

Phase 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 III Funding: \$67,726,858

DOE: \$47,601,858

Non-DOE: \$20,125,000*

Work Period: June 1, 2021 – May 31, 2026

**\$20 MM cost share supplied by the state of Illinois*



*City Water, Light and Power
(CWLP) in Springfield, IL*

PROJECT OBJECTIVES:

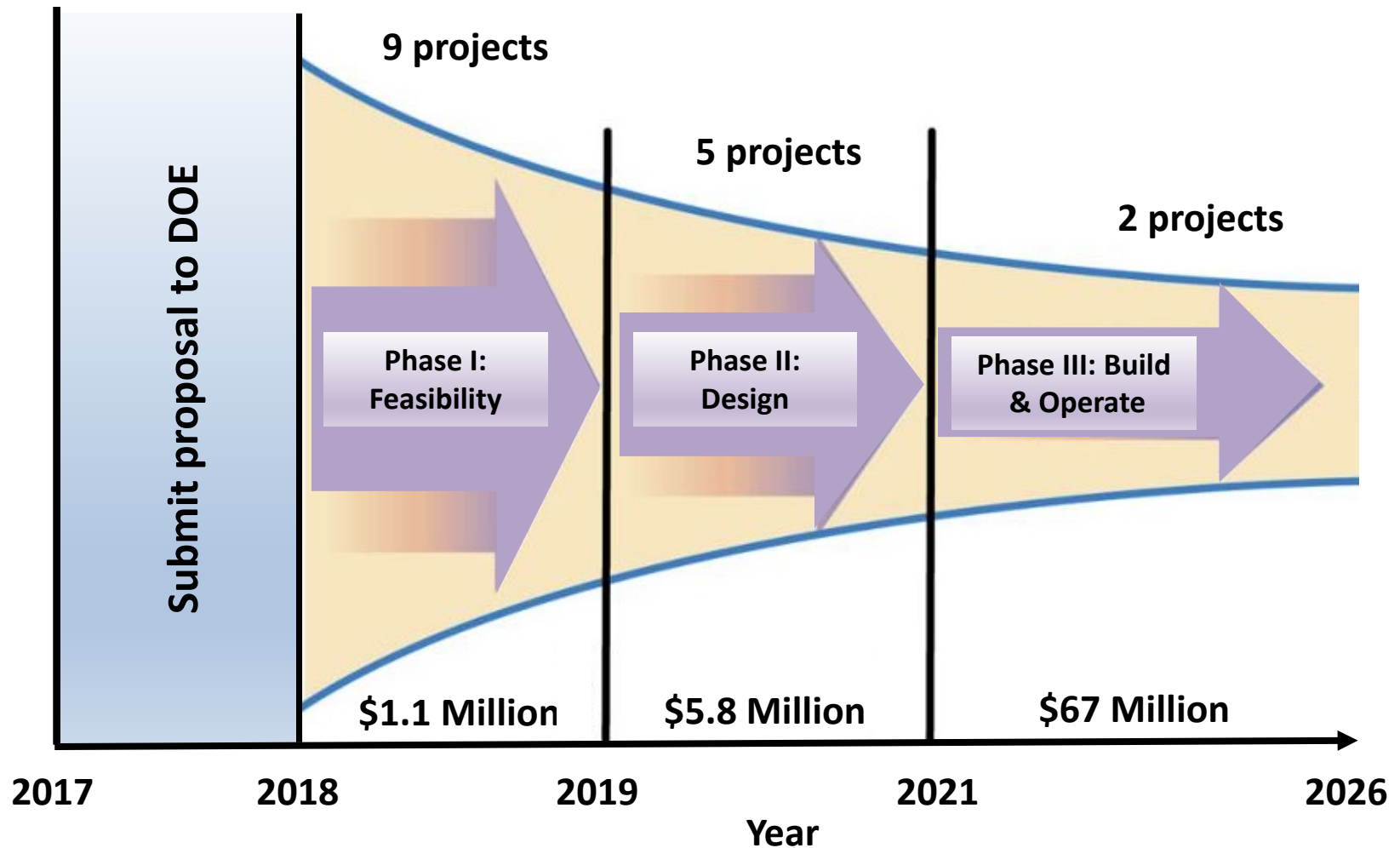
Overall: Design, construct, and operate a 10 MW capture system based on the Linde / BASF advanced amine-based, post-combustion carbon dioxide (CO₂) capture technology at CWLP Dallman Unit 4, Springfield, IL.

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.



UIUC / CWLP Team Wins Highly Competitive Phase III Award

First-of-a-kind large carbon capture pilot: 10 MW advanced Linde/BASF solvent system



ILLINOIS
Prairie Research Institute



AEI Affiliated Engineers



Visage Energy



Illinois:

A Confluence of Geology, Technology, and Government Investment

Creates unique advantages for the state of Illinois

Illinois advantages

- Unique CO₂ storage geology of Illinois is a major motivator for large capture pilots and large-scale capture demonstration projects at CO₂ emitters within the state
- State of Illinois supporting project with major cost share investment
- State of Illinois has a history of supporting CCS demonstrations (ADM, FutureGen) and is very supportive of CCS research and deployment activities

