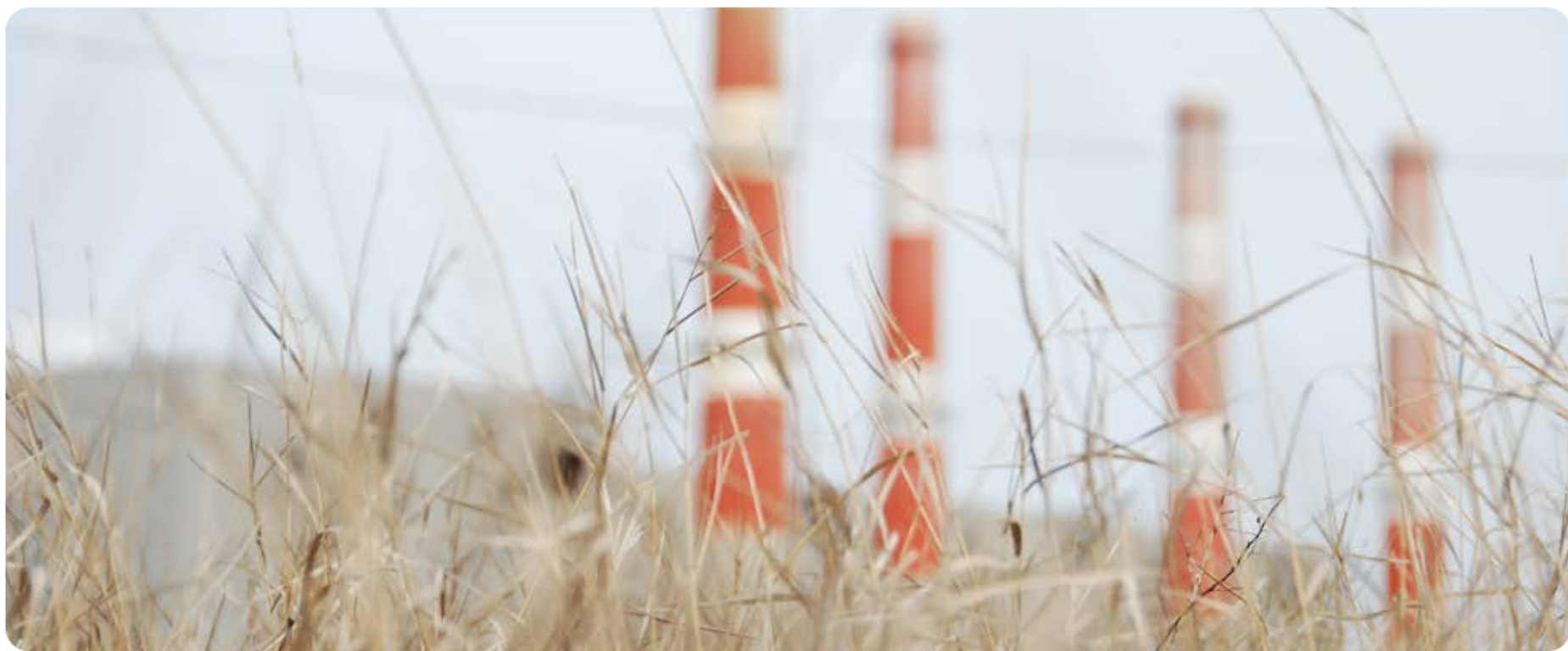


Carbon Capture & Storage (CCS)

