Beneath the surface:
a review of key facts in the oilsands debate

Jennifer Grant, Marc Huot, Nathan Lemphers, Simon Dyer, Matt Dow

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Foreword

by Ed Whittingham, Executive Director, the Pembina Institute

As both an advocate for responsible oilsands development and a consultant to industry, including "Big Oil," the Pembina Institute has its fair share of detractors on different sides of the political spectrum. We've been called a lot of things over the years; but these days, in my travels as executive director of the Pembina Institute, "pragmatic" is the most common description I hear of our work.

We have earned this label in part for our efforts over 20 years to promote responsible development of the oilsands, through a combination of research, advocacy and consulting. Over these two decades we have invested countless hours in key multi-stakeholder groups; critiqued numerous environmental impact assessments; bilaterally negotiated agreements with a host of producer companies that have formed important parts of their conditions of approval; published score card reports on mine and in situ operations; intervened in more than 15 oilsands development hearings; and consulted to major producers like Suncor, Shell, ConocoPhillips, Nexen, Statoil and Total. This combined experience informs our perspectives, including our definition of responsible development.[1] It is also why I often hear people describe Pembina as a "moderate" environmental group during my travels – not exactly a word to build a brand around, but at a time of high polarization when it comes to energy issues, I'll take it as a compliment.

Twenty years of working on an issue in these diverse ways has afforded us a good nose for compiling reliable, factual information, a role that various stakeholders within the Canadian public consistently ask us to play. And that's what we have set out to do in the following pages — to provide a detailed, factual analysis of a series of industry and government claims regarding the environmental impacts of oilsands development and how those impacts are managed.

Some context in advance of those pages: We know that no one wakes up thinking of new and inventive ways to destroy the environment, and that many oilsands producers are striving to improve their environmental performance — principally toward driving down the environmental impacts of producing each barrel of bitumen. And the focus on reducing greenhouse gas emissions from oilsands production shouldn't come at the expenses of also cutting emissions from coal-fired electricity or other sectors. (In fact, the Pembina Institute has just as long a track record on working on coal-related issues as it does on oilsands issues.)

What is also unquestionable is that "spin" happens on all sides of the energy debate. The spinning of facts is not limited to just oilsands boosters; critics of irresponsible development are also guilty of making misleading statements and stretching the truth at times.

The big difference, however, is in the delivery. It's evident that oilsands proponents in industry and government combined spend an order of magnitude more than oilsands critics on public relations efforts. As concern regarding environmental management in the oilsands has increased internationally, so too has industry and government spending on slick PR and lobby campaigns

[1] See Jennifer Grant, "'Responsible resource development' must be more than a slogan," *Hill Times,* August 27, 2012. Available at www.pembina.org/op-ed/2369.

designed to counter that concern. The Alberta government's "Tell It Like It Is" campaign in 2008 was a multi-million dollar effort, and featured full-page ads including a $50,000 advertorial by then-premier Ed Stelmach in the Washington Post.[2] This was followed by the barrage of expensive television commercials and billboard ads paid for by the Canadian Association of Petroleum Producers, Cenovus and others, highlighting industry's efforts to restore habitat or comparing bitumen to comfort foods like yoghurt or peanut butter. Viewers of the Super Bowl or Hockey Night in Canada know these ads to be staples during TV timeouts.

Take the time to flip through the following pages, however, and you'll notice something interesting. Many of the industry and government claims about oilsands development that we've highlighted are not false. Some are entirely factual — but often they are only telling part of the story.

As much as these claims may be persuasive, they can also be misleading — and that's bad for the development of sound policies and regulations governing responsible oilsands development. A few years ago I looked at an industry analysis of issue-by-issue claims made by groups across the debate spectrum. It found that:

- Easily accessible information on most aspects of oilsands development is lacking (though the situation has somewhat improved since then).
- Information presented by industry interests tends to describe what is happening now in the oilsands, whereas information presented by non-governmental organizations (like the Pembina Institute) tends to be forward-looking and suggest what could happen under a scenario where all approved development goes ahead.
- Industry information tends to focus on impacts of individual projects or impacts per barrel of production, while criticism of oilsands development focuses on the regional or cumulative impact of multiple projects.
- Due to the general lack of information specific to the region, single studies (often not peer-reviewed) or the actions of single companies tend to be extrapolated over the entire region, presenting the best (or worst) case scenario — depending on the point of view.
- Poorly differentiated information relating to surface mining and in situ operations blurs the lines between the two, masking some issues and exaggerating others.

All of the above can lead to statements that are certainly misleading. For example, in 2008 the UK's Advertising Standards Authority found that an advertisement in the *Financial Times* in which Shell claimed it was "working to secure a profitable and sustainable future" was "misleading"[3] given the company's oilsands projects.

So Canadians can be rightly forgiven for not knowing which facts to believe these days. But studies frequently confirm that Canadians are certain about one thing: they want the oilsands to be developed in a way that ensures the environment is protected. For that to happen they will have to demand that governments and industry implement the best policies, regulations and practices — ones backed by factual information, and not misleading factoids.

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[2] Government of Alberta, "Alberta. Tell it like it is." http://www.oilsands.alberta.ca/tellitlikeitis.html

[3] John Vidal, "Shell rapped by ASA for 'greenwash' advert," *The Guardian*, August 13, 2008.

Beneath the Surface

A review of key facts in the oilsands debate

Key facts — Page

Introduction

Looking back, 2012 was another challenging year. It was challenging in terms of reconciling the cumulative impacts of oilsands development with the need to urgently reduce greenhouse gas pollution and ensure the scientific limits of air, land and water systems are respected in northeastern Alberta. And it was challenging because the debate about the future of Canada's oilsands has become increasing polarized and the rhetoric was ratcheted up on all sides.

It was a year full of information and misinformation, progress and setbacks. Yet, three common themes emerge from an in-depth look at the developments in various issues over the year — from growing greenhouse gas pollution and continued delays in developing important policies to protect wetlands and biodiversity, to the establishment of new protected areas in the Lower Athabasca region and greater industry collaboration. What colours all of these issues are the dynamic nature of the oilsands industry, the diversity of views and the ongoing concern about the cumulative impacts of oilsands development and other industrial activity in northern Alberta.

Because of the pace, scale, and longevity of impacts associated with the decisions we make today, it is urgent to understand the full economic, social and environmental costs associated with oilsands development — and to do what is necessary to bring the forecast cumulative footprint within the limits of our air, land and water systems. The competitiveness and productivity of Canada's economy, and our ability to avoid dangerous climate change and to transition to a clean energy future, depend on it.

In this report, the Pembina Institute examines some common claims about the environmental performance of oilsands producers and the environmental impacts of oilsands production. These claims come from various sources within the oilsands industry, individual companies, and the governments of Alberta and Canada, and each statement we reference has been made in a public forum.

Canadians and international observers, from concerned citizens to investors and regulators, need to have a solid grasp of the facts about the environmental implications of oilsands development to arrive at informed opinions and take appropriate actions. Many of the claims we examine in this document are not false, but they selectively present information to minimize the negative impacts of oilsands production or overstate the positive strides that industry or governments have made toward addressing those impacts. Focusing on public relations instead of changes in practice, technology and public policy is a strategy that has backfired for producers — in the past year alone, oilsands companies have found their access to markets challenged, and their plans to build export pipelines opposed by people whose concerns have not been adequately resolved. Given the public interest at stake, transparent and factual reporting on both improvements and worsening impacts is critical to improving environmental management in the oilsands sector.

Downplaying the risks or overstating the significance of steps taken to reduce the impacts is irresponsible and counterproductive. Some recent steps that industry and governments have taken to give environmental issues more consideration — for instance, through the Canadian Oil Sands Innovation Alliance — could result in progress on the significant environmental improvements that are required. However, the majority of the impact may already be "locked in" and isn't likely to be meaningfully reduced without serious efforts by all parties. Regulators have already approved a near tripling in production to over five million barrels of bitumen per day

(Figure 1) based on today's technology, despite industry's own forecasts[4] showing critical ecosystem and air quality limits have or will be surpassed in some areas. Developing the oilsands responsibly requires a more significant and sustained effort by industry, science-based decision making, stronger regulations from governments, unwavering and informed public pressure and the recognition that there is such a thing as "too much" oilsands development.

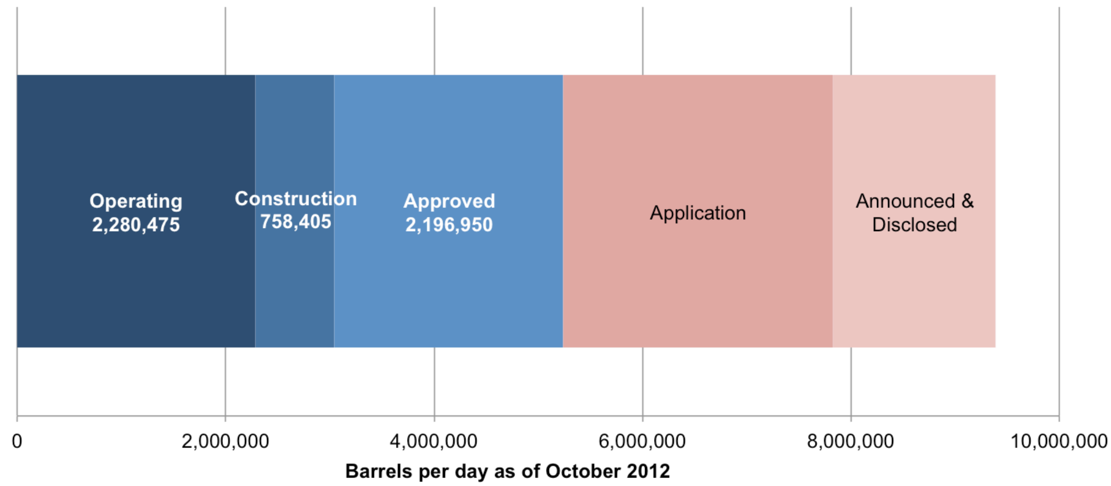

Figure 1. Oilsands expansion plans

As of October 2012, regulators had approved more than five million barrels of bitumen production per day.

Data Source: Oilsands Review.[5]

The information presented here draws on independent research, public information and expert analysis to put key facts about oilsands production in their proper context. It delivers the Pembina Institute's updated perspective[6] on the current approaches to environmental management in the oilsands and the impacts of oilsands production on air, land, water, biodiversity and our climate.

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[4] Oil Sands Environmental Coalition, *Submission to Joint Review Panel for the Shell Jackpine Mine Expansion Project*, October 1, 2012, 26. http://pubs.pembina.org/reports/osec-submission-jackpine-expansion-oct-2012-corrected.pdf

[5] Oilsands Review, "Oil Sands Statistics." http://www.oilsandsreview.com/statistics/production.asp

[6] Jennifer Grant, Dan Woynillowicz and Simon Dyer, *Clearing the Air on Oilsands Myths* (Pembina Institute, 2009). http://www.pembina.org/pub/1839

Overview: the Canadian Oil Sands Innovation Alliance

Early in the development of the oilsands, it was acknowledged that water usage, tailing ponds size, stability, and ultimate rehabilitation and natural gas usage would present significant problems for the industry.[7] Forty years later, the technical solutions to these problems are still under development.

Recognizing this lag, in 2012, 14 oilsands producers representing 80 per cent of current production established Canada's Oil Sands Innovation Alliance (COSIA). The alliance between companies seeks to accelerate the pace of improvement in environmental performance by sharing experience and intellectual property across its members and with broader experts. Its four environmental priority areas are tailings, water, land and greenhouse gases.[8] Recognizing that these issues present a challenge to the entire sector's ability to earn and maintain the social license to operate, they have agreed to collaborate rather than compete in the development and commercialization of environmental technologies, with the intent of leveraging shared resources.

[7] Annette Hester and Leah Lawrence. *A sub-national public-private strategic alliance for innovation and export development: the case of the Canadian province of Alberta's oil sands,* (United Nations, 2010) 30-31.

[8] COSIA, "Overview." http://www.cosia.ca/about-cosia/overview/

Climate and air

Average oilsands production is significantly more greenhouse gas-intensive than conventional oil production.

The oilsands extraction process is energy intensive and consumes large volumes of natural gas, electricity, and diesel. As a result, producing crude from the oilsands generally results in significantly greater greenhouse gas emissions than crude from conventional sources.

However, some points of contention remain surrounding precisely how much oilsands emissions exceed those of conventional oil. In a world transitioning toward lower-carbon forms of energy, the higher carbon footprint of oilsands crudes could represent a barrier to trade in some markets, such as the European Union, which is developing a policy to favour fuel sources imports with lower carbon-intensities. For this reason, efforts to promote oilsands often downplay the greenhouse gas emissions associated with production.

For instance, a report published by Canadian Association of Petroleum Producers in July 2012 states that,

> *"Life cycle [greenhouse gas] emissions for oilsands are comparable to U.S. domestic and imported conventional crude oils."*[9]

The American Petroleum Institute has also made an effort to challenge the perception of oilsands as high carbon, stating:

> *"The average [greenhouse gas emissions] for oilsands imported into the U.S. is only 6 per cent higher than the average crude consumed in the U.S."*[10]

Other sources have identified the life cycle (well-to-wheels) emissions intensity of crude from the oilsands at a range from eight to 37 per cent higher than conventional oil. The difference in the numbers is largely due to how emissions from oilsands are calculated, particularly in terms of how "conventional" crudes are defined and what aspects of fuel production and use are included in the emissions estimates.

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[9] Canadian Association of Petroleum Producers, *Air Emissions in Canada's Oil Sands*, June 2012, http://www.capp.ca/getdoc.aspx?DocId=193748&DT=NTV

[10] American Petroleum Institute (API). *Canadian Oil Sands: Enhancing America's Energy Security*, (2011), 9. http://oilsandsfactcheck.org/wp-content/uploads/2012/05/API_OIL_SANDS_PRIMER_MAY_2011.pdf

Background

The life cycle (well-to-wheels) emissions intensity of crude from the oilsands ranges from eight to 37 per cent higher than conventional crude.[11] However, two aspects of how emissions from crude sources are compared can result in large variations in the numbers, making it very challenging to understand the results of a particular study in proper context.

Both the definition used for conventional crude and the scope of the study (production, well-to-tank, or well-to-wheels) can significantly change the magnitude of the difference between emissions from oilsands crude and conventional crudes. While all of the approaches can be technically correct if done properly, a basic understanding of life cycle assessment is often needed to accurately interpret the results.[12]

Defining 'conventional'

With respect to the definition of 'conventional' crude, it is important to understand exactly what is being compared in a study. For example, there are differences in emissions between light conventional crudes and heavy conventional crudes and, similarly, there are differences between various methods of extracting oilsands crude. When comparing oilsands crude to conventional crude, comparing the lowest greenhouse gas emitting oilsands project to the highest greenhouse gas emitting conventional crude is very different from comparing "average oilsands" to "average conventional" — terms for which the meanings also change over time. To be consistent, many studies refer comparisons to the 2005 U.S. baseline (the average of all fuels consumed in the U.S. that year, calculated by the Environmental Protection Agency).

Studies that indicate lower differences (e.g., around six per cent) in emissions levels when comparing oilsands with other crudes are not based on averages; instead they compare a select set of better-performing oilsands to a select set of crudes that have higher-than-average emissions.[13]

The scope of the study

Second, emission comparison results can vary significantly based on what aspects of crude production are being compared. The typical full life cycle of oilsands crude includes many major steps from the production to end use. These include: extraction (e.g. mining or in situ), upgrading, pipeline or tanker transport, refining, and use (e.g., combustion in a vehicle). The major differences between oilsands and conventional crudes all occur at the extraction/upgrading stage, which is often referred to generally as "production".

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[11] Natural Resources Defense Council, *Setting the Record Straight: Lifecycle Emissions of Tar Sands* (2010), 2. http://docs.nrdc.org/energy/files/ene_10110501a.pdf

[12] Pembina's life cycle assessment checklist (Dan Woynillowicz, Jeremy Moorhouse and Danielle Droitsch, *Life cycle assessments of oilsands greenhouse gas emissions* (Pembina Institute, 2011). http://www.pembina.org/pub/2163) provides guidance on how to conduct a meaningful and robust greenhouse gas life cycle assessment for the oilsands industry.

[13] For more information about comparisons not based on averages, see this Pembina Institute backgrounder: P.J. Partington and Marc Huot, *Oilsands, heavy crudes and the EU fuel-quality directive* (Pembina Institute, 2012) http://www.pembina.org/pub/2325

For the most part, the amount of emissions from refining, transport and use (combustion) of oilsands crude is essentially the same as for any fossil-based crude, and combustion accounts for a very large amount of emissions from all crudes, regardless of the source. Studies compare crudes on different scope levels for a variety of reasons, but comparisons of production emissions will show the biggest difference between oilsands and conventional crudes because the scope is focused on the processes where emissions rates differ. Since the rest of the processes are similar, the broader the scope of study, the smaller the difference appears to be between oilsands and conventional crudes, simply because the denominator in the calculation is growing.

In a comparison of production emissions only, the per-barrel greenhouse gas emissions associated with oilsands extraction and upgrading are estimated to be 220 to 350 per cent (3.2 to 4.5 times) higher than conventional crude oil produced in Canada or the United States.[14]

Full life cycle (well-to-wheels) calculations look at all processes, from extraction up to and including combustion. Looking at this scope, a comparison of oilsands emissions intensities from seven data sources to the EPA's 2005 U.S. baseline showed that average values for oilsands emissions range from eight to 37 per cent higher than the baseline.[15] In a peer-reviewed assessment completed for the European Fuel Quality Directive, the average oilsands greenhouse gas emissions were 23 per cent greater than the average crude processed in European refineries.[16]

Today, there are a number of life cycle studies comparing oilsands greenhouse gas emissions across a range of scopes and assumptions. While these studies add value, the value is undermined when the facts are misrepresented by selectively focusing on results between comparisons of better-performing oilsands projects with higher-than-average conventional crudes. This approach makes the difference in emissions between average oilsands and average crude look small, when in fact the difference is very significant.

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[14] National Energy Technology Laboratory, *Development of Baseline Data and Analysis of Life Cycle Greenhouse Gas Emissions of Petroleum-Based Fuels*, DOE/NETL-2009/1346 (2008), 12.

[15] *Setting the Record Straight*, 2.

[16] Adam Brandt, *Upstream greenhouse gas (GHG) emissions from Canadian oilsands as a feedstock for European refineries*, Executive summary. (Department of Energy Resources, Stanford University, 2011), 41–42.

Oilsands emissions are a growing problem.

The emissions intensity of oilsands, or the amount greenhouse gases emitted per barrel produced, improved quite dramatically over the period of 1990 to the mid 2000s as the industry matured. This point is often emphasized by industry proponents as evidence of the progress that has been made in reducing emissions from oilsands production. For instance, in an article promoting his recently-published memoir, *Sun Rise*, Rick George, the former CEO of Suncor Energy Inc., presents a rosy view of the challenge of reducing greenhouse gas emissions:

> *"If you look at the last decade, improvements on air, land and water emissions, it's crazy good," he says. "On every single count – CO_2, water use – they're all dropping like a stone."*[17]

Unfortunately, this is not the case. Although emissions per barrel did improve in the oilsands for a period of time, absolute emissions (total emissions per year) across the industry have been steadily increasing. While we address other environmental impacts from oilsands development elsewhere in this report, emissions from oilsands upgrading and processing in Canada nearly tripled between 1990 and 2010, and government projections show emissions are likely to double again between 2010 and 2020.

