http://www.interboreal.org/globalwarming/.

atmosphere. [130] Global Forest Watch estimates that the capacity of Alberta s forests and wetlands to absorb industrial GHG emissions was exceeded in 2003. In other words, the region now exports vast amount of CO_2 emissions to other parts of Canada and the rest of the planet. [131]

The demand for natural gas for steam plants disturbs large landscapes throughout Western Canada. Given that the steam plants use four times more natural gas than mining operations, they require four times more natural gas infrastructure.[132] Natural gas production to fuel steam plants will disturb more forest and grassland carbon sinks than the actual steam facilities. In fact, land use impacts of natural gas extraction may be more significant than previously recognized and are often under accounted."[133]

130 Dale H. Vitt et al., The Future of the Peatland Soils of Western Canada: Cumulative Effects of Natural Anthropogenic Disturbance, presentation to the Symposium on Stability of Peatland Soil Carbon Pools and Trace Gas Emissions to Disturbance, Joint Annual Meeting, Houston, Texas, October 8, 2008.

131 Peter Lee et al., The Last Great Intact Forests of Canada: Atlas of Alberta, Global Forest Watch, 2009, p. 72.

132 University of Calgary and University of Toronto, Life Cycle Assessment of Oil Sands Technology, Land Use Impacts, http://www.ucalgary.ca/lcaos/Land_use_impacts.shtml.

133 Sarah M. Jordaan et al., Quantifying Land Use of Oil Sands Production: A Life Cycle Perspective, Environmental Research Letters (4) 2009.

The implications for wildlife are also profound. Mining activity alone will result in the loss of breeding habitat for between 480,000 and 3.6 million Boreal songbirds.[134] A 2008 report by the Cumulative Environmental Management Association, an industry group, disclosed that the steam plants, as currently designed, would exterminate caribou, fish, bear and moose over a region 400,000 hectares, due to habitat fragmentation.[135]

Reclamation of peatlands remains an uncertain and untested science in Canada. Industry admits that, it is unclear whether natural fens and bogs will persist in the oil sands region, and if so whether they will continue to accrue peat. [136] Moreover, industry lobbyists have opposed globally accepted standards for replacing destroyed wetlands (estimated at 800 to 2500 sq. km), by arguing that it would cost billions of dollars.[137]

A Global Carbon Bully

Perhaps the most destructive legacy of rapid tar sands development has been the paralysis of Canadian public policy on climate change at home, and the nation s persistent obstruction of global action abroad. In 2006, the Commissioner of the Environment and Sustainable Development reported that Canada's tar sands is "significantly increasing greenhouse gas emissions, yet few federal efforts are underway to reduce these emissions. Moreover, audits by the commissioner revealed a long history of inadequate leadership, planning and performance on climate change. I am more troubled than ever by the government s long-standing failure to confront one of the greatest challenges of our time. Our future is at stake. [138]

On the global stage, climate change negotiators now recognize Canada as a stalwart defender of high-carbon fuels. In 2008, international non-governmental delegates awarded Canada the dubious honour of Fossil of the Year at climate meetings in Poznan, Poland.

Draconian restrictions prevented federal scientists from attending the last two meetings of the Kyoto Protocol.[139] Sir David King, former chief scientific adviser to the United Kingdom, singled out Canada and Japan as nations blocking the process to a new climate deal in Copenhagen this year. To many international observers, Canada s objections to effective action simply mirror the selfish interests of a power tar sands lobby that wants to accelerate oil exports. These people are very outspoken, aggressive lobbyists, said Dr. Robert Falkner of the London School of Economics. They are gung-ho about rising oil prices and want to exploit that. [140]

---

134 Jeff Wells, Danger in the Nursery: Impact on Birds of Tar Sands Oil Development in Canada s Boreal Forest, Natural Resources Defense Council, 2008. Available at: http://www.nrdc.org/wildlife/borealbirds.asp.

135 Andrew Nikiforuk, Bitumen Oilsands: Slick Science, Canadian Business Magazine, September 15, 2008.

136 Megan Harris, Guideline for Wetland Establishment on Reclaimed Oil Sands Leases, Revised (2007) Edition, Cumulative Environmental Management Association, p. 83. Online at: http://environment.gov.ab.ca/info/library/6868.pdf.

137 Alberta Chamber of Resources, Letter to Wetlands Policy Project Team of Alberta Water Council, July 30, 2008.

138 Johanne G linas, The Commissioner s Perspective, Report of the Commissioner of the Environment and Sustainable Development to the House of Commons, Government of Canada, 2006. Online at: http://www.oag-bvg.gc.ca/internet/English/parl_cesd_200609_00_e_14982.html.