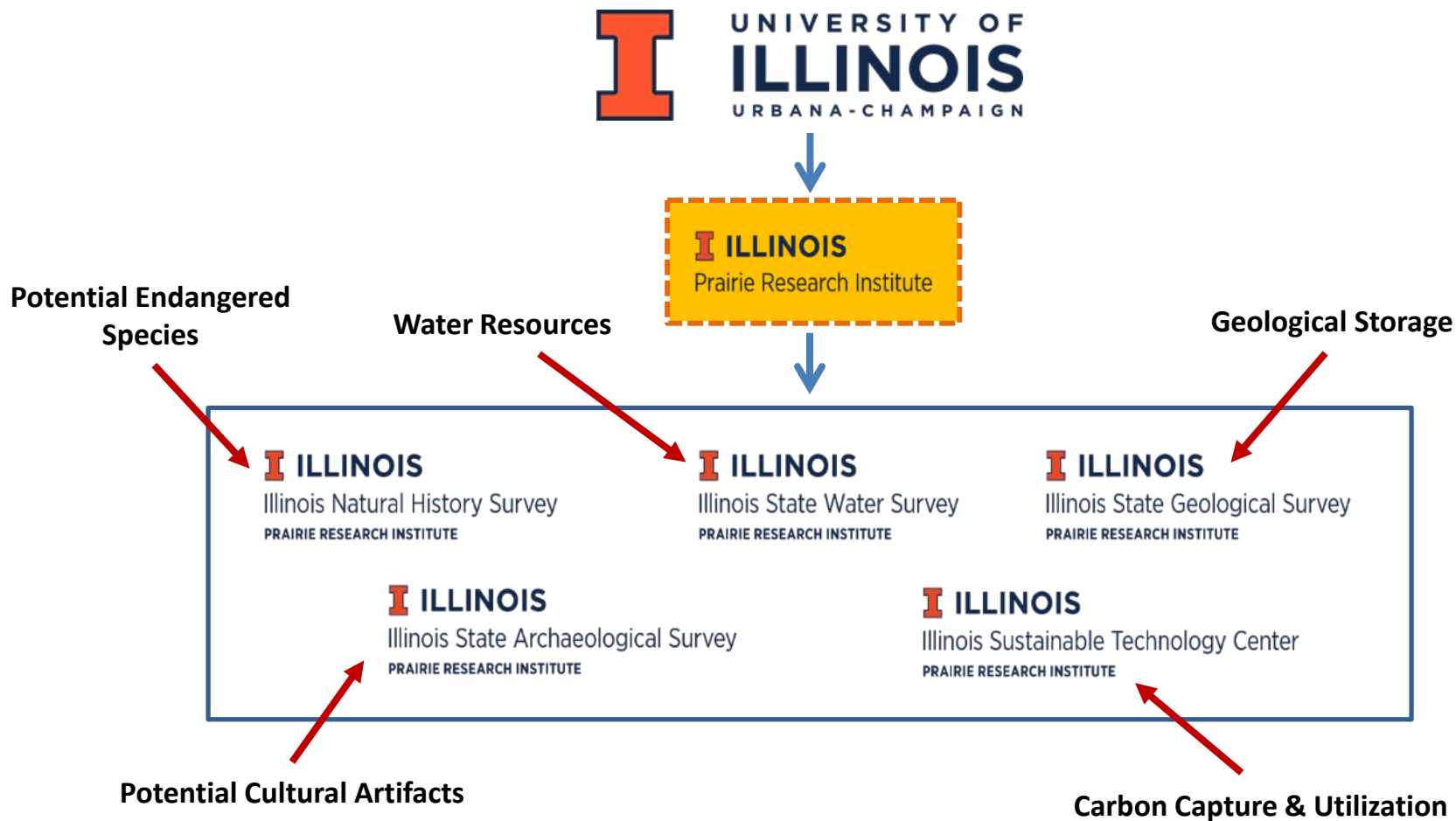
Project benefits

- Creates Union construction jobs
- Supports Illinois' focus on reducing carbon emissions
- Drives regional economy through tourism due to visits by global researchers
- Maintains Illinois' global leadership in CCUS
- With recent federal legislation (Inflationary Reduction Act) CO₂ can be monetized through 45Q and the utilization of CO₂



