



# Diamond Vault Carbon Capture FEED Study DE-FE0032165

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**Cleco Power**

2023 Carbon Management Research Project Review Meeting  
August 28 – September 1, 2023



# Disclaimer

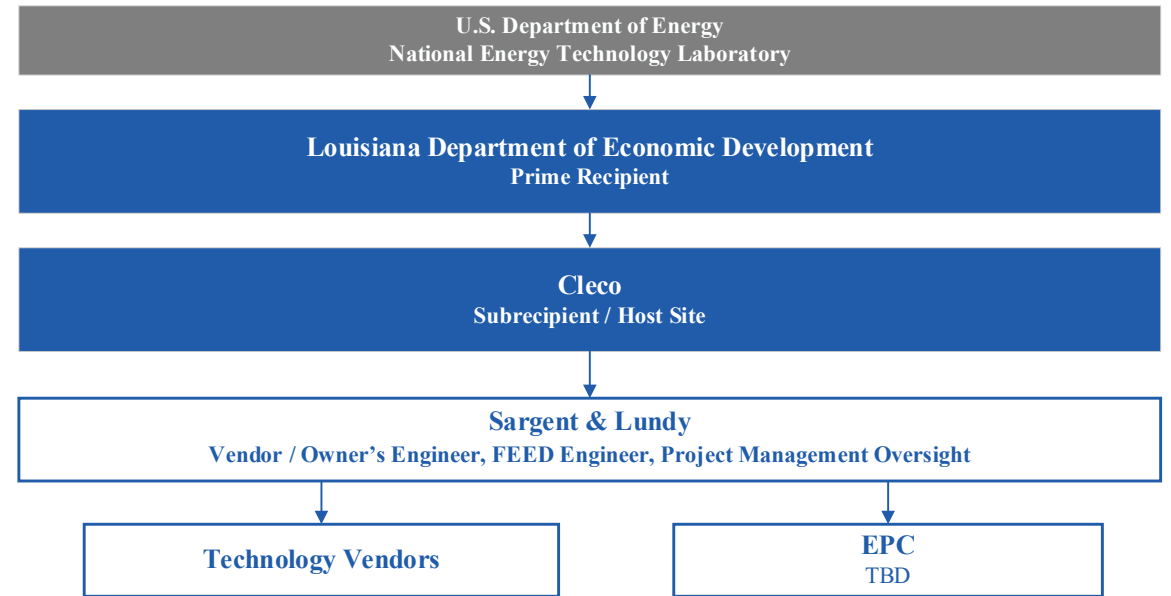
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# Project Overview

**Total Funding: \$11,314,994**

- DOE: \$9,029,540
- Cost Share: \$2,285,454 (20%)

**Work Period: April 1, 2023 –  
September 30, 2024**



## Project Objectives:

- Diamond Vault is anticipated to reduce Madison Unit 3's CO<sub>2</sub> emissions by 95% by storing the CO<sub>2</sub> in geological features.
- The overall objective of this project is to perform a front-end engineering and design (FEED) study for the installation of a carbon dioxide (CO<sub>2</sub>) capture system at a power plant in Louisiana.
- The future implementation and operation of this project would be a first-of-a-kind (FOAK) installation and would serve as an example for other coal facilities considering the adoption of carbon capture technology.