139 Ed Struzik, The Big Thaw: Travels in the Melting Arctic, Toronto: Wiley, 2009, p. 253.

140 Hannah Devlin, Canada and Japan Blocking Climate Change Deal, Sir David King Warns, The Times, July 2, 2009.

Briefing documents recently prepared by the Department of Foreign Affairs underscore Canada s international strategy as a carbon bully. The documents propose that Canada try to split members of the EU on their GHG commitments, backpedal on reduction targets and tie any assistance to developing nations to binding GHG targets. The documents also highlighted Canada s appallingly low-level targets, compared to European commitments to reduce emissions by 25 to 40 per cent from 1990 levels. Canada s negotiating challenge is compounded by the fact that our domestic goal for 2020 is a reduction of 20 per cent from 2006 levels (this is equivalent to roughly two per cent below the 1990 levels), the documents say.[141]

Although the federal government has spent $6 billion on climate change programs since 1997, it has failed to achieve one public target.[142] Under the admittedly problematic Kyoto Protocol, Canada promised to keep its emissions to an average of six per cent below 1990 levels, or around 558 MT. But subsidies, propaganda and voluntary measures failed to make a difference. Instead, Canada will exceed that target by more than 30 per cent by 2012. Canadian economist Mark Jaccard has repeatedly noted that without a substantial shift in policy, the federal government will be burning our money to warm the planet. [143]

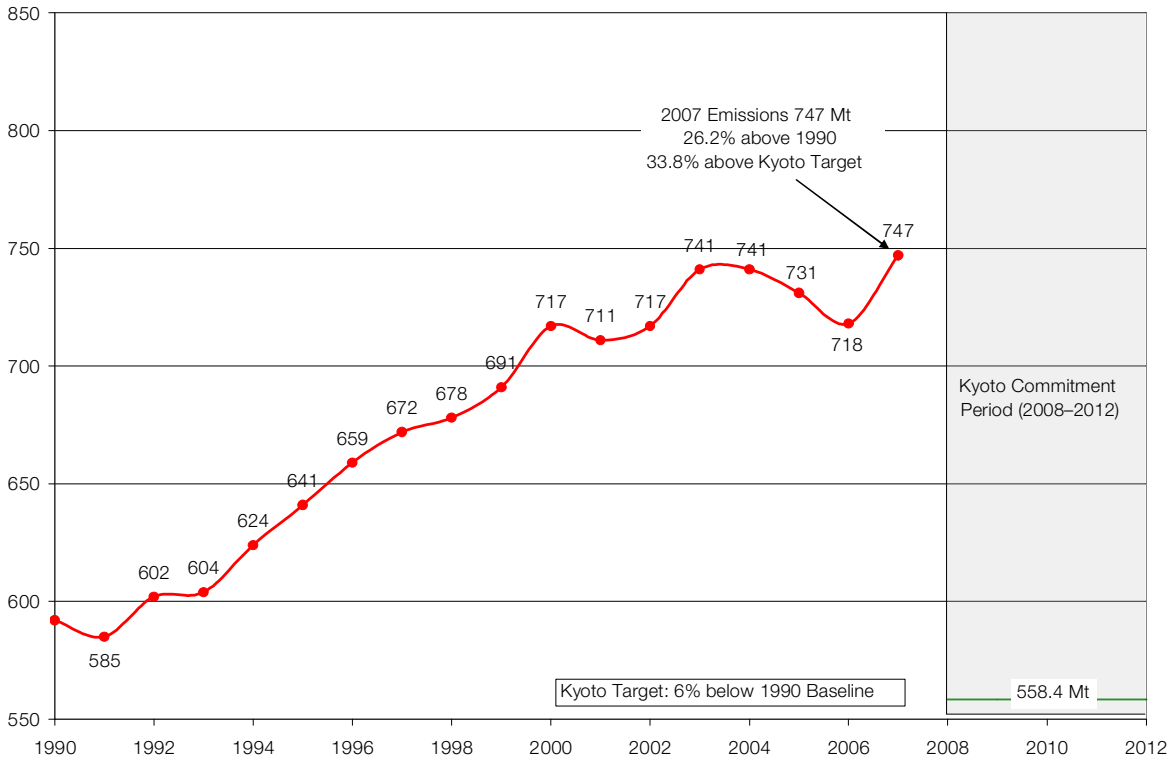


Figure 13: Canada's GHG Emissions, 1990–2007

Source: Environment Canada, Information on Greenhouse Gas Sources and Sinks: Canada s 2007 Greenhouse Gas Inventory A Summary of Trends, 2008, p.1.

141 Lee Berthiaume, Government Planned to Split EU On Climate Change Talks, Embassy Magazine, June 17, 2009.

142 Johanne G linas, The Commissioner s Perspective, Report of the Commissioner of the Environment and Sustainable Development to the House of Commons, Government of Canada, 2006, p. 10.

143 Mark Jaccard et al., Burning Our Money to Warm the Planet: Canada s Ineffective Efforts to Reduce Greenhouse Gas Emissions, Commentary, no. 234, May 2006, C.D. Howe Institute. Online at: http://www.emrg.sfu.ca/EMRGweb/pubarticles/2006/Commentary_234.pdf.

No real shift has yet materialized. The federal government s new 2008 program, Turning the Corner, promises to reduce emissions by 20 per cent from 2006 levels by 2020. Based largely on the promise of unproven technologies, cap and trade and intensity targets, it is highly unlikely that the policies of the government of Canada will achieve the target of reducing national emissions by 20 per cent. [144] Given that corporate taxes on tar sands production generate up to $5 billion in federal revenue every year, oil revenue has effectively trumped effective carbon policy in Canada.[145] The political willingness of extracting more revenue from oil and gas extraction industries will continue to be a key factor driving up fossil fuel production, concluded one 2008 GHG study.[146] Canada now plans to harmonize its policies with the US climate change program.[147]

The growing gap between Canada s emissions and promised reductions under Kyoto Protocol.

