FutureGen 2.0
Oxy-Coal Carbon Capture Plant
with permanent CO₂ Storage

Steve Moorman
Manager - Business Development
Advanced Technology
Project Participants

Power Generation & CO₂ Capture

CO₂ Transport and Storage
Summary of Funding –

Oxy combustion large scale test

Project Cost Projection $737,000,000

• DOE Cost Share @ 80% = $590,000,000
• Non-Government share @ 20% = $147,000,000
# Project Schedule

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<th>Task</th>
<th>Complete</th>
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<td>Cooperative Agreement -</td>
<td>September 2010</td>
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<td>Project Definition / Pre-FEED -</td>
<td>September 2011</td>
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<td>FEED, NEPA, Permitting -</td>
<td>October 2012</td>
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<td>Detail Engineering, Procurement, Construction, Start-up -</td>
<td>April 2016</td>
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<td>Testing -</td>
<td>December 2018</td>
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Project Objectives

Prove the Oxy-combustion process at commercial scale

• Establish a cost and schedule baseline for the technology
• Equipment Designs – Primarily Boiler
  ➢ Reliability – component design, materials of construction
  ➢ Maintainability – erosion, corrosion, outage cycles
  ➢ Not designed for high efficiency – designed for flexibility & learning
  ➢ Basic process and heat transfer data – can move to high efficiency, larger capacity w/o incremental steps

• Process Designs
  ➢ Safety, Functionality, Operability

• Integrated operation of ASU – Boiler & AQCS – CPU – Storage
  ➢ Start-up, Shutdown, Load Swing, Capacity Factor, System Dynamics
Oxy-combustion Development Path

Oxy-coal Combustion Development

- Multiple Oxy Eng Studies, including ASU / CPU Optimization & Process Heat Integration completed
- Small & Large Scale Oxy Pilot testing, completed, Lacq Oxy-Gas & CPU test, Callide CPU test in progress
- Reference plant design complete at 680/450 MWe net SCPC
- Next step - FutureGen 2.0

FutureGen 2.0 - 200MWe gross
**Oxy-Coal Combustion Principles**

**Conventional Combustion**

1. **Oxygen** + Coal → **CO₂**
2. **Nitrogen**

**Oxy-Coal Combustion**

1. **Oxygen** + Coal → **CO₂**
2. **Oxy-Coal Combustion Flow Rate to CO₂ Capture Process**
3. 25 to 30% flow rate to stack

**Flue Gas after WFGD**

- **N₂** 100%
- **H₂O** 50%
- **CO₂** 0%

**Flue Gas to CPU**

- **H₂O** 100%
- **CO₂** 25 Lb/hr
- **O₂** 0%
Oxy-Combustion Process

ASU

- Air In
- Oxygen \((O_2)\) Out

Air Separation Unit

Boiler Island

- Recycled Flue Gas
- CO\(_2\) and Flue Gas

Boiler

Environmental Cleanup Equipment

- Ash
- \(H_2O\)
- \(SO_2\)
- Other Captured Emissions

CPU

- Other Cleaned Gases
- CO\(_2\) Storage (liquid)

Compression and Purification Unit

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FutureGen 2.0
Oxycombustion Carbon Capture Plant

Power Block Configuration

Steam; 2400psi, 1000F/1000F

Burners
Coal

Pulverizers

ASU

Secondary (FD) Fan
Air Intake

Recycle Dampers

Gas Htr

FD Fan

Sorbent for SO₃

Recycle

Htr

DCCPS

Gas Htr

CPU

To Storage

Cool Recycle Process
FutureGen 2.0 – Oxy-Combustion Project

Meredosia Plant

- Meredosia, IL: Owned/operated by AER
- 3-coal fired units (2 retired)
- Unit 4, 200 MWe oil-fired boiler built in 1975
  2400 psig 1000 / 1000F Steam Cycle
- 3500 TPD CO₂ to Storage
FG2.0 Oxy-Coal Capture Plant

Not the optimal equipment arrangement for a new plant but the best possible in this case due to site space limitations. Will be a common occurrence with existing plant retrofits and repowerings.
Steam & Water Flow Path
Oxy-Combustion Pros

- Boiler and AQCS equipment utilize conventional designs, materials of construction and arrangements. Combination of equipment and processes that are known to industry users.
- The oxy system will look and operate like a conventional power plant. Pilot Testing indicated minimal impact to boiler combustion and little change to thermal performance. AQCS performance is unchanged.
  - Furnace and Heating surface
  - Pulverizers
  - Burners
  - FGD Systems
  - Baghouse and ESP
  - Basic Process Controls unchanged
Oxy-Combustion Pros Cont’d

- Oxy process can utilize a wide variety of coals including lignite, sub-bituminous and bituminous fuels
- For retrofit or repowering less complex integration into the existing plant energy balance than PCC
- No new chemicals or waste streams introduced into the plant process. Bottom ash, fly ash, FGD waste streams unchanged.
- No major change to the plant water balance. For low rank fuels may be a positive water balance from condensation of water from the flue gas stream
Oxy-Combustion Challenges

- Cost – CAPEX and OPEX but no different than the other CCS technologies
- Auxiliary Power – same here Oxygen making and CO₂ Compression are still energy intensive
- Not a partial capture technology – all or nothing
- Need to prove the integrated operation of a large scale ASU – Boiler /AQCS – CPU Start-up, Shut-down, Load Swings, Upsets
FG 2.0 Project Status – Pre-FEED
Accomplishments to Date

- Owner’s Engineer selected – URS
- Integrated Project Schedule, DOR, WBS, Project Cost Estimate
- Existing Plant Assessment
- Project LCOE model
- Federal and State government affairs, Illinois EPA efforts on-going
- Draft Phase 1 Decision Application in progress

- Boiler / GQCS design and performance
- GA’s, plot plans
- Quotes for 85% of major equipment
- Specifications and bid packages for BOP
- Preliminary P&ID’s, PFD’s, I&C architecture
- High level construction plan

- ASU and CPU design, GAs, plot plans
- Quotes for 70% of major equipment
- Specifications and bid packages for BOP
- PFDs, Control architecture, interface list
- High level construction plan
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