
Integrated CO₂ Network

ICON₂

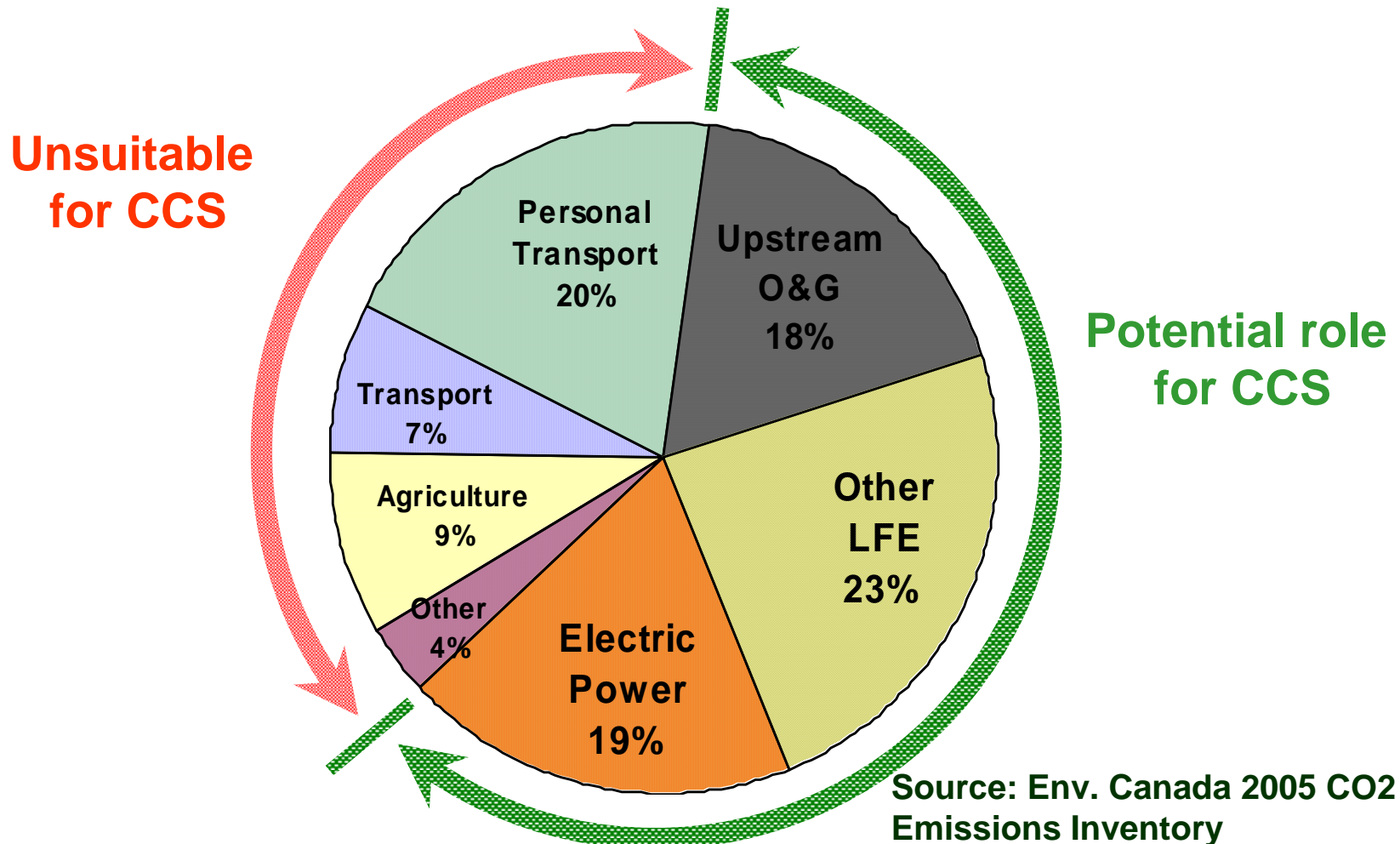
PTAC Vision to Value Forum – November 21, 2006



OVERVIEW

- CCS Fundamentals for Canada
- Need for a Common Vision
- Shared Responsibility and Action
- CO₂ Market Development Concepts
- ICO₂N
- Summary

GHG EMISSION SOURCES IN CANADA



Not every sector can undertake CCS. The varied sources of GHG emissions in Canada require a balanced and broadly funded approach to GHG reductions