Prairie Research Institute: Experts in CCUS

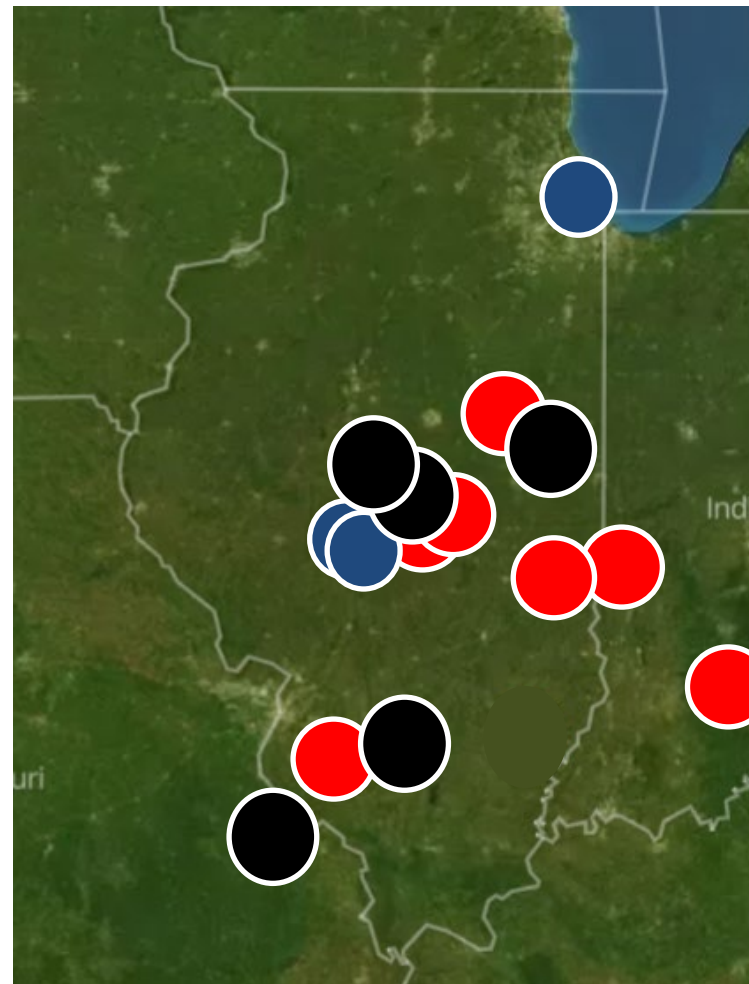
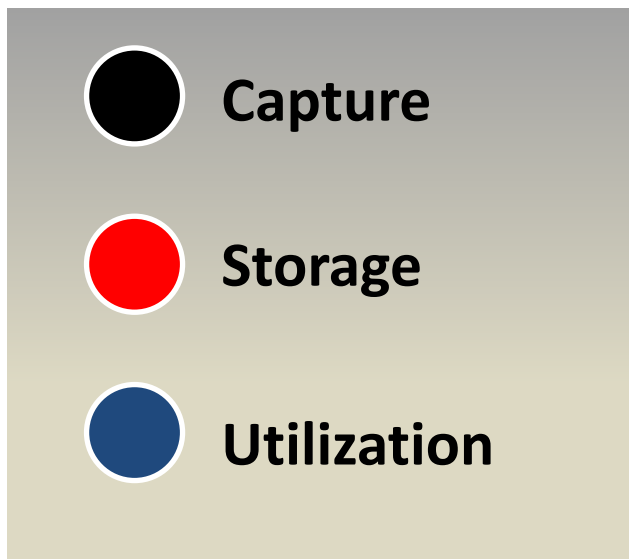
"One-stop shop" to address project needs



Building The CO₂ Value Chain

Integrated Value Chain to Enable Point Source and DAC

UIUC is the prime for all the Capture, Storage, and Utilization projects depicted

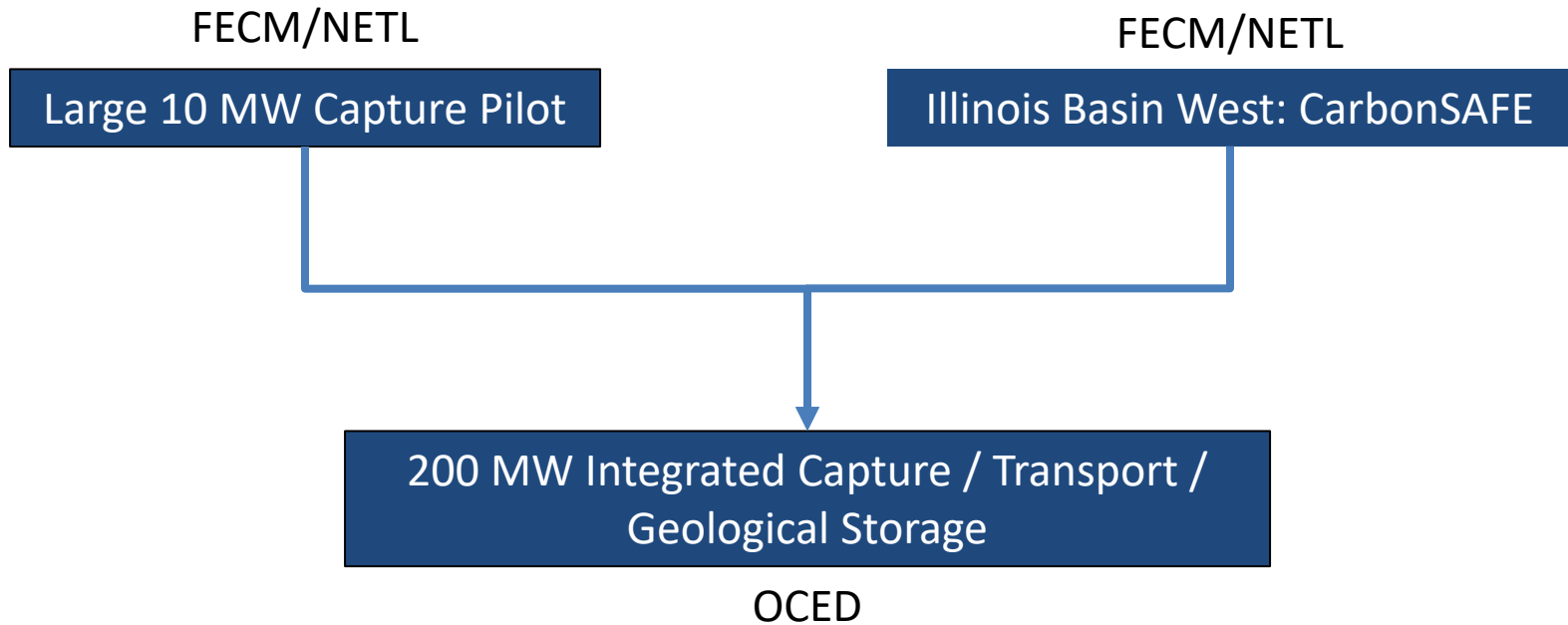


Source: [CarbonSAFE Publications | netl.doe.gov](https://www.netl.doe.gov)



