DE-FE0032248

Black River Net-Zero Lime Kiln & Carbon Removal Facility

PI: Deborah Jelen

Presented By: Kathy Fagundo, Program Manager
Electricore, Inc.

Nick Papanicolaou, Decarbonization Manager
Carmeuse Americas

Acknowledgement
This material is based upon work supported by the Department of Energy under Award Number DE-FE0032248.

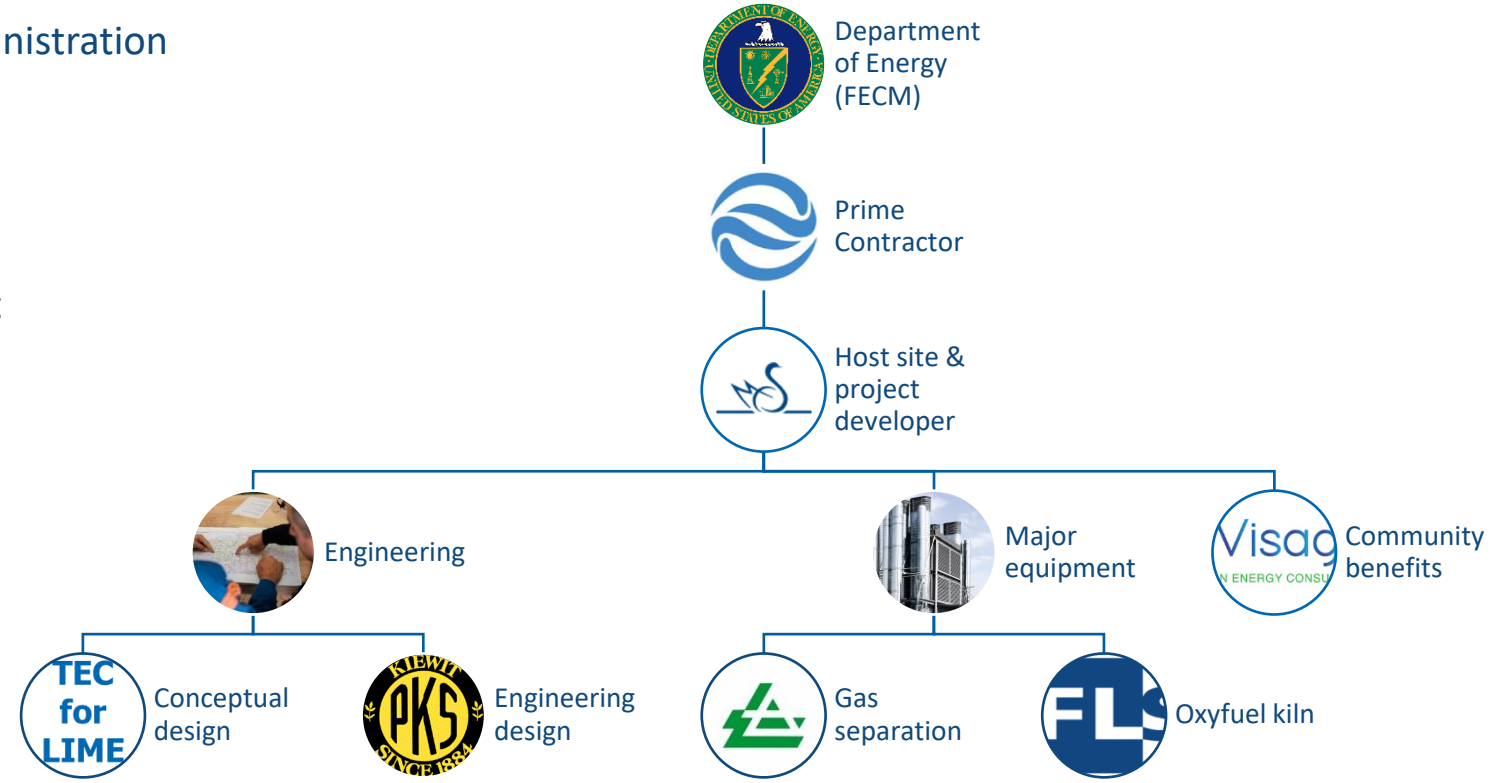
Project Overview

- Award Period: 7/27/2023 through 01/26/2025
- Project Funding
  - Total Funding: $1,875,000
  - Federal Funding: $1,500,000
  - Cost Share Funding: $375,000
- DOE-NETL Team
  - Project Manager: Mr. Sai Gollakota
  - Contracting Officer: Ms. Lisa A. Kuzniar
  - Award Administrator: Ms. Jennifer Burbage
- Project Objective