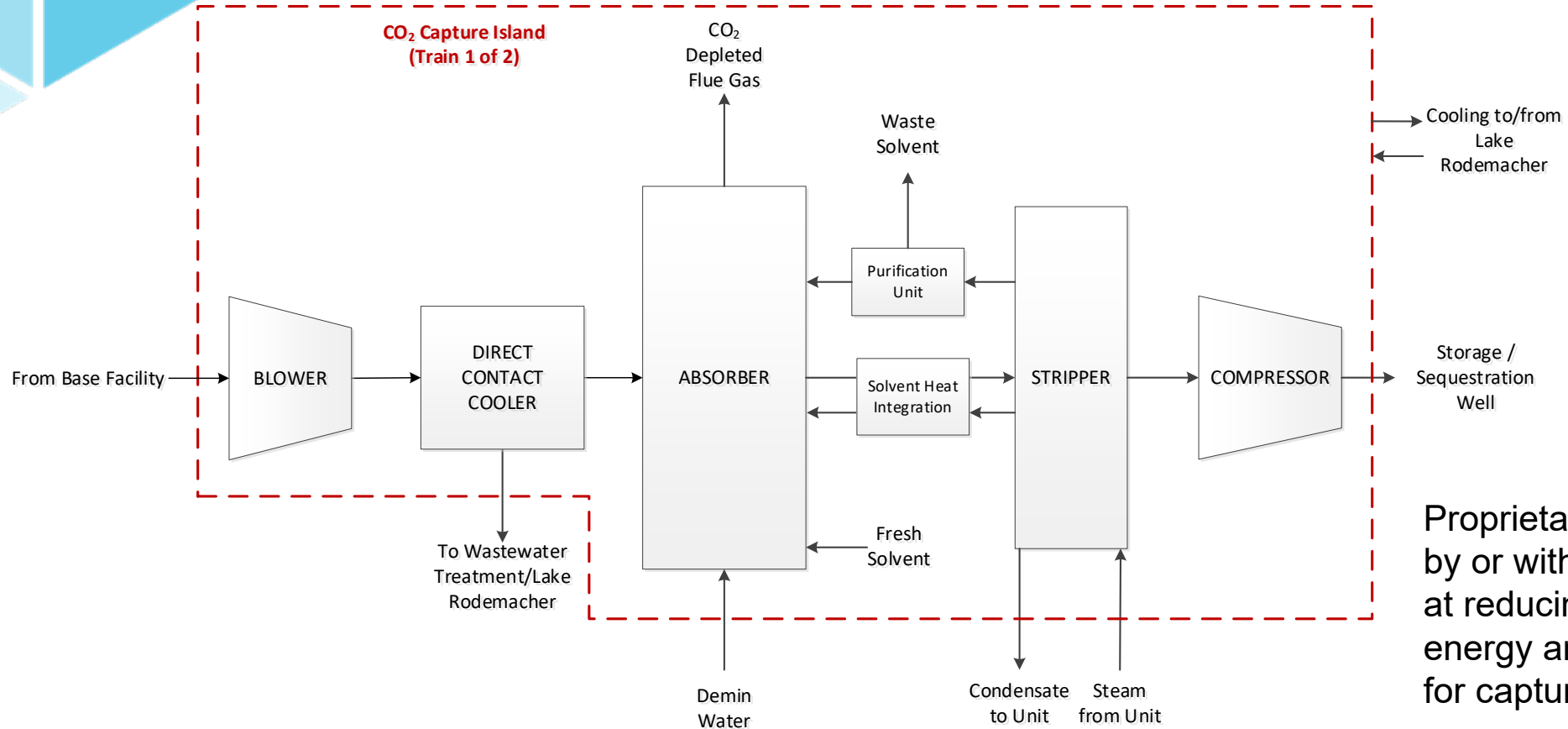
# Brame Energy Center

## Madison Unit 3

- Boiler: 600 MW, Circulating Fluidized Bed (CFB)
- Fuel: 70% petroleum coke (a waste product of oil refining) and 30% Illinois Basin coal
- Existing AQCS Controls: Circulating Dry Scrubber (CDS), Selective Non-Catalytic Reduction (SNCR), and fabric filter for SO<sub>2</sub>, NO<sub>x</sub>, and PM.
- Commercial Operation: 2010



# Technology Overview and Plant Integration



CO<sub>2</sub> rich solvent sent to regenerator where CO<sub>2</sub> is steam-stripped from the solvent.

Low pressure steam required to regenerate solvent and strip CO<sub>2</sub> out.

Proprietary amine blends developed by or with technology providers aim at reducing thermal regeneration energy and improve overall kinetics for capture.

Direct Contact Cooler (DCC) cools and pre-treats incoming gas.

CO<sub>2</sub> absorbed by reaction with amine-based solvent in the absorber.

CO<sub>2</sub> depleted flue gas exits through absorber stack.

# Technical Approach / Project Scope



The FEED Study will be performed in three separate phases:

- (i) an initial feasibility phase that defines the project and establishes preliminary costs;
- (ii) a pre-FEED phase based on the feasibility phase results to further refine the project and preliminary costs; and
- (iii) a final-FEED phase which will be a continuation of the pre-FEED phase with a construction contractor to develop a final cost estimate for the project and make the project execution ready.

