

Carbon Sequestration Leadership Forum

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CCS Activities in Canada

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Technical Group Meeting

May 18-19, 2011

Edmonton, AB, Canada



Canada's Conditions

Canada's economy is resource-based, located in a cold climate, hence the need for energy for resource production, power generation and heating, and with large distances between population centers, hence the need for energy for transportation

Canada is ranked 9th in the world in terms of its greenhouse gas emissions, however with only ~ 1.6% of world emissions compared with ~25% and ~23% respectively for #1 and #2: China and US

Canada's emissions grew since 1990 by >35%

Canada's economy is similar only to those of Australia and Norway, but, unlike them, is closely linked with the economy of the US, hence the solution to reducing greenhouse gas emissions has to be unique to Canada's conditions



CCS in Canada's Strategy for Reducing GHG Emissions

- Energy production is a critical component of the Canadian economy
- Canada has ambitious GHG reduction targets
- The goal – reconciling an economically important energy sector with climate change objectives
- Carbon capture and storage (CCS) is one element of achieving that goal

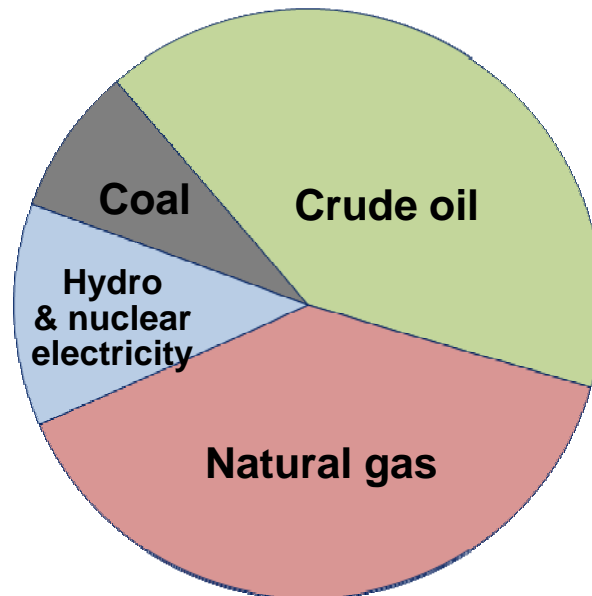
“Carbon capture and sequestration technology holds enormous potential to reduce our greenhouse gas emissions as we use our own energy resources to power our economy.”

Prime Minister Stephen Harper , February 19, 2009

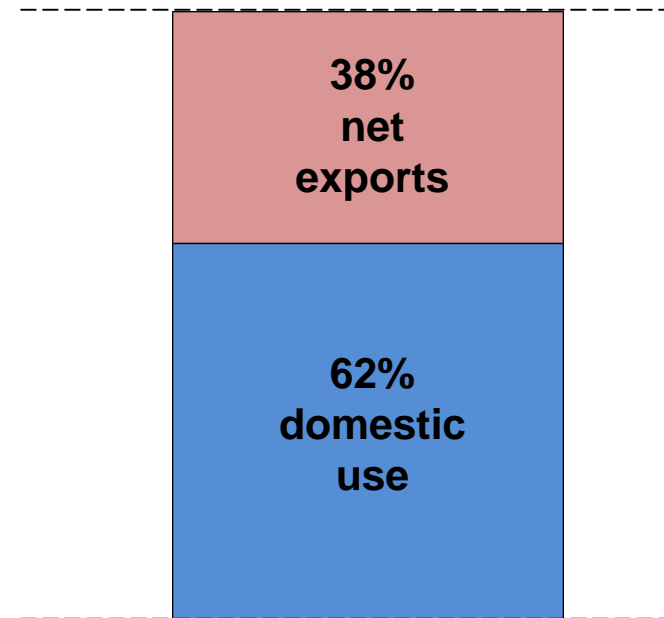


Fossil Fuels Remain Key in Canada's Energy Portfolio

Energy Usage (2008)



Energy Exports (2008)





Canada's Specific Conditions

Asymmetry in:

- Jurisdictions
- Population distribution
- Geology
- Industrial Base
- Greenhouse gas emissions profile