Source: Environment Canada, Canada's 2007 Greenhouse Gas Inventory: A Summary of Trends, 2008. Available at: http://www.ec.gc.ca/pdb/ghg/inventory_report/2007/som-sum_eng.cfm.

Canada s poor domestic record complements its aggressive global defence of fossil fuel production. When California passed legislation in 2009 supporting a low-carbon fuel standard, Minister of Natural Resources Lisa Raitt strongly objected, arguing that "any unjustifiable discrimination against Canadian crude oil could be contrary to the international trade obligations of the United States. [148] Kevin Stringer, director general of Canada s Petroleum Resource Branch, has even objected to classifying bitumen as non-conventional. [149] At recent climate change negotiations in Poznan, Poland, and Bali, Canadian officials were signalled out for their obstructiveness.[150] Canada s Foreign Affairs branch boldly admits that the federal government will resist efforts to label one form of energy as appropriate, such as renewables, and others as inappropriate such as hydrocarbons and nuclear. [151]

Canada's failed policy and lack of leadership reflects extreme political changes in the country. Canadian Prime Minister Stephen Harper, the son of an Imperial Oil executive,

---

144 Mark Jaccard et al., Assessing Canada s 2008 Climate Policy, press release, Simon Fraser University, September 26, 2008. Online at: http://www.sfu.ca/pamr/files/fall2008/PDF/AssessmentofCanadasClimatePolicySep26-08.pdf.

145 Govinda R. Timulsinda et al., Economic Impacts of Alberta s Oil Sands, vol. 1, Study No. 110, Canadian Energy Research Institute (CERI), October 2005, p. 98. Online at: www.ceri.ca/Publications/documents/OilSandsReport-Final.PD.

146 John Nyboer and JianJun Tu, GHG Emissions Trend Analysis in the Fossil Fuel Production Industries 2008 Update, Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC) Simon Fraser University, Burnaby, BC, February, 2008, p. 42.

147 Renata D Aliesio, Canada: Alberta frets over US Climate Change Tariff Bill, Calgary Herald, August 14, 2009

148 Lisa Raitt, Minister of Natural Resources, letter to Arnold Schwarzenegger, Governor of California, April 21, 2009.

149 Kevin Stringer, letter to CARB. Online at: http://www.canadainternational.gc.ca/washington/events-evenements/LCFS_Stringer.aspx?lang=eng.

150 Claire Demerse, Canada Blocks Climate Change Progress, Hill Times, December 15, 2008. Available at: http://climate.pembina.org/op-ed/1757.

151 Foreign Affairs and International Trade Canada, Energy Security: A Canadian Perspective, 2009, http://www.international.gc.ca/enviro/energy-energie/overview-appercu.aspx?lang=eng.

is as pro-oil as former US president George W. Bush and is a longtime climate change skeptic. He recently appointed Dr. Mark Mullins, executive director of the Fraser Institute, to the Natural Sciences and Engineering Research Council of Canada. Mullins believes that climate change is "somewhat sensational and definitely exaggerated."[152] Harper also appointed John Weissenberger, an oil patch geologist and active climate change skeptic, to the Canada Foundation for Innovation. Weissenberger once characterized climate change science, in the *Calgary Herald*, as a cabal of government-funded scientists, environmental activists and journalists. [153] One of Harper s chief political mentors, Tom Flanagan, refers to man-made global warming as allegedly caused by carbon-rich greenhouse gas emissions. He also describes lawsuits and blockades as security threats to energy developments in the tar sands.[154] In addition, the Canadian government no longer has a chief scientific advisor. A group called the Science, Technology and Innovation Council has replaced that key role. Its 2008 annual report lists energy production in the oil sands and resource production in the Arctic as key priorities.[155] Climate change adaptation is mentioned once.

The Growing European Footprint

European investors and energy companies have made multi-billion-dollar investments in what one BP executive calls the largest accumulation of oil on the planet. The sheer scale of these business commitments suggest that European companies want to remain oil producers, as opposed to energy companies, by investing in Canada s capital- and carbon-intensive bitumen deposits. By throwing their hats into the magic sandbox, Shell, BP, Total and StatoilHydro will dramatically increase their financial liabilities and carbon footprints. These European companies will also lend support to a petro-state that effectively obstructs climate change action at home and abroad.

Shell, the largest private energy company in the world, holds more land leases in Canada s tar sands than other company. About a third of the company s total remaining oil reserves lie in northern Alberta. For two of its city-sized open pit mines, Jack Pine and Muskeg (121 sq. km), Shell recently revoked a voluntary agreement with an environmental group to reduce its GHG emissions by 900,000 tonnes.[156] (In exchange for the GHG deal, the group did not oppose Shell s project in public hearings in 2004.) Alberta s energy regulator refused to reopen the hearing.[157]

Shell has also purchased 219,000 acres (87,000 hectares) in Athabasca s Grosmont carbonate formation, containing an estimated potential of 30 billion barrels of oil. About a quarter of Canada s bitumen resources lie in carbonate rock, as opposed to sand. To produce bitumen trapped in rock requires huge amounts of electricity. Electrodes placed in the rock must heat the formation to over 600 C over several years. One 2007 study

---

152 Peter Severensen, Enquiring Minds: Mark Mullins, podcast, BCBusiness Online, September 21, 2007. Available at: http://www.bcbusinessonline.ca/bcb/podcast/inquiring-minds-podcast/2007/09/21/inquiring-minds-mark-mullins.