Background

As illustrated in Figure 2 below, production from Alberta's oilsands increased between 1990 and 2010 by 260 per cent, and the corresponding greenhouse gas emissions have almost tripled from 17 megatonnes (Mt) in 1990 to 48 Mt in 2010 (a 180 per cent increase in emissions). Based on recent projections from the Government of Canada, oilsands emissions growth will increase from 48 Mt in 2010 to 104 Mt in 2020 under existing federal and provincial climate policies, as the figure shows.

[17] Nathan Vanderklippe, "Rick George: The reincarnation of Mr. Oil Sands," *Globe and Mail,* October 13, 2012. http://www.theglobeandmail.com/report-on-business/careers/rick-george-the-reincarnation-of-mr-oil-sands/article4610663/?page=all

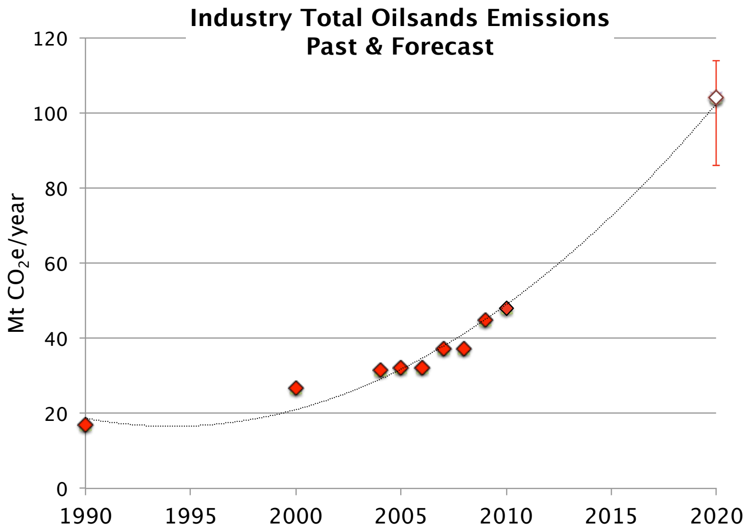

Figure 2: Actual and forecast emissions growth from oilsands extraction and upgrading in Canada

Data source: Environment Canada[18]

The oilsands industry did reduce its overall greenhouse gas intensity (emissions per barrel produced) by 29 per cent from 1990 to 2009, as shown in Figure 3. However, for now it appears that these per-barrel improvements also have stalled. And, in order to maintain absolute greenhouse gas emissions across the industry at 2009 levels (45 Mt per year), the industry would need to reduce its emissions intensity by 53 per cent by 2020 and 72 per cent by 2030 based on the current production forecasts.[19] This would mean reducing emissions more than three times faster than the reductions made by industry between 1990 and now. Per-barrel improvements are unlikely to resume without substantially increasing the ambition of climate policies at both the federal and provincial levels.[20]

[18] Sources include: Environment Canada, National Inventory Report (1990-2008 & 1990-2010), and Environment Canada, *Canada's Emissions Trends*, (2012), 24. http://www.ec.gc.ca/Publications/253AE6E6-5E73-4AFC-81B7-9CF440D5D2C5/793-Canada's-Emissions-Trends-2012_e_01.pdf

[19] *Responsible Action?* 31.

[20] *Responsible Action?* 31–35.

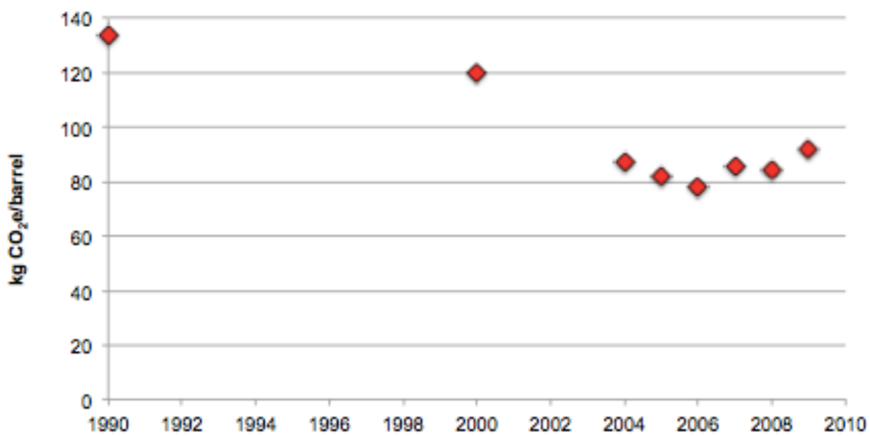

Figure 3: Past changes in industry-wide greenhouse gas intensity in the oilsands.

Source: Pembina Institute:[21]

[21] Retrieved from Matthew Bramley, Marc Huot, Simon Dyer and Matt Horne, *Responsible Action? An Assessment of Alberta's Greenhouse Gas Policies* (2011), 31. http://www.pembina.org/pub/2295. The source for emissions data is *National Inventory Report 1990–2008: Greenhouse Gas Sources and Sinks in Canada, Part 1*, 86. Note: the value for 2009 was provided in an e-mail communication from Environment Canada officials. The source for production data is *Table 126-0001 — Supply and disposition of crude oil and equivalent, monthly (cubic meters),* (CANSIM database), Statistics Canada (accessed July 22, 2010).

Oilsands emissions matter on a national scale, and are a significant barrier to meeting Canada's 2020 climate commitment.

While other sectors across Canada are making progress on reducing greenhouse gas emissions, the rapid growth in emissions from the oilsands is set to undo the progress that is being made in other sectors. In July 2012, Peter Kent, the federal environment minister, assured Canadians that,

> *"Canada is now fully half way to its [climate] target of reducing total GHG emissions by 17 per cent (on our 2005 base levels) by 2020…"*[22]

However, closing the gap between current emissions and our 2020 target will require slowing the planned growth of oilsands emissions substantially, and that will require a significant increase in effort from industry, as well as all levels of government.

Background

Numerous recent studies confirm that existing provincial and federal policies are grossly insufficient to fulfill Canada's current commitment to reduce emissions to 17 per cent below 2005 levels by 2020. To meet that target, further substantive action must be taken at all levels of government.

In 2011, Environment Canada's *Emissions Trends* report projected that Canada would achieve just one-quarter of the reductions it has committed to by 2020.[23] As a result of new accounting rules for forestry and land-use change and some economic factors, the 2012 version of the same report projected Canada would achieve 50 per cent of its committed reductions by 2020.[24] This large jump in "progress" did not occur because of any new efforts by the federal government between 2011 and 2012.[25]

Between 2010 and 2020, Canada's net greenhouse gas emissions are projected to increase by 28 Mt.[26] While some economic sectors are reducing their emissions (see Figure 4), emissions from the oilsands — including in situ, mining and upgrading — are expected to grow in that time

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[22] "Kent says Canada 'Halfway' to 2020 emissions targets," *CBC News*, August 8, 2012. http://www.cbc.ca/news/canada/sudbury/story/2012/08/08/pol-emissions-report-kent.html

[23] Environment Canada, *Canada's Emissions Trends* (2011). Figure 6.

[24] Environment Canada, *Canada's Emissions Trends* (2012). Figure ES.1. http://www.ec.gc.ca/Publications/253AE6E6-5E73-4AFC-81B7-9CF440D5D2C5/793-Canada's-Emissions-Trends-2012_e_01.pdf

[25] See: P.J. Partington, "Are we there yet? Closing the gap on Canada's climate commitments," *Pembina Institute*, August 9, 2012. http://www.pembina.org/blog/643

[26] *Canada's Emissions Trends* (2012), 19. Note: This includes the 25 Mt reduction contributed by the reporting of the Land Use, Land-Use-Change and Forestry sector (LULUCF).

period by 56 Mt.[27] Under these projections, much of the ground gained through reductions made in other sectors will be essentially cancelled out by the growth in oilsands emissions.

As Figure 4 shows, between 2010 and 2020 the oilsands stand out as both the fastest growing and most significant source of emissions across Canadian economic subsectors. The oilsands accounted for approximately seven per cent of Canada's emissions in 2010 and are forecast to grow to over 14 per cent by 2020.[28]

By the end of this decade, oilsands emissions are projected to exceed those of other major categories; for example all passenger transportation in Canada or all electricity generation in Canada.[29] Oilsands emissions are forecast to reach levels higher than the emissions from every province except Alberta and Ontario.[30] If Canada is to meet its 2020 climate change targets, it will have to address the growing challenge of oilsands emissions or rely on other sectors making even steeper reductions in their emissions.

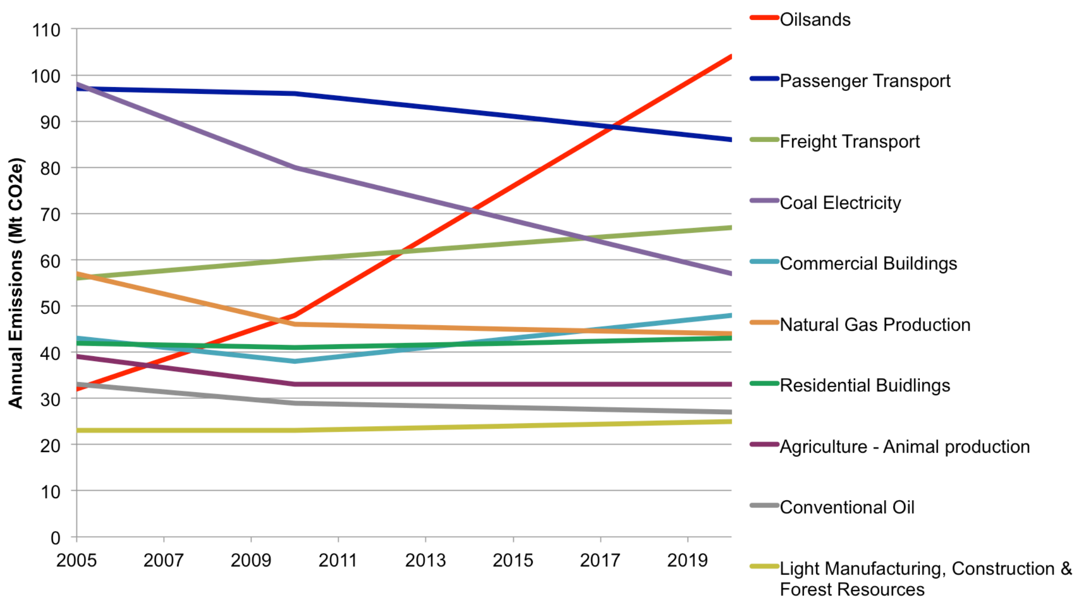

Figure 4: Oilsands greenhouse gas emissions (past and forecast) under existing policies

Data source: Environment Canada[31]

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[27] Ibid. 24.

[28] Ibid., 19 and 24.

[29] Ibid., 20, 21 and 24.

[30] Ibid., 24 and 33.

[31] Ibid., 24.

Oilsands emissions matter on a global scale.

It is common to hear oilsands proponents talk about how insignificant greenhouse gas emissions from the sector appear on the global scale — yet comparing current levels of oilsands emissions to a national or global total masks the fact that emissions from the oilsands are growing faster than from any other source in Canada.

Despite our relatively small population, Canada produces far more than its share of greenhouse gas emissions globally, ranking among the top-10 biggest emitters internationally. And even though oilsands are the fastest-growing source of emissions in Canada, government and industry consistently downplay the significance of emissions from this sector by stating that:

> *"Oilsands account for 6.9 per cent of Canada's GHG emissions and 1/600th (or 0.16) of global GHG emissions."*[32]

While any single source of emissions appears small relative to a global total, oilsands emissions are globally significant, because they represent the main barrier to meeting Canada's national and international climate commitments.

Background

Climate change is a global challenge that will require a serious effort from all countries, especially major emitters like Canada. Limiting global temperature rise below the internationally agreed upon threshold of two degrees Celsius will require a complete transformation of the global energy system, taking decades of unprecedented and sustained effort.

The success of this global, collaborative approach to fighting climate change depends on individual actions. The challenge of this approach is that, when viewed in isolation, individual actions seem insignificant relative to the scale of the problem. On the global scale, emissions from the oilsands — or any other single economic sector, for that matter — may appear insignificant. But it is their relative contribution to Canada's emissions as a whole that matters.

Canada is one of the world's top-10 greenhouse gas producers. According to International Energy Agency data on energy-related CO_2 emissions, Canada ranks as the eighth largest absolute emitter in the world.[33] On a per capita basis (excluding countries with populations below 1 million),[34] Canada is the ninth largest greenhouse gas polluter.

Further, while emissions from the production and upgrading of Canada's oilsands may look small relative to the global total, oilsands emissions alone are actually larger than the emissions from many countries as a whole. If Canada's oilsands emissions are compared against other

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[32] CAPP, *Oilsands Factbook*, (2012), 32. http://www.capp.ca/getdoc.aspx?DocId=191939&DT=NTV

[33] International Energy Agency, *CO_2 Emissions from Fuel Combustion* (2012). http://www.iea.org/media/statistics/CO2Highlights2012.XLS

[34] Luxembourg, Brunei Darussalam, Netherlands Antilles, and Gibraltar also have higher per capita emissions than Canada due to their very low populations.

countries' emissions, they would rank as the 56th largest emitter out of a total of 142 countries, ranking similar to Portugal.[35]

In addition to producing more than its share of greenhouse gas pollution globally, Canada is also criticized for its lack of leadership in international efforts to address climate change. Some countries are already moving toward encouraging the use and import of lower-carbon fuels, while Canada has actively lobbied against such initiatives, including the European fuel quality directive,[36] California's low-carbon fuel standard,[37] and the European Union's inclusion of international aviation in their emissions trading system.[38]

While proponents argue that oilsands emissions appear insignificant relative to the global total, it is clear that oilsands expansion and the corresponding rise in emissions from this sector represent a serious barrier to Canada playing a constructive role in the global fight to reduce greenhouse gas emissions.

[35] Assuming oilsands emissions of 48 Mt in 2010 and 104 Mt in 2020.

[36] Max Paris, "EU delays 'anti-oilsands' fuel quality directive decision", *CBC News,* April 20, 2012. http://www.cbc.ca/news/politics/story/2012/04/20/pol-fuel-directive-europe-canada.html

[37] Climate Action Network Canada, *The Tar Sands' Long Shadow: Canada's Campaign to Kill Climate Policies Outside our Borders* (2010). http://climateactionnetwork.ca/issues/getting-off-fossil-fuels/tar-sands/report/

[38] James Kanter, "U.S. steps up its effort against a European system of fees on airline emissions," *New York Times,* September 9, 2010. http://www.nytimes.com/2010/09/10/business/energy-environment/10emit.html?_r=1

Current regulations do not result in meaningful reductions in greenhouse gas emissions from oilsands development.

Alberta was the first jurisdiction in North America to implement a carbon price, and this fact is often stated as evidence of the province's leadership on climate change. According to the Canadian Association of Petroleum Producers:

> *"The Government of Alberta implemented [greenhouse gas] regulations in 2007 (the first jurisdiction in North America to do so) requiring a mandatory 12 per cent reduction in GHG emissions intensity for all large industrial sectors including existing oil sands facilities, or a payment in lieu (current carbon price is $15/tonne)."*[39]

Despite its early leadership on carbon pricing, however, there are much stronger examples of effective carbon prices on the continent and around the world. For example, B.C.'s carbon tax is currently set at $30 per tonne, while Norway's carbon price for the oil and gas sector will be increasing to $71 per tonne in 2013. In addition to the higher prices, these two policies apply to every tonne of carbon emissions — an approach that is more effective at curbing greenhouse gas emissions than Alberta's 12 per cent intensity reduction target.

In other words, while Alberta took an early lead on establishing climate regulations, the limits placed on those policies have made them ineffective in cutting real greenhouse gas emissions and shifting industry's investments and business practices towards lower-carbon options.

Background

It is true that Alberta's carbon price was the first in North America, and it was a significant policy improvement at the time. However simply having climate regulations in place is not enough — today, Alberta's carbon price on heavy emitters is too weak to provide an incentive for oilsands operators to meaningfully reduce greenhouse gas emissions. As a consequence, the oilsands industry will continue to be the fastest-growing source of greenhouse gas emissions in Canada.[40]

Alberta's Specified Gas Emitters Regulation (SGER) is the main greenhouse gas reduction policy imposed on the oilsands industry, and one of the province's key tools to meet its greenhouse gas emission reduction targets for 2020 and 2050 (Alberta also had a 2010 target to reduce emissions by 20 Mt below the business-as-usual level — a target the province failed to even come close to meeting in 2011).[41] This regulation requires all facilities emitting more than

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[39] CAPP, *Oil Sands Factbook* (2012), 34. http://www.capp.ca/getdoc.aspx?DocId=191939&DT=NTV

[40] As shown in Figure 2, oilsands emissions are projected to more than double between now and 2020, even accounting for federal and provincial policies (which includes Alberta's SGER).

[41] *Responsible Action?*, 10.

100,000 tonnes of carbon dioxide equivalent per year to reduce their emissions intensities by up to 12 per cent,[42] relative to a three-year facility baseline.[43]

Oilsands operators have four options to comply with this target: they can reduce emissions on site, purchase Alberta-based offset credits, purchase or use "Emissions Performance Credits," or pay into a climate change fund at a rate of $15 per tonne.

Because of its design, SGER falls short of providing an incentive to industry to adopt progressive carbon mitigation strategies. By allowing large emitters to fully comply by paying into a fund at $15 per tonne, this policy essentially establishes a carbon price maximum of $15 per tonne in Alberta. In effect, any emissions reductions that cost more than this ceiling price make less economic sense than paying into the fund. Since emitters are allowed to comply by using any of the four options (including paying into the climate fund) for 100 per cent of their emissions, at the price of $15 per tonne, the SGER sends only a weak price signal to oilsands operators to reduce their emissions.

This is problematic because many of the opportunities for the oilsands industry to make significant greenhouse gas reductions cost more than $15 per tonne. For example, the cost of applying carbon capture and storage (CCS) to an oilsands project is around an order of magnitude higher than $15 per tonne. While the price varies between mining, in situ and upgrading projects, CCS in the oilsands industry costs between $95 and $255 per tonne.[44] It is clear that the current SGER policy is not strong enough to create an incentive for CCS. As such, the primary policy that serves to address oilsands emissions is not effective at driving real reductions.

Considering that a facility must only reduce emissions by a maximum of 12 per cent at a maximum cost of $15 per tonne, this works out to a net compliance cost of $1.80 per tonne. In other words, compliance with Alberta's climate policies costs a typical oilsands operator an equivalent of between 18 and 22 cents per barrel of oil produced.

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[42] For new facilities or facilities that began operation after the year 2000 with less than eight years of commercial operations starts, the intensity targets start in their fourth year of operation and gradually increase to 12 per cent (increasing two per cent each year).

