Good morning Chair and Committee

My name is Simon Dyer. I am the Policy Director with the Pembina Institute, based in Alberta, Canada.

The Pembina Institute is a Canadian non-profit think tank that advances sustainable energy solutions through research, education, consulting and advocacy. We have a long history as a leading independent expert on oilsands environmental performance and policy. We have participated in oilsands regulatory processes in Alberta for 20 years and conducted extensive research on policy solutions to current environmental problems in the oilsands.

The biggest impediment to progress on reducing the environmental impact of oilsands development through the deployment of new technologies is the lack of regulatory policy to drive improved performance. Major environmental accomplishments such as dealing with acid rain and the hole in the ozone layer and removing lead from gasoline were all driven by regulatory approaches that resulted in increased performance and technological innovation from industry. In the oilsands, however, little attention has been focused on the appropriate role of government in regulating environmental performance — and thus many environmental impacts continue to worsen.

My comments today, due to the short time, will be focused on greenhouse gas pollution, though the same principles apply to the other unresolved environmental impacts of oilsands development such as tailings waste management, fresh water use, air pollution and land and wildlife impacts.

Oilsands are the fastest growing source of greenhouse gas pollution in Canada

Over the last two decades, oilsands greenhouse gas emissions have more than doubled.[1] In 2009, oilsands operations in Canada emitted 45 million tonnes of

[1] Oilsands emissions have grown from 17 Mt in 1990 to 45 Mt in 2009. Source: Environment Canada, *National Inventory Report - Part 1 1990-2008 Greenhouse Gas Sources and Sinks in Canada* (2010) 86, Table 2-16. http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=492D914C-2EAB-47AB-A045-C62B2CDACC29 Note: the value for 2009 oilsands total emissions was provided in e-mail communication from Environment Canada officials.

greenhouse gases (GHGs). According to recent projections from the Government of Canada, in a business-as-usual oilsands scenario this emissions growth will continue, with the total annual emissions from the oilsands doubling from 2009 to 2020.

What is less well known is that oilsands greenhouse emissions intensity — that is, how much CO_2 is emitted per barrel produced — has actually worsened over the past 6 years. This has undone some of the improvements in emissions intensity that other presenters have mentioned. Improvements since 1990 were largely driven by one-time changes like switching fuels from coke to natural gas, and by incorporating cogeneration into projects. The insinuation that these kinds of improvements will continue is not supported by recent evidence.

The worsening emissions profile for the oilsands can be attributed to three main issues that cannot be disputed:

First, an increasing proportion of oilsands production comes from insitu oilsands development instead of mining. Insitu development produces 2-and-a-half times more GHG emissions per barrel than oilsands mining does.

Second, as oilsands development increases, companies are exploring lower-quality and harder-to-access bitumen resources; developing these resources means increased environmental impacts.

Third, the very weak regulatory environment for greenhouse gas management in Alberta and Canada does not require substantial improvements in greenhouse gas emissions.

As you may know, the Government of Canada has repeatedly failed to meet its own targets to reduce greenhouse gas pollution, and the oilsands are a major reason behind this. While most industries in Canada are holding steady, oilsands emissions continue to rise. A 2010 MIT study quantified this effect with economic models, concluding that "the niche for the oil sands industry seems fairly narrow and mostly involves hoping that climate policies will fail." In Canada, hitting climate targets while the oilsands expand dramatically would mean asking other sectors to do more than their share — a prospect so unappealing that every Canadian environment minister to date has opted to miss our targets instead.

Much attention has been paid to the potential role that carbon capture and storage (CCS) could play in limiting GHG emissions from Canada's oilsands. This is partly because Alberta's climate change plan assumes that CCS alone will provide approximately 70%[2] of planned reductions from business-as-usual by 2050.

However, there are no operating CCS projects in the oilsands to date. One planned integrated project, Shell's Quest project, proposes to capture 1.2 million tonnes of emissions from the Scotford Upgrader.[3] This project will receive 865 million dollars in subsidies from the Canadian federal and Alberta governments. While in principle CCS could be applied at several different stages in the oilsands, it is not economic under current policies.

Projected carbon capture costs for oilsands projects range from 75 to 230 dollars per tonne.[4]In Alberta, the effective carbon price is set at only $15 per tonne of CO_2.[5] At this price level, and in the absence of further massive public subsidies, there will be no deployment of CCS in the oilsands beyond Shell's Quest project. Unfortunately, Alberta's climate plan states that 30 MT of annual reductions will be derived by CCS by 2020 — the equivalent of building 25 Quest-type projects in the next 8 years. Clearly, this is a fiction.

For carbon capture to be economic, governments would have to either implement carbon prices an order of magnitude higher than they have contemplated to date, or mandate carbon capture for the oilsands industry.

Last December, Pembina Institute completed the first and only comprehensive assessment of Alberta's climate change plan. By assembling government and

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[2] CCS accounts for 139 of a planned 200 MT of reductions by 2050.

[3] Shell Canada, "Oilsands: Shell's Quest." Accessed March 1, 2011. http://www.shell.ca/home/content/can-en/aboutshell/our_business/business_in_canada/upstream/oil_sands/quest/

[4] Ibid.

[5] $15/tonne is the charge that large emitters can pay into the province's Climate Change and Emissions Management Fund in order to comply with Alberta's Specified Gas Emitter Regulation, which mandates a 12% emission intensity reduction for heavy industry in the province. Government of Alberta, *Technical Guidance for Completing Specified Gas Compliance Reports,* (2010) 4,8. http://environment.alberta.ca/documents/Tech-Guidance-Doc-for-2009-Specified-Gas-Compliance-Reports.pdf.

industry data we concluded that Alberta will miss its emissions reduction target by 2020 by two-thirds. The primary reason for this failure is that Alberta does not place a high enough price on pollution to incentivize the kinds of reductions it has committed to in its plan.

We characterized Alberta's climate plan as a car without an engine. It has many elements that could be effective, but without a meaningful price that penalizes CO_2 pollution, the car won't run and it won't get Alberta to its stated destination.

In its 2010 World Energy Outlook, the International Energy Agency modelled a "450 Scenario" to project energy supply and demand that would be consistent with stabilizing atmospheric GHG concentrations at 450 parts per million of carbon dioxide. This scenario projects that oilsands production would continue to grow, although much more slowly than in the current unregulated environment, with production reaching just over 3 million barrels per day of production in 2035.[6] In other words, under this scenario Canada could have an oilsands industry and a carbon price while still meeting international climate targets.

The current frenzied rate of oilsands development is a symptom of Canada's failure to implement policies and regulations to meet its commitments to reduce greenhouse gas pollution. Rosy projections by industry for oilsands expansion are simply mathematically inconsistent with these commitments.

Finally, I would like to comment on the fact that while Pembina Institute is supportive of voluntary measures and research and development by the oilsands industry, it is important to distinguish among lab research, small-scale pilot projects and commercial penetration of new technologies. The commercial application of new technologies is simply not keeping pace with expansion, and as a result the vast majority of new production will rely upon conventional, more polluting technology. This represents a significant opportunity lost, and one that can only be addressed through policy and regulatory intervention.

In closing, I'd like to thank you for this opportunity to speak to you and look forward to your questions.

