

# *SaskPower's Carbon Capture Demonstration Projects*



**Presented to:**

Saskatchewan Mining Association, Saskatoon, Sk.

April 14, 2010

# Presentation Outline

---

- **Who is SaskPower**
- Issues Affecting Power Generation
- Generation Supply Options
- Clean Coal Project Objectives
- Technology Concept
- Why CO<sub>2</sub> for EOR
- Progress on Project to Date
- Shand Reference Facility

# SaskPower: Who We Are

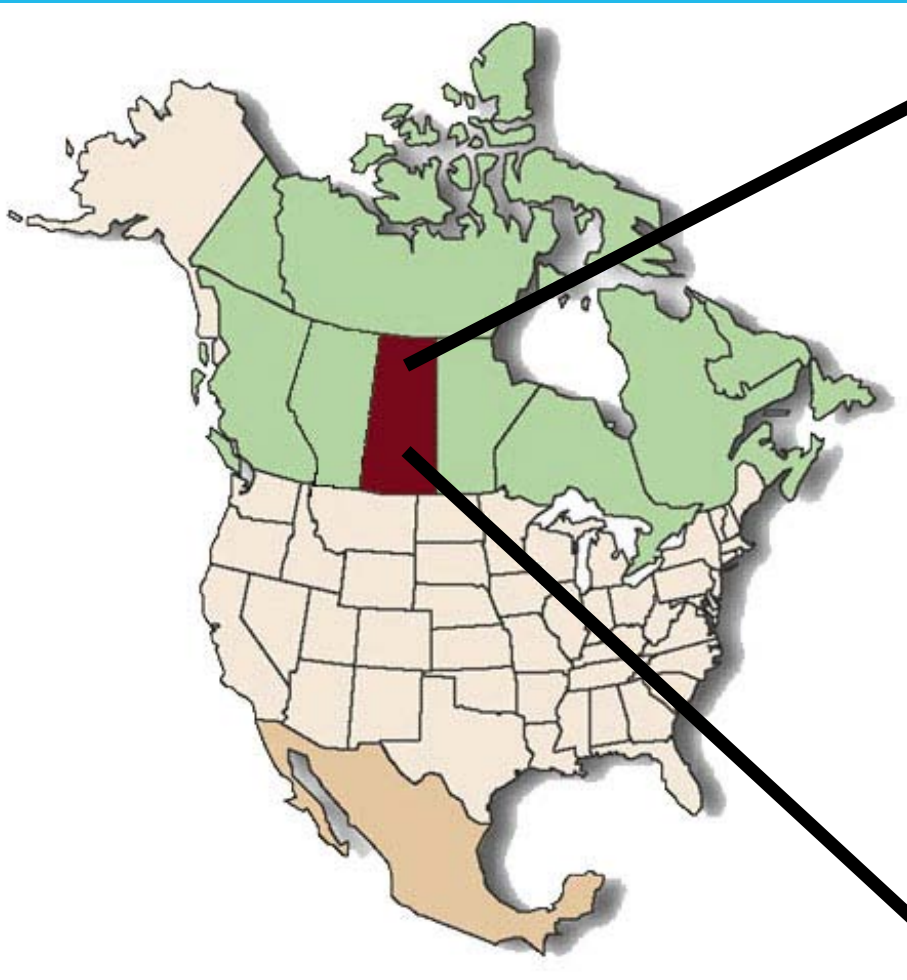
---

## Crown Corporation

- Owned by Government of Saskatchewan;

## Customer Focused

- SaskPower's mission is to provide safe, reliable and sustainable power to the people of Saskatchewan;
- Providing customers with power at the lowest possible cost.



100  
MW



- 451,713 customers.
- 155,818 km of T&D lines
- 3668 MW generation
- 6.5% Peak Load Growth - 2008

300  
MW

150  
MW

clean **co<sub>2</sub>**™

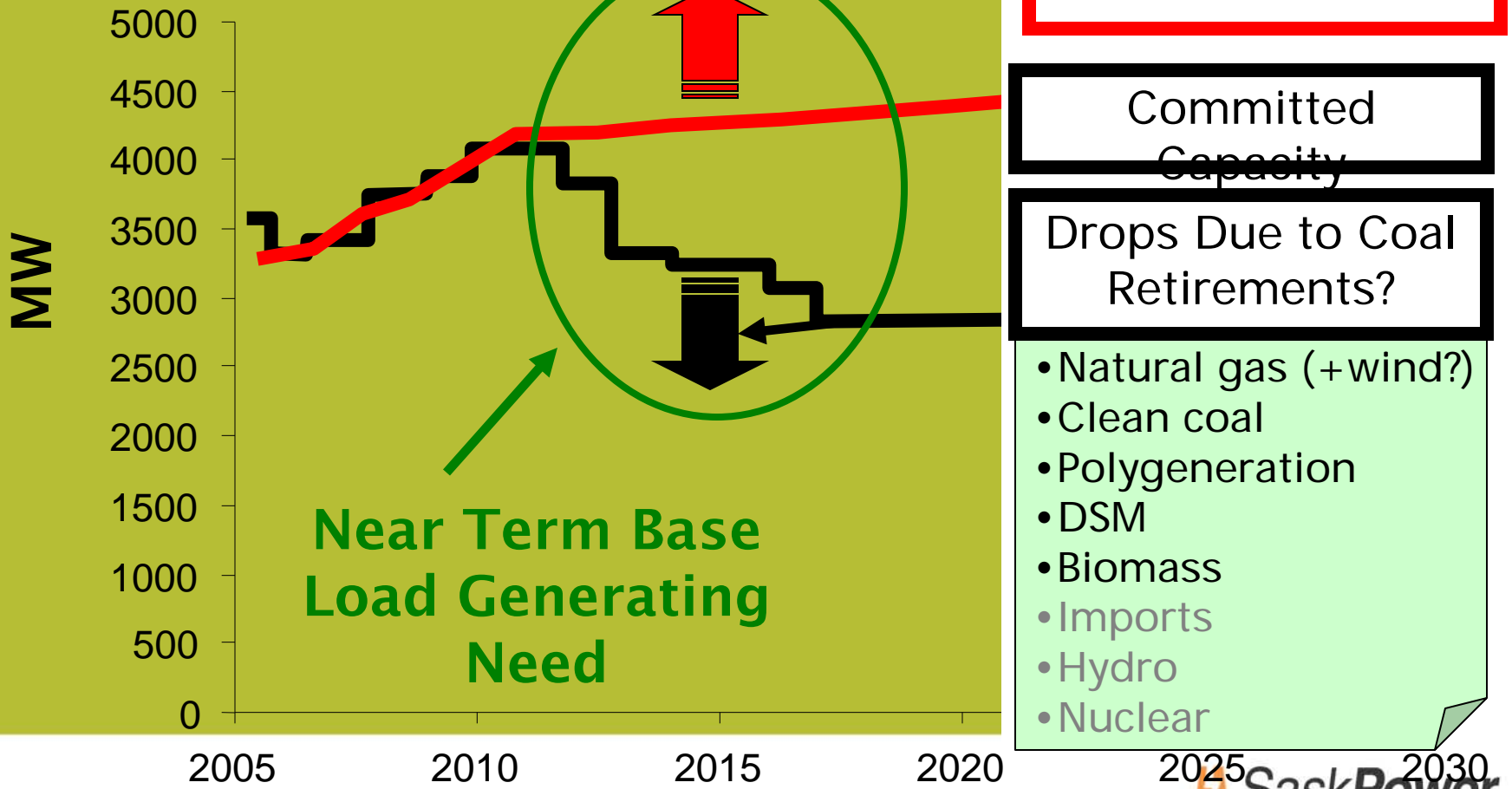
 **SaskPower**  
Powering the future

# Presentation Outline

---

- Who is SaskPower
- **Issues Affecting Power Generation**
- Generation Supply Options
- Clean Coal Project Objectives
- Technology Concept
- Why CO<sub>2</sub> for EOR
- Progress on Project to Date
- Shand Reference Facility

# SaskPower Capacity Position



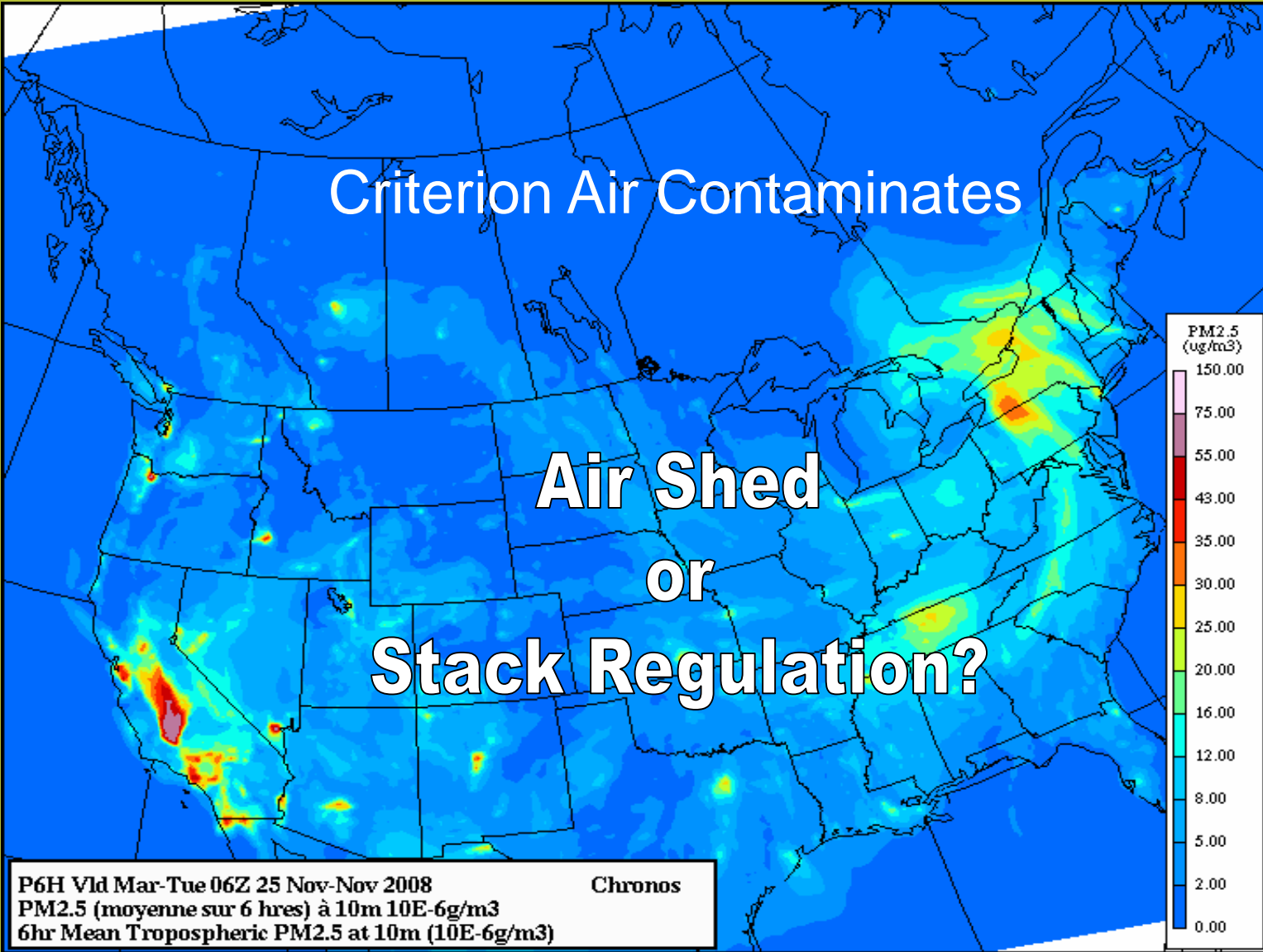
**Near Term Base Load Generating Need**

# Greenhouse Gas & Criteria Air Emission Regulations

- Greenhouse Gas Regulations:
  - Canadian Federal Regulations;
    - **20 per cent reduction by 2020**
    - **Non-CO2 Capture New Coal – “Banned”?**
  - Provincial Regulations also in progress.