153 George Koch and John Weissenberger, Climate Change Debate Should Stick to Facts, Calgary Herald, April 28, 2006.

154 Tom Flanagan, Resource Industries and Security Issues in Northern Alberta, Canadian Defence and Foreign Affairs Institute, June 2009.

155 Science Technology and Innovation Council, State of the Nation 2008: Canada s Science, Technology and Innovation System, p. 24. Available at: http://www.stic-csti.ca/eic/site/stic-csti.nsf/eng/h_00011.html.

156 Sara Bulbeck, Managing Alberta s Water Resources for Sustainable Oil Sands Development, Shell paper competition submission, 2008. Online at: http://www.ercb.ca/docs/documents/decisions/2004/2004-009.pdf.

157 Dave Cooper, ERCB Rejects New Hearing on Alberta Oilsands Mine, Calgary Herald, June 12, 2009.

estimates GHG intensity for Grosmont production at 438 kg of CO_2 eq per barrel.[158] That s 23 times more intensive than North Sea production. Given its heavy tar sands investments, Shell will soon become the world s most carbon intensive oil company. [159]

BP, one of world's largest energy firms, once categorized the tar sands as too dirty for investment. But in 2007, the company reversed its position and signed agreements with Husky Petroleum to jointly develop a steam plant (Sunrise), as well as a refinery in Toledo, Ohio. The company has also invested billions to retrofit its Whiting refinery in Indiana to handle bitumen exports from Canada. The United States Environmental Protection Agency

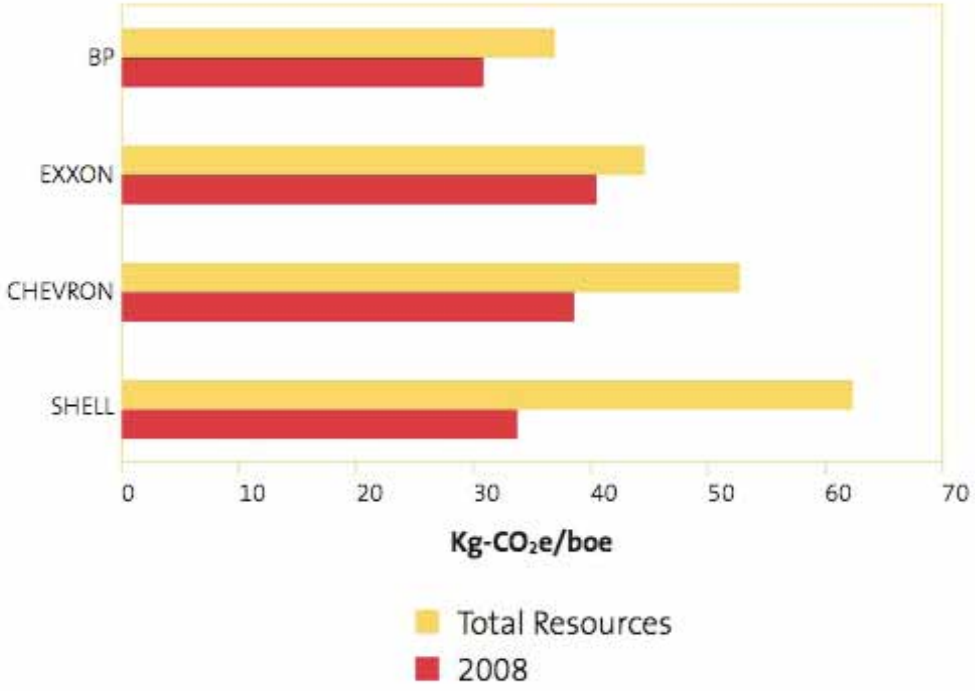


Figure 14: Carbon Intensity of Oil and Gas Production, by Company

Note: Kg-CO_2e/boe = kilograms of carbon dioxide equivalent per barrel of oil equivalent.
Source: Lorne Stockman et al., Shell: World's Most Intensive Carbon Company, briefing paper, OilChange International, Friends of the Earth, Greenpeace, Platform, May 2009.

(US EPA) cited the BP Whiting refinery for trying to refine tar sands crude without the proper permit and for releasing cancer-making pollutants at 16 times the acceptable level.[160] Husky s current steam plant operations have been plagued by problems and have recorded CO_2 emissions as high as 417 kg per barrel.[161]

StatoilHydro, the state-owned Norwegian company, has invested more than $2 billion in Canada s tar sands, or what it calls a platform for long-term growth for the company. The

158 Bruce Peachey et al., Low Carbon Futures, Petroleum Technology Alliance Canada, March 31, 2007, p.

159 Lorne Stockman et al., Shell: World's Most Intensive Carbon Company, briefing paper, OilChange International, Friends of the Earth, Greenpeace, Platform, May 2009. Online at: http://priceofoil.org/wp-content/uploads/2009/05/shelliefinal.pdf.

