Phase II / III Review: Large Pilot Testing of Linde-BASF Advanced Post-Combustion CO₂ Capture Technology at a Coal-Fired Power Plant (FE-0031581)

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PROJECT OVERVIEW

Phase II Funding: $3,736,684
DOE: $2,988,359
20% Cost Share: $748,325
Phase II Completed: May 31, 2021

Phase III Funding: $67,000,000
DOE: $47,000,000
Cost Share: $20,000,000 (supplied by the State of Illinois)
Phase III Complete: May 2026

PROJECT OBJECTIVES:

Overall: Design, construct, and operate a 10 MW capture system based on the Linde / BASF advanced amine-based, post-combustion carbon dioxide (CO₂) capture technology at CWLP Dallman Unit 4, Springfield, IL.

Phase III: Build / Operate 10 MW capture system and compare performance with results from 1.5 MW testing at the NCCC. If successful, keep system for evaluating future capture and utilization testing technologies.
WHY THE INVESTMENT BY THE STATE OF ILLINOIS?

Part of Plan for Decarbonization of the Grid
Illinois: A Confluence of Geology, Technology, Government Investment

*Creates unique advantages for the state of Illinois*

- Ability to store CO₂ has provided a major motivator for large capture pilots and large-scale capture demonstration projects at CO₂ emitters within the state
- Unique geology of Illinois a major asset for CO₂ storage
- 45Q has been a major incentive – a means to monetize CO₂
- US DOE funding has enabled the maturation of capture technologies that can be deployed at locations throughout the state
- State of Illinois’ support with major cost share investment
- Elected officials at all levels interested in the job creation and regional economic benefits of these projects
Capture Studies Coordinated with Geological Storage Studies

*CarbonSAFE Phase III: Geological Storage*

- Able to connect to CarbonSAFE’s Phase III Illinois Geological Storage Corridor
- Sufficient CO$_2$ geological storage capacity near the host sites
- All sites within 100 miles of storage site
- Immediate access to Interstate highway
Illinois: Knowledge Base for Carbon Capture & Storage

Concentration of natural resources and intellectual capital

- Carbondale
- Fairfield, Olney, Robinson, Mt. Carmel
- Marissa
- Springfield
- Urbana
- Decatur

- Operator Training
- Storage of CO₂: ADM Project
- Capture of CO₂: Phase III Large Pilot (10 MW)
- HGCC 350 MW
- Aerosol reduction / Capture of CO₂

- Existing projects
- Educational Resources

Capture of CO₂: Large FEED (+800 MW)

States mentioned: Illinois

Institutions and projects:
- Prairie State Generating Company
- Illinois Eastern Community Colleges
- Prairie Research Institute
- Illinois
- MGSC
- Richland
- ADM
- Southern Illinois University Carbondale
- BASF
- AEI
- ACS
- National Energy Technology Laboratory
- U.S. Department of Energy

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Build / Operate: Largest Capture R&D Pilot in the World (10 MW)

CITY, WATER, LIGHT AND POWER
CWLP Location and Configuration

*Traditional PC plant*

Dallman Unit 4 configuration

Location of city of Springfield within the state of Illinois
System Boundaries for Project

Follow-on projects can connect to existing DOE projects for storage and utilization.

- System Boundaries for this Project
- CWLP Dallman #4 Unit Flue Gas Source
- 10 MWe CO₂ Separation and Capture System (PCC)
- CO₂ Compression & Transport
- CO₂ Utilization (Carbon to Value)
- CO₂ Geological Storage
- Previously DOE project on use of CO₂ to grow algae
- Carbon SAFE effort
City Water, Light and Power (CWLP)

*Water and power supplier for City of Springfield*
Capture Plant and Tie-Ins to Plant – Birds-Eye View
TRL of Capture System Ready for 10 MW Scale

