SOLVING the Puzzle

ENVIRONMENTAL RESPONSIBILITY IN OILSANDS DEVELOPMENT

JENNIFER GRANT • SIMON DYER • DANIELLE DROITSCH • MARC HUOT

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Solving the Puzzle

Environmental responsibility in oilsands development

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Danielle Droitsch • Marc Huot

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The Pembina Institute is a national non-profit think tank that advances sustainable energy solutions through research, education, consulting and advocacy. It promotes 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. For more information about the Pembina Institute, visit www.pembina.org or contact info@pembina.org. Our engaging monthly newsletter offers insights into the Pembina Institute's projects and activities, and highlights recent news and publications. Subscribe to Pembina eNews: http://www.pembina.org/enews/subscribe.

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Executive summary

The Government of Alberta faces a narrow and critically important window of opportunity to raise the bar on oilsands development. While there are new plans and frameworks in development that strive to "use a cumulative effects management approach to balance economic development opportunities and social and environmental considerations,"[1] we question if the emphasis placed on these considerations is capable of achieving the environmental outcomes consistent with the expectations of Albertans and Canadians. It is time to set higher standards and improve the rules governing oilsands development.

In *Solving the Puzzle: Environmental responsibility in oilsands development,* the Pembina Institute presents a 19-point plan that identifies policies required to protect the environment and restore Alberta's international reputation.

pol·i·cy

noun, often attributive

a definite course or method of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions[2]

The Athabasca River in winter.

PHOTO: JENNIFER GRANT, THE PEMBINA INSTITUTE

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LAND

- ❑ The Alberta Government should legislatively protect at least 50% of its public forest lands from industrial development. Protected areas should be developed and co-managed with Aboriginal peoples.
- ❑ Require establishment of biodiversity offsets for all oilsands development to offset impacts to all habitat types. To ensure a net positive environmental benefit and address existing cumulative effects, offsets should be established with a 3:1 offset ratio — three hectares of land should be conserved or restored for every hectare of new disturbance that occurs within the Boreal Forest Natural Region.
- ❑ Land use plans should mandate that no more than 5% of any Alberta planning region is available to oilsands development at any time.
- ❑ Develop a new, transparent and risk-averse mine security program that ensures the Alberta government collects financial security equivalent to the total liabilities created by oilsands extraction.
- ❑ Follow the recommendations of the Alberta Caribou Committee and demonstrate that all caribou ranges in Alberta meet science-based objectives to maintain caribou populations through a combination of establishing protected areas, setting thresholds on maximum levels of development in caribou habitat, and establishing biodiversity offsets in caribou habitat.

WATER

- ❑ Alberta Environment should complete a water management plan that identifies a science-based Ecosystem Base Flow (EBF) for the lower Athabasca River, as a low-flow threshold below which all water withdrawals would cease. The EBF should be legally enforceable and all water permits issued by the Alberta Government at any one time should be accountable to meet that EBF. In the interim, the low-flow threshold for the lower Athabasca River should be at least 100 m^3/s.
- ❑ Measure and map the quantity and quality of groundwater and surface/groundwater interactions, to determine both the short and long-term sustainable yield of non-saline groundwater in the Lower Athabasca's groundwater management areas. Set legal requirements to implement and enforce the sustainable yield of groundwater.
- ❑ Ensure enforceable regulations are in place to protect non-saline groundwater resources by updating and implementing existing guidelines and definitions. To protect more of our finite water resources, the Alberta government should expand its definition of regulated groundwater from the current level of water containing less than 4,000 mg/l of total dissolved solids (or TDS, a measurement of mineral, salt and metal content) to include water with up to 10,000 mg/l TDS.
- ❑ New mines should not be approved until the operation adopts a proven technology that eliminates the creation of wet tailings. In the interim, all current mines must be required to conform to the new tailings rules.

- ❑ Mine applications that propose the storage of tailings under end pit lakes as their reclamation strategy should not be approved. Existing operations with approved end pit lake plans should be modified to eliminate the need for end pit lakes as long-term storage sites for toxic tailings waste.

AIR

- ❑ Establish air emission limits to achieve the World Health Organization's Air Quality Guidelines to protect air quality and human health. Implement a progressive, multi-tiered system that requires varying degrees of action to prevent degradation of ambient air.
- ❑ Require oilsands operations to use equipment with the lowest achievable emissions or to deploy best-available technology for air emissions reductions.

GREENHOUSE GASES

- ❑ Commit to an Alberta greenhouse gas emissions reduction target consistent with a fair Alberta contribution to prevent dangerous levels of global warming (defined as keeping the global average temperature increase to 2°C, relative to the pre-industrial level).
- ❑ Implement a carbon dioxide equivalent (CO_2e) emissions price, as either a full auction cap-and-trade system or a carbon tax covering all combustion and almost all fixed process emissions (i.e., covering the vast majority of Alberta's emissions).
- ❑ Mandate the use of capture and storage (CCS) technology to capture greenhouse gas emissions from all major new industrial sources by 2016, This would apply to: all formation carbon dioxide (CO_2) from new natural gas processors; all process CO_2 from new hydrogen production facilities; and all combustion CO_2 from all new coal fired electricity plants, oilsands facilities, and upgraders.

MONITORING

- ❑ Ensure full funding of the Alberta Biodiversity Monitoring Institute, either directly from government or through an equitable funding model that requires all natural resource developers who impact biodiversity to contribute as a mandatory component of the regulatory approval process.
- ❑ Expand air monitoring to meet scientific needs. Monitoring design should be developed through a consensus-based approach with full stakeholder input, and with government implementing final decisions.
- ❑ Disband the Regional Aquatics Monitoring Program and replace it with a comprehensive, scientifically robust monitoring system that is adequately resourced and free of industry influence.
- ❑ Make a long-term commitment to fund a regional monitoring network to monitor and assess trends in groundwater levels and groundwater quality indicators.

Introduction

"The current visibility of relevant provincial and federal agencies, in particular in dealing with the major environmental challenges is low, and is generally not in line with those challenges."

---The Royal Society of Canada Expert Panel[3]

Global criticism of oilsands development shows no sign of abating. Nor should it, so long as the scale and scope of oilsands impacts outstrip the governments' willingness and ability to act as a responsible steward. Plans to double production within the decade will only intensify regional impacts, and further expose the gap between the rhetoric and reality of cumulative effects management in northeastern Alberta.

Despite beginning to talk about the need to address cumulative impacts, Alberta's delivery of new policy has been unable to keep pace with the scope and scale of development. Through the Land-use Framework process, the Government of Alberta has for the first time committed to setting cumulative environmental limits to inform oilsands development, through the Lower Athabasca Integrated Regional Plan. In April 2011, the province released its final draft of this plan for a 60-day consultation period.

While the draft Lower Athabasca Integrated Regional Plan (LAIRP) acknowledges that a cumulative effects management approach is required and that objectives must be set for environmental, social and economic outcomes, the plan also included many gaps; there is no plan to protect threatened woodland caribou and still no regional disturbance limit. The Pembina Institute argues that the environmental objectives being sought in the draft LAIRP are compromised by commitments made to developers prior to the proposal of the LAIRP, in effect allowing past decisions that favoured accelerated development to undermine the ability of the regulator to protect the public interest.[4]

In *Solving the Puzzle*, Pembina offers concrete suggestions on where the LAIRP could go further in achieving the environmental outcomes expected by Albertans, Canadians and increasingly, the international community.

The Pembina Institute has focused on solutions to address the need for responsible oilsands development for many years. In 2007 Pembina released *Oilsands Fever: Blueprint for Responsible Oilsands Development*,[5] which outlined six essential elements for responsible oilsands development:

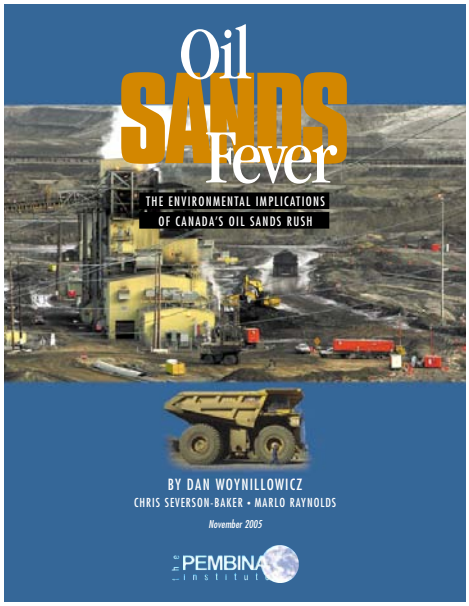
1. **Limit environmental impacts:** Apply science-based precautionary limits that tell us when ecosystems are threatened, so that we can make informed decisions about whether and how oilsands projects proceed.
2. **Address cumulative impacts:** Improve the systems and approaches for monitoring and addressing the impacts of

oilsands development on the climate, air, fresh water, boreal forest and wildlife.