Asymmetrical solution to reducing CO₂ emissions

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Canada's Sedimentary Basins

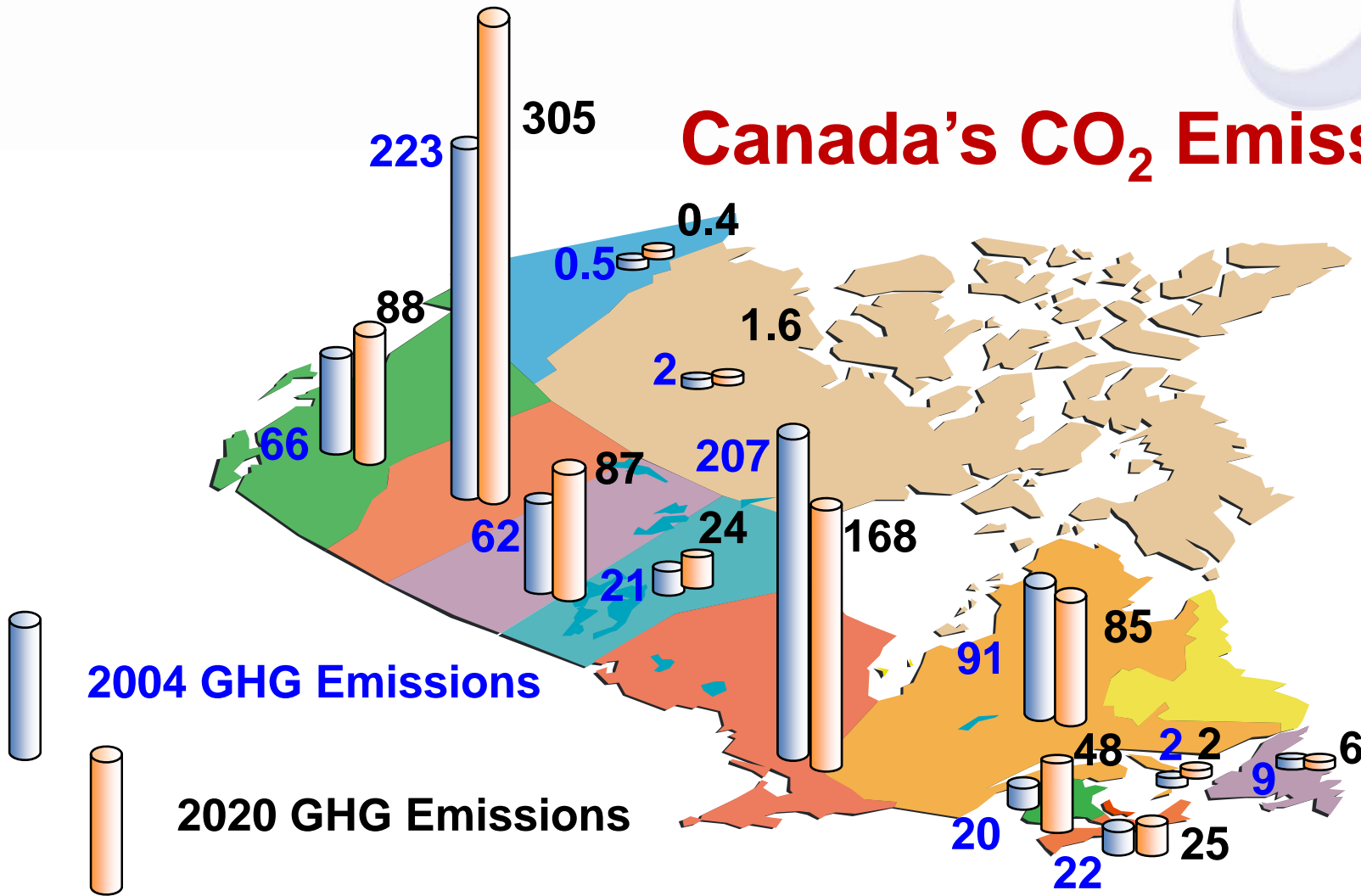


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Canada's CO₂ Emissions



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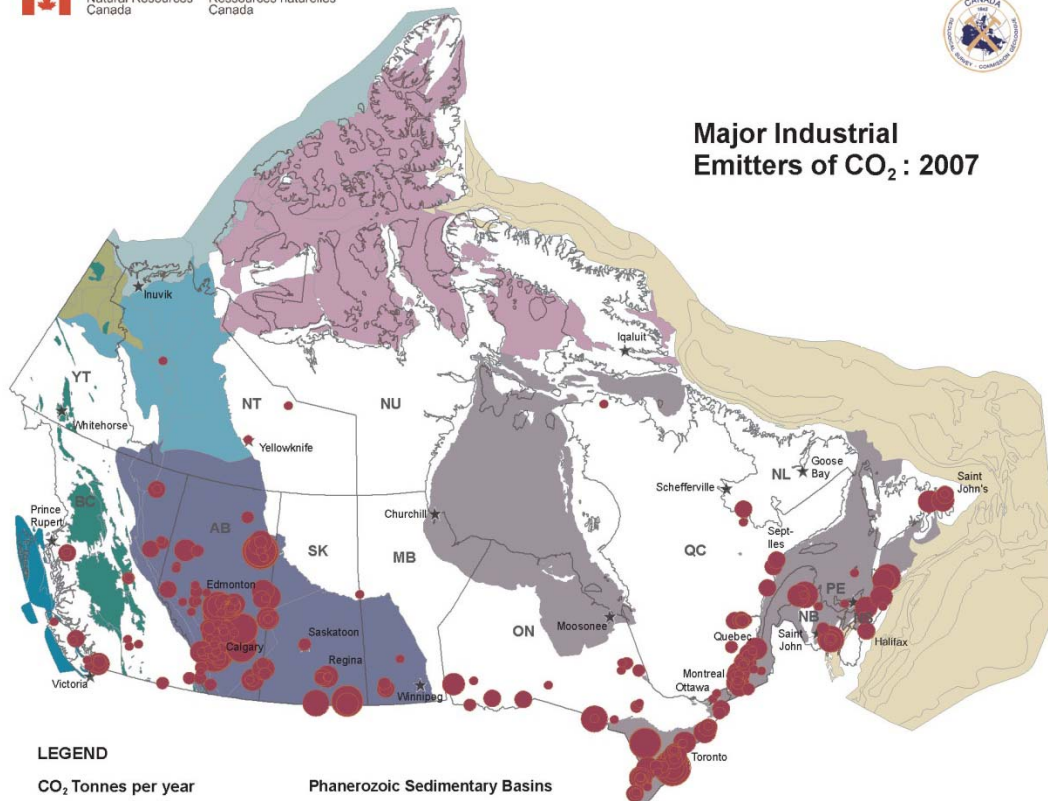
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 Natural Resources Canada / Ressources naturelles Canada



Major Industrial Emitters of CO₂ : 2007



LEGEND

CO₂ Tonnes per year

- 100,000 - 250,000
- 250,000 - 500,000
- 500,000 - 1,000,000
- 1,000,000 - 2,500,000
- 2,500,000 - 5,000,000
- 5,000,000 - 10,000,000
- 10,000,000 - 25,000,000

Phanerozoic Sedimentary Basins

- Arctic Islands Basin
- Arctic Margin Basin
- Eastern Canada Offshore Basin
- Eastern Cratonic Basin
- Intermontane Basin
- Northern Interior Platform
- Northern Yukon Fold Complex
- Pacific Margin Basin
- Western Canada Sedimentary Basin

KM
0 500 1,000

Distribution of Large Stationary CO₂ Sources in Canada

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Canada's Sedimentary Basins Targeted for CCS

CCS activities are focused in:

- Alberta
- Saskatchewan
- NE British Columbia
- Nova Scotia



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Canada's Approach

- Federal focus on legislation for reduction of GHG emissions without affecting economic recovery and development of Canada's resources
- International engagement (Canada-US, Canada-UK, Canada-EU, CSLF, IEA, GCCSI, APEC, Major Economies Forum, International Energy Forum)
- Provincial and federal focus on large-scale, integrated demonstration projects that will prove the technology
- Research provided by federal and provincial laboratories, and by universities under the Carbon Management Canada (CMC) Network funded by the federal and provincial governments
- Provincial focus on development of legislative and regulatory framework for CO₂ storage
- National effort led by the federal government (Geological Survey of Canada) to map and inventory the CO₂ storage capacity in the sedimentary basins that will be the focus of CCS activities in the short-to-medium term, as part of the Atlas of CO₂ Storage Capacity in North America (coordinated effort with US and Mexico)

