

Carbon Capture & Storage (CCS)

# The Boundary Dam Story



**Presented by Michael J. Monea, Vice President, Integrated Carbon Capture  
& Storage Projects, SaskPower**

 **SaskPower**  
Powering the future

Carbon Capture & Storage (CCS)

# The Boundary Dam Story



**Apr 1 26, 2011**  
**Boundary Dam Power Station, Estevan, Saskatchewan**

 **SaskPower**  
Powering the future

# Welcome to Saskatchewan

- 473,000 customers
- 150,000 km of T&D lines
- 3,513 MW generation



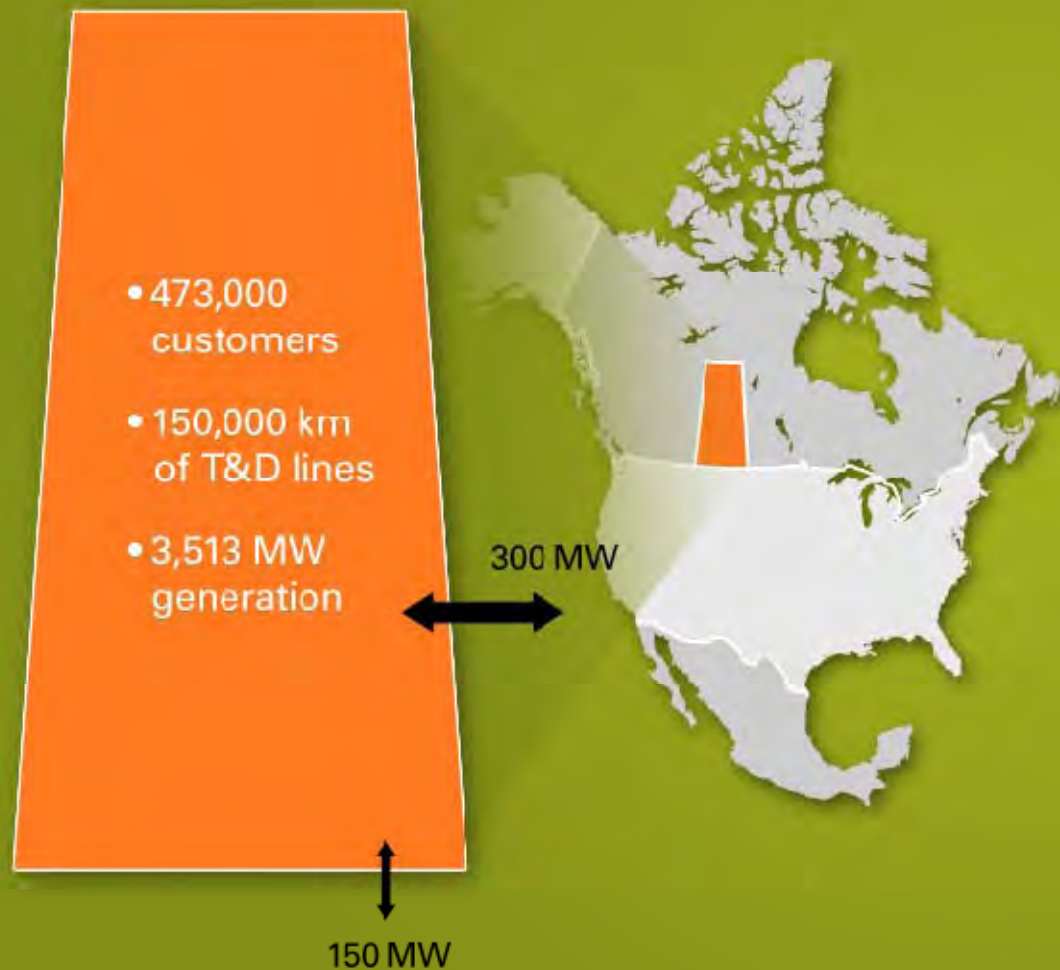
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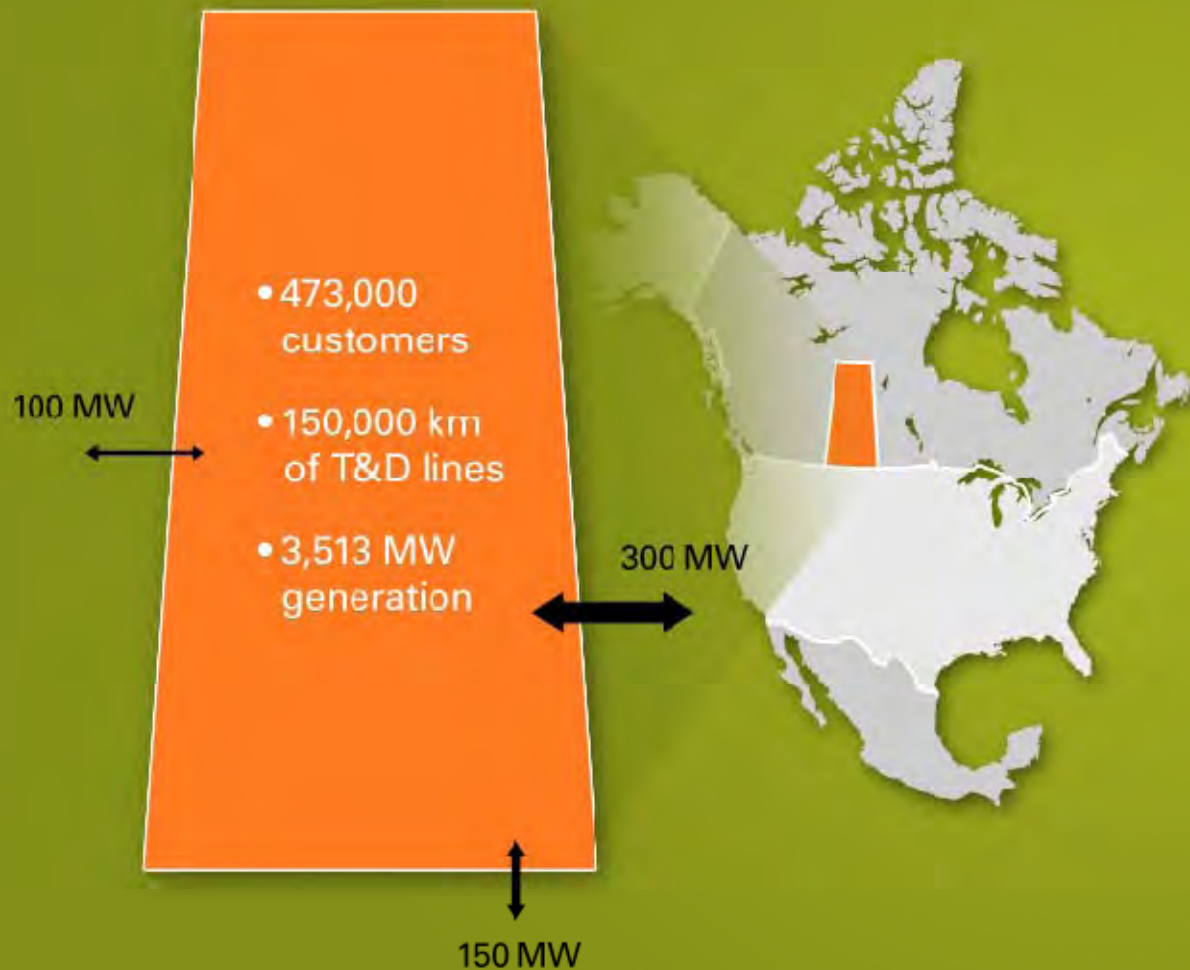
300 MW