3. **Focus on quality of life:** Manage the rate of oilsands growth to maximize the benefits to Albertans' quality of life, and ensure that social services and infrastructure can keep pace.
4. **Think like an owner:** Reform the oilsands royalty regime so that Albertans obtain maximum value from the development of the resources they own.
5. **Make better decisions for Albertans:** Reform the Energy and Utilities Board's[6] decision-making process so that the public interest comes first and only responsible oilsands projects proceed.
6. **Plan for the future:** Take advantage of Alberta's prosperity so as to build a more diversified, green and competitive future that includes low-impact renewable energies and responsible energy use.

These six elements offer a useful yardstick against which to assess any policy framework for management of the oilsands resource, but in Pembina's opinion, little progress in addressing these themes has been made. As well, although this was not specifically addressed in Blueprint, Pembina recognizes the imperative of ensuring that future oilsands development meets the needs of Aboriginals living in project-affected communities, and maintains that project approval be conditioned on the demonstration of free, prior and informed consent. Additional information on Aboriginal communities' concerns about the impacts of oilsands development and their legal rights is reported elsewhere.[7]

In 2010, the Pembina Institute released *Duty Calls*, a report that outlined the role of the federal government in achieving responsible oilsands development.[8] In *Solving the Puzzle*, Pembina goes further, offering 19 critical actions that the Government of Alberta could take to help



limit environmental impacts and address cumulative effects. This report outlines appropriate environmental limits and performance standards for oilsands development, from the perspective of both scientific and public interest, that should be considered in combination to ensure the cumulative impacts of oilsands development are meaningfully addressed.

The opportunity to responsibly develop the oilsands is clearly available to Albertans. Government, industry and the citizens of Alberta can set appropriate regional limits that protect the environment, achieve higher levels of performance from oilsands operations, and deliver on the economic opportunity represented by the resource. Further, the magnitude of economic opportunity, perhaps unprecedented in Canadian history, can help Alberta to be a leader in the global transition to a low carbon and low-impact clean energy future.

The Pembina Institute will report on Alberta's progress toward achieving responsible oilsands development at www.pembina.org/oil-sands/solutions.

Cumulative impacts of oilsands development on the environment must be meaningfully addressed.

PHOTO: DAVID DODGE, CPAWS

Land

Establish 50% protected areas

Ensuring Alberta develops an adequate network of protected conservation lands is an important element of responsible oilsands management. It is not surprising that oilsands mines and intensive in situ developments have impacts on wildlife and forests, but a significant failure to address regional conservation issues has contributed to criticism of oilsands mismanagement.

Protecting wildlife and forests involves more than reclamation, although unfortunately this is often the only land-related issue that comes up under discussions of oilsands impacts on ecosystems.

One solution for land protection is to ensure that enough land area in the regions is kept intact to maintain habitat for the wildlife that Albertans value. This can be achieved through establishing a world-class network of protected areas free of industrial activity. Unfortunately, Alberta's existing protected areas network is not adequate to meet these outcomes. Currently only 12.5% of Alberta is protected from industrial activity,[9] while in the Lower Athabasca Region, where oilsands development is currently focused, only 6.7% of the land area is protected.[10]

Alberta and Canada are far from leaders in conserving an adequate percentage of their land base from industrial development. Many countries have established far higher percentages of their terrestrial ecosystems as legislatively protected areas (see Figure 1). Alberta with its low population, significant amount of intact habitat and large projected impacts associated with oilsands development could be a world leader in land conservation.

There is no clear threshold for the appropriate level of protected areas, although higher levels of protection will conserve

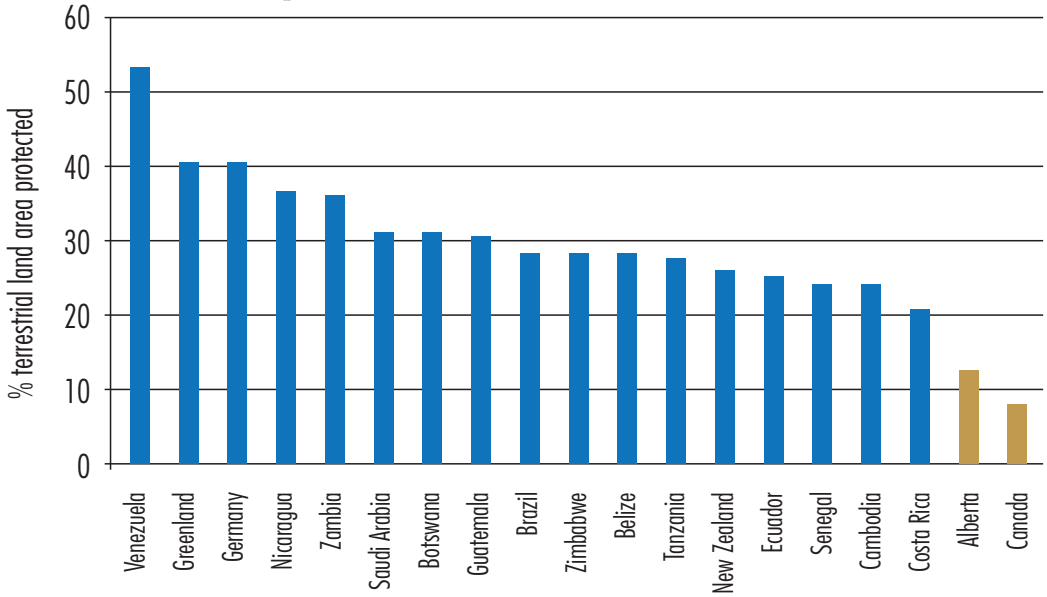


Figure 1. Selected world leaders in establishment of legislatively protected areas compared to Canada and Alberta[13]

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LAIRP

The draft LAIRP document identifies approximately 11% of the region as new protected areas, which, when added to the 6.7% already protected, brings legislative protection to a total of only approximately 18% of the region.[11]

Unfortunately, it is clear that LAIRP conservation recommendations were led by avoidance of industrial commitments, not conservation science. Thus the protected areas recommended by LAIRP are skewed to the north of the Lower Athabasca region and are largely unrepresentative of the kinds of habitats that are being impacted by oilsands development. The LAIRP document also ignores many of the conservation sites proposed by the Regional Advisory Council charged with making recommendations for the Lower Athabasca region.

The draft LAIRP identifies 6% of the region as "ecosystem forestry" conservation areas that allow industrial logging.[12] These are not considered protected areas by the environmental community. All the proposed protected areas allow development of existing oil and gas leases.

more habitat for species and reduce the threat to biodiversity. Protected areas serve many roles. One important criteria for protected areas in the province relates to the habitat needs for woodland caribou, a threatened species in Alberta with declining populations.

The Cumulative Environmental Management Association (CEMA) recommended that between 20 and 40% of the Regional Municipality of Wood Buffalo be permanently protected from industrial activity. The Boreal Leadership Council, a group made up of leading resource development companies (including oilsands producer Suncor and forest company Alberta-Pacific Forest Industries) has recommended that 50% of Canada's boreal forest be permanently protected, while the remaining 50% of the forest be handled using world-class sustainable forest management practices.

While establishment of protected areas will close off future opportunities for oilsands and forestry development, a substantial increase in protected areas is economically viable. Research from the University of Alberta, sponsored by the Alberta Government's Land Use Secretariat, has shown that Alberta could permanently protect 40% of its public forests from industrial activity at a cost of only 3 to 7% of the net present value of natural resource development in Alberta.[14]

RECOMMENDATION

The Alberta Government should legislatively protect at least 50% of its public forest lands from industrial development. Protected areas should be developed and co-managed with Aboriginal peoples

Implement a wetlands and biodiversity offset policy

Unlike U.S. jurisdictions, Alberta has neither a wetland policy nor conservation offset policies for its forested areas. Biodiversity offsets should be required for upland and wetland habitats as best practice to mitigate project-specific impacts of developments.

The Alberta Land Stewardship Act is enabling legislation that could support the establishment of biodiversity offsets. Alberta could make mandatory offsets for oilsands companies part of land use plans. Offsets should be area-based and could include additional wetland or forest restoration, conservation of environmentally significant private lands or the retirement of development tenures.