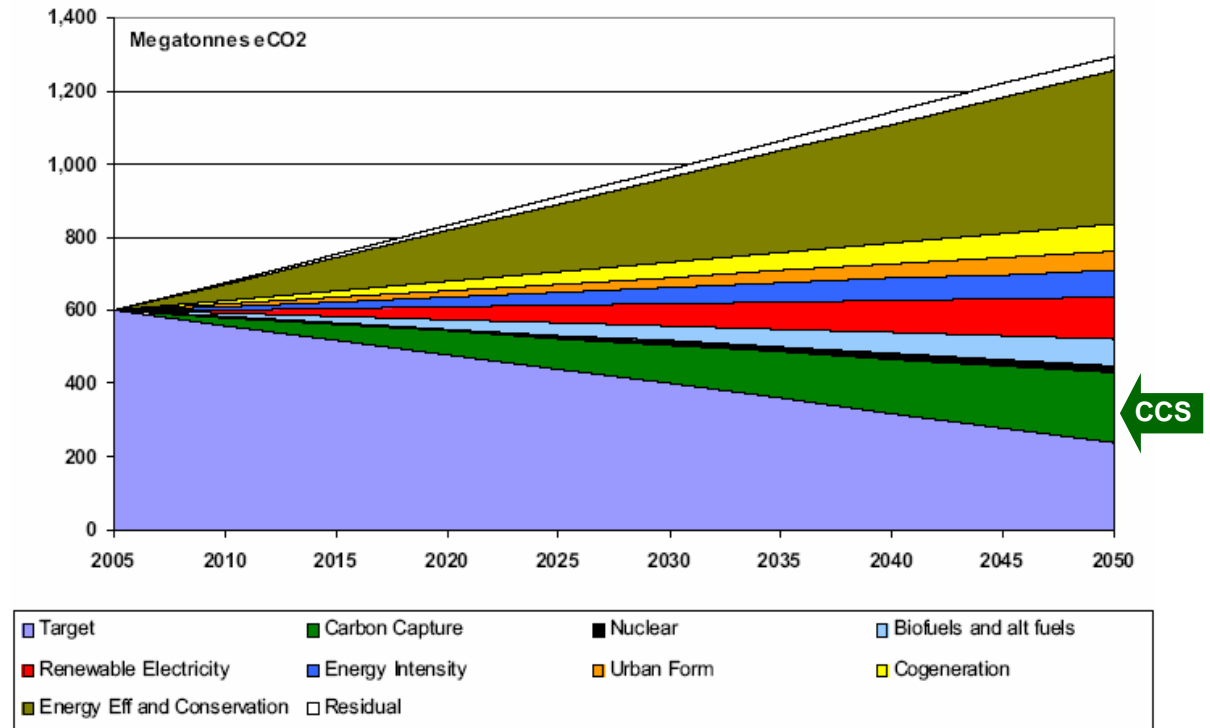
CCS IS IMPORTANT

- CO₂ capture and storage (CCS) is potentially the most substantive way for Canada to reduce GHG emissions. It can deliver **large scale CO₂ reductions within five to ten years**

“From a ‘wedge perspective’, the emissions that could be reduced (by CCS) represents 18 per cent of the overall target and is the largest single wedge.”

National Roundtable on Environment and Energy in the study ‘Advice on a Long-Term Strategy on Energy and Climate Change’

GHG Reduction Diagram for Canada -- Aggregate Wedges



Source: NRTEE ‘Advice on a Long-Term Strategy on Energy and Climate Change’

CCS FITS WITHIN A CANADIAN STRATEGY

Made in Canada

- Investment and CO₂ reductions will occur in Canada. CCS is consistent with a **'Made in Canada'** approach to large-scale, tangible CO₂ reductions in Canada.

Technology Driven

- CCS is an approach based on **advancing technology**. CCS is also an enabling technology with potential to transform Canadian energy production over the next 20 years. It will help transition to lower carbon fuels, while effectively using legacy infrastructure of the oil & gas and electricity generation industries.

“Canada has the opportunity to be on the leading edge of deploying this technology (CCS). This not only has significant benefits for Canada in terms of resource development but it also becomes an important exportable expertise.”

National Roundtable on Environment and Energy in the study 'Advice on a Long-Term Strategy on Energy and Climate Change'

THREE ESSENTIAL ELEMENTS OF CCS

For a CCS system to function, all three elements need to be in place and operational

1. Capture:

- Represents majority of capital investment. However, it is an environmental control activity that is not commercial and not a core business function
- Available as retrofit or designed into new facilities

2. Transportation (pipeline):

- Existing technology applied as a fee for service business
- Needs both willing supplier and customer

3. Enhanced Oil Recovery (EOR) & Storage:

- Commercially driven, with substantial profits expected
- Existing technology - Used for 30 years in the Southern US
- Non revenue sequestration is essential to substantial CO₂ reductions

CCS won't get off the ground if left to the market. CO₂ capture needs to be addressed and ICO₂N is the group to engage.

