

# Hydrolytic Softening of Ocean Water for Carbon Dioxide Removal

ARPA-E (award under negotiation)

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University of North Dakota

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U.S. Department of Energy

National Energy Technology Laboratory

**Direct Air Capture Kickoff Meeting**

February 24-25, 2021

# Program Overview

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## a. Funding

- ARPA-E share: \$500,000
- Cost share: 0%

## b. Overall Project Performance Dates

- Start: tentatively March 2021
- Duration: 18 months

## c. Project Participants

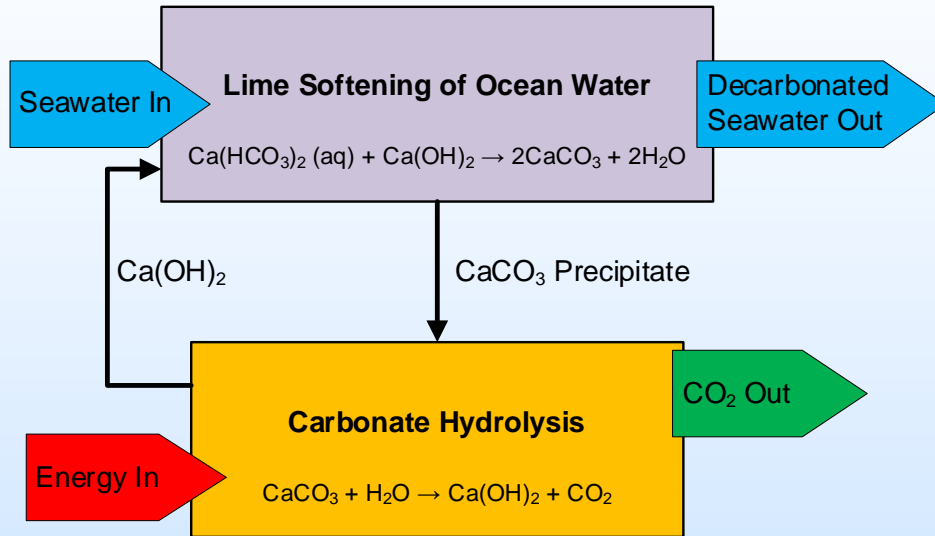
- Energy & Environmental Research Center

## d. Overall Project Objectives

- Address the high energy costs needed to drive ocean CO<sub>2</sub> removal.
- Scale the process of lime softening to have a meaningful impact on global CO<sub>2</sub> reduction.

# Technology Background

## Hydrolytic Softening Concept



Key innovation is carbonate hydrolysis. Compared to calcination:

- Lower temperature: 900°C → 400°C
- 28% lower energy consumption

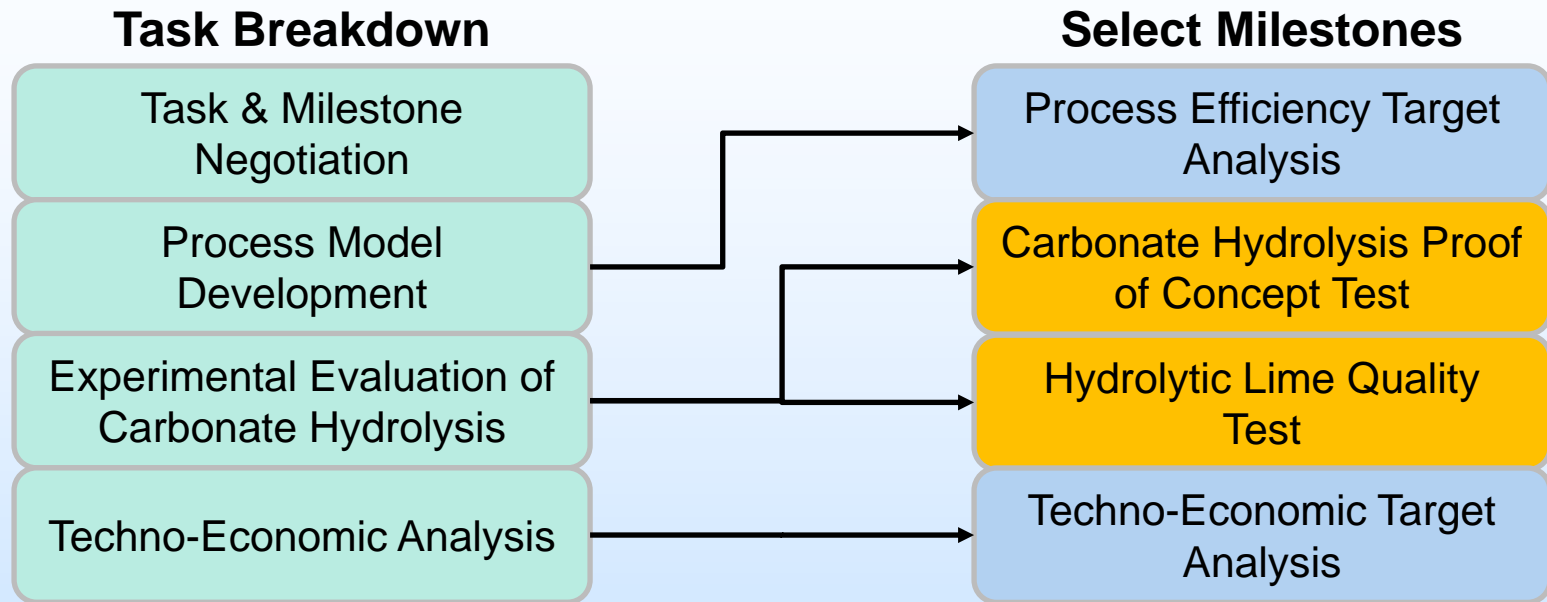
### Advantages:

- Lower energy costs.
- CO<sub>2</sub> separation from seawater and temporary storage as a solid precipitate.
- Robust process. Softening is itself a pretreatment step applicable to raw seawater.

### Challenges:

- Ca(OH)<sub>2</sub> regeneration within energy budget.
- Limiting co-precipitation of competing cations (Mg<sup>++</sup>).
- Offshore heat source.

# Technical Approach/Project Scope



## Proposed Targets

Metric	Program Objectives	Proposed
<i>Levelized Cost of CO<sub>2</sub> Capture</i>	<\$100 per ton CO <sub>2</sub>	\$62
<i>Second-Law Efficiency</i>	>10%	27%
<i>Embodied Emissions</i>	<5%	0.9%

# Team and Facilities



EERC facilities in Grand Forks, ND.



Chris Martin, EERC  
Project PI



Mark Musich, EERC  
Task Lead

# Current Status of Project

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Project not yet started; planning for March 2021.

# Opportunities for Collaboration

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Key innovation is carbonate hydrolysis:

- Might also be applied for DAC solvent regeneration e.g., NaOH/KOH.

Seeking partners with offshore modeling and engineering experience for follow-on projects!

For more information contact:

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