LAIRP

Alberta committed to development of a biodiversity offset program in its 2008 oilsands planning document *Responsible Actions*,[15] but has apparently not made any progress in implementing such a plan. While the advice from the Regional Advisory Council to the Government of Alberta recommended that the LAIRP should "Develop and implement land-use offsets for industrial development" and "Implement Alberta's new wetland policy once it is developed"[16] neither of these issues is mentioned in the draft plan.

RECOMMENDATION

Require establishment of biodiversity offsets for all oilsands development to offset impacts to all habitat types. To ensure a net positive environmental benefit and address existing cumulative effects, offsets should be established with a 3:1 offset ratio — three hectares of land should be conserved or restored for every hectare of new disturbance that occurs within the Boreal Forest Natural Region.

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Set maximum levels of development

Both oilsands mining and in situ oilsands development are intensive land uses. The Cumulative Environmental Management Association was mandated by the Government of Alberta to make recommendations on how to limit environmental impacts of oilsands development. The CEMA Terrestrial Ecosystem Management Framework recommended that limits be placed on the maximum amount of lands available for oilsands development at any time.[17] When adequate reclamation had been demonstrated, other areas could be opened to development.

In order to protect ecosystems, Pembina recommends as an interim threshold that no more than 5% of any planning area be under oilsands development at any time. CEMA recommended measuring "intensive area" as any quarter township (3 mile x 3 mile area) that included oilsands development, to account for the fragmentation associated with in situ oilsands development. A 5% interim disturbance limit would mean that for the 93,000 km^2 Lower Athabasca Area, no more than 4,600 km^2 of oilsands leases would be available for development at any time (The current area of oilsands leases in Northern Alberta is 85,000 km^2).[19]

LAIRP

The draft LAIRP plan does not set maximum levels of development but acknowledges that this work needs to be completed by 2013.[18] The commitment in the draft LAIRP hints that development targets may not be protective of the environment:

> *Develop a **land disturbance plan** for public land in the Green Area for the Lower Athabasca Region by 2013. Features of the plan will include:*
>
> *Land disturbance limit(s) and pre-limit management triggers to address established biodiversity indicator targets in the biodiversity management framework. Setting of limits will involve stakeholders and integrate economic development and social needs. Limits will recognize that to meet economic outcomes, land disturbance is projected to increase substantially from current levels as oilsands are further developed.*

RECOMMENDATION

Land use plans should mandate that no more than 5% of any Alberta planning region is available to oilsands development at any time.

Reform the approach to reclamation liability management

Until recently, the Alberta government held letters of credit to cover the cost of mine reclamation should companies default on their reclamation commitments. The Pembina Institute calculated that this older program did not collect adequate security, and that provincial taxpayers may be carrying an unaccounted liability of up to $15 billion. Inadequate security collection, along with transparency and accountability concerns, have been raised by the Alberta Auditor General for the past eleven years.

In March 2011, the Government of Alberta announced a new reclamation financial liability program, the result of closed-door collaboration with industry. While the new program is more transparent and accountable in the estimation of reclamation costs, it still places Alberta taxpayers and the environment at risk. The new program actually weakens security in the short to medium term by allowing companies to use undeveloped bitumen as an asset to offset their clean-up costs. While many of the companies involved in oilsands mining are financially solvent, they are highly vulnerable to changes in global oil prices and regulatory costs. As a result, if the price of oil dropped significantly or if new regulations made the industry uneconomic, this new approach would leave Alberta taxpayers liable for reclamation costs. The Alberta government should be risk-averse in its reclamation liability management, not risk-tolerant. Oilsands companies, not taxpayers, should provide sufficient security to cover all of the liabilities created by oilsands mining.

RECOMMENDATION

Develop a new, transparent and risk-averse mine security program that ensures the Alberta government collects financial security equivalent to the total liabilities created by oilsands extraction. Consequently, if an oilsands mine was unable to pay for reclamation, adequate funds would be available to complete all reclamation. Using the proposed asset-to-liability approach to oilsands reclamation is not appropriate and places taxpayers at risk.

LAIRP

The draft LAIRP document commits to:[20]

Implement the progressive reclamation strategy enhancing the suite of policies, strategies and reporting mechanisms used to drive progressive on-going reclamation of mining operations. The strategy includes an enhanced reclamation certification process, a transparent public reporting system for reclamation progress and a new progressive reclamation financial security program.

The draft LAIRP commits to using a policy that does not collect security equivalent to the full cost of reclamation for oilsands mines.

The total liabilities created by oilsands mining must be covered by the amount of financial security collected.

PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

Conserve woodland caribou

All caribou herds in Alberta are considered non-self-sustaining. Declines in woodland caribou populations in Alberta are a symptom of inadequate land management policies and too-high levels of cumulative development.

Maintaining caribou populations requires maintaining sufficient caribou habitat. This can be achieved through a combination establishing large protected areas throughout caribou ranges in Alberta (see protected areas, above), setting maximum levels of development (see maximum levels of development) and aggressively restoring those caribou ranges that have already been impacted by decades of poorly-managed development (see biodiversity offsets, above).

The Alberta Caribou Committee, a body responsible for making recommendations on caribou conservation in Alberta, has developed management recommendations for the Lower Athabasca Region. These include establishing six conservation areas, thousands of square kilometres in size and free from industrial development, for caribou in northeastern Alberta.[21]

LAIRP

The draft LAIRP document does little to address caribou habitat needs, stating only that "A new biodiversity management framework for the Lower Athabasca Region…..will be developed by 2013 and will…. address caribou habitat needs in alignment with provincial caribou policy."[22]

The proposed protected areas identified in the LAIRP plan cover only 11% of the caribou range in the Lower Athabasca Region, substantially less than would be required to stabilize caribou population declines. As proposed, development of existing oil and gas leases would be allowed in all of these areas.

RECOMMENDATION

Follow the recommendations of the Alberta Caribou Committee and demonstrate that all caribou ranges in Alberta meet science-based objectives to maintain caribou populations through a combination of establishing protected areas, setting thresholds on maximum levels of development in caribou habitat, and establishing biodiversity offsets in caribou habitat.

Water

Protect the Athabasca River from water withdrawals during low flow periods

Oilsands mining operations divert substantial amounts of water from the Athabasca River, potentially placing pressure on aquatic ecosystems during low flow periods. Because diversions are largely permanent (only 3.3% of the water used in oilsands processing is returned to the river), a comprehensive water management plan is needed to ensure that current and future projected diversions protect aquatic ecosystems.

When too much water is diverted from a river system, water quality may change and fish habitat may decrease. On the lower Athabasca River, surface water withdrawals have a direct influence on flow, potentially reducing the available habitat during the low-flow periods common during winter months. In turn, surface winter withdrawals can jeopardize the overwintering survival of many fish and other aquatic species. The Athabasca River watershed and Peace-Athabasca Delta are critical to First Nations for hunting, fishing and gathering. In recent years, traditional resources from the river system have been more difficult to access due to lower flows.[23]

While efforts to establish water management planning have been initiated for the Lower Athabasca, they have failed in several respects. A 2007 joint water management framework announced by the Department of Fisheries and Oceans and Alberta Environment took a first step by establishing a plan to account for water demand and establish cumulative limits on withdrawals. But Phase 1 did not create an enforceable framework requiring companies to stop withdrawing water under the law, instead opting for a voluntary industry sharing arrangement. Of greater concern is the fact that two major oilsands companies are not subject to the management system as their licences have been effectively grandfathered leaving aquatic ecosystems vulnerable.[24]

Aboriginal communities remain concerned about the impact of lower water flows on access to culturally-significant places, travel on the river, and opportunities to pass culture and knowledge to future generations. Currently, there is no consensus around what constitutes an appropriate Ecosystem Base Flow (EBF) on the lower Athabasca river. While many stakeholders have agreed upon a flow target of 87 m^3/s this was not the consensus of all parties, and issues remain around the exemption of "legacy water rights holders".[25] A report prepared for the Athabasca Chipewyan

ECOSYSTEM BASE FLOW

An Ecosystem Base Flow (EBF) establishes a flow target in a river below which no withdrawals are permitted. An EBF is in place to ensure that there are no increases in the frequency and duration of very low flows which can affect habitat availability, food production, and water quality.[30]

and Mikisew Cree First Nations recommended the adoption of a precautionary flow level whereby no surface withdrawals would be allowed when the river flow drops below 100 m^3/s. This would require active management among all stakeholders.[26] This precautionary flow was recommended as a management tool until a more scientific consensus could be reached.[27] First Nations have also stated that additional studies are needed to fully consider the relationship between water flows, instream flow needs[28] and aboriginal water rights.[29]

By 2011, the problems of Phase 1 for the Athabasca Framework remain unresolved. While Government of Canada scientists have acknowledged the need to establish an Ecological Base Flow that would set an absolute cut-off for withdrawals, the voluntary system remains in place.[31] At the time of writing, the final Phase 2 water management framework has not yet been officially adopted, but there are concerns that the new framework will follow the voluntary approach used in Phase 1 and will continue to grandfather the rights for two existing oilsands companies.