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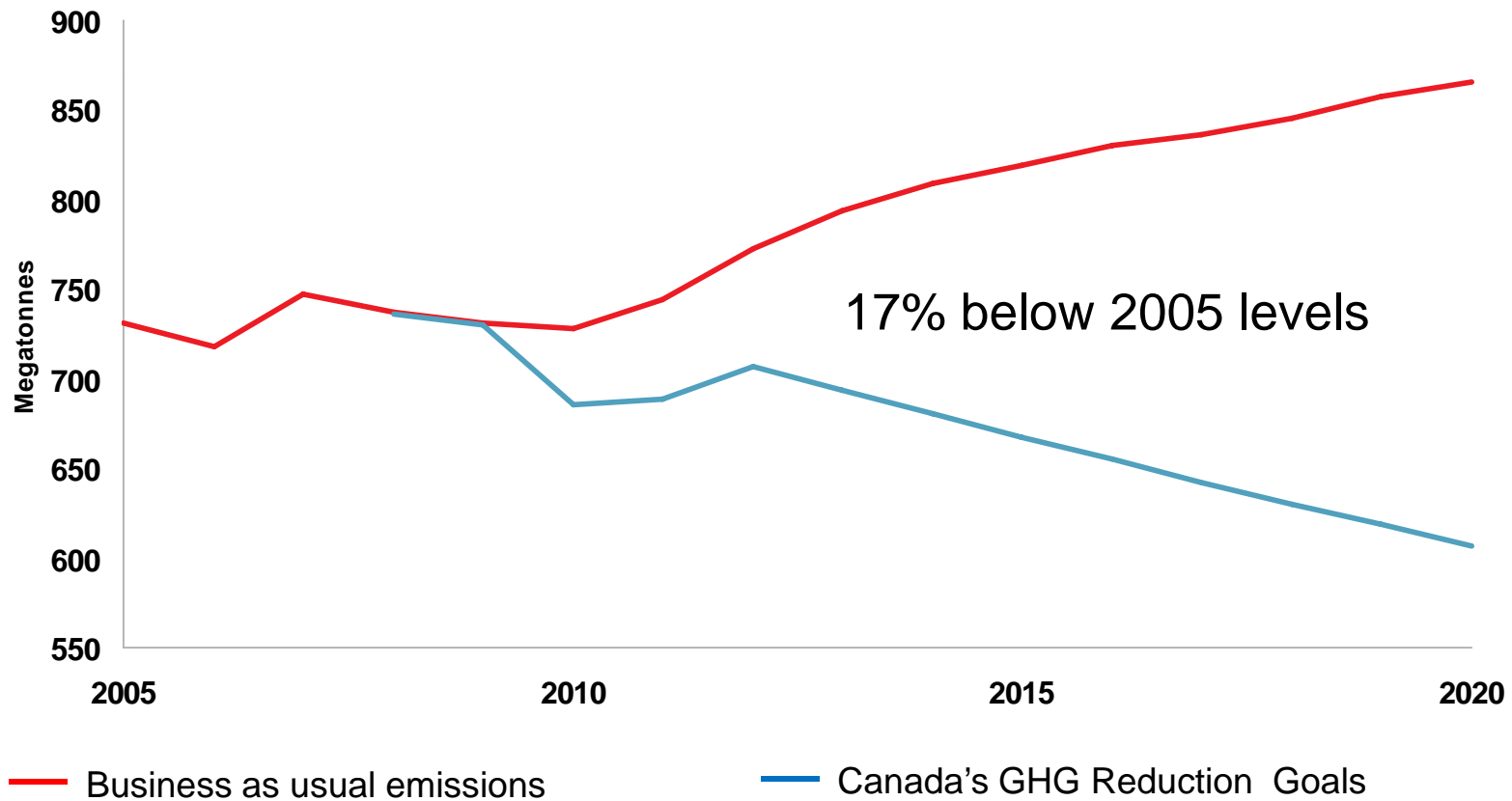