[43] Government of Alberta, Specified Gas Emitters Regulation, http://www.qp.alberta.ca/574.cfm?page=2007_139.cfm&leg_type=Regs&isbncln=9780779758791&display=html

[44] Capture costs from The Delphi Group, *ICO$_2$N GHG Alternatives Report* (2009), 79. http://delphi.ca/images/uploads/IC02N_GHG_Alternatives_Report.pdf.

Cost totals (including capture, transport, sequestration) from *Responsible Action?*, 30.

Air quality is starting to be impacted by oilsands air pollution.

Air quality in the Fort McMurray region is generally good, with the Government of Alberta noting,

> *"Annual average concentrations of common air pollutants indicate that the region's air quality is not deteriorating despite an increase in emissions-related activities and population growth.*
>
> *"Alberta's Air Quality Index shows that air quality in the oil sands area rates as "low risk" at least 95 per cent of the time."*[45]

However, some significant negative effects are already being noted as a result of growing oilsands development and the resulting air pollution.

Background

In the oilsands region, the only major anthropogenic (human caused) sources of air pollution are the oilsands and the small city of Fort McMurray. Given that the whole region is essentially surrounded by boreal forest, it shouldn't be too surprising that, according to some of the types of pollution being measured, the air quality in Fort McMurray is better than some of Canada's large urban centers. Large urban centres have high populations and many sources of urban and industrial emissions both within and neighboring the regions — all of which increase the strain on air quality. For example, the air quality in Fort McMurray is often compared to cities such as Edmonton, Calgary, and Toronto — metropolitan regions with populations 15 to 72 times that of Fort McMurray.[46] Unfortunately, there is little information available comparing Fort McMurray to comparable centres.

Going beyond regional comparisons, it is clear that some aspects of the air quality in the Fort McMurray oilsands region are already presenting problems.

In Alberta the Alberta Ambient Air Quality Objectives (AAAQO) are designed to protect the air sheds and preserve environmental and human health, but only to the extent that is technically, economically and politically feasible.[47] In this sense the AAAQOs provide air quality limits for different pollution types, but given their allowance for what is economically achievable, it is important to view them as absolute maximums rather than protective pollute-up-to limits.

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[45] Government of Alberta, "Air," *Alberta's Oil Sands*. http://www.oilsands.alberta.ca/air.html

[46] Metropolitan populations: Edmonton – 1,159,869; Calgary – 1,214,839; Toronto – 5,583,064. Source: Statistics Canada, "Population and Dwelling Counts", http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/hlt-fst/pd-pl/Table-Tableau.cfm?LANG=Eng&T=205&S=3&RPP=50. Fort McMurray population – 76,797. Source: Regional Municipality of Wood Buffalo, "Fort McMurray", http://www.woodbuffalo.ab.ca/living_2227/Communities/Fort-McMurray.htm

[47] Alberta Environment, "Ambient Air Quality Objectives" http://environment.alberta.ca/0994.html

Current monitoring data shows an increasing number of recorded AAAQO exceedances in the oilsands region. According to data from the multi-stakeholder Clean Air Strategic Alliance, there were 33 times more exceedances in the oilsands region in 2009 compared to 2004.[48]

Air concentrations for a number of pollution types including nitrogen dioxide (NO_2), sulphur dioxide (SO_2), hydrogen sulphide (H_2S), and ozone (O_3), are getting close to limit levels. These are summarized below in Table 1.

Table 1: Summary of air pollution levels by types nearing or exceeding AAAQO limits

Limit		Maximum Measured Levels	Summary of maximum readings
Time period	**Maximum average** [49]		
Nitrogen Dioxide (NO_2)			
1-hour	159 ppb	Industry: 153.9 ppb	1-hour measurements for highest industry location reached 97% of the air quality limit
Annual	24 ppb	Industry 15.2 ppb Community 11.3 ppb	The annual average at the same industry site was at 63% of the limit Even a community station is experiencing air concentrations at the level of 47% of the limit over the whole year.
Sulphur Dioxide (SO_2)			
1-hour	172 ppb	Industry 122.5 ppb Industry 112.1 ppb Industry 104.8 ppb Fort McKay 82.7 ppb	While annual averages are low, on an hourly basis, the maximum from 3 stations reached hourly levels above 60% of the limit, with the highest one reaching 71% of the limit. Levels in the community of Fort McKay approached 50% of the limit.
Hydrogen Sulphide (H_2S) / Total Reduced Sulphur (TRS)			
1-hour	10 ppb	Industry 98.2 ppb Industry 92.6 ppb Industry 60.4 ppb Industry 30.1 ppb Industry 12.0 ppb Fort McKay 5.7 ppb Anzac 6.6 ppb	Levels for 5 industry sites went over the hourly limit with the two highest reaching levels over 9 times the limit. Levels reached above 50% of the limit for two community stations (Fort McKay and Anzac)
24-hour	3 ppb	Industry 23.1 ppb Industry 10.3 ppb Industry 6.6 ppb Industry 5.2 ppb Fort McKay** 3.3 ppb	Looking at 24-hour periods, 4 industry stations and had periods above the limit. Levels were also high in the community of Fort McKay. **As noted by the WBEA, "By convention, concentrations are rounded to prescribed reporting precision for comparison with air quality objectives. 3.3 ppb is not an exceedance of the 3 ppb objective"
Ozone (O_3)			

[48] Environmental Defense, *Dirty Oil, Dirty Air: Ottawa's Broken Pollution Promise* (2010). http://environmentaldefence.ca/reports/dirty-oil-dirty-air-ottawas-broken-pollution-promise

[49] AAAQO limits as applicable in 2011, as cited in the Wood Buffalo Environmental Association *Annual Report 2011*.

1-hour	82 ppb	Industry 90.6 ppb Fort McKay 88.8 ppb Fort Chipewyan 83.5 ppb Anzac 78.9 ppb Fort McMurray 77.3 ppb	Ozone levels exceeded the hourly limit at one industry site and at Fort McKay and Fort Chipewyan. Levels in Anzac and Fort McMurray reached around 95% of the limit.

Data source: Wood Buffalo Environmental Association[50]

[50] Wood Buffalo Environmental Association, *Annual Report 2011*. http://www.wbea.org/library/terrestrial-monitoring/doc_download/1597-wbea-2011-annual-report See Table 27. 1-hour concentrations of NO_2 (ppb) for 2011, Table 6. 1-hour concentrations of SO_2 (ppb) for 2011, Table 9. 1-hour concentrations of TRS/H_2S (ppb) for 2011, Table 10. 24-hour concentrations of TRS/H_2S (ppb) for 2011, and Table 24. 1-hour concentrations of O3 (ppb) for 2011.

Forecasted growth in oilsands will present very serious air pollution challenges in the Wood Buffalo Region.

The oilsands industry has made some progress in reducing the amount of air pollution released per barrel produced in the oilsands, particularly when it comes to sulphur dioxide emissions. The Oil Sands Developers Group notes:

> *"… air quality has consistently improved and continues to improve in the Fort McMurray Wood Buffalo region."*
>
> *"The oil sands industry has continually reduced nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) emissions on a per barrel basis since production first began."*[51]

However, the oilsands are a major source of several types of air pollution, and the overall growth in the oilsands industry means that the absolute growth in air emissions will be an ongoing challenge for the protection of air quality in the region.

Background

Alberta has already approved more than 2.5 times the production capacity of what is already operating in the oilsands. This means that all of the air quality issues that are starting to become apparent now are only foreshadowing what is to come. As a part of their approval process, new oilsands projects are required to model future air quality anticipated for when all of the projects already approved are operating. Recent data tabled by industry shows some alarming predicted air impacts on the horizon.

Of all the air pollution types modelled in forward-looking assessments, nitrogen dioxide presented the biggest challenge in terms of forecasted air quality. In Alberta, annual concentrations of nitrogen dioxide are regulated through Alberta's Ambient Air Quality Objectives, which sets a limit of 45 $\mu g/m^3$ (equivalent to 24 ppb).[52] However the new Lower Athabasca Regional Plan includes an Air Quality Management System that establishes a legal limit for NO_2 concentrations in the Lower Athabasca Region (45 $\mu g/m^3$) but also establishes triggers levels below the limit where specific management actions start to take place.[53]

Currently, the highest industry station in the Lower Athabasca region is just below the brink of the Trigger Level 3 (see Figure 5), meaning substantial efforts to reduce air pollution need to be underway soon. According to air quality projections, unless serious action is taken now, NO_2 levels will greatly exceed the legal limit for air quality in the region when all of the oilsands

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[51] Oil Sands Developers Group, "Air." http://www.oilsandsdevelopers.ca/index.php/thank-you/oil-sands-facts/environment/air/

[52] Government of Alberta, "Alberta Ambient Air Quality Objectives: Nitrogen Dioxide", Effective June 15, 2011.

[53] Government of Alberta. *Lower Athabasca Regional Plan 2012-2022* (2012), 73. https://www.landuse.alberta.ca/LandUse Documents/Lower Athabasca Regional Plan 2012-2022 Approved 2012-08.pdf

projects that are already approved in Alberta are operational (illustrated in Figure 5 – 'Approved Oilsands).

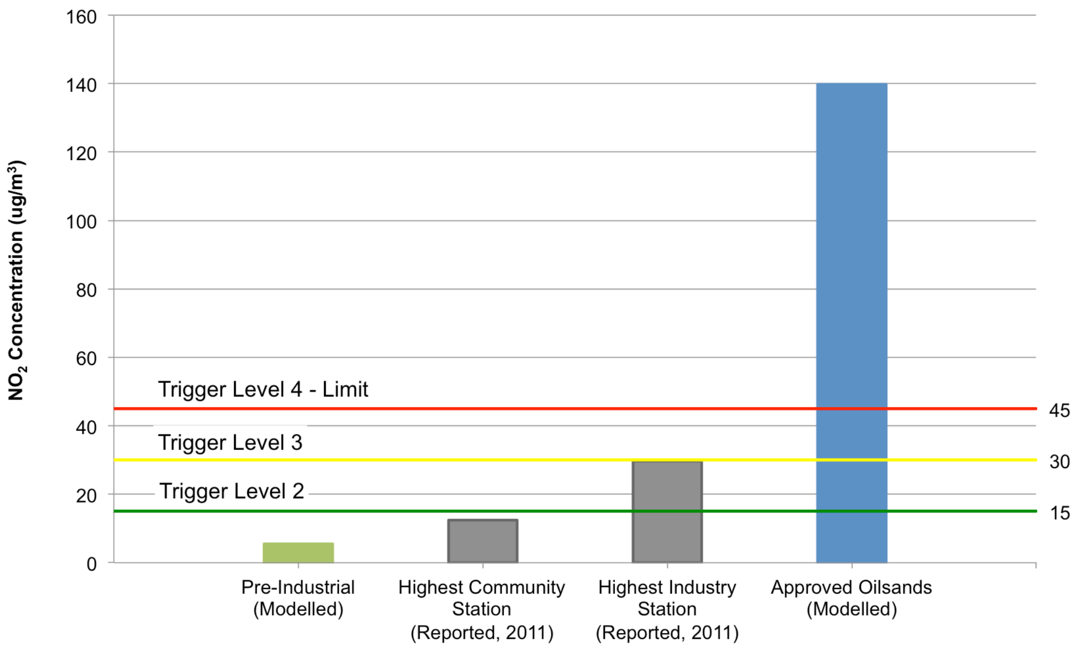

Figure 5: Annual concentrations of NO_2 compared to trigger levels and limits

Data source: Shell Canada Ltd. and Wood Buffalo Environmental Association[54]

According to Shell's model for the already approved oilsands in the region, the highest NO_2 concentration predicted to occur anywhere region (the blue bar in Figure 5) will reach levels over three times the air quality limit. A map output of the model (Figure 6) shows that when all approved oilsands are operating, the maximum air concentration for NO_2 will exceed the limit in large portions of the region.

[54] Pre-development: Shell Canada Ltd., *Response to JRP August 15, 2012 Supplemental Information Requests*, September 2012.

Current levels for highest community station (Fort McKay) and the highest industry station (Millennium Mine): Wood Buffalo Environmental Association, *Annual Report 2011*, AMS 1 Station: Table T27, AMS 12 Station: Table T6.

Modelled results for air quality if all currently approved oilsands are operational: Shell Base Case: Shell Canada Ltd., *Joint Review Panel Supplemental Information Requests*, May 2012. Appendix 3.2: Air Emissions and Prediction, Table 4.2-1

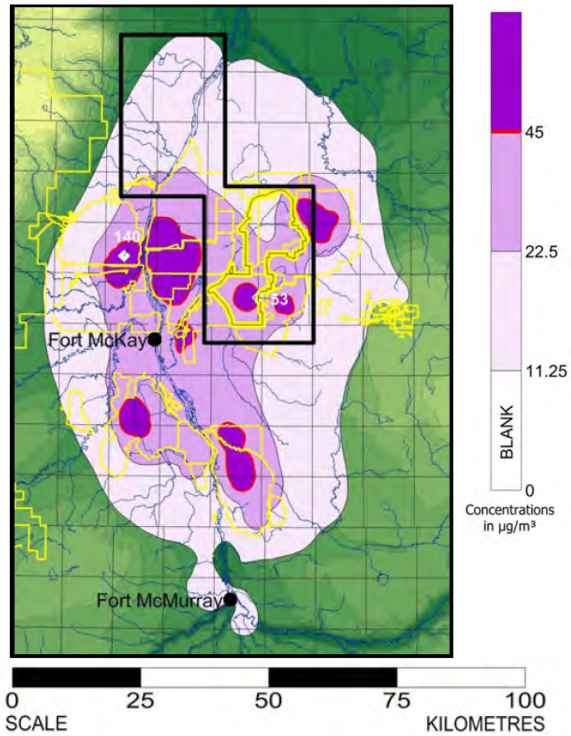

Figure 6: Predictions for annual concentrations of NO_2 in the oilsands region – assuming all oilsands projects currently approved are operating

Adapted from Shell Canada Ltd[55]

These predictions use the best publicly available source of air quality predictions for the oilsands region. The data for expected NO_2 levels in the Lower Athabasca region make it clear that oilsands approvals are already outpacing Alberta's air quality limits. If regional air quality is to remain acceptable, serious action must be taken to reduce emissions from all of the projects that are already approved.

[55] Figure adapted from Shell Canada Ltd., *Joint Review Panel Supplemental Information Requests*. Appendix 3.2: Air Emissions and Prediction, Figure 4.2-2.

Water

Water monitoring in northeastern Alberta has been inadequate, yet governments continue to approve new oilsands projects.

In recent years, a number of independent commentators and government reports have indicated that water monitoring in the Athabasca region is inadequate. The governments of Alberta and Canada have agreed that major improvements are needed. Yet data from the current inadequate system is still being used as a basis to grant approvals for new developments.

For example, the Government of Alberta says,

> *"Monitoring stations downstream of mine sites show industrial contribution cannot be detected against historically consistent readings of naturally occurring compounds in the Athabasca River."*[56]

It is true that the Athabasca River has always contained naturally occurring oilsands-derived hydrocarbon compounds, such as polycyclic aromatic hydrocarbons from naturally seeping bitumen along the river's edges. Yet given that a number of independent commentators and government reports have indicated that water monitoring in the Athabasca region is inadequate, it is erroneous to conclude that if the current system has not found problems, then no problems exist. In addition, scientific research funded by Environment Canada has concluded that oilsands development has increased the delivery of pollutants in remote lake ecosystems in the Athabasca oilsands region to well above "natural," predevelopment levels.

Background

The Government of Alberta has monitored the impacts of oilsands development since the 1970s. Today Alberta Environment and Sustainable Resource Development draws its conclusions from:

1. monitoring information collected from their own monitoring stations,
2. auditing the monitoring data collected by oilsands companies,
3. participating in the Regional Aquatics Monitoring Program (RAMP)
4. evaluating current contaminant load concentrations and comparing to historic conditions.[57]

A 2004 scientific peer review of RAMP for the Athabasca region criticized the design of the monitoring program citing "significant shortfalls" and recommending more independent and

[56] Government of Alberta, "Alberta's Oil Sands: Water." (2012) http://www.oilsands.alberta.ca/water.html

[57] Ibid.

expert input.[58] These shortfalls were not addressed, the recommendations were never implemented, and it remains to be seen if the 2010 peer review recommendations[59] will be acted upon.

In 2011, Environment Canada and a team of independent experts concluded that the current water monitoring system for the Athabasca region "did not deliver data of sufficient quantity or quality to detect or quantify the effects of oilsands development."[60] Other sources that have also indicated that water monitoring in the Athabasca region is inadequate.[61]

Furthermore, independent research from the University of Alberta indicated higher concentrations of heavy metals and polycyclic aromatic compounds downstream of oilsands development, in comparison to upstream, in tributaries to the Athabasca.[62] It was learned in November 2012 that Environment Canada scientists confirmed these results but were unable to speak publicly about them.[63] Most recently, Environment Canada researchers cored the sediment of six lakes ranging from 35 km to 90 km away from oilsands development due to "the absence of well executed environmental monitoring in the Athabasca oil sands."[64] The results showed

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[58] G. Burton Ayles, Monique Dubé and David Rosenberg, *Oil Sands Regional Aquatic Monitoring Program (RAMP) Scientific Peer Review of the Five Year Report,* (2004), 59. http://www.cec.org/Storage/94/9193_10-2-RSUB-Appendix_XVI-_RAMP_Review.pdf

[59] Alberta Innovates – Technology Futures, *2010 Regional Aquatics Monitoring Program (RAMP) Scientific Review* (2011). http://www.ramp-alberta.org/UserFiles/File/RAMP 2010 Scientific Peer Review Report.pdf

[60] Environment Canada. *Lower Athabasca Water Quality Monitoring Program. PHASE 1 Athabasca River Mainstem and Major Tributaries* (2011), 5. http://www.ec.gc.ca/doc/publications/pollution/COM1396/index-eng.htm

[61] The critical reviews focused on either provincial or federal responsibilities in the management of surface and/or groundwater in the Athabasca region. Besides those already cited in this section, they include:

1) Royal Society of Canada Expert Panel, *Environmental and Health Impacts of Canada's Oil Sands* (2010). http://rsc-src.ca/en/expert-panels/rsc-reports/environmental-and-health-impacts-canadas-oil-sands-industry

2) Oilsands Advisory Panel, *A Foundation for the Future: Building an Environmental Monitoring System for the Oilsands*, report to the Minister of the Environment (2010) http://www.ec.gc.ca/pollution/default.asp?lang=En&n=E9ABC93B-1;

3) Commissioner of the Environment and Sustainable Development, Auditor General of Canada, "2010 Fall Report of the Commissioner of the Environment and Sustainable Development," http://www.oag-bvg.gc.ca/internet/English/ parl_cesd_201012_e_34435.html;

4) Water Monitoring Data Review Committee, *Evaluation of Four Reports on Contamination of the Athabasca River System by Oilsands Operations*, report to the Government of Alberta (2011). http://environment.alberta.ca/03380.html

[62] Erin Kelly, Jeffrey Short, David Schindler, Peter Hodson, Mingsheng Maa, Alvin Kwana and Barbra Fortina "Oil sands development contributes polycyclic aromatic compounds to the Athabasca River and its tributaries," *Proceedings of the National Academy of Sciences of the United States of America* 106 (2009) http://www.pnas.org/content/106/52/22346.full.pdf+html

Erin Kelly, David Schindler, Peter Hodson, Jeffrey Short, Roseanna Radmanovich, and Charlene Nielsen, "Oil sands development contributes elements toxic at low concentrations to the Athabasca River and its tributaries," *Proceedings of the National Academy of Sciences of the United States of America* 107 (2010). http://www.pnas.org/content/107/37/16178.full.pdf+html

[63] Mike De Souza, "Federal government learning more about oilsands impacts, Kent says," *canada.com,* November 5, 2012. http://o.canada.com/2012/11/05/peter-kent-says-feds-are-learning-more-about-oilsands-impacts/

[64] Joshua Kurek, Jane L. Kirk, Derek C. G. Muir, Xiaowa Wang, Marlene S. Evans, and John P. Smol, "Legacy of a half century of Athabasca oil sands development recorded by lake ecosystems," *Proceedings of the National*

that polycyclic aromatic hydrocarbons (PAHs) within lake sediments increased significantly after development of the bitumen resource began. Total PAHs trapped in sediments in the six study lakes, including one site 90 km northwest of the major development area, are now 2.5–23 times greater than ~1960 levels. The study conclusively shows that oilsands development has increased the delivery of PAHs and other pollutants in remote lake ecosystems in the Athabasca oilsands region to well-above "natural," predevelopment levels.[65]

In February 2012, the Alberta and Canadian governments announced a joint monitoring plan for air, water and biodiversity, considered worthy of the 'world class' designation. The plan is meant to address the concerns raised about the current water monitoring system and to improve governments' understanding of the current state of the environment and ability to detect environmental change.[66] While there have been commitments to make the plan's data public and the new plan's expanded depth and breadth of coverage are promising, the new plan is not expected to be complete until 2015. Meanwhile, there is a barrage of new evidence[67] that highlights many concerns regarding the industry's impact on fish, other species and the aquatic environment.

