Presentation Overview

- PreFEED design summary
- Overall HGCC Project Execution Plan
- Overall HGCC Schedule
- Prime Contractor
- DOE FEED Study Proposal
- Host utility
- Project Financing Plan
- FEED Study
  - Schedule
  - Division of Responsibility
- FEED Study (continued)
  - Non-commercial component development
  - Site Selection
  - Prospective Permitting Plan
  - Commercialization Plan
- Detailed Engineering, Procurement and Construction
PreFEED Design Summary

- Boiler/burner size for base case
- Indirect system concept
- Steam and gas turbine
- CO₂ purging for pulverized coal
- Air quality control systems
- CO₂ capture
- Plant water balance and balance of plant
- Class 4 cost estimate
- ESS
Gross Power output: 407.6 MW
Aux. Power: 57.6 MW
Net Power output: 350 MW
Overall HGCC Project Execution Plan

<table>
<thead>
<tr>
<th>PreFEED (Complete)</th>
<th>FEED/Site Selection (Approx. 2 years)</th>
<th>Detailed Engineering, Procurement &amp; Construction Mgmt (Approx. 4-years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of IL</td>
<td>Project Manager</td>
<td>Support for state and local funding and permitting</td>
</tr>
<tr>
<td>Kiewit</td>
<td>30% Design</td>
<td>Project Management/Detailed Engineering Procurement Construction</td>
</tr>
<tr>
<td>Barr</td>
<td>PM/Concept Design</td>
<td>Detailed Engineering</td>
</tr>
<tr>
<td>Doosan</td>
<td>Boiler Concept/AQCS/ESS</td>
<td>Detailed Engineering/OEM</td>
</tr>
<tr>
<td>University of North Dakota</td>
<td>Concept Model</td>
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<tr>
<td>Envergex</td>
<td>R&amp;D/Non Commercial Component Development</td>
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<tr>
<td>Microbeam</td>
<td>R&amp;D/Non Commercial Component Development</td>
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Support for state and local funding and permitting:
- Project Management/Detailed Engineering Procurement Construction
- Detailed Engineering
- Detailed Engineering/OEM
**Overall HGCC Schedule**

**PreFEED Study**  
- Start: 9/23/2019

**Design Development and FEED Study** - Approx. 24 months

**Host Site Selection**

**Permit Planning**

**Procurement**

**Site Selection**

**Engineering** - Approx. 20 Months

**Construction** - Approx. 36 months

**Commercial Operation**

Today
Prime Contractor – University of Illinois........
Prairie Research Institute
Illinois-focused Resource Research and Service

ILLINOIS

Prairie Research Institute

ILLINOIS
Illinois Natural History Survey
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
Illinois State Water Survey
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
Illinois State Geological Survey
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
Illinois State Archaeological Survey
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
Illinois Sustainable Technology Center
PRAIRIE RESEARCH INSTITUTE
Existing DOE Capture Related Projects in Illinois

Prairie Research Institute engaged in all projects and awardee in almost all

Abbott Power Plant: UIUC campus
- Aerosol reduction technologies
- Bi-Phasic solvent for carbon capture
- CO$_2$ utilization: Algae cultivation for animal feed

City, Water, Light, and Power (CWLP): Springfield
- 10 MW Large Capture Pilot
- Water recycle and reuse

Prairie State Generating Company (PSGC): Marissa
- Large FEED – 816 MW
DOE FEED Study Proposal

- March-September 2020

Technology Partners

- **Committed Prime: University of Illinois – project management**
  - University of Illinois

- **Kiewit - EPC**
  - Energy

- **Doosan – OEM Technology Partner**
  - Doosan Heavy Industries
    - Boiler and turbines
    - Air quality control systems
  - Doosan Babcock
    - CO₂ capture
    - Solvent technology
  - Doosan Gridtech
    - Energy storage system
  - Microbeam
    - Condition-based monitoring

- **Committed Host Utility: CWLP City of Springfield**

- **Barr Engineering – Engineering**
  - Energy

- **Microbeam – R&D/Non-commercial component development**

- **Envergex – R&D/Non-commercial component development**
  - Envergex

- **University of North Dakota – R&D/Non-commercial component development**
  - University of North Dakota

