NuDACCS – Nuclear Direct Air Capture with Carbon Storage

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U.S. Department of Energy
National Energy Technology Laboratory
Carbon Management Project Review Meeting
August 15 - 19, 2022

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AC AirCapture
Southern Company
THE UNIVERSITY OF ALABAMA
Sargent & Lundy
CARBONVERT

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Project Overview

Period of Performance:

18 months

Project Funding:

Federal Share: $2,499,178

Non-Federal Share: $864,446

Total: $3,363,624

Project Team Members:

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AirCapture

Southern Company

THE UNIVERSITY OF ALABAMA

Sargent & Lundy

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Project Goal:

The project will define system costs, performance, socio-economic impacts, and business-case options for leveraging available thermal energy from the nuclear plant to separate CO_2 from ambient air for off-site geologic storage.

Project Objectives

Conduct a Front-End Engineering and Design (FEED) and associated supplemental studies to determine the technical, economic, and socio-economic viability of utilizing nuclear heat/power source for deploying a direct air capture (DAC) installation capturing at least 5,000 net tpa

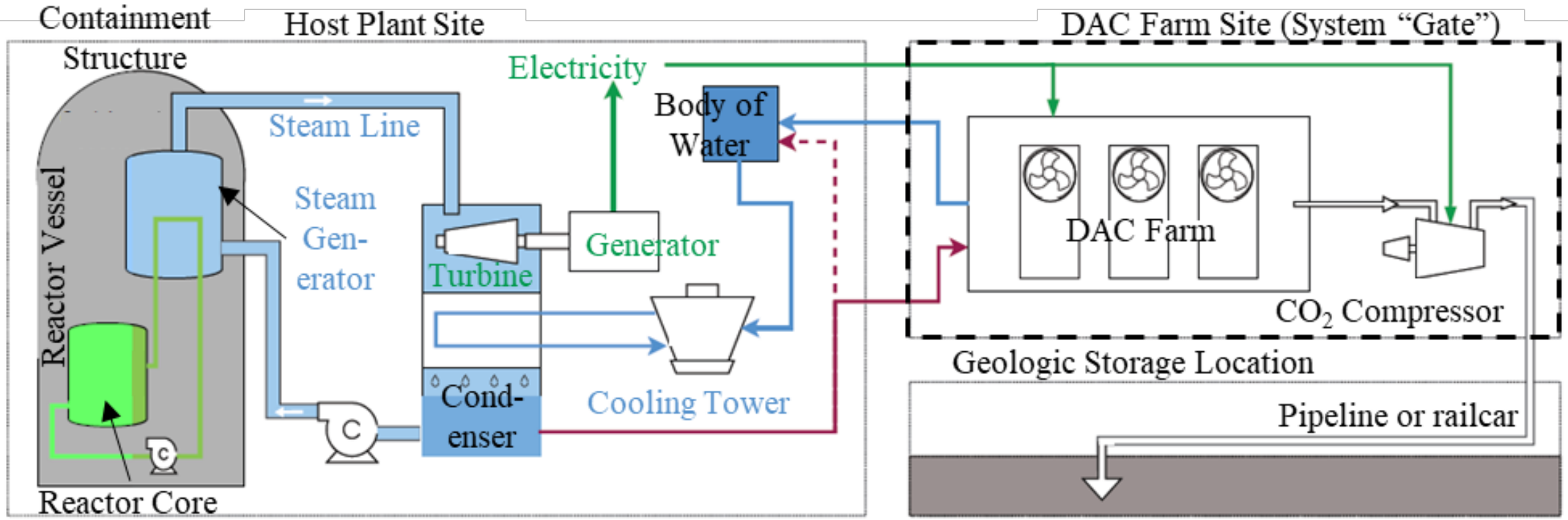
This project seeks to:

- Further DAC module and system design at the 5,000 tpa level
- Understand balance of plant requirements for this configuration
- Understand the key contributors to the Cost estimate and Business case analysis (BCA) for the system
- Develop a Lifecycle analysis (LCA) for this system configuration
- Determine the key inputs and outcomes of this system with an environmental justice lens
- Determine the impacts on and requirements for jobs