160 US Environmental Protection Agency, EPA issues amended citation to BP for clean-air violations at its Whiting (Ind.) refinery," Post-Tribune, October 2, 2008. See also: Gitte Laasby, "BP Cited For High Benzene Release, Post-Tribune, June 3, 2009.

161 The figure is based on reported production for Husky's Tucker Thermal plant and CO_2 emissions data reported to Environment Canada: 250, 069 tonnes. Environment Canada, 2007 Emissions Data, http://www.ec.gc.ca/pdb/ghg/onlineData/kdt_t3_e.cfm?year=2007.

Kai Kos Dehseh project will industrialize a forest twice the size of Oslo (1,110 sq. km) with pipelines and well pads in order to steam the bitumen out of the ground. If not seriously redesigned, the project could undermine Statoil s laudable GHG emission record.[162]

In 2009, the company reported that its CO_2 emissions averaged below 8 kg per barrel, compared to 19 kg per barrel for North Sea competitors.[163] Yet impact statements filed with Alberta regulators show that CO_2 emissions from Kai Kos Dehseh could range anywhere between 60 and 180 kg.[164]

Shell's vast tar sands investments will make it the world's most carbon-intensive company.

Source: Lorne Stockman et al, Shell's Big Dirty Secret: Insight into the World's Most Carbon Intensive Oil Company and the Legacy of CEO Jeroen van der Veer, Oil Change International, June, 2009, p. 7.

The project could create 13 million tonnes of CO_2 emissions by 2021, an amount nearly equal to the company s total CO_2 emissions in 2008 (14 million tonnes).[165]

Total S.A., Europe s third-largest oil company, proposes to invest nearly $10 billion in tar sands projects over the next decade. Christophe de Margerie, Total S.A. s CEO, concedes that the company s energy-intensive projects emit lots of GHG emissions, but the market can t afford to turn its back on Canada s vast resources. [166] Total S.A. s pilot steam plant, Joslyn, sprouted a major steam release that created a 300-metre crater in the forest, and has been mothballed due to its growing energy intensity.[167] CO_2 emissions from Total s proposed mining project could be nearly two million tonnes a year, or 45 kg per barrel.[168] That s nearly three times the average for North Sea production.

---

162 Wood Mackenzie, Heavy Investment: Statoil Arrives in the Oil Sands, Upstream Insights, May 2007.

163 Statoil (UK) Limited, 2008 Offshore Environmental Statement, March 23, 2009, p. 6.

164 North American Oils Sands Corporation, Application For Approval of the Kai Kos Dehseh Project, submitted to Alberta Energy and Utilities Board and Alberta Environment, April 2007, pp. 121 124.

165 Dan Woynillowicz, The Energy and Global Warming Implications of Canadian Tar Sands Development, Powerpoint presentation, Pembina Institute, August 2008. See also: Statoilhydro, Fact Book Extract from Annual Sustainability Report, 2008.

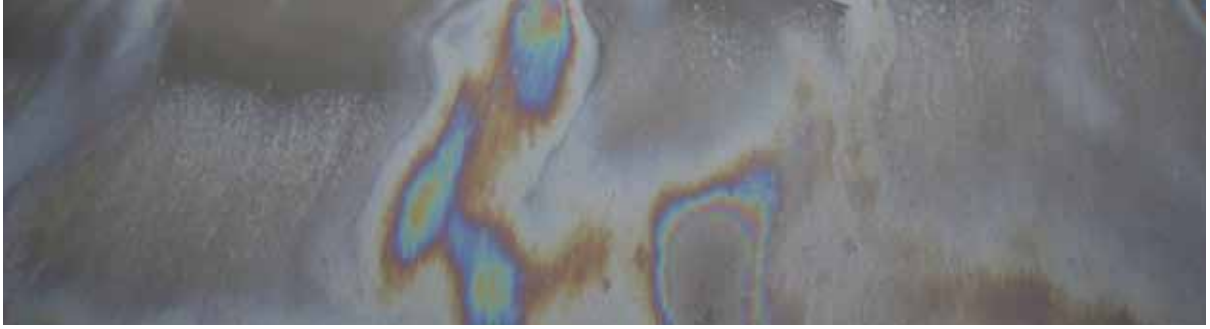
166 Total SA, Interview with Christophe de Margerie, 2007. Online at: http://www.total.com/static/en/medias/topic1612/TOTAL_csr_en_2007_itw_margerie.pdf.

167 See: Energy Conservation Resources Board (ERCB) In Situ Progress Report Deer Creek. Online at: http://www.ercb.ca/docs/products/osprogressreports/2006/2006AthabascaDeerCreekJoslynCreekSAGD9272.pdf.

168 Total E&P Joslyn Ltd., Letter to Oil Sands Environmental Coalition, Canadian Environmental Assessment Registry Joslyn North Mine Project, January 29, 2008.

A dramatic steam release destroyed 300 sq. m of forest at a Total project.

The Document comes from a website for mandated public reporting on in situ performance AN
Source: Total S.A. / Energy Conservation Resources Board (ERCB) In Situ Progress Report Deer Creek, 2006.
Online at: http://www.ercb.ca/docs/products/osprogressreports/2006/2006AthabascaDeerCreekJoslynCreekSAGD9272.pdf.