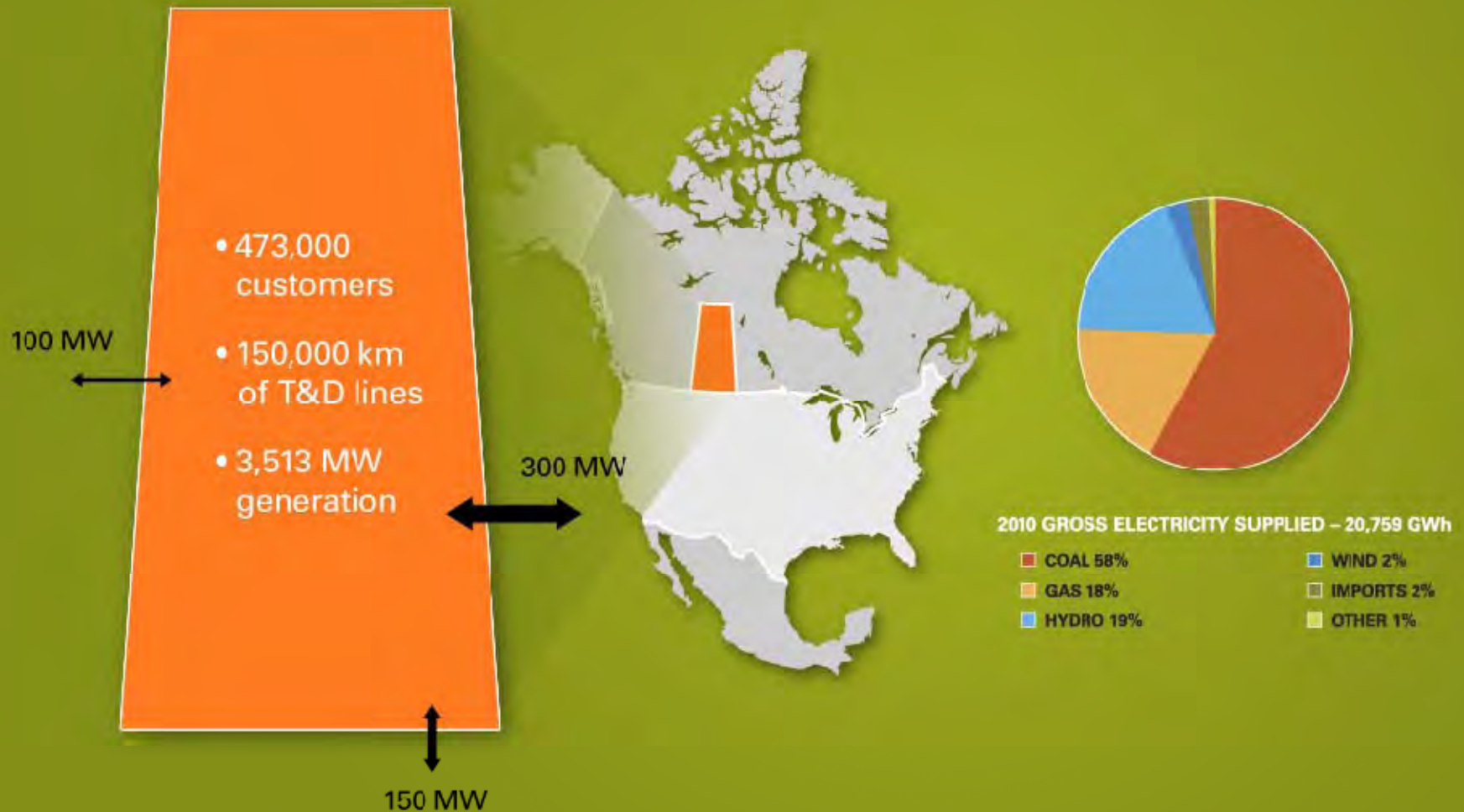
# Welcome to Saskatchewan



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# Greenhouse Gas (GHG) Emissions Reductions

## **GHG Requirements (discussed to date)**

National GHG Target: 17% below 2005 levels by 2020

Proposed Federal regulation to limit CO<sub>2</sub> from coal-fired electricity generation:

- establishes performance standard of 360 – 420 tonnes /GWh
- to become law in 2011 and applied in 2015
- new units that are CCS ready exempt to 2025

# Greenhouse Gas (GHG) Emissions Reductions

Draft Saskatchewan Climate Change regulation:

- cap and cut system to reduce GHGs by 20% below 2006 levels by 2020
- targets large final emitters that release 50,000 tonnes or more per year
- province seeking equivalency agreement with federal government
- challenges exist for linking federal coal CO<sub>2</sub> intensity based system with provincial GHG cap and cut system
- to be finalized in 2012

