

**“Carbon capture and sequestration technology holds enormous potential to reduce our greenhouse gas emissions as we use our own energy resources to power our economy.”**

*Prime Minister Stephen Harper, February 19, 2009*



# Large-Scale CCS Demonstration Projects in Canada

**IEA WPF - MOST CCUS Workshop: Joint Activities and Opportunities**

**Marc D'lorio, Director General, Natural Resources Canada  
Beijing, 18-19 September 2011**



Natural Resources  
Canada

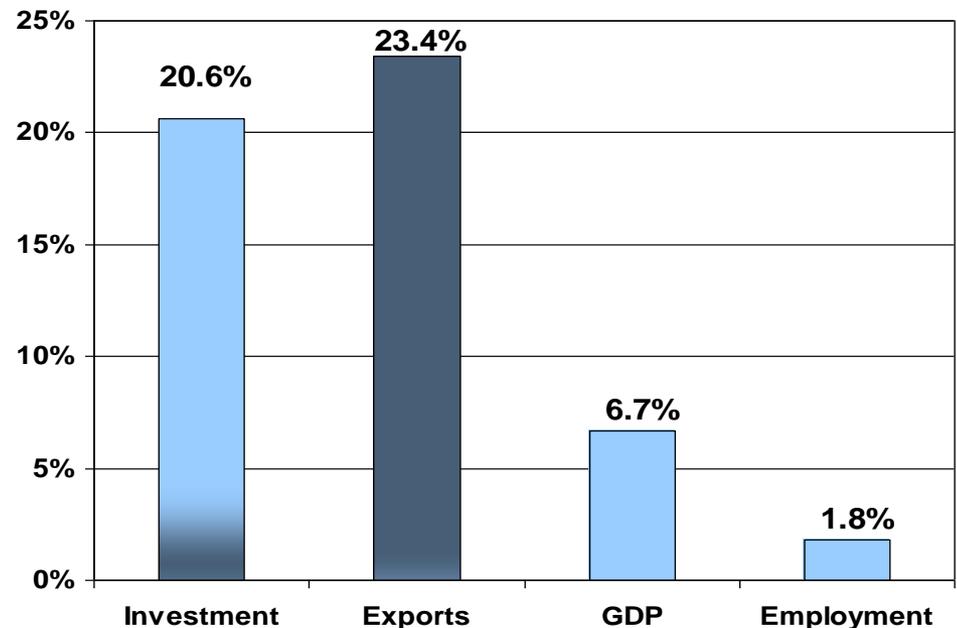
Ressources naturelles  
Canada

**Canada**

# Energy – Important to Canada’s economic prosperity

- Energy means more to Canada than any other industrialized country
  - Only OECD country with sustained oil production growth
  - Stable and secure energy supplier
  - Major consumer
- \$84B in exports in 2009, primarily oil and gas
  - 23.4% of total exports
- In 2009, energy represented 6.7% of GDP, with direct employment of about 263,000 people

Energy as a Percentage of Canadian Total (2009)