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[6] International Energy Agency, *World Energy Outlook 2010*, (2010), p.450

Written Testimony of

Simon Dyer

Policy Director

Pembina Institute

before the

U.S. House of Representatives

Committee on Energy and Commerce

Subcommittee on Energy and Power

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the PEMBINA institute

Sustainable Energy Solutions

Executive Summary

- As Canada's oilsands continue to expand production, the environmental impacts from oilsands development will also increase.
- The biggest impediment to progress on reducing the environmental impact of oilsands development through the deployment of new technologies is the lack of regulatory policy to drive improved performance.
- This testimony will focus on greenhouse gas emissions and the role of technology and public policy in the oilsands, though the same principles apply to the need to address other unresolved environmental impacts of oilsands development such as tailings management, water use, air emissions and land and wildlife impacts.
- The oilsands are a major and growing source of greenhouse gas emissions. Over the past six years, emissions have been rising on a per-barrel basis.
- Neither the Government of Canada nor the Government of Alberta has climate policies in place that will counter the fast growth of greenhouse gas emissions from oilsands.
- Alberta's climate targets are weak. Alberta's long-term climate target lags significantly behind the effort being made by many other industrialized nations — including the U.S.
- Alberta's climate plan is likely to achieve less than one-third of the reductions it calls for by 2020. This is due to weaknesses in the policies and accounting for emissions reductions.
- The projected increase in Canada's greenhouse gas emissions between 2005 and 2020 will come almost solely from the oilsands, but Canada's and Alberta's efforts to constrain these emissions is out of step with Canada's climate commitments.
- Carbon capture and storage and other experimental emission-reducing technologies are unlikely to significantly reduce emissions in the oilsands in the next 20 years.
- The rapid pace and scale of oilsands development also serves to undermine any incremental improvements from new environmental technologies.
- A stronger regulatory environment will not only moderate growth but also accelerate technological innovation by providing clear signals to oilsands companies to invest in new research and development. Without a meaningful and effective price on carbon, the cost of capturing emissions from many sources is likely to be prohibitive.

About the Pembina Institute

The Pembina Institute is a Canadian non-profit think tank that advances sustainable energy solutions through research, education, consulting and advocacy. We promote environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance.

The Pembina Institute has a long history as a leading independent expert on oilsands environmental performance and policy. We have participated in oilsands regulatory processes in Alberta for 20 years and have conducted extensive research on policy solutions to current environmental problems in the oilsands.

Role of regulation in environmental innovation in the Canadian oilsands

The biggest impediment to progress on reducing the environmental impact of oilsands development through the deployment of new technologies is the lack of regulatory policy to drive improved performance. Major environmental accomplishments, such as dealing with acid rain and the hole in the ozone layer and removing lead from gasoline, were all driven by regulatory approaches that resulted in increased performance and technological innovation from industry. In the oilsands, however, little attention has been focused on the appropriate role of government in regulating environmental performance — and thus many environmental impacts continue to worsen.

My comments today, due to the short time, will be focused on greenhouse gas pollution, though the same principles apply to the other unresolved environmental impacts of oilsands

development such as tailings waste management, fresh water use, air pollution and land and wildlife impacts.

Oilsands are a major and growing source of greenhouse gas emissions

Oilsands are the fastest growing source of greenhouse gas pollution in Canada.

Over the last two decades, oilsands greenhouse gas emissions have more than doubled.[1] In 2009, oilsands operations in Canada emitted 45 million metric tonnes (Mt) of greenhouse gases (GHGs), an increase of 22 million tonnes over 2000 levels. According to recent projections from the Government of Canada, in a business-as-usual oilsands scenario this emissions growth will continue, with the total annual emissions from the oilsands doubling from 2009 to 2020.[2]

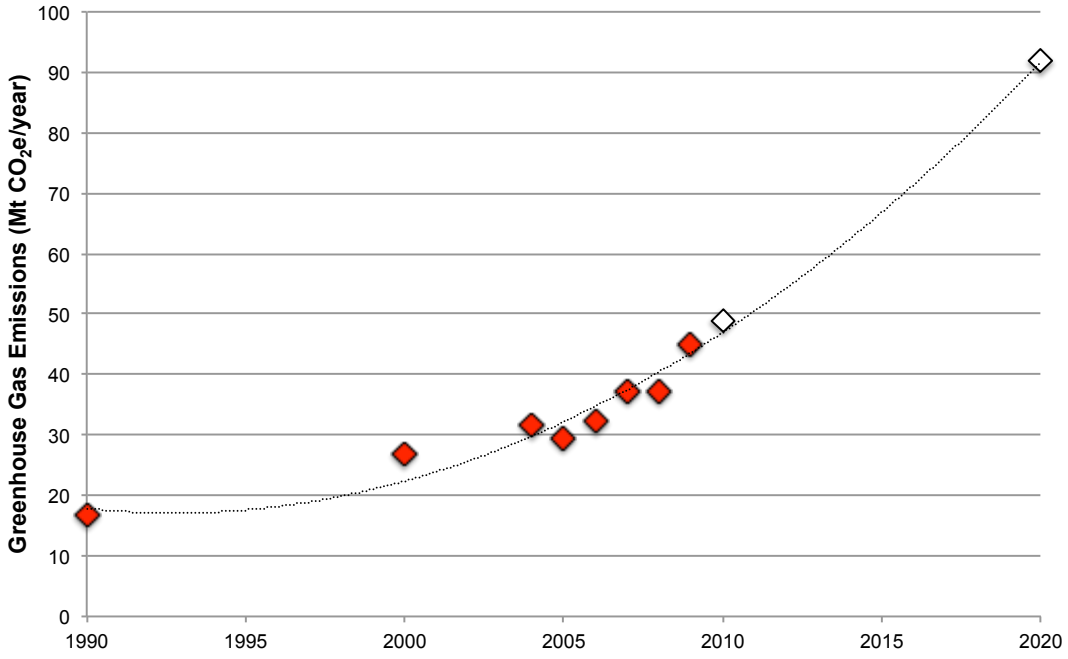

Figure 1. Annual total oilsands greenhouse gas emissions

Source: Data from 1990 to 2009[3] are actual measured values, while 2010 to 2020[4] represent Environment Canada's forecast values.

The rapid growth rate of oilsands GHG pollution is even more evident when compared with the projected emissions from other economic sub-sectors in Canada. As shown in Figure 2, GHG emissions are growing faster in the oilsands than any other sub-sector in Canada.