TECHNICAL BACKGROUND
Linde / BASF Milestones

- 2004: Lab & Mini Plant Ludwigshafen, Germany
  - BASF anime-based Solvent Selection
- 2009: 0.45 MWe Pilot Plant Niederaussem, Germany
  - Performance Verification
- 2014: DOE-funded 1.5 MWe Pilot Plant NCCC, Wilsonville, AL
  - Emission reduction system testing
- 2016: DOE-funded Phase I 15 MWe Pilot Abbott Power Plant, Champaign, IL
  - Dry bed, flue gas pre-treatment Effective for emissions
  - Advances in absorber, stripper, and wash units
  - 85%-95% CO₂ capture rate
  - TEA of 550 MWe pulverized coal power plant
  - 2,589 hours of operation on flue gas
  - 5,096 hours of solvent circulation
  - Reduced gas emissions, liquid, solid waste disposal
  - Significant Energy Savings in CO₂ capture
- 2015-2018: DOE-funded Phase II 10 MWe Pilot City Light, Water and Power Springfield, IL
  - -13% decrease in COE
- 2019: DOE-funded Phase III 10 MWe Pilot City Light, Water and Power Springfield, IL (proposed)
  - -6% increased HHV power plant efficiency
- 2021-2026: Phase III 10 MWe Pilot City Light, Water and Power Springfield, IL (proposed)
Linde / BASF Solvent Based Capture System

Reduced capital costs / energy costs
- Optimized BASF OASE® blue solvent
- Efficient CO₂ capture from low-pressure sources
- Longer solvent stability
- Lower solvent circulation rate

Notable Linde process improvements
(F, E) Dry bed water wash design to minimize solvent losses
(J) Stripper regeneration at 3.4 bars reducing CO₂ compressor cost and power consumption
(K) Advanced Stripper Interstage Heater to reduce regenerator steam consumption.
### Scale-up Factors at Each Stage for Development

<table>
<thead>
<tr>
<th>DEVELOPMENT SCALE</th>
<th>YEAR</th>
<th>SIZE (MWe)</th>
<th>SCALE-UP FACTOR*</th>
<th>DEVELOPMENT STRATEGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab scale; mini pilot</td>
<td>2004</td>
<td>0.015</td>
<td>n/a</td>
<td>Solvent selection and proof-of-concept under laboratory conditions</td>
</tr>
<tr>
<td>Bench scale: Niederaussem</td>
<td>2009</td>
<td>0.45</td>
<td>30</td>
<td>Solvent performance validation; emissions control testing under realistic conditions</td>
</tr>
<tr>
<td>Small pilot: NCCC</td>
<td>2016</td>
<td>1 to 1.5</td>
<td>3</td>
<td>Validation of unique process features aimed at reducing CAPEX – i.e. high capacity structured packing, gravity-driven absorber inter-stage cooler, and unique reboiler design</td>
</tr>
<tr>
<td>Proposed large-scale pilot</td>
<td>2021-2026</td>
<td>10 to 12</td>
<td>7 to 8</td>
<td>Equipment performance validation at commercially relevant scale (i.e. uniform gas/liquid distribution in absorber and inter-stage heating in the stripper)</td>
</tr>
<tr>
<td>First commercial plant</td>
<td>2025-2030</td>
<td>200 to 600</td>
<td>20 to 50</td>
<td>At scale demonstration of complete CCS value chain (capture, compression, transport, and storage/utilization)</td>
</tr>
<tr>
<td>nth commercial plant</td>
<td>2030+</td>
<td>600+</td>
<td>3 to 5</td>
<td>Safe, reliable, and economic operation in compliance with regulations</td>
</tr>
</tbody>
</table>

*Assumes PCC capacity of 20 tpd captured CO₂ for every 1 MWe (flue gas 13% CO₂ concentration)
# TRL Improvement of Key Subsystems