# Opportunities for CCS in Canada

GHG Emissions by Jurisdiction

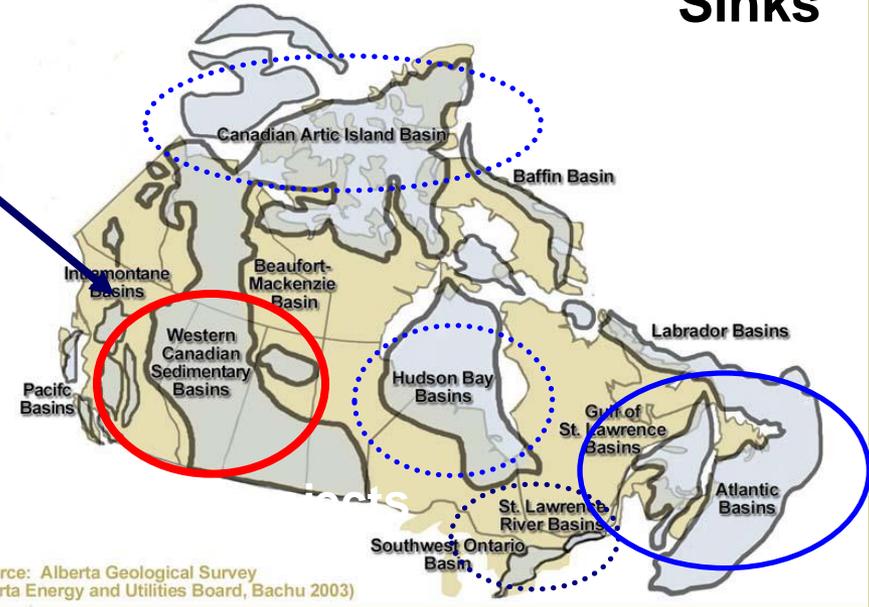
## Sources



Many large point sources are located near potential storage sites

Canada's Sedimentary Basins

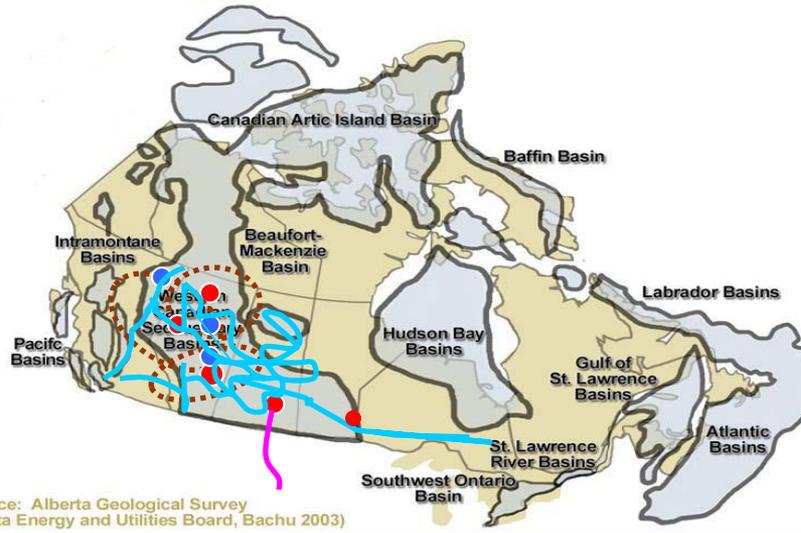
## Sinks



Source: Environment Canada 2005

## Experience

Canada's Sedimentary Basins



- Enhanced Oil Recovery using CO<sub>2</sub>
- Acid gas operations
- Deep Saline Formation Storage projects
- Gas pipeline
- CO<sub>2</sub> pipeline

(Source: Alberta Geological Survey, Alberta Energy and Utilities Board, Bachu 2003)



Natural Resources Canada

Ressources naturelles Canada

Canada

# Canada's Investments in Demonstration Projects

**\$3 billion in public funding, \$7 billion total investment**

## Spectra - Fort Nelson

Project: Natural gas processing  
Capacity: 2 Mt/yr  
Public \$: \$7.4M fed + \$3.4M prov

## Shell - Quest

Project: Oil sands  
Capacity: 1 Mt/yr  
Public \$: \$120M fed + \$745M prov

## TransAlta - Pioneer

Project: Coal-fired electricity  
Capacity: 1 Mt/yr  
Public \$: \$342.8M fed + 436M prov

## Enhance - Alberta Carbon Trunk Line

Project: Oil sands & pipelines  
Capacity: 1.9 Mt/yr (14.6 Mt/yr)  
Public \$: \$63.2M fed + \$495M prov

## Weyburn-Midale CCS Project

Project: Gasification, MMV  
Capacity: 2.8 Mt/yr  
Public \$: \$15.2M fed + \$3.8M SK + \$1.05M AB