An Unconventional Bomb

The rapid development of unconventional hydrocarbons such as Canada s tar sands could tip the scales toward dangerous and uncontrollable climate change. In fact, consumption of high-GHG fuels could rise from four per cent in 2008 to 30 per cent in 2030, an event not fully predicted by the International Panel on Climate Change. According to one Dutch analysis, burning less but dirtier oil that has a larger carbon footprint will create a global conundrum: Either policies on the CO_2 emissions associated with oil production are relaxed in order to make more oil available, to limit economic and social problems; or a strong commitment is made to limiting unconventional oil as part of a climate policy that will lead to less oil becoming available. [169] Hermann Scheer, chair of the World Council for Renewable Energy, is even blunter: the exploitation of non-conventional fossil fuels such as tar sands "will definitely overstress regional ecological systems and the global ecosphere. [170]

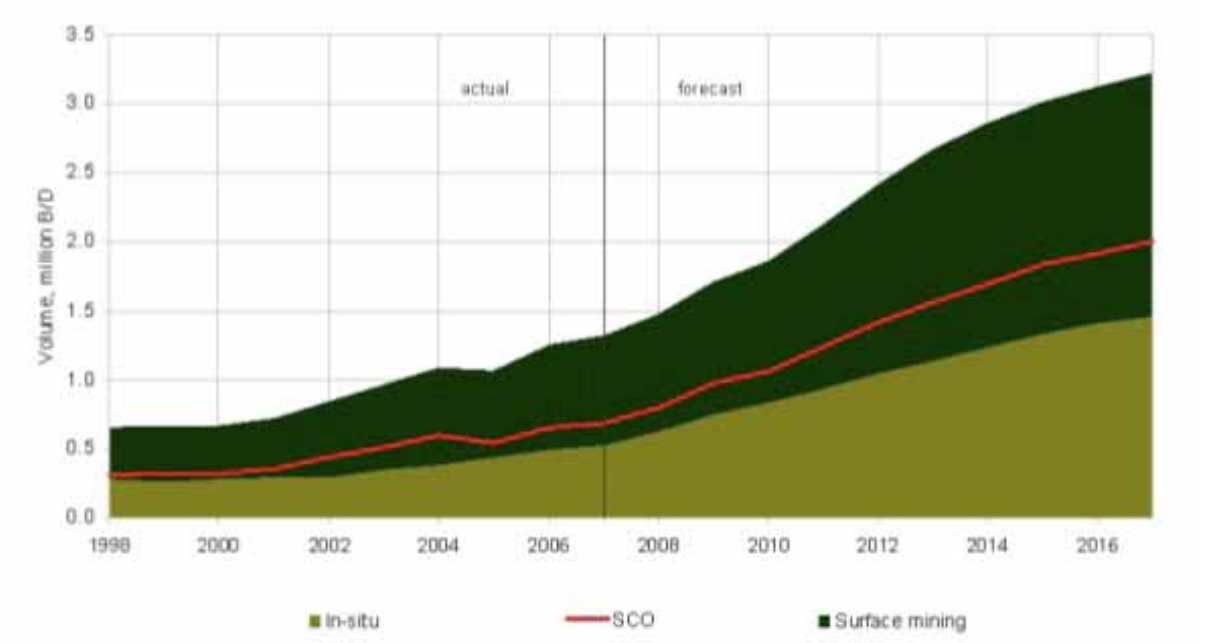


Figure 15: Alberta Bitumen and Synthetic Crude Oil Production, Actual and Forecast

Note: B/D = barrels per day.
Source: Katherine Elliot, Examination of Oil Sands Projects: Gasification, CO2 Emissions and Supply Costs, paper presented at the International Thermal Operations and Heavy Oil Symposium, October 20 23, 2008, SPE/ PS/CHOA, p.3.

169 Rembrandt Koppelaar et al., Less Oil, More C02: The Interplay between Climate Change and Peak Oil, Association for the Study of Peak Oil and Gas (ASPO) Netherlands, April 2009, p. 3.

170 Hermann Scheer, Speech to Asia-Pacific Parliamentary Conference on Renewable Energies, Gifu, Japan, June 4, 2005.

Canada s production of bitumen and synthetic crude from steam plants and mines could triple by 2017, from 2004 level.

Katherine Elliot, Examination of Oil Sands Projects: Gasification, CO2 Emissions and Supply Costs, paper presented at the International Thermal Operations and Heavy Oil Symposium, October 20–23, 2008. [/box]

Many US government agencies now champion Canada as a global leader in the exploitation of GHG-intensive fuels. The US Department of Energy pointedly regards Canada s tar sands as a how-to kit for the development of 800 billion barrels of oil shale in Colorado, as well as for tar sands in Utah. In particular, its Office of Petroleum Reserves has studied Canada's lenient fiscal and regulatory regime with the idea of accelerating development of domestic unconventional fuel sources. [171] Paul Michael Wihbey, president of the US-based Global Water and Energy Strategy Team, argues that the tar sands combined with oil shale in Colorado could become the most important axis of the global economy of the 21st century. [172]