Leveraging Multiple DOE Projects at CWLP

Enabling the development of the CO₂ Value Chain in the Springfield area



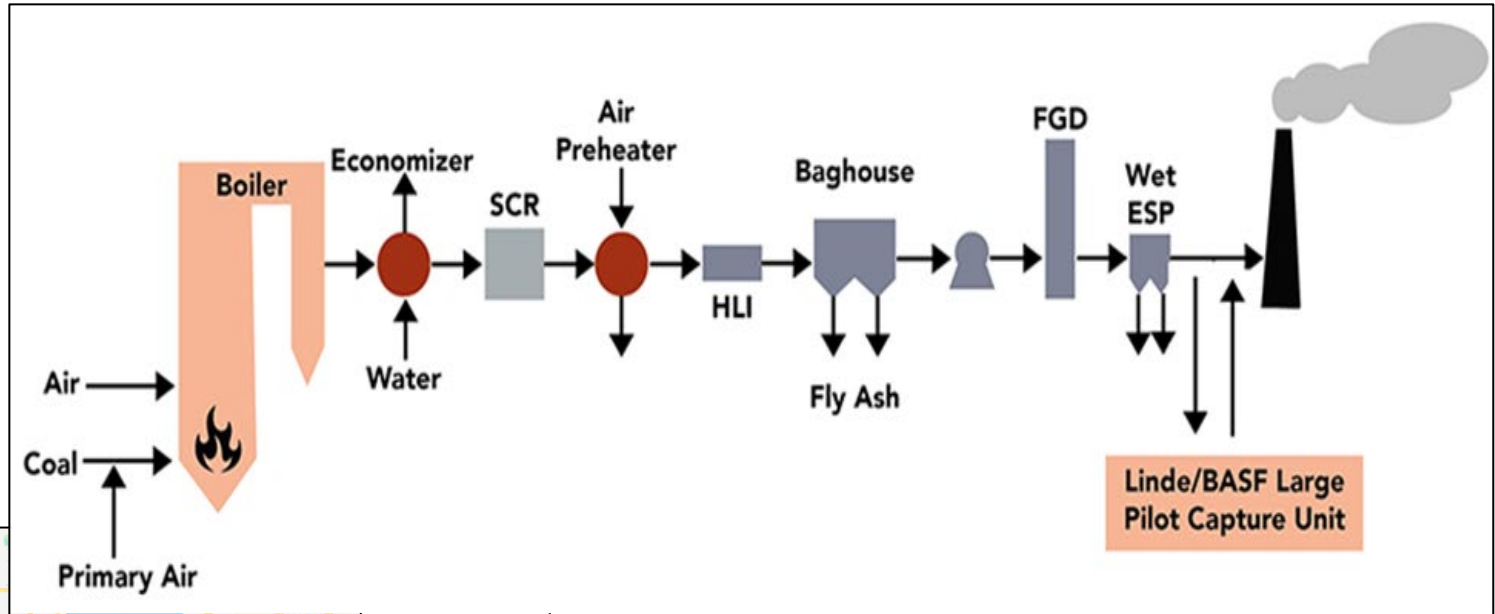
Host Site: City Water, Light and Power (CWLP)