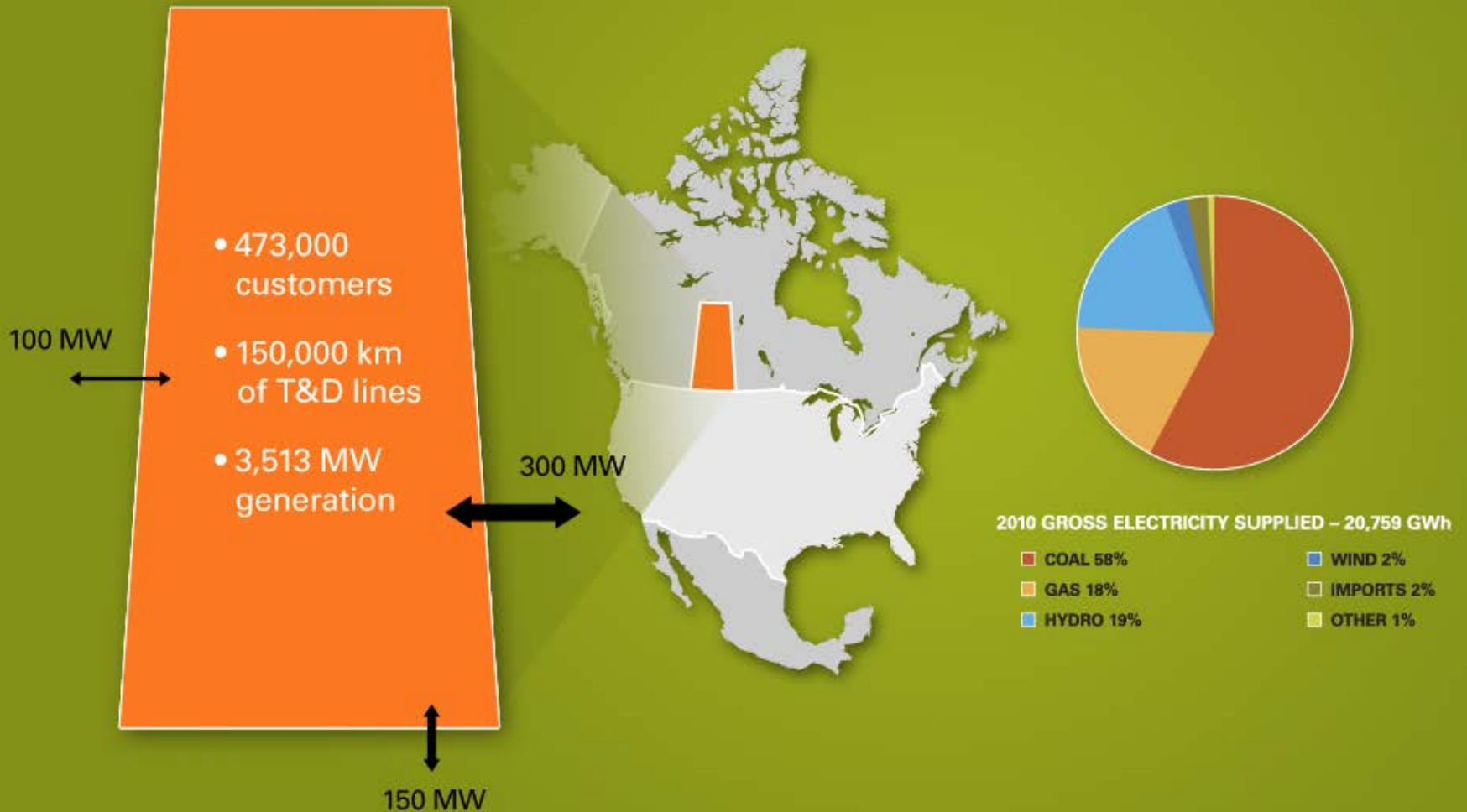
The Boundary Dam Story



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

 **SaskPower**
Powering the future

Welcome to Saskatchewan



Greenhouse Gas (GHG) Emissions Reductions

GHG Requirements

National GHG Target: 17% below 2005 levels by 2020

Proposed Federal regulation to limit CO₂ from coal-fired electricity generation:

- establishes performance standard of 360 – 420 tonnes CO₂ /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:

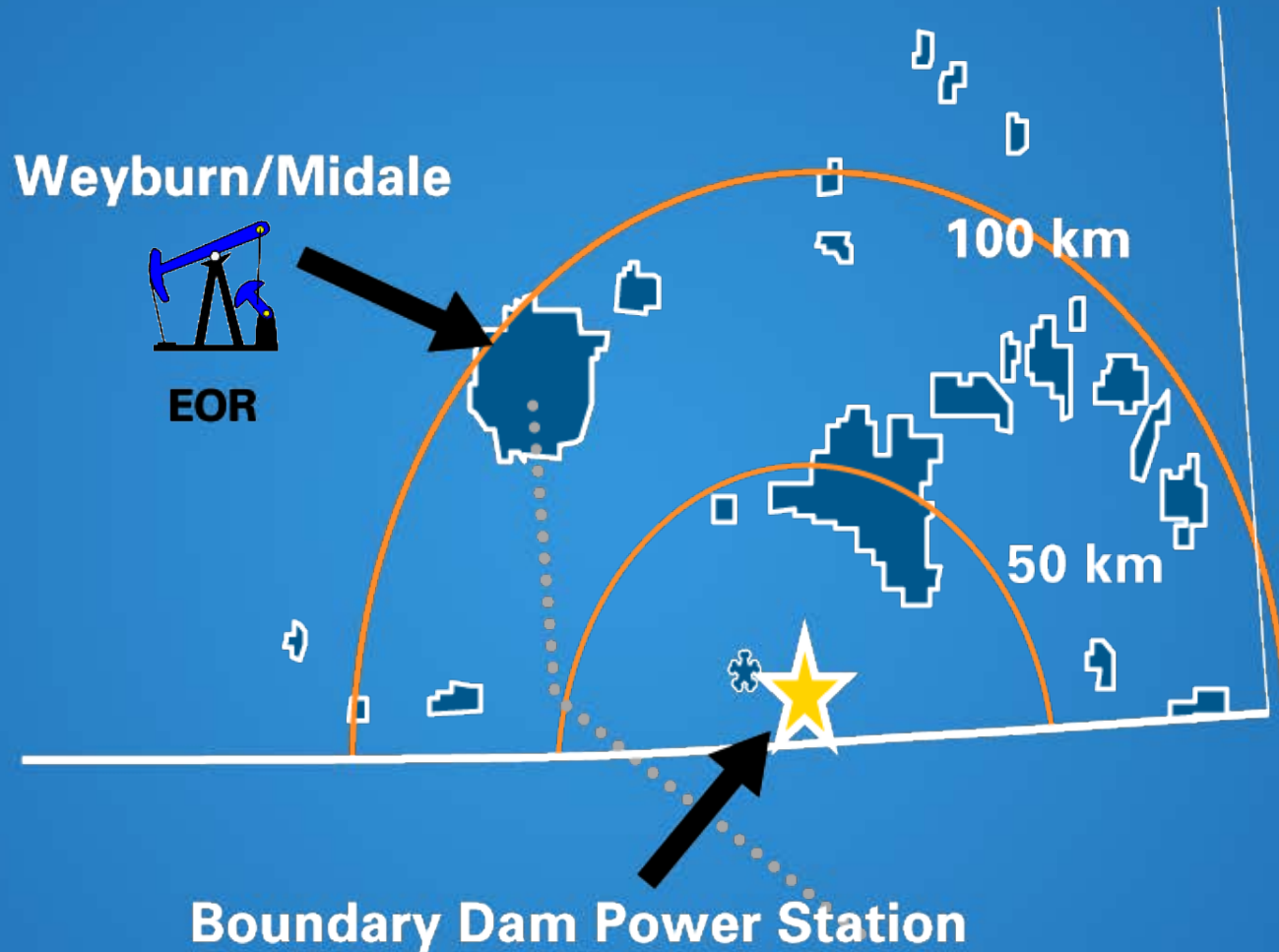
- cap and cut system to reduce GHGs by 20% below 2006 levels by 2020
- targets large final emitters that release 50,000 tonnes or more per year
- province seeking equivalency agreement with federal government
- challenges exist for linking federal coal CO₂ intensity based system with provincial GHG cap and cut system
- to be finalized in 2012

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.