Recent calculations suggest that if both Canada and the United States fully exploited their unconventional fuels over the next 50 years, North America could increase atmospheric CO_2 levels between 49 and 65 parts per million (ppm). This catastrophic exercise would tip CO_2 levels beyond a climate stabilization target of 450 ppm.[173]

James Hansen, the prominent NASA climate change scientist and director of the Goddard Institute for Space Studies, has long argued that the burning of conventional oil and gas reserves will ultimately make the planet ice-free. But the exploitation of unconventional fossil fuels is a wild card that invites dangerous climate insecurity. In other words, the production and consumption of unconventional fuels such as bitumen almost guarantees the extinction of polar and alpine species, as well as massive coastal flooding and freshwater shortages. You can t exploit tar shale and tar sands without pushing things way beyond the limit, argues Hansen. They re just too carbon-intensive. [174]

171 Strategic Unconventional Fuels Task Force, Development of America s Strategic Unconventional Fuels Resources: Initial Report to the President and the Congress of the United States, 2006, p. 17. Online at: http://www.unconventionalfuels.org/publications/reports/sec369h_report_epact.pdf.

172 Paul Michael Wihbey, Global Oil Sands Development and the Rocky Mountain Energy Corridor, Alberta Enterprise Group, Washington, DC, January 16, 2008.

173 James Leaton, Unconventional Oil: Scraping the Bottom of the Barrel?, WWF, 2008. Online at: www.wwf.org.uk/filelibrary/pdf/scraping_barrell.pdf.

174 Deborah Zabarenko, NASA s Hansen concerned about Canada s oil sands, Reuters, February 18, 2009.

Canada s Climate Meltdown

Canada s indifference to policy on climate change is almost inversely proportional to the threat it poses to the country s economy, water supplies and sovereignty. In the Rocky Mountains, 328 out of 853 inventoried glaciers feeding the North and South Saskatchewan River basins have disappeared completely, threatening water security throughout the prairies.[175] In a 2007 report, Natural Resources Canada recognized that climate change had already unsettled every region of Canada with extreme weather events such as ice storms and unprecedented flooding, as well as the largest insect infestation in North America. In the Arctic, where global warming is the most dramatic, loss of permafrost, sea ice and snow cover imperils Arctic infrastructure, traditional food supplies for aboriginal people and the integrity of entire ecosystems. [176]

The report predicts reduced water quality and quantity on a seasonal basis in every region of Canada. Erosion of coastlines has been extreme in both the Beaufort Sea and the St. Lawrence Seaway. An unrelenting Arctic meltdown has led to increased insecurity for aboriginal communities as well unresolved sovereignty issues over newly accessible oil and gas reserves. While Arctic ponds and wetlands are disappearing, the populations of iconic animals such as caribou and polar bears have become endangered. We should be paying attention but we are not, notes John Smol, an acclaimed Arctic scientist. “Politicians have a difficult time appreciating that half of Canada’s real estate is Arctic and that two-thirds of its coastline is in the Arctic. We should be concerned because the changes taking place up there are eventually going to catch up with us down here. [177]

175 Statistics Canada, Human Activity and the Environment: Climate Change in Canada, 2008. Online at: http://www.statcan.gc.ca/daily-quotidien/080422/dq080422a-eng.htm.

176 Lemmen, D.S., Warren, F.J., Lacroix, J., and Bush, E. (editors), From Impacts to Adaptation: Canada in a Changing Climate, 2007; Government of Canada, Ottawa, ON, 2008. Available at: http://adaptation.nrcan.gc.ca/assess/2007/index_e.php.

177 Ed Struzik, The Big Thaw: Travels in the Melting Arctic, John Wiley & Sons, 2009, Introduction.

Conclusion

Replacing inexpensive light oil with dirty bitumen from the tar sands has dramatic implications for both the global climate and the economy.

The rapid development of the tar sands has socialized environmental costs and privatized the gains for major oil producers. Canada has failed to exercise either fiscal or carbon accountability over the project.

European oil companies have invested in the tar sands to extend their lifespans as oil companies, at the expense of the global atmosphere. Carbon emissions from the project will soon exceed those of many European countries. By 2020 the tars sands will become such an extraordinary industrial emitter of $C0_2$ that this mega project will exceed the annual emissions of the world s volcanoes.

The global impact of tar sands production on climate change will probably be several magnitudes greater than has been estimated. The destruction of carbon storehouses by steam plants, mines and supporting natural gas infrastructure has not been accounted for. The cannibalization of Canada s natural gas supplies by the tar sands is unsustainable.

The controversial use of nuclear reactors to produce steam and electricity to accelerate bitumen exports to the US and China poses a large reputation and trade risk for Canada, as well as European investors.

Canada, a carbon debtor nation, appears to be leading the international community toward a chaotic and volatile energy future. To date, most proposed technological solutions to reduce emissions in the tar sands seem designed to perpetuate the status quo and will not likely lead to energy security or effective climate action. The nation s weak GHG policies and its technological gamble will not only escalate emissions, but fail to moderate fossil fuel demand and consumption.

Canada is now one of the world s leading emitters of GHGs, and a global defender of dirty fuels.

