CARBON CAPTURE & Storage in Canada

FACT SHEET

CARBON CAPTURE & STORAGE THOUGHT LEADER FORUM • JANUARY 2009

CCS and Canada's Climate Strategy

Silver Bullet or Distraction on the Way to a Sustainable Energy Future?

The Canadian and Alberta governments have committed billions of dollars to encourage the development of large-scale Carbon Capture and Storage projects. The reason: to ensure coal-fired power plants and carbon-intensive operations like oil sands reduce their carbon footprints.

Is Carbon Capture and Storage Up To the Task?

The stakes are high. Climate change demands action, and politicians, government and industry are betting big on capture and storage (CCS). Still, no one is sure how well it will work.

The Pembina Institute views CCS as one of a number of potentially effective technologies for reducing GHG emissions on the scale required to combat dangerous climate change. It is also critical that CCS is seen as part of the portfolio of solutions, and that adequate attention is also paid to more sustainable, low-impact solutions such as ramping up the use of renewable energy and energy efficiency. The urgent need to deal with Canada's rising GHG emissions (which are now 22% higher than they were in 1990) compels consideration of CCS, but it is not without environmental risks and barriers to implementation.

Just How Much Can CCS Do?

- The Intergovernmental Panel on Climate Change (IPCC) estimates that CCS could contribute 15 to 55% of the total global GHG reduction effort between now and 2100.
- The ecoENERGY CCS Task Force estimates the Canada-wide potential for CO_2 capture and storage at roughly 40% of Canada's projected 2050 "business-as-usual" GHG emissions.

It looks like CCS may be a very important solution to help reduce greenhouse gas emissions while humanity transitions to cleaner energy solutions of the future – if it works as planned.

While most people recognize that we can't change our polluting ways overnight, there are huge differences of opinion on whether CCS should be used to extend the use of some of the more pollution-intensive fossil fuels or simply as a transition to cleaner fuels.

What is Carbon Capture and Storage?

Carbon capture and storage (CCS) is a means of reducing carbon dioxide (CO_2) emissions from industrial sources such as coal-fired power plants and oil sands operations. CCS refers to the capture of CO_2 emissions from industrial sources and the long-term storage of these emissions in stable underground reservoirs and aquifers. CCS can help tackle global climate change by reducing the amount of greenhouse gases (GHGs) released into the atmosphere.

Canada's Current Target for Reducing Greenhouse Gas Emissions

- 3% below 1990 levels by 2020
- 51 to 63% below 1990 levels by 2050

This target is still weaker than our Kyoto commitment and far below what science tells us we need to do.

the PEMBINA institute
Sustainable Energy Solutions

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CCS: Sum of the Parts

"The CCS component technologies (capture, transport, and storage) all exist today at industrial scale. What is missing is the full integration and application of these components in commercial facilities at a large-scale."

– ecoENERGY Carbon Capture and Storage Task Force

The nuts and bolts of capturing carbon

In the CCS process, CO_2 is captured, transported and stored.

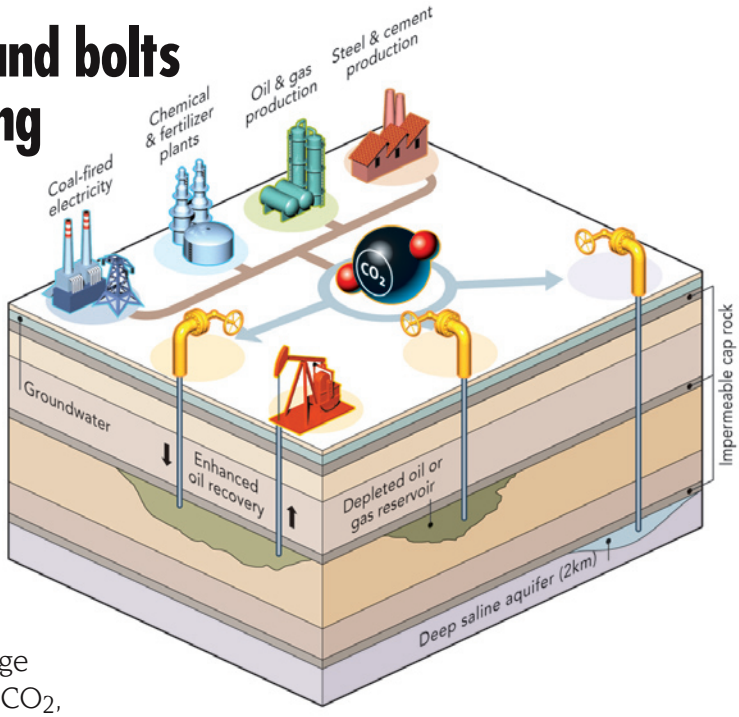


Figure 1: CO_2 can be captured from a variety of industries, and used or stored in a number of ways.
SOURCE: INTEGRATED CO_2 NETWORK