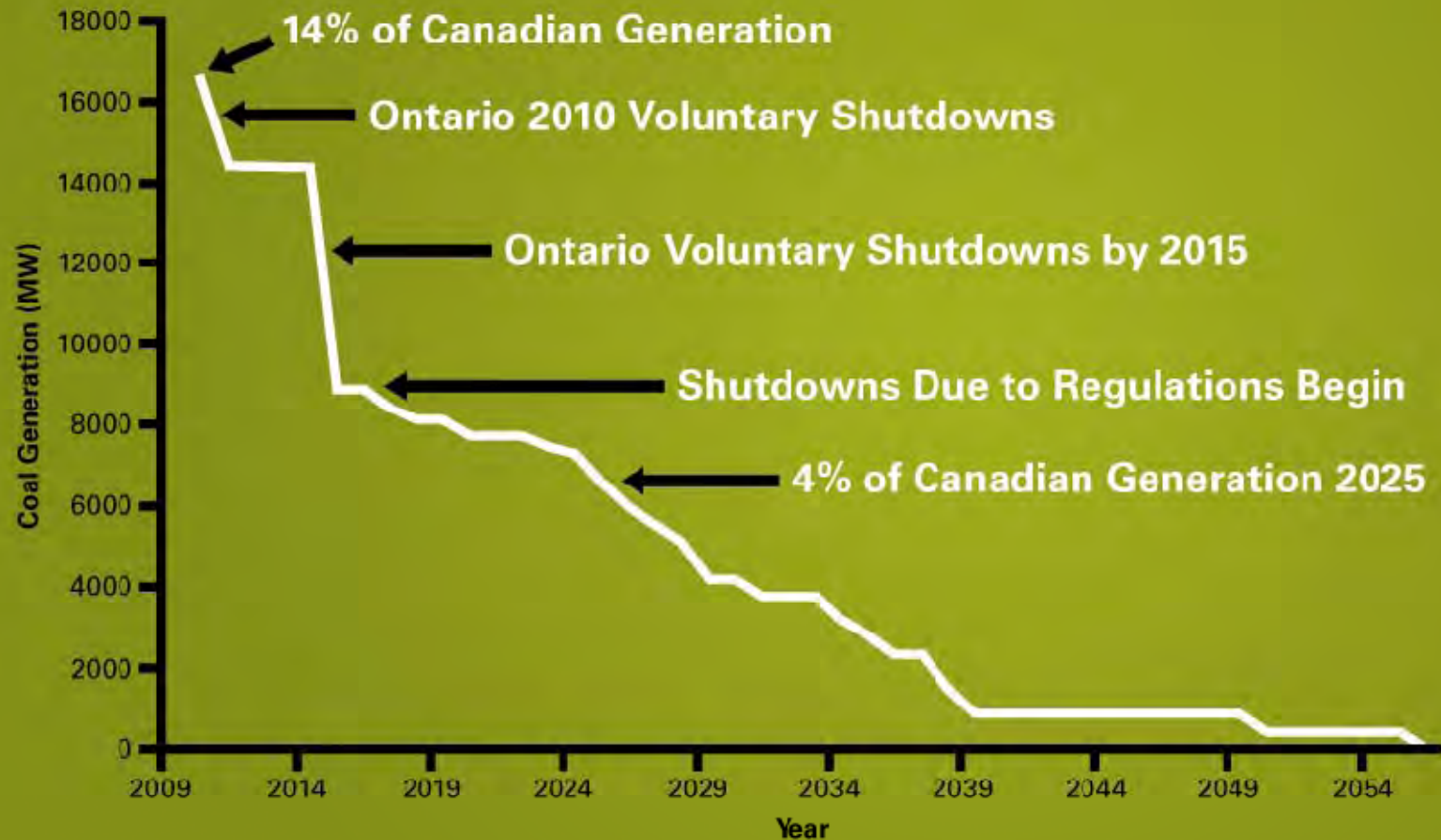
# Reduction of Coal Usage in Canada

- At the start of 2010, coal made up 13.5% of the Canadian fleet.
- In 2010, 2260 megawatts (MW) have been retired - mainly in Ontario. This reduced the use of coal to 11.8% of the Canadian fleet.
- Even with no regulations at all, there are an additional 5,100 MW of coal to be retired by 2015 (includes all coal in Ontario). This further reduces coal to 7.5% of the Canadian fleet.

# Reduction of Coal Usage in Canada

- If the 2015 regulations come into play, coal will be reduced as follows:
  - 2015: 796 MW retired
  - 2020: 1142 MW retired
  - 2025: 1191 MW retired
- By 2025, only 6400 MW would still be in service - 5% of the Canadian fleet.
- Of the potential shutdowns required by regulations, the percentage of loss of its original coal fleet is as follows:
  - Alberta: 25%;
  - Maritimes: 20%;
  - Saskatchewan: 66%

# Coal Generation in Canada – The Decline



# SaskPower's Carbon Capture and Storage Objectives



- Minimize future customer cost increases related to emissions regulations.
- Develop economically and environmentally sustainable electricity supply options through coal.
- Ensure cost of electricity is lower than other available options to be viable in long term.

# BD3 ICCS



# Clean Coal Project a Go

**The StarPhoenix**  
**Mah honoured by Chinese community** / C5  
**Bolts force Game 7** / B1  
**Charlie Pride sings from deep talent pool** / C1  
 Tuesday, April 26, 2011  
 Breaking news at TheStarPhoenix.com  
 Saskatoon, Saskatchewan

## Clean coal project a go

**SaskPower, gov't expected to unveil \$1.2-billion project**

By Bruce Johnstone  
 The Leader-Post

REGINA — The provincial government is expected to announce the start of a \$1.2-billion clean coal project in Saskatchewan.

The project, which will be the first of its kind in the world, is expected to be completed by 2015. It will involve the construction of a new power plant with a capacity of 1,200 megawatts. The plant will be equipped with a carbon capture and storage (CCS) system, which will allow it to produce electricity without emitting any carbon dioxide into the atmosphere.

The project is being developed by SaskPower, the provincial utility, in partnership with the federal government. The federal government is providing a loan guarantee for the project, which is expected to be completed by 2015. The project is being developed in Regina, Saskatchewan, and is expected to create 1,000 jobs during its construction phase.

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**LEADER-POST**  
 REGINA, SASKATCHEWAN  
 A former church, the Artesian is now a performance venue. // B1  
**BUSINESS**  
 Flooding to cause delays in seeding. // D1  
 BREAKING NEWS AT LEADERPOST.COM

## Project a 'game-changer'

By BRUCE JOHNSTONE  
 Leader-Post

ESTEVAN — A \$1.2-billion project to capture a million tonnes of carbon dioxide a year from a boundary dam generating station — equivalent to the emissions from 250,000 vehicles annually — was announced here Tuesday.

"Boundary Dam will be a world leader — the very first commercial-scale power plant with a fully integrated carbon-capture system," said Rob Norris, minister responsible for Saskatchewan.

"This is a game-changer," added Robert Watson, SaskPower president and CEO. "This is the start of the people of this province's largest power plant with 224 megawatts (MW) of generating capacity."

The concept of capturing carbon from the exhaust of fossil fuels isn't new — currently, there are about 200 capture and sequestration projects in the world — the first in the world — the Boundary Dam Carbon Capture and Storage (CCS) project. It will be the world's first commercial-scale application of CCS technology.