Boundary Dam ICCS Demonstration



BD3 ICCS

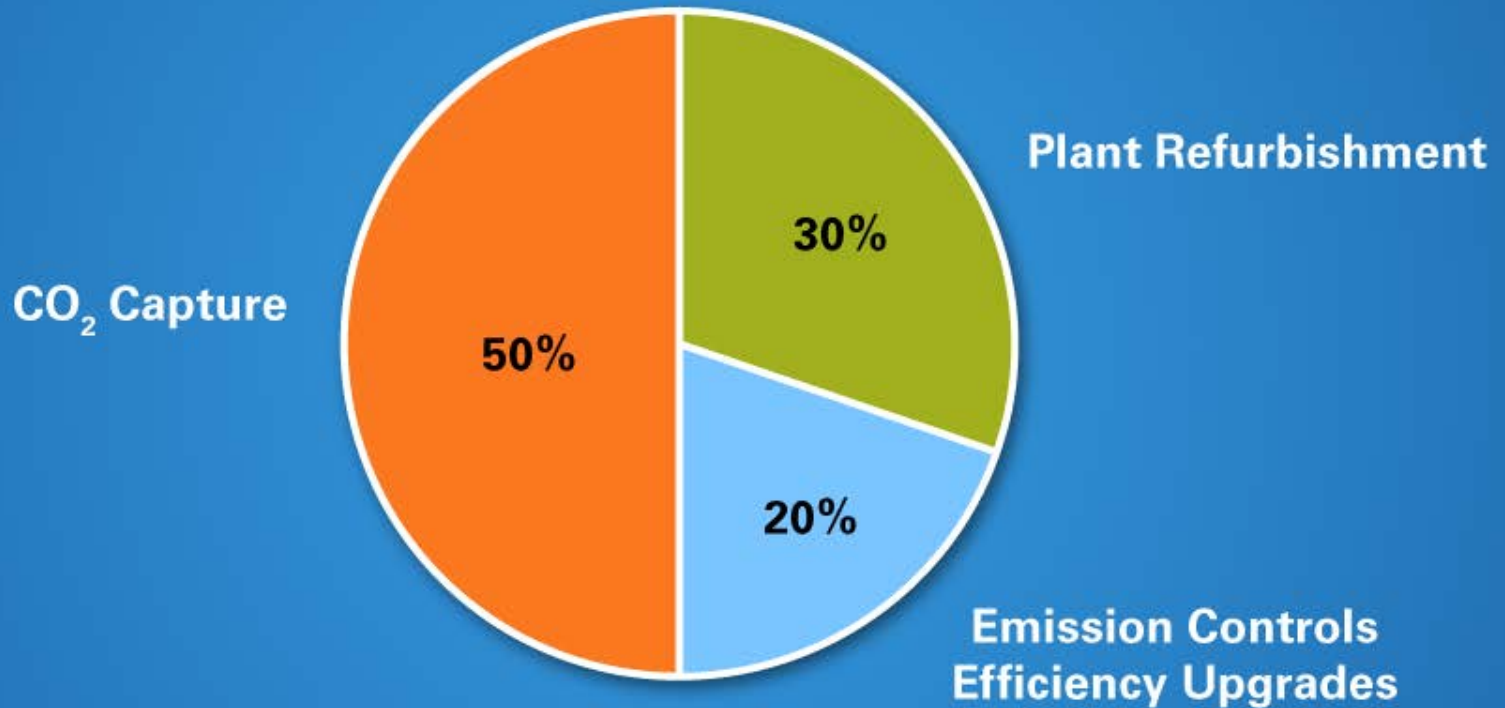


Boundary Dam Project



- World's first commercial carbon capture technology applied to a coal plant and the sale of carbon dioxide (CO₂) for enhanced oil recovery (EOR)/storage
- First fully integrated power plant:
 - CO₂ capture;
 - EOR operation; and
 - Storage.
- Demonstrating:
 - Advanced technologies;
 - Mechanics of integration; and
 - Regulatory setting.