# Criterion Air Contaminates

## Air Shed or Stack Regulation?



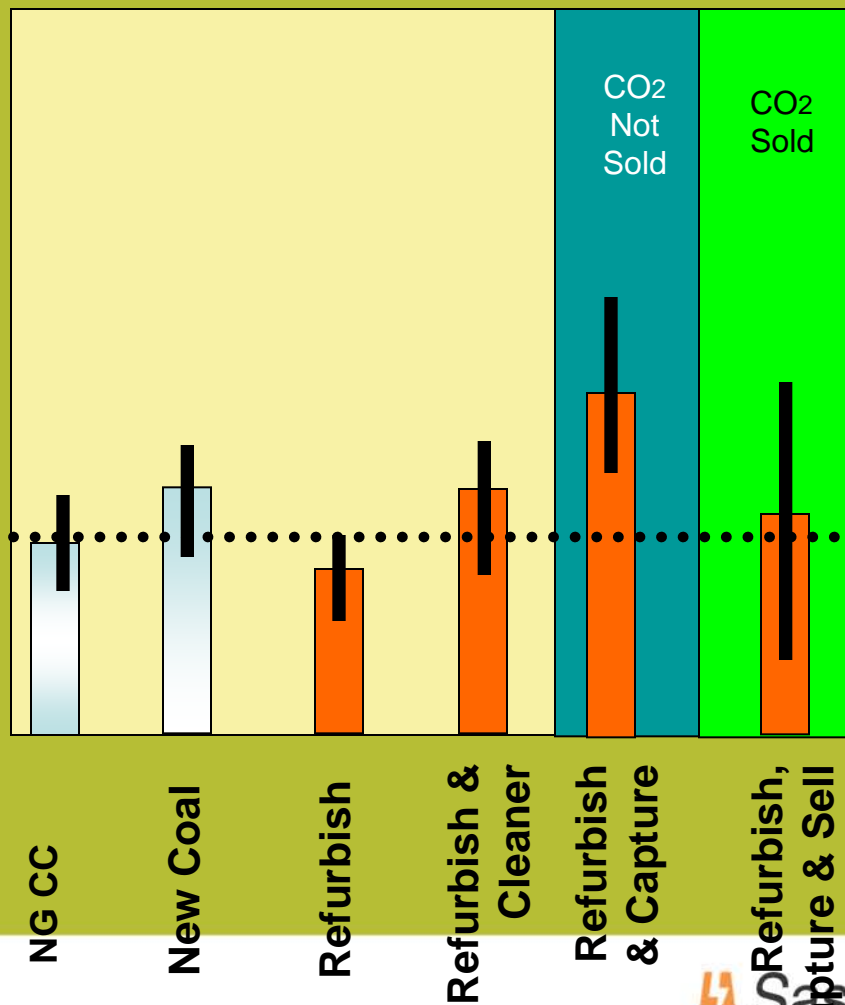
# Presentation Outline

---

- Who is SaskPower
- Issues Affecting Power Generation
- **Generation Supply Options**
- Clean Coal Project Objectives
- Technology Concept
- Why CO<sub>2</sub> for EOR
- Progress on Project to Date
- Shand Reference Facility

# Cost of Electricity

baseline is cost of new natural gas generation



# Presentation Outline

---

- Who is SaskPower
- Issues Affecting Power Generation
- Generation Supply Options
- **Clean Coal Project Objectives & Deliverables**
- Technology Concept
- Why CO<sub>2</sub> for EOR
- Progress on Project to Date
- Shand Reference Facility

## BD ICCS Demonstration

### Why BD3?

#### 1) Valuable Existing Assets:

–lowers capital costs = lower cost of electricity

#### 2) Right Size:

–1 million tonnes per year matches EOR market

#### 3) BD3 reaches major decision in 2013:

–If no action – default is retirement – 0 MWs

#### 4) Applicable to other aging coal fired units

# SaskPower Clean Coal Objectives

---

- To minimize future customer cost increases related to emissions regulations;
- Develop economically and environmentally sustainable electricity supply options through coal;
- Cost of Electricity (COE) must be lower than other available options to be viable in long term.

# Project Deliverables

1) **Life Extension** - Refurbish Unit 3 to allow an additional 30 years of reliable, safe operation

2) **Performance**  
NOx, Hg),

3) **CO<sub>2</sub> Cap**  
overall Co

4) **Cost Eff**  
that of the  
EOR to ac

## A Unique Project

- *Demonstrate a cost-effective, environmentally sustainable, long-term model for existing coal-fired electricity generation*

trol (SOx,

est meets

or below  
ale for

5) **In-Service 2013**

# Boundary Dam Demonstration Project

---

## First fully integrated power plant

- CO<sub>2</sub> capture
- EOR operation
- Sequestration

## Demonstrating

- Technologies
- Mechanics of Integration
- Business opportunity and realities
- Regulatory Setting

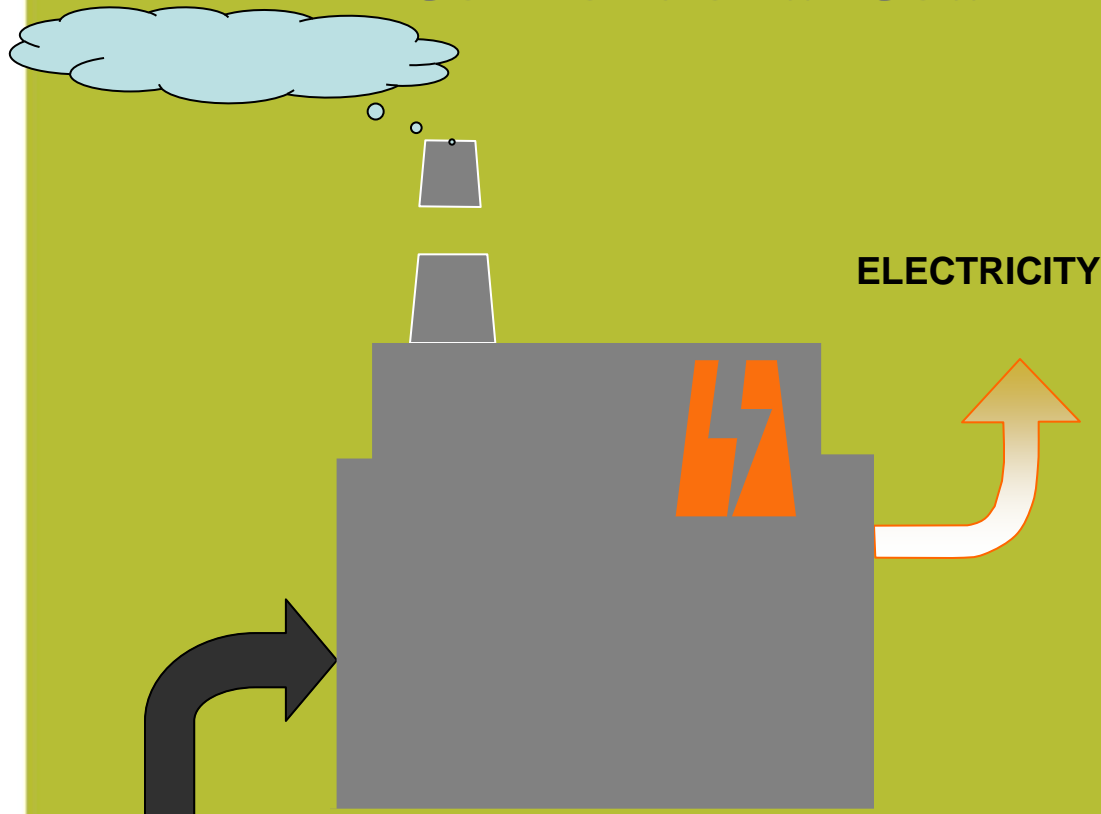
## Forming the experience to move forward

# Presentation Outline

---

- Who is SaskPower
- Issues Affecting Power Generation
- Generation Supply Options
- Clean Coal Project Objectives & Deliverables
- **Technology Concept**
- Why CO<sub>2</sub> for EOR
- Progress on Project to Date
- Shand Reference Facility