PROJECT STRUCTURE AND ACTIVITY



CWLP Location and Configuration

Traditional PC plant



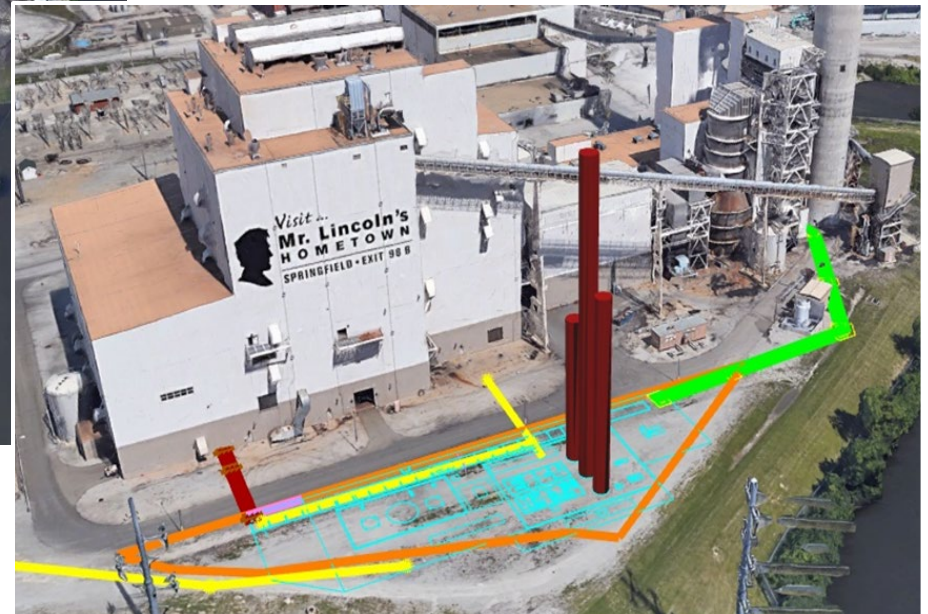
Dallman Unit 4 configuration



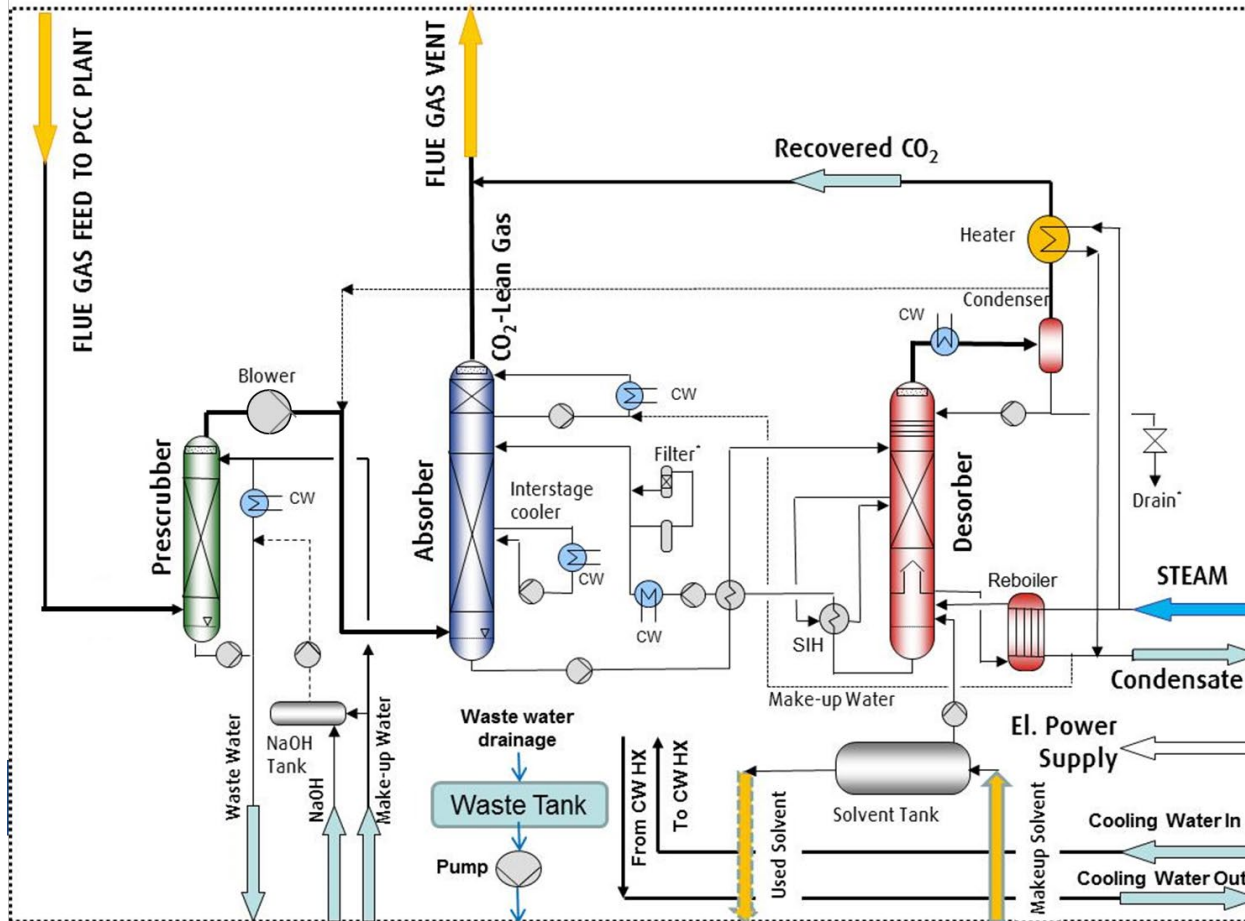
Location of city of Springfield within the state of Illinois

City Water, Light and Power (CWLP)

Water and power supplier for City of Springfield



Linde / BASF Solvent Based Capture System



Reduced capital/energy costs

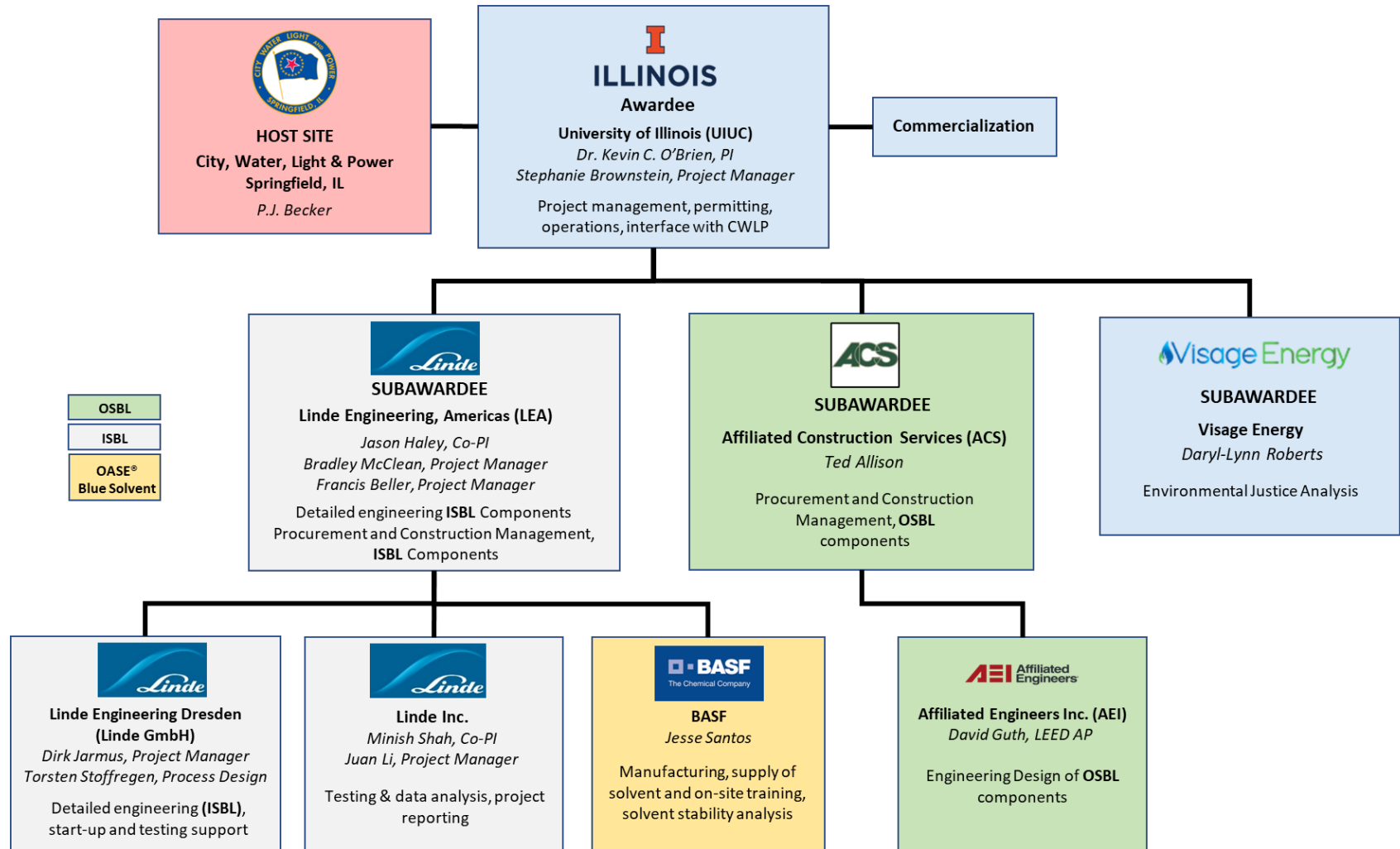
- Optimized BASF OASE® blue solvent
- Efficient CO₂ capture from low-pressure sources
- Longer solvent stability
- Lower solvent circulation rate