Boundary Dam Project Capital Cost Breakdown





BD3 ICCS

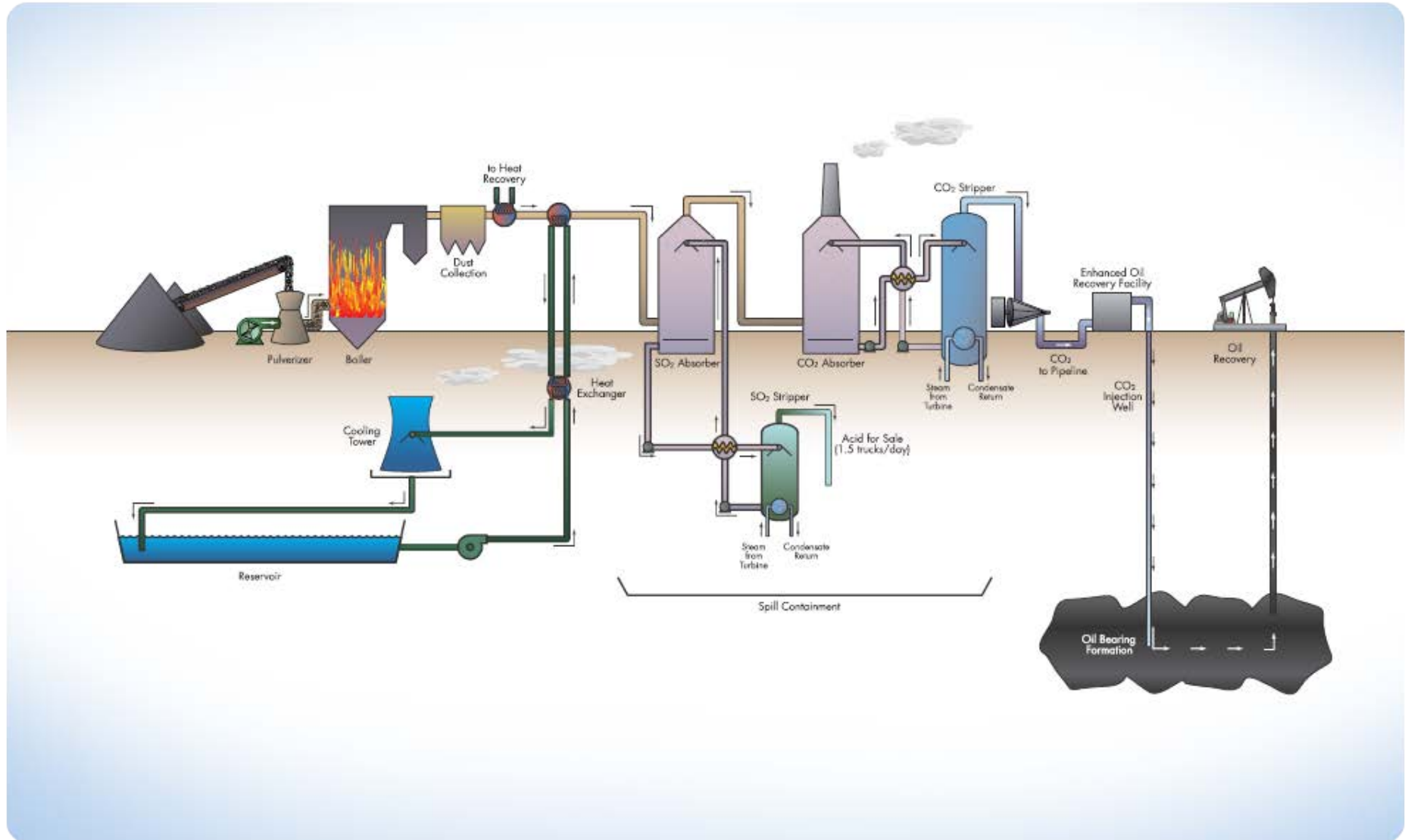
Unit 3

SaskPower
Boundary Dam

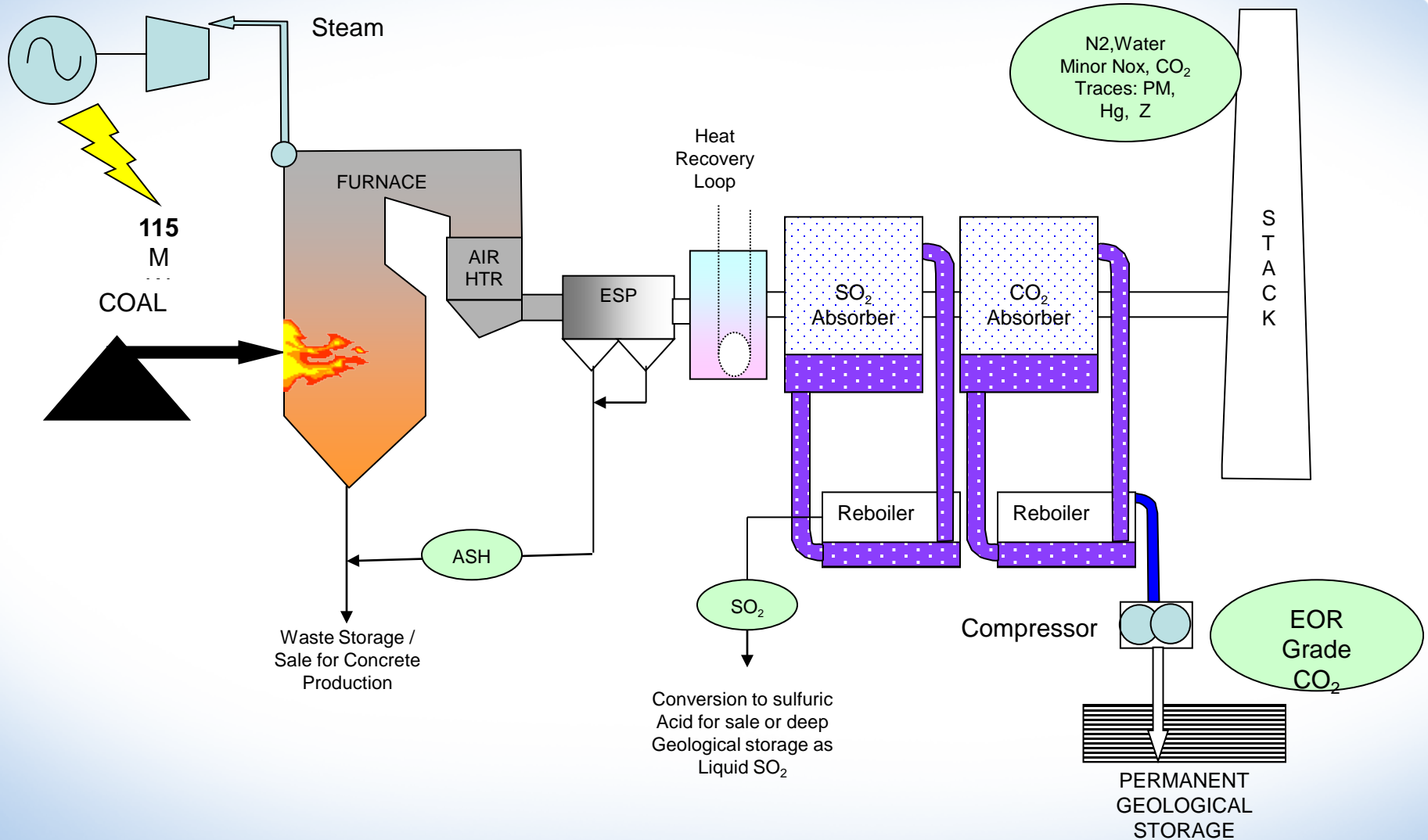
An aerial photograph of a power plant facility, overlaid with a semi-transparent blue filter. The image shows four tall, cylindrical smokestacks with alternating white and reddish-brown horizontal bands. To the right, a large, multi-story industrial building is visible, with the text 'Unit 3' overlaid in white. The surrounding area includes various smaller structures, pipes, and a parking lot with several vehicles. The background shows a flat landscape under a clear sky.