Task	Description	Target Start Date	Target Completion Date
1.0	Project Management and Planning	July 25, 2022	September 30, 2024
2.0	Phase 1: Feasibility Study	July 25, 2022	February 27, 2023
3.0	Phase 2: Pre-FEED Study	February 28, 2023	January 8, 2024
4.0	Phase 3: FEED Study	January 9, 2024	September 9, 2024
5.0	Phase 3: DOE Reporting and Required Project Deliverables	April 23, 2024	September 9, 2024

# Project Success Criteria



Goal/Objective	Date	Success Criteria
Competitively Evaluate Technology Options to Select Preferred Technology	February 27, 2023	Two Vendor Feasibility Studies Complete and Vendor Selection Memo Complete
Process Design for Technology Finalized	December 4, 2023	Process Design Package Complete and Reviewed
Select Preferred EPC Contractor	January 8, 2024	Preliminary Project Execution Plan Complete and DOE Review Meeting
Provide Cleco with information to evaluate whether to pursue CC at Madison Unit 3 as part of their overall GHG reduction approach.	December 25, 2023 September 9, 2024	Initial: Pre-FEED Summary Report Complete Final: FEED Summary Report and Business Case Analysis Complete
Provide proof of concept that an amine-based CO <sub>2</sub> capture process can be economically applied on a large-scale coal/petcoke electric generating unit.	September 30, 2024	DOE Topical Report Submitted
Accelerate Project Development of Diamond Vault	Future	The project will be ready to move into execution at the conclusion of the FEED study having selected a technology vendor and EPC to support the FEED study and develop the documents needed to obtain permits and approvals as well as funding to move into project execution.

# Risk & Mitigation Strategy



Perceived Risk	Risk Rating			Mitigation/Response Strategy
	Probability	Impact	Overall	
<b>Financial Risks:</b>				
Availability of Cost Share	Low	Medium	Low	An estimated spend plan has been developed based on the proposed schedule and firm price proposals, allowing Cleco, the primary source of cost share, to plan for the expected spend.
Budget Overruns	Low	Medium	Low	Firm priced proposals have been received from all participants based on the SOPO. Additional costs, if encountered, will be covered by Cleco.
<b>Cost/Schedule Risks:</b>				
Schedule Delays	Low	High	Medium	A Level 1 schedule has been developed for the proposed project. Pre-award authorization we received on July 26, 2022 to allow the project schedule to be maintained during negotiation. The schedule will continue to be tracked to ensure any adjustments to the schedule are identified early.
Resource Availability	Low	Medium	Low	Core project team members have been designated for each organization that will be assigned to support the project through its duration.
<b>Technical/Scope Risks:</b>				
Feasibility of Applying CC Technology to this Application	Low	High	Low	A preliminary TEA was completed prior to award. In addition, a feasibility phase is included to evaluate multiple technology vendors and select a technology vendor.
Unidentified Trace Constituents in the Flue Gas Adversely Impact CC Performance/Costs	Low	Medium	Low	As part of the project, trace constituents will be identified in the design criteria from fuel sources and data from similar applications and flue gas testing will be performed. Constituents of major concern will be highlighted by the technology suppliers.
<b>Management, Planning, and Oversight Risks:</b>				
Lack of Coordination Between Participants	Low	Medium	Low	All organizations have a historical working relationship, and recurring status updates are planned.





# Progress and Current Status

# Project At-a-Glance

## Phase 1: Feasibility (complete)

### Phase Outcome: AACE Class 4 Estimate

#### Deliverables:

- Flue Gas Design Basis
- Process Flow Diagrams
- Heat & Material Balances
- Utility and Chemical Consumption List
- Equipment List (preliminary)
- Electrical Load List (preliminary)
- Emissions and Effluent List (preliminary)
- Site Plan / Site Layout (preliminary)
- General Arrangement Drawing (preliminary)
- Engineering Studies (preliminary)
- Capex and Opex Estimates