The process to establish a water management plan goes back to the early 2000's when the Surface Water Working Group of the Cumulative Environmental Management Association was charged with the task of establishing the in-stream flow needs assessment for the lower Athabasca River. The assessment anticipated that by 2003, a water usage management system as well as criteria for water usage that protect science-based and social values would be in place in the lower Athabasca River. [32]

The draft LAIRP notes that "the Alberta government is committed to updating the surface water quantity management framework for the Lower Athabasca River by 2012."[33] It does not commit to ensuring that water withdrawals will be halted during low flow periods.

RECOMMENDATION

Alberta Environment should complete a water management plan that identifies a science-based Ecosystem Base Flow for the lower Athabasca River, as a low-flow threshold below which all water withdrawals would cease. The EBF should be legally enforceable, and all water permits issued by the Alberta Government at any one time should be accountable to meet that EBF. In the interim, the low-flow threshold for the lower Athabasca River should be at least 100 m^3/s.

Define sustainable groundwater yield for the Lower Athabasca region's groundwater management areas

While much attention has been focused on how oilsands mining operations affect surface water diversion from the Athabasca River, a potentially more challenging and equally troubling issue concerns oilsands impacts to groundwater. Groundwater moves relatively slowly and recharge rates for aquifers can range from days to tens of thousands of years.

Both mining and in situ oilsands production affects groundwater resources. Before mining operations can begin, the forest must be cleared and wetlands drained. The basal aquifer underlying the bitumen may need to be drained to prevent flooding into the mined areas. The elimination of the wetlands decreases groundwater recharge, and artificially-restored boreal wetlands are not yet capable of replicating this function.[34] The creation of tailings lakes covering hundreds of square kilometres also threatens groundwater quality as a result of potential seepage. Groundwater withdrawals from aquifers for in situ development can have an indirect influence on surface water flows. Groundwater discharge is likely an important contributor to the Athabasca River flows, particularly in the low-flow winter months.

While individual companies may try to predict how long it would take for an aquifer to recover from these withdrawals, groundwater impacts could still be significant because each project is assessed separately[35] and there is not yet a consideration of the cumulative impacts over the many-decade life span of multiple projects. Additionally, the complex geology of northern Alberta with buried valleys and channels increases the difficulty in understanding the connections between surface and groundwater.[36]

While mining operations use more water than in situ operations at this time, groundwater use for in situ operations will increase given that in situ development is growing even faster than mining. In the future, water use for in situ production could be as great as or greater than for mining unless new extraction processes are adopted that reduce or avoid the use of water.

The absence of an integrated regional groundwater framework in the region impacted by oilsands development requires the adoption of the precautionary principle to protect fresh aquifers. Dr. Jim Bruce, member of the Council of Canadian Academies' 2009 Expert Panel on Groundwater, has said that oilsands projects are providing a "completely inadequate understanding of the groundwater regime in the area" despite having a significant impact on groundwater.[37]

Some of the groundwater unknowns[38] include:

- how low-flow levels in the Athabasca River affect shallow groundwater;
- how increased oilsands operations dewater or reduce non-saline aquifer

supplies as well as depressure or dewater saline aquifers;

- how changes in water quality, resulting from aquifer disturbance and tailings-pond leakage, affect the quality of groundwater and surface water resources;
- what data are required to assess the claim that deep injection of steam and waste does not negatively impact the regional and local aquifer systems, and whether these data are available
- what regional threshold objectives should be to ensure sustainable groundwater management.

Some of these knowledge gaps were echoed by CEMA[39] in their 2010 groundwater quality study, a study that was acknowledged by the Royal Society of Canada report as a first step towards the establishment of a regional groundwater framework.[40]

While efforts are underway to develop a conceptual model of the hydrogeology of the Athabasca oilsands region,[41] more work is needed to create an integrated regional groundwater framework for the region. Groundwater concerns are currently only considered at the local scale; hydrogeological studies are conducted on a case-by-case basis[42] and thereby fail to consider cumulative effects. Furthermore, the often poorly-understood interaction between surface water and groundwater resources has traditionally meant that each component is managed as a separate resource. The management of water resources, both surface water and groundwater, needs to be based on an appropriate level of understanding of their interactive relationship in the hydrologic cycle. In the absence of a regional geological framework that can be used to assess this degree of interrelationship, it is appropriate to manage surface water and groundwater as a single resource.

The capacity of Lower Athabasca aquifers to deliver water in a sustainable way should be defined and determined. This concept of "sustainable yield"[43] for groundwater can aid in identifying a threshold to protect groundwater quantity and quality. A sustainable yield for groundwater should consider overall regional withdrawals with rates of recharge that will not compromise the quantity and quality of water-sustaining wetlands, lakes and rivers. In other words, groundwater limits should follow the hydrologic principles of mass balance, preparing for the possibility that there maybe much less groundwater available than anticipated under existing case-by-case approvals.[44]

RECOMMENDATION

Measure and map the quantity and quality of groundwater and surface/groundwater interactions, to determine both the short and long-term sustainable yield of non-saline groundwater in the Lower Athabasca's groundwater management areas. Set legal requirements to implement and enforce the sustainable yield of groundwater.

Ensure enforceable regulations are in place to protect non-saline groundwater resources

The primary source of water used for in situ oilsands operations is groundwater. In situ techniques require approximately 1.1 barrels of water to extract a barrel of bitumen.[45] In 2010, in situ industry water consumption was approximately 17 million m^3 per year of fresh surface or groundwater, and that amount is expected to increase to 22 million m^3 per year by 2015.[46] Restrictions that would limit freshwater use by in situ operations have yet to be implemented.[47] The amount of groundwater available for bitumen extraction is unknown and as a result, the quantitative impact of extraction on regional groundwater reserves is also unknown.[48]

The current policy framework related to groundwater use by the oil sector remains inadequate in light of the unknowns around the availability of non-saline groundwater. In 2005, the Alberta Government adopted the Water Conservation and Allocation Policy for Oilfield Injection to reduce or eliminate the use of fresh water for enhanced oil recovery and in situ operations.[49] At present, most in situ projects are not in "water short" or "potentially water short" areas and the volume of water that they will be permitted to use depends in part on weighing the economic costs of alternatives. This policy is currently under review, however currently appears to favour economic criteria.[50]

Alberta Environment and the Energy Resources Conservation Board (ERCB) developed a draft directive in 2009 that would require in situ operators to minimize their use of fresh water by evaluating alternatives when possible.[51] Larger operators would be required to recycle water to reach a maximum of 10 percent of annual water to be fresh water.

The Water Conservation and Allocation Guideline for Oilfield Injection relies on the discretion of the director to some extent,[52] while the draft ERCB directive is not yet in force and appears to be stalled.

LAIRP

The draft LAIRP does propose a Groundwater Management Framework for the Lower Athabasca Region. However, the draft LAIRP does not include environmental limits for groundwater quantity at this time.[56] The draft LAIRP also excludes groundwater having a mineralization of 4,000 mg/l TDS or greater.

Given the uncertainty about the sustainability of using non-saline groundwater resources, companies must be required to seek alternatives in a timely fashion. For this reason, Alberta Environment must carefully evaluate the findings of its current review of the Policy and Guideline as they affect in situ operations, to determine to whether more stringent requirements are necessary. Alberta Environment should ensure that the guideline and draft ERCB directive are updated to

the extent indicated by the review, and that the revised directive is implemented as soon as possible and strictly enforced.

Alberta Environment defines saline water as water that contains more than 4,000 milligrams per litre of total dissolved solids (mg/l TDS).[53] This level was set to include all groundwater that is expected to be potentially useable by the public in the future with reasonable levels of treatment. A higher cutoff is desirable as more complex treatment technology is possible in extreme water shortage situations. For example, the U.S. has a much more stringent standard and protects certain underground sources up to 10,000 mg/l TDS to ensure an adequate supply for present and future generations.[54] In the Lower Athabasca region, shallower bedrock aquifers have TDS values from 1,000 to 4,000 mg/l, with the deeper formations (Basal McMurray and Methy formations) generally having saline conditions (4,000 to greater than 300,000 mg/l TDS).[55]

RECOMMENDATION

Ensure enforceable regulations are in place to protect non-saline groundwater resources by updating and implementing existing guidelines and definitions and requiring companies to seek alternatives to non-saline groundwater. To protect more of our finite water resources, the Alberta government should expand its definition of regulated groundwater from the current level of water containing less than 4,000 mg/l of total dissolved solids (or TDS, a measurement of mineral, salt and metal content) to include water with up to 10,000 mg/l TDS.[57] Operators should explicitly detail the efforts made in design to minimize environmental trade-offs between reducing use of non-saline water and increasing water treatment needs, which could potentially result in increased waste, energy use and greenhouse gas emissions.

