

Geological Carbon Capture & Sequestration In Canada

**CEC Joint Public Advisory Committee
Vancouver, British Columbia, Canada
March 24, 2010**

Dale Friesen
ATCO Group of Companies, Utilities

ATCO
GROUP

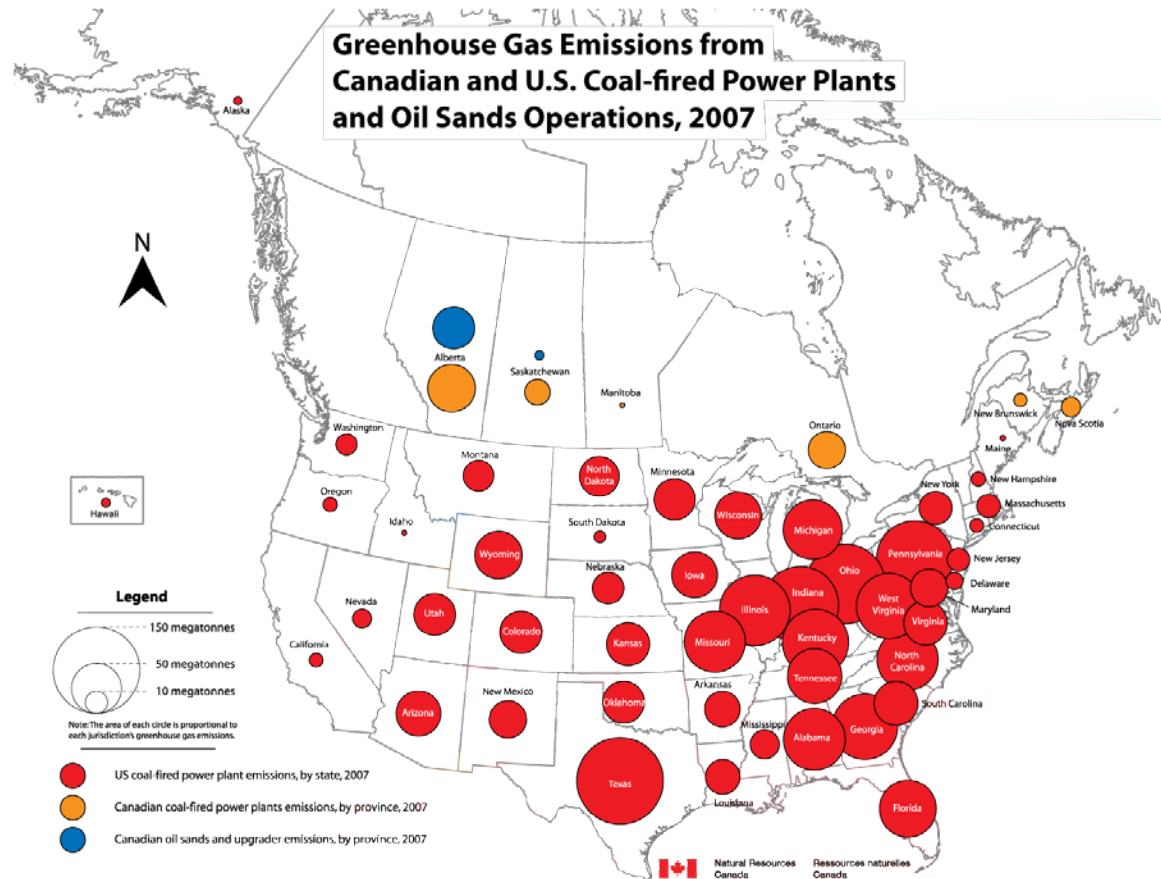
Agenda

- 1. Power Sector: Emissions Profile**
- 2. Canadian CCS Opportunities**
- 3. Challenges**
- 4. Transitioning to a Low “C” Economy**