Tasks

- Task 1.0 PM
- Task 2.0 FEED
  - DAC
  - Balance of Plant (BOP)
- Task 3.0 Project Economics and Business Case
- Task 4.0 Lifecycle Analysis and EH&S
- Task 5.0 Socio-Economic Impact
  - Environmental Justice
  - Economic Revitalization and Jobs Outcomes Analysis
  - Workforce readiness

Overall Concept



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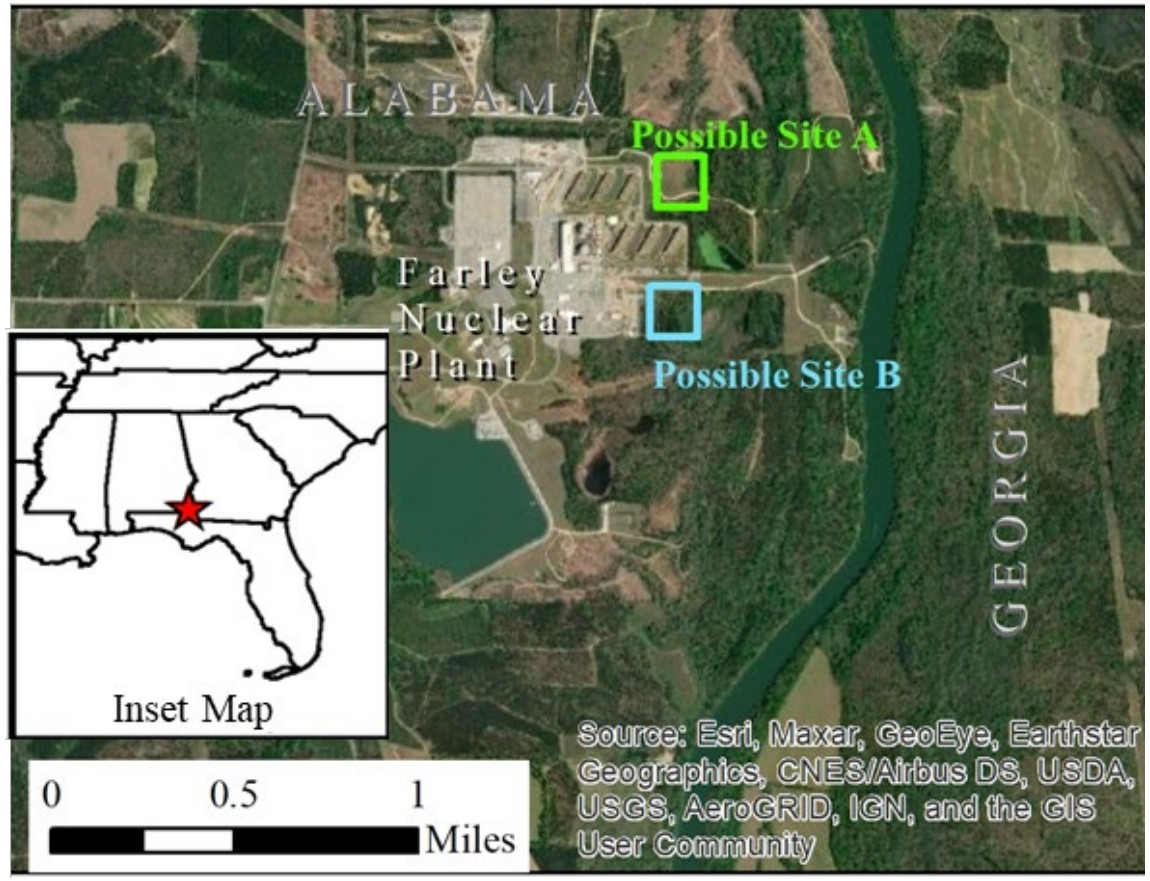
Plant Farley



Host site: Southern Company Plant Farley

- SE Alabama 1,850-acre site (400 used for the facility
- Two 950 MW rated , 3 loop Westinghouse Pressurized Water Reactor (PWR) units
- Online since 1977/1981