The energy crisis cannot be overwhelmed by more energy inputs. Ivan Illich

DIRTY OIL:

How the tar sands are fueling the global climate crisis

GREENPEACE CANADA

33 Cecil St. Toronto, Ontario M5T 1N1

www.greenpeace.ca 1 800 320-7183

Greenpeace is one of the world s most effective and best-known environmental organizations, with almost three million supporters worldwide in thirty countries. Greenpeace is an independent global campaigning organization that acts to change attitudes and behaviour, in order to protect and conserve our environment and promote a peaceful future.

Greenpeace has had a long-standing interest in nuclear issues, and has worked to promote a shift away from nuclear power and fossil fuels towards sustainable energy systems based on conservation and renewable technologies.

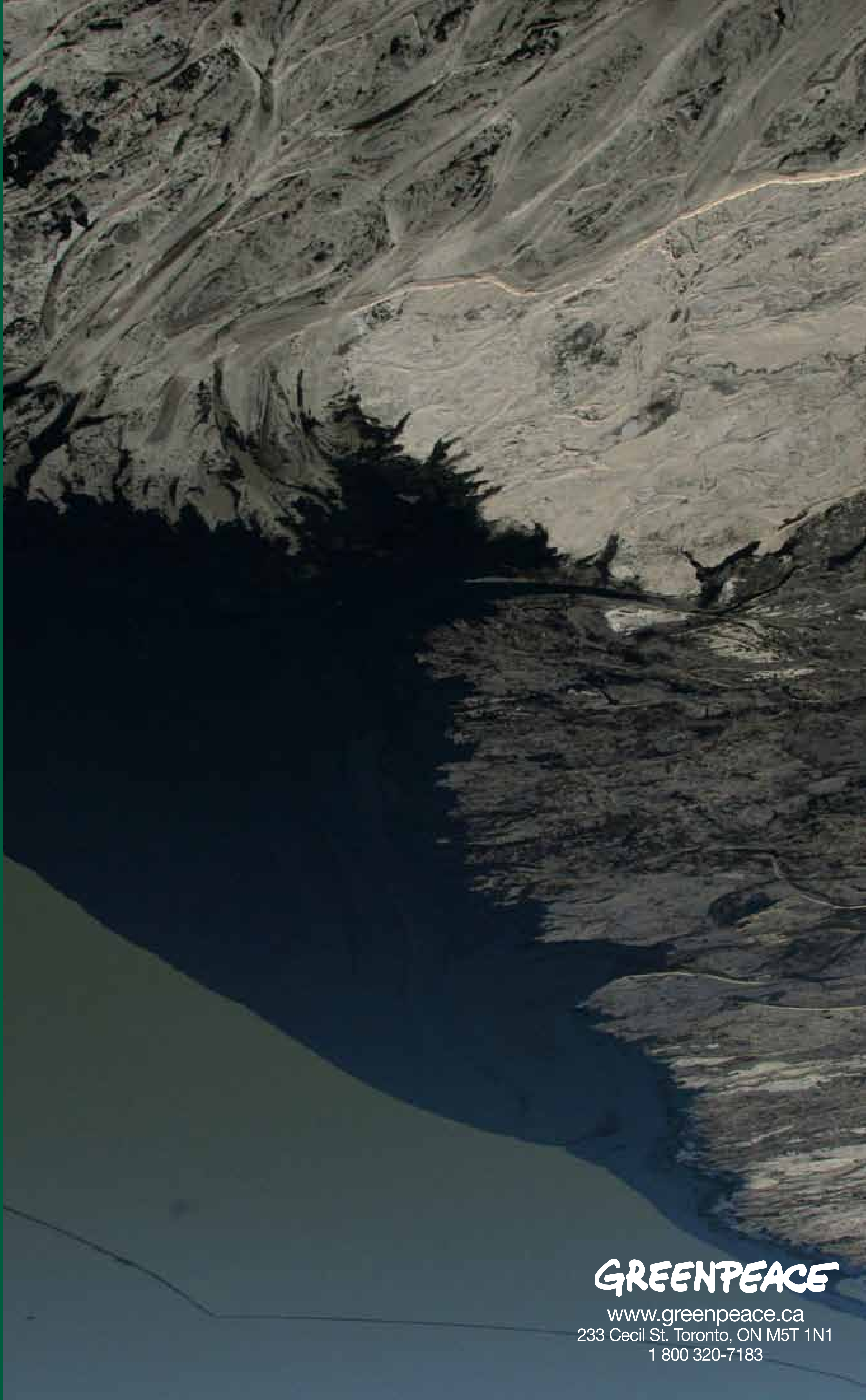
PREPARED BY: Andrew Nikiforuk

ACKNOWLEDGEMENTS: Christy Ferguson, Mike Hudema, Brian Blomme, Jessica Wilson, Jo Kuper, Jasper Teulings and Wendel Trio all gave valuable feedback on various drafts.

Cheryl Johnstone and Raina Delisle copy edited the text while David Fields helped with production.

Finally, we would like to thank Eamon Mac Mahon for the wonderful photography.

Dirty: How The Tar Sands Are Fueling The Global Climate Crisis



GREENPEACE

www.greenpeace.ca
233 Cecil St. Toronto, ON M5T 1N1
1 800 320-7183