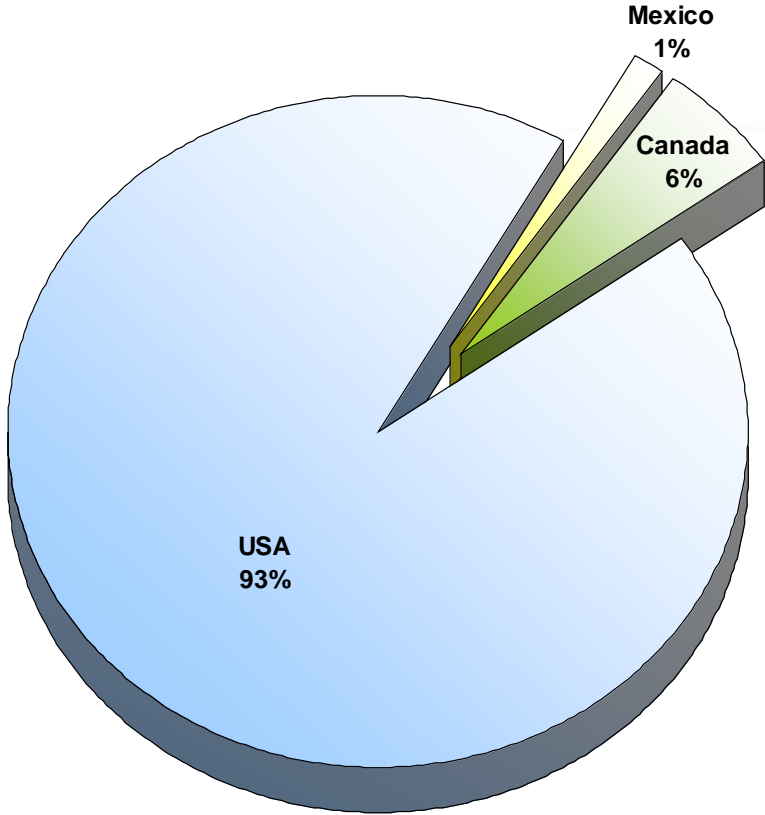


CO2 Emissions: Power Industry & Oil Sands

- **Canada:**
26 Coal Fired Generating Stations
- **USA:**
600 Coal Fired Generating Stations