Tie-in Benefits

- Use of this heat source does not affect the plant operation
- Tie-in is outside of containment leading to lower regulatory hurdles
- Potential to achieve >5,000 tpa from this high-quality heat source

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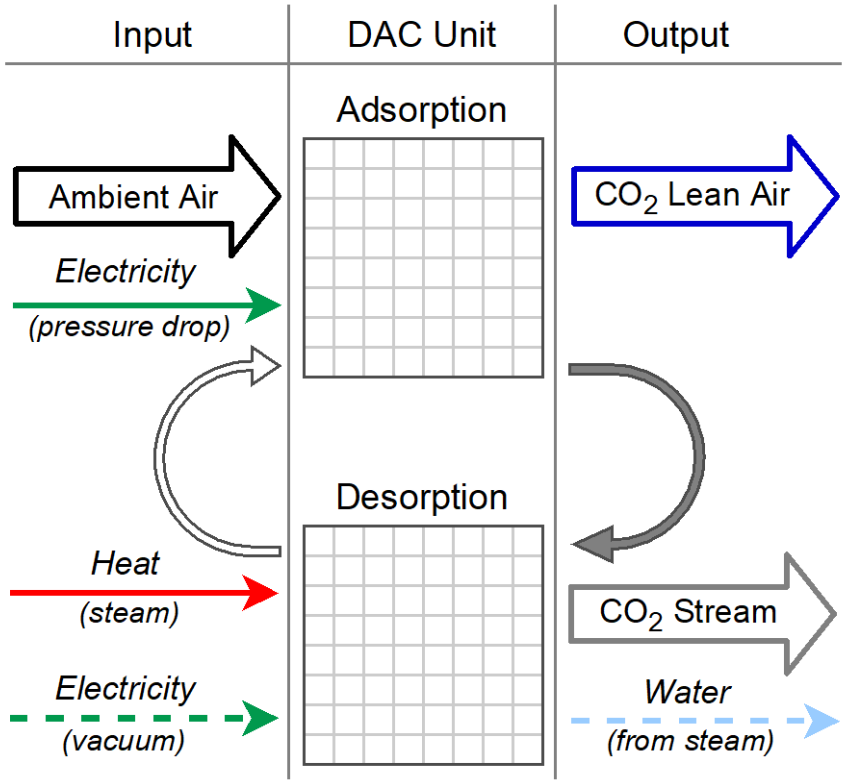
Technology Background

Step 1 (Capture): CO_2 is collected by moving air or mixtures of air and CO_2 rich gases across a proprietary contactor which adsorbs CO_2.

Step 2 (Regeneration): The contactor is moved into a regeneration box where low-temperature steam flows across the contactor, removing CO_2 from the contactor, and the CO_2 is collected.



Goal: Use commercially available contactors and sorbents in an efficient system design to decrease the cost of DAC.

Polymeric Amine Sorbent

Monolithic Contactor

- Low pressure drop
- Low thermal mass
- High geometric surface area
- Compatible with various construction methods

Adsorption

- 900 seconds / monolith in ambient air

Desorption

- Saturated Steam in less than 90 seconds

Monoliths & sorbents provided by Global Thermostat

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Air Capture Scale-up/testing under other DOE funding

- 9,000 SQ FT of design, fabrication, manufacturing and laboratory space
  - power, water, steam, natural gas, vacuum
- Testing Facilities
  - FAT, analysis in Berkeley
  - Integrated Systems at the NCCC in Wilsonville, Alabama
- Laboratories

Synapse Build Labs (Seattle, SF)

AirCapture Manufacturing, Laboratory & Fabrication Facilities (Berkeley, Oakland)

