GE VERNOVA




HOUSTON AREA DAC HUB

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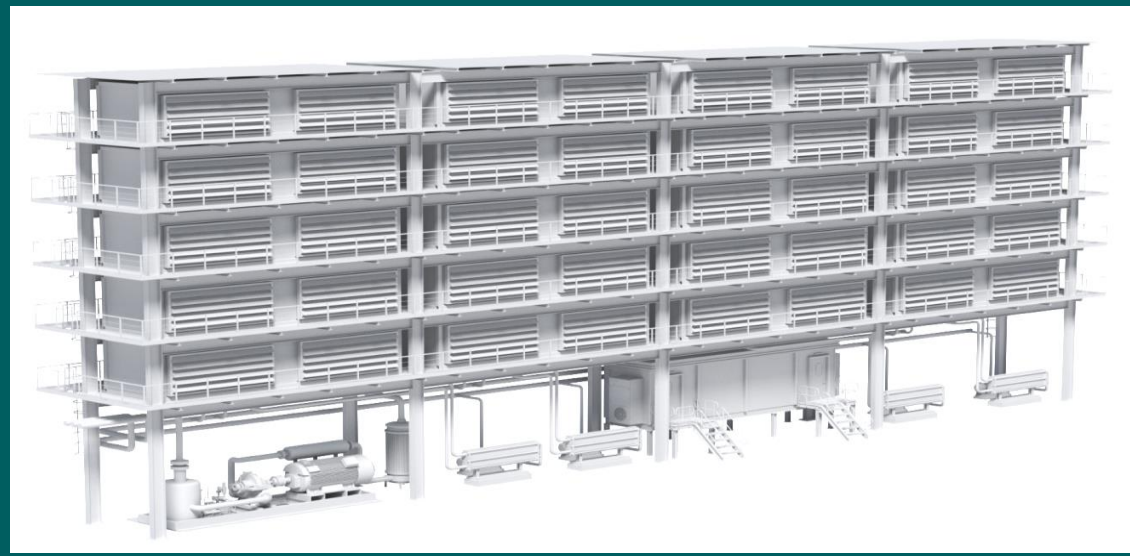
DE-FE0032380



2024 FECM/NETL Carbon Management Research Project Review Meeting
August 5 – 9, 2024

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GE Vernova Advanced Research Mission

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POWER
Decarbonize

Carbon Capture, 100% H_2 ,eFuels
Next Gen Nuclear

WIND
Accelerate

Scalable Workhorse Product,
AI Enabled Service Tech

ELECTRIFICATION
More Resilient

A Secure, Flexible
& Resilient Grid

Bringing Research to Reality … Energy Innovation to Change the World

Advanced Research at a GLANCE

GE VERNOVA

TALENT

275+

Global Researchers

70%

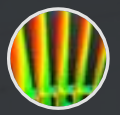
PhDs

LOCATIONS

Niskayuna, NY

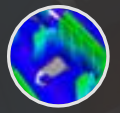
Bangalore, India

TECH CAPABILITIES



Aero & Thermosciences

AI, Robotics & Software



Controls & Optimization

Electrical & Power Systems

Embedded Systems & Cybersecurity

Material Chemistry & Physics

Materials, Coatings & Modeling

Mechanical Systems & Design

Houston DAC HUB Project Team

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Program Team

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Project management, DAC technology, Pre-FEED study, prime

- Project Execution
- Business & Finance plan
- Pre-FEED study
- DAC Technology & Utilization