# Conventional Coal Fired Generator

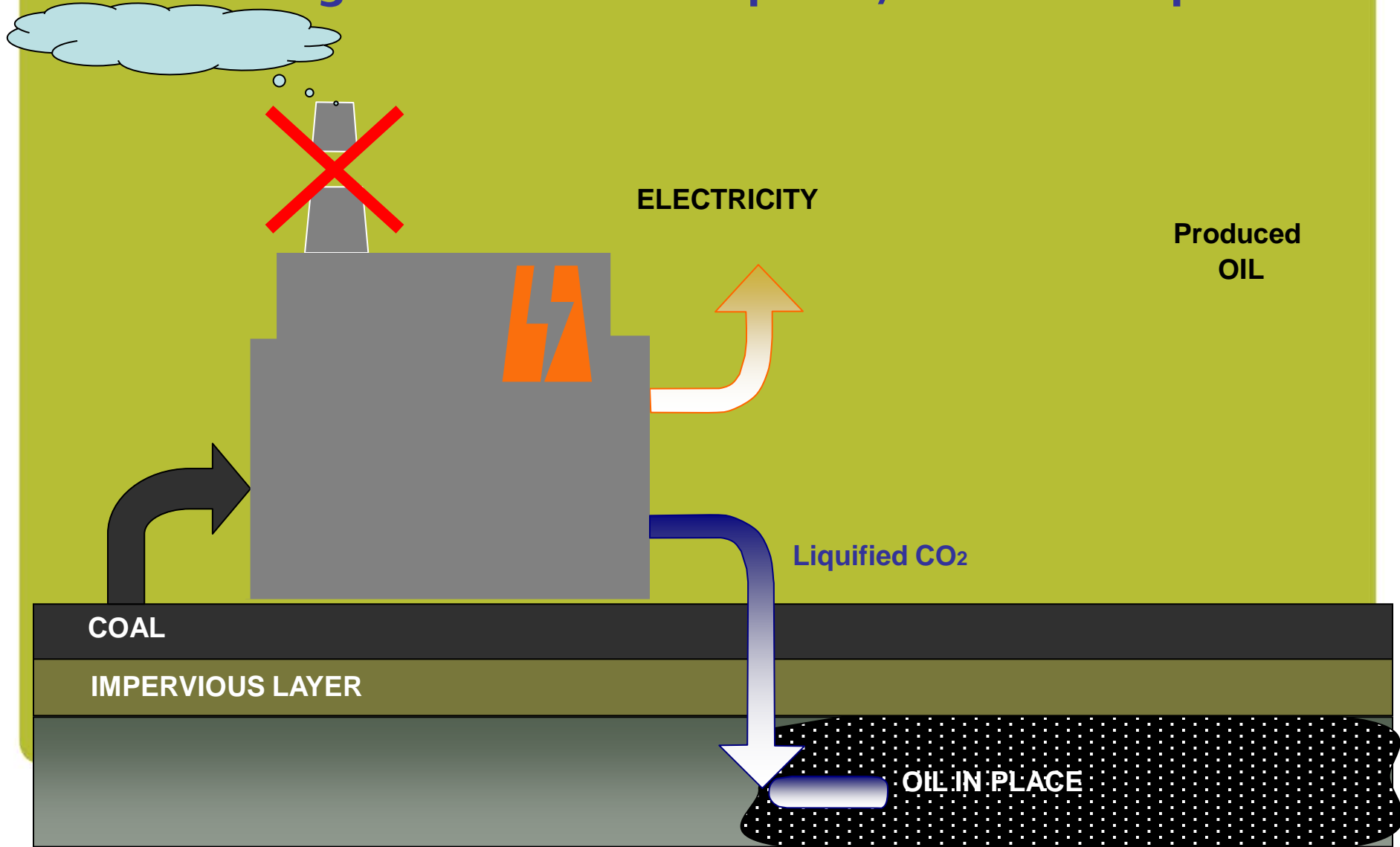


COAL

IMPERVIOUS LAYER

OIL IN PLACE

# Integrated Carbon Capture/EOR Concept



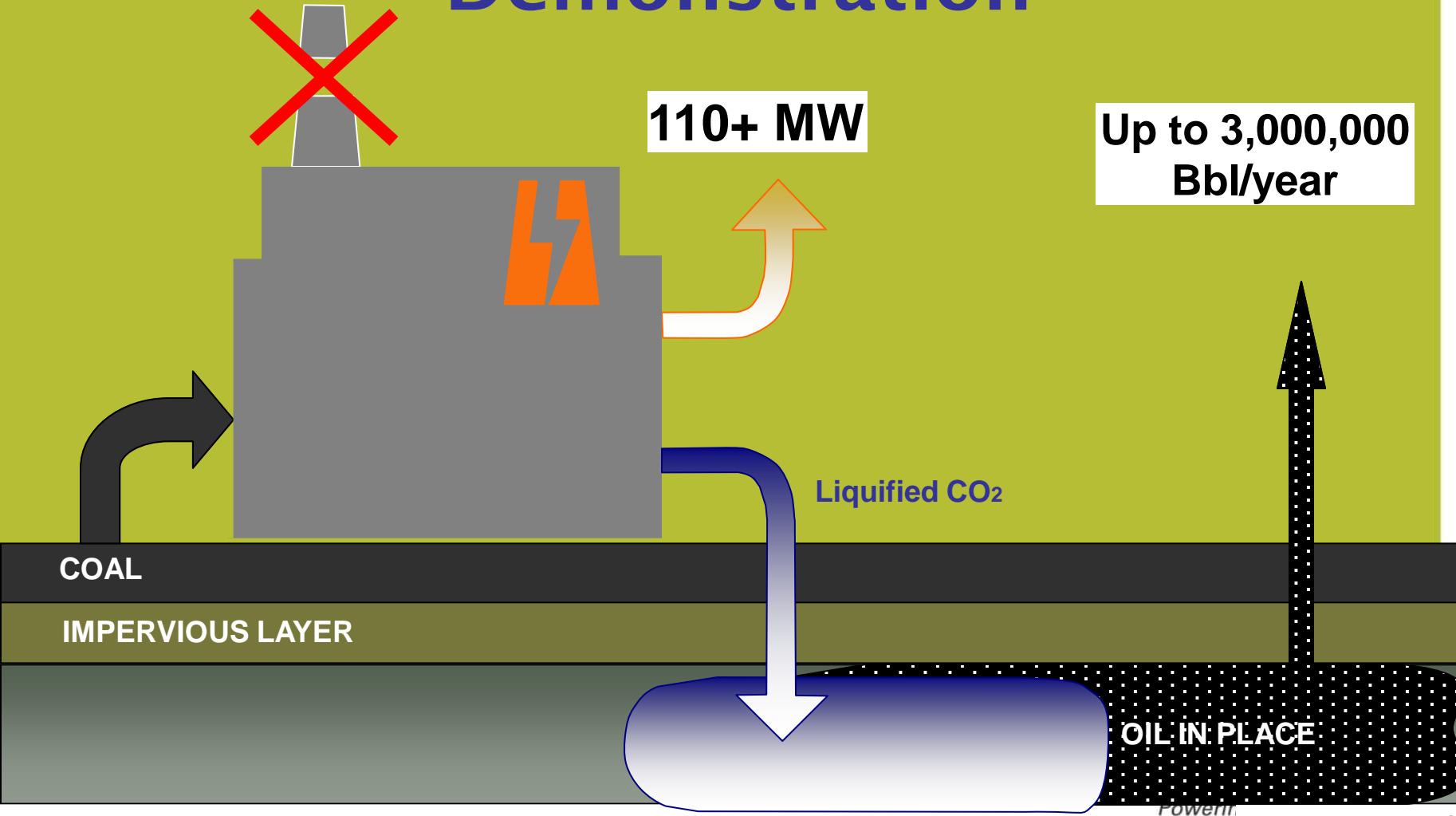
# Boundary Dam Demonstration

-1,000,000 T/year



110+ MW

Up to 3,000,000 Bbl/year