National Carbon Capture Center
https://www.nationalcarboncapturecenter.com

Technical Approach

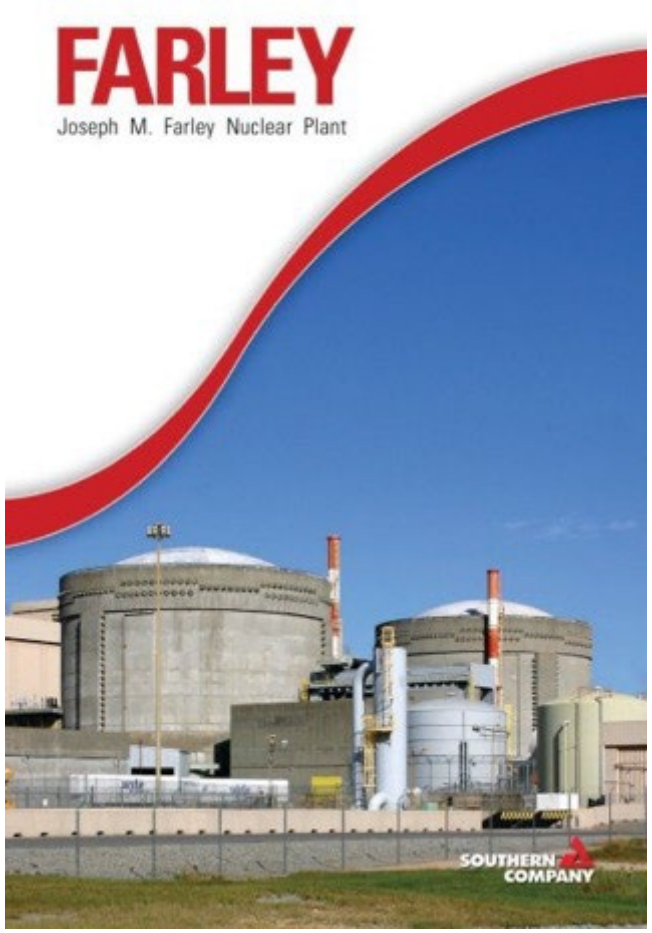
Technical Approach

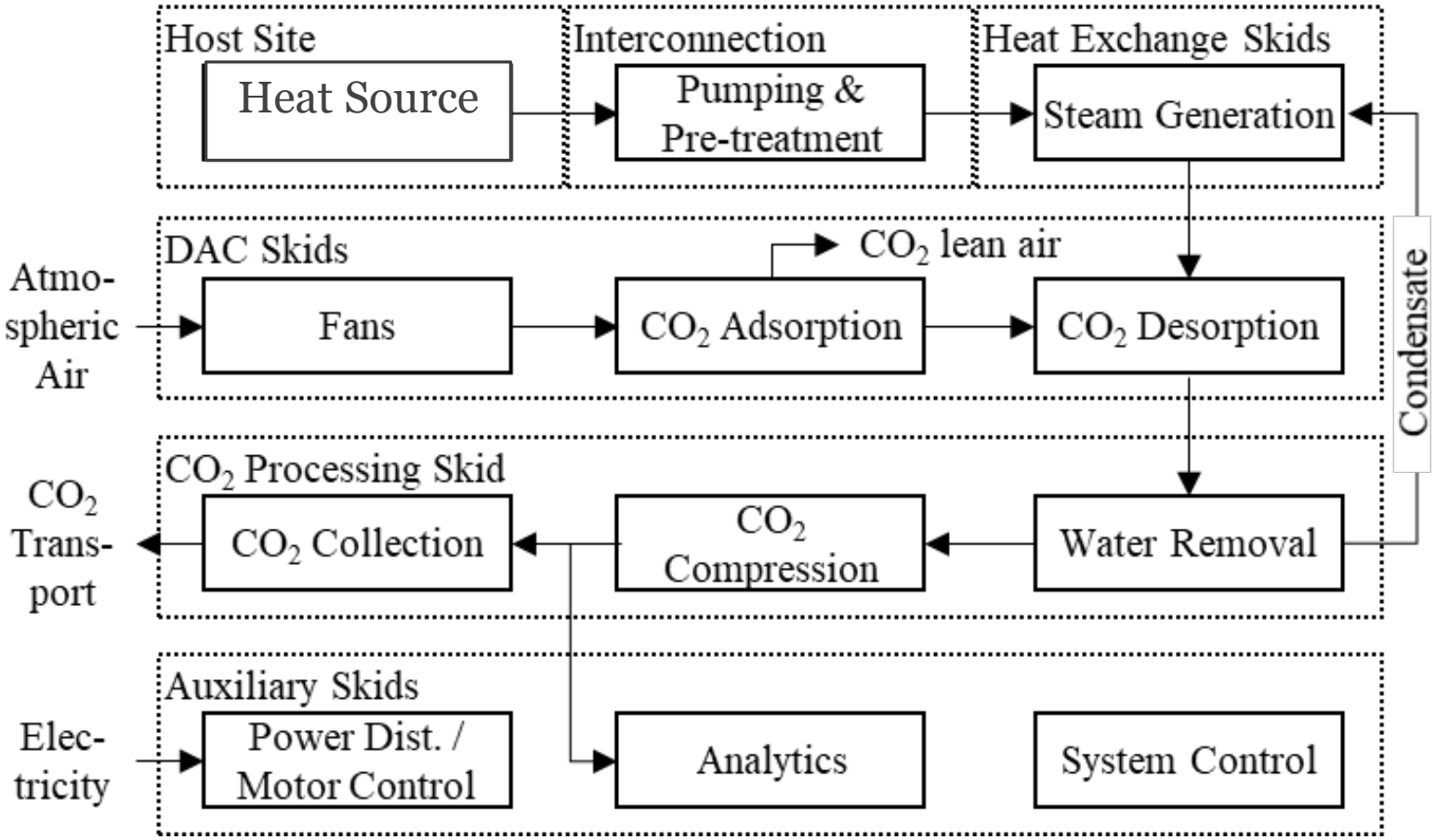
- Battelle – Prime, high-level subsurface assessment, LCA, EEEJ, and EHS assessments
- Air Capture Co-PI and to lead DAC FEED
- Sargent & Lundy to perform BOP FEED
- Southern – Host site and advisor on tasks
- University of Alabama to lead Cost Estimate and BCA
- Carbonvert to advise on all tasks