Require technology that eliminates wet tailings production

Tailings lakes, which now cover an area the size of the City of Vancouver or Washington, D.C., are projected to grow by 30% in the next decade — from 843 million cubic metres in 2010 to over 1.1 billion cubic metres in 2020.[58] Containing a host of toxic compounds, tailings lakes pose an ongoing threat to surface water and groundwater through seepage, represent a significant public liability, and poses a mortality risk to waterfowl.

Political and industry leaders have recognized the liability of tailings on the landscape. In April 2010, Alberta Premier Ed Stelmach stated his objective to eliminate wet tailings ponds within "a few years."[59] Retired Shell Canada CEO Clive Mather said it is time the industry moved to eliminate tailings.[60] Nevertheless, technology and regulatory oversight has not kept pace with the growing volume of toxic tailings on the landscape. A weak regulatory framework providing inadequate incentives to further advance commercialized technology has contributed to the failure to eliminate wet tailings from the landscape.

The technology of choice for the past 15 years has been consolidated tailings or non-segregating tailings (CT/NST), a process that helps free up a fraction of the tailings water to be recycled for plant use and reduce the overall volume of mature fine tailings (MFT) contained in the lake. Because the CT/NST process requires a significant amount of sand, and the sand is also required to build containment for the released and recycled water, the success of CT as a means to substantially reduce the volume of toxic tailings has been limited.

While there has never been a complete reclamation of a tailings lake, existing technology and regulation suggests progress has been made. Recently, Suncor announced that it is planning to adopt a new approach called Tailings Reduction Operations (TRO), a drying process that converts fluid fine tailings more rapidly into a solid landscape suitable for reclamation. If successful, the technology could enable Suncor to clean up existing tailings waste and significantly

LAIRP

The draft LAIRP does not specifically commit to eliminate wet tailings production. The plan notes:[68]

Government of Alberta will establish a tailings management framework for mineable oilsands operations by 2012. The framework will provide guidance on managing tailings to provide assurance that fluid fine tailings will be reclaimed as quickly as possible, and that legacy (current) inventories will be reduced. The framework will establish regional limits, as well as a focus on the development and implementation of new technologies over the next ten years.

reduce the legacy volume of end-of-mine fine tailings to 75 Mm^3 versus the 108 Mm^3 that would have resulted from the previous CT technology. The area of Suncor's end-pit lake could end up being reduced from 14 km^2 to 8.4 km^2.[61] According to Suncor, the TRO technology has enabled it to cancel plans for five additional tailings ponds at existing mine operations.[62],[63]

Regulatory compliance could clearly act as a major impetus toward the adoption and commercialization of new technology. This was thought to be the case when Alberta's Energy Resources and Conservation Board (ERCB) announced Directive 74 in 2009 to regulate the reclamation of tailings waste. The directive requires oilsands companies to submit tailings management plans,[64] and stipulated that by June 30, 2013, oilsands operators are to divert at least 50% of the fine particles in their ore to a dedicated disposal area with a solid surface strength of 5kPa in the first year and 10kPa after five years.

Unfortunately, the ERCB stopped short of requiring full compliance with the regulation. Only two of the nine current oilsands projects met the requirements.

While significant research has already been dedicated to reducing or eliminating toxic tailings, it is clear that far more is needed to ensure that tailings management and water conservation technology keeps pace with increasing production. This means making the needed capital investments in research and technology development to advance these practices to a commercial scale. In December 2010, seven companies[65] announced a collaborative approach towards sharing information on research and development as well as technology.[66]

The Royal Society of Canada has noted, "Technologies for improved tailings management are emerging but the rate of improvement has not prevented a growing inventory of tailings ponds. Reclamation and management options for wet landscapes derived from tailings ponds have been researched but are not adequately demonstrated."[67]

Government will need to send strong regulatory signals to promote the needed technology advancements to eliminate wet tailings accumulation and ultimately remediate existing tailings accumulations. All of this needs to be underpinned by a regulatory system that is viewed as strict and consistent.

RECOMMENDATION

New mines should not be approved until the operation adopts a proven technology that eliminates the creation of wet tailings. In the interim, all current mines must be required to conform to the new tailings rules.

Prohibit water capping of fine tailings as a long-term reclamation solution

One proposed solution to the tailings problem has been to cap fine tailings with water in an end pit lake (EPL) at the end of mine life. Operators would deposit tailings waste into the last mine pit and cap it with fresh water from the Athabasca River.[69] End pit lakes are proposed to remain a permanent feature of the reclaimed landscape even though it has not been demonstrated that a pit that contains many millions of cubic metres of toxic tailings at the bottom can support a sustainable aquatic ecosystem. While at least 27 EPLs are planned over the next 60 years, a fully realized EPL has yet to be constructed.[70]

There continues to be much uncertainty related to issues of salinity, retention time, groundwater recharge and discharge rates, EPL limnology, and the chronic toxicity of oilsands process-affected water and its constituents. Given the extreme uncertainty, it is prudent to reject water capping of fine tailings as an acceptable oilsands reclamation strategy.

LAIRP

The draft LAIRP does not prohibit water capping of fine tailings as a long-term reclamation solution. The draft plan notes:[71]

> *Government of Alberta will establish a tailings management framework for mineable oilsands operations by 2012. The framework will provide guidance on managing tailings to provide assurance that fluid fine tailings will be reclaimed as quickly as possible, and that legacy (current) inventories will be reduced. The framework will establish regional limits, as well as a focus on the development and implementation of new technologies over the next ten years.*

RECOMMENDATION

Mine applications that propose the storage of MFT under end pit lakes as their reclamation strategy should not be approved. Existing operations with approved end pit lake plans should be modified to eliminate the need for end pit lakes as long-term storage sites for toxic tailings waste.

Air

The mining or in situ extraction of bitumen from oilsands, and the upgrading of bitumen into synthetic crude oil, are very energy intensive and involve processes that generate significant air emissions. These processes include fossil fuel combustion to produce steam, and in some cases electricity;[72] bitumen separation using solvents that are subsequently emitted from tailings ponds; diesel exhaust emissions associated the large mine fleets; sulphur recovery when bitumen is upgraded, resulting in production of sour gas; and numerous other bitumen and water storage and treatment processes that have fugitive emissions which can be significant for a large facility. Flares and diverter stacks used to deal with emergency and upset conditions can also be a significant source of air contaminant emissions.

Oilsands operations lead to increases in air pollutants including sulphur oxides (SO_x), nitrogen oxides (NO_x), fine particulate matter ($PM_{2.5}$), volatile organic compounds (VOCs), ozone (O_3) as a result of NO_x and VOC emissions, polynuclear aromatic hydrocarbons (PAHs), and airborne mercury. The emissions produced by oilsands operations are predicted to increase significantly over the next decade.[73] As summarized in Table 1, elevated levels of SO_x and NO_x could lead to smog, acid rain, and the acidification of soils and surface waters, which in turn poses risks to human health. See Appendix A for more information on the impacts from air emissions from oilsands development.

Acidifying emissions from oilsands development may pose a risk to northern lakes.

PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

Implement world-class air quality standards

The current Alberta Ambient Air Quality Objectives (AAAQO) while intended to provide protection of the environment and human health, do so only to the extent deemed technically and economically feasible, as well as socially and politically acceptable.[74] In this regard Alberta Environment has indicated that "AAQOs are often a compromise between science and achievability. They are not entirely protective of human health and/or the ecosystem and, importantly, they are not a safe level that can be polluted up to."[75] As a result, Alberta standards are less stringent than those of the European Union, U.S. Environmental Protection Agency and World Health Organization for what qualifies as an "exceedance" or "poor air quality". Compared with guidelines established by the World Health Organization, AAAQOs permit higher concentrations of particulate matter, double the hourly-average concentrations of NO_x, and over seven times the daily-maximum concentrations for SO_2.[76]

Table 1. Air quality criteria from various jurisdictions

Parameter	Averaging Time	Air quality criteria in noted jurisdiction[a] (ug/m^3)[b]			
		Alberta Environment (objectives or guidelines)	USEPA (standards)	WHO (guidelines)	European Union (targets, limits or objectives)[c]
Sulphur Dioxide (SO_2)	10 minute	no criteria	no criteria	500	no criteria
	1 hour	450	196 (3 year average of the 99%tile of maximum daily values in a year)	no criteria	350 (not to be exceeded more than 24 times in a calendar year)
	24 hour (daily)	125	no criteria	20	125 (Not to be exceeded more than 3 times in a calendar year)
	30 days	30	no criteria	no criteria	no criteria
	Annual	20	no criteria	no criteria	20
Nitrogen Dioxide (NO_2)	1 hour	400	188 (3 year average of the 98%tile of maximum daily values in a year)	200	200 (not to be exceeded more than 18 times in a calendar year)
	24 hour	200	no criteria	no criteria	no criteria
	annual	60	100	40	40

Parameter	Averaging Time	Air quality criteria in noted jurisdiction[a] (ug/m^3)[b]			
		Alberta Environment (objectives or guidelines)	USEPA (standards)	WHO (guidelines)	European Union (targets, limits or objectives)[c]
Ozone (O_3)	1 hour	160	no criteria	no criteria	no criteria
	8 hour	128 (4th highest measurement annually averaged over 3 consecutive years)	147(4th highest measurement annually averaged over 3 consecutive years) under review	100	120 (from 2010 not to be exceeded more than 25 days per calendar year averaged over 3 years) 120 (from 2020)
Carbon Monoxide (CO)	15 minutes	no criteria	no criteria	100,000	no criteria
	30 minutes	no criteria	no criteria	60,000	no criteria
	1 hour	15,000	40,000	30,000	no criteria
	8 hours	6,000	10,000	10,000	10,000
Particulate Matter ($PM_{2.5}$)	1 hour	80	no criteria	no criteria	no criteria
	24 hour	30	35 (3-year average of the 98th percentile of 24-hour values)	25 (a 99%tile value of maximum daily values (i.e. 3 days a year can have values >25)	no criteria
	annual	no criteria	15 (3 year average)	10	25 (effective 2015) and 20 (effective 2020)
Hydrogen Sulphide (H_2S) or Total Reduced Sulphur (TRS)	30 minute	no criteria	no criteria	no criteria	no criteria
	1 hour	14 (for H_2S but also applied to TRS)	no criteria	no criteria	no criteria
	24 hour	4 (for H_2S but also applied to TRS)	no criteria	no criteria	no criteria

[a] Criteria as of September 2010 except for Alberta Environment which is as of December 2010

[b] All values converted to ug/m^3 with most at 1 atm and 25°C

[c] EU values at 20°C

LAIRP

The draft LAIRP includes an air quality management framework that identifies potential limits for NO_2 and SO_2. The framework proposes strengthening the current ambient air quality objectives for these pollutants. The LAIRP does not propose new management frameworks for other pollutants such as VOCs, PAHs and particulate matter. While the air quality management framework identifies four "trigger" levels for managing air emissions, the management actions proposed are relatively weak until Level 4 is reached. The framework does not appear to strive for good or improving air quality, merely avoiding unacceptable levels.

However, it should be acknowledged that the LAIRP air quality management framework does introduce some improvements to the current management of air quality in the region. The framework specifies that exceedances of AAAQOs will continue to be managed in the same way, externally and independent from the LAIRP process. New triggers for short-term air quality management are presented in the draft LAIRP that would serve as an additional tool to the existing air quality objectives.

In addition, the LAIRP air quality management framework states that it intends to incorporate any changes to the AAAQOs, using any improved air quality objectives as the limit for the annual triggers. The draft plan includes limits based on proposed updates to the AAAQO for NO_2 annual and hourly averages. While this update to the AAAQO has not yet been implemented, it would represent a considerable improvement compared with the current values and a positive step towards the health guidelines recommended by the World Health Organization. See Table 2 below for a comparison of the proposed changes.

Table 2: Proposed updates to the AAAQO for NO_2 (2011)

Averaging Time	Current AAAQO (µg/m³)	Proposed AAAQO (µg/m³)	Relative Improvement	WHO guidelines (µg/m³)
1 hour	400	300	25%	200
Annual	60	45	25%	40

The WHO Air Quality Guidelines (AQG) represent the most up to date and widely agreed-upon assessment of health effects of air pollution, recommending targets for air quality at which the health risks are significantly reduced.[77] The WHO AQG are intended to be relevant and applicable worldwide and to provide clear health-based recommendations on the targets for air pollution reduction.[78] The recent U.S. EPA National Ambient Air Quality Standards for NO_2 and SO_2 are consistent with the maximum 1-hour limits for these pollutants.[79],[80] Regulating emissions at higher allowable concentrations than the WHO guidelines puts the health of Albertans at risk and limits the creation of a credible environmental management system for the oilsands.

Even with the higher allowable concentrations in Alberta, the AAAQOs were frequently exceeded by oilsands operators in recent years — with an increasing trend.[81] In 2009, the AAQOs were exceeded 1,556 times in 2009 in the Athabasca region, up from 47 times in 2004.[82] These exceedences were largely related to hydrogen sulphide/reduced sulphur emissions and provide an indication of the air quality issues that can result if emissions are not properly managed.

RECOMMENDATION

Establish air emission limits to achieve the World Health Organization's Air Quality Guidelines to protect air quality and human health. Implement a progressive, multi-tiered system that requires varying degrees of action to prevent degradation of ambient air. This includes:

- Adopt the World Health Organization's Air Quality Guidelines for NO_x of 40 µg/m³ (annual) and 200 µg/m³ (hourly)
- Adopt the World Health Organization's Air Quality Guidelines for SO_2 of of 20 µg/m³ per 24 hours and the EU 1-hour guidelines for SO_2 of 350 µg/m³
- Adopt the World Health Organization's Air Quality Guidelines for $PM_{2.5}$ of 25 µg/m³ per 24 hours.

Large trucks used for mining are the primary source of NO_x emissions in the oilsands

PHOTO: C. CAMPBELL, THE PEMBINA INSTITUTE

Require best available technology to address air emissions

Good air quality depends in large part on how effectively air emissions are controlled and managed. It is not unreasonable for Albertans to expect that oilsands operators will employ the best available emission control technologies at new projects and that existing operations will strive for continuous reductions in emissions. Unfortunately this is not the case: Alberta does not currently require best available technologies to reduce air emissions associated with oilsands development. Alberta Environment has an Industrial Release Limits Policy[83] that has as one of its principles:

"Industrial release limits will be established based on limits achievable using the most effective demonstrated pollution prevention/control technologies ..."

This policy needs to be rigorously applied to the oilsands industry.

In some cases, policies cite targets that should either be converted into enforceable requirements or limits, or at a minimum, be aggressively applied as opposed to being totally voluntary. For example, large boilers, heaters and turbines used in the oilsands industry are significant sources of emissions. There is currently a policy[84] aimed at improving

the emissions rates from these types of equipment. The policy outlines Performance Targets based on best available technologies that are "economically achievable" but then only really requires companies to meet the significantly lower Compliance Limits.

In other cases there is simply no policy in place to ensure that oilsands facilities are using the best equipment available and updating this equipment regularly as improvements are made available on the market. For instance, the large trucks used for mining are the primary source of NO_x emissions in the oilsands. However, many of the trucks currently in operation are older models with significantly higher rates of emissions. While retrofits, upgrades and new models are available that would result in a significant decrease in emissions, there is no requirement in place to upgrade or replace this equipment. In fact, outside of the oilsands approval process, which has the ability to mandate equipment for one project at the time of approval, there is no requirement for new oilsands development to start with the best available technologies and no requirement for continuous improvement through retrofits.

The environmental community has outlined 11 opportunities for higher performance standards for oilsands operations including higher standards for sulphur recovery, Tier 4 standards for NO_x emissions by mine trucks, and controls on particulate emissions. For more information see Appendix B.

RECOMMENDATION

Require oilsands operations to use equipment with the lowest achievable emissions or to deploy best-available technology for air emissions reductions.

Greenhouse gases

Set science-based greenhouse gas reduction targets

The oilsands are the fastest growing industrial source of greenhouse gas (GHG) emissions in Canada.[85] As shown in Figure 2 below, the oilsands sector's GHG emissions more than doubled between 1990 and 2008 and emissions are forecast to double again between 2008 and 2020.