Notable Linde process improvements

- Dry bed water wash design to minimize solvent losses
- Stripper regeneration at 3.4 bars reducing CO₂ compressor cost and power consumption
- Advanced Stripper Interstage Heater to reduce regenerator steam consumption

Phase III: Project Management Structure

Consistent team throughout all phases



Project Tasks

BP1 for Phase III = BP3 overall for project

Blue = "Complete"

Orange = "In Progress"

All BP3 tasks completed

BP4 tasks in progress

Task #	Task	BP
1.0	Project Management and Planning	All BP
2.0	Baseline Techno-Economic Analysis (TEA)	BP3
3.0	Detailed Engineering and Specifications	
4.0	Permit Application	
5.0	Construction and Execution Plan	
6.0	Long Lead Item Equipment Procurement	
7.0	Equipment Procurement and Fabrication	BP4
8.0	Site Preparation and Foundations Installation	
9.0	Plant Construction and Installation	
10.0	Commissioning and Test Plan	BP5
11.0	Start-up and Operations	
12.0	Operations and Testing	
13.0	Analysis of Test Campaign Results	
14.0	Updated Techno-Economic Analysis (TEA)	
15.0	Update of EH&S Assessment, TMP, and TCP	
16.0	Economic Revitalization and Job Creation Outcomes Analysis	
17.0	Dismantling and Removal	



Blue = "Complete"

Orange = "In Progress"

Deliverables for Phase III

Task/ Subtask	Deliverable	Due Date
1	Project Management Plan	Update due 30 days after award. Revisions to the PMP shall be submitted as requested by the Project Manager.
1	Resource Loaded Schedule	Update due 30 days after award. Revisions to the PMP shall be submitted as requested by the Project Manager.
1	Earned Value & Risk Management Systems	Update due 30 days after award. Revisions to the PMP shall be submitted as requested by the Project Manager.
1	Workforce Readiness Plan	End of Budget Period 5
1	Environmental Justice Analysis	End of Budget Period 5
2	Baseline TEA	End of Budget Period 3
3.1	PFDs, P&IDs, and Utility Balances	End of Budget Period 3
3.1	Equipment Lists and Process Data Sheets	End of Budget Period 3
3.2	Plant Layout and General Arrangement Drawings	End of Budget Period 3
3	Final Detail Design Report	End of Budget Period 3
5	Construction Plan	End of Budget Period 3
10	Pre-Startup Safety Review (PSSR) Report	End of Budget Period 4
10	Pilot Commissioning and Test Plan	End of Budget Period 4
14	Updated TEA	End of Budget Period 5
15	Update of EH&S Assessment, TMP, and TCP	End of Budget Period 5
16	Updated Economic Revitalization and Job Creation Outcomes Analysis	End of Budget Period 5



Cost Challenges that Arise from Limited Skilled Labor

Another reason why workforce development is important

Labor

- Major cost driver for assembly of components on site

Possible Market Drivers

- The “Great Retirement” removed highly experienced trades people from the work force
- Results in trades people with less experience performing tasks
- Bidders account for reduced efficiencies as a result of less experienced work force

Efficiency

- Based on location/craft availability and experience, bidders have built in greater contingency for anticipated Q&A impact

***ISTC is working to help alleviate this through DEIA initiatives.
Create more trades people from disadvantaged groups.***



Environmental Justice Analysis

EJ of major interest in the Illinois region

Objective

- Assess project impact on surrounding communities and potential distribution of anticipated benefits with key focus on traditionally marginalized and disproportionately impacted areas
- Facilitate involvement of affected stakeholders by encouraging information exchanges and a mixture of engagement techniques, such as focus groups, small discussions, and educational workshops

Progress

- Initiated social characterization/stakeholder mapping process of the surrounding areas to assess key EJ issues impacting regions
- Will leverage coalition building and community engagement accomplished through recently passed *Illinois Climate and Equitable Jobs Act* which is *aligned with DOE's Justice40 Initiative* objectives