1 Capture – To a Point

Carbon capture is feasible for large point sources of CO_2, such as coal-fired power plants and oil and gas facilities. Carbon dioxide is separated from the rest of the gases in the production process by using a commercial capture technology such as chemical or physical absorption.

2 Transportation – Into the Pipe

CO_2 must then be compressed and transported at high pressure to a storage location within or outside a plant's boundaries. Pipelines are the most economical method of transportation. A new network of pipelines for carbon transport would be required.

3 Storage – Going Underground

Finally, the CO_2 is pumped underground for storage. Careful selection of a site, based on its particular geological characteristics, is crucial to minimize the risk of leakage. Suitable, economically feasible storage options in Canada include deep saline aquifers, as well as depleted gas, oil and bitumen reservoirs.

Another storage option is to inject CO_2 into existing oil and gas reservoirs that are nearing depletion in order to enhance oil and coalbad methane recovery. Termed "enhanced oil recovery" (EOR), this process can increase resource recovery and avoid the use of water that is typically used in EOR, thereby providing added economic value.

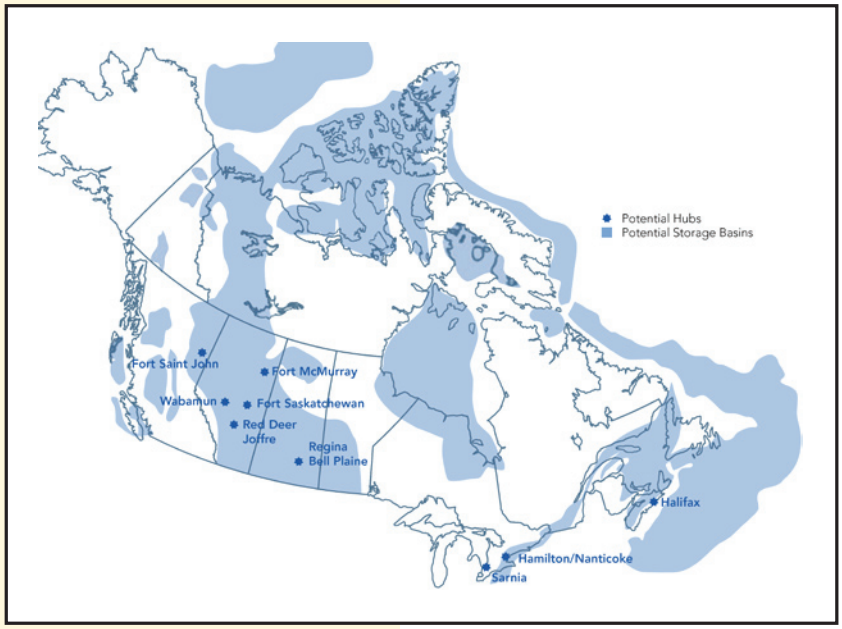


Figure 2: Current research indicates that the best opportunities for CCS in Canada are concentrated in Alberta, Saskatchewan and northeastern British Columbia.
SOURCE: GOVERNMENT OF CANADA

Economics of Carbon Capture and Storage in Canada

CCS is most cost effective for emission sources and industries that produce a relatively pure stream of CO_2, as high CO_2 concentrations make capture easy. For other industries, like electricity and oil sands upgrading, costs to implement CCS are significantly higher. Even with the likely cost savings in CO_2 reduction compliance and the possible extra revenue from selling CO_2 for enhanced oil recovery that industry could net from CCS, it still doesn't add up to the cost of implementation. The size of this financial gap is still subject to debate.