Coal Emissions: Power Generation

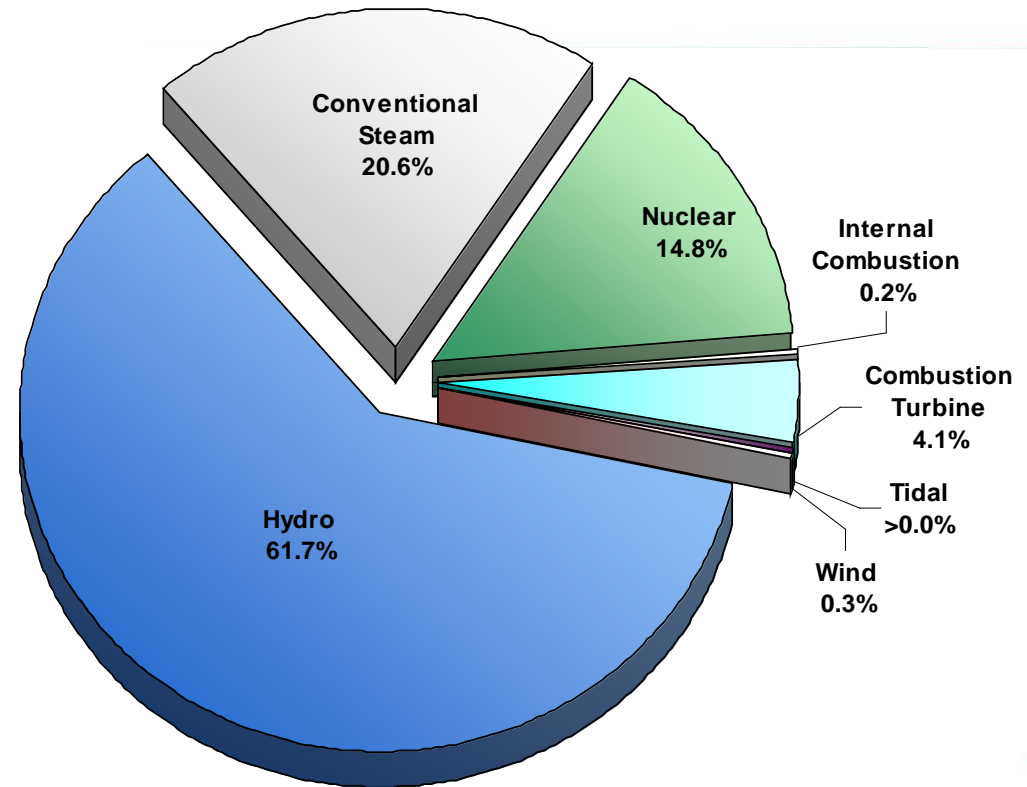


Reference: 2008 United States Energy Information Agency

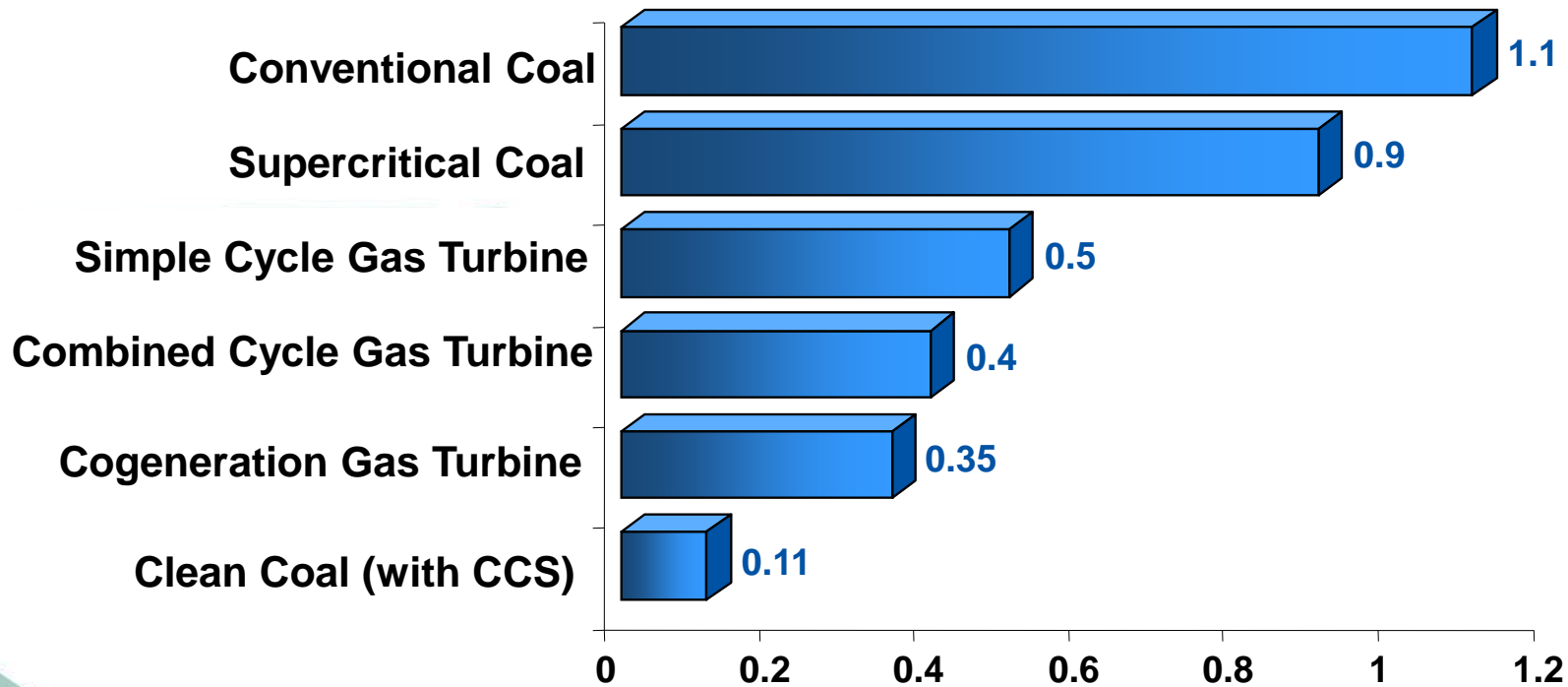