This new information and the number of critical reviews of the state of monitoring in northeastern Alberta poses a number of important questions. Were regulators' decisions to approve five million barrels per day of oilsands projects based on credible and comprehensive information regarding how these projects impact the environment? How are regulators to make sound public interest decisions for the projects in the regulatory queue between now and when the new monitoring plans are complete and generating data?

Alberta notes that a new three-year study is underway to examine the effects of air emissions, land disturbance, drainage and the potential for seepages or spills.[68] Until a truly world class monitoring system has been implemented and such studies completed — which will take some time — decision makers will be challenged to make sound public interest decisions. How the plan is governed also remains uncertain despite a number of recommendations from scientists and civil society that governance be independent.[69]

Governments are simply unable to effectively assess the impacts of oilsands development on water quality until a new system is implemented, verified and generating credible data because

Academy of Sciences of the United States of America – Early Edition. www.pnas.org/cgi/doi/10.1073/pnas.1217675110 . p. 1.

[65] Ibid.

[66] Alberta Environment and Sustainable Resource Development, "Joint Canada-Alberta Implementation Plan for Oil Sands Monitoring." http://environment.alberta.ca/03902.html

[67] Society of Environmental Toxicology and Chemistry North America, *Abstract Book: 33rd Annual Meeting: Catching the Next Wave: Advancing Science Through Innovation and Collaboration, Long Beach, California,* November 11–15, 2012. http://longbeach.setac.org/sites/default/files/SETAC-abstract-book-2012.pdf

[68] Government of Alberta, "Alberta's Oil Sands: Water." (2012) http://www.oilsands.alberta.ca/water.html

[69] Kelly Cryderman, "Head of oilsands review panel sees conflict of interest for Alberta government," *Calgary Herald*, September 8, 2012. http://www.calgaryherald.com/business/Head+oilsands+review+panel+sees+conflict+interest+Alberta+government/7211317/story.html#ixzz2DYMi7shE

of the reported problems with the existing monitoring programs such as sampling concerns, a general lack of understanding of baseline conditions and inadequate analytical capabilities.

Oilsands extraction uses large amounts of water, despite recycling efforts.

Oilsands operators used approximately 170 million cubic meters in 2011, equivalent to the residential water use of 1.7 million Canadians. Most of the freshwater used comes from the Athabasca River. While strong efforts are being made to recycle water, the Alberta government notes that:

> *"Oil sands projects recycle 80 to 95 per cent of water used...Water use per barrel is comparable to other energy resources; about 2.5 barrels of fresh water per barrel of oil produced is used by mining operations and 0.5 barrels for in situ operations."*[70]

However, oilsands mining uses at least three times as much fresh water to produce one barrel of oil in comparison to conventional oil. In situ operations use less water and have recycle rates of up to 90 per cent, but absolute amounts of groundwater used will increase given that in situ development is growing even faster than mining.

Background

Oilsands operators used approximately 170 million cubic meters of water in 2011, equivalent to the residential water use of 1.7 million Canadians.[71] Water use ranges greatly with the extraction type and the age of the mining operation. Oilsands mining uses at least three times more fresh water to produce one barrel of oil than conventional oil.[72]

Mining

Mining requires a net volume of two to four barrels of freshwater to extract and upgrade one barrel of bitumen.[73] The gross volume of water utilized ranges from 7.5[74] to 12[75] barrels of water

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[70] Government of Alberta, "Alberta's Oil Sands: Water." (2012) http://www.oilsands.alberta.ca/water.html

[71] Alberta Environment & Sustainable Resource Development, "Oil Sands Water Use," *Oil Sands Information Portal*. http://environment.alberta.ca/apps/osip/ The Canadian residential average water consumption is 274 litres per person per day (based on 2009 data). See Environment Canada, "2011 Municipal Water Use Report – Municipal Water Use 2009 Statistics."

[72] The RCE 2010 progress report notes that about 0.6 barrels of fresh water was used to produce each barrel of oil produced from conventional oil operations in Alberta in 2010. Responsible Canadian Energy, *2010 Progress Report*. http://www.rce2010.ca/western-canada/water/water-usage/

[73] "Alberta's Oil Sands: Water." Water use/barrel of bitumen and SCO varies greatly by company. This is because as the mines mature, they provide a greater proportion of the required extraction process water from rainfall and runoff on the larger disturbed area of the mine site. There is also increased water available from tailings lakes – as tailings mature, more tailings water becomes available for use in the bitumen extraction process. Based on data available from the Oil Sands Information Portal, water use for mining companies in 2011 was as follows: Suncor Base Operations (Millennium Mine, Steepbank Mine, and Upgraders 1 and 2) used 1.7 bbl fresh water per bbl SCO; Shell Albian Sands Muskeg River Mine and Jackpine Mine used 2.0 and 3.2 bbl fresh water per bbl bitumen, respectively; Syncrude Aurora North Mine used 0.7 bbl freshwater per bbl bitumen; Sycrude Mildred Lake Mine used 2.6 bbl fresh water per bbl SCO; and CNRL Horizon Mine used 4.5 bbl fresh water per bbl SCO. Source: http://environment.alberta.ca/apps/osip/

per barrel of bitumen in surface mined oilsands operations; between 40 to 70 per cent of this water is recycled back into the oilsands mining extraction process.[76] The remaining water is tied up in the pore spaces of the mineral sand, clay, and silt left over after the bitumen is extracted from the oilsands. Some of this wet material forms mature fine tailings, which presents large reclamation challenges — left on its own, mature fine tailings could take centuries to solidify.[77]

The primary source of water for oilsands mining is the Athabasca River. More than 95 per cent of the water withdrawn from the river for this industrial use is ultimately too polluted to be returned to the natural cycle and must be stored on site in tailings ponds.

While total water use for the mining sector has stabilized recently (see Figure 7 below) based on per barrel improvements in mining operations, tailings volumes continue to grow and water use could be on an upward trend should new projects such as Shell's Jackpine Mine Expansion, Shell's Pierre River Mining Project, and the Teck Frontier Mine be approved (these projects amount to roughly 577,000 barrels of day in oilsands production).[78]

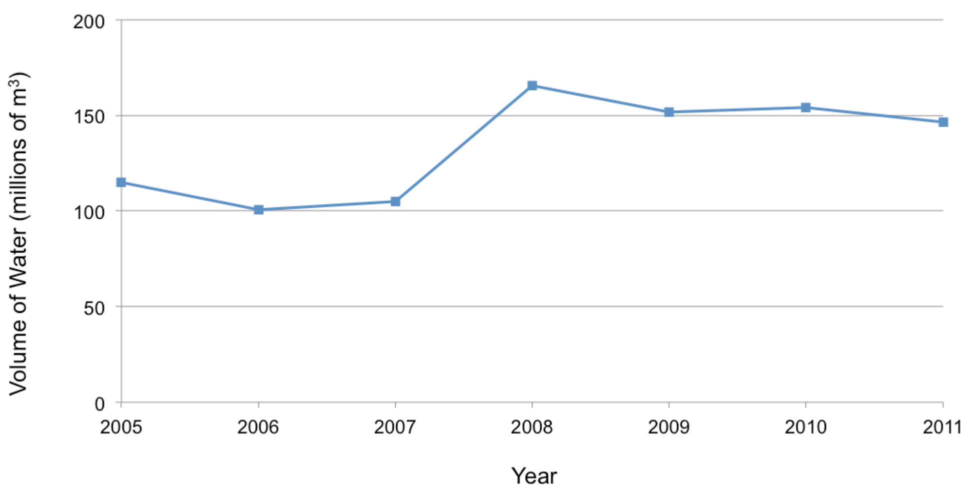

Figure 7. Water use by oilsands mining operations.

Data source: Government of Alberta[79]

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[74] Alberta Energy, "Facts and Statistics: Water Use," 2012. http://www.energy.alberta.ca/oilsands/791.asp

[75] R. J. Mikula, V. A. Munoz, and O. Omotoso, "Water Use in Bitumen Production: Tailings Management in Surface Mined Oil Sands," presented at the Canadian International Petroleum Conference, June 17-19, 2008, Calgary, Alberta. Available at http://www.onepetro.org/mslib/servlet/onepetropreview?id=PETSOC-2008-097

[76] "Facts and Statistics: Water Use."

[77] Suncor, *2010 Report on Sustainability. Oil Sands Tailings* (2012). http://sustainability.suncor.com/2010/en/responsible/1779.aspx

[78] According to Oil Sands Review statistics, the total production for these projects is 575,000 bpd (Pierre River = 200,000; Jackpine Mine Expansion = 100,000; and Teck Frontier = 275,000). http://www.oilsandsreview.com/statistics/projects.asp

[79] Alberta Environment & Sustainable Resource Development, "Oil Sands Operators' Water Use History," 2012. http://environment.alberta.ca/apps/OSIPDL/Dataset/Details/56

In Situ

In 2011, in situ techniques required approximately 0.8 to 1.7 barrels of water to extract and upgrade a barrel of oil.[80] The most common in situ recovery methods use water to create steam that heats the heavy oil underground, allowing it to flow to the surface through wells. Both surface water and groundwater sources are utilized for in situ recovery and a large percentage of the injected steam condenses in the reservoir and returns to the surface with the oil. Despite a large recycle rate of upwards of 90 per cent[81], groundwater use for in situ operations will increase given that in situ development is growing even faster than mining. The total amount of water used by all in situ operators in 2011 was more than 28 million cubic metres (Figure 8).[82]

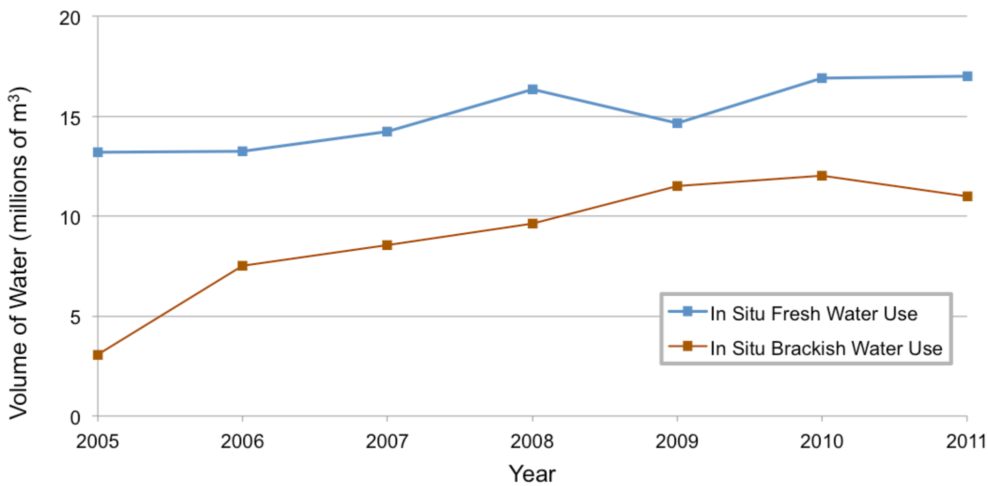

Figure 8. Water use by in situ oilsands operations

Data source: Government of Alberta[83]

In conclusion, while it is true that water recycle rates for oilsands operations range from 40 to 90 per cent, and that some companies have been able to gradually reduce their water consumption needs on a per-barrel basis, the cumulative growth in production is expected to lead to an increase in the overall water consumption for both the mining and in situ sectors.

[80] "Oil Sands Water Use," *Oil Sands Information Portal.*

[81] "Facts and Statistics: Water Use."

[82] "Oil Sands Water Use," *Oil Sands Information Portal.*

[83] "Oil Sands Operators' Water Use History."

Oilsands companies are not required to stop withdrawing water from the Athabasca River, even if river flows are so low that fisheries and habitat are at risk.

Oilsands mining is currently the largest consumer of water from the Athabasca River. The Athabasca River's flow is highly variable throughout the year, with high flow periods during the summer months and low flow periods during the winter months. It is common for oilsands mining proponents to present water demand as a percentage of average annual flow. Joe Oliver, federal Minister of Natural Resources,[84] has said, for example,

> *"The Athabasca River Water Management Framework sets mandatory limits on withdrawals. Less than one per cent of the Athabasca River's annual flow has been used by the oilsands. Withdrawals cannot exceed three per cent per year."*

However, expressing allocations in terms of percentages of annual flows masks the seasonal concern that exists during the low flow winter months, and suggests the aquatic ecosystem is being protected when it is not.

Background

Oilsands mining is currently the largest consumer of water from the Athabasca River. In the past twelve years, water allocations have nearly doubled largely because of the oilsands.[85] Too much water withdrawn from the Athabasca River, particularly during low flow periods, will compromise the ecological integrity of the river and the natural areas that rely on the river's seasonal flows. The current water management framework for the Athabasca River prioritizes industry needs over aquatic protection. A key gap in the current framework is the absence of an ecological base flow (EBF) which would halt water withdrawals at a point where 100 per cent of the flow is required by the aquatic environment to maintain the ecological integrity of the river system. Theoretically, the flow of the lower Athabasca River could be reduced to zero under the current water management framework.

The Athabasca River's flow is highly variable throughout the year, with high flow periods during the summer months and low flow periods during the winter months. Spring and summer peak flows are commonly 10 times greater than winter low flows.[86] During low flow periods, the Athabasca River is susceptible to low oxygen levels that are known to be "detrimental to the

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[84] Joe Oliver, "Fixing the oil sands," letter to the editor, *Globe and Mail,* Dec. 6, 2012. http://m.theglobeandmail.com/commentary/letters/dec-6-modern-monarchy-and-other-letters-to-the-editor/article6011183/?service=mobile

[85] Alberta Environment and Sustainable Resource Development, "Athabasca River Basin," 2012. http://www.environment.alberta.ca/01750.html

[86] Mathieu Lebel, Tony Maas, and Robert Powell, *Securing Environmental Flows in the Athabasca River* (WWF-Canada, 2011), 7.

eggs and fry of fall-spawning species such as lake whitefish and bull trout."[87] High flow periods are also critical to the integrity of the river system since the high flows "shape the morphometry of river channels" and "flood the shallow side channels and mouths of tributaries...which are critical nursery habitats for young fish and other organisms."[88]

It is common for oilsands mining proponents to present water demand as a percentage of average annual flow. However, average supply and demand numbers aren't able to reveal the potential environmental impact of water withdrawals during low flow periods. That is to say, *when* water is withdrawn is as important a consideration as *how much* is withdrawn,[89] and expressing allocations in terms of percentages of annual flows masks the seasonal concern that exists during the low flow winter months.

In addition to industrial threats, the Athabasca River is subject to a downward long-term trend in flow rates due to the implications of climate change and reduced glacial flow. Runoff below Fort McMurray is predicted to decrease by 30 per cent by 2050.[90]

Water withdrawals from the Lower Athabasca River are currently governed through Phase 1 of the *Water Management Framework: Instream Flow Needs and Water Management System for the Lower Athabasca River.*[91] Under this framework, withdrawal conditions are classified according to the flow rate along a green, yellow and red framework. At times of low water flows, oilsands operations are allowed to continue to withdraw water, even at the expense of fisheries and habitat. There is never a time when water withdrawals must be halted, even if fish and fish habitat are being damaged.

Phase 1 of the Water Management Framework does not include an EBF and is inadequate without it.[92] The EBF concept has been developed (e.g., South Saskatchewan River Basin) and employed (e.g., Pipestone River) elsewhere in Alberta as well as in other provinces and states (e.g., British Columbia and California) and is increasingly implemented as part of water management regimes in many jurisdictions.[93]

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[87] David W. Schindler, et. al. "Future Water Flows and Human Withdrawals in the Athabasca River," in *Running out of Steam? Oilsands Development and Water Use in the Athabasca River-Watershed: Science and Market Based Solutions* (2007), 6. http://www.ualberta.ca/~ersc/water.pdf

[88] Ibid., 7

[89] *Securing Environmental Flows in the Athabasca River,* 7.

[90] J. Bruce, "Oil and water – Will they mix in a changing climate? The Athabasca River story," in *Implications of a 2ºC Global Temperature Rise on Canada's Water Resources* (Sage Centre, 2006).

[91] Alberta Environment and Fisheries and Oceans Canada, *Water Management Framework: Instream Flow Needs and Water Management System for the Lower Athabasca River* (2007). http://environment.alberta.ca/documents/Athabasca_RWMF_Technical.pdf

[92] "Future Water Flows and Human Withdrawals in the Athabasca River," 11.

[93] *Securing Environmental Flows in the Athabasca River*, 10.

Tailings

Oilsands tailings volumes continue to grow due to a permissive regulatory approach.

For the first 40 years of oilsands operations, tailings treatment and management was conducted on a largely voluntary basis. As a result, vast lakes of polluted wastewater accumulated on the landscape in Northern Alberta. The provincial regulator introduced a new policy in 2009 that aimed to establish a more consistent and comprehensive approach to dealing with tailings waste, with the aim of eventually reducing the volume of tailings waste on the landscape. As the Government of Alberta notes,

> *"In February 2009, the Alberta Energy Resources Conservation Board issued Directive 074 with aggressive criteria for managing tailings."*[94]

Oilsands proponents often point to the existence of Directive 074 as evidence that the industry is taking tailings management seriously. Since the directive was introduced, however, it has not been enforced, and most projects are not meeting the standards it established.

Because the directive is not being enforced and because its design was limited to only require operators to reduce a portion of the volume of future tailings waste, tailings volumes continue to grow today.