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Current TRL</th>
<th>Comments</th>
<th>Expected TRL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorber and Stripper Columns</td>
<td>6</td>
<td>At larger column diameters, the importance of uniform liquid and gas distribution and proper design of feed inlets and gas liquid offtake becomes critical to achieve predicted performance of the target CO₂ capture rate and minimum regeneration energy. In addition, a proper build and install strategy is required in order to achieve the lowest cost option at scale.</td>
<td>7(9)*</td>
</tr>
<tr>
<td>Heat Exchangers and Reboiler</td>
<td>6</td>
<td>Plate-fin exchangers have been used in the pilot plants and will be scaled up for the large pilot. The large pilot reboiler design will be selected as appropriate for the advanced stripper design configuration.</td>
<td>7</td>
</tr>
<tr>
<td>Stripper Heat Integration and Recovery</td>
<td>6</td>
<td>Prior to the lean-rich heat exchange, the large pilot will incorporate a stripper inter-stage heater to use heat recovered from the CO₂-lean solvent to vaporize semi CO₂-lean solvent from an intermediate section of the stripper column. Detailed design has shown the energy reduction possible and this will be validated in the large pilot.</td>
<td>7</td>
</tr>
<tr>
<td>Materials of Construction</td>
<td>6</td>
<td>Several materials including carbon steel, different stainless-steel options, fiberglass reinforced plastic (FRP) and concrete sections with polypropylene in-liners have been tested and evaluated in the pilot plants. The materials for the large pilot will be specified based on the results from the current pilot plant analysis.</td>
<td>7</td>
</tr>
<tr>
<td>Emission Control</td>
<td>6</td>
<td>Solvent emissions minimization well below air emissions compliance limits is a key success factor for commercial implementation of a solvent-based post-combustion capture system. Assessment of key operating parameters and flue gas aerosol reduction options will be validated at the proposed pilot.</td>
<td>7</td>
</tr>
<tr>
<td>Solvent Management</td>
<td>6</td>
<td>Scale-up involves management of a much larger inventory of solvent, introducing complexity in the logistics of delivery and storage. Experience from other amine-based commercial systems, such as intermediate solvent storage and delivery, and solvent reclamation and recycling, will be considered for the large pilot.</td>
<td>7</td>
</tr>
</tbody>
</table>

* TRL 9 based on Linde’s related experience in building up to ~1.2m diameter columns for other commercial applications. This has been validated in other commercial-scale aiming operations and will be applied in the large pilot.
### Attractive Techno-Economics for Linde / BASF Process

**Baseline case: DOE-NETL supercritical PC power plants**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>DOE NETL Case B12A</th>
<th>DOE NETL Case B12B</th>
<th>Linde BASF LB1</th>
<th>Linde BASF SIH</th>
<th>Linde BASF VHR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>No CO₂ Capture</td>
<td>90% Capture w/ Cansolv PCC process</td>
<td>90% Capture w/ OASE® Blue</td>
<td>90% Capture w/ OASE® Blue and SIH</td>
<td>90% Capture w/ OASE Blue® SIH, and WHR</td>
</tr>
<tr>
<td>Net Power Output (MWe)</td>
<td>550</td>
<td>550</td>
<td>550</td>
<td>550</td>
<td>550</td>
</tr>
<tr>
<td>Gross Power Output (MWe)</td>
<td>580</td>
<td>642</td>
<td>630.4</td>
<td>629.3</td>
<td>626.3</td>
</tr>
<tr>
<td>Coal Flow Rate (tonne/hr)</td>
<td>179.2</td>
<td>224.8</td>
<td>221.9</td>
<td>218.5</td>
<td>210</td>
</tr>
<tr>
<td>Net HHV plant efficiency (%)</td>
<td>40.70%</td>
<td>32.50%</td>
<td>32.97%</td>
<td>33.40%</td>
<td>34.73%</td>
</tr>
<tr>
<td>Total Overnight Cost ($2011) ($/MT)</td>
<td>$1,379</td>
<td>$2,384</td>
<td>$1,970</td>
<td>$1,950</td>
<td>$1,921</td>
</tr>
<tr>
<td>Cost of CO₂ captured with T&amp;S ($/MT)*</td>
<td>N/A</td>
<td>$68.00</td>
<td>$53.58</td>
<td>$52.71</td>
<td>$51.31</td>
</tr>
<tr>
<td>Cost of CO₂ captured without T&amp;S ($/MT)*</td>
<td>N/A</td>
<td>$58.00</td>
<td>$43.58</td>
<td>$42.71</td>
<td>$41.31</td>
</tr>
<tr>
<td>COE ($/MWh) with T&amp;S*</td>
<td>$82.30</td>
<td>$142.80</td>
<td>$127.97</td>
<td>$126.50</td>
<td>$123.63</td>
</tr>
<tr>
<td>PCC specific reboiler duty (MJ/kg CO₂)</td>
<td>N/A</td>
<td>2.48</td>
<td>2.60</td>
<td>2.30</td>
<td>1.50</td>
</tr>
</tbody>
</table>

*Case implemented in Phase III*
Future Trends: Designing for Variation in Plant Loads

Capture system design accommodates this variation in gross generation

Just like the DOE vision for future power plants, over the 18-month period the plant demonstrated a consistent variation in gross generation between the limits of 100 MW and 225 MW