Canada's Electricity Generation

- 62% Hydro
- 75% Non-Emitting
- Opportunity to reduce GHG emissions with CCS

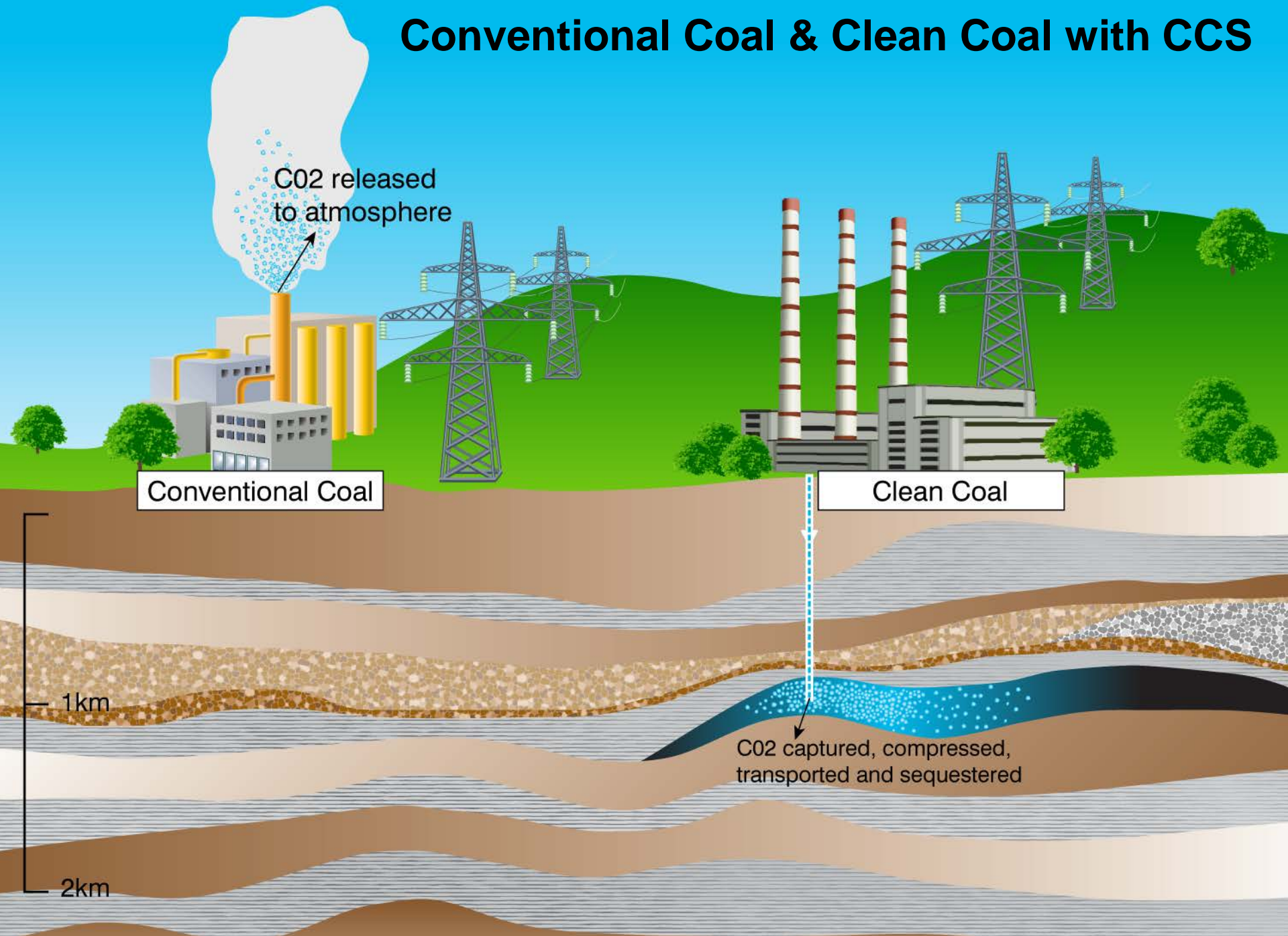
Total Electricity Generation (2008)
~ 600TWh