Background

After 40 years of voluntary tailings management, the first binding tailings rules known as Directive 074 were released in 2009. Regulators claimed that all projects were to meet the new Energy Resources Conservation Board (ERCB) tailings standards "if they want to operate in Alberta."[95] Since that time the directive has not been enforced and the regulator adopted a flexible approach in accepting management plans from nine operations — only two of which were in full compliance. No enforcement actions were taken on those operators who filed plans not in compliance.

When the ERCB released Directive 074, it was hoped the regulations represented the beginning of a suite of tailings performance criteria to curb the growing volume of tailings. When the

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[94] Government of Alberta, "Alberta's Oil Sands: Tailings" (2012). http://www.oilsands.alberta.ca/tailings.html

[95] Dave Cooper, "Only two Alberta projects will meet tougher tailings rules: groups," *Global Calgary*, December 1, 2009. http://www.globaltvcalgary.com/only+two+alberta+projects+will+meet+tougher+tailings+rules+groups/67697/story.html

directive was released, roughly 720 billion litres of tailings waste was being stored in lake-like structures spanning 130 square kilometres.[96]

Nine tailings management plans were submitted by six different companies, and only two plans (Fort Hills Energy mine and the Suncor Millennium/North Steepbank mine) were actually in full compliance.[97,98] Other operators negotiated agreements with weaker performance standards with the ERCB.[99]

When challenged why the ERCB accepted the management plans despite acknowledge non-compliance, the ERCB stated that it has the power to "exempt from its own regulatory requirements."[100] Directive 074 is thus shown to be a voluntary regulation since companies are not required to comply.

In addition to the lack of compliance, there has also been a lack of transparent reporting. There have been no annual reports for the 2011-2012 year publicly posted on the ERCB's website. Actual current performance of companies is unknown.

Because the directive is not being enforced and because it was limited in its design to only require operators to reduce a *portion* of the volume of future tailings waste, tailings volumes continue to grow today.

As of 2010, the surface area of all tailings lakes in the mineable area is 176 square kilometres and the total volume of mature fine tailings contained in these lakes is 830 million cubic metres (5.2 billion barrels).[101] By 2030, this volume is expected to increase by 40 per cent to 1.2 billion cubic metres (7.5 billion barrels).[102] Looking back to 2005, the area of tailings was 50 square kilometres.[103] In only seven years, the total area for tailings has nearly quadrupled (see Figure 9).

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[96] Jennifer Grant, Dan Woynillowicz and Simon Dyer, *Clearing the Air on Oilsands Myths* (Pembina Institute, 2009). http://www.pembina.org/pub/1839

[97] Ibid., 6.

[98] For a review of each of the individual management plans, see Terra Simieritsch, Joe Obad and Simon Dyer, *Tailinsg Plan Review* (Pembina Institute and Water Matters, 2009). http://www.water-matters.org/docs/tailings-plan-review.pdf

[99] Jennifer Grant, "Rules Optional for Oil Sands' Toxic Tailings Lakes," *Pembina Institute*, December 10, 2010. http://www.pembina.org/blog/445

[100] Don McFayden, ERCB, letter to Ecojustice, December 1, 2010. Available at http://www.ecojustice.ca/media-centre/media-release-files/ercb-response-to-request-for-review-dec.-1/at_download/file

[101] Alberta Environment & Sustainable Resource Development, "Total Tailings Ponds Surface Area," *Oil Sands Information Portal.* http://environment.alberta.ca/apps/osip/

[102] R.H. Houlihan and C. E. Hale, "Alberta mine reclamation and abandonment requirements," in *Mine Closure 2011, Proceedings of the Sixth International Conference on Mine Closure*, September 18 to 21, 2011, Alberta, Canada, vol. 2, 13. (Based on data from 2009 ERCB Directive 74 submissions.)

[103] B. Peachey, *Strategic Needs for Energy Relate Water Use Technologies*, Water and the EnergyINet (2005), p. 34, http://www.aeri.ab.ca/sec/new_res/docs/EnergyINet_and_Water_Feb2005.pdf

Tailings

Figure 9. Growth of tailings lakes by surface area since 2005

Data source: Peachey; Pembina Institute; Alberta Environment & Sustainable Resource Development[104]

In 2011, Alberta produced 326 million barrels (51.8 million cubic metres) of bitumen (893,000 barrels/day, 142,000 m^3/day) from mining alone.[105] The corresponding amount of mature fine tailings produced was 1.3 million barrels/day (206,000 m^3/day),[106] enough to fill Toronto's Rogers Centre (formerly Sky Dome) 47 times in a year.[107]

Even if Directive 074 were fully enforced, it would not result in absolute reductions of tailings, as it does not address the "legacy tailings" that have been allowed to accrue over the past 45 years.[108] There are still no regulations in place to address legacy tailings. Under the current tailings policies, even with some of the companies making progress in reducing future production of liquid tailings, tailings lakes on the surface will grow until 2060 when the volume will finally stabilize and potentially trend downwards.[109]

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[104] *Strategic Needs for Energy Relate Water Use Technologies; Clearing the Air on Oilsands Myths;* "Total Tailings Ponds Surface Area."

[105] Energy Resources Conservation Board, *Alberta's Energy Reserves 2011 and Supply/Demand Outlook—Overview,* ST98-2012 (2012). www.ercb.ca/sts/ST98/ST98-2012.pdf

[106] Calculated based on the production of 1.5 barrels of mature fine tailings per barrel of bitumen (R. J. Mikula, V. A. Munoz, and O. Omotoso, "Water Use in Bitumen Production: Tailings Management in Surface Mined Oil Sands," presented at the Canadian International Petroleum Conference, June 17-19, 2008, Calgary, Alberta. Available at http://www.onepetro.org/mslib/servlet/onepetropreview?id=PETSOC-2008-097)

[107] The Rogers Centre has a volume of 1.6 billion litres. Rogers Centre, "Fun Facts and Figures." http://www.rogerscentre.com/about/facts.jsp

[108] Energy Resources Conservation Board, *Directive 074 Tailings Performance Criteria and Requirements for Oil Sands Mining Schemes* (2009). ercb.ca/directives/Directive074.pdf

[109] "Alberta mine reclamation and abandonment requirements," 13.

Tailings lakes house compounds known to be acutely toxic to aquatic organisms.

The Canadian Association of Petroleum Producers says that

> *"tailings are a mixture of water, clay, sand and residual bitumen."*[110]

This list is incomplete; tailings also include elevated concentrations of salts and toxic compounds such as metals, polycyclic aromatic hydrocarbons, naphthenic acids and solvents that are added to the bitumen during the separation process.

Naphthenic acids cause tailings to be acutely toxic to aquatic organisms. Heavy metals are very toxic and can build up in biological systems to become a significant health hazard.

Background

Tailings are more than just a mixture of clay, water, sand and residual bitumen. The Government of Alberta maintains a zero-discharge policy for oilsands mining operations, meaning all process affected water and tailings must be stored on-site to allow the tailings to settle and water quality to recover. The zero-discharge policy means that tailings, especially the fluid fine tailings, continue to not only accumulate but also increase in toxicity: toxic substances, including the solvents that are added to the bitumen during the separation process, become concentrated in tailings lakes over time as the upper water layer is removed and pumped back into the extraction process.

Tailings contain elevated concentrations of salts and toxic compounds such as metals, polycyclic aromatic hydrocarbons (PAHs), naphthenic acids and solvents that are added to the bitumen during the separation process. [111,112] Metals detected in tailings lakes include arsenic, cadmium, chromium, copper, lead and zinc, all of which are labelled as priority pollutants under the United States Clean Water Act.[113] Heavy metals, such as arsenic, cadmium and lead, are very toxic and can build up in biological systems and become a significant health hazard.[114] Historic data from tailings lakes indicates that metals have exceeded Canadian Council of Ministers of the

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[110] Canadian Association of Petroleum Producers, "Tailings Ponds," 2012. http://www.capp.ca/environmentCommunity/land/Pages/TailingsPonds.aspx

[111] Government of Alberta, "Alberta's Oil Sands: Tailings" (2012). http://oilsands.alberta.ca/tailings.html

[112] Oilsands Advisory Panel, *A Foundation for the Future: Building an Environmental Monitoring System for the Oilsands*, report to the Minister of the Environment (2010) http://www.ec.gc.ca/pollution/default.asp?lang=En&n=E9ABC93B-1

[113] Erik W Allen, "Process water treatment in Canada's oil sands industry: 1. Target pollutants and treatment objectives," *Journal of Environmental Sciences* 7 (2008).

[114] United States Occupational Safety and Health Administration, "Toxic Metals," *Safety and Health Topics*. www.osha.gov/SLTC/metalsheavy/index.html.

Environment water quality guidelines.[115] Tailings also contain residual bitumen (e.g., Suncor's tailings lake contained 9 per cent residual bitumen)[116] and diluent[117] (e.g., naphtha).

Table 2 provides a list of *some* of the toxic compounds present in oilsands tailings lakes relative to regional lakes in the Athabasca boreal forest.[118]

Table 2. Compounds present in oilsands tailings waste water relative to regional lakes

	Syncrude Mildred Lake Settling Basin (1985-1998)	Suncor tailings lakes (1982-1998)	Regional lakes (2001)
Oil and grease (mg/L)	25	9–31	–
Naphthenic acids (mg/L)	49	68	1–2
Cyanide (mg/L)	0.5	0.01–0.04	–
Phenols (mg/L)	0.008	0.03–1.8	0.002–0.004

Source: Adapted from Allen, "Process water treatment in Canada's oilsands industry"[119]

Ambient levels of naphthenic acids are below 1 mg/L in rivers in northeastern Alberta. However, tailings lake waters may contain as much as 110 mg/L,[120] more than one hundred times their natural concentration levels. The presence of naphthenic acids in local water bodies and their potential effects on water quality and fish reproduction and tainting has brought significant attention to their persistence in the environment and to their aquatic toxicity at the levels found in tailings lakes.[121] Naphthenic acids cause tailings to be acutely toxic to aquatic organisms[122] and mammals.[123,124] Mammalian toxicological results indicate that while acute toxicity in wild

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115 Allen, "Process water treatment in Canada's oil sands industry."

116 P.M. Fedorak et al., "Methanogenic Potential of Tailings Samples from Oil Sands Extraction Plants," *Canadian Journal of Microbiology* 48 (2002), 24.

117 Diluent is added to bitumen to dilute its thick, heavy and viscous state so it will flow through a pipeline.

118 Allen, "Process water treatment in Canada's oil sands industry."

119 Ibid.

120 John V. Headley, Kerry M. Peru, and Mark P. Barrow, "Mass Spectrometric characterization of naphthenic acids in environmental samples: a review," *Mass Spectrometry Reviews* 28 (2009).

121 Ibid.

John V. Headley and Dena W. McMartin, "A Review of the Occurrence and Fate of Naphthenic Acids in Aquatic Environments," *Journal of Environmental Science and Health.* 39, no. 8 (2004).

122 Alan Scarlett, Charles West, David Jones, Tamara Galloway, and Steve Rowland, "Predicted Toxicity of Naphthenic Acids Present in Oil Sands Process-Affected Waters to a Range of Environmental and Human Endpoints," *Science of The Total Environment* 425 (2012).

M. MacKinnon and H. Boerger, "Description of Two Treatment Methods for Detoxifying Oil Sands Tailings Pond Water," *Water Pollution Research Journal of Canada* 21 (1986).

123 United States Environmental Protection Agency Office of Toxic Substances, "Fate and Effects of Sediment-Bound Chemicals in Aquatic Systems," *Proceedings of the Sixth Pellston Workshop,* August 12-17, 1984.

124 Royal Society of Canada Expert Panel, *Environmental and Health Impacts of Canada's Oil Sands Industry* (2010), 129. http://rsc-src.ca/en/expert-panels/rsc-reports/environmental-and-health-impacts-canadas-oil-sands-industry

mammals is unlikely under worst-case exposure conditions, repeated exposure may have adverse health effects.[125] In addition to being acutely toxic, the naphthenic acids associated with oilsands tailings do not easily break down in the natural environment.[126]

Existing standards, including the new Surface Water Quality Management Framework for the Lower Athabasca Regional Plan and Alberta's Surface Water Quality Guidelines, do not incorporate water quality limits for naphthenic acids[127,128] despite concerns about the persistence and aquatic toxicity of this toxin.

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[125] V.V. Rogers et al., "Acute and Subchronic Mammalian Toxicity of Naphthenic Acids from Oil Sands Tailings," *Toxicological Sciences* 66 (2002).

[126] Angela C. Scott, Michael D. Mackinnon, and Phillip M. Fedorak, "Naphthenic Acids in Athabasca Oil Sands Tailings Waters Are Less Biodegradable than Commercial Naphthenic Acids," *Environmental Science & Technology* 39, no. 21 (2005).

[127] Alberta Environment and Sustainable Resource Development, *Surface Water Quality Management Framework for the Lower Athabasca Regional Plan* (2012). http://environment.alberta.ca/03423.html

Alberta Environment and Sustainable Resource Development, *Surface Water Quality Guidelines for Use in Alberta* (1999). http://environment.alberta.ca/01323.html

[128] Headley and McMartin, "A Review of the Occurrence and Fate of Naphthenic Acids in Aquatic Environments."

Tailings lakes seep an undetermined amount of toxic waste.

Toxic wastewater seeps out of tailing lakes at an estimated rate of more than 11 million litres per day.[129] The Canadian Association of Petroleum Producers states that,

> *"Several methods are used to limit and manage seepage from tailings ponds. For example, ditches around tailings facilities capture seepage that is pumped back into the tailings ponds."*[130]

While the public is assured that industry is monitoring and capturing seepage, there is little publicly available information that could substantiate these claims. It is uncertain exactly what is seeping, how much is seeping and what ecosystem components are affected.

Background

The approvals issued under Alberta's *Environmental Protection and Enhancement Act* require that surface mine operators report on seepage of tailings release water into groundwater or surface water. Two studies examining seepage mitigation provided mixed results; in some cases, tailings liquids had managed to bypass the collection ditches and enter uncontaminated water.[131]

For its Joslyn North Mine Project, Total E&P Canada Ltd. compiled seepage flow values reported in EIAs for all existing, approved, and planned developments to compute the total seepage to the Athabasca River. They calculated that the total oilsands process wastewater seepage into the Athabasca River will be 12.6 million litres per day in 2013 and 23.9 million litres per day in 2044.[132] Other studies have predicted that tailings lakes may be leaking into the surrounding environment at a rate of 11 million litres per day.[133] As noted in the Royal Society of Canada Expert Panel's report on oilsands, "in neither case is it clear to what extent reduction of seepage flow by seepage collection has been accounted for."[134]

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[129] Royal Society of Canada Expert Panel, *Environmental and Health Impacts of Canada's Oil Sands* (2010), 123. http://rsc-src.ca/en/expert-panels/rsc-reports/environmental-and-health-impacts-canadas-oil-sands-industry

[130] Canadian Association of Petroleum Producers, "Environment: Water," *Upstream Dialogue: The Facts on Oil Sands*. http://appstore.capp.ca/oilsands/page/tailings-ponds-2012-01-23-03-01-23

[131] *Environmental and Health Impacts of Canada's Oil Sands*, 123.

[132] Ibid., 124.

[133] Matt Price, *11 Million Litres a Day: The Tar Sands Leaking Legacy* (Environmental Defence, 2008). http://www.environmentaldefence.ca/reports/tarsands_dec_2008.html

[134] *Environmental and Health Impacts of Canada's Oil Sands*, 124.

Capping toxic tailings waste in end pit lakes with water is an unproven and risky concept.

The concept of water capping of tailings waste is risky, experimental and has never been demonstrated. Syncrude Canada Ltd. has received approval for a "demonstration project" for which it claims,

> *"We are demonstrating how fresh water can be layered over a deposit of fine tails to form a lake. This is called water capping. Our research with test ponds has shown that these lakes will evolve into natural ecosystems and, over time, support healthy communities of aquatic plants, animals and fish."*[135]

However, this demonstration project could take decades to produce results that determine whether or not the water capping of fine tailings will actually work. Currently, there is uncertainty regarding the long-term monitoring liabilities, salinity issues, and the chronic toxicity of oilsands process affected water. If after decades this process is found to not work, then Albertans will be left with dozens of toxic lakes and a costly liability.

Background

Pit lakes are used in other mining sectors to control water drainage before discharging the water into the environment. The same process is used the oilsands industry, except that about half of the 29 end pit lakes (EPLs) proposed by the oilsands industry, tailings will be placed at the bottom of the pit, before being covered with a "cap" of fresh water.[136] Operators hope that the tailings layer and freshwater layer won't mix and a self-sustaining ecosystem will form over time. The permanent placement of tailings in end pit lakes has been approved for many oilsands mines, subject to demonstration, based on previous decision reports for mining projects:

- Decision 94-5, which approved Syncrude's Base Mine Lake project, subject to successful demonstration of water capping [137]
- CNRL Horizon Decision 2004-005, which states that "The Panel expects that this work would be completed in the next 15 years"[138]
- Imperial Oil Kearl Decision 2007-013 which states "The Joint Panel notes that the concept of EPLs have been approved subject to successful full-scale demonstration of this reclamation method"[139]

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[135] Syncrude Canada Ltd., "Tailings Management," 2012. http://www.syncrude.ca/users/folder.asp?FolderID=5913#1

[136] Cumulative Environmental Management Association, *End Pit Lakes Guidance Document* (2012), 22. http://cemaonline.ca/index.php/administration/doc_download/174-end-pit-lake-guidance-document

[137] Ibid.

[138] Alberta Energy and Utilities Board, *Application by Canadian Natural Resources Limited for an Oil Sands Mine, Bitumen Extraction Plant, and Bitumen Upgrading Plant in the Fort McMurray Area*, Decision No. 2004-005 (January 27, 2004), 66. http://www.ercb.ca/decisions/2004/2004-005.pdf

Currently, storing tailings in an end pit lake is the least costly reclamation option for the oilsands industry.[140] Because there is no functioning example to learn from, there is uncertainty regarding the long-term monitoring liabilities, salinity issues, and the chronic toxicity of oilsands process-affected water. Despite this, companies are allowed to proceed with this cheaper option for dealing with tailings. As the recently produced Cumulative Environmental Management Association guidelines note, "when scientific uncertainty is high and the potential for substantial negative and environmental and/or social impacts exists — a likely scenario for EPLs — decision-makers and designers should err on the side of caution."[141]

Late November 2012, the Government of Alberta gave the go ahead for Syncrude's EPL "demonstration project" to help regulators determine if the technology works on a commercial scale and is therefore a proven reclamation technique.[142] It is expected that it will take decades for bacteria to digest and transform toxic process-affected waters containing naphthenic acids and polycyclic aromatic hydrocarbons to the point where they pose no significant risk to the flora and fauna that colonize the EPLs or the greater ecosystem that receives outflow from the EPLs.[143]

Alternatives to end pit lakes include new technologies that are currently being developed or are in their early phase of implementation. For example, Suncor's tailings reductions operations process increases the rate of solidification by mixing tailings with a polymer flocculent that is then spread out in a thin layer over sandy areas with shallow slopes.[144] This turns tailings into a dry material that can be reclaimed in a shorter time period.[145] Major industry players have also joined together in the Oil Sands Tailings Consortium to share research and technology to advance tailings management.[146] Although these are important steps that are being taken to improve the impact of tailings on the regions ecosystem, some technologies are clearly more risky than others.