**LEADER-POST**  
 REGINA, SASKATCHEWAN  
 Local, federal election candidates will debate on Access 7 // A4  
 A Regina fashion designer displayed her work recently // B1  
 Former Hager Don Naisicos launches new football camp // C3  
**CLEAN COAL PROJECT AT SASKPOWER'S BOUNDARY DAM**  
**Clean coal plan global first**  
 By BRUCE JOHNSTONE  
 Leader-Post

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# Leading the World



BDS ICCS

Government approves  
\$1.2 billion project

- Boundary Dam Integrated Carbon Capture and Storage Demonstration Project.
- Demonstration is critical to the future of coal-fired generation.
- Nowhere in the world do we see the kind of commitment and visionary leadership on the issue of carbon capture and storage as we do in Saskatchewan.
- SaskPower is positioned to lead the world into a cleaner, greener future.

# Re-Inventing Coal-Fired Power Generation



BDS ICCS

SaskPower is moving forward with the world's largest integrated carbon capture and storage demonstration project.

The project will:

- demonstrate a cost-effective, environmentally sustainable model for existing coal-fired electricity generation;
- fully integrate and rebuild a coal-fired generation unit with carbon capture and an enhanced oil recovery operation; and
- measure the technical, economic and environmental performance of this ground-breaking technology.

# Boundary Dam Project



**BDS ICCS**

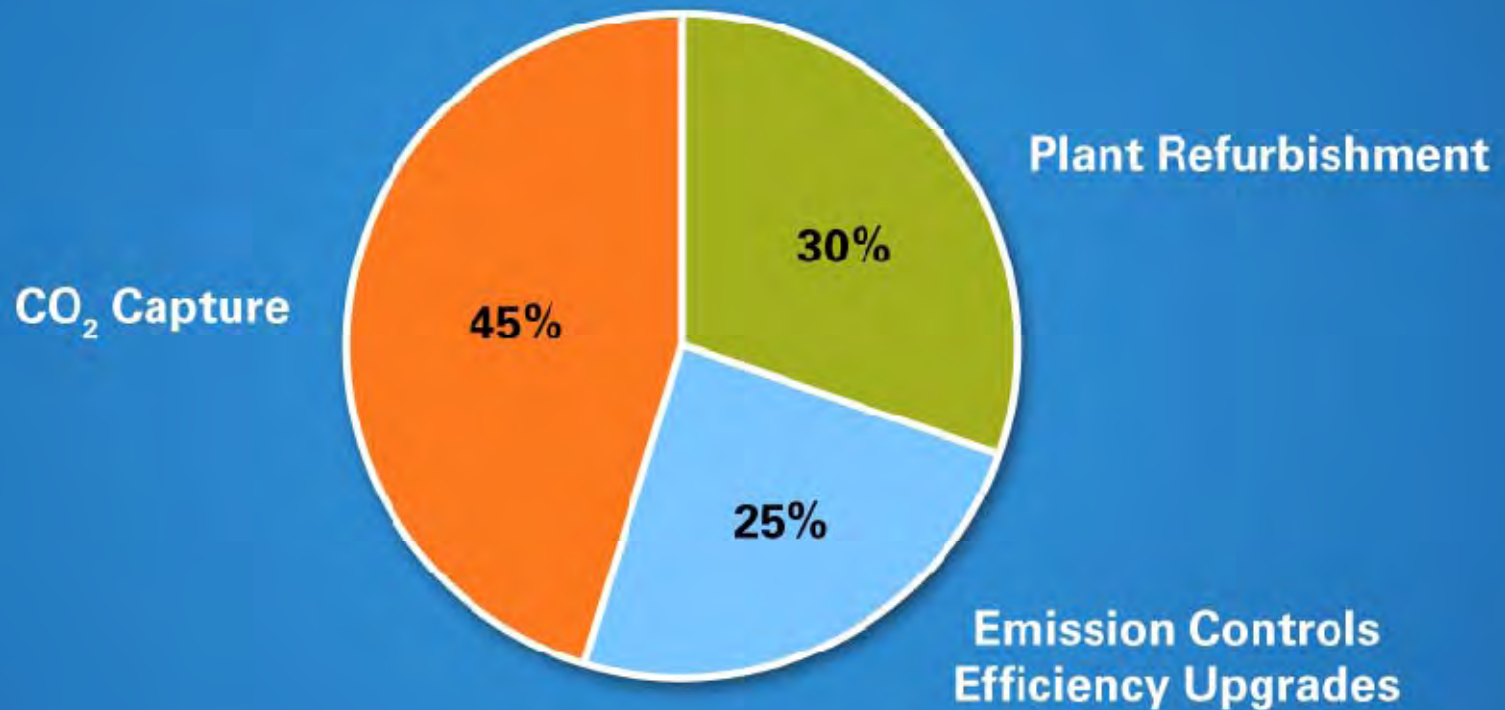
- World's first commercial carbon capture technology applied to a coal plant and the sale of carbon dioxide (CO<sub>2</sub>) for enhanced oil recovery (EOR)/storage
- First fully integrated power plant:
  - CO<sub>2</sub> capture;
  - EOR operation; and
  - Storage.
- Demonstrating:
  - Advanced technologies;
  - Mechanics of integration; and
  - Regulatory setting.

# Boundary Dam Project Deliverables



- Life extension;
- Performance upgrades;
- CO<sub>2</sub> Capture Technology;
- Acceptable Cost of electricity (COE); and
- In service 2014.