- **Bituminous Sub-bituminous Lignite**
  - Bituminous
  - Sub-bituminous
  - Lignite
Host utility........
City, Water, Light, & Power (CWLP)
Supplies electricity and water to Springfield, IL

- Currently four coal-fired steam turbine-generators with a total nameplate capacity of 578 MW (Units 31 & 32, Unit 33, Dallman #4)
- Three of the four units to be retired as part of Integrated Resource Planning (Unit 31 & 32 by 12/31/2020 commissioned in 1968 & 1972) and (Unit 33 by 9/15/2023 commissioned in 1978)
- Only one unit, Dallman #4 will remain (207 MW commissioned in 2009)
- Dallman #4 is site for 10 MW Large Capture Pilot (DOE funded Phase II FEED ongoing and will be proposed for DOE funded Phase III build/operate)
Why CWLP is an Excellent Host Site

Need for generation and physical space will be available

- Proposed Coal FIRST technology could fill “gap” in generating capacity lost due to shut down of older units
- Between shut down on Units 31, 32, and 33 and demolition of Lakeside Power Station sufficient space would be available
- Existing relationship with UIUC on DOE projects
- CWLP has history of interest in new generation and environmentally sound generation technologies
- Strong support by the City of Springfield for technologies such as carbon capture (i.e., City ratified 10 MW large capture pilot for Dallman #4)
- Site details and commitment already in hand

Total space available for project by 2023
Proven Means to Select Host Site
Used in previous DOE projects

<table>
<thead>
<tr>
<th>Site Selection Criteria</th>
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<tr>
<td>Flue gas availability</td>
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<td>Flue gas CO₂ concentration</td>
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<tr>
<td>Aerosol concentration in flue gas</td>
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<tr>
<td>Steam and utility availability for ISBL</td>
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<tr>
<td>Design costs for OSBL</td>
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<tr>
<td>Available plot size for ISBL</td>
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<tr>
<td>Use of domestic coal</td>
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<tr>
<td>Existing abatement equipment (FGD, ESP, SCR, etc.)</td>
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<tr>
<td>Logistics of transportation and lifting</td>
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<tr>
<th>Technical</th>
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<tbody>
<tr>
<td>Permitting requirements</td>
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<tr>
<td>Permitting timelines</td>
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<tr>
<td>Supports NEPA</td>
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<td>Safety culture</td>
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<tr>
<th>Regulatory and Environmental</th>
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<tr>
<td>Cost share commitment</td>
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<tr>
<td>Contractual terms and conditions</td>
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<tr>
<td>Site interest</td>
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<tr>
<td>Sign-off requirements</td>
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<tr>
<td>Potential for capture system to permanently remain</td>
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<tr>
<td>Interest in serving as future training site</td>
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<tr>
<td>Personnel support and responsiveness</td>
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**CWLP meets all these criteria for the Coal FIRST project**
Project Financing Plan

- **FEED funding**
  - DOE funds
  - 20% cost share
    - Kiewit and Doosan
    - In-kind cost share from utility

- **Establish steering committee**
  - Created to carry out specific objectives for financing

- **Commercialized Project financing**
  - RUS loans (if applicable) and DOE/State/Federal grants
Establishing utility investment

- Develop financial pro forma plan for HGCC concept
  - Energy storage for peak capacity revenue generation
  - Fuel flexibility using lower cost fuel
- Monetize revenue streams
  - Power sales
  - CO₂ 45Q credits or sales for EOR
  - Fly ash/bottom ash
  - Gypsum
September 2020 – December 2023

HGCC design development
- 30% Engineering
- Environmental permitting review
- Develop financing plan
- CAPEX/OPEX updates