Clearly EPLs represent a risky gamble; if after decades EPLs are found to not work then Albertans could be left with dozens of toxic lakes and a costly liability.

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[139] Alberta Energy and Utilities Board, *Application by Imperial Oil Resources Ventures Limited for an Oil Sands Mine and Bitumen Processing Facility (Kearl Oil Sands Project) in the Fort McMurray Area*, Decision No. 2007-013 (February 27, 2007), 44. http://www.ercb.ca/decisions/2007/2007-013.pdf

[140] R. J. Mikula, V. A. Munoz, and O. Omotoso, "Water Use in Bitumen Production: Tailings Management in Surface Mined Oil Sands," presented at the Canadian International Petroleum Conference, June 17-19, 2008, Calgary, Alberta. Available at http://www.onepetro.org/mslib/servlet/onepetropreview?id=PETSOC-2008-097

[141] *End Pit Lakes Guidance Document,* 22.

[142] Sheila Pratt, "Syncrude tests plan to turn tailing ponds into clean lakes," *Edmonton Journal,* December 3, 2012. http://www.edmontonjournal.com/business/Pollution+pristine+Syncrude+test+plan+turn+tailing+ponds+into+clean+lakes/7641040/story.html#ixzz2E3FbBLxI

[143] *End Pit Lakes Guidance Document,* 44.

[144] Suncor Energy, "Tailings Management." http://www.suncor.com/en/responsible/3229.aspx

[145] Ibid.

[146] CAPP. "Oil Sands Tailings Consortium", (2012). http://www.capp.ca/ENERGYSUPPLY/INNOVATIONSTORIES/LAND/Pages/OSTC.aspx

Land and wildlife

Restoration of wetlands continues to be a major challenge and may never occur.

Peatlands, the primary kind of wetland habitat throughout northeastern Alberta, cannot feasibly be replaced using current reclamation techniques. Reclamation efforts so far have replaced valuable peatlands with very different landscapes, as described by Patrick Moore in a series of television and print advertisements for the Canadian Association of Petroleum Producers:

> *"All this land around us has been mined. Look at it now. You have this beauty returning to the landscape.*
>
> *"Here I've got Alder, Spruce, Aspen.*
>
> *"Where there was once an oilsands mining operation, you now have a beautiful, bio-diverse landscape again, where you'd never know there'd been a mine there in the first place."*[147]

Although the traces of the mine may be gone after reclamation, the new forested landscape is not an equivalent replacement to the original wetland ecosystem.

Background

Peatlands, the primary kind of wetland habitat throughout northeastern Alberta, are likely to be permanently lost after mining, given the current lack of protective policy and the inability to restore peatlands. Wetland ecosystems dominate the oilsands landscape, occupying up to 65 per cent of the active surface mining area.[148] Wetlands are disproportionately valuable in their ability to sustain healthy watersheds by providing water storage, purification and filtration, carbon storage, groundwater recharge, and diverse ecosystems.[149] As of November 2011, approved mining production is expected to result in a loss of approximately 28,000 hectares of peatlands alone.[150]

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[147] Patrick Moore, in television and print ads for Canadian Association of Petroleum Producers. http://www.capp.ca/canadaIndustry/oilSands/Innovation/media/Pages/PatrickMoore.aspx

[148] M. Raine, I. Mackenzie, and I. Gilchrist, *Terrestrial vegetation, wetlands and forest resources baseline*, CNRL Horizon Project Environmental Impact Assessment Volume 6, Appendix B. Report # 012-2220. (Golder Associates, 2002).

[149] L. Foote, "Threshold considerations and wetland reclamation in Alberta's mineable oil sands," *Ecology and Society* 17 (2012). http://dx.doi.org/10.5751/ES-04673-170135

[150] Rebecca C. Rooney, Suzanne E. Bayley, and David W. Schindler, "Oil Sands Mining and Reclamation Cause Massive Loss of Peatland and Stored Carbon," *Proceedings of the National Academy of Sciences of the United States of America.* (2012), 1. http://www.pnas.org/content/109/13/4933.full

Unlike many jurisdictions, Alberta has no policy that requires protection of wetlands on public lands in northern Alberta. A promised wetland policy that would require avoidance of wetlands and compensation for wetland loss is more than five years overdue.[151]

In the absence of any policy, companies are actively researching wetlands reclamation. However, the best reclaimed wetlands on process-affected oilsands mining sites to date are salt marshes that are low in species biodiversity compared to the prevailing pre-disturbance freshwater peat wetlands.[152]

Despite these efforts, peat wetland re-creation is not expected in the post-mining leases. Researchers have noted that "...peatlands, the primary class of wetland cover throughout the oil sands region, cannot feasibly be replaced because of insufficient available area, time requirements for peat development, gaps in reclamation knowledge, and expense….Even with these exacting conditions, at 1 to 3 mm of peat accumulation per year, approximately one to three centuries would be needed to generate the 30 cm minimum of accumulated peat to technically qualify as a peatland."[153]

Suggesting that one would "never know there'd been a mine in the first place" is clearly misleading given the substantial landscape changes that are predicted, even if reclamation is successful.

[151] Pembina Institute, "Oilsands Industry Blocks New Wetland Protection Rules," media release, September 16, 2008. http://www.pembina.org/media-release/1697

[152] Marsha Trites and Suzanne E. Bayley, "Vegetation communities in continental boreal wetlands along a salinity gradient: Implications for oil sands mining reclamation," *Aquatic Botany* 91 (2009).

[153] Foote, "Threshold considerations and wetland reclamation in Alberta's mineable oil sands."

The boreal forest will not be restored to its native state following mine closure.

Operators in Alberta's oilsands are not required to restore disturbed land to its original state, but rather to reclaim it. This distinction is not often made clear, as in a series of television and print ads for the Canadian Association of Petroleum Producers where Garrett Brown of ConocoPhillips states,

"I grew up on a farm. I know what it means to have the land restored."[154]

Restoration is generally understood to mean returning to the natural state of the area prior to disturbance. However, oilsands company plans show the post-mine closure landscape dominated by end pit lakes and forested uplands, not the original wetland-dominated ecosystem. In the context of oilsands mining, industry advertisements that suggest they will restore the land are inaccurate.

Background

Operators in Alberta's oilsands are not required to restore disturbed land to its original state but rather reclaim land with the objective of achieving "equivalent land capability." The Government of Alberta defines equivalent land capability as:

"The ability of the land to support various land uses after conservation and reclamation is similar to the ability that existed prior to any activity being conducted on the land, but that the individual land uses will not necessarily be identical."[155]

Reclamation is juxtaposed against restoration which is generally understood as the return to the natural state of the area prior to disturbance and is guided by ecological principles to promote the recovery of ecological integrity.[156] A restored ecosystem contains a characteristic assemblage of the species that occurred in the reference ecosystem.

The post-mine closure landscapes described by oilsands companies in their environmental assessments are dominated by end pit lakes and forest uplands, not the original the peatlands and

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[154] Garrett Brown in television and print ads for Canadian Association of Petroleum Producers (2012). http://www.capp.ca/canadaIndustry/oilSands/Innovation/media/Pages/garrett.aspx

[155] Under Alberta's EPEA, reclamation means any or all of the following:
"- the removal of equipment or buildings or other structures or appurtenances;
- the decontamination of buildings or other structures or other appurtenances, or land or water;
- the stabilization, contouring, maintenance, conditioning or reconstruction of the surface of land; and
- any other procedure, operation or requirement specified in the regulations."

Conservation and Reclamation Regulation, Alberta Regulation 115/1993.

[156] Society for Ecological Restoration International, *The SER International Primer on Ecological Restoration*. (2004). http://www.ser.org/resources/resources-detail-view/ser-international-primer-on-ecological-restoration

old-growth forests.[157] In the context of oilsands mining, industry advertisements that suggest they will restore the land are inaccurate.

The rapid expansion of oilsands development and a lack of a regulatory requirement for oilsands operators to promptly reclaim has led to poor reclamation performance overall. To date, of the land impacted by oilsands mines, only Syncrude's Gateway Hill has been certified as reclaimed. Gateway Hill, the remnants of an overburden dump that was never actually mined or polluted by tailings, represents 0.1 per cent (1.04 square kilometres) of the total area disturbed by oilsands mining.

Suncor's Wapisiw lookout[158] (formerly known as tailings pond 1 or Tar Island Dyke) is the only tailings lake that has been reclaimed in terms of industry standards and currently represents roughly 1 per cent of the total tailings surface area. However, this was accomplished in part by moving approximately 12.5 million cubic metres of tailings out of Pond 1 and into other Suncor tailings ponds.[159] The former lake was then filled in and revegetated. The reclamation certification of Wapisiw lookout and the much more difficult mine pits and remaining tailings lakes are many years away. Wapisiw lookout remains an outlier with regard to the average tailings reclamation effort that is being completed across the region.

In 2009, Alberta introduced new reclamation milestones to better track reclamation performance.[160] Under these new definitions, mine operators have to have permanently reclaimed 48 square kilometres (6.7 per cent of the disturbed area). New reclamation liability regulations that came into effect in 2011 now require a modest financial deposit ($75,000 per hectare of unreclaimed land) for oilsands mine operators who fail to meet their approved reclamation schedule.[161]

As oilsands production rapidly increases, it remains uncertain if these new measures will be sufficient to improve the reclamation rate in northeastern Alberta (see Figure 10 and Figure 11).

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[157] Oil Sands Environmental Coalition, *Submission to Joint Review Panel for the Shell Jackpine Mine Expansion Project*, October 1, 2012, 26. http://pubs.pembina.org/reports/osec-submission-jackpine-expansion-oct-2012-corrected.pdf

[158] Suncor Energy Ltd., "Wapisiw Lookout Reclamation." http://www.suncor.com/en/responsible/3708.aspx

[159] Pembina Institute, *Pond 1 Backgrounder* (2010). pubs.pembina.org/reports/pond-1-backgrounder.pdf

[160] These milestones include: certified reclaimed, permanent reclamation, temporary reclamation, soils placed, ready for reclamation, disturbed, and cleared. Government of Alberta, "Alberta's Oil Sands: Reclamation." http://www.oilsands.alberta.ca/reclamation.html

[161] Alberta Environment, *Guide to Mine Financial Security Program* (2011), 32. http://environment.alberta.ca/documents/MFSP_Guide_-_2011_03_30.pdf

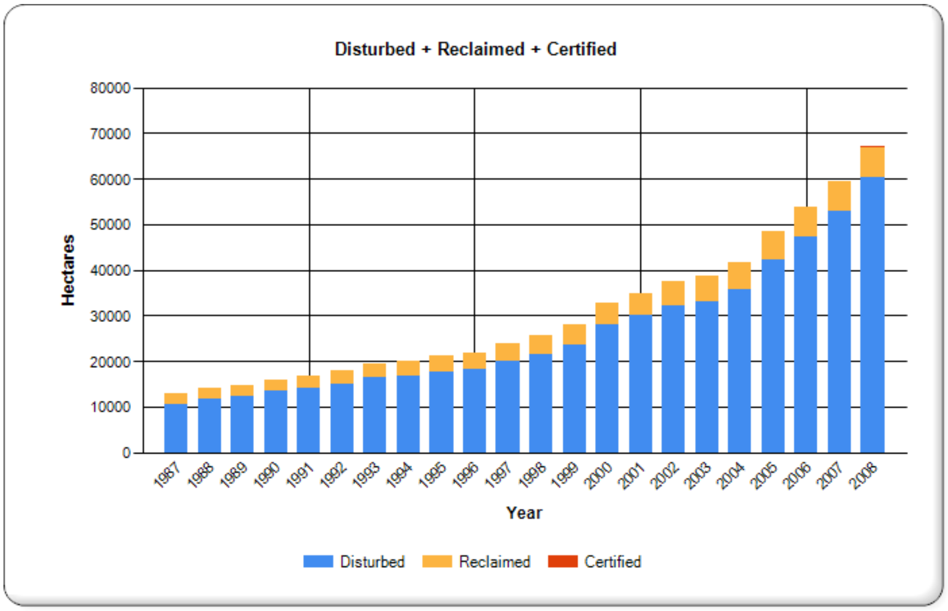

Figure 10. Oilsands disturbance vs. reclamation from 1987-2008

Source: Alberta Environment[162]

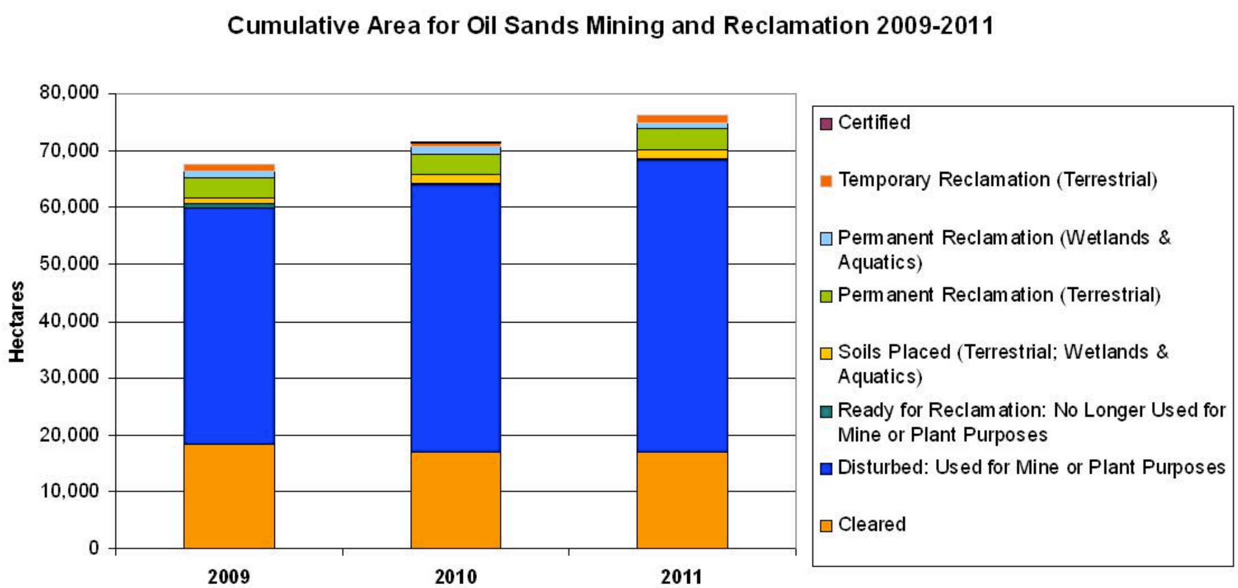

Figure 11. Recent reclamation performance using the new reclamation milestones

Source: Alberta Environment[163]

[162] Alberta Environment, "Historical Oil Sands Mine Land Disturbance and Reclamation Tracking (1987 to 2008)," *Oil Sands Information Portal.* http://environment.alberta.ca/apps/osip/

[163] Alberta Environment and Sustainable Resource Development, "Oil Sands Mining Development and Reclamation," 2012. http://environment.alberta.ca/02863.html

In situ developments may affect a much larger area than oilsands mining.

While the direct area cleared for in situ development is currently less than for mining on a hectare-by-hectare basis, in situ developments also result in additional impacts from habitat fragmentation and through greater natural gas use. The Canadian Association of Petroleum Producers claims that,

> *"…the remaining reserves that underlie 97 per cent of the oil sands surface area, are recoverable by drilling (in situ) methods which require very little surface land disturbance…"*[164]

Yet the accumulation of impacts means the potential area affected by in situ development is actually about 30 times larger than the area that could be mined.

Background

Only 20 per cent of oilsands deposits are accessible through mining, while the rest is accessible by in situ extraction technologies.[165] The potential area that could be affected through in situ development is 137,400 square kilometers, which represents 21 per cent of Alberta[166] and is equivalent to the size of England.[167] Production from in situ development is projected to surpass that of bitumen from mining projects by 2015.[168]

Compared to oilsands mining, in situ oilsands development covers an area approximately 30 times larger than the mineable zone.[169] While the direct area cleared for in situ development is less than for mining on a hectare-by-hectare basis, the additional impacts from habitat fragmentation and greater natural gas use, not to mention the potential scale of future in situ developments, may lead to significant cumulative effects from in situ that present greater risks to forested ecosystems than the relatively concentrated impacts of mining.

In situ development disturbs and fragments the land in a variety of different ways including the extensive networks of pipelines, roads, power lines, seismic lines and well pads that are required to extract and transport the resource to upgrading and refining. The direct disturbance from in situ is less than from mining, but if you compare the full life cycle land disturbances, including direct and peripheral land use, the area of land influenced by in situ development is comparable

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[164] Canadian Association of Petroleum Producers, "Environment: Land," *Upstream Dialogue: The Facts on Oil Sands*. http://appstore.capp.ca/oilsands/page/land-impacts-2012-01-23-03-01-40

[165] Alberta Energy, "About Oil Sands: Facts and Statistics." http://www.energy.gov.ab.ca/OilSands/791.asp

[166] Government of Alberta, *Responsible Actions: A Plan for Alberta's Oil Sands — Progress Report 2011,* 2. http://www.energy.alberta.ca/pdf/OSSResponsibleActionsProgressReport2011.pdf

[167] Area of England is 132,938 square kilometres. U.K. Office of National Statistics, "The countries of the U.K." http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/administrative/the-countries-of-the-uk/index.html

[168] Energy Resources Conservation Board, *Alberta's Energy Reserves 2011 and Supply/Demand Outlook—Overview* ST98-2012 (2012).

[169] Pembina Institute, *Mining vs. In Situ Fact Sheet* (2010). http://www.pembina.org/pub/2017

to mining and potentially greater.[170] The significant demand for natural gas for in situ extraction as well as the other upstream impacts greatly increases the scale of impact for the sector.[171]

Landscape fragmentation occurs when large areas of land are divided and separated as a result of human disturbance and infrastructure; the network of pipelines and roads create smaller patches from larger, formerly contiguous, areas. The wildlife populations in fragmented landscapes are susceptible to isolation and various features of the local ecosystem can be adversely impacted, including a shift in predator–prey dynamics.[172] Species that require niche habitats, like woodland caribou, are most likely to be adversely affected by habitat fragmentation.[173]

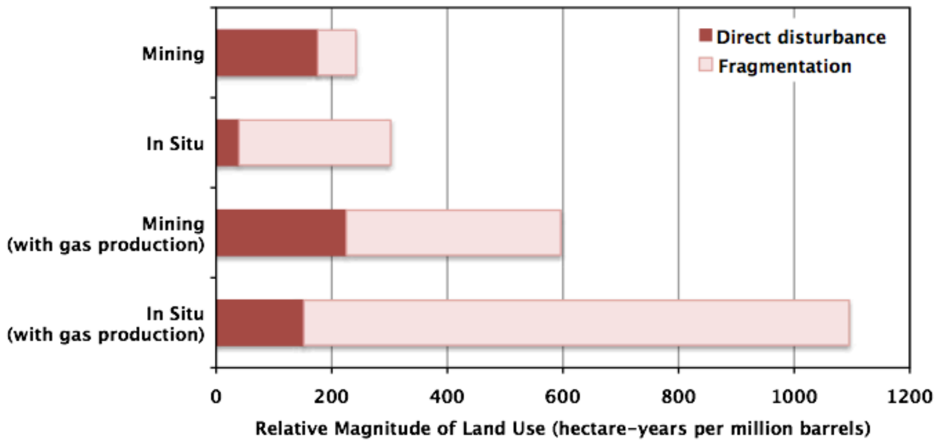

Figure 12. Direct and indirect land disturbances in mining and in situ operations

Source: The Pembina Institute[174]

In situ production is not a low-impact form of oilsands development, especially considering the scale at which in situ technologies will be deployed across northern Alberta. More focus is required on improving management of the terrestrial impacts of in situ oilsands development.