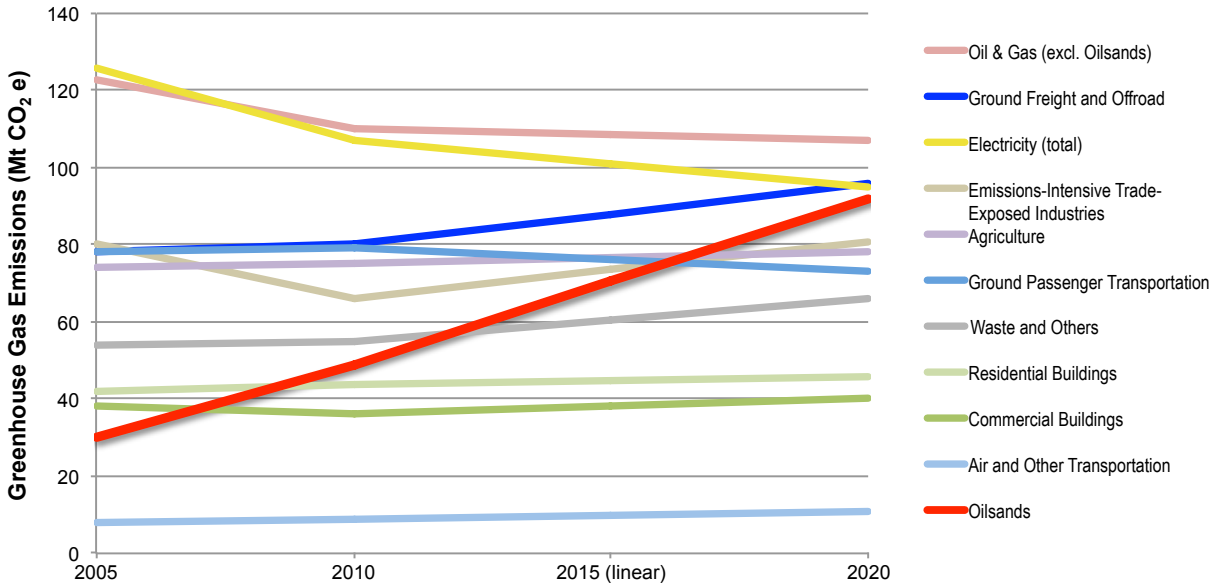

Figure 2. Projected annual greenhouse gas emissions by economic sub-sector

Figure produced from Environment Canada data[5]

Extracting and upgrading synthetic crude from the oilsands is a very emissions-intensive means of producing transportation fuel

In comparison to conventional sources of crude, producing transportation fuels from the oilsands is a very energy-intensive process. The vast quantities of natural gas burned to power the oilsands industry result in unusually high GHG pollution. Numerous studies have compared the GHG intensity of oilsands with a variety of conventional crudes and other heavy or non-conventional fuel sources, and have shown oilsands at or near the top of the list of the most emissions-intensive commercial sources to date. Industry-wide average GHG emissions for oilsands extraction and upgrading are estimated to be 3.2 to 4.5 times greater per barrel than for conventional crude oil produced in Canada or the United States.[6]

The Royal Society of Canada Expert Panel on the Environmental and Health Impacts of Canada's Oil Sands Industry noted, "In summary, comparisons of GHG emissions from oil sands

with other petroleum sources is very dependent on the petroleum source that is used for comparison and the specific details concerning the processing of bitumen. Nonetheless, life-cycle GHG emissions from oil sands are in the upper part or at the top of range of all petroleum sources. In situ bitumen recovery is the highest for GHG emissions and its proportion of bitumen production is increasing."[7]

Oilsands intensity improvements will not compensate for absolute oilsands growth

Environment Canada's most recent figures show that, from 1990 to 2009, oilsands GHG intensity (emissions per barrel produced) declined by 29%.[8,9] Industry advocates often use this statistic to imply that substantial intensity improvements will continue in the future. However, this is not likely to be the case.

While past technology and process improvements resulted in increased efficiency, a significant component of the intensity reductions from the past two decades were made possible by fuel switching from coke to natural gas[10] and by increased use of cogeneration of heat and electricity.[11] These one-time advances have been widely adopted across the industry and so are not likely to result in further significant GHG intensity reductions in the future.[12]

While new technologies are being researched that could potentially lead to future GHG intensity reductions, the long lag time between research, piloting and commercial deployment means that any benefits from the technologies are likely 15 to 20 years away.[13] In fact, as illustrated in Figure 3, the historical decline in GHG intensity now appears to have ended, with intensity levelling off and increasing somewhat over the past four years.

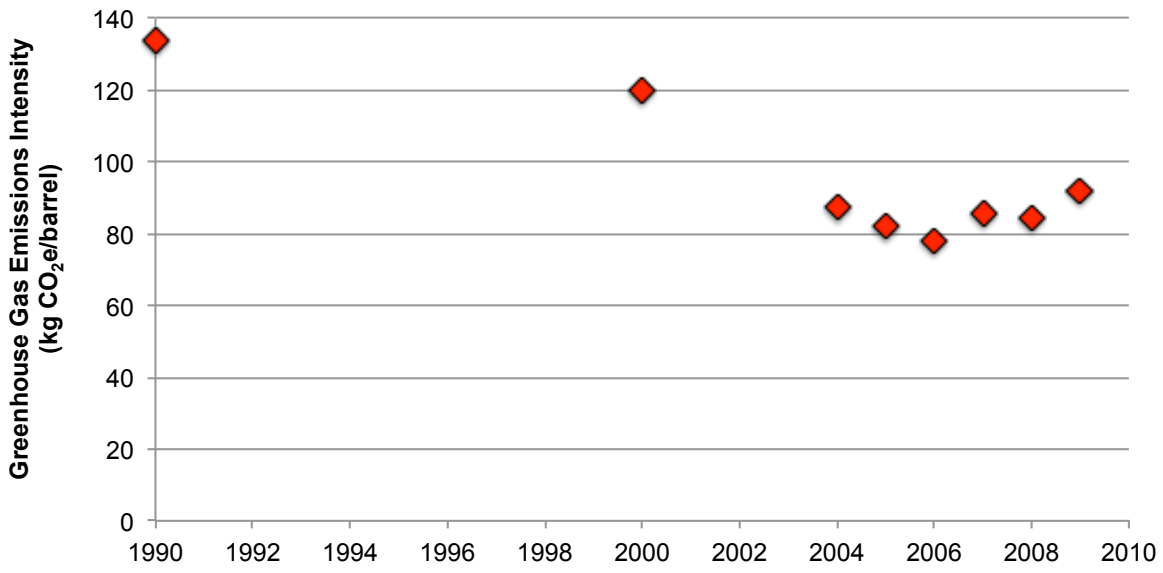

Figure 3. Industry-wide greenhouse gas emissions intensity trends for oilsands

Source: Emissions data from Environment Canada[14] and production data from Statistics Canada[15]

In addition, new intensity reductions brought by future technologies may be diminished or cancelled out by other changes to the industry. For example, current projects tend to start where the best bitumen reservoirs are located, but future oilsands operations are likely to be located at reservoirs that are less easily accessible, therefore requiring more energy and producing relatively higher GHG emissions.[16] Furthermore, in situ oilsands extraction — a significantly more GHG-intensive means of production (on average 2.5 times more intensive than mining)[17] — is expected to become a major portion of overall oilsands production over the next decade.[18] Such a shift would increase the industry-wide GHG intensity.

Another reason why continued GHG emission intensity reductions are unlikely is because the current weak regulatory environment for greenhouse gas management does not require substantial improvements in greenhouse gas emissions, as described below.

It is important to note that both the absolute and intensity-based GHG emissions do not account for land use change — a factor that is likely to be significant. A study published in the Proceedings of the National Academy of Sciences last week found that loss of peatland in the oilsands region is significant source of carbon pollution. The post-mining landscape in the oilsands region will support 65% (29,500 ha) less peatlands. From approved oilsands mines

alone, up to 47 Mt CO_2eq will be released from the carbon stored in the peatlands; the ecosystem will reduce its ability to absorb carbon by up to 7,000 tonnes per year.[19] Life cycle studies of oilsands emissions intensity do not incorporate this important information.