Unit 3

Carbon Capture Process



BD 3 Repowered

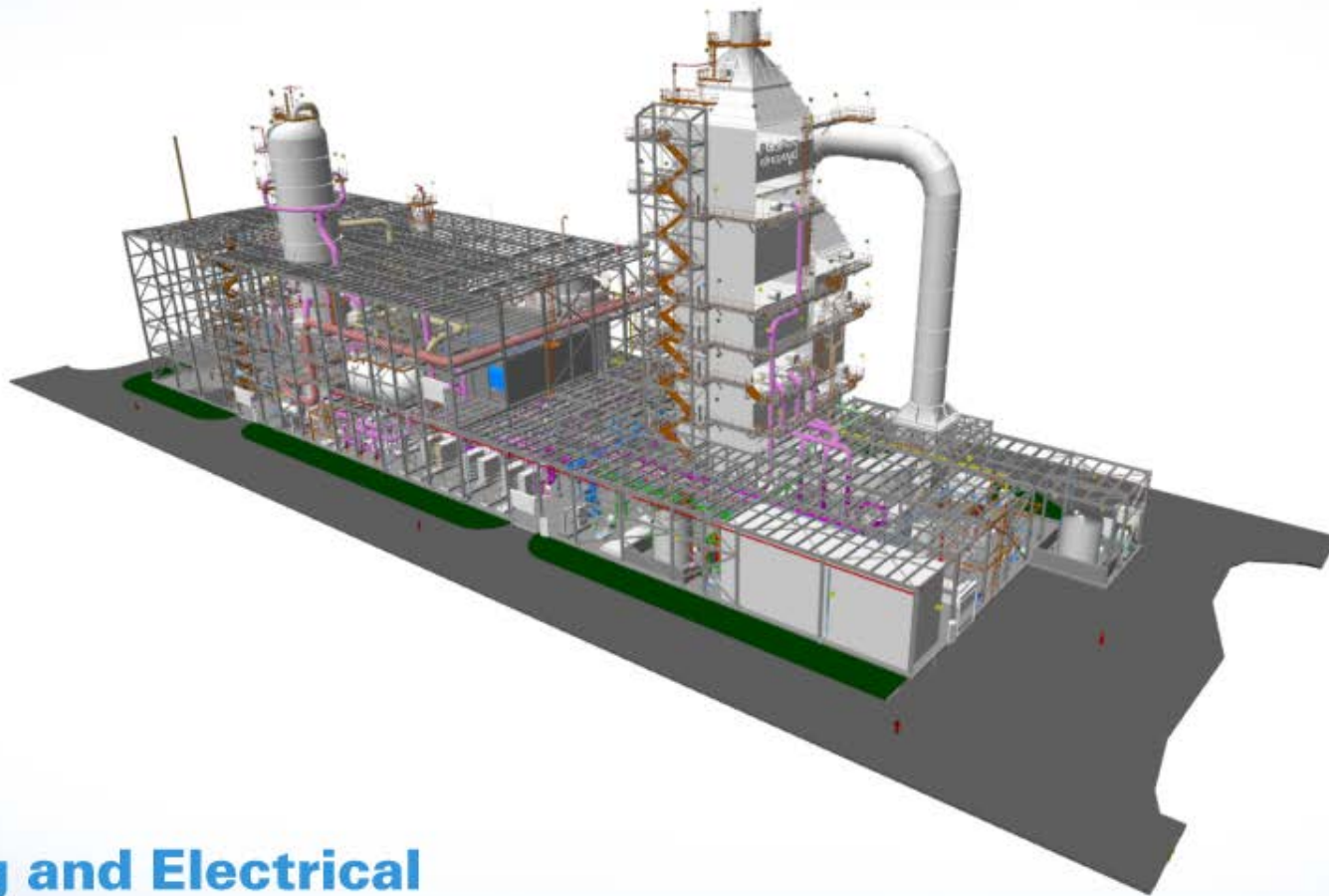


SO₂ and Carbon Capture Plant

Graphics adapted
from SNC-Lavalin
Design Model



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Piping and Electrical

(2Q 2012 to 2Q 2013)