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[170] Sarah M. Jordan, David W Keith and Brad Stelfox, "Quantifying Land Use of Oil Sands Production: A Life Cycle Perspective." *Environmental Resource Letters.* (2009), 13. http://iopscience.iop.org/1748-9326/4/2/024004/pdf/1748-9326_4_2_024004.pdf

[171] Ibid., 13.

[172] Ibid., 3.

[173] S.J. Dyer, J.P. O'Neill, S.M. Wasel and S. Boutin, "Avoidance of Industrial Development by Woodland Caribou. *Journal of Wildlife Management* (2001).

[174] *Mining vs. In Situ Fact Sheet,* 2.

Woodland caribou herds are declining in the oilsands and are on track to be extirpated.

Woodland caribou populations are in rapid decline as a result of industrial development in their habitat. All herds in northeastern Alberta are expected to disappear in the coming decades.

According to the Canadian Association of Petroleum Producers,

> *"The oil and gas industry, [works to] balance industrial activities in northern Alberta with the conservation of caribou and their habitat."*[175]

Yet despite such assurances, the threshold for responsible development has already been exceeded. Management activities should focus on conservation and land restoration, not further oilsands expansion.

Background

Woodland caribou populations are in rapid decline as a result of industrial development in their habitat. Their extirpation from Alberta is expected in the coming decades and the one herd whose range overlaps with oilsands development is expected to disappear in the next 30 years.[176] All caribou ranges in northeastern Alberta currently have levels of industrial disturbance that exceed the science-based threshold identified in the Federal Recovery Strategy for woodland caribou.

Caribou are extremely sensitive to habitat disturbance and require large, continuous tracts of undisturbed forests and boreal peatlands to survive.[177] Thus, their current habitat is threatened with destruction and fragmentation from oilsands and forestry development. Habitat change created by industry has an additional, compounding, impact on caribou because it increases populations of moose and deer "which in turn increases predator populations, mainly wolves, and eventually leads to increased predation of boreal caribou and decline in the size of local populations."[178]

Caribou populations in northeastern Alberta are in decline due to oilsands development and other industrial activities on the land[179] (see Figure 13) and caribou have been labelled as a "threatened" species under both the *Alberta Wildlife Act* and the federal *Species at Risk Act.*

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[175] Canadian Association of Petroleum Producers, "Protecting Wildlife," 2012. http://www.capp.ca/environmentCommunity/land/Pages/ProtectingWildlife.aspx

[176] Samuel K Wasser, Jonah L Keim, Mark L Taper, Subhash R Lele, "The influences of wolf predation, habitat loss, and human activity on caribou and moose in the Alberta oil sands," *The Ecological Society of America* 9, no. 10 (2011), 546.

[177] Ecojustice, *Protecting Alberta's Caribou* (2011), 1. http://www.ecojustice.ca/media-centre/caribou-backgrounder-june-2011/at_download/file

[178] Coleen Volk in Mike De Souza, "Elevated Risk' of Caribou Disappearing From Oil Sands Region, Memo tells Peter Kent." *Postmedia News*, July 6, 2012. http://o.canada.com/2012/07/06/elevated-risk-of-caribou-disappearing-from-oilsands-region-memo-tells-peter-kent/

[179] Wasser et. al., 546.

However, the provincial and federal governments have failed to manage the cumulative effects of development within caribou ranges.[180]

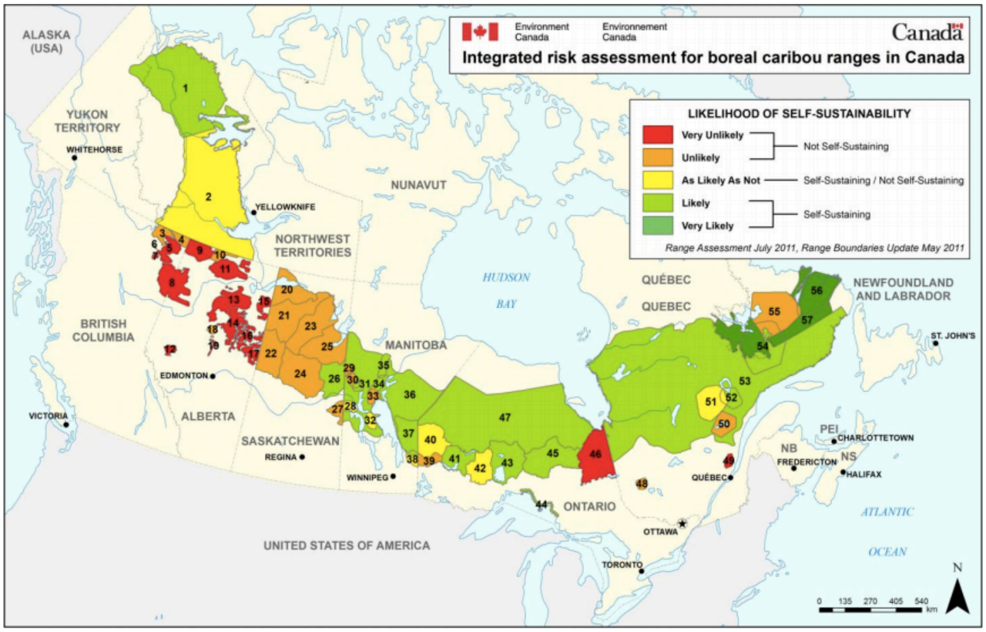

Figure 13. Threatened boreal caribou ranges in Canada

Source: Environment Canada [181]

The Canadian government has a legal responsibility to protect "threatened" species under the *Species at Risk Act* but was five years overdue on releasing a recovery plan for woodland caribou.

The 2012 Federal Recovery Strategy for woodland caribou identifies 65 per cent intact habitat as the target for caribou ranges in Alberta. The average amount of undisturbed habitat in caribou ranges in the oilsands is only 24 per cent (Figure 14). This means that the threshold for a responsible development has been exceeded, and management activities should focus on conservation and land restoration, not further oilsands expansion.

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[180] Evidence submitted in *Allan Adam, Alphonse Lameman and Harry Sharphead v. Minister of the Environment and Attorney General of Canada.* (2011), 4. Available at http://pubs.pembina.org/reports/20110310-justice-envcanada-affidavit-caribou-judreview.pdf

[181] Environment Canada, *Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal population, in Canada*, Species at Risk Act Recovery Strategy Series (2012), 8. http://publications.gc.ca/collections/collection_2012/ec/En3-4-140-2012-eng.pdf

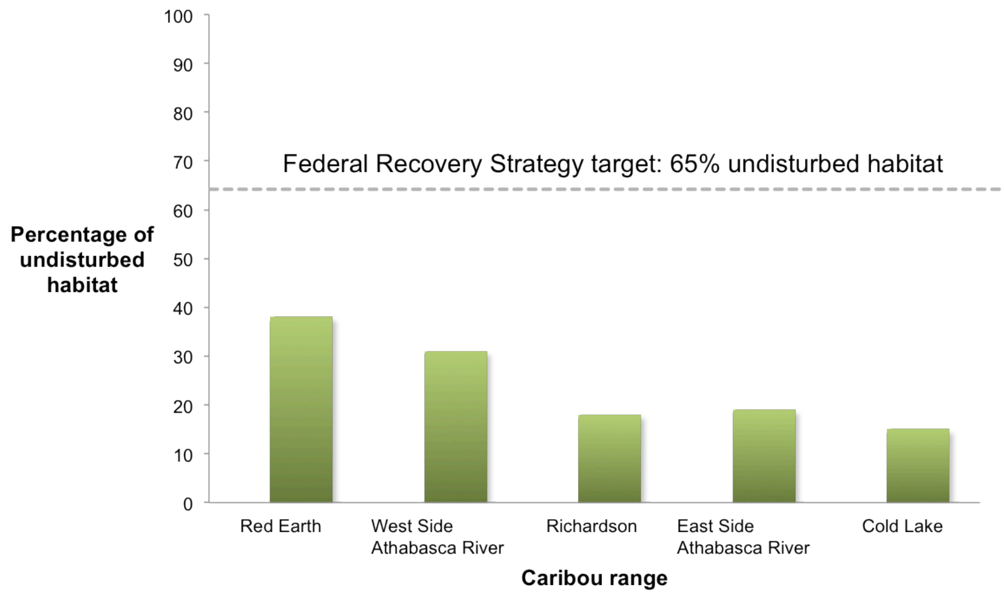

Figure 14. The average amount of undisturbed habitat in caribou ranges in the oilsands is only 24 per cent

Data source: Environment Canada[182]

[182] Pembina graphic using data from Environment Canada, *Recovery Strategy for the Woodland Caribou,* 99-103.

Oilsands development threatens to harm millions of birds through habitat fragmentation and destruction.

While regional bird populations in northeastern Alberta are currently healthy, planned oilsands development is predicted to result in significant declines in bird populations. Industry has spent millions of dollars on bird deterrent systems as a result of the highly publicized threat to waterfowl from tailings ponds, and as Suncor Energy notes,

> *"Oilsands operators do in fact care and share a common goal of protecting wildlife from harm."*[183]

However, both mining and in situ development have adverse impacts on birds, including habitat loss, fragmentation, destruction of valuable wetlands, noise pollution, increase in air and water contamination and general impacts on the boreal forest from climate change.

Background

Beyond the highly publicized threat to waterfowl from tailings ponds, millions of birds are projected to be lost as a result of oilsands development. Millions more will lose their breeding habitat and the subsequent offspring they would produce.[184]

As industry and government are quick to point out, the highly publicized mass bird deaths that have occurred when the waterfowl have mistaken tailings lakes for a natural body of water pale in comparison to the number of birds that are killed from hunters, domestic cats and skyscrapers in Canada every year. Industry has spent millions of dollars on bird deterrent systems but the largest threat to birds in northeastern Alberta is projected cumulative habitat loss.

Every year, between 22 and 170 million birds breed in the area of boreal forest that is targeted for oilsands development.[185] These migratory birds travel from all over North America to reach the rich wetland habitats of northern Alberta. This region is known to support at least 292 species[186], many of which are in decline; 65 of these species are of conservation concern.[187]

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[183] Suncor Energy, "Do Oil Sands Companies Care About Protecting Wildlife?" *Oil Sands Question and Response (OSQAR),* 2010. http://osqar.suncor.com/2010/11/do-oil-sands-companies-care-about-protecting-wildlife.html.

[184] Royal Society of Canada Expert Panel, *Environmental and Health Impacts of Canada's Oil Sands* (2010), 189. http://rsc-src.ca/en/expert-panels/rsc-reports/environmental-and-health-impacts-canadas-oil-sands-industry

[185] Jeff Wells, Susan Casey-Lefkowitz, Gabriela Chavarria and Simon Dyer, *Danger in the Nursery: Impact on Bireds of Tar Sands Oil Development in Canada's Boreal Forest* (Natural Resources Defense Council, 2008), 1. http://www.nrdc.org/wildlife/borealbirds.pdf

[186] Federation of Alberta Naturalists, *Atlas of Breeding Birds of Alberta* (2007). Quoted in *Danger in the Nursery*.

[187] Lists of conservation concern include Alberta's Species at Risk, Committee on the Status of Endangered Wildlife in Canada (COSEWIC), the Canadian Species at Risk Act list and the IUCN-World Conservation Union Red List of Threatened Species. See *Danger in the Nursery*.

While regional bird populations in northeastern Alberta are currently healthy,[188] planned development is predicted to result in significant declines in bird populations. Both mining and in situ development create disturbances for birds, including habitat loss, fragmentation, destruction of valuable wetlands, noise pollution, increase in air and water contamination and general impacts on the boreal forest from climate change.[189] Direct oilsands mining operations may impact the breeding habitat for between 280,000 and 3.6 million birds over a 20- to 40-year period. Including the subsequent generations that would have been born, this represents a loss ranging from 4.8 million to 36 million birds over a 20-year period.[190] In situ development could impact as many as 14.5 million birds.[191]

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[188] Alberta Biodiversity Monitoring Institute, *The Status of Landbirds in Alberta's Boreal Plains Ecozone – Preliminary Assessment* (2012).

[189] *Danger in the Nursery,* 7.

[190] Ibid., 8.

[191] Ibid., 12.

Economics

Taxpayers may foot the bill for cleanup of oilsands mines.

Over 96 per cent of Albertans believe that oilsands mining companies should be responsible for all of the mine cleanup costs.[192] Yet although the public believes that the polluter should pay, current government regulations allow for much of the financial risks associated with cleaning up the oilsands to be borne by taxpayers and not the companies responsible for the mines.

In its 2011 *Guide to the Mine Financial Security Program*, the Government of Alberta states that the program

> *"provides a responsible balance between protecting the people of Alberta … and maximizing the opportunities for responsible and sustainable resource development."*[193]

Yet the environmental liabilities created by oilsands development create significant financial liabilities. With more than 10,000 abandoned or unreclaimed mines of different types across the country, there is a legacy of mine owners leaving Canadian taxpayers to foot costly cleanup bills. These financial liabilities are risks that should be borne squarely by oilsands developers and not Canadians.

Background

The Government of Alberta unveiled a new Mine Financial Security Program in 2011. This program does contain some marked improvements on the previous system, such as improved transparency and accountability of reclamation cost estimates. However, it changes the basis of liability management from a system that holds oilsands developers responsible for 100 per cent of the current cleanup costs to one where undeveloped oilsands deposits can be offered as collateral, instead of actual cash or cash equivalents.[194]

Only toward the end of the mine's life will the total amount of reclamation security actually be collected by the government. This means that over almost all of a mine's lifetime, there is relatively little protection for taxpayers except for the asset — bitumen — that created the liability in the first place. As oilsands production continues to increase, so will the risk exposure of taxpayers. This asset-to-liability approach frees up capital for oilsands developers but ultimately forces the public to underwrite the massive financial liabilities created by oilsands mining.

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[192] Cambridge Strategies Inc. June 2010. Random conjoint survey of 1032 Albertans. "The companies operating in the oil sands should be held liable for all environmental damages caused by their operations." Completely agree: 57%, Agree: 30%, Slightly agree: 9%, Slightly disagree: 2%, Disagree: 1%, Completely disagree: 1%.

[193] Government of Alberta, *Guide to the Mine Financial Security Program,* 2011.

[194] For more information see: Nathan Lemphers, "New oilsands reclamation program more transparent, but still financially risky," *Pembina Institute,* Mar 24, 2011, http://www.pembina.org/blog/513

The costs and benefits of oilsands development are not spread evenly across Canada.

A lively and ongoing debate on the economic impacts of oilsands development made headlines across the country in 2012. In a commentary piece on the subject, the Macdonald-Laurier Institute argues that

> *"there is a 'shower of substantial benefit' on Ontario, B.C. and Quebec from the Alberta oil sands development."*[195]

Yet research and analysis from a number of sources, including the Organization for Economic Cooperation and Development (OECD),[196] Macro Research Board Partners,[197] and Pembina Institute,[198] has found that the development of Alberta's oilsands have altered the economic dynamics across Canada, creating challenges in regions — particularly in manufacturing-driven economies like Ontario and Quebec.

Background

While oilsands development has clearly brought some additional wealth to other provinces, this is only half the story. Alberta is expected to see the vast majority (94 per cent) of GDP impacts from oilsands development.[199] The downside to Alberta's oilsands boom is that the rapid pace of development has altered the economic dynamics across Canada, creating disparities among regions. Booming commodity exports, dominated by oilsands exports to the United States, have combined with a flagging American economy to increase the value of the Canadian dollar, making struggling manufacturing exports even less competitive.

In 2008, the OECD said that oilsands development is "generating large regional disparities" and that Canada's system of equalization payments among provinces may be inadequate to address the growing gaps.[200] These disparities are particularly noticeable in Ontario and Quebec, where the manufacturing sector has gradually declined while the natural resource industry has boomed. Consequently, resource-rich provinces like Alberta have increased their dominance of Canadian exports, outperforming the traditionally strong manufacturing base. This does not mean that the

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[195] Macdonald-Laurier Institute, "Commentary – No Dutch Treat: Oil and Gas Wealth Benefits All Parts of Canada," media release, May 30, 2012. http://www.macdonaldlaurier.ca/commentary-no-dutch-treat-oil-and-gas-wealth-benefits-all-parts-of-canada/

[196] OECD, *OECD Economic Surveys: Canada* (2008), 109. http://www.oecd.org/document/3/0,3746,en_2649_34111_40732867_1_1_1_1,00.html

[197] MRB Partners, *O Canada (Part I) and Uh-Oh Canada (Part II).*

[198] Nathan Lemphers and Dan Woynillowicz, *In the Shadow of the Boom: How oilsands development is reshaping Canada's economy,* (Pembina Institute, 2012).

[199] Pembina calculations based on data from Afshin Honarvar, Jon Rozhon, Dinara Millington, Thorn Walden, Carlos Murillo and Zoey Walden, *Economic Impacts of New Oil Sands Projects in Alberta (2010–2035)*, Study no. 124 (Canadian Energy Research Institute, 2011), Table 1.18, Case Four – Announced and Potential Capacity.

[200] *OECD Economic Surveys: Canada* (2008).

oilsands are entirely responsible for the decline of manufacturing in central Canada;[201] rather, it indicates that clear winners and losers are being established in the Canadian economy. This has led a growing number of economists to diagnose Canada with anywhere from a mild to severe case of the Dutch disease.[202,203,204,205,206]

Home to the majority of the nation's oil reserves, Alberta is situated to prosper when oil prices remain high. Meanwhile, other provinces — those lacking oil and other high-priced commodities, and those that rely heavily on manufacturing, like Ontario and Quebec — will struggle to compete with Alberta for skilled labour and financial capital. This situation is compounded when businesses in other provinces need to compete with other lower-cost suppliers throughout the world. In the past 12 years, Ontario's unemployment rate has increased by 40 per cent.[207]

Oilsands proponents frequently cite the industry's job-creation potential as evidence of its national benefits.[208] Yet the Canadian Energy Research Institute estimates that of all the jobs created from the oilsands in the next 25 years, 86 per cent will remain in Alberta while Ontario and British Columbia will receive only 7.3 per cent and 3.5 per cent respectively.[209] Given this low number of oilsands-related jobs outside of Alberta, in combination with the oilsands industry's ability to negatively impact the much larger manufacturing sector through a higher dollar and increased competition for skilled labour and capital, this new dynamic may further exacerbate regional tensions.

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201 A struggling American and global economy as well as a shift in manufacturing to developing nations has also reducted the competitiveness of Canada's exporting sector.