Canada's Federal Government

- Awarded CAD 140M in 2009 to 7 CCS projects in western Canada
- Awarded CAD 240M to SaskPower to for CO₂ capture at Unit #3 (110 MW) of its Boundary Dam coal-fired power plant
- Awarded CAD 5M to CCS Nova Scotia for identification of a CO₂ storage site in Nova Scotia and develop front end engineering design (FEED) for CO₂ capture and storage from one of the 5 power plants of Nova Scotia Power
- New 5-years, CAD 1B Clean Energy Fund announced in 2010 for:
 - large scale CCS demonstration projects (650M),
 - R&D, including CCS (150M)
 - alternative energy (200M)
- Currently developing regulations for new coal-fired power plants and for plants reaching the end of their economic life to meet GHG emission intensity performance standards equivalent to those of high-efficiency natural-gas power generation



Canada's Federal Government Emission Reduction Targets





Alberta's Government Legislative Actions

- Legislated in 2007 reduction in 2020 of GHG emission intensity ratio to GDP by 50%, with an immediate reduction of 12%, through:
 - Actual emission reduction
 - Purchase of Alberta accredited offsets
 - Payment of \$15/t CO₂ into Technology Fund
- By 2050 CO₂ emissions should be 50% of those in a Business as Usual (BAU) scenario and 14% below 2005 levels, of which 70% would be by application of CCS (~140 Mt/yr)
- Passed “CO₂ Capture and Storage Statutes Amendment Act” by which:
 - The pore space is owned by the Crown
 - Designated the Energy Resources Conservation Board as the regulatory agency for CO₂ storage
 - Stated that the Province will assume long-term liability of stored CO₂
 - Established that CO₂ storage sites must be at least 1 km deep
- Established a Regulatory Framework Assessment process to review regulations as they pertain to CCS



Alberta's Government Project Support

- Established a Climate Change and Emission Management Fund into which industry pays CAD 15/t CO₂ emitted over target, to be used for technology development and diffusion (the fund stood last year at > CAD170M and projects have been funded this year)
- Established a CAD 2B fund for supporting four CCS projects in the province that will inject at least 1 Mt CO₂/year each by 2015, funded also by the federal government:
 - Shell's Quest (CSLF Recognized): CO₂ storage in a deep saline aquifer (1 Mt CO₂/year)
 - TransAlta's Pioneer: Alstom's chilled ammonia capture from a coal-fired power plant and storage in EOR and deep saline aquifer (1 Mt CO₂/year)
 - Enhance Energy's "Trunkline": capture from fertilizer plant, transportation by 280 km pipeline and storage in EOR (1.9 Mt CO₂/year)
 - Swan Hills Synfuels: coal underground gasification, CO₂ capture and storage in EOR (1.3 Mt CO₂/year)

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Alberta's Government Objectives in Project Support

- Demonstration of large-scale integration of CCS technologies for various classes of CO₂ emitters
- Build public confidence in CCS technologies
- Reduce Alberta's CO₂ emissions
- Develop a world-class legal and regulatory framework for CCS
- Contribute to the global effort of learning by doing; knowledge sharing being a condition of approval and funding of these projects



British Columbia's Government Initiatives

- Established a Carbon tax on gasoline of 1 c/L
- Is supporting Spectra's Fort Nelson CCS project (CSLF recognized) that will capture CO₂ from a gas plant and store between 1.2 and 2 Mt CO₂/year in a deep saline aquifer, funded also by the federal government
 - The US Department of Energy is also participating in the Fort Nelson project through the Plains CO₂ reduction Partnership (PCOR)
- Is reviewing its legal and regulatory framework to facilitate CCS projects



Saskatchewan's Government Initiatives

- Supports through royalty rebates the Weyburn-Midale EOR project
- Supports, with the federal and Alberta governments, the IEA-GHG Weyburn-Midale Monitoring and Verification project
- Provides support to SaskPower for retrofitting its Unit #3 at the Boundary Dam coal-fired power plant in southeast Saskatchewan for capture of 1 Mt CO₂/year and storage in EOR
- Is amending its Oil and Gas Conservation Act to accommodate CCS development