While the oilsands sector was able to reduce its GHG emissions intensity (emissions per barrel) by 39% between 1990 and 2006,[87] the rate of performance improvement has stalled in recent years. Much of the past improvement resulted from "low-hanging fruit" opportunities that have already largely been exploited, such as fuel switching (from more carbon-intensive coke to natural gas) and energy efficiency increases through cogeneration of heat and electricity. Furthermore, an increasing proportion of oilsands production is forecast to come from in situ techniques[88] which result in significantly higher GHG emissions per barrel of bitumen produced.[89]

One recent report did conclude that new innovations will enable oilsands emissions intensities to continue a declining trend; the report also projects that absolute oilsands emissions levels will increase as a result of the rapid pace of oilsands growth.[90] According to industry projections, under business-as-usual conditions, oilsands production could nearly triple in the next 15 years.[91]

There is now a broad scientific consensus that a global temperature rise of more than 2°C above the pre-industrial level would constitute a dangerous level

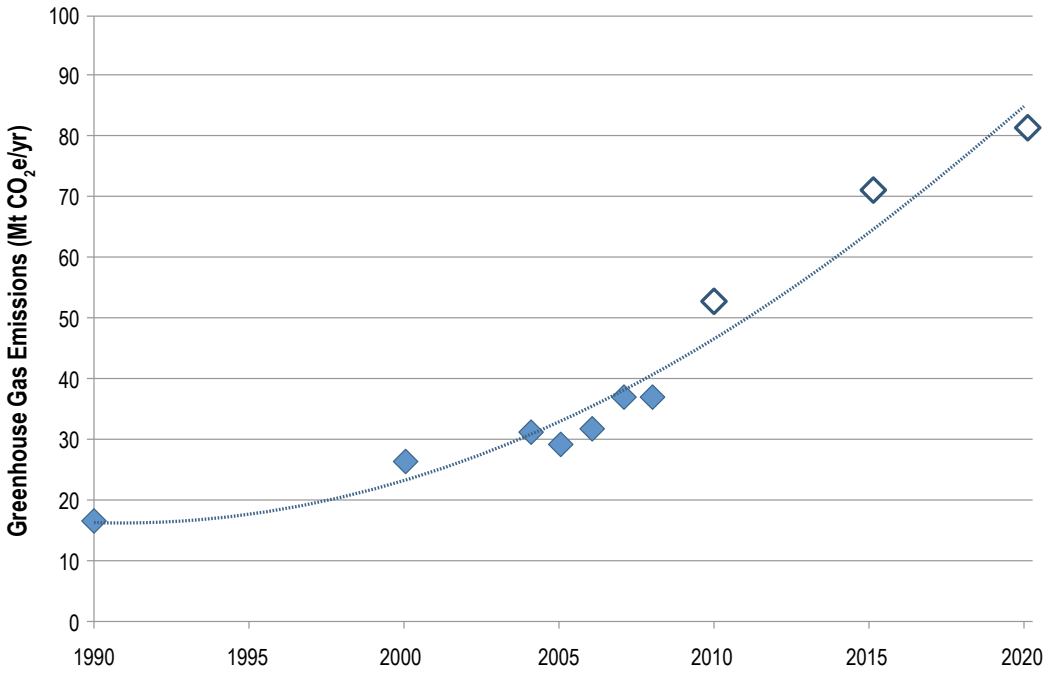

Figure 2: Historical and projected oilsands greenhouse gas emissions[86]

of climate change. Along with other G8 leaders, Canada accepted this 2°C limit at the G8 meeting in L'Aquila, Italy in 2009.[92] The Government of Canada re-affirmed its commitment to a 2°C limit by supporting the Copenhagen Accord and the Cancun Agreements[93] at the United Nations climate change conferences in 2009 and 2010 respectively. Analysis published by the Intergovernmental Panel on Climate Change, the world's leading climate science body, has shown that to have a reasonable chance of not exceeding the 2°C limit, industrialized countries should reduce their combined GHG emissions to 25 to 40% below the 1990 level by 2020, if they are to make a fair contribution to the necessary cuts in global emissions.

RECOMMENDATION

Commit to an Alberta greenhouse gas emissions reduction target consistent with a fair Alberta contribution to preventing dangerous levels of global warming (defined as keeping the global average temperature increase well below 2°C, relative to the pre-industrial level). Alberta's targets should include near-term, mid-term and longer-term (2050) goals.

Absolute oilsands emissions levels are predicted to increase as a result of the rapid pace of oilsands growth.

PHOTO: JENNIFER GRANT, THE PEMBINA INSTITUTE

Place an appropriate price on greenhouse gas pollution to drive emission reductions

The Pembina Institute has explored what policies would be required to achieve this level of reductions in GHG emissions for Canada as a whole, and what the ramifications would be for Alberta and the oilsands in achieving this target. The economic modelling firm MK Jaccard and Associates has conducted modelling that shows it is possible for Canada to reduce its GHG emissions to 25% below the 1990 level by 2020 through the implementation of an appropriate national price on GHG emissions and a package of other policy measures.[94]

Alberta can demonstrate leadership by supporting a high enough carbon[95] price that will drive significant reductions in greenhouse gas emissions. While a Canada-wide (or broader) price on greenhouse gas emissions is more economically efficient, provincial initiatives can make an important contribution in the absence of federal leadership on carbon pricing.

Even under the ambitious emission-reduction policy scenario modelled in the report, Alberta's economy still grows faster than that of any other province in Canada, with GDP growth of 38% from 2010 to 2020 (compared to a national average GDP growth of 23% from 2010 to 2020).[96] During this period, oilsands production grows to approximately 2.5 million barrels per day even while Canada meets an ambitious, science-based emission reduction target.[97]

RECOMMENDATION

Implement a carbon dioxide equivalent (CO_2e) emissions price, as either a full auction cap-and-trade system or a carbon tax covering all combustion and almost all fixed process emissions (i.e., covering the vast majority of Alberta's emissions). In order to incent adequate emission reductions, the emissions price should be approximately $50/tonne CO_2e in 2010 and reach about $200/tonne by 2020. If Alberta adopts a cap-and-trade system, these price levels can be achieved by tightening the cap over time; if Alberta implements a carbon tax, the tax level should rise on a predictable schedule that is transparently communicated in advance.

Require carbon capture and storage for oilsands operations

Requiring carbon capture and storage (CCS) for oilsands operations helps to moderate the carbon price level for the rest of Alberta's economy. Requiring CCS also spurs faster development of the technology, which helps reduce the costs of further CCS deployment by encouraging technological innovation.

RECOMMENDATION

Mandate the use of capture and storage technology to capture greenhouse gas emissions from all major new industrial sources by 2016. This would apply to: all formation CO_2 from new natural gas processors; all process CO_2 from new hydrogen production facilities; and all combustion CO_2 from all new coal fired electricity plants, oilsands facilities, and upgraders.

CO_2 from the upgrading process should be captured and stored.

PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

Monitoring

Effective monitoring is a crucial to inform responsible management of oilsands development. There has been substantial criticism of the current approach and level of monitoring.

The Pembina Institute has submitted detailed recommendations about what elements are required for effective and rigorous monitoring. These include elements such as program design and governance, meaningful stakeholder representation, resourcing, transparency, rigour, comprehensiveness and the ability to inform decision-making. Our recommendations to enhance monitoring of biodiversity, air, surface and groundwater are outlined here.

LAIRP

The draft LAIRP plan notes that Alberta is currently undertaking a review of its environmental monitoring, evaluation and reporting systems: [98]

In order to understand the effectiveness of Alberta's environmental management tools, the region's air, water, land and biodiversity are monitored, evaluated and reported on. Monitoring initiatives in the region include the Wood Buffalo Environmental Association, the Lakeland Industrial Community Association, the Regional Aquatics Monitoring Program and the Alberta Biodiversity Monitoring Institute.

There is significant investment in environmental monitoring systems in the Lower Athabasca Region, including systems for air, surface water, groundwater, land and biodiversity. Alberta is currently undertaking a review of environmental monitoring, evaluation and reporting systems. Recommendations from the Provincial Environmental Monitoring Panel are expected in 2011 regarding the development of an integrated, world-class monitoring system for the Lower Athabasca River, encompassing both the condition of the river and effects of development on the river, as well as recommendations on how the system can be expanded to all media in the region and to the entire province.

Develop a world-class biodiversity monitoring system

The existing Alberta Biodiversity Monitoring Institute (ABMI) has the potential to be a world-class monitoring system for biodiversity. Unlike other environmental media, where substantial changes to governance and rigour of monitoring programs are required, the major limitation of ABMI is currently a lack of funding to enable it to deliver its mandate of providing effective biodiversity monitoring information for Alberta.