Opinions on Who Should Pay for the CCS "Financial Gap"

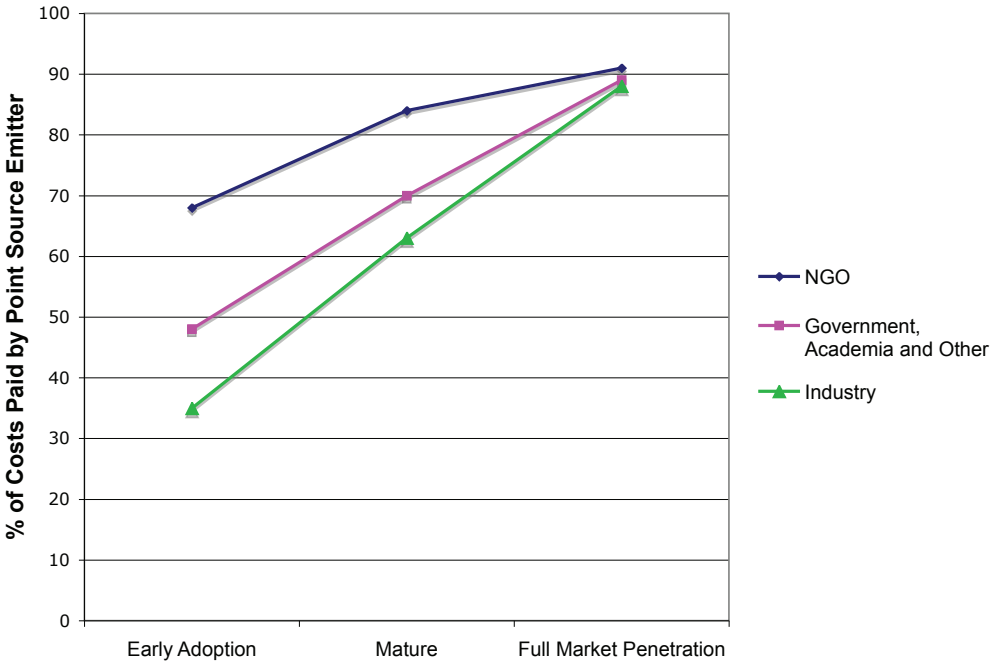


Figure 3:
Sector leaders disagree as to how much private investment is needed in the early stages of developing CCS technology, but all agree that as the technology matures, less taxpayer support will be needed. SOURCE: M.K. JACCARD AND ASSOCIATES

In recent opinion polling commissioned by the Pembina Institute and the University of Calgary's Institute for Sustainable Energy, Environment and Economy (ISEEE), respondents said that industry should eventually pay for the majority of the costs of CCS, as these costs can be transparently passed on to consumers with adequate transition time. Opinions differ on the degree of public versus private investment over the short-term, with some observers suggesting that significant public sector investment is needed to jumpstart CCS projects. Observers on all sides agree on one point: to bridge the gap on an ongoing basis, Canada needs to place a high enough price on carbon emissions to spur implementation of emission reduction technologies.

SEVEN PERSPECTIVES ON CCS

A Coal Guy, an Environmentalist and a Politician: What Do They Think?

Pembina asked seven thought leaders to share their perspectives on Carbon Capture and Storage. To listen to the 10-minute video interviews with each thought leader, visit climate.pembina.org/solutions/ccs

"If we can't get carbon capture and storage to work right, then we really have to think about phasing out the tar sands industry in short order.... [CCS] is the only technology that can take the huge amounts of carbon emissions coming from coal-fired generating plants and from the tar sands industry and permanently storing them. It's the only other option other than decomissioning coal plants and decomissioning the tar sands industry."

Stephen Hazell, Executive Director of Sierra Club Canada

"In the near term if you want to take a really big bite out of emissions from electricity or industry, it looks like wind power, nuclear power and CCS are among the really big hammers."

David Keith, Director of the Institute for Sustainable Energy, Environment and Economy (ISEEE)

"We need a sufficiently high price signal. That's what's going to drive innovation, that's what going to drive the Green Revolution, including carbon capture and storage, more than anything else."

John Drexhage, Director of Climate Change and Energy. International Institute for Sustainable Development

"We are starting, but I think everybody needs to be patient. If we get too far ahead of ourselves we shock the system, we implement technologies that are too risky and they fall apart, and we don't succeed in where we're trying to go."