## Phase 2: Pre-FEED (in progress)

### Phase Outcome: AACE Class 3 Estimate

#### Deliverables:

- Project Design Criteria
- Updated Phase 1 Deliverables
- Tie-In List
- Piping & Instrumentation Drawings
- Control Description & Operating Philosophy
- Equipment Layout Drawings
- Structural Load List (preliminary)
- Terminal Point List
- BOP Mechanical System Design
- Foundation List
- Ductwork Sketches
- Geotechnical Investigation / Civil Design
- Engineering Studies
- HAZOP
- Constructability Review
- Major Equipment Vendor Quotes
- Capex and Opex Estimates

## Phase 3: FEED

### Phase Outcome: AACE Class 2 Estimate

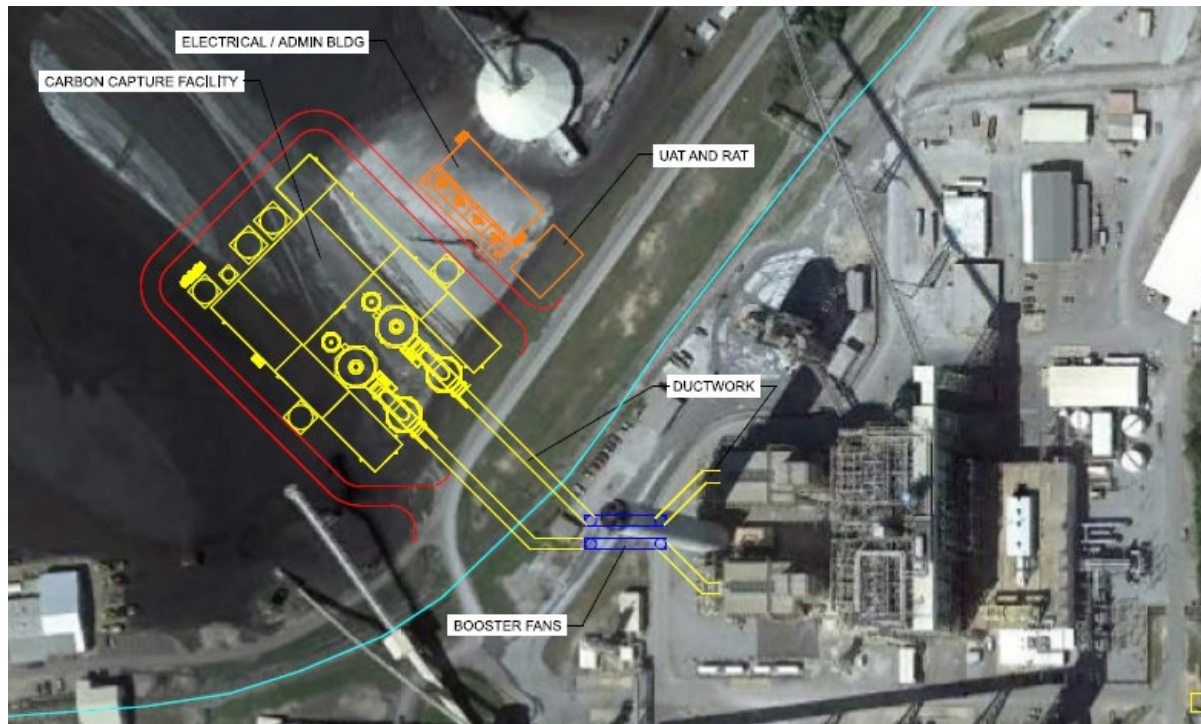
#### Deliverables:

- Updated / Final Phase 2 Deliverables
- Structural Design Package
- Mechanical Design Package
- Electrical Design Package
- Equipment Vendor Quotes
- Commodity Estimates
- Capex and Opex Estimates
- Execution Schedule
- Execution Plan

# Phase 1: Feasibility Results

Completed in February 2023

Total Cost of Capture:  
\$50 - \$55 per tonne  
(12 Year Evaluation Period)



## Preliminary Utility Sourcing

- Steam and Electric Supply:
  - Steam Extraction from Host Unit
  - Switchyard Expansion and Direct Sourcing
- Cooling Water Supply:
  - Once-Through Cooling System (mirroring existing facility)

CCS Island located adjacent to stack to minimize ductwork and utility routing.

MHI was selected as technology vendor for future phases.