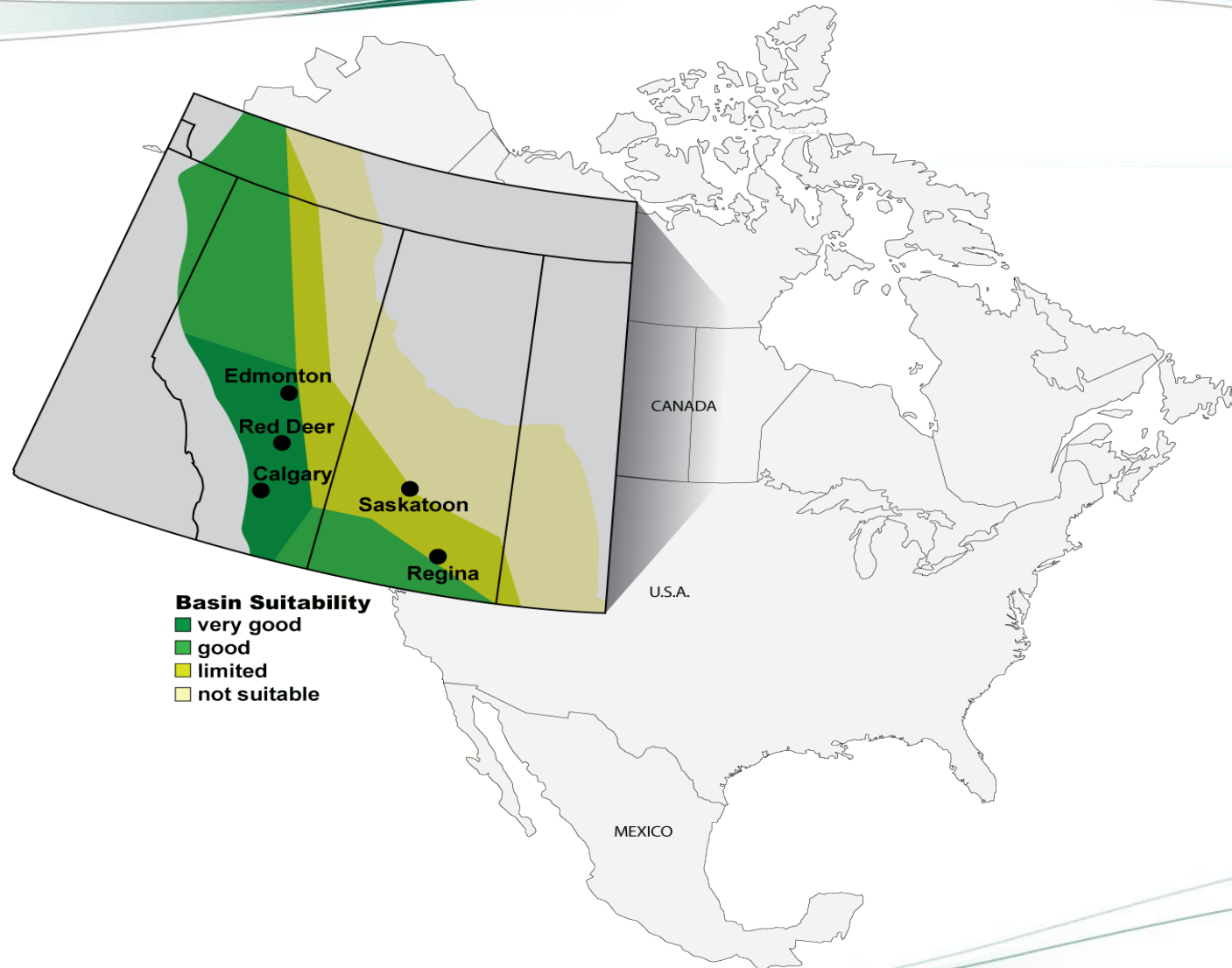
GHG Emissions (t/MWh)