Federal climate policies will fail to meet the country's 17% emissions reduction target unless the government increases its effort tenfold

Current federal and provincial policies put Canada's GHG emissions on a trajectory to be 7% above the 2005 level by 2020, not 17% below it as the government has promised

Environment Canada's latest projections show that in the absence of any government policies to curtail emissions, and with mid-range assumptions about economic growth and the price of oil, Canada's annual GHG emissions would reach 850 Mt in 2020, compared to 731 Mt in 2005. When taking into account all currently announced federal and provincial climate policies, just one-quarter of the gap between our projected 2020 emissions and our 2020 target (17% below the 2005 level) will be closed, meaning that Canada's 2020 emissions would be 785 Mt.[20]

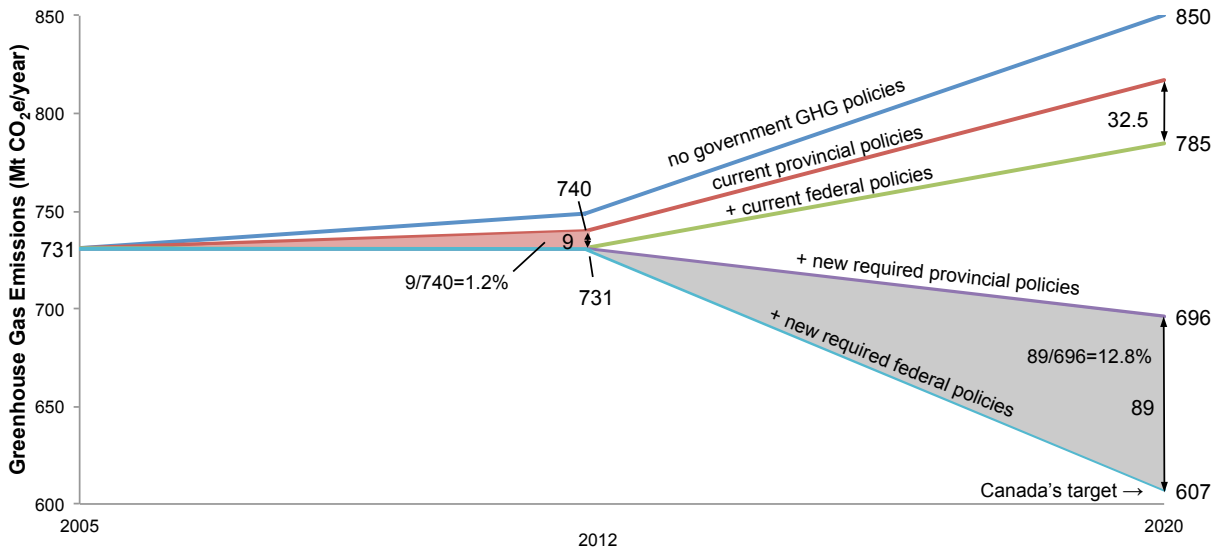

Figure 4. Canada's greenhouse gas emissions 2005-2020

Source: Pembina Institute presentation of data from Environment Canada[21]

The left-hand red shaded area in Figure 4, which depicts numbers published by Environment Canada, shows that during the Harper government's first seven years in office (2006–2012 inclusive), its efforts will have reduced Canada's annual emissions by 9 Mt or 1.2%, equivalent to 0.17% per year. The grey shaded area in the figure shows that during the subsequent eight years (2013–2020 inclusive), federal policies would have to reduce annual emissions by 89 Mt, or 12.8%, in order to meet Canada's 2020 target. Meeting this target is equivalent to 1.7% reductions each year. This indicates that a tenfold increase is required in the current federal policy implementation effort from now on.[22]

Overall, Canada's annual GHG emissions are projected to increase by 54 Mt between 2005 and 2020, under currently announced federal and provincial policies.[23] Emissions from the oilsands (including emissions from upgrading) are projected to grow by 62 Mt over the same period.[24] Because the ups and downs in emissions in other sectors largely cancel each other out, essentially the entire projected increase in Canada's emissions between 2005 and 2020 will come from the oilsands.

New climate policies fail to raise the bar

The federal government is implementing new policies intended to slow the future growth in Canada's GHG emissions. The most significant of these include regulated emission standards for cars and trucks based on the U.S. regulations, stronger efficiency standards for energy-using equipment, and public investment in four industrial-scale CCS projects (two in the oilsands). The government is also proposing to regulate GHG emissions from coal-fired electricity generation, starting in 2015.

However, the effectiveness of these initiatives is questionable. Loopholes in the car regulations, and the fact that Canada's fleet is historically more efficient than the U.S. fleet, may allow automakers to simply continue with business as usual in Canada until as late as the 2016 model year.[25] Some of the CCS projects may not proceed, if their proponents decide they are not economically viable. The proposed regulations for coal-fired electricity will allow existing plants to operate for their full economic life (45 years) and will allow those new plants that plan to use CCS to avoid capturing the majority of their emissions until 2025. Under these regulations, about two-thirds of currently operating plants will not be required to meet the standard until after 2020, and nine will operate past 2030 without constraint.[26]

Canadian targets could be met with no negative impact to job creation

While a far more significant federal commitment to manage oilsands GHG emissions would be required for Canada to meet its emissions target in 2020, a recent study[27] by M.K. Jaccard and Associates, a leading economic modelling firm, concluded that Canada could sharply reduce its emissions between 2010 and 2020 with only a slight slowing of economic growth, and with no negative impact on job creation. The study also showed that Canada could surpass the federal government's GHG target for 2020 while still expanding the oilsands industry and allowing Alberta to continue having the fastest growing economy in the country.[28] This would, however, require massive and urgent deployment of CCS in the oilsands.

Canada is a climate follower, not a climate leader

Since the election of Barack Obama, the Government of Canada has consistently emphasized a commitment to harmonize its climate change action with that of the U.S.[29] Doubts over the Harper government's sincerity about this harmonization are fuelled however by Canada's failure to match its southern neighbour on key climate policies. In the 2010–2011 fiscal year, the Obama administration proposed 18 times more new spending on renewable energy, per capita, than the Government of Canada did.[30] The Obama administration also began regulating GHG emissions from some industrial facilities in January 2011, under the Clean Air Act, but Canada's federal government is still at the stage of talking about such regulations,[31] not implementing them. Even the proposed coal regulations that the Government of Canada published in August 2011 are not yet finalized and would not take effect until 2015. In the meantime, this leaves the oilsands sector without any federal GHG regulations or limits.

Alberta's climate regulations are weak and will not counteract the growing GHG emissions from the oilsands sector

Alberta's climate plan can be called a car without an engine. It has many elements that could be effective, but without a meaningful price that penalizes CO_2 pollution, the car won't run and it won't get Alberta to its stated destination.