## Swan Hills

Project: In-situ coal gasification  
Capacity: 1.3 Mt/yr  
Public \$: \$285M prov (no fed \$)

## SaskPower - Boundary Dam

Project: Coal-fired electricity  
Capacity: 1 Mt/yr  
Public \$: \$240M fed



# SaskPower's Boundary Dam coal-fired power plant

- SaskPower announced its final investment decision to move forward with the CCS components of the project in April 2011
- 110 MW demonstration
- Re-build of existing unit: boiler and turbine upgrades, integration of FGD and CO<sub>2</sub> capture
- Capture 1 million tonnes annually CO<sub>2</sub> by 2014
- CO<sub>2</sub> for Enhanced Oil Recovery
- Public funding: Government of Canada: \$240 million
- **Status:**
  - SaskPower has chosen SNC Lavalin to oversee detailed engineering, procurement and construction activities at the Boundary Dam project
  - Cansolv, a wholly owned subsidiary of Shell Global Solutions, will supply the carbon capture process. (Amine-based)
  - Hitachi will supply a state-of-the-art steam turbine - the first in the world designed to fully integrate a coal-fired power plant with carbon capture technology
  - Boiler and turbine rebuild will begin in 2013



# SaskPower Boundary Dam



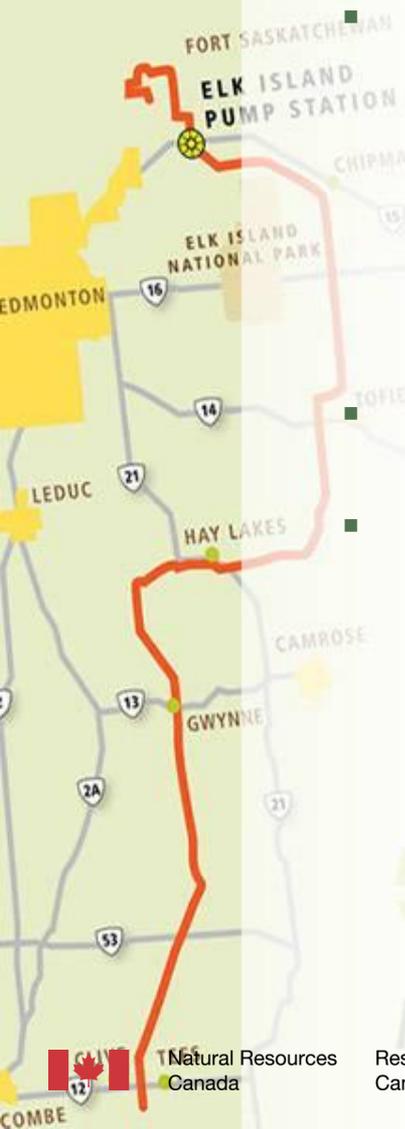
# Shell's Scotford Oil Sands Upgrader

- Joint venture between Shell Canada (60%), Chevron Canada Limited (20%) and Marathon Oil Sands L.P. (20%)
- Capture from steam methane units which produce hydrogen for bitumen to synthetic crude oil
- Capture and store 1 million tonnes annually, starting in 2015
- CO<sub>2</sub> storage in deep saline formation
- Two injection wells in test phase
- Public funding: Government of Canada: \$120 million, Government of Alberta: \$745 million
- **Status:**
  - Regulatory applications for the Quest Project were submitted in November 2010. Pending regulatory approval, Shell will make a decision to proceed with the project in 2012, with first injection in 2015.
  - Shell began consulting with the community on the project in 2008 and will continue to talk with and listen to communities, landowners, governments and other stakeholders throughout the life of the project.
  - Detail engineering stage currently underway