  Execute and complete the initial design of a commercial-scale, oxyfuel fired flash calciner lime kiln with carbon capture system that:
  - separates CO2 with 95% capture efficiency from process flue gas streams;
  - utilizes sustainably sourced biomass (SSB) alone or in combination with natural gas;
  - maximizes utilization of SSB (up to 90% thermal substitution);
  - captures and permanently sequesters 400,000 metric tonne per year (TPY) of CO2 producing a net zero product and net negative emissions from operations

Project Partners

- **Electricore:** Prime Contractor and program administration
- **Carmeuse:** Host site and project developer
- **TECforLime**: Conceptual design of the lime plant and technical advisor
- **Kiewit:** EPC partner
- **FLSmidth**: Oxyfuel kiln design
- **Air Products:** Air separation and CO2 purification unit design
- **Visage Energy:** Community benefits



Carmeuse has ambitious GHG reduction Targets: Carbon neutral for our scope 1 emissions by 2050

Pathways to Decarbonization

- Efficiency Improvements / Asset Modernization
- Low Carbon Alternative Fuels
- Carbon Capture, Utilization and Sequestration

The Black River Net Zero Pre-Feed Study seeks to better understand the feasibility of implementing these pathways with a new modern kiln, utilizing low carbon fuels and sequestering CO2 emissions within known onsite geological storage

Site Selection

Carmeuse Black River Plant in Butler, KY

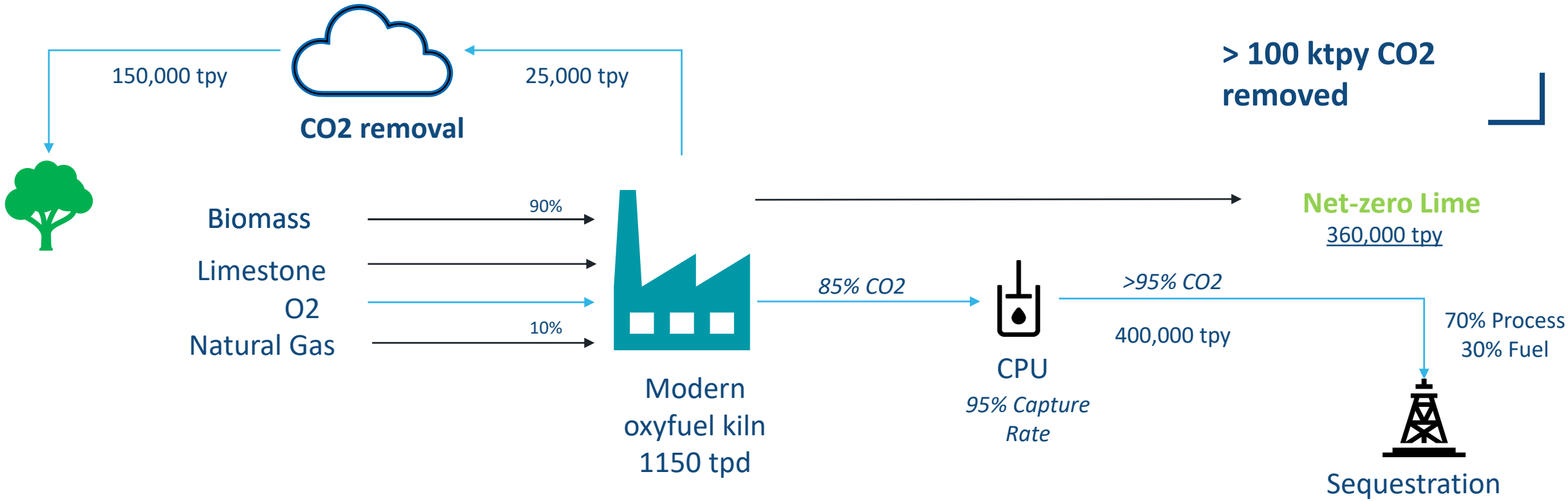
- 5 kilns, 3 long rotary kilns, 2 pre-heater rotary kilns
- Favorable geology for on-site carbon sequestration, Mt Simon Sandstone formation
- Ability to ship via truck, rail and marine distribution to market
- Raw material reserves