PowerGen

# Boundary Dam Demonstration

**-1,000,000 T/year**



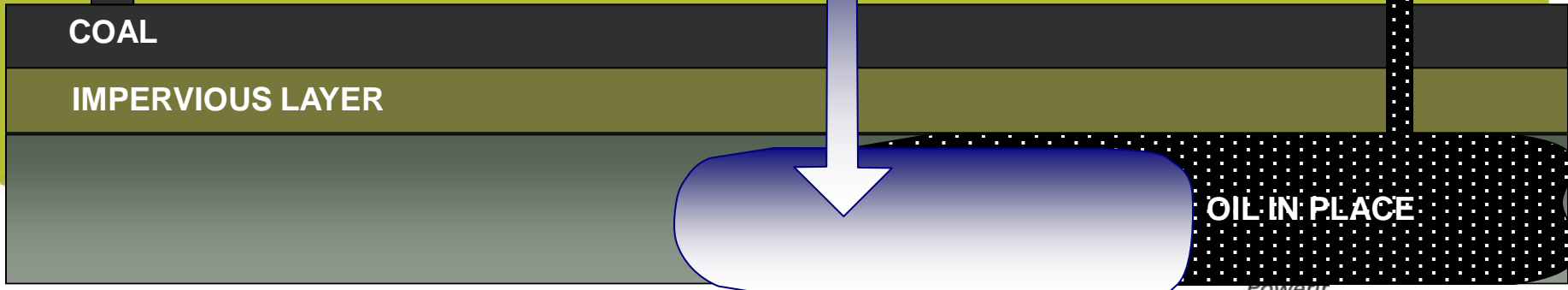
**~ \$90 million/year**

**110+ MW**

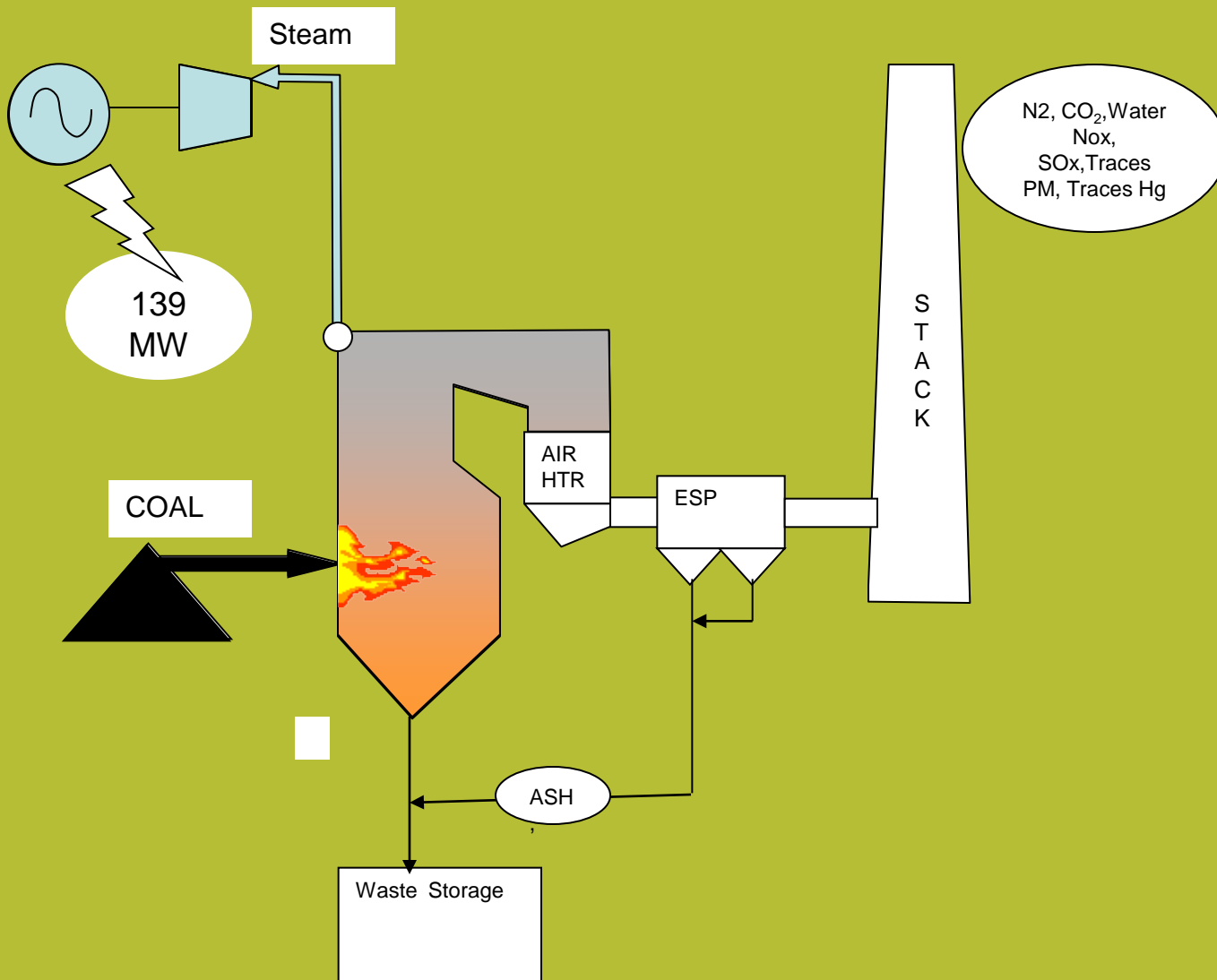
**Up to 3,000,000 Bbl/year**

**\$200~ \$300 million/year**

Liquified CO<sub>2</sub>