Deliverables

- FEED Study - Month 14
- Final Technology Maturation Plan – Month 15
- Business Case Analysis – Month 15
- LCA - Month 17
- Environmental Justice – Month 17
- Economic Revitalization Analyses – Month 17

DAC Integration with Plant Farley





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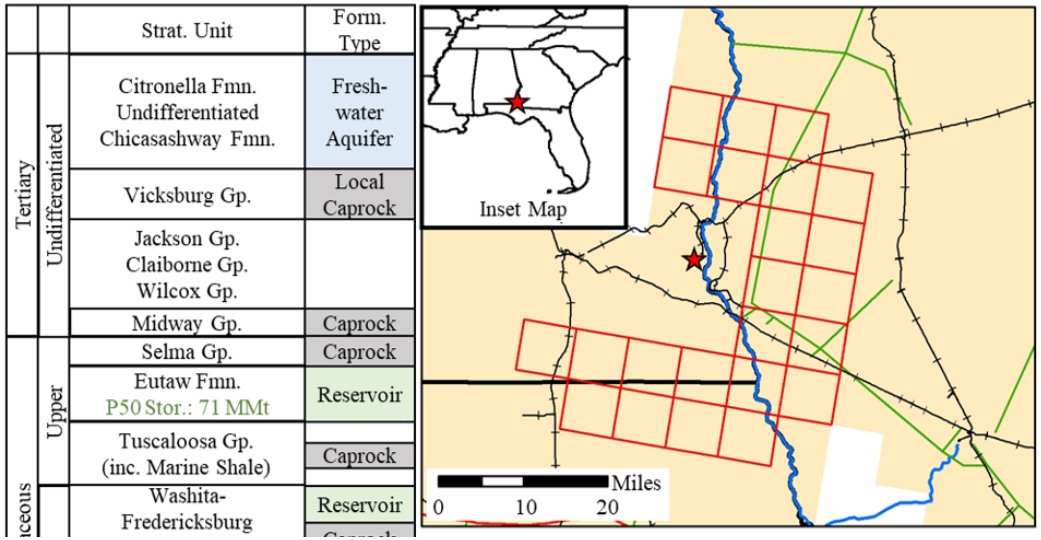
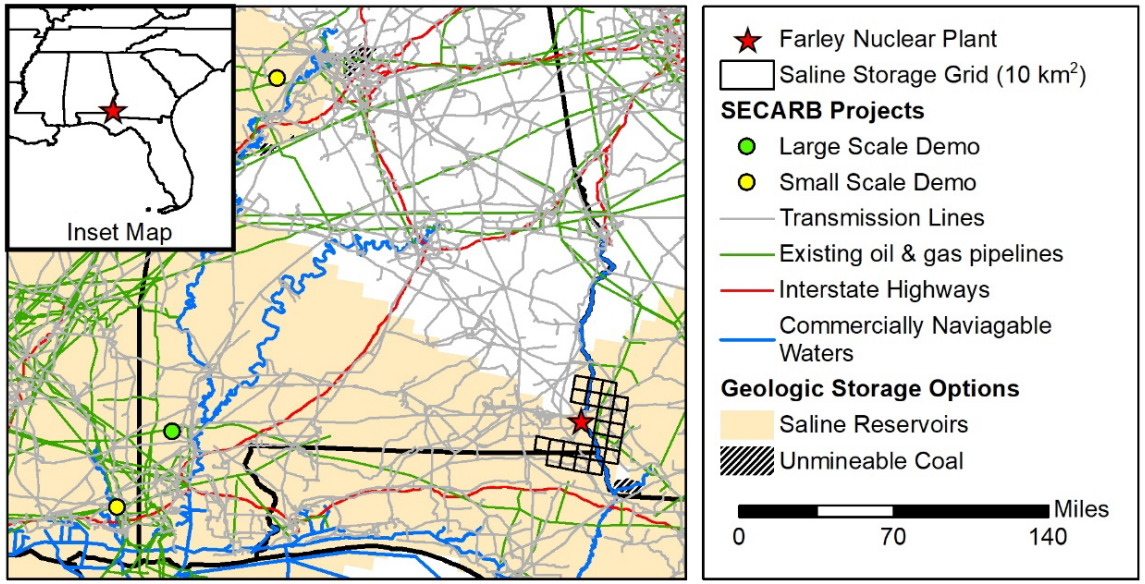
Transport and Subsurface Feasibility

- Feasibility level subsurface assessment
- Suitable geology avoiding exclusion zone for facility
- FEED will consider Rail, Barge, Pipeline transport