Technology Overview

> 500 ktpy CO2 avoided

> 100 ktpy CO2 removed

Project Overview

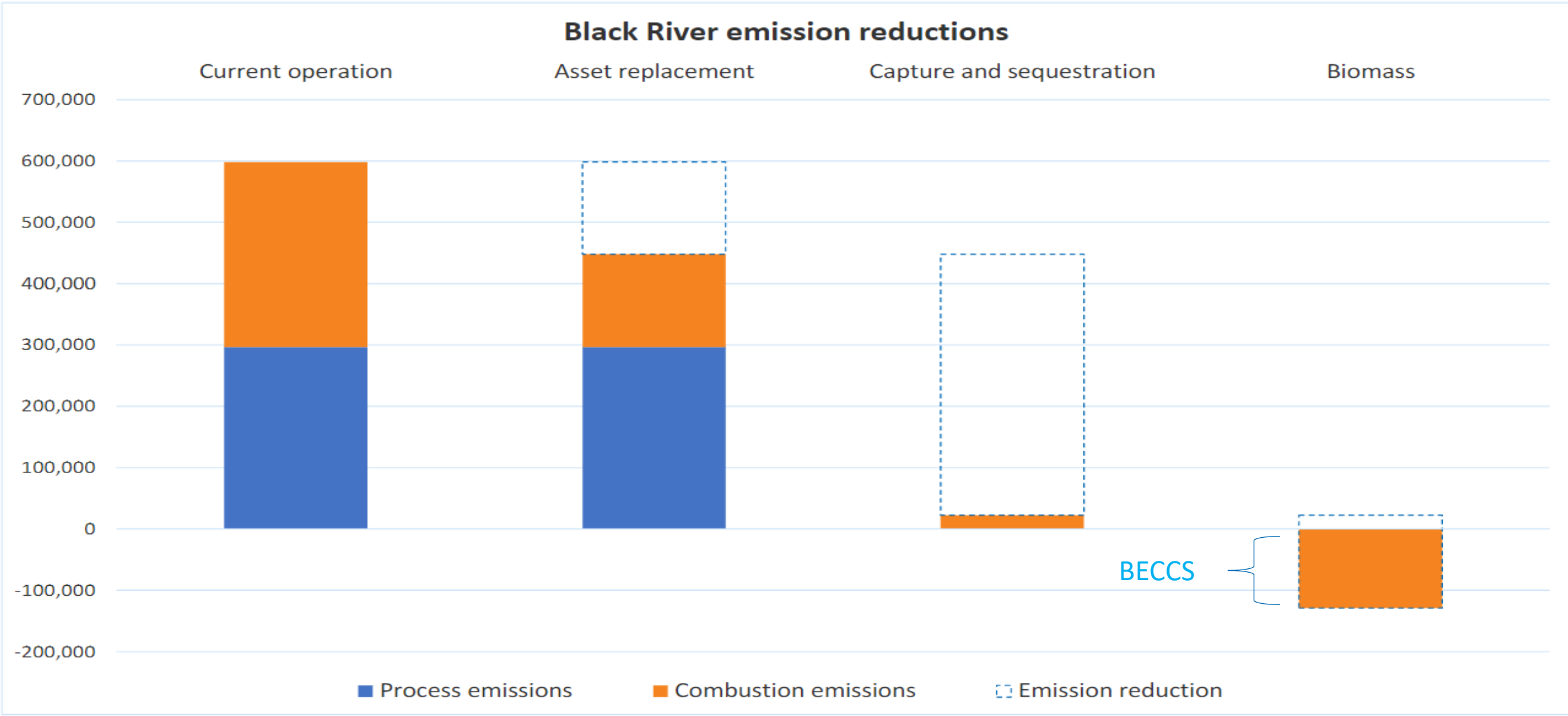


Oxyfuel kiln design operates with pure oxygen environment, eliminating nitrogen in the process, the CO2 in flue gases are concentrated and purified to 95% in the CPU for sequestration

The capture and sequestration of the biogenic CO2 allows for net negative emissions (BECCS) where the production facility operates as a carbon removal facility