The ABMI includes many of the elements of a rigorous monitoring program, including a rigorous, university-led scientific design plus value-neutral, arm's-length and publicly-accessible data and knowledge products.

However, ABMI only receives funds to cover about one-quarter of its full operating costs. The Government of Alberta has provided significant initial start-up resources to the ABMI, but funding has not been adequate for full delivery of the program. Full funding of the ABMI is an essential missing element of responsible development in Alberta.

RECOMMENDATION

Ensure full funding of the the Alberta Biodiversity Monitoring Institute, either directly from government or through an equitable funding model that requires all natural resource developers who impact biodiversity to contribute as a mandatory component of the regulatory approval process.

The cumulative impact of many typesof development affects biodiversity.

PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

Develop a world-class air monitoring system

The Wood Buffalo Environmental Association (WBEA) monitors ambient air quality for industry compliance and community air quality, terrestrial ecosystem effects and human exposure. WBEA has many of the features necessary in an effective air-monitoring program. WBEA data collection is transparent, is conducted by qualified technicians, uses appropriate equipment, and undergoes quality control verifications. The majority of WBEA data is publicly accessible online — downloadable in raw data formats by monitoring station or summarized in annual reports. Some of the passive sampler data is not easily accessible to the public. New monitoring projects are designed by qualified scientists and reviewed by an external third party.

WBEA data is limited by the size of the air quality monitoring network and the sub-optimal placement of monitoring stations. However, the WBEA monitoring program has insufficient funding to improve the network in a meaningful way. Currently, the majority of the funding for WBEA is provided directly by industry. This itself is not a concern; however, industry members have direct control on budget and other key decisions which are made through a multi-stakeholder consensus-based approach. WBEA membership is currently by organization, not by sector. Each company may have their own representative on the WBEA Board and as a result, industry members significantly outnumber other stakeholder members.

RECOMMENDATION

Expand air monitoring to meet scientific needs. Monitoring design should be developed through a consensus-based approach with full stakeholder input, with government implementing final decisions. To prevent a direct conflict of interest, the associated budget and funding mechanism should be developed by the Government of Alberta utilizing a 'polluter pay' approach. Provision of fees should be mandatory.

Develop a world-class water monitoring system

The current approach to monitoring oilsands impacts on water has now been widely discredited. Most recently, Environment Canada and a team of independent experts concluded that the current monitoring system for the Athabasca region "did not deliver data of sufficient quantity or quality to detect or quantify the effects of oilsands development."[99] This is the sixth critical review of the state of aquatic monitoring since December 2010.[100]

RECOMMENDATION

Disband and replace the Regional Aquatics Monitoring Program (RAMP) with a comprehensive, scientifically robust monitoring system that is adequately resourced and free of industry influence.

Groundwater monitoring needs to be in place to gain a better understanding of the cumulative impacts of withdrawals from aquifers (both fresh and saline) and the relationship between groundwater and surface water. To date, monitoring for groundwater quality in the oilsands region as a whole has yet to be done, although work is underway to create a framework.[101] Monitoring is in place for project-specific needs of in situ operators; however, the cumulative effects of in situ operations are unknown, largely because the supply and quality of groundwater for the oilsands region is unknown.[102]

RECOMMENDATION

Make a long-term commitment to fund a regional monitoring network to monitor and assess trends in groundwater levels and groundwater quality indicators.

Appendix A Impacts from air emissions

Table 3: Effects of key oilsands pollutants on human health and the environment

Pollutant	Principal sources	Environmental impact	Health impact
Sulphur oxides[103]	Produced gas from in situ operations, burning of petroleum coke, extraction and upgrading for mining, sulfur in diesel fuel.	Is a major component of acid rain Contributes to the formation of smog and haze	At high levels can cause premature death, increased respiratory symptoms and disease, decreased lung function, as well as alterations in lung tissue and structure, and in respiratory tract defence mechanisms[104]
Nitrogen oxides[105]	Exhaust of mine fleet and burning of gas for boilers and heaters	Is a major component of acid rain, which can[106] leach essential nutrients from the soil and thereby negatively affect health and rate of growth of trees, reduce capacity of lakes and soil to neutralize acids and potentially change the pH condition of lakes and soil	Irritates the lungs and increases susceptibility to respiratory infections[107] Combines with VOCs in the presence of sunlight to form ground-level ozone, which can cause damage to human health[108]
Fine Particulate Matter[109]	Solid and liquid airborne particles emitted from fleet exhaust and combustion of all fossil fuels	Is composed of organic and elemental carbon particles from combustion of fossil fuels as well as sulphur and nitrogen compounds that can contribute to acid deposition Contributes to the formation of smog and haze	Can be carried deep into the lungs Has been linked with heart and lung problems such as asthma, bronchitis and emphysema[110] Strong links between high levels of airborne sulphate particles and increased hospital admissions for heart and respiratory problems, and higher death rates from these ailments[111]
Volatile Organic Compounds[112]	Evaporate readily from tailings ponds Venting of solution gas and unloading/loading of tanks. Fugitive emissions	Can combine with NO_x in the presence of sunlight to form ground-level ozone[113] Contributes to the formation of smog and haze.	Individual VOCs can be toxic to humans Benzene is a VOC emitted by oilsands operations. It is carcinogenic to humans and a non-threshold toxicant, which means that there is some probability of harm at any level of exposure[114]
Mercury[115]	Combustion of petroleum coke.	Airborne mercury can deposit and accumulate in streams, lakes, or estuaries, where it can be converted to methylmercury through microbial activity. Methylmercury accumulates in fish at levels that may harm the fish and the other animals that eat them.	Mercury, at high levels, may damage the brain, kidneys, and developing fetus.

Appendix B Recommendations for equipment emissions standards

- ❑ Implement the emissions rates outlined in the Alberta Environment Policy 2 performance targets as a required standard.[116]
- ❑ Implement the USEPA Tier 4 limits for the control of all emissions of air pollution from nonroad diesel engines and immediately engage the USEPA in discussions regarding a review of the Tier 4 NO_x limit for mobile sources greater than 750 hp.[117]
- ❑ Require units that emit more than 100 tonnes/yr of NO_x to meet emissions reduction rates equivalent to what would be achieved if they were required to install selective catalytic reduction controls.
- ❑ Employ stricter requirements under ERCB Directive 2001-3 for the smaller range of emission sources in this category. Units with inlet sulphur levels in the 1-5 tonnes per day size category should be required to meet a SO_x recovery rate of 90%.
- ❑ Ensure flared emissions are included in calculations of sulphur recovery rates from all sulphur recovery units and that their emissions rates still meet the given standards.
- ❑ Set a limit on the sulphur content of any gaseous fuel combusted in boilers, heaters and turbines.[118]
- ❑ Extend the AENV Policy 1B NO_x and SO_2 limits for new and retrofit boilers and heaters burning non-gaseous fuels to the whole oilsands industry, including those operations that burn and recycle coke as a part of bitumen upgrading.
- ❑ Apply PM controls (e.g. fabric filters/ baghouses or electrostatic precipitators) if primary PM emissions from a process unit are significant.
- ❑ Ensure all major stationary primary particulate emission sources are required to measure and report their condensable PM emissions.
- ❑ Reduce the ERCB limit on solvent releases to tailing ponds from 4 bbl/1000 bbl of bitumen to 3 bbl/1000 bbl by 2015.
- ❑ Ensure all operators are required to undertake a detailed and ongoing emission characterization and quantification monitoring program for their tailings ponds.

Appendix C Oilsands report summary

Since 2005, the Pembina Institute has completed over 40 reports that address management of the oilsands. All Pembina Institute reports include detailed recommendations to improve management of the oilsands. For more detailed background information on any of the recommendations in this document, please review the following publications.

2011

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 environmental 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/borealbird-sreport.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-Under-mining-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
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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
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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

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115 U.S. Environmental Protection Agency, "Environmental Effects: Fate and Transport and Ecological Effects of Mercury," 2010, http://www.epa.gov/hg/eco.htm

116 Alberta Environment, *Interim Emission Guidelines for Oxides of Nitrogen (NOx)*.

117 It is the view of the NGO stakeholders that Environment Canada could encourage the USEPA to improve the requirements for units above 750 hp making them the same as for units in the 600-750 hp range (i.e., applying an emission limit of 0.3-0.5 g/hp-hr).

118 For example, for produced gas and refinery fuel gas used for combustion, a sulphur content level of no more than 30 to 50 ppmv could be set. Such a level is achievable with commercially available gas clean-up processes.