eologic Storage Options
Saline reservoirs

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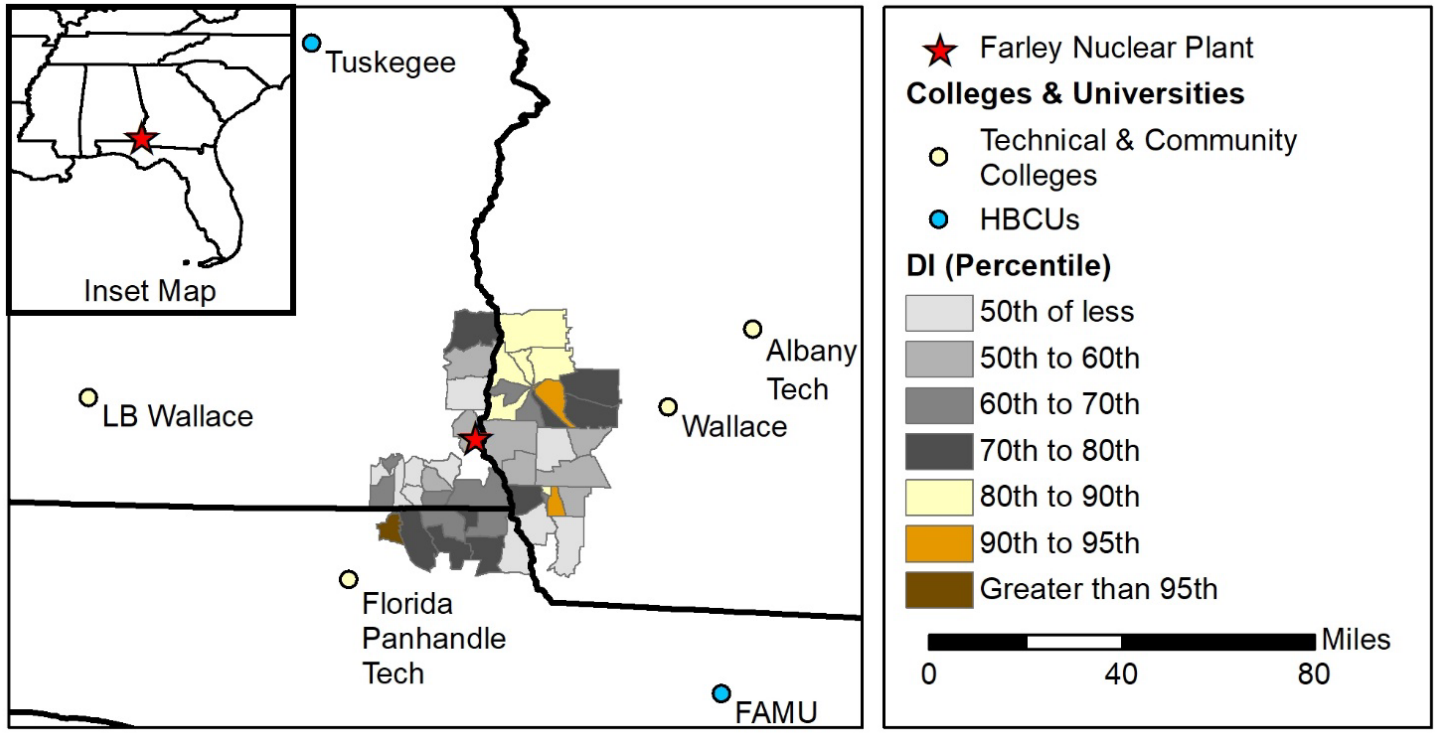
Socio-Economic Impacts

- Understand the impacts of this DAC/Nuclear facility on the surrounding disadvantaged communities
- Determine what the project would do to address these findings.
- Understand the impacts of this DAC/Nuclear combination on job creation
- Understand workforce readiness and how the project would achieve this (e.g. career resource centers, HCBUs)



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Current Status

- Teaming established
- Plan established
- The project team anticipates the project to begin in August 2022

Future Potential

- This work will provide the technical, economic, and socio-economic assessment for a DAC installation powered by a Nuclear facility.
- Establish a baseline for other installations and future work
- These studies will inform scale-up potential and hurdles

Thank You!

- DOE NETL Project Manager – Zachary Roberts
- AirCapture LLC
- Southern Company
- University of Alabama
- Sargent and Lundy
- Carbonvert