- Increase in CO$_2$ concentration in the flue gas with increasing load on the power plant
- Inverse relationship between O$_2$ concentration and increasing load
- May conceivably happen when the plant operates at lower capacities, without adjusting the air intake to the turbine
- Flue gas is effectively diluted as the ratio of combustion air to combustion fuel in higher at lower power generation
## Phase III: Evaluating Linde/BASF Technology vs. DOE Power Plant Vision

<table>
<thead>
<tr>
<th>Grouping</th>
<th>Qualities in Grouping</th>
<th>Previous Evaluations</th>
<th>Evaluations During Phase III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility &amp; Efficiency</td>
<td>(10) Integrated carbon capture, +90% capture (1) High overall plant efficiency (3) Capable of high ramp rates and minimum loads</td>
<td>• 1 MWe at NCCC (<a href="#">1.B.4</a>)</td>
<td>• Measurements made during long-term testing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Updating of TEA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Host site load varies, capture system ability to follow will be demonstrated (<a href="#">1.A.5</a>)</td>
</tr>
<tr>
<td>CAPEX and OPEX</td>
<td>(6) Reduced design, construction, and commissioning schedules (7) Enhanced maintenance features</td>
<td>• Outlined in previous TEA developed for 1 MWe</td>
<td>• Tracked during build / operate of Phase III</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Updated TEA will address</td>
</tr>
<tr>
<td>Environmental Footprint</td>
<td>(2) Near-zero emissions (5) Minimized water consumption</td>
<td>• 1 MWe at NCCC (<a href="#">1.B.4</a>)</td>
<td>• Permits require measurements during testing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• NEPA addressed these issues</td>
<td></td>
</tr>
<tr>
<td>Changes to Upstream Processes of Power Plant</td>
<td>(4) Integration with energy storage (8) Integration with coal upgrading (9) Capable of natural gas co-firing</td>
<td>• Capture technology integrated with energy storage in 21st Century Power Plant (DE-FE0031995) and H₂ energy storage DE-AR0001310</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Testing at small sizes were conducted with various types of coal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Included in natural gas fired systems studies</td>
<td></td>
</tr>
</tbody>
</table>
## HAZOP Review – Recommendations & Responses

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Mitigation and Response Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check safety measures upstream</td>
<td>Host site confirmed there is no foreseen likelihood of a negative pressure situation, the controls will be designed to shut down the pilot plant and dampers in the event of an upset</td>
</tr>
<tr>
<td>Check maximum possible pressure from boundary limit</td>
<td>Confirmed maximum pressure that could occur at the battery limit from the wet ESP if ID fans are on with no recycle pumps</td>
</tr>
<tr>
<td>Heat tracing required for low points in OSBL flue gas lines</td>
<td>Project will make every attempt to design OSBL flue gas lines at a constant slope with no low points – if low points must exist, they will include heat traced drain lines</td>
</tr>
<tr>
<td>Check maximum possible temperature at boundary limit</td>
<td>Confirmed maximum design temperature that could occur at the battery limit from the wet ESP and declared PPE requirements</td>
</tr>
<tr>
<td>Check maximum allowable amine emissions per local regulations</td>
<td>Confirmed maximum permissible amine emissions (categorized as VOC/VOM) based on Dallman 4 air permit limit and emission test results</td>
</tr>
</tbody>
</table>
Linde/BASF Capture Unit

3D rendering

Looking down from power plant

Looking back towards power plant
Transitioning from Phase II to Phase III

PROJECT MANAGEMENT & RISK MANAGEMENT
Prairie Research Institute: Addressing Societal Issues

Structure creates ability to address the many factors for large projects

- **Potential Endangered Species**
- **Water**
- **Storage**
- **Capture**
- **Potential Artifacts**
Phase III: Project Management Structure

Consistent team throughout all phases

HOST SITE
City, Water, Light & Power, Springfield, IL
P.J. Becker

ILLINOIS
Awardee
University of Illinois (UIUC)
Dr. Kevin C. O’Brien, PI
Stephanie Brownstein, Project Manager
Project management, permitting, operations, interface with CWLP

SUBAWARDEE
Linde Engineering, Americas (LEA)
Jason Haley, Co-PI
Matthew Parker, Project Manager
Detailed engineering ISBL Components
Procurement and Construction Management,
ISBL Components