Doug McLeod, Vice President of Environment, EPCOR

"We need to find a way to make truly renewable technologies work, and that should be our number-one priority. CCS is something we may need to roll out in the short term.... We need to look toward a new vision of a clean energy revolution in Canada and around the world."

Graham Saul, Executive Director of the Climate Change Action Network

"We're trying to get to energizing our society, our economy, heating our homes and energizing everything we do in the way that is the least damaging to the environment and in a way that is actually sustainable in the long run… taking into account that negative stream, that environmental stress stream, that is associated with virtually everything that we do and avoiding it if we can, mitigating it if we must and finding alternatives if that's the way to resolve it."

Preston Manning, President of the Manning Centre for Democracy

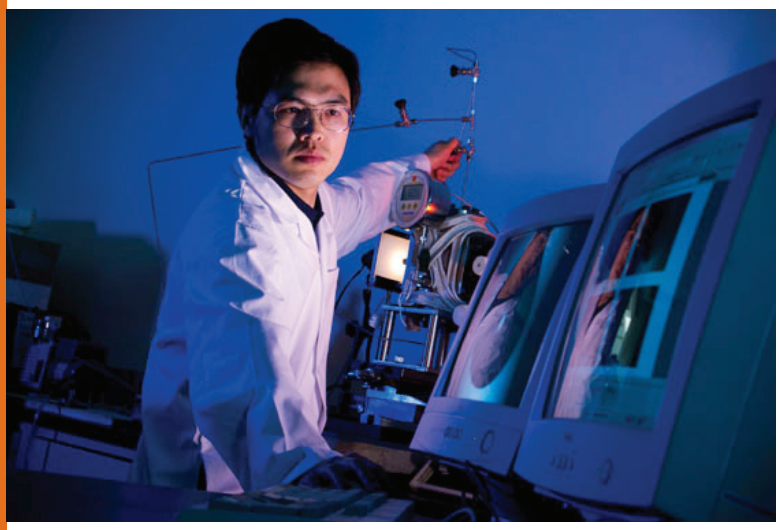
"(CCS) is a technique that's going to allow us to continue to use oil and coal – the two primary high-carbon fuels – into the future for a significant period of time while we begin to develop the other energy sources... to the level where they can be a large proportion of our energy infrastructure."

Stephen Kaufman, Director of Business Development, Suncor Energy

Key Environmental and Liability Concerns

CCS could affect the local environment...

- Dissolved subsurface CO_2 may affect groundwater chemistry.
- Fluids displaced by injected CO_2 may contaminate drinking water, damage mineral resources, or induce seismicity.
- Storage leaks could lead to potentially dangerous concentrations of CO_2 in a local area, posing a threat to human, animal and plant health.
- Pipeline leaks may pose localized risks similar to those from existing hydrocarbon pipelines.



The Petroleum Technology Research Centre in Regina manages the world's largest CO_2 storage project.

PHOTO: PETROLEUM TECHNOLOGY RESEARCH CENTRE

...but the risk of leaks is moderate

Leakage is the most significant risk associated with CCS. According to the IPCC, the amount of CO_2 that will be *retained* in appropriately selected and managed geological reservoirs is:

- very likely to exceed 99% over 100 years;
- likely to exceed 99.9% over 1000 years.

The IPCC estimates that the local risks are comparable to the risks associated with current activities such as natural gas storage.

CCS still raises broader environmental concerns

- CCS for enhanced oil recovery may not result in a net reduction of GHG emissions.
- CCS may not offer the ancillary benefits provided by other GHG reduction options.
- CCS requires more energy than a project without CCS, amplifying the non-climate impacts of resource extraction (e.g. land-use impacts of coal mining).
- Some CCS processes require significant water consumption, as well as the use and disposal of toxics.
- Public investments in CCS could take resources and focus away from other climate change mitigation options.

Regulations are needed

Regulations in Canada do not yet address many of the issues unique to CCS. Issues that need to be addressed include:

- commercially feasible rules for long-term liability;
- access to and ownership of large reservoirs;
- measurement, monitoring, verification and reporting frameworks;
- acceptable levels of risk.

Want More Information?

Visit climate.pembina.org/solutions/ccs for video interviews, CCS information and papers. Reference papers, including the Pembina Institute's *Carbon Capture and Storage: A Canadian Primer* (2005) and the IPCC *Special Report on Carbon Dioxide Capture and Storage*, are also available at this site.

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