202 Philippe Bergevin, *Energy Resources: Boon or Curse for the Canadian?* prepared by Parliamentary Information and Research Service, PRB 05-86E (2006). http://www.parl.gc.ca/Content/LOP/researchpublications/prb0586-e.htm

203 Glen Hodgson, *Learning to Live With a Strong Canadian Dollar* (Conference Board of Canada, 2010), 7.

204 MRB Partners, *O Canada (Part I) and Uh-Oh Canada (Part II),* 23.

205 Mohammad Shakeri, Richard S. Gray and Jeremy Leonard, *Dutch Disease or failure to compete? A Diagnosis of Canada's Manufacturing Woes,* IRPP Study No. 30. (Institute for Research on Public Policy, 2012), 4.

206 *In the Shadow of the Boom.*

207 Between January 2000 and January 2012; Statistics Canada, CANSIM Table 282-0087, "Labour force survey estimates (LFS), by sex and age group, seasonally adjusted and unadjusted." http://www5.statcan.gc.ca/cansim/a05?lang=eng&id=2820087

208 Joe Oliver, "Announcement: Completion of an Important Milestone for the Joslyn North Mine Project," speech, Ottawa, Ont. (December 8, 2011) Available at http://www.nrcan.gc.ca/media-room/speeches/130/3360.

209 Calculations based on data from Afshin Honarvar, Dinara Millington, Jon Rozhon, Thorn Walden, and Carlos Murillo, *Economic Impacts of Staged Oil Sands Projects in Alberta (2010–2035)* Study no. 125 (Canadian Energy Research Institute, 2011), Case Four – Announced and Potential Capacity, 31. Includes direct, indirect and induced employment from the oilsands.

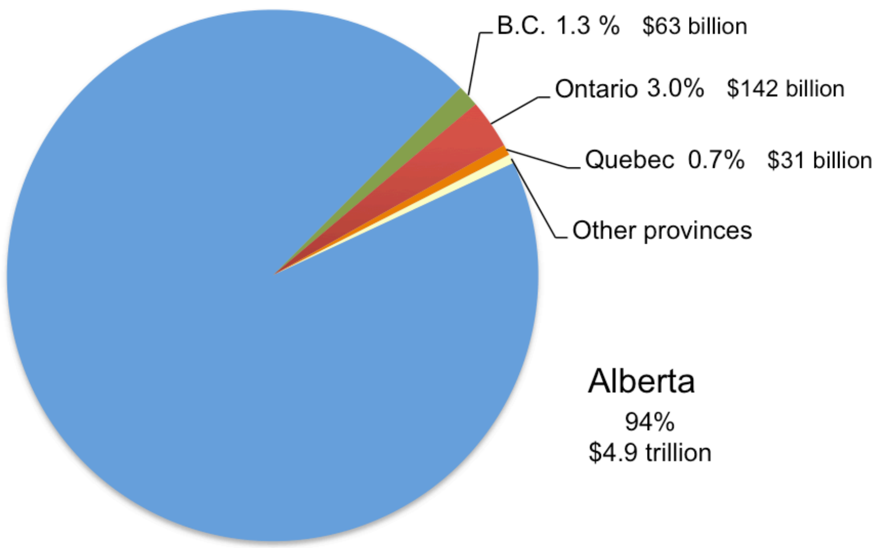

Figure 15. Regional distribution in Canada of GDP impacts from oilsands investment and operation in Alberta, 2010-2035

Source: Pembina Institute[210]

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[210] *In the Shadow of the Boom,* 48. Calculations based on data from Honarvar et al., *Economic Impacts of Staged Development of Oil Sands Projects in Alberta,* Table 1.18, Case Four – Announced and Potential Capacity.

Relying on the volatile profits from oilsands projects to fund government and social programs creates financial risks for both the private and public sector.

Depending on volatile oil revenues to fund social programs creates both immediate and long-term financial risks. Yet that message has yet to sink in among decision makers in Ottawa and Alberta, where relying on revenues from resource development — primarily oil and gas — is a common practice, and one that can lead to economic challenges when revenues fall short of expectations. Joe Oliver, the federal natural resources minister, regularly emphasizes the economic benefits of oilsands production; in a speech at the Calgary Chamber of Commerce in January 2012, he stated:

> *"Today, energy accounts for one quarter of Alberta's GDP, nearly 70 per cent of Alberta's exports and 35 per cent of Alberta Government revenues. I think we can agree that's good news, and I can assure you our government wants Albertans and all Canadians to continue to hear that kind of news."*[211]

In another announcement late the previous year, Oliver stated:

> *"These [oilsands] revenues will pay for social programs such as health care and education and benefit all Canadians."*[212]

This rosy view of the economic benefits of oilsands production ignores the volatile nature of natural resource-based economies, and the potential risks for both the private and public sector of depending too heavily on revenues from resource development.

Background

Decision makers in Ottawa and Alberta continue to rely on revenues from resource development — primarily oil and gas. This practice, however, can lead to economic challenges when revenues fall short of expectations.[213]

A rosy view of the economic benefits of oilsands production ignores the volatile nature of natural resource-based economies, and the potential risks for both the private and public sector of depending too heavily on revenues from resource development. This risk is magnified in Canada where one particular commodity — oilsands — dominates. Over the past 15 years, oil has risen

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[211] Joe Oliver, "Forging New Paths Toward Canada's Energy Future," speech, Calgary Chamber of Commerce, January 25, 2012. http://www.nrcan.gc.ca/media-room/speeches/2012/13/3703

[212] Joe Oliver, "Announcement: Completion of an Important Milestone for the Joslyn North Mine Project," speech, Ottawa, Ont., December 8, 2011. http://www.nrcan.gc.ca/media-room/speeches/130/3360

[213] James Wood, "Uncertainty grows over Redford's balanced budget promise," *Calgary Herald*. Dec. 10, 2012. http://www.edmontonjournal.com/news/alberta/Redford+balanced+budget+appears+broken+campaign/7678338/story.html

from 18 per cent to 46 per cent of total Canadian commodity production — nearly as much as forestry, mining, agriculture and natural gas development combined.[214]

Like all commodity prices, the price of oil fluctuates based on speculation on a variety of global and regional variables. The oilsands do not escape this reality, and as an unconventional energy source that requires significant energy inputs, Alberta's oilsands remain among the most expensive sources of oil to extract and are thus most vulnerable to the volatile price of oil. If the price of oil is too low, projects will no longer be profitable; if the price is too high, it could lead to a demand-destroying recession that could render the oilsands unprofitable and unable to recover.[215]

Oilsands projects have a much higher break-even threshold than conventional oil. A new in situ project requires an oil price around $60 per barrel to make the project economically viable, while a new mine operation with upgrading requires a price around $85 to $95 per barrel.[216] Depending on the future of the global economy, some analysts project that the break-even price of new oilsands projects could breach $100 per barrel.[217] The International Energy Agency's 2012 World Energy Outlook estimated that Canadian oilsands projects with upgrading have capital costs up to 10 times higher than new oil projects in the Middle East, and operating costs up to 15 times greater.[218] These marginal economics means that oilsands projects are vulnerable to anything that could increase the costs of production or decrease the price of oil.

However, the oilsands are also susceptible to a price ceiling if the price of oil were to rise too high. Such a high price could sink the global economy into another global recession, which could effectively destroy demand and lead to a decline in global commodity prices past the point where oilsands operations are profitable.[219] A high price of oil could also stimulate energy efficiency measures, regulatory policy changes and greater innovation and investments in other unconventional fuel sources and alternative energy sources.[220,221] In 2008, Cambridge Energy Research Associates predicted this break-point ceiling is between US $120 and $150.[222]

This means that oilsands producers have a relatively narrow price window in which to operate, a problem which will be compounded if oilsands producers are unable to bypass the glut of oil in the midwestern United States and sell their diluted bitumen to export markets. This narrow

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[214] Mark Carney, "Dutch disease," Speech, Spruce Meadows Round Table, September 7, 2012. http://www.bankofcanada.ca/wp-content/uploads/2012/09/remarks-070912.pdf

[215] Pembina Institute and Ceres, *Full Disclosure: Environmental Liabilities in Canada's Oil Sands*, (2010). http://www.pembina.org/pub/2224

[216] National Energy Board, *Canada's Energy Future: Energy Supply and Demand Projections to 2035*, (2011), 19. http://www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/nrgyrprt/nrgyftr/2011/nrgsppldmndprjctn2035-eng.pdf

[217] Ceres, *Canada's Oil Sands: Shrinking Window of Opportunity*, prepared by Risk Metrics Group (2010). http://www.ceres.org/oilsandsreport

[218] International Energy Agency, *2012 World Energy Outlook*, Table 14.2, 424.

[219] *Canada's Oil Sands: Shrinking Window of Opportunity*, 19.

[220] Ibid.

[221] Cambridge Energy Research Associates, *Break Point Revisited: CERA's $120-$150 Oil Scenario,* CERA Special Report." (2008),19. In *Canada's Oil Sands: Shrinking Window of Opportunity*.

[222] Ibid.

window of oilsands profitability poses significant risks to the private sector, which is quickly re-orienting to capture the current economic growth from rapid oilsands development.

Oil price volatility can also impact public sector coffers as well. It's a familiar story in Alberta, and one that will be increasingly relevant to other provinces that are becoming more and more reliant on oilsands-related revenue: depending on volatile oil revenues to fund social programs creates both immediate and long-term financial risks.

Compared to all other provinces, in the last 10 years Alberta has experienced the greatest volatility in percentage change in GDP. Alberta's GDP growth exceeded all other provinces from 2003 to 2007 but experienced the largest drop in GDP growth during the recent recession when it went from plus 6.5 per cent in 2006 to minus 4.8 per cent in 2009.[223] Between 2008 and 2009, oilsands investments in Alberta dropped by nearly 50 per cent, or $10.1 billion.[224]

According to an analysis by the C.D. Howe Institute, from 1981 to 2007 the volatility of Alberta's government revenues was twice that of B.C., Saskatchewan or Ontario. However, when resource revenue is excluded from revenue calculations, Alberta's income is no more volatile than that of other provinces — a clear indication that Alberta's revenue volatility comes from its oil and gas revenue,[225] which is increasingly dominated by oilsands revenues.

Paul Boothe, an economist and the former deputy minister of Environment Canada, recently published a commentary piece cautioning Canadians about the country's "resource roller coaster," suggesting that "We can stop listening to those who proclaim the promise of the current boom [yet] ignore the volatility that is part and parcel of staking our future primarily on natural resources."[226] Former Alberta finance minister Ron Liepert used the same metaphor, saying "riding this roller coaster of non-renewable resource revenue is not workable going into the future."[227]

But while Alberta's experience on the revenue roller coaster should serve as a cautionary tale, the federal government seems to continue ignoring the extent to which the rise and fall of oil prices will increasingly affect its revenues in the future and the sustainability of the social programs it intends to fund with this volatile revenue source.

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[223] Statistics Canada, CANSIM Table 379-0025.

[224] Alberta Energy, "Facts and Statistics," *About Oil Sands.* http://www.energy.alberta.ca/oilsands/791.asp

[225] Stuart Landon and Constance Smith, *Energy Prices and Alberta Government Revenue Volatility,* Commentary 313 (C.D. Howe Institute, 2010), 20. www.cdhowe.org/pdf/Commentary_313.pdf

[226] Paul Boothe, "The natural resources economy is a roller-coaster ride," *Canada.com*, November 22, 2012. http://o.canada.com/2012/11/22/opinion-the-natural-resource-economy-is-a-roller-coaster-ride/

[227] Richard Blackwell, "Alberta Finance Minister warns on overspending," *Globe and Mail*, February 15, 2012.

Conclusion

We hope that this report helps to inform efforts to move beyond a superficial treatment of the challenges facing oilsands development by identifying the substantive issues that still require policy action and performance improvements. The good news is that there are significant opportunities to enhance environmental management in the oilsands. Those solutions are outlined in our 2011 publication *Solving the Puzzle: Environmental Responsibility in Oilsands Development*.

Since 2005, the Pembina Institute has completed nearly 50 reports that address the impacts and regulation of the oilsands industry. All Pembina Institute publications include detailed solutions to improve management of the oilsands. For more detailed background information on the issues outlined in this summary, please review the following publications:

2012

Clearing the Air on Oilsands Emissions
http://pubs.pembina.org/reports/clearing-the-air-climate-oilsands.pdf

The Case Against the Proposed Shell Jackpine Oilsands Expansion
http://pubs.pembina.org/reports/backgrounder-jackpine-expansion-2012.pdf

Lower Athabasca Regional Plan Performance Backgrounder
http://pubs.pembina.org/reports/larp-performance-bger.pdf

In the Shadow of the Boom: How Oilsands Development is Reshaping Canada's Economy
http://pubs.pembina.org/reports/in-the-shadow-of-the-boom-30052012-report-web.pdf

Oilsands, Heavy Crude and the EU Fuel Quality Directive
http://pubs.pembina.org/reports/heavy-crude-comparison.pdf

2011

Responsible Action: An assessment of Alberta's Greenhouse Gas Policies
http://pubs.pembina.org/reports/responsible-action.pdf

Solving the Puzzle: Environmental Responsibility in Oilsands Development
http://pubs.pembina.org/reports/solving-puzzle-oilsands.pdf

Developing an environmental monitoring system for Alberta
http://pubs.pembina.org/reports/alberta-oilsands-monitoring-submission.pdf

Life cycle assessments of oilsands greenhouse gas emissions
http://pubs.pembina.org/reports/pembina-lca-checklist.pdf

The uncertain prospect of oilsands exports to Asia
http://pubs.pembina.org/reports/pipelinetonowhere-usbriefingnote.pdf

2010

Pipeline to Nowhere? Uncertainty and unanswered questions about the Enbridge Northern Gateway pipeline
http://pubs.pembina.org/reports/pipelinetonowhere-final-withcover.pdf

Duty Calls: Federal responsibility in Canada's oilsands
http://pubs.pembina.org/reports/ed-fedpolicy-report-oct2010-web-redo.pdf

Pond 1 Backgrounder
http://pubs.pembina.org/reports/pond-1-backgrounder.pdf

Canadian Aboriginal Concerns with Oilsands
http://pubs.pembina.org/reports/briefingnoteosfntoursep10.pdf

Toxic Liability: How Albertans Could End Up Paying for Oilsands Mine Reclamation
http://pubs.pembina.org/reports/toxic-liability-report.pdf

Canadian Oilsands and Greenhouse Gas Emissions: The Facts in Perspective
http://pubs.pembina.org/reports/briefingnoteosghg.pdf

Northern Lifeblood: Empowering Northern Leaders to Protect the Mackenzie River Basin from Oilsands Risks
http://pubs.pembina.org/reports/northern-lifeblood-report.pdf

How Do Two Pipelines Stack Up? Reviewing the Review Processes for the Mackenzie Gas Project and the Enbridge Northern Gateway Pipeline
http://pubs.pembina.org/reports/enbridge-mgp-comparison-june29-final.pdf

Mining vs. In Situ: What is the highest environ- mental impact oil?
http://pubs.pembina.org/reports/mining-vs-in-situ.pdf

Drilling Deeper: The In Situ Oilsands Report Card
http://pubs.pembina.org/reports/in-situ-report-card.pdf

Opening the Door to Oilsands Expansion: The Hidden Environmental Impacts of the Enbridge Northern Gateway Pipeline
http://pubs.pembina.org/reports/gateway- upstream-report.pdf

2009

Tailings Plan Review: An Assessment of Oilsands Company Submissions for Compliance with ERCB Directive 074
http://pubs.pembina.org/reports/tailings-plan-review-report.pdf

Climate Leadership, Economic Prosperity: Final Report on an Economic Study of Greenhouse Gas Targets and Policies for Canada
http://pubs.pembina.org/reports/climate-leadership-report-en.pdf

Pipelines and Salmon in Northern British Columbia: Potential Impacts
http://pubs.pembina.org/reports/pipelines-and-salmon-in-northern-bc-report.pdf

Carbon Copy: Preventing Oilsands Fever in Saskatchewan
http://pubs.pembina.org/reports/sask-carbon-copy-report.pdf

Highlights of Provincial Greenhouse Gas Reduction Plans
http://pubs.pembina.org/reports/highlights-of-provincial-greenhouse-gas-reduction-plans.pdf

Upgrader Alley: Oilsands Fever Strikes Edmonton
http://pubs.pembina.org/reports/Upgrader_Alley-report.pdf

Cleaning the Air on Oilsands Myths
http://pubs.pembina.org/reports/clearing-the-air-report.pdf

The Waters That Bind Us: Transboundary Implications of Oilsands Development
http://pubs.pembina.org/reports/watersthat-bindus-report.pdf

The Pembina Institute's Perspective on Carbon Capture and Storage
http://pubs.pembina.org/reports/pembina-perspective-ccs-feb-19-09.pdf

Heating Up in Alberta: Climate Change, Energy Development and Water
http://pubs.pembina.org/reports/heating-up-in-alberta-report.pdf

Carbon Capture and Storage in Canada: CCS and Canada's Climate Strategy
http://pubs.pembina.org/reports/ccs-fact-sheet.pdf

2008

Danger in the Nursery: Impact on Birds on Tar Sands Oil Development in Canada's Boreal Forest
http://pubs.pembina.org/reports/borealbirdsreport.pdf

Taking the Wheel: Correcting the Course of Cumulative Environmental Management in the Athabasca Oilsands
http://pubs.pembina.org/reports/Taking_the_Wheel-report.pdf

Catching Up: Conservation and Biodiversity Offsets in Alberta's Boreal Forest
http://pubs.pembina.org/reports/CatchingUp-Offsets.pdf

Fact or Fiction: Oilsands Reclamation
http://pubs.pembina.org/reports/fact-or-fiction-report-rev-dec08.pdf

Under-Mining the Environment: The Oilsands Report Card
http://pubs.pembina.org/reports/OS-Undermining-Final.pdf

2007

Royalty Reform Solutions: Options for Delivering a Fair Share of Oilsands Revenues to Albertans and Resource Developers
http://pubs.pembina.org/reports/Royalty_Reform_Report_May07.pdf

Haste Makes Waste: The Need for a New Oilsands Tenure Regime
http://pubs.pembina.org/reports/OS_Haste_Final.pdf

Thinking Like an Owner: Overhauling the Royalty and Tax Treatment of Alberta's Oilsands
http://pubs.pembina.org/reports/Owner_FullRpt_Web.pdf

2006

Carbon Neutral by 2020: A Leadership Opportunity in Canada's Oilsands
http://pubs.pembina.org/reports/CarbonNeutral2020_Final.pdf

Death by a Thousand Cuts: The Impacts of In Situ Oilsands Development on Alberta's Boreal Forest
http://pubs.pembina.org/reports/1000-cuts.pdf

Troubled Waters, Troubling Trends
http://pubs.pembina.org/reports/TroubledW_Full.pdf

Down to the Last Drop: The Athabasca River and Oilsands
http://pubs.pembina.org/reports/LastDrop_Mar1606c.pdf

2005

The Climate Implication of Canada's Oilsands Development
http://pubs.pembina.org/reports/oilsands-climate-implications-backgrounder.pdf

Carbon Capture and Storage: an Arrow in the Quiver or a Silver Bullet to Combat Climate Change – A Canadian Primer
http://pubs.pembina.org/reports/CCS_Primer_Final_Nov15_05.pdf

Oilsands Fever: The Environmental Implications of Canada's Oilsands Rush
http://pubs.pembina.org/reports/OilSands72.pdf