OSBL
ISBL
OASE®
blue solvent

SUBAWARDEE
Linde Engineering Dresden
(Linde GmbH)
Torsten Stoffregen
Detailed engineering (ISBL), start-up and testing support

SUBAWARDEE
Linde Inc.
Dr. Krish Krishnamurthy, Co-PI
Makini Byron, Project Manager
Testing & data analysis, project reporting

SUBAWARDEE
BASF
John Nichols
Manufacturing, supply of solvent and on-site training, solvent stability analysis

SUBAWARDEE
Affiliated Construction Services (ACS)
Greg Larson
Procurement and Construction Management, OSBL components

SUBAWARDEE
Affiliated Engineers Inc. (AEI)
David Guth, LEED AP
Engineering Design of OSBL components
# Project Tasks

*BP1 for Phase III = BP3 overall for project*

<table>
<thead>
<tr>
<th>Task #</th>
<th>Task</th>
<th>BP</th>
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</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Project Management and Planning</td>
<td>All BP</td>
</tr>
<tr>
<td>2.0</td>
<td>Baseline Techno-Economic Analysis (TEA)</td>
<td>BP3</td>
</tr>
<tr>
<td>3.0</td>
<td>Detailed Engineering and Specifications</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>Permit Application</td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>Construction and Execution Plan</td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>Equipment Procurement</td>
<td></td>
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<tr>
<td>7.0</td>
<td>Site Preparation and Foundations Installation</td>
<td>BP4</td>
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<td>8.0</td>
<td>Plant Construction and Installation</td>
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<td>Start-up and Operations</td>
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<td>Analysis of Test Campaign Results</td>
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<td>Updated Techno-Economic Analysis (TEA)</td>
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<td>Update of EH&amp;S Assessment, TMP, and TCP</td>
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<td>Dismantling and Removal</td>
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## Task vs. Responsible Organization

<table>
<thead>
<tr>
<th>WBS #</th>
<th>WBS Title</th>
<th>UIUC</th>
<th>Linde</th>
<th>ACS</th>
<th>BASF</th>
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<tr>
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<td>Detailed Engineering and Specifications</td>
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<td>Construction and Execution Plan</td>
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### Milestones for Phase III

*BP1 for Phase III = BP3 overall for project*

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<tr>
<th>Budget Period</th>
<th>Task Number</th>
<th>Description</th>
<th>Verification Method</th>
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<tbody>
<tr>
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<td>1</td>
<td>Updated Project Management Plan</td>
<td>Project Management Plan file</td>
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<td>3</td>
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<td>Phase III Kickoff Meeting</td>
<td>Presentation file</td>
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<td>3</td>
<td>4</td>
<td>Permitting Issuances Complete</td>
<td>Quarterly RPPR file</td>
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<tr>
<td>3</td>
<td>3</td>
<td>Detailed Engineering Complete</td>
<td>Quarterly RPPR file</td>
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<tr>
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<td>6</td>
<td>Equipment Procurement and Fabrication Complete</td>
<td>Quarterly RPPR file</td>
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<td>8</td>
<td>Construction &amp; Installation Complete</td>
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<tr>
<td>5</td>
<td>10</td>
<td>Commissioning and Pre-Start-up Checks Complete</td>
<td>Quarterly RPPR file</td>
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<td>5</td>
<td>10</td>
<td>Steady-State Operations Established</td>
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<tr>
<td>5</td>
<td>11</td>
<td>Parametric Testing Complete</td>
<td>Quarterly RPPR file</td>
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<td>5</td>
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<td>Steady-State Testing Complete</td>
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<td>Quarterly RPPR report</td>
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## Transition from Phase II to Phase III – Risk Mitigation