EJ Profile of Surrounding Communities								
Census Tracts	Region	DAC	Coal Employment	Job Access	Low Income Population	Less High School Education	Energy Burden	RMP Proximity
17167001400	Springfield, Sangamon	0	0.000396432	-10	0.503816794	0.242663657	2	1.139092131
17167000800	Springfield, Sangamon	0	0.000396432	-9.9	0.658695652	0.25786802	6	3.22086381
17149952800	Nebo village, Pike	1	0.000940937	-1.2	0.262	0.148560209	6	0.459473255
17115000200	Decatur, Macon	1	0	-4.8	0.605683837	0.195710456	7	2.525183636
17163504500	East St. Louis, St. Clair	1	0.000369986	-6.8	0.685061846	0.145545797	7	4.382510421



Steps that enabled the civil work to be completed

CONSTRUCTION UPDATE: A STORY IN PICTURES



Hydroexcavation

October 2022



Completion of pit area perimeter hydroexcavation

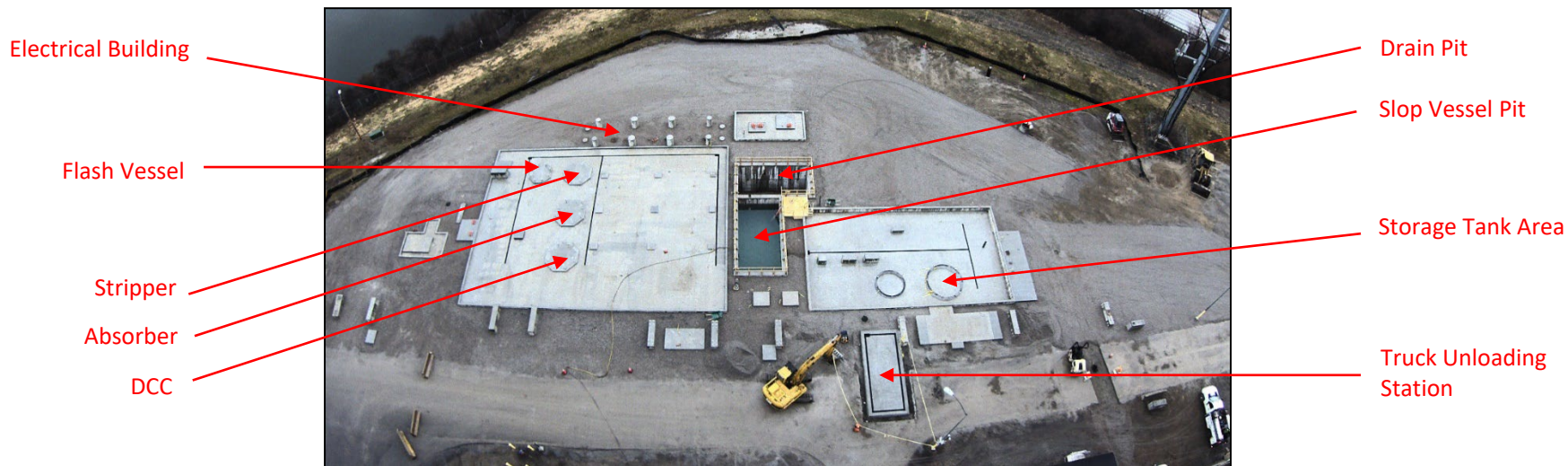
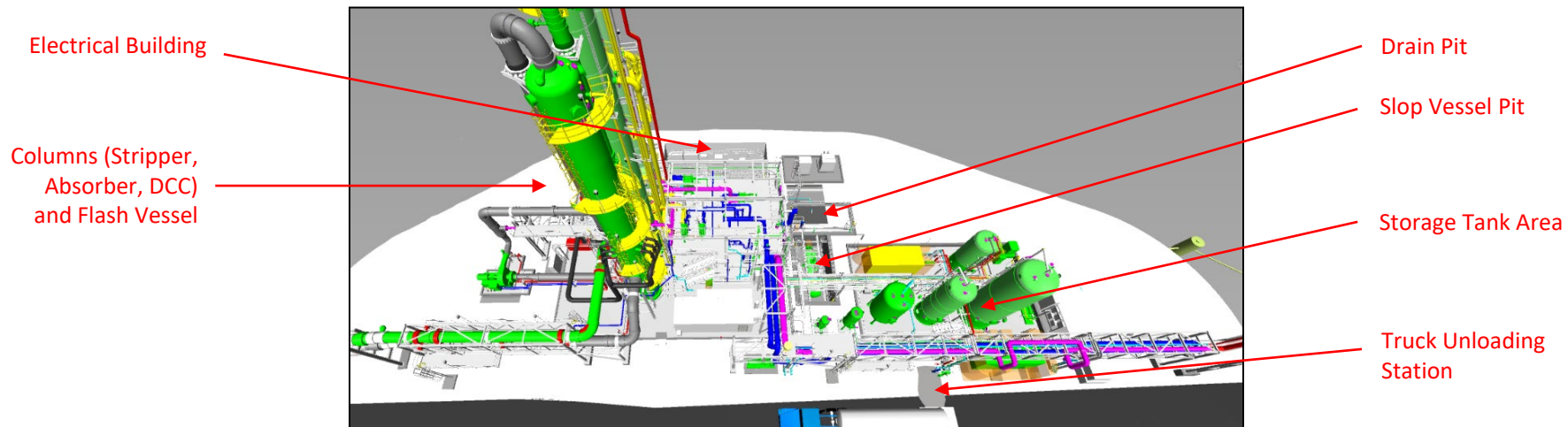