CARMEUSE

Description of Project - Net-Zero Lime & Carbon Removal Facility



Work Plan

Task/ Subtask	Milestone Title & Description	Planned Completion Date	Actual Completion Date	Verification method
1.0	Kick-Off Meeting	10/02/2023		Presentation File
1.1	Project Management Plan	08/25/2023	08/25/2023	Submitted PMP IAW Appendix G
1.2.1	Initial Technology Maturation Plan	10/25/2023		Submitted TMP IAW Appendix J
1.2.2	Final Technology Maturation Plan	10/29/2024		Submitted TMP IAW Appendix J
1.3	Workforce Readiness Plan	10/29/2024		Submitted Workforce Readiness Plan IAW Appendix V
1.4	Data Management Plan	07/27/2023	07/27/2023	Submitted DMP IAW Appendix H
2.2	Preliminary Engineering Design Package	01/23/2024		Submitted Preliminary Engineering Design Package
2.3; 2.4; 2.5	Final Engineering Design Package	10/29/2024		Submitted Final Engineering Design Package
2.6	Project Cost Estimate	10/29/2024		Submitted Project Cost Estimate IAW AACE Class 4
3.0	Business Case Analysis (BCA)	10/29/2024		Submitted Business Case Analysis (BCA) IAW Appendix S
4.0	Technology EH&S Risk Assessment	10/29/2024		Submitted EH&S Analysis IAW Appendix R
5.0.1	Initial Life Cycle Analysis (LCA)	11/24/2023		Submitted LCA IAW Appendix P
5.0.2	Final Life Cycle Analysis (LCA)	10/29/2024		Submitted LCA IAW Appendix P
6.0	Environmental Justice Questionnaire	10/29/2024		Submitted Environmental Justice Questionnaire IAW Appendix T
7.0	Economic Revitalization and Job Creation Outcomes Questionnaire	10/29/2024		Submitted Economic Revitalization and Job Creation Outcomes Questionnaire IAW Appendix U
8.0.1	Initial Justice40 (J40) Initiative Plan	11/24/2023		Submitted Justice40 (J40) Initiative Plan
8.0.2	Final Justice40 (J40) Initiative Plan	10/29/2024		Submitted Justice40 (J40) Initiative Plan
9.0.1	Initial Community and Stakeholder Engagement Plan (CSEP)	11/24/2023		Submitted Community and Stakeholder Engagement Plan (CSEP)
9.0.2	Final Community and Stakeholder Engagement Plan (CSEP)	10/29/2024		Submitted Community and Stakeholder Engagement Plan (CSEP)

Success Criteria

Budget Period	Date	Success Criteria
BP 1	1/26/2025	• Initial engineering design completed for commercial-scale, advanced carbon capture system that separates CO_2 with at least 95% capture efficiency from process streams at an existing industrial lime facility • All required deliverables are complete and acceptable

Risks and Mitigation Strategies

Perceived Risk	Risk Rating			Mitigation/Response Strategy
	Probability (Low, Med, High)	Impact (Low, Med, High)	Overall (Low, Med, High)	
Financial Risks:				
Cost Share from Project Sponsors	Low	High	Low	Carmeuse has committed cash and in-kind contribution in writing
Cost/Schedule Risks:				
Study cost overrun	Medium	Medium	Medium	Either reduce project scope or increase cost share
Technical/Scope Risks:				
Existing knowledge gaps on technology	Medium	High	Medium	FLSmidth Allentown pilot plant construction and testing
Limited technological knowledge from partner organizations	Medium	Medium	Medium	Support and review from TECforLime expertise
Management, Planning, and Oversight Risks:				
Retrofit adds complexity for tights spaces and plant documentation	Low	Low	Low	Host site information and involvement will allow to optimize space use at the plant
Efficient collaboration among partnering organizations	Low	Low	Low	Weekly team meetings to encourage clear communication and collaboration.
ES&H Risks:				
NEPA Approvals Delayed or Denied	Low	High	Low	Will not deter results from the study but will require intervention before construction
Permitting Delayed or Denied	Medium	High	Medium	Use local expertise to ensure compliance. Will not deter results from the study but will require intervention before construction
External Factor Risks:				
COVID Restrictions	High	Medium	Medium	Study completed remotely

Community Benefits Plan

Societal Considerations and Impact (SCI) tasks include:

- Environmental Justice Questionnaire
- Economic Revitalization and Job Creation Outcomes Questionnaire
- Justice40 Initiative Plan
- Community and Stakeholder Engagement Plan

Validation to occur:

- Initial Assistance & Validation – within 90 days of award
- Interim Assistance & Validation – preparation of detailed SCI plans
- Final Assistance & Validation – final reporting on SCI plan

Thank You!

CARMEUSE

IMPACTING EVERYDAY LIFE