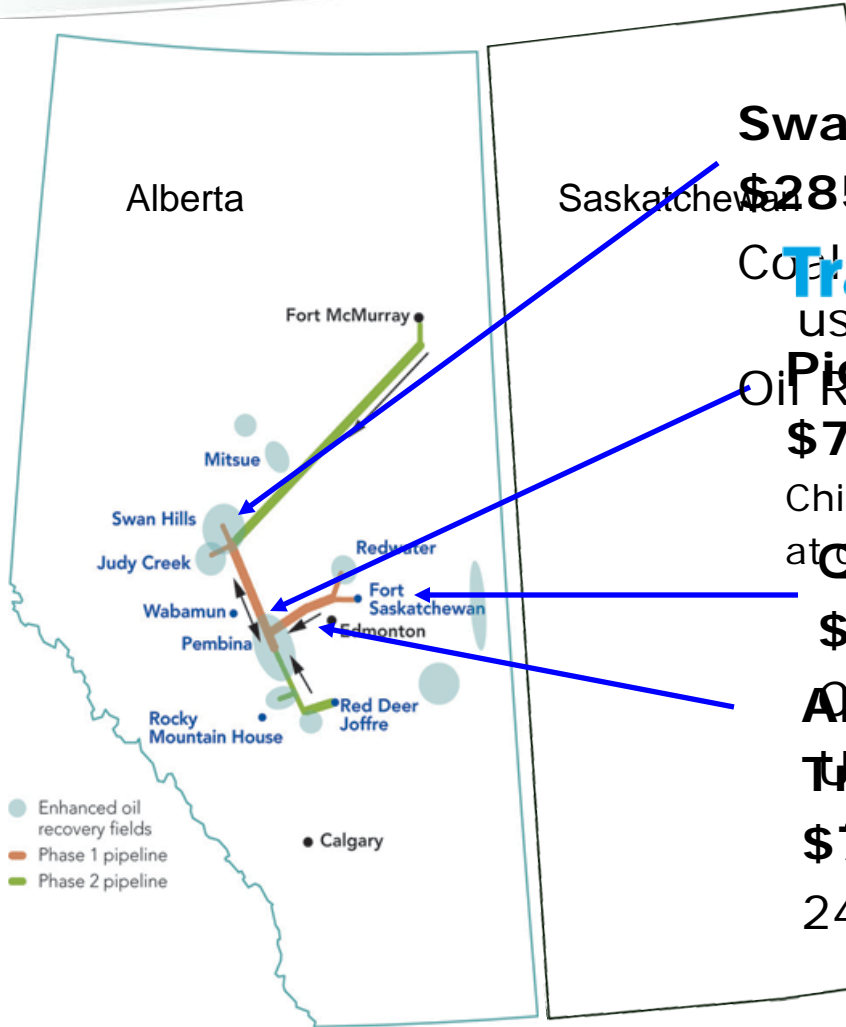
Conventional Coal & Clean Coal with CCS



Sequestration Locations



Government Funded CCS Projects in Canada



Swan Hills Synfuels



\$285 Million

Total Government Support

\$2.97 Billion

\$780 Million

Quest

\$885 Million

Alberta Carbon

Trunk Line

\$771 Million

240 km CO2 Pipeline for EOR

Boundary Dam
used for Enhanced Oil Recovery (EOR)

Pioneer (Power-5th)

Chilled Ammonia Capture at coal-fired plant for EOR



Geological CCS

Challenges:

- **Lower Efficiency**
- **Liability**
- **Regulatory Uncertainty**
- **Not Currently Economic**

Geological CCS

Challenges:

- **Lower Efficiency**
- **High Parasitic Loads:**
30 to 40% of Generation required for Capture, Compression and Sequestration

Geological CCS

Challenges:

- **Liability**
 - Who is liable?
 - For how long?

“ If you inject it – you’re responsible for it.”

Sequestration Risk Management

- **Probabilities of Leakage are Low**
However since 1972 in the USA:
 - **10 Serious Cases of Salt Cavern Storage Failure**
 - 5 involving Property Damage
 - 5 involving Injury/Death and Property Damage

Geological CCS

Challenges:

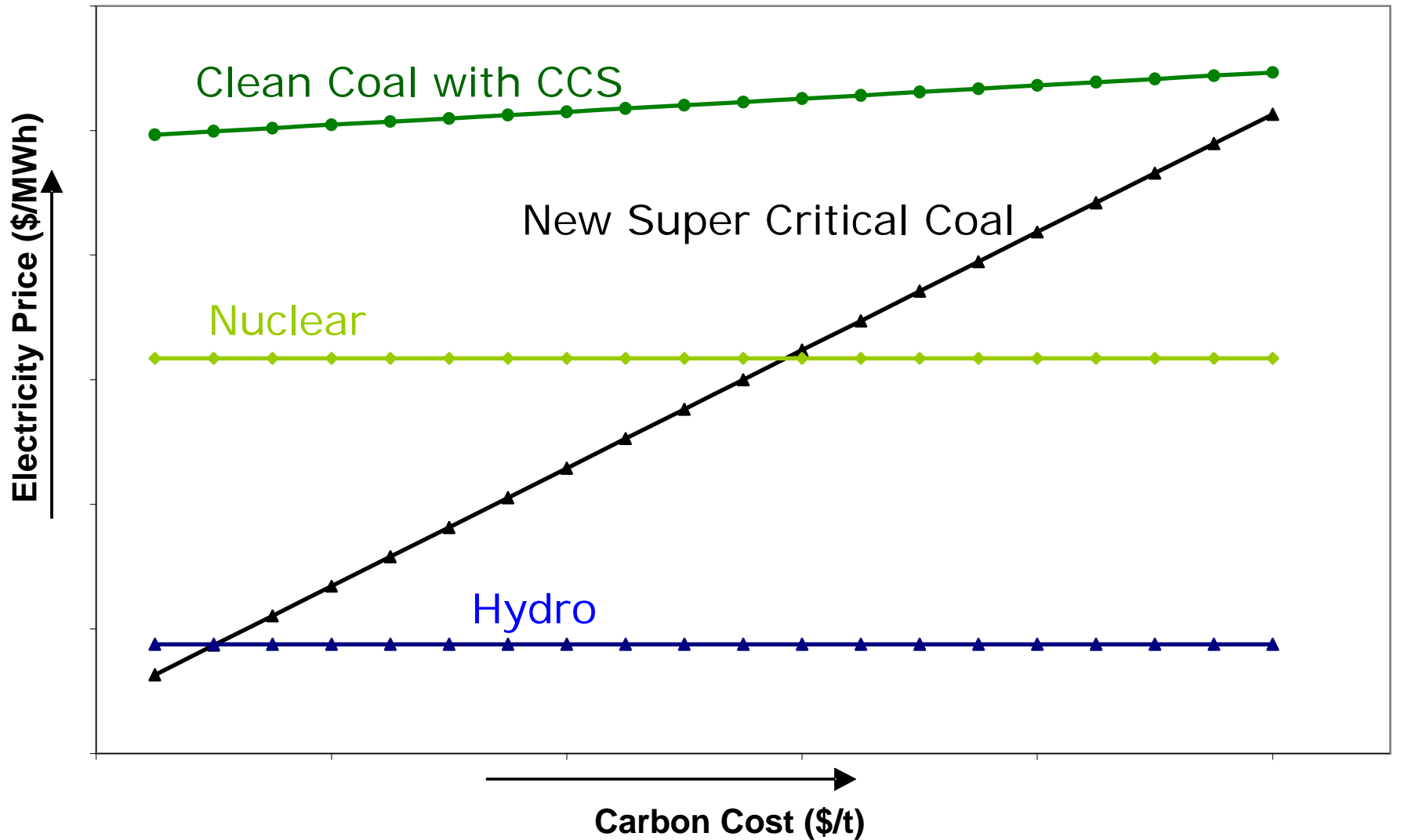
- **Regulatory Uncertainty**
 1. Penalties associated with a release?
 1. Monitoring required?
 1. Who will enforce?

Geological CCS

Challenges:

- **Not Currently Economic**
 - **Electricity Costs >200% Supercritical Coal**
 - **Currently requires Government support**
 - **Carbon and Electricity Prices must be linked**

Carbon Price vs. Electricity Price



Transitioning to a Low “C” Economy

- **Match Continental Sources and Sinks for CO₂**

Example: Transboundary Transport of CO₂ from USA to Canada (eg. Weyburn Enhanced Oil Project)

- **Renewable Power Projects:**
Rarely located near Load Centers
Create Green Transmission Corridors: Bring Renewable and Non-Emitting power to Continental Markets



Encouraging “Green” Corridors

- **Match Continental CO₂ Sources and Sinks:**
 - Consider existing US DOE and Canadian regional partnerships (eg. Plains and Mid-West)
- **Renewable Power (Transboundary):**
 - Include Hydro in NAFTA “Renewable Energy” Def’n
 - Green power not subject to border tariffs

Summary

- 75% Canadian Power from Non-Emitting Sources
- CCS will help reduce CO2 emissions from Coal Fired Generation and Oil Sands
- Canadian Government Investment: ~\$3B for 5 CCS Projects
- Western Cdn Sedimentary Basin: Hydrocarbons & CO2 Storage
- CCS Challenges
 - Efficiency, Liability, Regulatory, Costs

Next Steps:

- Continue Continental Trans boundary CO2 shipments: Source to Sink
- Create Green Transmission Corridor: Allow Renewable Power transboundary transfers with no border tariffs

Geological Carbon Capture & Sequestration In Canada

Questions?

Dale Friesen
ATCO Group of Companies

ATCO
GROUP