# Phase 2: Pre-FEED Progress

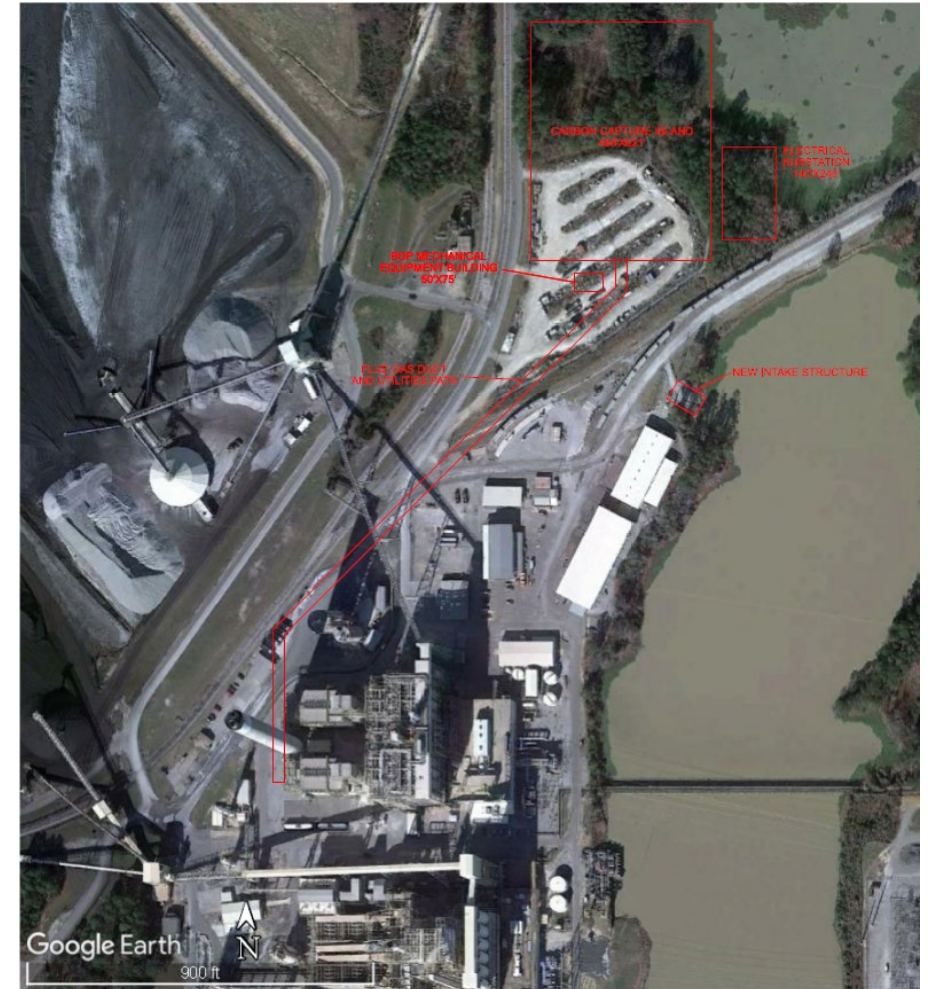


- The Pre-FEED phase was initiated at the end of February 2023.
- Major tasks completed as of August 2023:
  - Completed stack testing and finalized design basis.
  - Revised process design package (PDP) developed by MHI.
  - Project Site Plan finalized.
- Tasks in Progress:
  - Final Utility Sourcing Studies, updated to reflect revised PDP.
  - Engineering deliverables, including P&IDs and Layout Drawings.
  - Balance of Plant design and deliverables.

# Phase 2: Pre-FEED Progress

## Changes from Feasibility Phase:

1. Location of the CCS Island has moved to the north to minimize impacts to base facility operations.
2. Equipment sparing for final design basis and turn-down.
3. Evaluating additional controls based on stack test results.



# Next Steps

- Pre-FEED Phase to be complete by end of 2023.
  - EPC Selection to be completed as part of Pre-FEED
  - AACE Class 3 Cost Estimate at end of Pre-FEED
- FEED Phase to be initiated in early 2024 and complete by September 2024.
- Evaluate other project impacts including life cycle emissions, environmental justice, and economic revitalization to be completed with the FEED.