# Boundary Dam Project Capital Cost Breakdown





**BDS ICCS**



Unit 3

SaskPower  
Boundary Dam

**BDS ICCS**

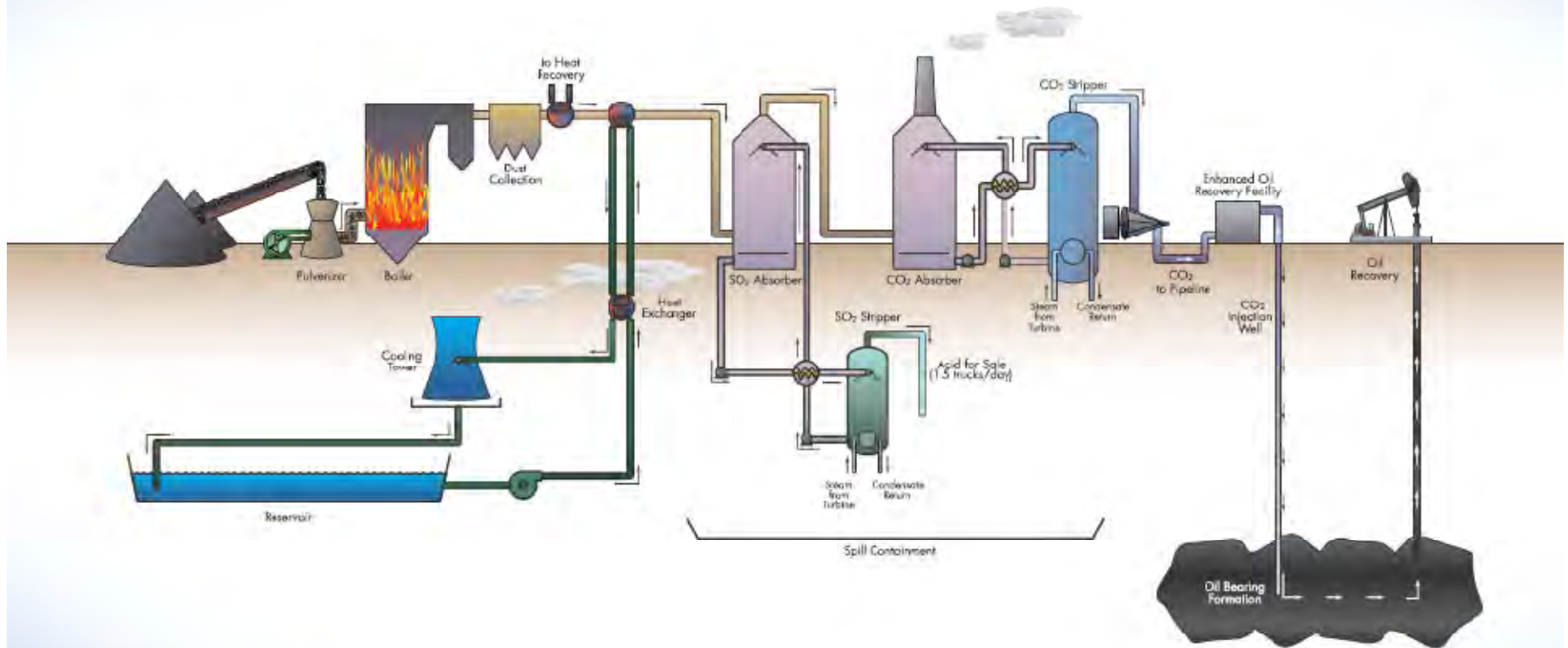


**BDS ICCS**

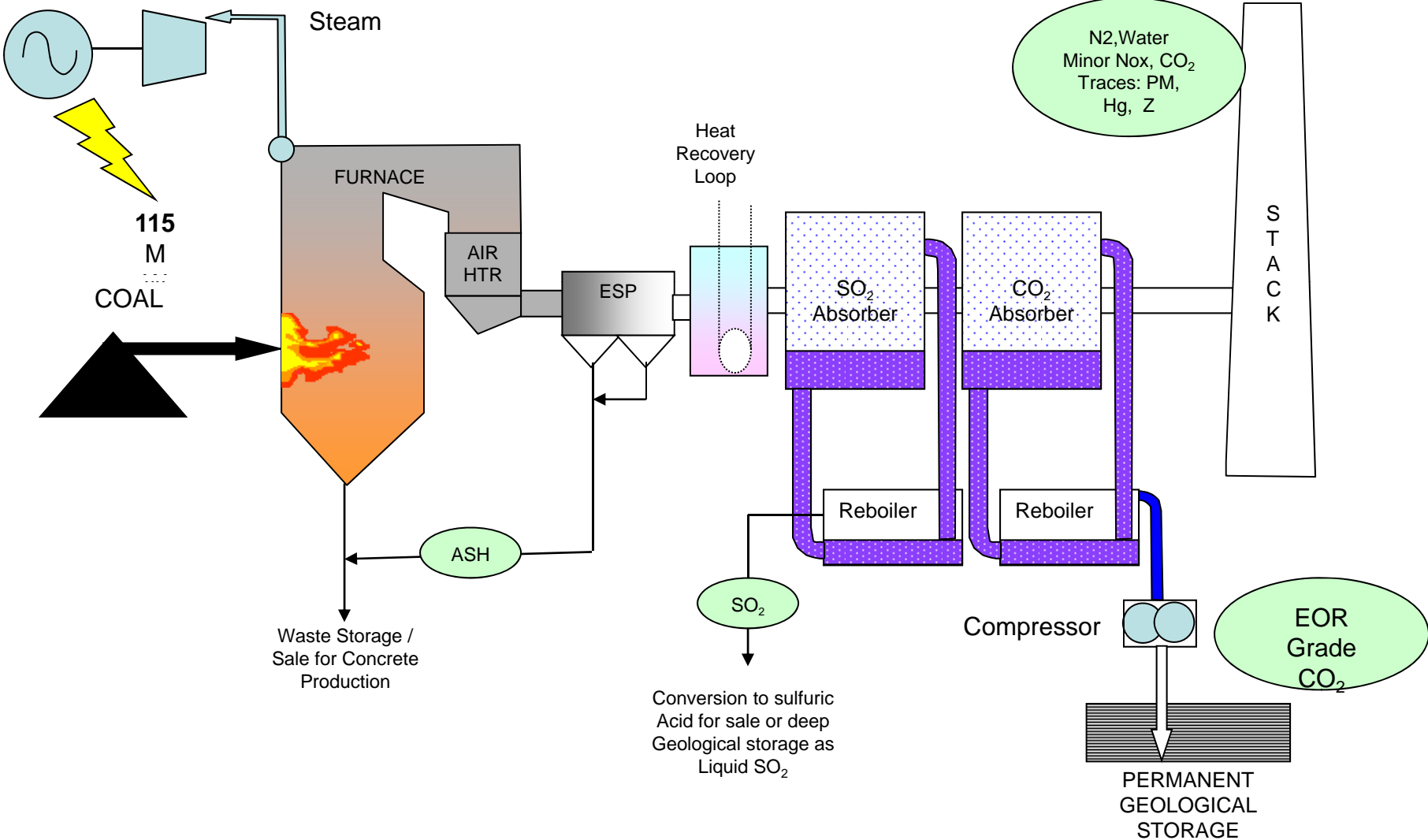


Unit 3

# Carbon Capture Process



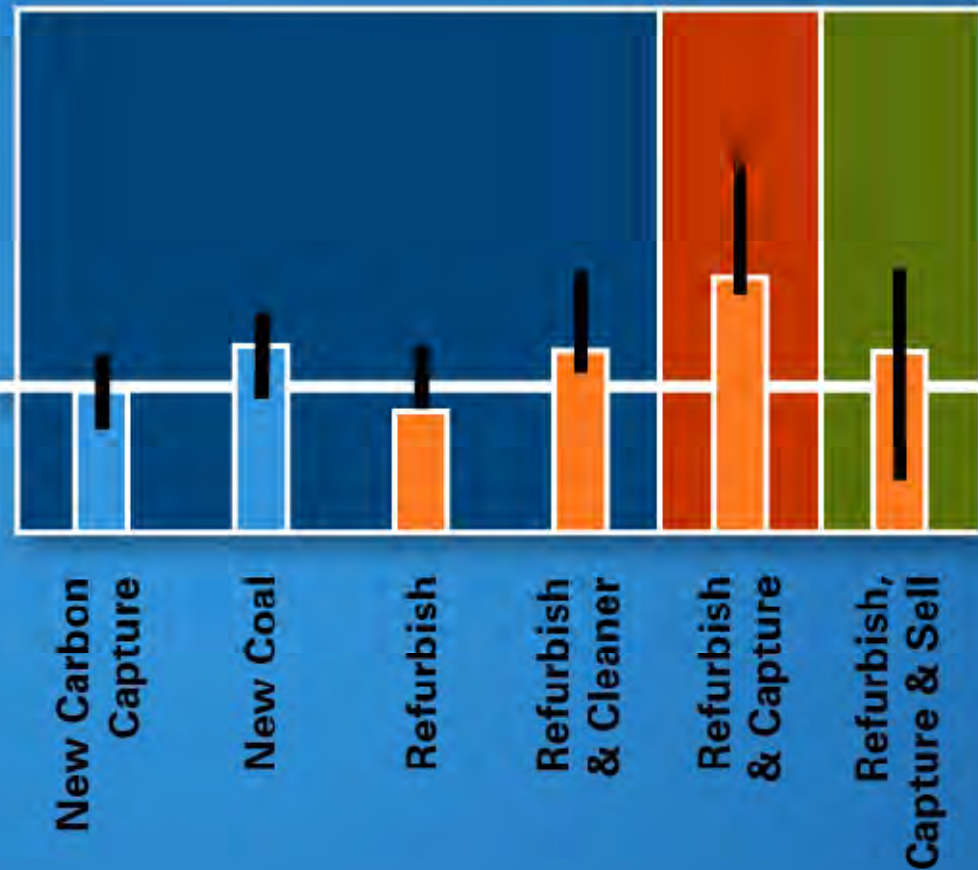
# BD 3 Repowered





# Cost of Electricity

Baseline is cost of new natural gas generation.



**Existing Power Plant**

- Turbine Commitment
- Balance of Plant Repair Planning and Mobilization
- Turbine Install and BOP repairs

**Process Equipment**

- Select CO2 System (vendor & technology)
- Detailed CO2 system design
- Award Process Equipment Supply Contracts
- Detailed design, construction contracts ready
- Construct phase 1 (.5 Mtpy)
- Commission phase 1
- Procure/Construct/comm'n phase 2