While the Alberta government makes bold claims[32] about its actions to curb GHG emissions, both its mid-term and long-term targets are weak relative to other jurisdictions and its actual performance has lagged. Over the mid-term, scientific consensus is that the world needs to reduce greenhouse gases by 25 to 40% below 1990 levels by 2020 to avoid dangerous climate change.[33] Many jurisdictions such as Ontario, U.K and Japan have made reduction commitments within this range. Alberta's 2008 climate plan, by contrast, assumes an approximate 40% growth in emissions between 1990 and 2020,[34] making it one of the few industrialized jurisdictions to commit to emissions increases rather than decreases. The 2008 plan also included a target to

reduce annual GHG emissions by 20 Mt below the business-as-usual level by 2010 — a target the province failed to even come close to meeting.

Over the long term, many industrialized (Annex 1 Parties) jurisdictions have committed to 70–80% reductions in GHG emissions by 2050. For example, the U.S. is targeting an 83% reduction below 2005 levels by 2050.[35] Alberta's long-term climate target is a mere 14% reduction below 2005 levels by 2050[36] thereby lagging significantly behind the ambitions of most other jurisdictions. While the Alberta plan commits to a number of specific policy actions, it makes no attempt to show that the policies will be strong enough to achieve the objectives.

In December 2011, Pembina completed the first and only comprehensive assessment[37] of Alberta's climate change plan. By assembling government and industry data we concluded that Alberta will miss its emissions reduction target by 2020 by two-thirds. The primary reason for this failure is that Alberta does not place a high enough price on pollution to incentivize the kinds of reductions it has committed to in its plan. The Alberta government's current GHG initiatives could result in at most about a 14 Mt reduction by 2020 compared to business-as-usual annual emissions; the reduction could possibly be less than 10 Mt by 2020.[38] This will fall far short of halting the growth in Alberta's GHG emissions, let alone achieving absolute reductions. An analysis of the key components of Alberta's climate change plan is provided below.

Specified Gas Emitters Regulation (SGER)

This Alberta regulation requires all facilities emitting more than 100,000 tonnes of CO_2 equivalent per year to reduce average emissions intensities by 12% (for new facilities the requirement is phased in over several years).[39] These are, however, reductions on paper only, since facilities can comply by making payments of $15[*] per tonne CO_2e into the Climate Change and Emissions Management Fund and by purchasing offset credits from projects in Alberta — credits that in many cases do not represent incremental emission reductions.

[*] All dollar amounts in this paper are in Canadian dollars.

While it is true that Alberta does have a price on carbon, this price is only applicable to 12% of the emissions from new large facilities, such as those being built in the oilsands. Furthermore, the $15/tonne compliance option essentially caps the price on carbon in the province at a rate far lower than the cost of achieving on-site reductions through CCS and other technologies, thereby failing to provide an incentive to implement those technologies.

Alberta's offset program

Alberta's carbon offset program provides carbon credits to reductions made by projects that would already have taken place without any policy action. A Pembina Institute analysis of Alberta's offset registry revealed that more than 82% of credits used for compliance with the SGER during 2008 to 2010 came from projects that started before the policy was announced in 2007.[40] It is clear that the reductions associated with these projects cannot be attributed to the SGER and should not be awarded offset credits. Furthermore, offsets are largely reductions on paper only, diluting any real on-site GHG reductions achieved through the SGER.

Climate Change and Emissions Management Fund (CCEMF)

As noted above, large emitters can make $15/tonne payments into Alberta's CCEMF to meet the Specified Gas Emitters Regulation intensity targets rather than making on-site emission reductions. The funds are reinvested in a wide range of emission reduction projects. In the period 2007 to 2010, $256 million was paid into the CCEMF;[41] to date $126 million has been committed to approved projects.[42] It is too early to know by how much these projects will reduce emissions. However, it is clear that the emission reductions in the near term (e.g., by 2020) will be much smaller than the "reductions" for which Alberta's large emitters are given credit by making payments into the CCEMF.

CCS subsidies

Alberta has committed $2 billion to support large-scale CCS projects in the province, including two in the oilsands.[43] However, a recent proposal by the government to provide double offset credits for certain CCS projects may completely undermine any emission reductions made

under this program.[44] Even providing one credit for every tonne reduced would diminish the net emission reductions from CCS because each credit created allows the company receiving or purchasing that credit to emit an extra tonne (or avoid payments into the CCEMF). But when two credits are provided for every one tonne of reduction, the total allowed GHG emissions resulting from the CCS subsidies and offset system are higher still.

Carbon capture and storage will not be deployed to reduce oilsands emissions in the absence of regulation

Much attention has been paid to the potential role that carbon capture and storage (CCS) could play in limiting GHG emissions from Canada's oilsands. This is partly because Alberta's climate change plan assumes that CCS alone will provide 139 Mt of a planned 200 Mt reduction (approximately 70%) from business as usual by 2050.[45] Yet often the attention understates both the slow and limited deployment of CCS and the significant challenges in applying this technology to the oilsands sector.

To date there are no operating CCS projects in the oilsands. One planned integrated project, Shell's Quest project, will capture 35% of the emissions from the Scotford Upgrader.[46] This project will receive $865 million in subsidies from the federal and provincial governments.[47] A second planned project, the Alberta Carbon Trunk Line, proposes to transport CO_2 from an oilsands upgrader and other industrial facilities in central Alberta to oil fields for enhanced oil recovery.[48] At $558 million, federal and provincial subsidies will cover 47% of this project's costs.[49]

While in principle CCS could be applied at several different stages in the bitumen extraction and upgrading phases, the cost of capturing emissions from many of the sources is likely to be prohibitive unless governments are willing to implement carbon prices an order of magnitude higher than they have contemplated to date. In general, CO_2 emissions associated with hydrogen production at oilsands upgraders have relatively lower capture costs, estimated at

$75 to $155/tonne.[50] These costs are within the range of other relatively low-cost capture sources like coal-fired electricity production and oil refining. However, CO_2 streams from in situ oilsands have among the highest capture costs, estimated at $175 to $230/tonne.[51]

In Alberta, the effective carbon price is set at $15/tonne of CO_2 At this price level, and in the absence of further massive public subsidies, there is very little (if any) financial incentive for oilsands producers to pursue CCS projects.

IHS CERA noted that capturing CO_2 at upgraders presents the best opportunity for CCS implementation in the oilsands and could lead to a net decrease in emissions intensities of 11 to 14% for bitumen production and upgrading (well-to-tank).[52] According to the forecast scenario described in the report, CCS implementation in the oilsands will begin around 2020 and, as it expands, will lead to industry-wide GHG reductions of approximately 6 Mt from business as usual by 2035.[53] While CCS reductions may occur within other industries, at this rate Alberta will be required to substantially increase their implementation of CCS to achieve the target of 139 Mt of carbon capture and storage by 2050.

Unfortunately, Alberta's climate plan states that 30 MT of annual reductions will be derived by CCS by 2020 — the equivalent of building 25 Quest-type projects in the next eight years. Clearly, this is a fiction.

In its 2010 World Energy Outlook the International Energy Agency modelled a "450 Scenario" to project energy supply and demand that would be consistent with stabilizing atmospheric GHG concentrations at 450 parts per million of carbon dioxide. This scenario projects that oilsands production would continue to grow although much more slowly than current growth projections, with production reaching just over 3 million barrels per day (mbpd) of production in 2035.[54] In other words, under this scenario Canada can have an oilsands industry, a carbon price and meet international climate targets.