CURRENT CCS IN CANADA

1. Weyburn

- Approximately 1.8 Mt/yr of CO₂ from a gasifier in North Dakota, 320km pipeline and large scale EOR in Southern Saskatchewan
- Operates with ideal conditions:
 - Ideal CO₂ source (95% pure from coal gasification)
 - Capture is at an electrical plant lowering costs of electricity requirement
 - One of the largest, most suitable geological sites for CO₂ in N. America with close proximity to CO₂ source
- Enhanced through subsidization:
 - ND Gasifier was by US DOE with provisions for CO₂ capture already installed
 - Numerous facets of EOR (research, data verification) supported by Canadian, Saskatchewan and international funding. Including royalty incentives from Saskatchewan

2. Glencoe

- Commercial project using approximately 0.18Mt/yr
- Strategic use combining EOR and low cost CO₂ from process stream emissions

3. Several Proposed Projects

- Kinder Morgan CO₂ pipeline – will proceed only if willing buyers and sellers of CO₂
- Penn West pipeline & EOR – not yet 'ready to go' without government support
- Midale project (Apache) – will piggyback on Weyburn's low cost CO₂ source

Individual projects can prove economic. However these examples do not reflect the challenges facing large-scale deployment of CCS

A COMMON VISION IS REQUIRED

A large network that is planned from the beginning, but can be built in phases, is a key recommendation of ICO₂N's in-depth analysis.

- Coordinated approach is required in order to optimize long term efficiency and effectiveness.
- It will require multiple industry participants and coordinated input from Governments.
- It should be multi-sector and include an open access pipeline transportation system for CO₂ to connect various capture and storage locations.

SHARED RESPONSIBILITY AND ACTION

There is a role for industry and government to work together to overcome investment risk.

- An integrated approach is required to encourage large scale deployment
- Capture companies are willing to pay their part. CCS isn't a for-profit venture.
- Government has a role. Through CCS many companies can make CO₂ reductions that are more than their proportionate share of national targets.

A market based approach is required that:

- Aligns with, and is supported by, industry's natural capital expenditures
- Addresses potential oversupply of CO₂ to the EOR market and possible price erosion
- Provides incentives for early deployment and R&D
- Includes development of CCS regulation that consists of appropriate measurement & verification systems and addresses storage liability

A degree of risk and cost sharing over the long term (~20 years) is essential! Industry cannot act alone.

CCS - NASCENT MARKET DEVELOPMENT

Parameter	Mature Markets	Nascent Markets
Price disclosure	Open	Limited
Number of buyers and sellers	Many	Few of both
Transaction Costs	Usually low	Usually high
Supply/Demand Balance	Close	Can be widely divergent
Monopoly supply or demand	Infrequent	Typically an actual or effective monopoly
Market Growth rate	Low	High, and volatile
Technology	Mature, low rate of change	New, competing alternatives

**CCS has characteristics of an immature market.
Government involvement can advance adoption**

CCS – SIGNIFICANT BARRIERS TO ACTIVITY

Challenges

- Investment risk: large capital investments in an unstable long-term operating environment
 - Uncertain compliance rules, credit mechanisms over long term
 - Uncertainty of EOR uptake and ultimate revenue potential
- Cost of alternatives (Eg: credit purchase) are lower than cost of CCS
- Uncertainty as to technical cost improvements (CO₂ capture, Clean Coal, Gasification)
- Requirement for large scale “disposal” (greater than EOR) to address large GHG volume reduction

Progress on CCS will be limited without government and industry jointly addressing these barriers

OVERVIEW OF THE ICO₂N INITIATIVE

- The ICO₂N concept is an integrated system that combines strong policy with infrastructure development to encourage CCS across Canada.
- Twelve (12) major companies from a cross section of industries with potential to capture CO₂ working together on business planning and rational system design.
 - **Suncor Energy**
 - **TransAlta**
 - **Agrium**
 - **ConocoPhillips**
 - **Nexen**
 - **Husky Energy**
 - **Sherritt International**
 - **Syncrude**
 - **Shell Canada**
 - **Air Products**
 - **CNRL**
 - **Imperial Oil**
- ICO₂N seeks to optimize current operations / capital investment in anticipation of, and consistent with, future carbon constraints.
 - CCS supports investor and public confidence in sustainable oil sands growth by deploying existing CO₂ reduction technology.
 - CCS also enables significant reductions in CO₂ emissions from fossil fired electricity generation through gasification.
- ICO₂N offers an effective vehicle for Governments to engage industry in an effort to overcome the challenges facing CCS.