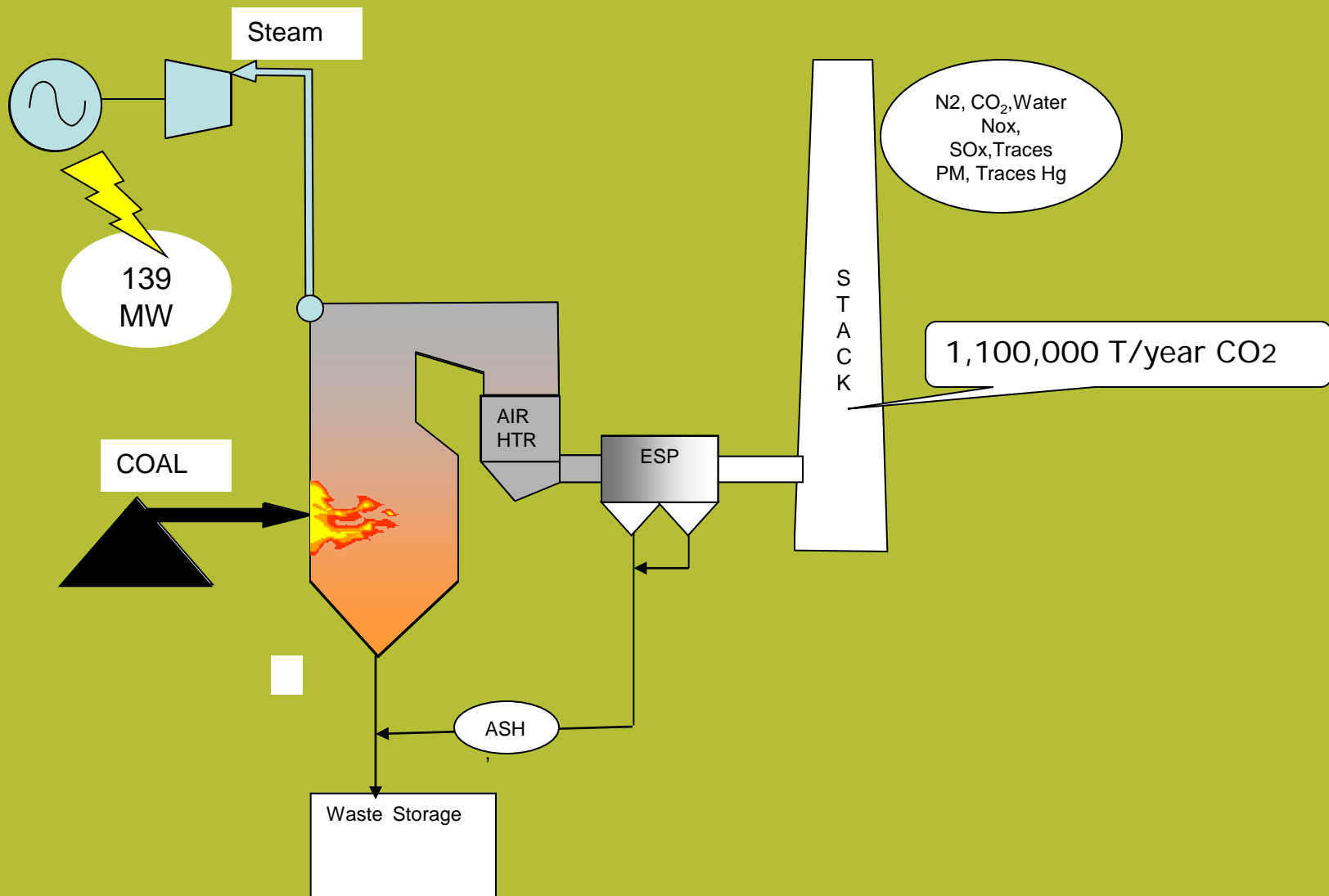


PowerGen

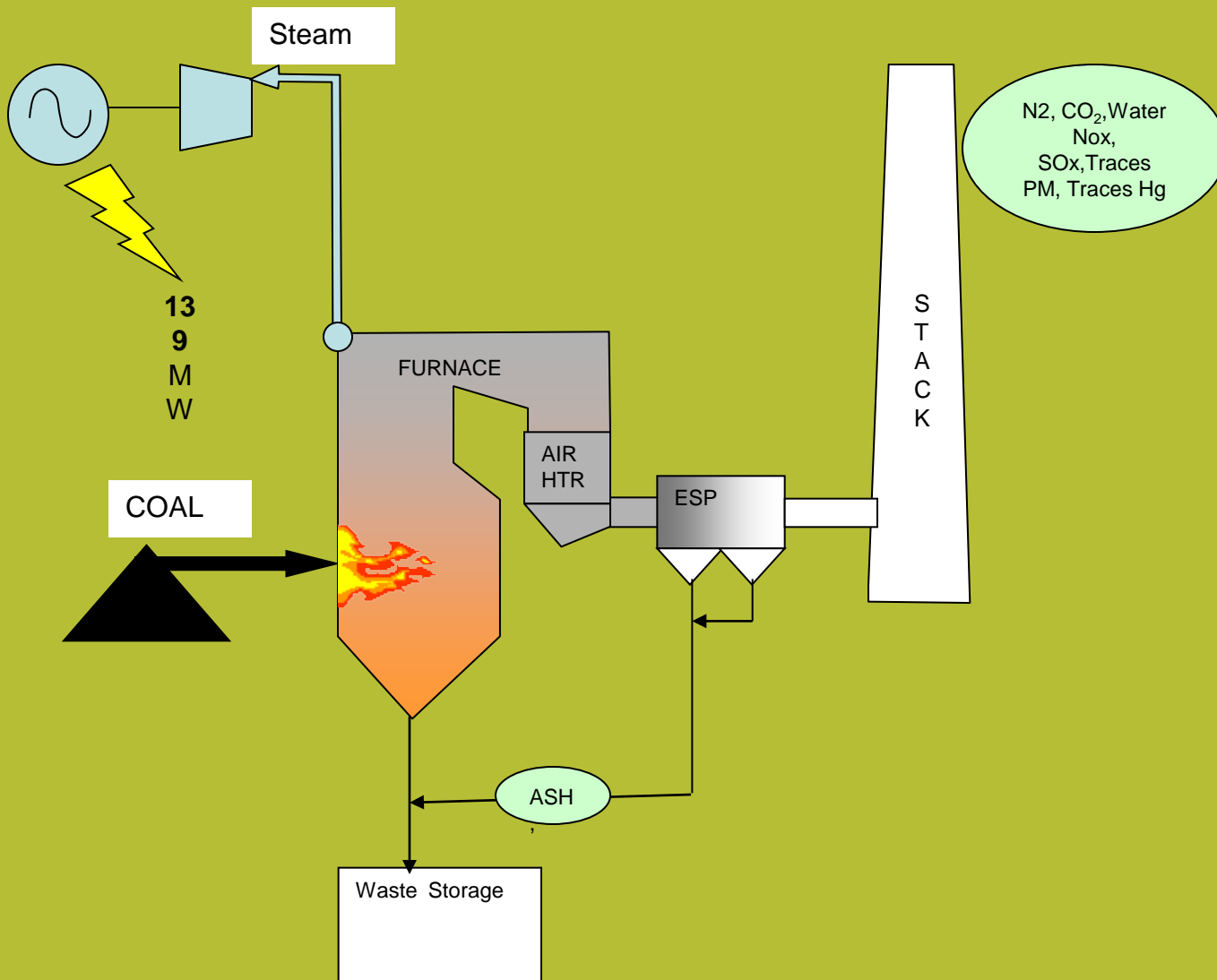


# BD 3 – Conventional Pulverized Coal Unit

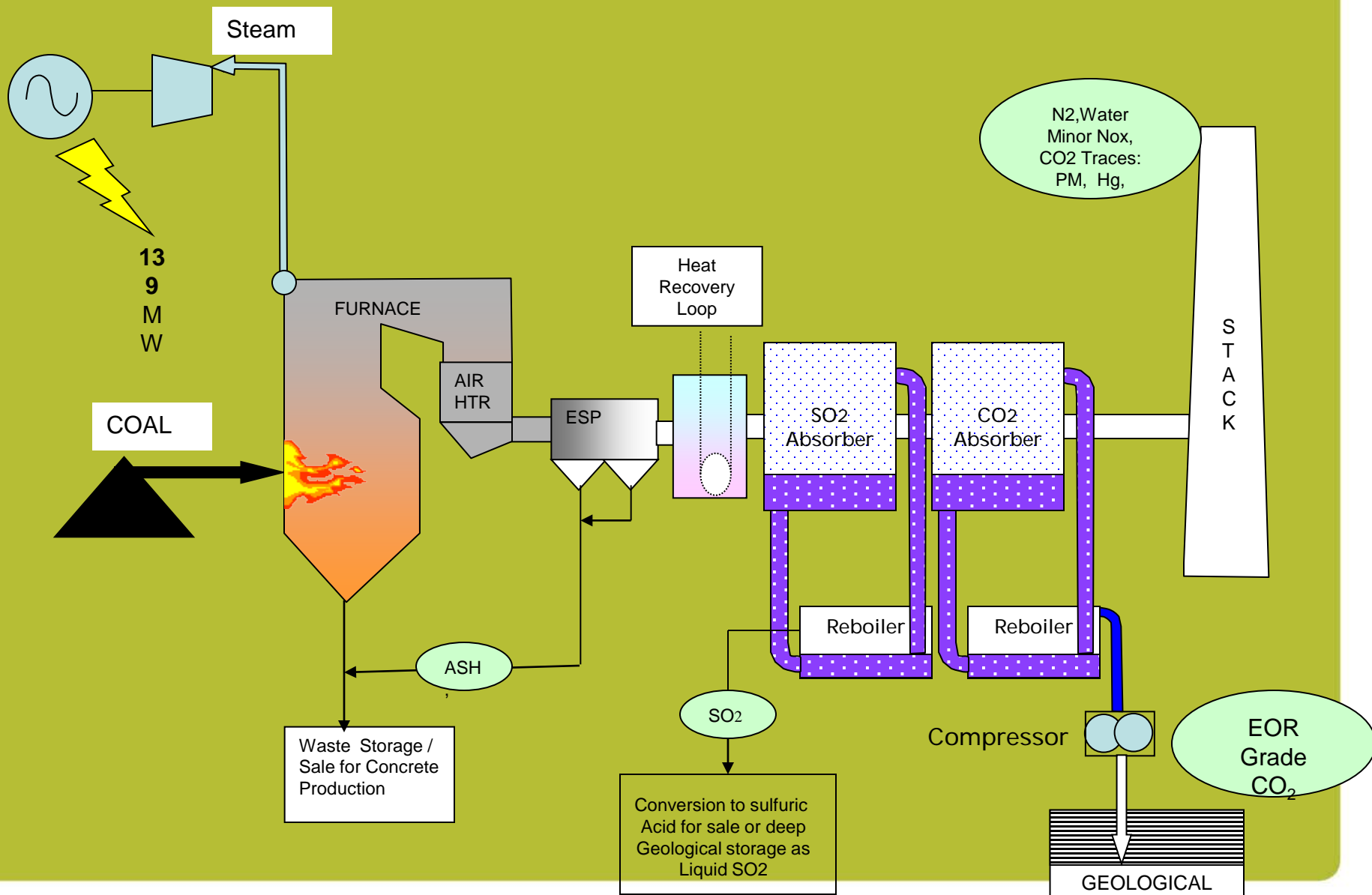
Powering the future



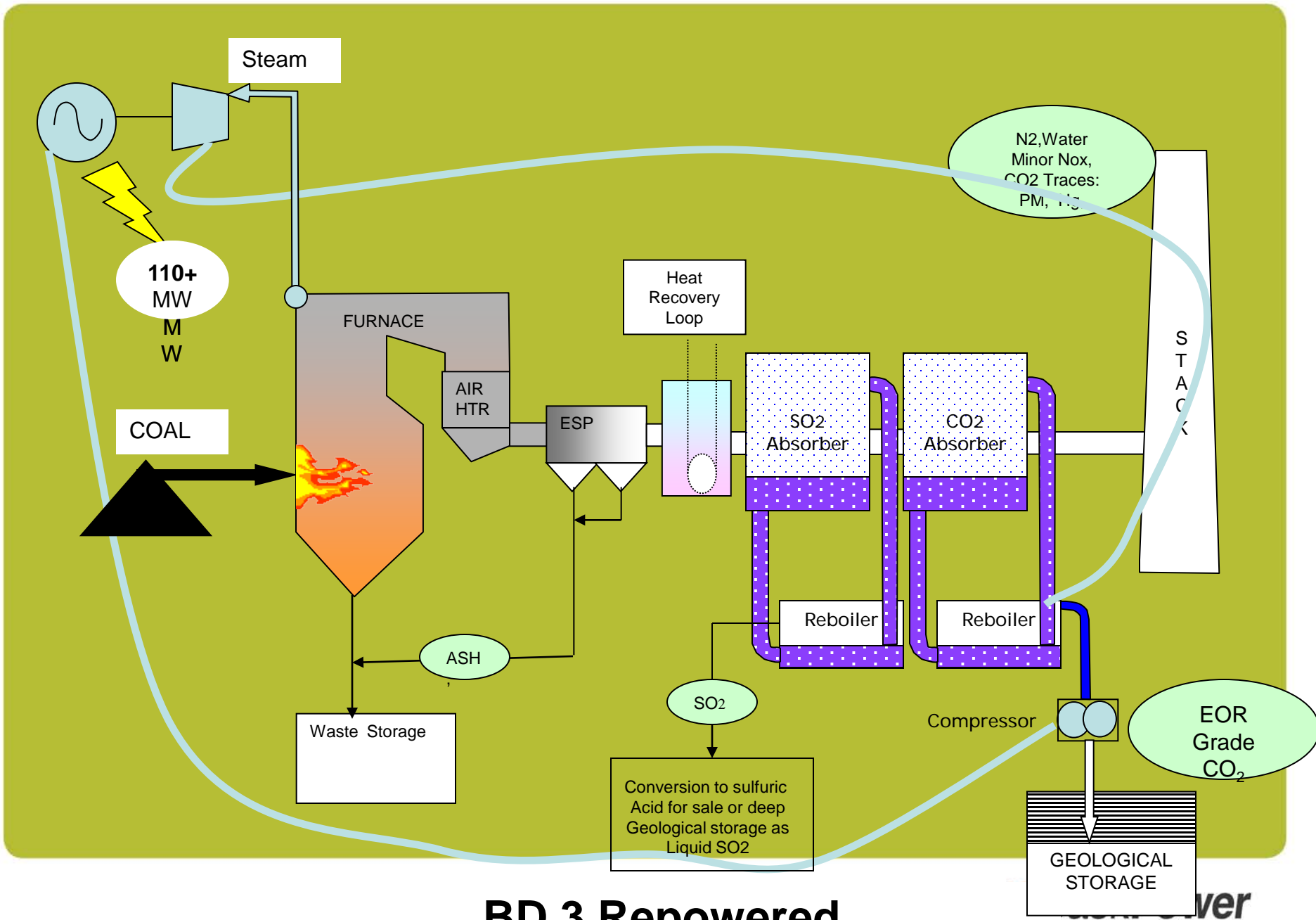
# BD 3 – Conventional Pulverized Coal Unit