Pembina has also conducted economic modelling that examines the fate of the oilsands in a regulatory environment where Canada meets its international commitments or science-based targets to reduce greenhouse gas pollution.[55] Both scenarios required mandatory CCS and resulted in a slowing of oilsands expansion.

The current unchecked rate of oilsands development is a symptom of Canada's failure to regulate greenhouse gas pollution, and it appears that rosy industry projections for oilsands expansion are mathematically inconsistent with North America's stated commitments to reduce greenhouse gas pollution.

Limited policy signals to drive innovation

Currently there are few strong policy signals to improve environmental management in the oilsands. As described above, the existing climate regulations are inadequate to spur the innovation necessary to reduce either emissions intensity or absolute greenhouse gas emissions.

In the absence of adequate environment policies, several leading oilsands companies have created their own initiatives. The recently-announced Canadian Oil Sands Innovation Alliance, a new and larger version of the older Oil Sands Leadership Initiative, is a partnership of 12 oilsands companies that intend to share experience and intellectual property amongst themselves. While these sorts of initiatives are a step forward, they are unlikely to result in meaningful improvements in environmental performance unless there are policy or price signals to compel companies to innovate.

As well, if clear policy signals were given to other aspects of the oilsands industry such as water and species at risk management, land impacts and reclamation, these signals would likely catalyze the necessary innovation to mitigate impacts and temper international scrutiny of the oilsands.

Pace and scale issues not solved by technology

The Canadian Association of Petroleum Producers predicts that oilsands production will double from 1.5 mpbd in 2010 to 3.0 mbpd by 2020, to over 3.73 mbpd by 2025 (Figure 5). If the oilsands production is forecasted by development stage, already over 4 mpbd in production capacity has received all the necessary regulatory approvals. If one also considers the projects

that are in application or have been disclosed or announced, then the potential nameplate capacity for the oilsands rises to over 8.1 mbpd (Figure 6).[56]

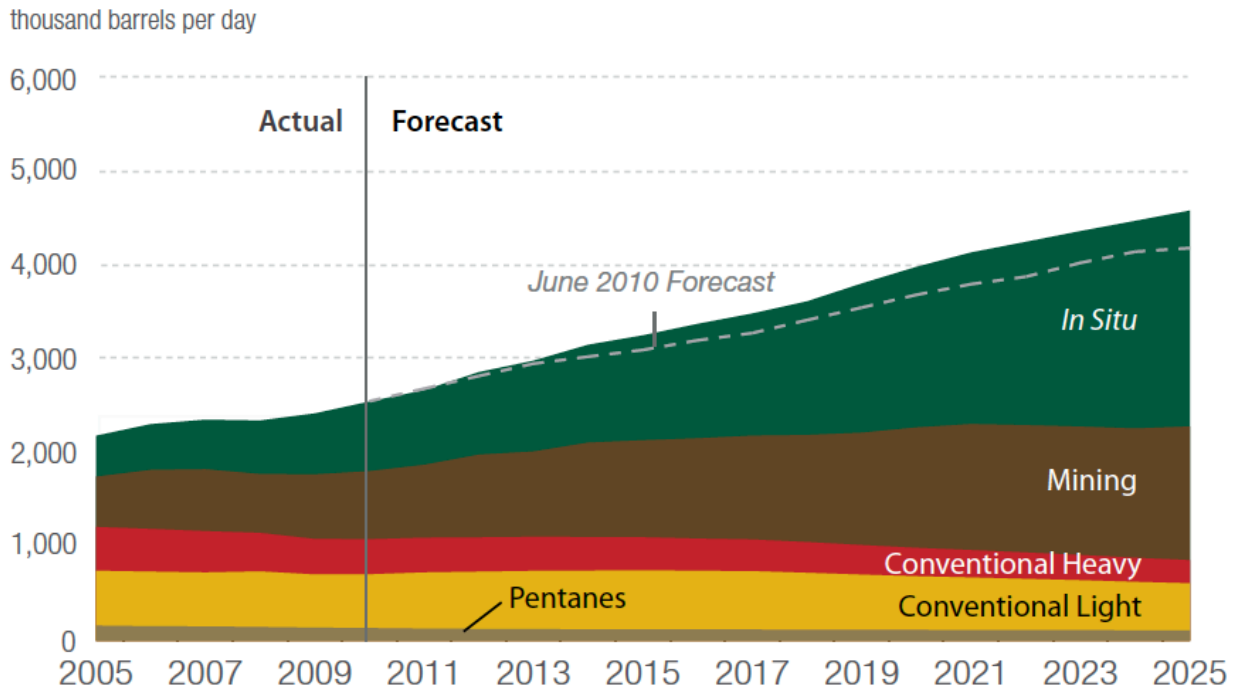

Figure 5. Projected oilsands growth, 2011 to 2025

Source: Canadian Association of Petroleum Producers, 2011-2025 Crude Oil Forecast, Markets & Pipeline Report

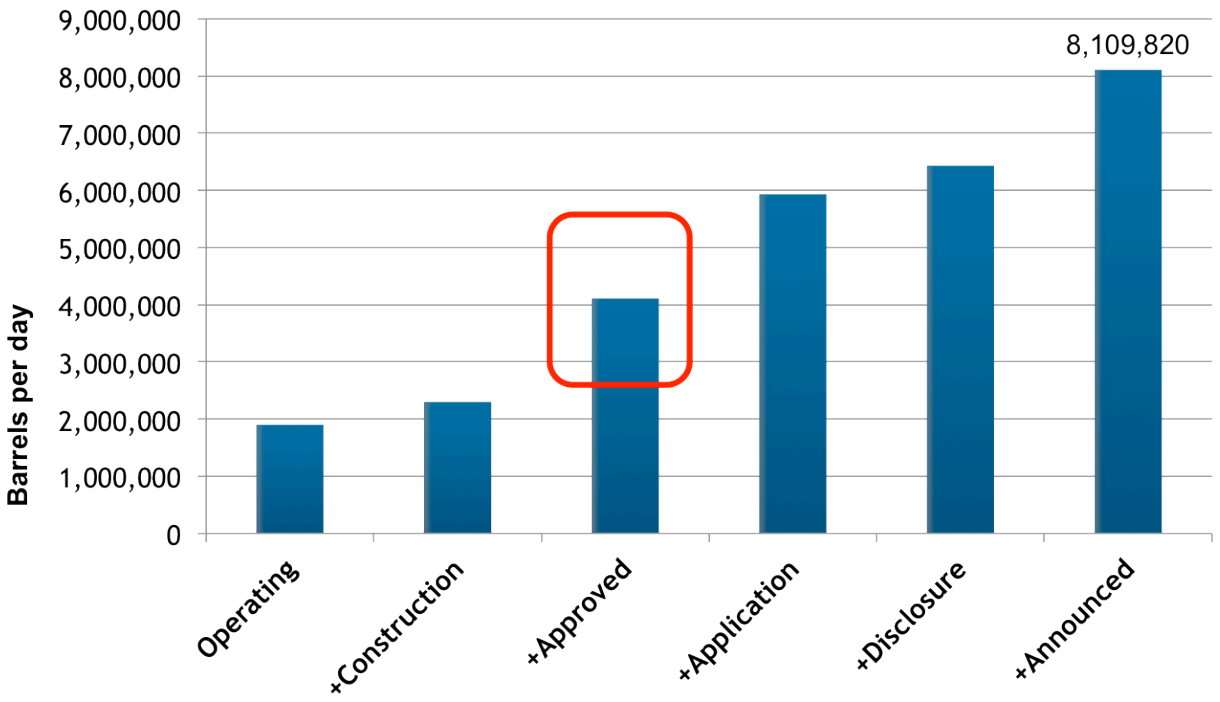

Figure 6. Projected oilsands capacity by development stage

Source: Dunbar, R. *Existing and Proposed Canadian Commercial Oil Sands Projects January 2011*. Strategy West, Calgary, AB, 2011.