Hydroexcavation in action



Hydroexcavation section revealing underground lines

Large Pilot – ISBL Progress



Large Pilot – ISBL Progress



Off-site module fabrication

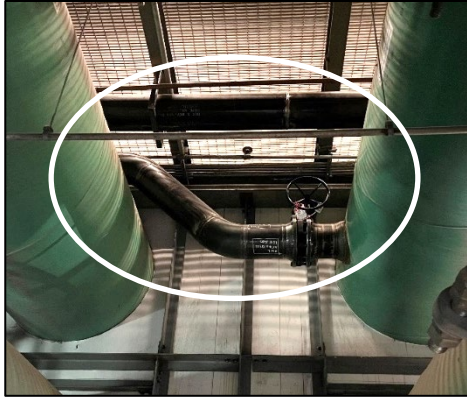


Absorber column at fabricator shop

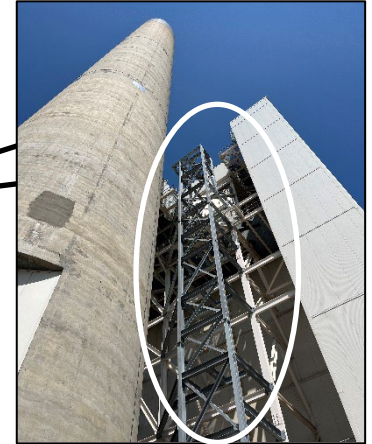
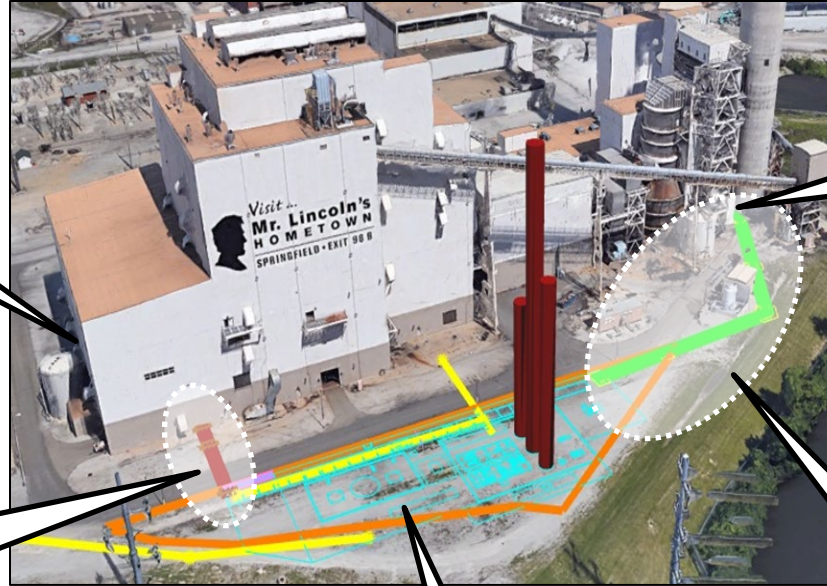


Pipe racks and cooling water piping delivered to site

Large Pilot – OSBL Progress



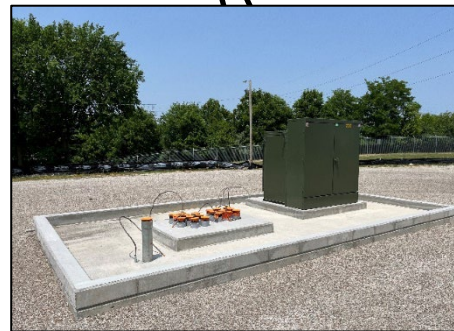
Cooling Water Tie-Ins & Piping



Flue Gas Ducting Support



Utility Bridge



Transformer



Flue Gas Ducting Bridge



Visits from Stakeholders;

Filing for Membership in International Carbon Capture Test Network

PROJECT CREATING HIGH VISIBILITY FOR CWLP AND SPRINGFIELD



I ILLINOIS
Prairie Research Institute



AEI Affiliated
Engineers



Visage Energy



Ground-Breaking Ceremony at CWLP

December 2022: Stakeholders from unions, elected officials, DOE



Key stakeholders included:

City of Springfield Mayor (Jim Langfelder)

DOE/FECM Point Source Carbon Capture Director (Lynn Brickett)

CWLP Chief Utility Engineer (Doug Brown)

Linde Senior VP (Dominic Cianchetti)

University of Illinois President (Tim Killeen)

Plumbers & Steamfitters #137 Business Manager (Aaron Gurnsey)



Teesside University Visit

July 2023: Transatlantic Net Zero Centre of Excellence



Successful meeting to explore joint collaborations and better understand UIUC projects



Sussex University Visit

August 2023: Performing worldwide analysis of CCUS projects



Provided on-site information to support industrial decarbonization research



Summary and Conclusions

- Budget Period 3:
 - On-time completion and within budget
 - Procurement of long lead time equipment complete
- Budget Period 4 progress:
 - All equipment procurement complete
 - Site foundations and civil work complete
 - OSBL construction close to completion
 - Off-site module/column/vessel fabrication close to completion
 - Market and labor induced cost increases have occurred for materials, equipment, and construction
 - Implemented risk mitigation plan to address cost increases
 - Increased stakeholder financial commitment and financial support
- EJ assessment in progress



Acknowledgements

Name	Organization
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Daryl-Lynn Roberts, Will Johnson	Visage Energy

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