**EIA, Water License**

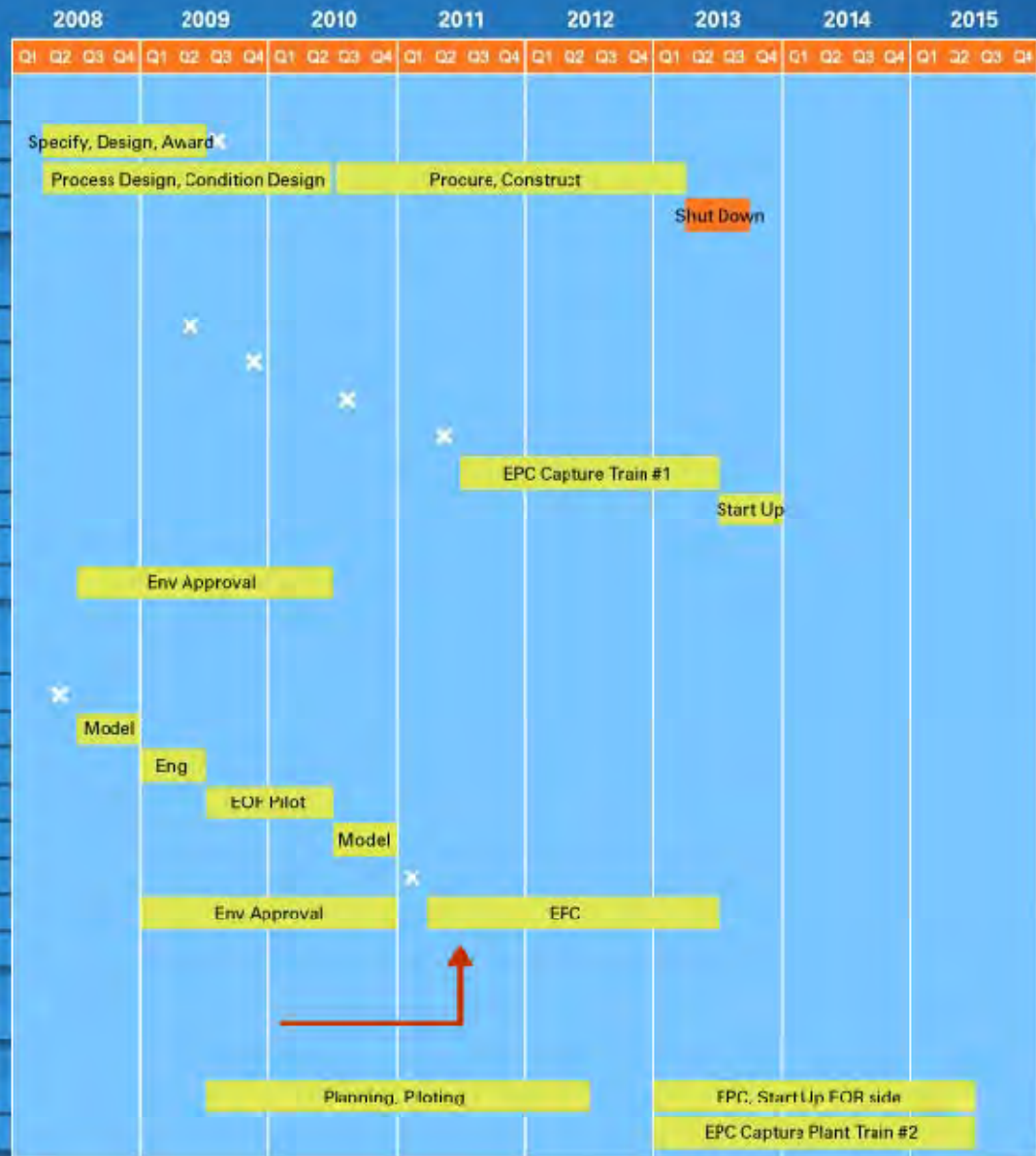
**EOR - Phase 1**

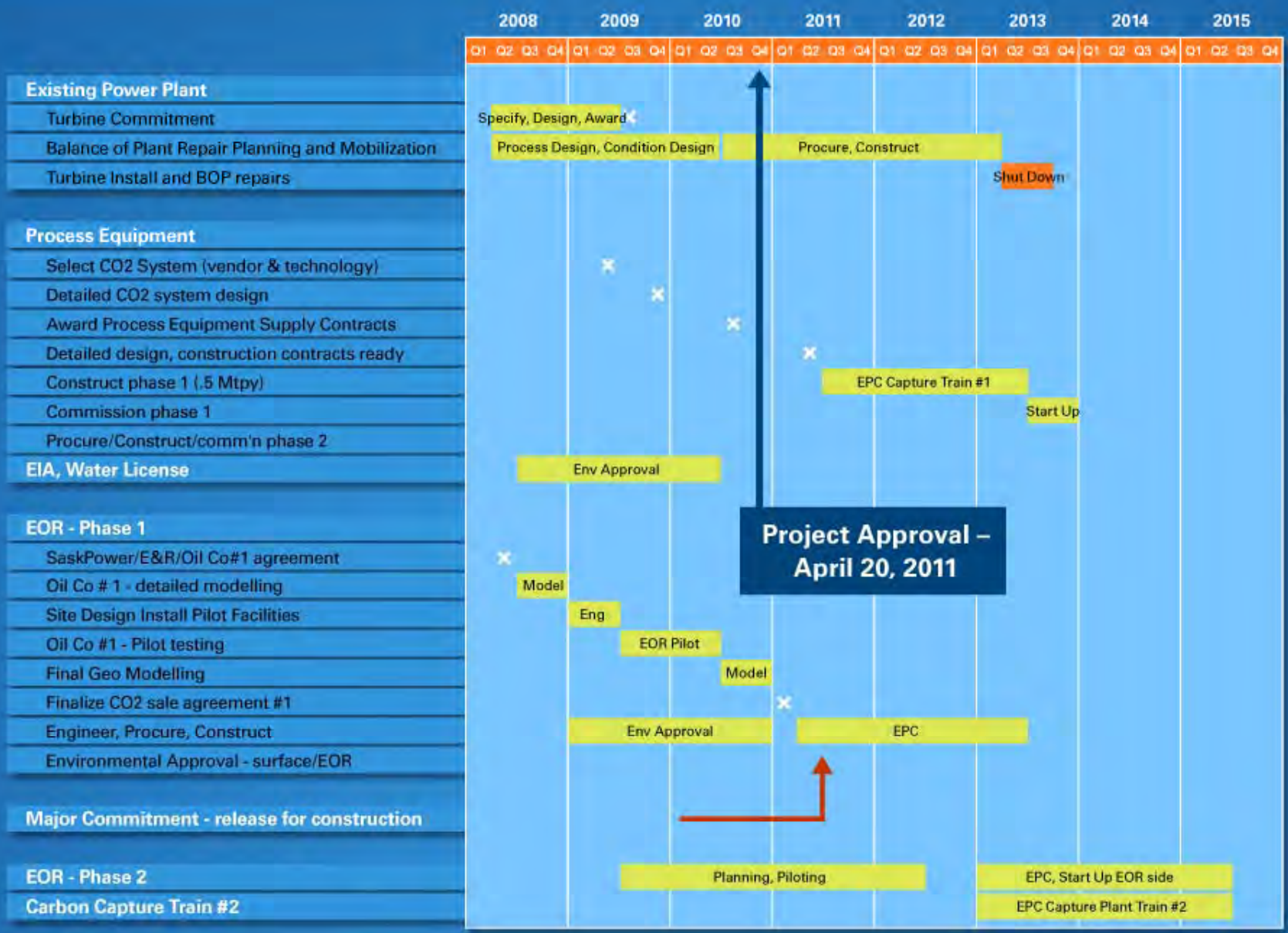
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- Oil Co # 1 - detailed modelling
- Site Design Install Pilot Facilities
- Oil Co #1 - Pilot testing
- Final Geo Modelling
- Finalize CO2 sale agreement #1