Non-commercial development
<table>
<thead>
<tr>
<th>Company</th>
<th>Responsibilities</th>
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<tbody>
<tr>
<td>University of IL</td>
<td>• Project management</td>
</tr>
<tr>
<td></td>
<td>• FEED study design basis</td>
</tr>
<tr>
<td></td>
<td>• Final FEED study package</td>
</tr>
<tr>
<td>Kiewit</td>
<td>• Mechanical, structural, and electrical/I&amp;C design</td>
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<td></td>
<td>• Balance of plant</td>
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<td></td>
<td>• Combustion turbine package</td>
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<td></td>
<td>• Cost assessment</td>
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<tr>
<td>Doosan</td>
<td>• Boiler, steam turbine, combustion turbine, AQCS, carbon capture package</td>
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<td></td>
<td>• ESS system package</td>
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<tr>
<td></td>
<td>• Cost assessment</td>
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<tr>
<td></td>
<td>• Non-commercial development</td>
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<tr>
<td>Barr</td>
<td>• Water treatment and coal handling package</td>
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<tr>
<td></td>
<td>• Permitting review</td>
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<tr>
<td></td>
<td>• Site civil and electrical</td>
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<tr>
<td></td>
<td>• Cost assessment</td>
</tr>
<tr>
<td>Envergex/UND/Microbeam</td>
<td>• Non-commercial development/Modeling support</td>
</tr>
</tbody>
</table>
## FEED Study - Non-Commercial Component Development

<table>
<thead>
<tr>
<th>HGCC System</th>
<th>Indirect Firing</th>
<th>ESS Integration</th>
<th>Environmental</th>
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</thead>
</table>
| • Burner optimization with GT flue gas  
• CFD Modeling  
• Unit flexibility  
• Modularization  
• Efficiency optimizing | • Efficiency optimizing  
• Pulverized coal storage CO₂ purging | • Cost reviews  
• Load following optimization | • Emissions profile  
• Water minimization  
• CO₂ capture energy/cost reduction |
- Anticipate 6 months during FEED study for final site for commercialization
FEED Study - Commercialization Plan

- Site selection for commercialization
- Commercial guarantees
- Letters of intent (equipment & material procurement)
Responsibilities and Capabilities of Prairie Research / University of Illinois Urbana-Champaign (UIUC)

- Overall project management
  - History of experience with DOE projects
  - Accounting systems in place
  - Proven ability to deliver on time and on budget
  - Proven ability to provide required deliverables

- Permitting agencies and timelines
  - Strong relationships with permitting authorities for this project – Illinois EPA and Sangamon Waste Reclamation District
  - Same groups for existing DOE 10 MW large capture pilot at CWLP

- Interaction with NEPA contractor
  - Existing relationship with NEPA contractor being used for 10 MW Large Capture Pilot at CWLP
  - NEPA considerations well understood at site

- Existing relationships with City of Springfield (owner of CWLP) and state legislators
  - Known pathway for approval – previous obtained for 10 MW Large Pilot
  - Known pathways to legislative support - previous obtained for 10 MW Large Pilot

- Link with CarbonSAFE and utilization activities to assure pathway to sequester or utilize CO₂ for Coal FIRST project

- Legislation at the State Level has stimulated the formation of a CO₂ value chain
Pathways to Commercialization

Known pathway with milestones well understood

- Connect with CarbonSAFE
- Secure syndicated funding
- Build and operate
- Support from Illinois Legislation
- Commitment from the City of Springfield
- Permitting and NEPA
- Coal FIRST FEED

Job creation and regional economic benefit outlined
Permitting will commence post FEED

Likely Approvals and Permits

- NEPA review: for federally funded projects, includes EIS
- State Utility Commission: e.g., siting permit, certificate of need
- Interconnection studies: independent system operator agreement
- PDS air permit: state-administered federal permit
- USFWS approval: federal protected species impacts
- EPA SDWA or delegated states: Underground Injection Control (UIC) permit
- Water allocation: state permit
- NPDES water discharge: assume zero liquid discharge for HGCC
- Ash disposal: assume beneficial use
- Local permits: land use, noise, road access, zoning
- December 2023 – February 2028
- Engineering
- Procurement
- Construction
- Permitting
- Startup
- Commercial operation
Engineering, Procurement, Construction

- December 2023 – October 2025
- Detailed engineering from 30% to 100%
  - 60% review
  - 90% review
  - 100% final
- Equipment procurement
  - Leverage FEED study equipment lists
  - Finalize equipment specs and complete procurement
- DOR will remain similar to FEED study
Construction & Startup

- Early 2025 – 2028
- Kiewit to complete construction as EPC
- Utility lead to complete startup
- Support from vendors and engineering team
THANK YOU!

QUESTIONS?