Boundary Dam ICCS Demonstration

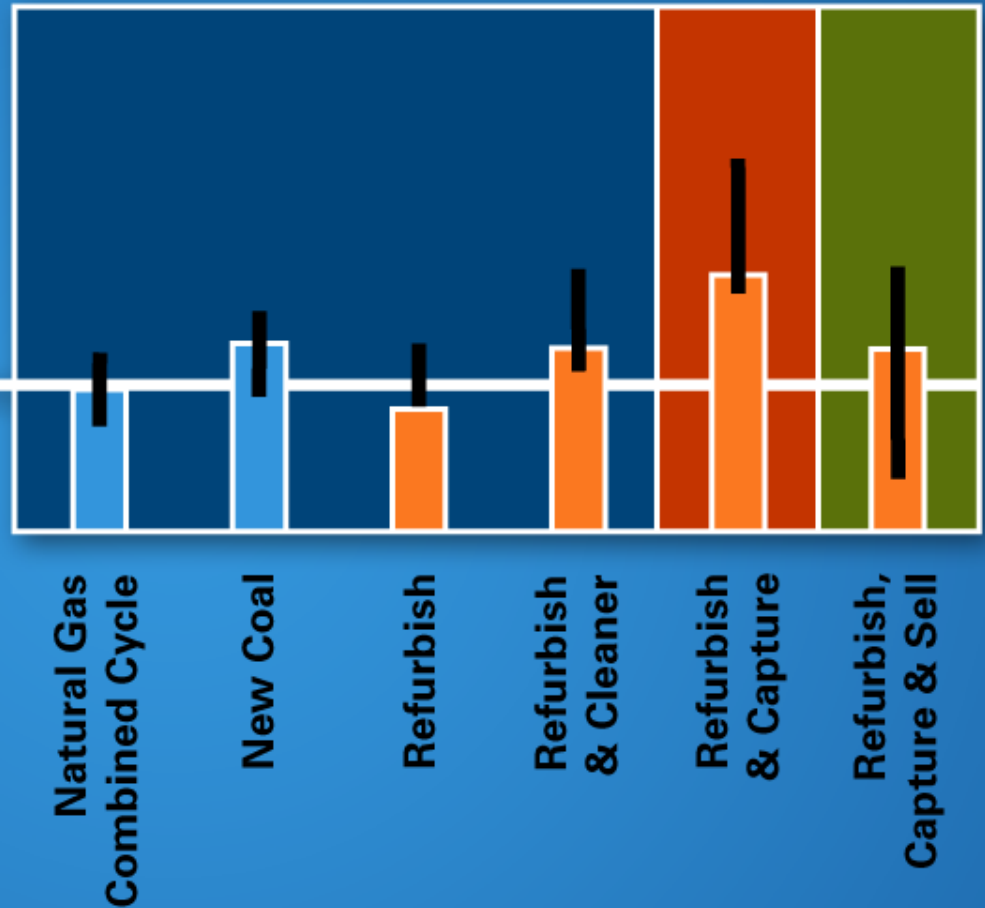


Commercial Operation
(1Q 2014)



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

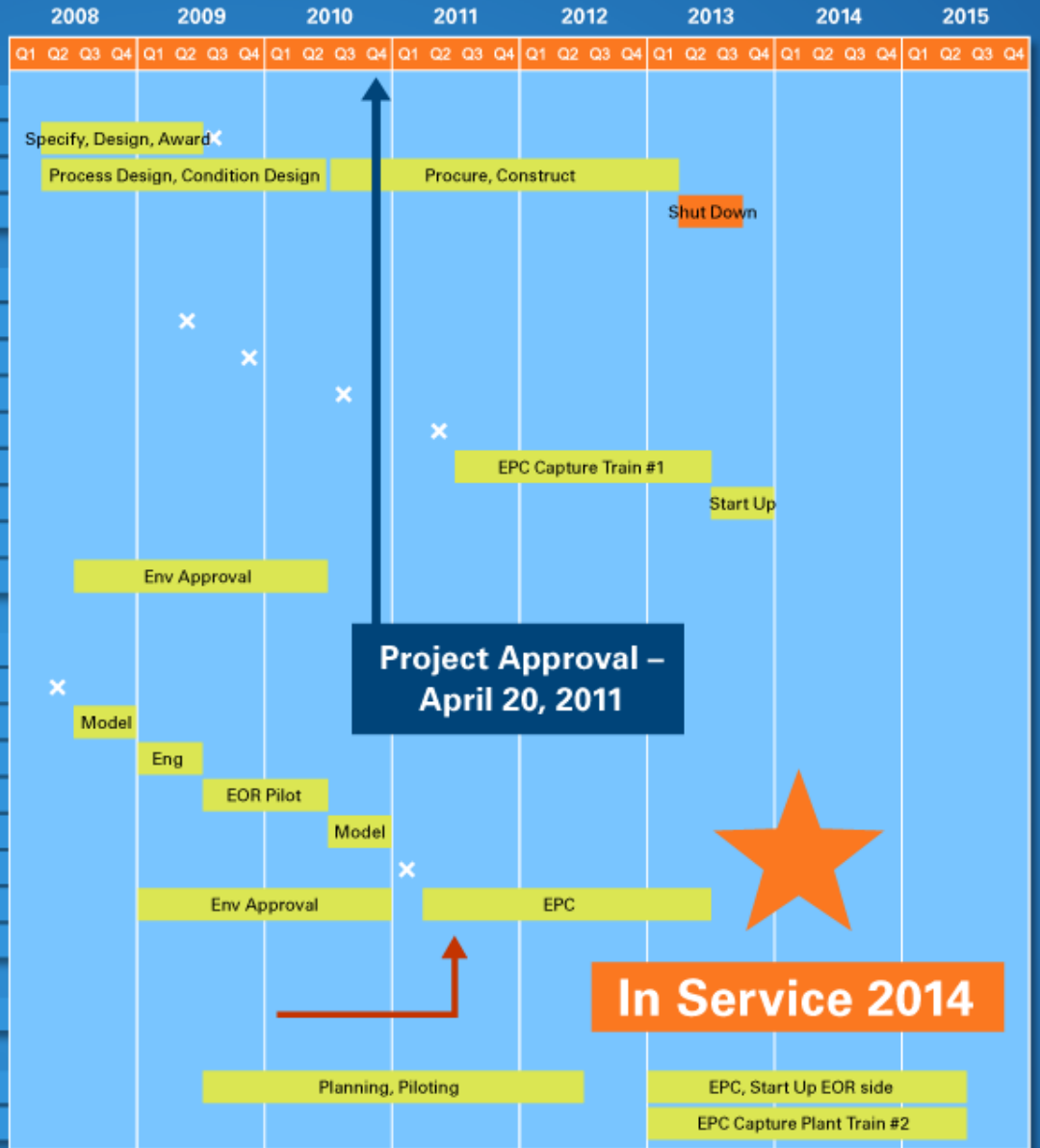
EOR - Phase 1

- SaskPower/E&R/Oil Co#1 agreement
- 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



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 CO₂ capture systems; and
- Results to date – as important as CO₂ capture technology selection.

2) CO₂ 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;
- CO₂ offtakers for CO₂ EOR markets are being identified; and
- SaskPower continuing to monitor emerging technologies.