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It can be done

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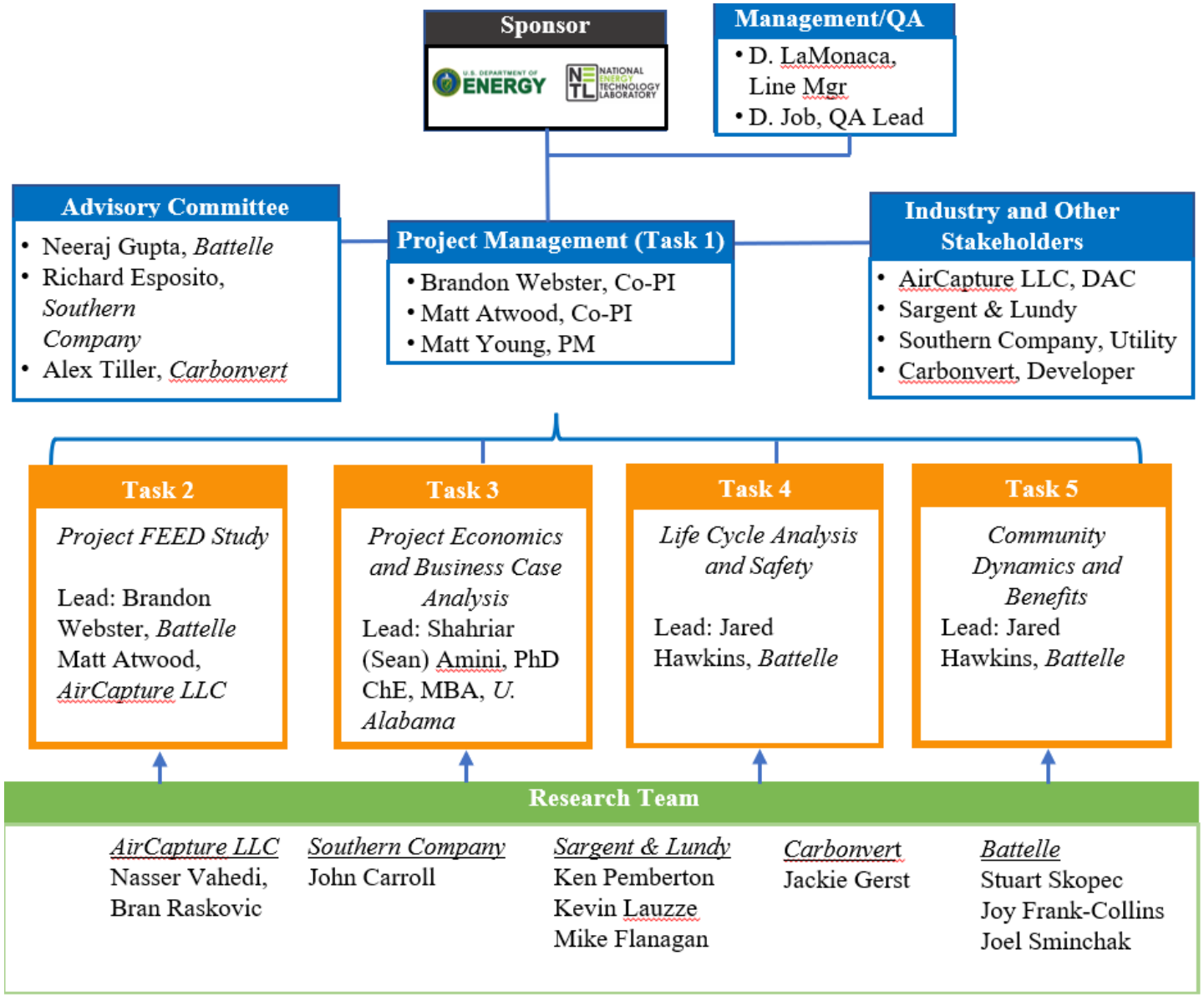
Appendices

Proposed Schedule

	month no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.0	**Project Management**																		
1.1	PM Plan Update (Milestone 2)	M2																	
1.2	Tech Maturation Plan Delivery (Initial/Final)			Initial												Final			
1.3	Workforce Readi Plan Deliv (M8: Init, Final)												Initial					M8	
1.4	Data Management Plan Update (Milestone 3)	M3																	
1.5	Project Status Reports																		
1.6	Project Status Mtgs (Milestone 1 = Kick Off)	M1																	
1.7	Final Report (Milestone 9)																		M10
2.0	**Engineering Design Package (Milestone 5)**																		
2.1	Project Scope and Design Basis																		
2.2	FEED Study														M5				
2.2.1	Process Design and Hazop Report									M4									
2.2.2	Equipment Design																		
2.2.3	Studies and Investigations																		
2.2.4	Mec, Civ, Struct, Elec, I &C, Arch																		
3.0	**Project Economics and Business Case**																		
3.1	Project Cost Estimate (Milestone 6)														M6				
3.2	Bus. Case Analysis and TMP Devel (ref 1.2)																		
4.0	**Life Cycle Analysis and Safety**																		
4.1	Life Cycle Analysis (LCA) (Milestone 7)															M7			
4.2	EH&S Risk Assessment															M7			
5.0	**Socio-Economic Impact**																		
5.1	Envil Justice Analysis (Milestone 9)										M9								
5.2	Econ Revital and Jobs Analysis (Milestone 9)										M9								

Org Chart



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