Based on these production forecasts, any incremental gains made by technological innovation will would be be overshadowed by the absolute increases in impacts caused by the entire industry. This was demonstrated earlier by the absolute increases in GHG emissions despite a 29% reduction in GHG intensity between 1990 and 2009.

While Pembina Institute is supportive of voluntary measures and research and development by the oilsands industry, it is important to distinguish among lab research, small-scale pilot projects and commercial penetration of new technologies. The vast majority of approved and proposed oilsands projects under development are traditional mines and in situ projects with traditional environmental impacts. Given the long life span of oilsands projects, the current rush to approve projects using existing technologies actually undermines the ability to deploy innovative technologies in the future.

Stronger regulatory environment needed to drive technological innovation

As demonstrated by historical achievements with acid rain, chlorofluorocarbons and leaded gasoline, a stronger regulatory environment facilitates technological innovation. In a comparatively marginal economic oil play like the oilsands, any additional costs on environmental improvements or research and development reduces the profitability of a company's producing oilsands assets. As a result, there can be an economic penalty for companies that undertake additional risks and seek to innovate. Clear regulations allow the environmental performance of the entire industry to improve and remain competitive in the international marketplace.

Market signals also create innovation

The market signals provided by regulations, like California's Low Carbon Fuel Standard, are critical to spurring innovation in the oilsands. As absolute and intensity-based GHG emissions continue to rise in the oilsands, it is clear that this fuel standard has caught the attention of oilsands producers. Clear market signals like those provided by fuel standards will likely provide the economic rationale to drive further innovation.

Land planning and thresholds are essential to addressing environmental impact

Beyond greenhouse gas management in the oilsands, land use planning that monitors and manages the cumulative impacts from oilsands development is also a critical policy to drive stronger environmental performance. The Alberta government is in the process of approving a regional land use plan for the oilsands region. The implementation of this plan creates an opportune policy window for substantive reform of how the region is managed. The Pembina Institute has produced a report that presents 19 policy recommendations that can mitigate the environmental impact of the oilsands and drive technological innovation.[57]

[1] Oilsands emissions have grown from 17 Mt in 1990 to 45 Mt in 2009. Source: Environment Canada, *National Inventory Report - Part 1 1990-2008 Greenhouse Gas Sources and Sinks in Canada* (2010) 86, Table 2-16. http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=492D914C-2EAB-47AB-A045-C62B2CDACC29 Note: the value for 2009 oilsands total emissions was provided in e-mail communication from Environment Canada officials.

[2] Environment Canada, *Canada's Emissions Trends* (2011) 25, Table 5. http://www.ec.gc.ca/Publications/E197D5E7-1AE3-4A06-B4FC-CB74EAAAA60F/CanadasEmissionsTrends.pdf

[3] Environment Canada, *National Inventory Report - Part 1* (2010) 86, Table 2-16. Note: the value for 2009 oilsands total emissions was provided in e-mail communication from Environment Canada officials.

[4] Environment Canada, *Canada's Emissions Trends* (2011) 25, Table 5.

[5] Ibid.

[6] Calculated using an average value of 111 kg of CO_2 equivalent emissions for producing one barrel of synthetic crude oil from oilsands. The GHG emissions from individual projects vary considerably because of differences in technologies, practices and oilsands quality from project to project. Average emissions per barrel for conventional crude oil production are 35.2 kg of CO_2 equivalent in Canada and 24.5 kg of CO_2 equivalent in the U.S. Source: National Energy Technology Laboratory, *Development of Baseline Data and Analysis of Life Cycle Greenhouse Gas Emissions of Petroleum-Based Fuels* (2008) 12, Table 2-5.

[7] Pierre Gosselin, Steve E. Hrudey, M. Anne Naeth, André Plourde, René T Errien, Glen Van Der Kraak, and Zhenghe Xu, *The Royal Society of Canada Expert Panel: Environmental and Health Impacts of Canada's Oil Sands Industry* (2010) 92-93. http://www.rsc-src.ca/documents/expert/RSC report complete secured 9Mb.pdf.

[8] See Figure 3 [source provided in footnote to figure caption]

[9] Note: due to revisions of historical data made by Environment Canada, intensity improvements are 29% rather than the 39% figure that was previously cited widely.

[10] Petroleum coke is a very carbon-intensive fossil fuel compared to natural gas.

[11] IHS CERA, *Oil Sands Technology: Past, Present, and Future (Special Report)* (2011) 9. http://www2.cera.com/cos_form/.

[12] For more information, refer to: Danielle Droitsch, Marc Huot, and P.J. Partington, *Canadian Oil Sands and Greenhouse Gas Emissions: The Facts in Perspective* (Pembina Institute, 2010). http://www.oilsandswatch.org/pub/2057

[13] IHS CERA, "Summary of Key Insights of IHS CERA's Analysis," *Oil Sands Technology: Past, Present, and Future (Special Report).* 2011.

[14] Environment Canada, *National Inventory Report - Part 1* (2010) 86, Table 2-16. Note: the value for 2009 oilsands total emissions was provided in e-mail communication from Environment Canada officials.

[15] Statistics Canada, Table 126-0001 - Supply and disposition of crude oil and equivalent, monthly (cubic metres), CANSIM database. Accessed July 22, 2010.

[16] Gosselin, et al, *The Royal Society of Canada Expert Panel,* 89.

[17] Based on 2007 operational data. Source: Marc Huot and Simon Dyer, *Mining vs In Situ Factsheet* (Pembina Institute, 2010). http://www.oilsandswatch.org/pub/2017.

[18] Ibid.

[19] Rebecca Rooney, Suzanne Bayley, and David Schindler, "Oil sands mining and reclamation cause massive loss of peatland and stored carbon," *Proceedings of the National Academy of Sciences*, (2012) published online before print March 12, 2012.

[20] This pledge has been inscribed in the Copenhagen Accord but with the caveat that it may change based on developments in the U.S. *Copenhagen Accord: Appendix I - Quantified economy-wide emissions targets for 2020, Annex I parties: Canada.* http://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/canadacphaccord_app1.pdf

[21] Environment Canada, *Canada's Emissions Trends,* 22, Table 3; Environment Canada, *A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act* (2011). http://www.climatechange.gc.ca/Content/4/0/4/4044AEA7-3ED0-4897-A73E-D11C62D954FD/COM1410_KPIA%202011_e%20-%20May%2031%20v2.pdf

[22] Note: It could be argued that federal emission]reduction efforts only need to be increased fourfold, because the 32.5 Mt impact of current federal policies in 2020 needs to be increased to 32.5+89=121.5 Mt to meet Canada's target (see the numbers at the right-hand side of Figure 4). But to make a fair comparison of the effort entailed in two sets of policies, it is important to compare their impact on emissions over similar time periods. This is because policies generally have a bigger impact on emissions over a longer time period, without any extra effort by government (the key government effort is at the beginning in getting the policies adopted and implemented). Current federal policies that have not yet begun to impact emissions are recognized in our tenfold calculation because they shrink the emission-reduction effort needed in the 2013–20 period.