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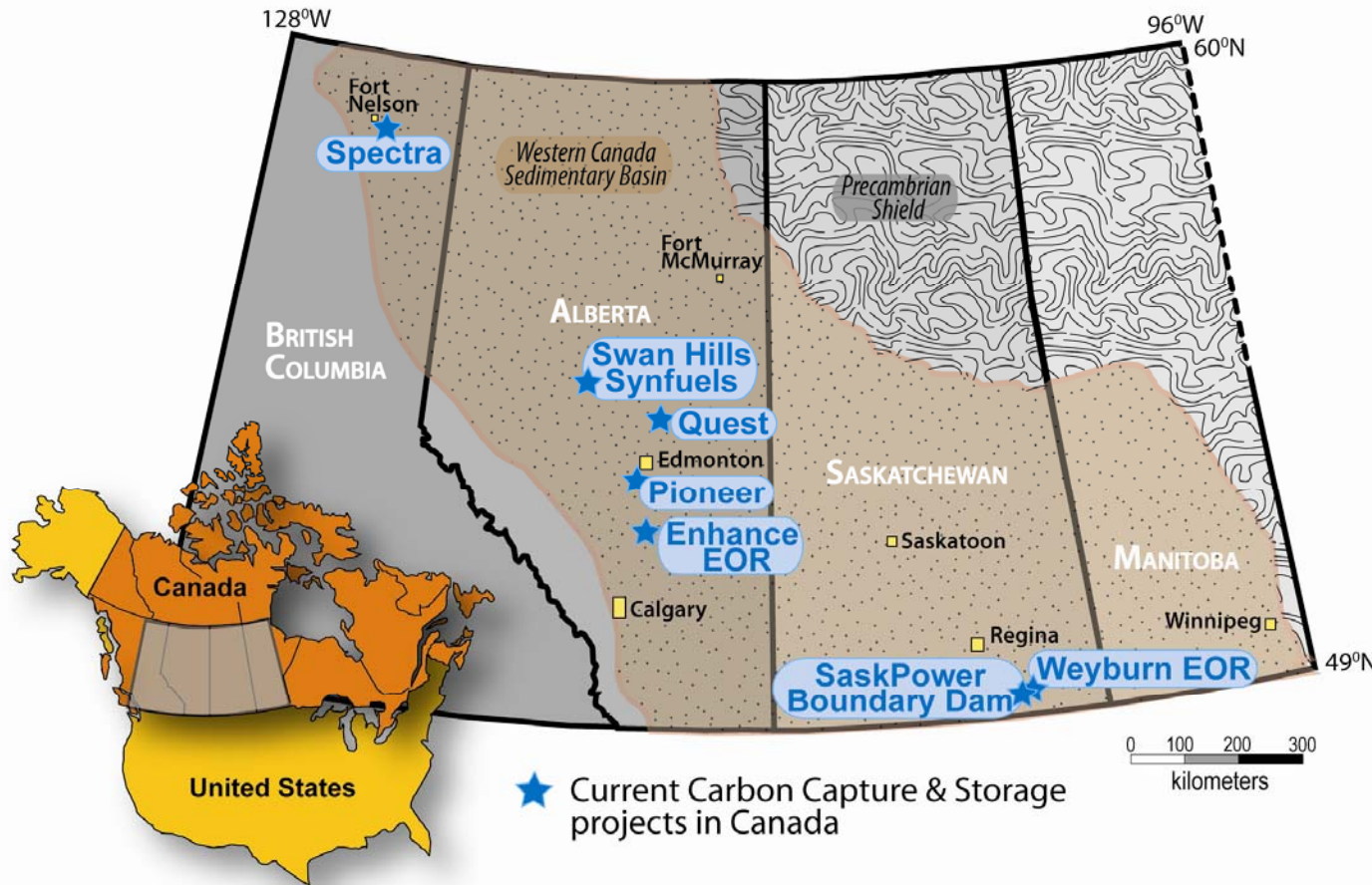


Other Projects Partially Supported by the Federal Government

- HARP project in Alberta (CSLF recognized)
- Husky's project in Saskatchewan for CO₂ capture from a heavy oil upgrader and a bioethanol plant and storage in heavy oil reservoirs
- Aquistore project in Saskatchewan for CO₂ storage in a deep saline aquifer

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Current CCS Projects in Western Canada



Concluding Remarks

- Governments in Canada are focusing on the deployment of integrated large-scale demonstration projects, developing the proper legal and regulatory framework for CCS implementation, knowledge sharing and public engagement
- Currently there are between 6 and 9 CCS projects in western Canada in various phases of planning and implementation, likely to be operational by 2015 and injecting upwards of 10 M tCO₂/year
- If a storage site is found, Nova Scotia will be another province in Canada where CCS will be deployed
- CCS may be applicable on a small scale in other provinces, but the main impact will be in the western provinces