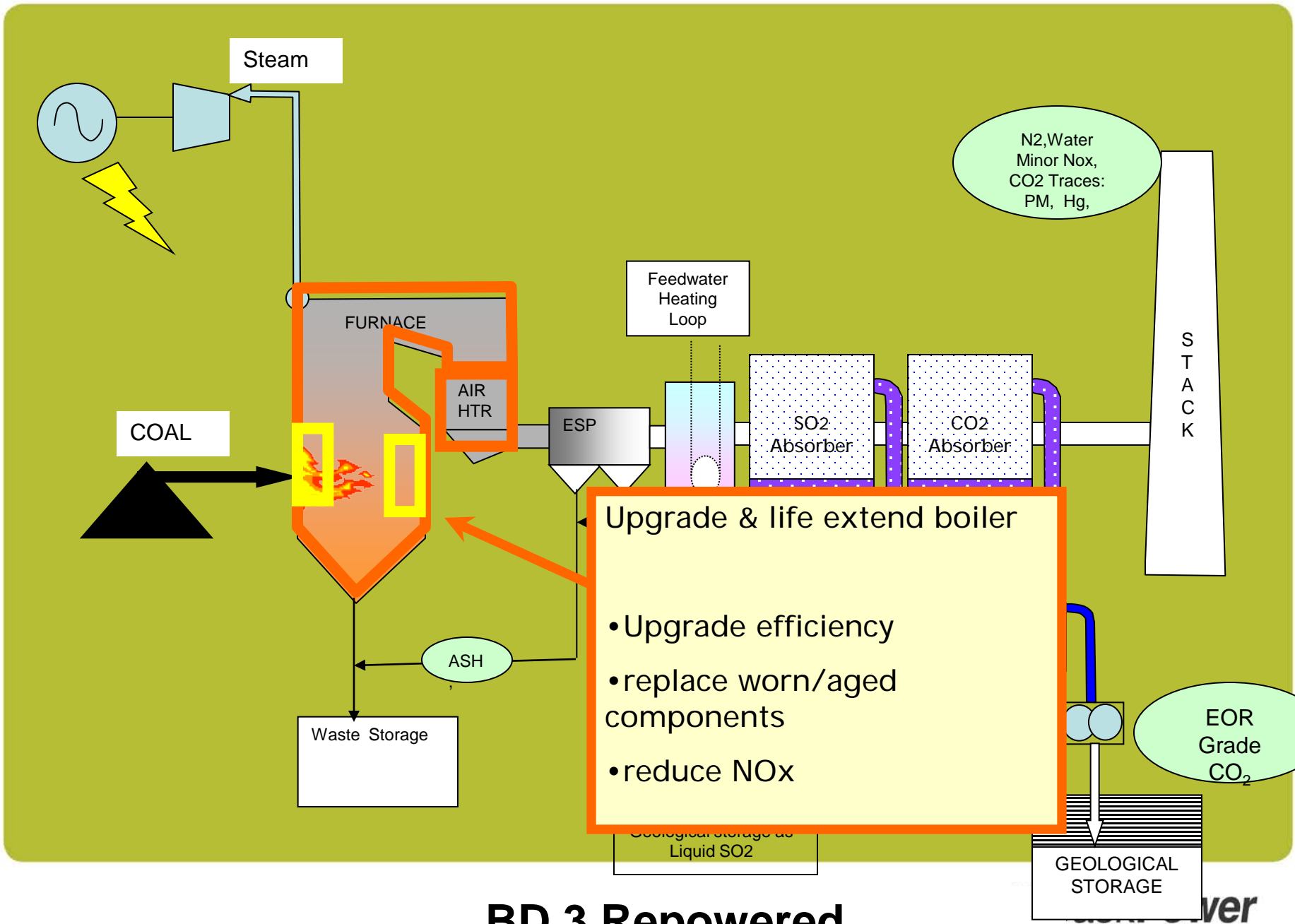
## BD 3 Repowered



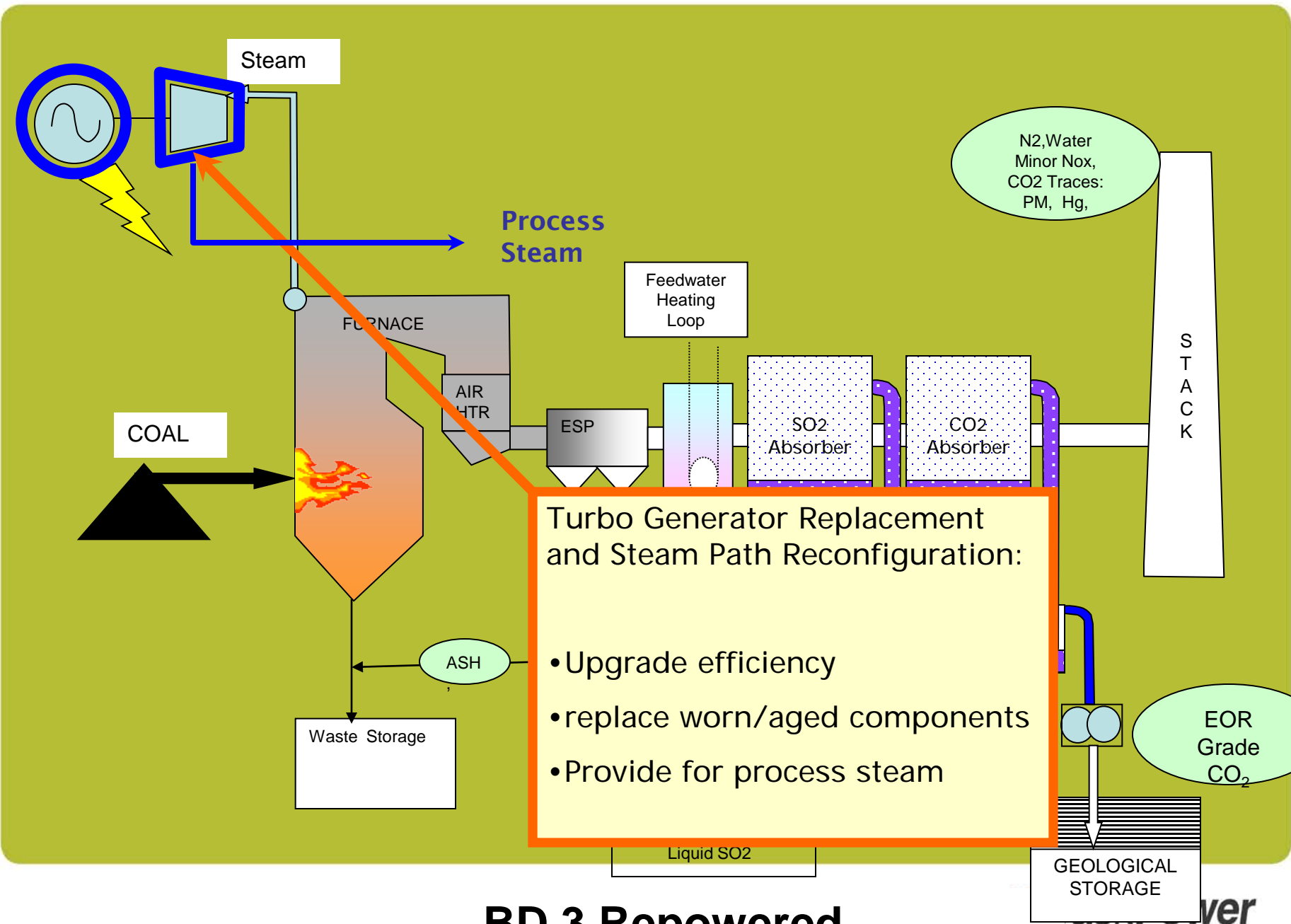
# BD 3 Repowered



# BD 3 Repowered



## BD 3 Repowered



**Turbo Generator Replacement and Steam Path Reconfiguration:**

- Upgrade efficiency
- replace worn/aged components
- Provide for process steam

# BD 3 Repowered



**Unit 3**

**SaskPower**  
Boundary Dam



clean **co<sub>2</sub>**™

 **SaskPower**  
Powering the future



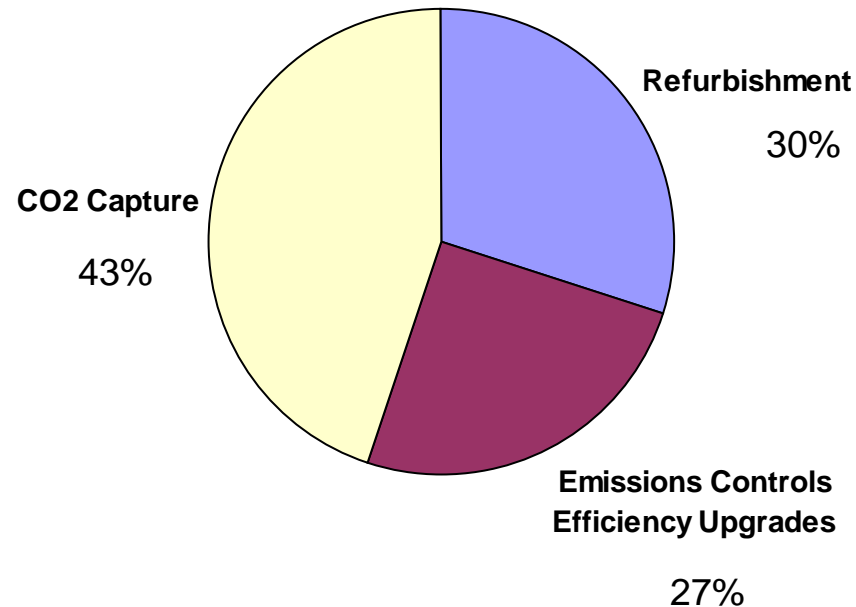
clean **co<sub>2</sub>**al™

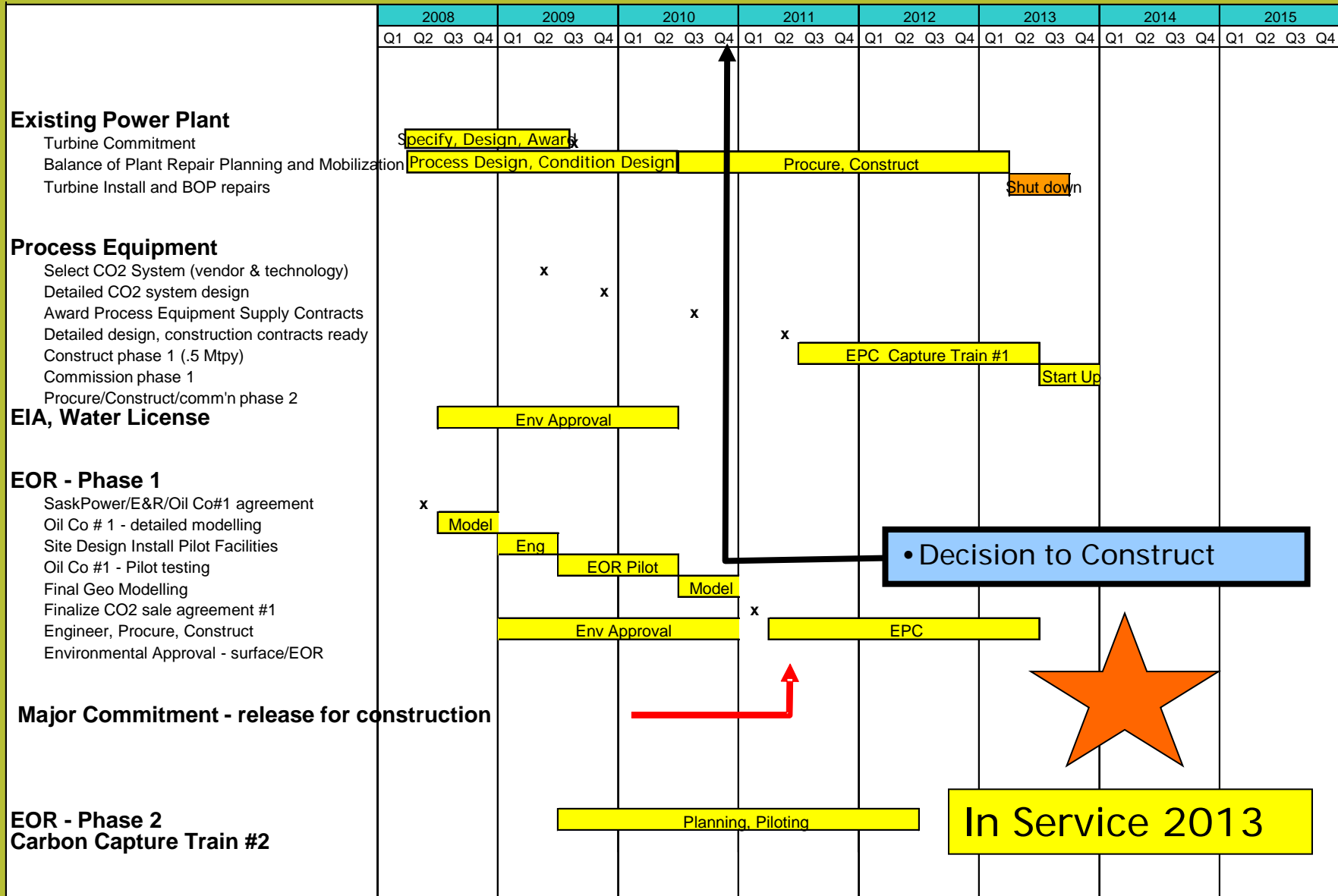
 **SaskPower**  
Powering the future

SaskPower BOUNDARY DAM CC System  
SNC-Lavalin CANSOLV



# Demonstration Project: Capital Cost Breakdown





# Presentation Outline

---

- Who is SaskPower
- Issues Affecting Power Generation
- Generation Supply Options
- Clean Coal Project Objectives & Deliverables
- Technology Concept
- **Why CO<sub>2</sub> for EOR**
- Progress on Project to Date
- Shand Reference Facility

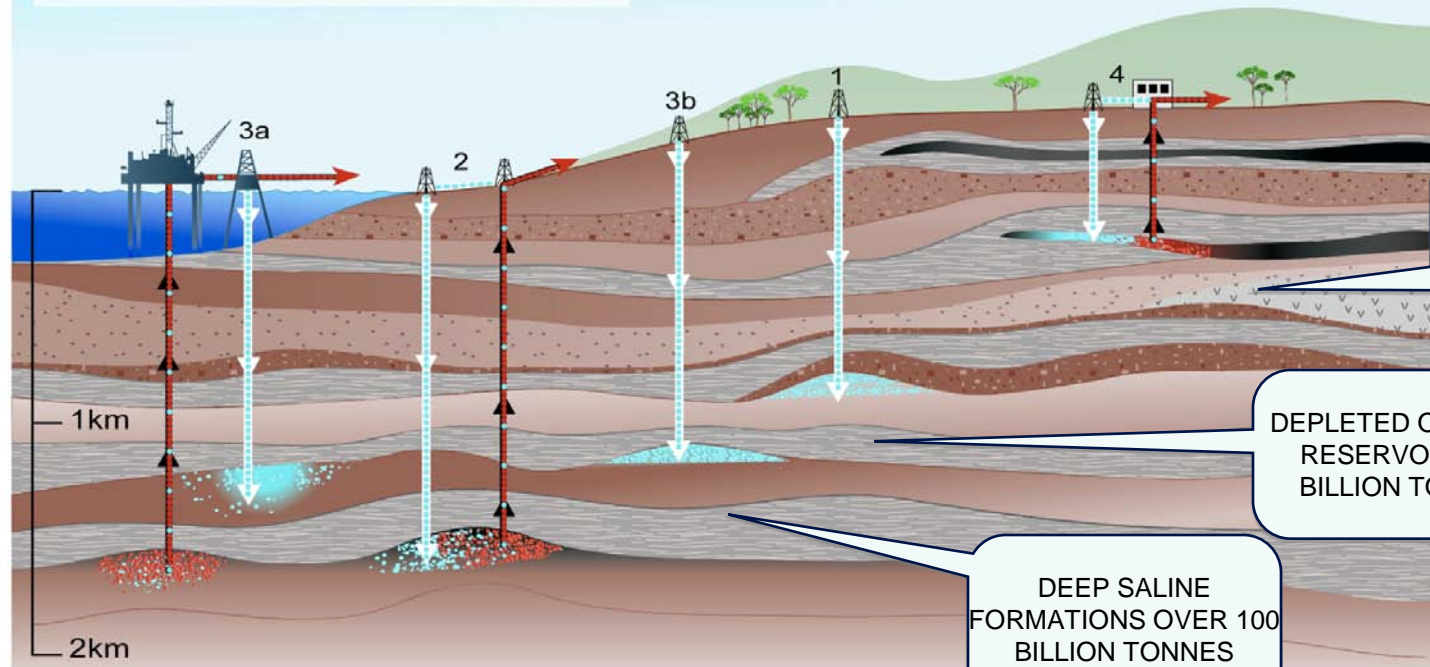
# Global capacities for geological CO<sub>2</sub> storage