Knowledge Gained

Lesson 1:

We Learn By Doing

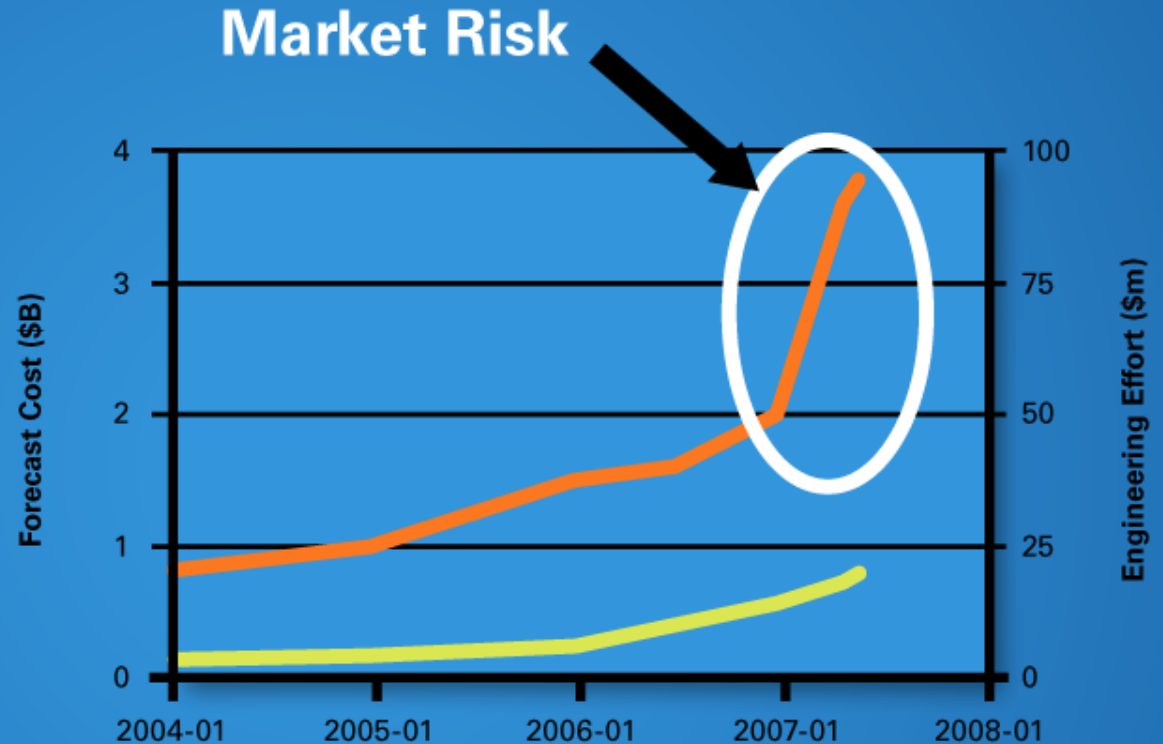
Corollary

Experience makes Success Possible

Knowledge Gained

Lesson 2:

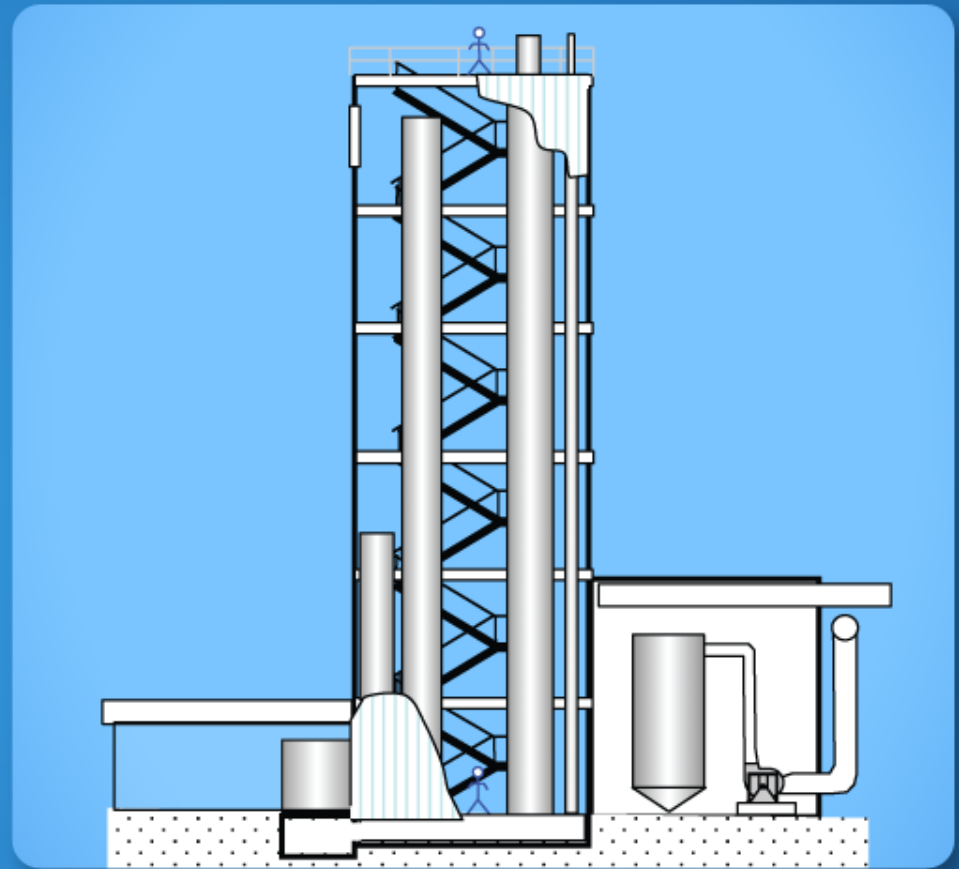
You don't know what it costs until you see the contract.