[23] Environment Canada, *Canada's Emissions Trends,* 22, Table 3.

[24] Ibid., 25, Table 5.

[25] Matthew Bramley and P.J. Partington, *Pembina Institute Comments on Canada's Proposed Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations,* (Pembina Institute, 2010). http://www.pembina.org/pub/2055.

[26] The Pembina Institute, "Pembina reacts to new federal regulations for coal-fired electricity," news release, August 19, 2011. http://www.pembina.org/media-release/2255

[27] M. K. Jaccard and Associates Inc., *Exploration of two Canadian greenhouse gas emissions targets: 25% below 1990 and 20% below 2006 levels by 2020* (Prepared for the David Suzuki Foundation and the Pembina Institute, 2009). http://www.pembina.org/pub/1910.

[28] Matthew Bramley, Pierre Sadik and Dale Marshall, *Climate Leadership, Economic Prosperity: Final Report on an Economic Study of Greenhouse Gas Targets and Policies for Canada* (The Pembina Institute and the David Suzuki Foundation, 2009). http://www.pembina.org/pub/1909.

[29] For example, when signing the Copenhagen Accord, the federal government announced "The Government of Canada has consistently emphasized the importance of harmonizing our approach to climate change with that of the United States." Source: Office of the Minister of the Environment, "Canada Lists Emissions Target under the

Copenhagen Accord," news release, February 2010. http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=EAF552A3-D287-4AC0-ACB8-A6FEA697ACD6

[30] Tim Weis, *Comparing U.S. and Canadian investments in sustainable energy in 2010* (The Pembina Institute, 2010). http://www.pembina.org/pub/1979.

[31] Federal regulations are expected out within the next year for the oil and gas sector; regulations for other sectors may follow.

[32] According to provincial Environment Minister Rob Renner, "We're taking tremendous steps forward on climate change. We're setting achievable targets and laying out ways we will get there. The world is looking for leadership on climate change. The opportunity is there for the taking. Alberta is taking it." From Rob Renner, "Climate Change" (speech in Washington, DC, March 30, 2009). Available at http://environment.alberta.ca/documents/Climate-Change-Was-NY-speech-Mar-30-31-2009.pdf.

[33] Matthew Bramley, *The Case for Deep Reductions: Canada's Role in Preventing Dangerous Climate Change* (Pembina Institute and David Suzuki Foundation, 2005) http://www.pembina.org/pub/536

[34] Alberta's emissions in 1990 were 177 Mt. Source*: National Inventory Report 1990–2009: Greenhouse Gas Sources and Sinks in Canada*, Part 3, 95.

Alberta's plan assumes emissions grow to approximately 250Mt in 2020. As interpreted from the Figure on page 24 of Alberta's 2008 plan. Source: Alberta Environment, *Alberta's 2008 Climate Change Strategy: Responsibility / Leadership / Action* (2008). http://environment.gov.ab.ca/info/library/7894.pdf

[35] Copenhagen Accord, Appendix I - Quantified economy-wide emissions targets for 2020 – United States (United States Department of State, Office of the Special Envoy for Climate Change, 2010). Available at: http://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/unitedstatescphaccord_app.1.pdf

[36] Alberta Environment, *Alberta's 2008 Climate Change Strategy: Responsibility / Leadership / Action* (2008). http://environment.gov.ab.ca/info/library/7894.pdf

[37] Matthew Bramley, Marc Huot, Simon Dyer and Matt Horne, *Responsible Action? An assessment of Alberta's greenhouse gas policies* (Pembina Institute, 2011). http://pubs.pembina.org/reports/responsible-action.pdf

[38] Ibid.

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

[40] Calculation by the authors based on an analysis of data publicly available at http://www.carbonoffsetsolutions.ca/aeor/. Further details in *Responsible Action? An assessment of Alberta's greenhouse gas policies.*

[41] Alberta Environment, "Greenhouse Gas Reduction Program." Accessed August 17, 2011. http://environment.alberta.ca/01838.html.

[42] Climate Change Emissions Management Corporation, "Funded Projects." Accessed August 17, 2011. http://ccemc.ca/funded-projects.

[43] Government of Alberta, "Carbon Capture and Storage: Major Initiatives." Accessed August 29, 2011. http://www.energy.alberta.ca/Initiatives/1897.asp

[44] Chris Severson-Baker, "Bonus credits for CCS weaken Alberta's greenhouse gas regulations," *The Pembina Institute*, blog post June 4, 2011. http://www.pembina.org/blog/552

[45] Alberta Environment, *Alberta's 2008 Climate Change Strategy: Responsibility / Leadership / Action* (2008). http://environment.gov.ab.ca/info/library/7894.pdf

[46] Shell Canada, "Oilsands: Shell's Quest." Accessed March 1, 2011. http://www.shell.ca/home/content/can-en/aboutshell/our_business/business_in_canada/upstream/oil_sands/quest/

[47] The Alberta government will provide $745 million and the Canadian government will provide $120 million. Source: Shell Canada, "Shell, governments agree funding for Canadian CO_2 storage project," news release June 24, 2011. http://www.shell.ca/home/content/can-en/aboutshell/media_centre/news_and_media_releases/2011/0624ccs.html

[48] Initial design will transport 4,600 to 5,100 tonnes of CO_2 per day from two sites: the North West Upgrading Inc. oilsands upgrader and Agrium Inc. Redwater complex. Source: Enhance Energy Inc., "Alberta Carbon Trunk Line," 2010. Accessed March 1, 2011. http://www.enhanceenergy.com/co2_pipeline/index.html

[49] Enhance Energy, Inc., "Alberta Carbon Trunk Line, Q & A." Accessed September 5, 2011. http://www.enhanceenergy.com/q_a

[50] CO_2 capture from coal power generation is the lowest cost at $60–130 per tonne. Source: Delphi Group, *2009 ICO2N Alternatives Report,* Table 2.4-2: http://delphi.ca/images/uploads/IC02N_GHG_Alternatives_Report.pdf

[51] Ibid.

[52] The net intensity decrease is based on a 40% reduction for the upgrading portion of the synthetic crude production but also takes into consideration a 30% loss of efficiency that results from adding CO_2 capture to an upgrader. Source: IHS CERA, *Oil Sands Technology: Past, Present, and Future,* 20.

[53] The Scenario forecasts 30% reductions (approximately 18 Mt), one third of which resulting from CCS. *Oil Sands Technology: Past, Present, and Future,* 31-32, Figure 10.

[54] International Energy Agency, *World Energy Outlook 2010*, (2010), 450.

[55] *Climate Leadership, Economic Prosperity.*

[56] Strategy West 2011 Outlook

[57] Simon Dyer, Jennifer Grant, Marc Huot and Danielle Droitsch, *Solving the Puzzle: Environmental responsibility in oilsands development* (Pembina Institute, 2011)