## Methods for storing CO<sub>2</sub> in deep underground geological formations

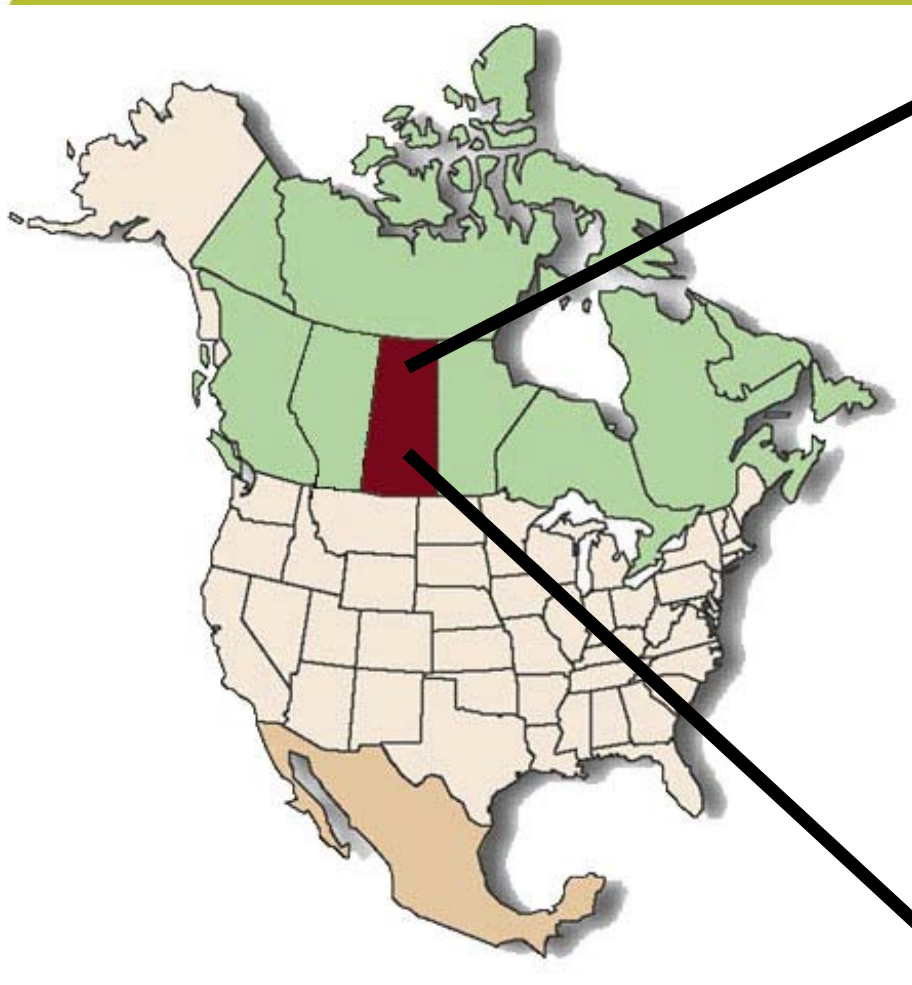
### Overview of Geological Storage Options

- 1 Depleted oil and gas reservoirs
- 2 Use of CO<sub>2</sub> in enhanced oil and gas recovery
- 3 Deep saline formations — (a) offshore (b) onshore
- 4 Use of CO<sub>2</sub> in enhanced coal bed methane recovery

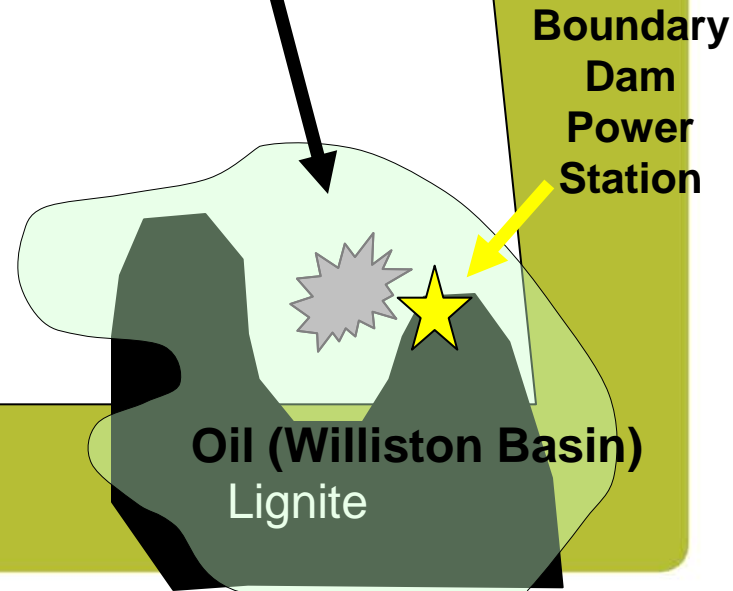
Produced oil or gas  
Injected CO<sub>2</sub>  
Stored CO<sub>2</sub>



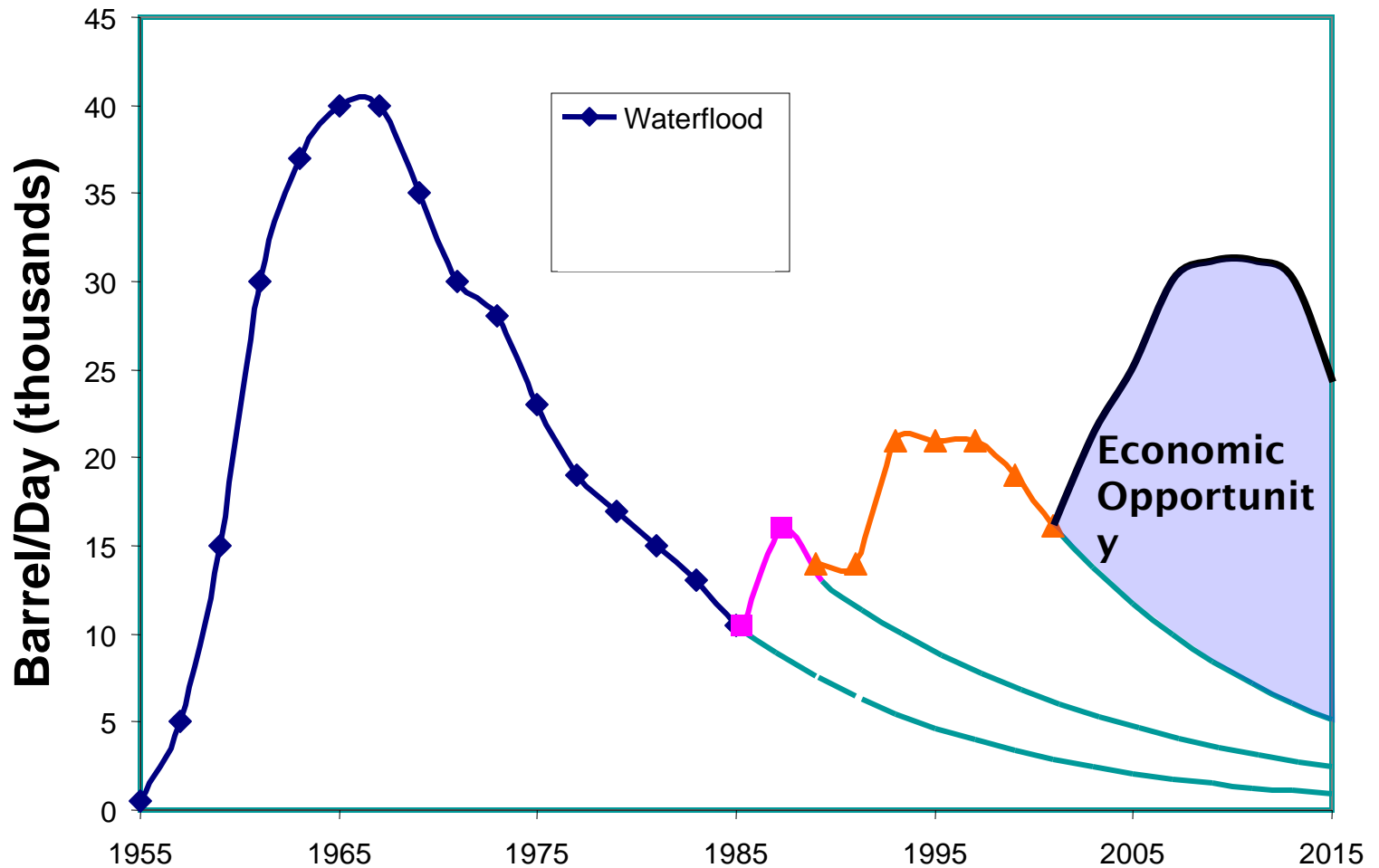
CS Figure TS-7



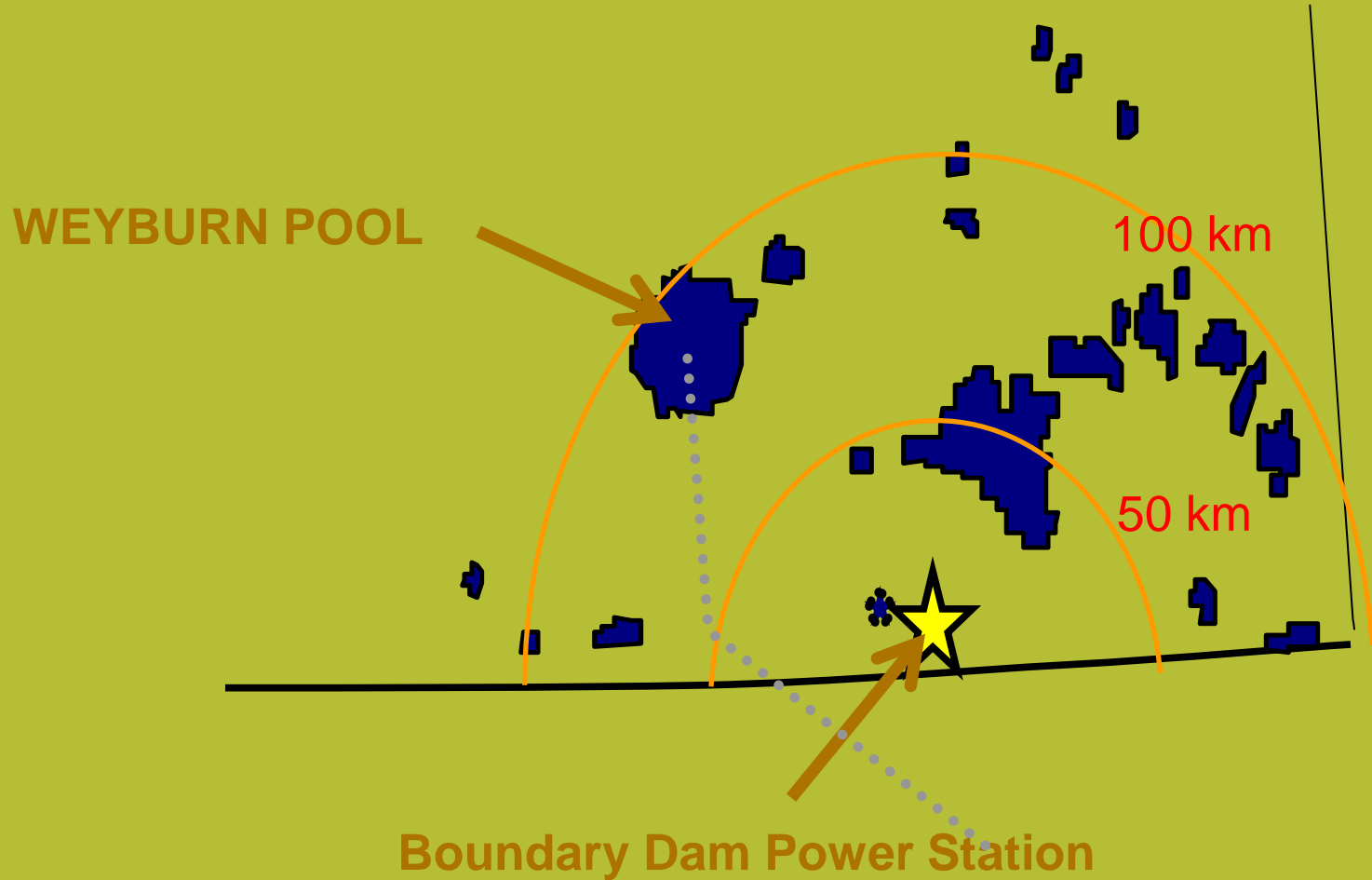
World's largest, full-scale,  
in-field MMV  
(Measurement, Monitor  
and Verification) study  
with EOR