Knowledge Gained

Lesson 4:

Industry Needs Better
Tools for Assessing
Performance and Risk
on Post Combustion
Capture Systems

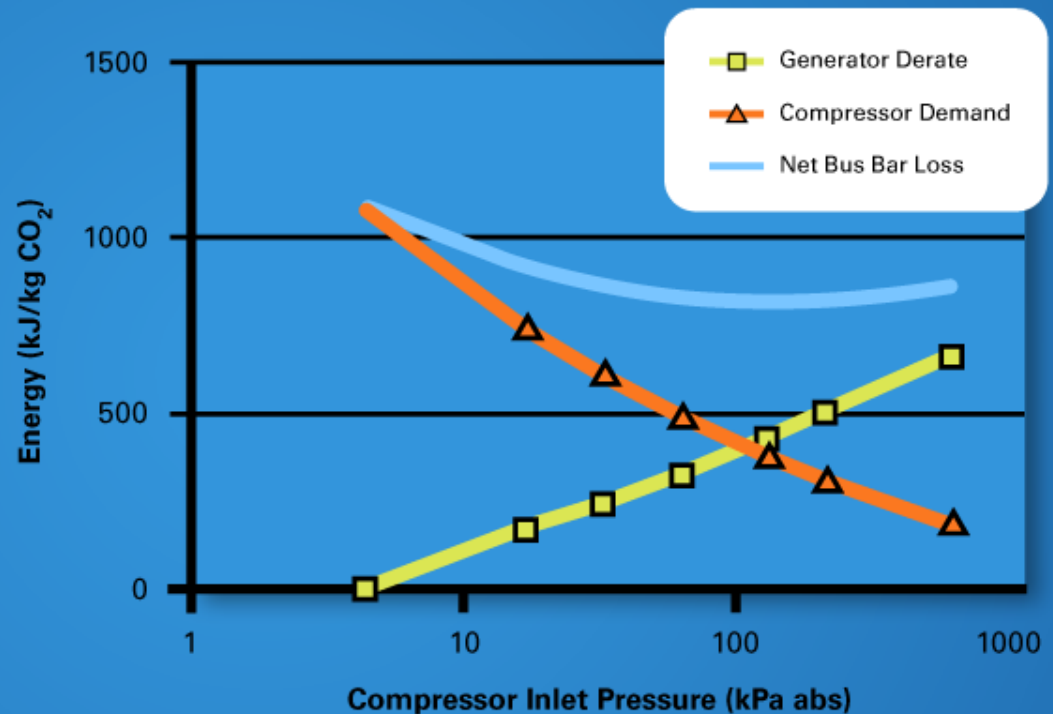


Knowledge Gained

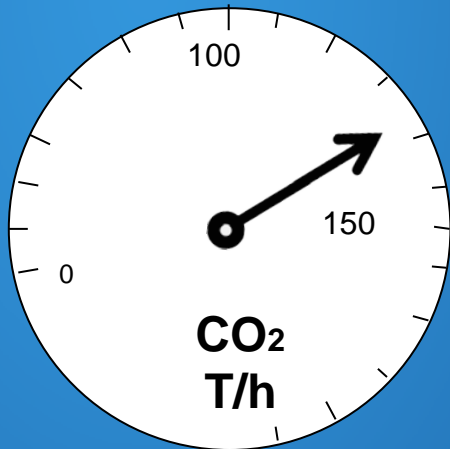
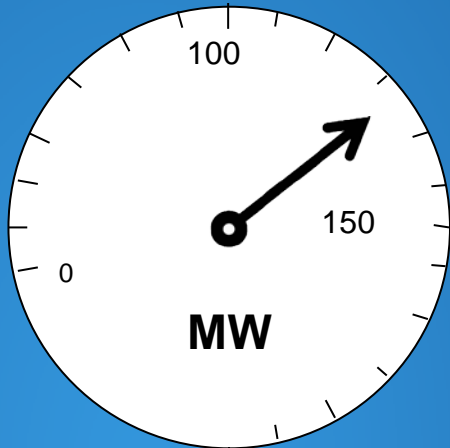
Lesson 5:

Carbon Capture and Power Plant Configuration are integral.

Steam Stripping Optima

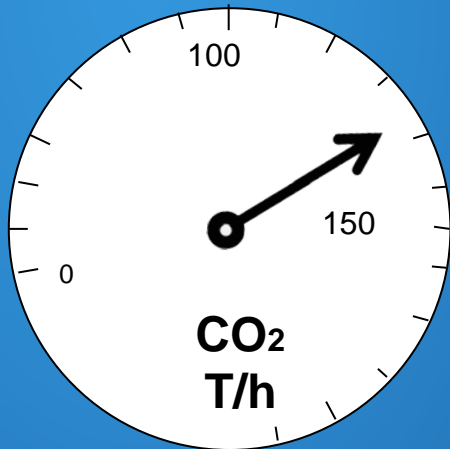
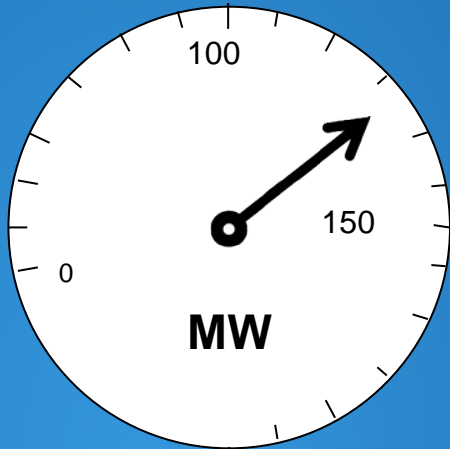


Knowledge Expected



- Will performance match engineering predictions?
- Will integrated operation perform as intended?
- Were the risk models actually of value in managing the project, or is this just fodder for the financiers?
- Can some of the opportunities which were bypassed on the Demo be brought into future projects?
- What new opportunities for cost and performance improvements will be uncovered?

Knowledge Expected



- To what extent will society support movement to low carbon future including accepting a cost premium?
- Will new public issues arise?
- To what extent will new industry grow?
- What regional economic impact will be seen?
- Your question here

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 CO₂ buyer market - has significant positive economic impact for the provincial economy.
- Future projects more economic - COE \$100/MWh.



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SNC • LAVALIN

EPC Contractor - SO₂/CO₂ System

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