<table>
<thead>
<tr>
<th>RISK AREAS/FACTORS</th>
<th>RESULTS FROM PHASE II THAT MITIGATE RISKS</th>
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| Permitting / Regulatory             | - All permitting agencies identified and extensive discussions held with agencies  
- Costs detailed for permits  
- Per instructions of agencies, documents for permit applications prepared and ready to submit  
- Applications informally reviewed  
- Submit applications in BP1 of Phase III                                                                                                                                                                                                 |
| Cost share                          | - Cost share obtained from state and schedule developed for disbursing funds  
- Cost share disbursement schedule designed based on procurement and construction schedule                                                                                                                                              |
| Interconnection of Utilities from host site to capture plant | - Detailed design of ISBL and OSBL slightly enhanced in Phase II to facilitate ease of interconnection  
- On-going communication between ISBL EPC (Linde) and OSBL EPC (ACS) enables understanding of responsibilities  
- Resolved means to design OSBL in order to avoid obstacles presented by existing infrastructure at host site  
- On-going communication with host sites assured volumes and quality of utilities are available for hook-up |
| Procurement                         | - Large equipment has bid ready documents developed during Phase II for both ISBL and OSBL  
- Identification of long-lead time procurements  
- Discussions with solvent supplier (BASF) on volume needs, timing, and logistics  
- Procurement schedule developed to assure project is not delayed                                                                                                                                                                       |
| Labor costs for construction         | - Union labor required for construction and operation of the plant  
- Engaged with labor unions to educate them on project and understand rates/concerns  
- Strong support from unions for construction and operation  
- Rates established and built into construction and operation costs  
- Qualifications required of contractors who can perform work at host site established  
- Potential local contractors (electrical, plumbing, welding, etc.) identified                                                                                                                                                       |
| Operational costs to run capture plant | - Working with host site, operational costs (i.e. extra coal, steam, etc.) established  
- Host site will be compensated for extra costs incurred during operation of the capture facility  
- Avoids the need to approach rate payers and seek reimbursement from them for costs of operation                                                                                                                                   |
| Variation in flue gas composition with variation in plant load | - Characterized flue gas based on load on host site  
- CO₂ and O₂ levels varied with load  
- Established design to accommodate variations in plant load                                                                                                                                                                                |
| Cost overruns during construction    | - Pre-engineering of major equipment in Phase II to improve the quality of bids received from vendors                                                                                                                                          |
NEPA
A NEPA working team was formed consisting of the NEPA contractor, ISTC, Linde, CWLP, and NETL/DOE
• NETL and DOE approved the Final EA and FONSI
• Created an Inadvertent Discoveries Plan based on feedback from regional Nations

PERMITTING
A working team for permitting issues was formed consisting of representatives from ISTC, CWLP, and the Illinois Environmental Protection Agency (IEPA)
• Stormwater – a construction permit will be submitted by project contractor; stormwater from project area covered by site NDPES permit
• Air emissions – emission values have been calculated; construction/operating permit will be managed as a “Modification to the Facility”
• Hazardous waste – a permit is not required; solvent contaminated waste will be tested to determine hazardous status and dispose appropriately
• Wastewater – 3rd party wastewater assessment complete; initial treatment design and costing complete
Job Creation and Environmental Justice Concerns

*Important additional study conducted as part of Phase III*

- Job Creation study was completed with non-project funds for Phase II
- Examined direct, indirect and induced job creation
- Phase III operation will employ some of plant workers that would have been laid-off due to shut down of older units
- Follow-up job creation study important to compare predicted vs. actual
- Environmental Justice of major interest since Qualified Opportunity Zones (QOZs) present in city of Springfield
Summary and Conclusions

- Legislation at the Federal Level and State Level has stimulated interest in CO\textsubscript{2} capture for both power generation and industrial applications
- US DOE funding for both capture and storage has been critical to stimulate efforts
- Large projects create learnings that cannot be otherwise obtained
- Phase III is an important evaluation of Linde / BASF capture technology
- Phase III viewed as having a great potential to stimulate job formation (direct, indirect, and induced)
- Phase III Environment Justice impact of interest since Qualified Opportunity Zones nearby
## Acknowledgements

<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
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<tbody>
<tr>
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<td>Scott Prause, Bajio Varghese Kaleeckal, Hafiz Salih, Sebastiano Giardinella</td>
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<td>Krish Krishnamurthy, Makini Byron, Jason Haley, Lars-Erik Gaertner, Devin</td>
<td>Linde</td>
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<td>Bostick, Tom Rayhill, Matthew Parker</td>
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<td>John Nichols</td>
<td>BASF</td>
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<td>David Guth</td>
<td>Affiliated Engineers Inc (AEI)</td>
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<tr>
<td>Greg Larson</td>
<td>Affiliated Construction Services (ACS)</td>
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