# Weyburn Pool Production History



# Weyburn Reservoirs of Interest



# Presentation Outline

---

- Who is SaskPower
- Issues Affecting Power Generation
- Generation Supply Options
- Clean Coal Project Objectives & Deliverables
- Technology Concept
- Why CO<sub>2</sub> for EOR
- **Progress on Project to Date**
- Shand Reference Facility

# Boundary Dam Project - Progress

- **Two broad areas of engineering**
  - **Power Island Performance and Integration**
    - Boiler and turbine performance upgrades
    - Integration with flue gas desulphurization (FGD) and CO<sub>2</sub> capture systems
    - Results to date – as important as CO<sub>2</sub> capture technology selection
- **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**
- **SaskPower continuing to monitor emerging technologies**

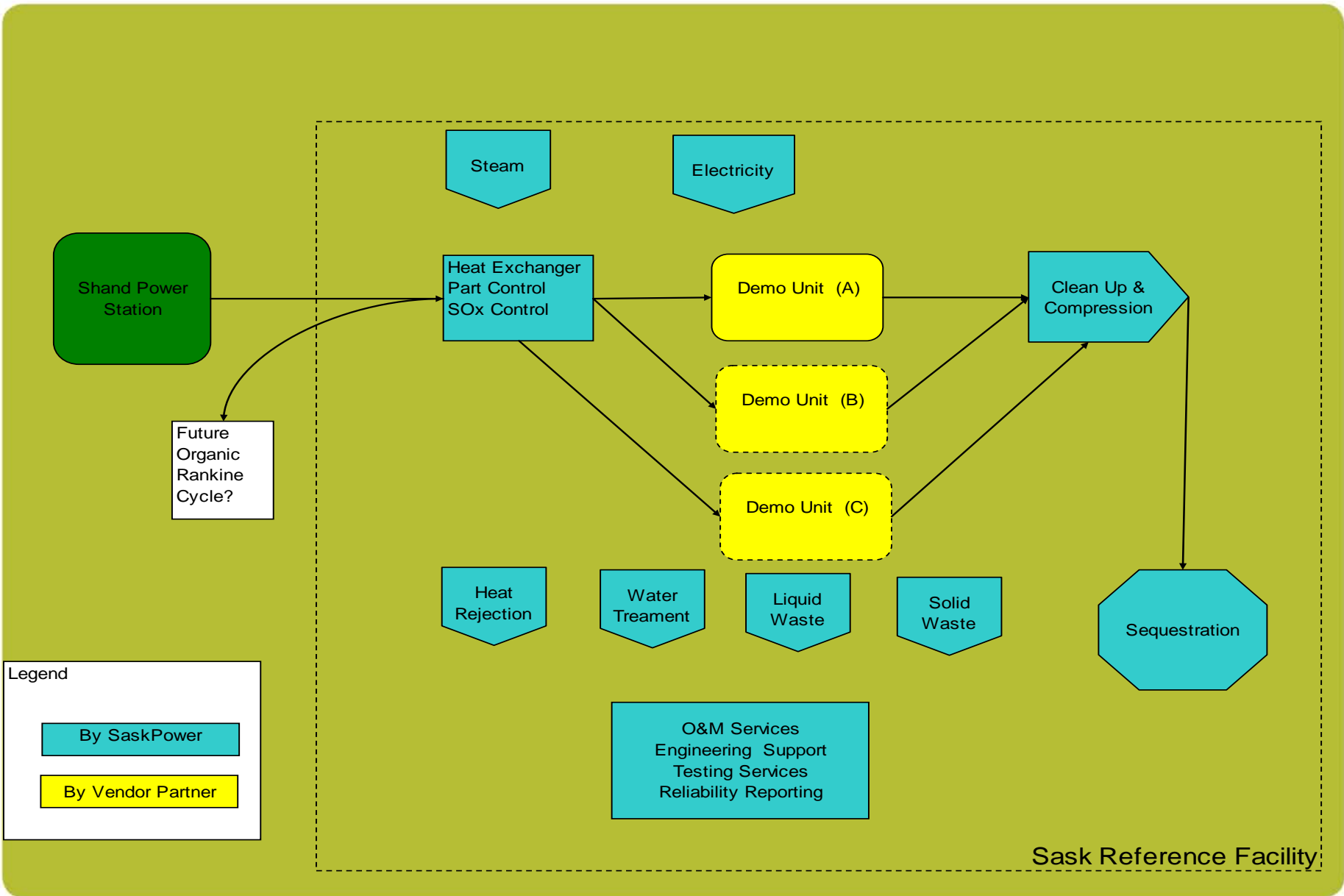
# Presentation Outline

---

- Who is SaskPower
- Issues Affecting Power Generation
- Generation Supply Options
- Clean Coal Project Objectives & Deliverables
- Technology Concept
- Why CO<sub>2</sub> for EOR
- Progress on Project to Date
- **Shand Reference Facility**

# Saskatchewan Reference Facility

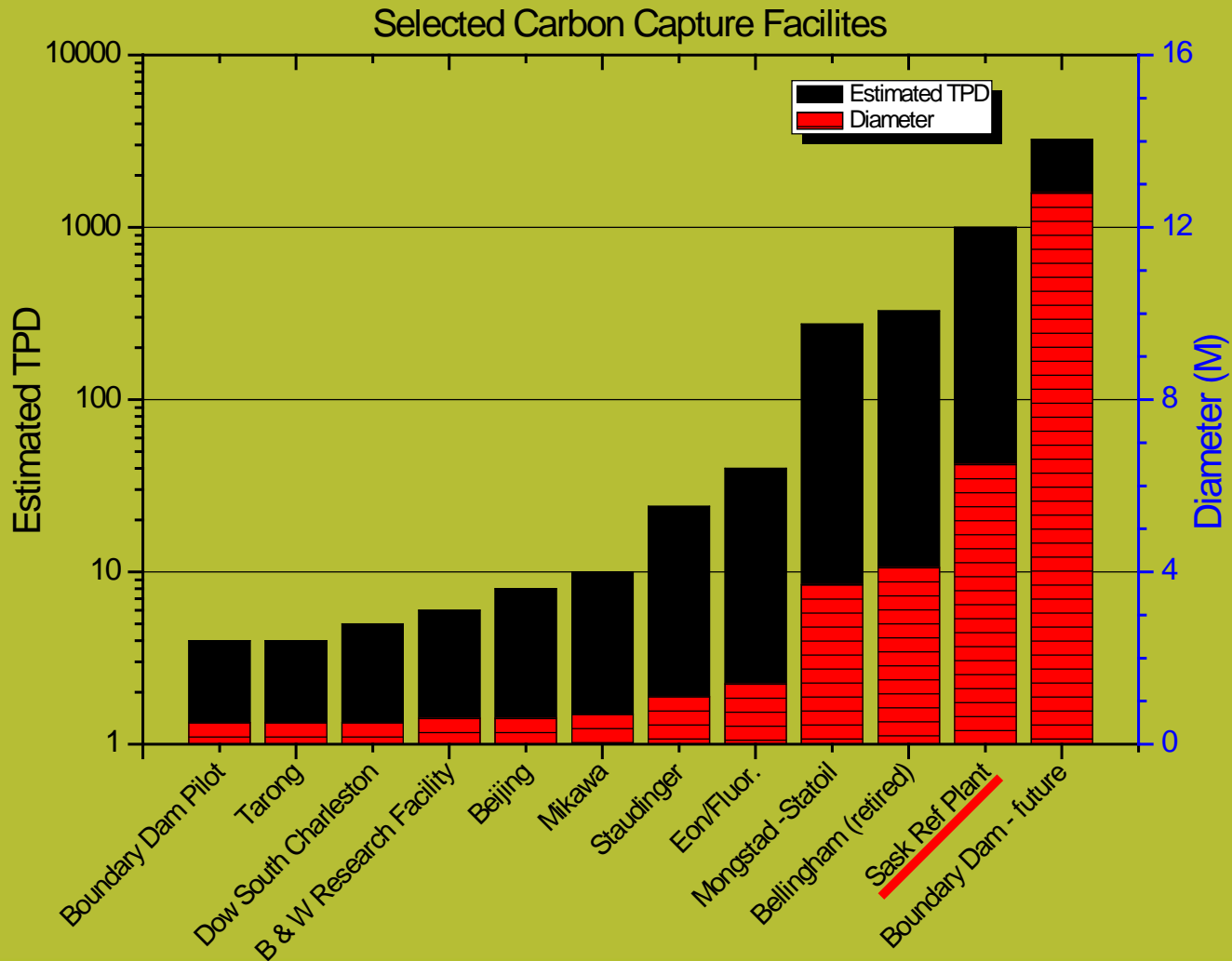
- Carbon capture plant to be located at SaskPower's Shand coal-fired generating station near Estevan.
- Host facility to demonstrate multiple carbon capture technologies.
- 600 tonnes of CO<sub>2</sub> per day from a 300 megawatt coal-fired unit.
- Key role to bring competing technologies to the market place.
- CO<sub>2</sub> product available to Saskatchewan Montana Project.



Legend

- By SaskPower
- By Vendor Partner

# A Bridge from Experiment to Commercial



# Shand Power Station - Estevan



# Proposed Reference Plant Facility





**Questions?**

**Terry Page, P. Eng.**  
**Senior Engineer, Power Island**  
**SaskPower Integrated Carbon Capture & Sequestration**

**Phone:** (306) 566-3233

**Fax:** (306) 566-3931

**Email:** [tpage@saskpower.com](mailto:tpage@saskpower.com)

**Mailing Address:** 12W, 2025 Victoria Avenue, Regina SK S4P 0S1