- Engineer, Procure, Construct
- Environmental Approval - surface/EOR

**Major Commitment - release for construction**

**EOR - Phase 2**

**Carbon Capture Train #2**





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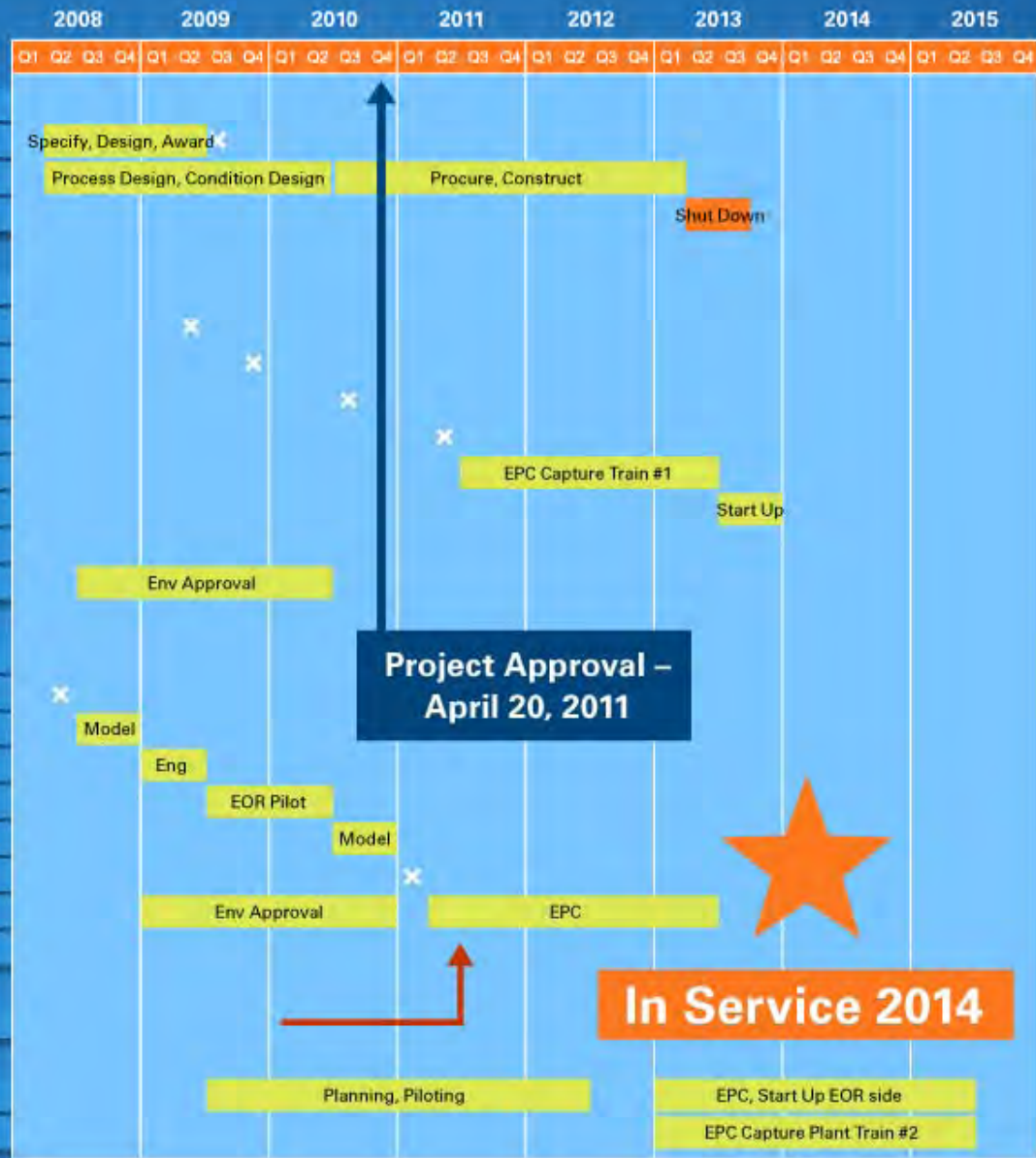
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# Boundary Dam Project Progress