# Enhance Energy Alberta Carbon Trunk Line



- **240 kilometre CO<sub>2</sub> pipeline**
- **Objectives:**
  - Develop and build the first leg of a CO<sub>2</sub> gathering and transmission infrastructure in Alberta;
  - Provide opportunities for recovery of incremental oil reserves not accessible with current secondary enhanced recovery schemes;
  - Sequester up to 15 million tonnes of CO<sub>2</sub> in the Clive and Bashaw reservoirs during and subsequent to enhanced oil recovery operations.
- The initial **supply of CO<sub>2</sub>** will come from Agrium Inc and later North West Upgrading Inc.
- **Public funding:**
  - Government of Canada: \$63.2 million
  - Government of Alberta: \$495 million
- **Status:**
  - Landowners have provided consent
  - Expect regulatory approval shortly
  - Detailed engineering is nearly complete and procurement underway for the Agrium CO<sub>2</sub> Recovery Facility
  - Long lead items have been procured for the North West Refinery



# IEAGHG Weyburn-Midale CO<sub>2</sub> Monitoring and Verification Project

- Commercial EOR project with a field research program for CO<sub>2</sub> monitoring and storage
- The first phase of research, launched in 2000 and completed in 2004, determined that the oil field was a suitable, stable geological formation for long-term storage
- The final phase of the project began in 2005 and will be completed in 2011
- Through an integrated approach between technical and non-technical research, the end deliverable of the Final Phase is to compile a **Best Practices Manual** to guide all aspects of future CO<sub>2</sub> storage projects including:
  - **Technical Components:** Site Characterization, Monitoring and Verification, Wellbore Integrity and Performance Assessment
  - **Policy Components:** Regulatory Issues, Public Communication and Outreach and Business Environment
- **Funding:**
  - Canadian governments: \$20.05 million
  - US Department of Energy: \$13.9 million
  - Industry: \$6.9 million



# Sharing Learnings from Large-Scale Demonstrations

- In order to ensure the rapid deployment of CCS, Canada is engaging in knowledge-sharing activities both domestically and internationally.
- Canada is working to develop a knowledge-sharing framework in order to collect and disseminate learnings from large-scale demonstration projects
- Categories of CCS related knowledge – technical and performance, cost, project management, environmental impacts, health and safety, MMV
- Knowledge holders and stakeholders – federal and provincial governments, project proponents, technology and services providers, R&D community, academia, NGOs, public
- Examples of International collaboration:
  - Canada-U.S. Clean Energy Dialogue (CED)
  - Global CCS Institute
  - Canada-EU High-level Energy Dialogue



# Addressing Legal and Regulatory Issues

## ***Federal Government***

- On August 27, 2011, the Government of Canada published draft GHG regulations for coal-fired electricity generation in Canada Gazette Part 1, commencing a 60-day comment period. Starting on July 1, 2015, all new coal-fired unit and units reaching the end of their economic life would have to meet a stringent performance standard equivalent to the emissions of high-efficiency natural gas-fired generation. Under the proposed regulations, new coal-fired units and those reaching the end of their economic life that incorporate CCS technology will receive a temporary deferral from the standard until 2025. Final regulations are expected to be published in 2012.

## ***Provincial Governments***

- Alberta
  - CCS Statutes Amendment Act - Bill 24 (2010)
  - Alberta Regulatory Framework Assessment
  - The Carbon Sequestration Tenure Regulation will outline the administrative details and processes necessary for the Energy Minister to issue agreements for pore space access
- British Columbia
  - reviewing its oil and gas regulatory framework to identify issues, gaps and changes needed to facilitate CCS project development
- Saskatchewan
  - amending its Oil and Gas Conservation Act to accommodate the development of CCS
- Nova Scotia
  - developing a legal report and a regulatory roadmap for a potential future CCS project



# Summary

- The energy sector is a critical component of the Canadian economy
- CCS is one component of Canada's approach to reducing GHG emissions.
- Canada supports R&D, demonstration, regulatory development and public engagement in CCS
- We are working with provinces and industry to make CCS technically and economically feasible
- Canada is engaged domestically and internationally on CCS