SUMMARY

- CCS is very important to future GHG reduction potential
- There are multiple benefits to Canada and the province from an integrated CCS system that is designed from the start.
- A market based system alone will not foster large scale CCS development
- Long-term benefits will only be realized with clear framework and appropriate regulation / policy design - linked to near-term capital investment decisions.
- Collaboration between industry and governments is essential.

Supplementary Information

SUMMARY OF INTERNATIONAL PROJECTS

Project	Year	Mt CO ₂ /yr	Project Capital	Type of Government Funding	Fundamental Commercial Driver & General Comments
Sleipner, Norway (Statoil)	1996	1	\$440 M (in CCS)	49% ownership of project	Compliance Driven: US\$40 CO ₂ tax helps drive economics
In Salah, Algeria (BP)	2004	1	\$8.4 B (100M in CCS)	Yes, 50% Statoil ownership	<ul style="list-style-type: none"> ▪ Removal of 10% CO₂ in methane stream. ▪ Project required CO₂ removal from the gas field and needed pressure maintenance elsewhere in the field. ▪ Not likely profitable and a corporate statement by BP
Existing US EOR	1970s	3.6		EOR tax credits	EOR supplied with inexpensive, naturally occurring CO ₂
FutureGen, USA	2011	1 – 2	\$1 B	DOE (U.S.) funding	Allowed to pass through costs to consumers???
Carson, USA (BP)	2011	4	\$1 B	Seeking public funding	petcoke gasifier with H ₂ power plant, CO ₂ sent to EOR
ZeroGen, Australia	2010	0.4	\$1 B	State-owned enterprise, + \$300M in additional funding	
Peterhead, UK (BP)	2009	1.8	\$600 M	Seeking public funding	Onshore coal gasifier power generation, offshore EOR

All figures are in US dollars – for the entire project, or for the CCS component only where noted.

CCS – WHAT THE EXPERTS ARE SAYING

IPCC Special Report on CCS issued Sept 2005

- *“In most scenario studies, the role of CCS in mitigation portfolios increases over the course of the century and including CCS in a mitigation portfolio is found to reduce the costs of stabilizing CO₂ concentrations by 30% or more”*

International Energy Agency - Claude Mandil, Executive Director June 2006

- *“If we do not succeed in making CCS viable, the cost of mitigating CO₂ emissions will be much higher”*

Dr. Howard Herzog- Laboratory for Energy & Environment-MIT (Scientific American.com Feb 14, '05):

- *“There's still a gap between the marketplace and the technology,”*

Dr. Robert Socolow, Princeton University (July 2005, Scientific American):

- *“The good news is that the technology for capture and storage already exists and that the obstacles hindering implementation seem to be surmountable.”*

David Hawkins- National Resource Defense Council (US NGO) (Scientific American.com Feb 14, '05):

- *“The best way to make CCS cheaper is for government to provide incentives to use it. Learning by doing is the thing that drives the cost down, not R&D dollars.”*

Dr. Judy Griffiths – the Pembina Institute in a report on CCS authored - October 2005:

- *“CCS might play an important role in reducing industrial emissions while the overall economy restructures to a de-carbonized energy system, especially as renewable energy and energy conservation may be insufficient to achieve the deep reductions (in the range of 50-60%) required in the mid-term.”*

NRCan CCS Technology Roadmap Document - May 2006:

- *“Developing world-class, low emissions energy sectors is the primary benefit of deploying domestic CCS infrastructure and systems. Achieving such an outcome would result in Canada becoming a leader in CCS technology deployment. However, this opportunity can only be realized if industry and government collaborate to address the technical, cost and policy barriers of CCS.”*

Canadian National Roundtable on the Environment and the Economy - June 2006

- *“Carbon capture and storage and “clean coal” technology virtually eliminate other forms of air pollution, such as emissions of SO₂, NO_x, mercury and particulate matter.”*

UK MP Alex Salmond on the proposed BP project in Scotland

- *“The viability of this project now depends on decisions to be made by the UK government. It is vital that an appropriate level of incentive is offered to this new technology, to match the current packages available through Renewables Obligation Certificates to other exciting developments.”* Buchan Observer July 12, 2006