**Two broad areas of engineering:**

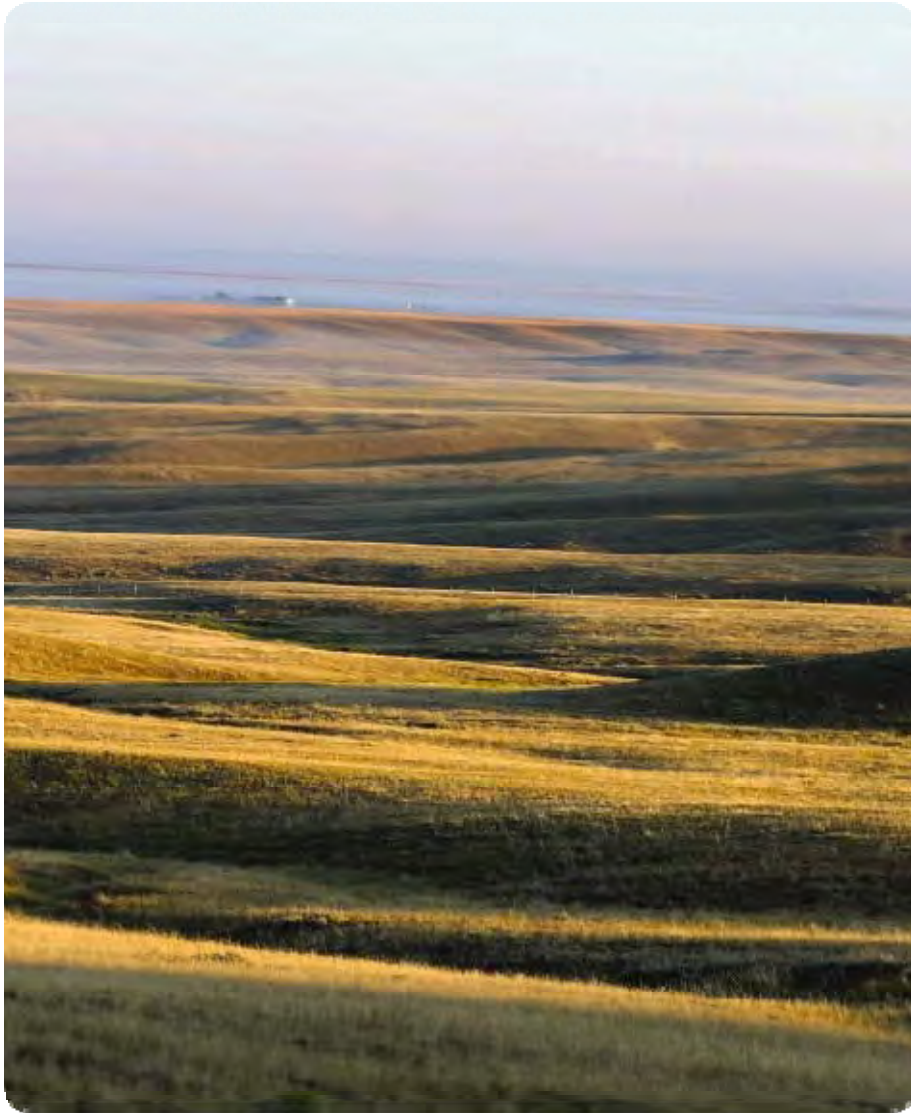
## **1) Power Island Performance and Integration**

- Boiler and turbine performance upgrades;
- Integration with flue gas desulphurization (FGD) and CO<sub>2</sub> capture systems; and
- Results to date – as important as CO<sub>2</sub> capture technology selection.

## **2) CO<sub>2</sub> Capture components**

- March 2, 2010, SaskPower announced Cansolv and SNC Lavalin will provide the technology and construction estimates for the boundary dam commercial project business case;
- CO<sub>2</sub> offtakers for CO<sub>2</sub> EOR markets are being identified; and
- SaskPower continuing to monitor emerging technologies.

# Conclusions



- Preserves coal as a fuel source and maintains fuel mix diversity.
- Cost of electricity competitive with natural gas.
- Provides information needed for making future decisions.
- Develops EOR CO<sub>2</sub> buyer market - has significant positive economic impact for the provincial economy.
- Future projects more economic - COE \$100/MWh.

# CCS projects in Saskatchewan



Image modified from  
Geoscape Southern Saskatchewan

- SaskPower Boundary Dam Integrated Carbon Capture and Storage Demonstration Project;
- SaskPower Carbon Capture Test Facility
- CO<sub>2</sub>-EOR (International Energy Agency GHG Weyburn-Midale CO<sub>2</sub> Monitoring & Storage Project)
- Deep Saline CO<sub>2</sub> Storage (Aquistore)
- Petroleum Technology Research Centre (PTRC)
- International Performance Assessment Centre (IPAC)
- International Test Centre (ITC)