TENASKA
Site owner, sequestration services

- Sequestration
- Site ownership
  - Pore space
  - Real-estate

Constellation
Renewable energy supplier, nuclear operator

- Renewable RECs via CORe+
- Largest Operator of Nuclear power plants in the US

HITACHI
Small Modular Reactor

- Pre-FEED study - SMR

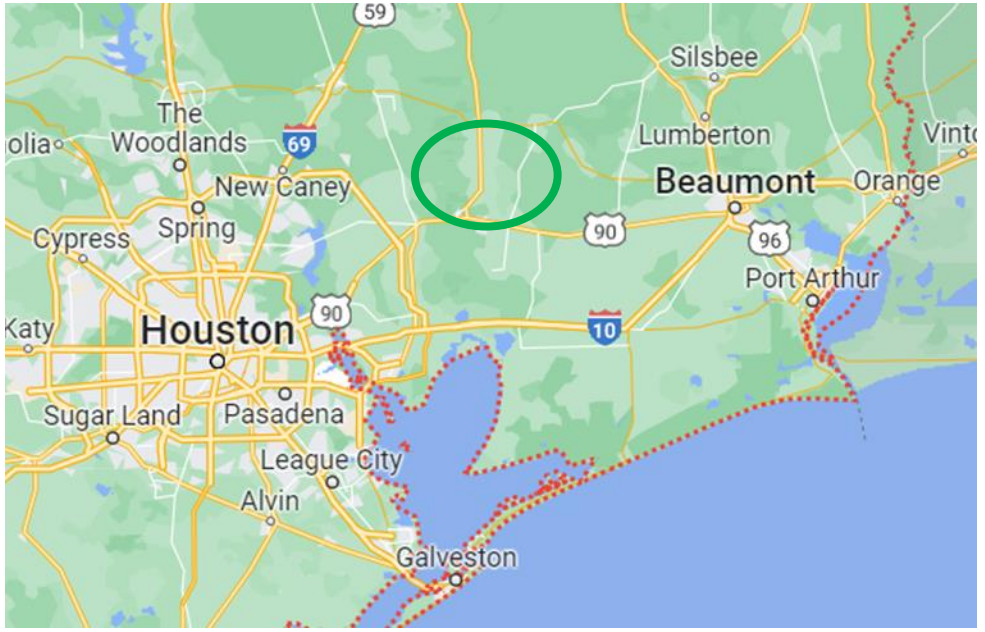
TEXAS
The University of Texas at Austin
Community benefits

- Bureau of Economic Geology
- Community outreach

Argonne
NATIONAL LABORATORY
LCA/TEA

- LCA Analysis
- GREET model

Phase 0a – BP1 5/24-1/25
Phase 0b – BP1 2/25-4/26
24 months
Total Cost $3,316,234
Federal $2,553,500
Cost Share $762734



TECHNICAL APPROACH

Three Top Level Objectives

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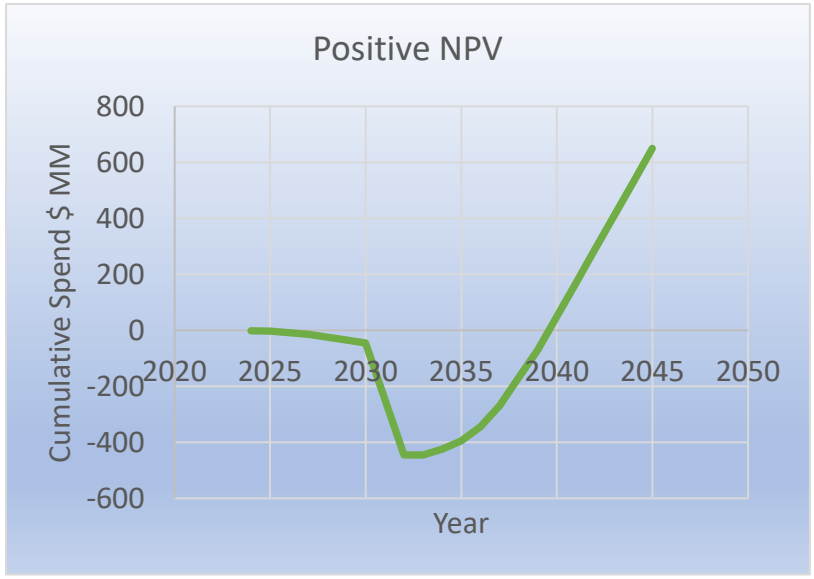
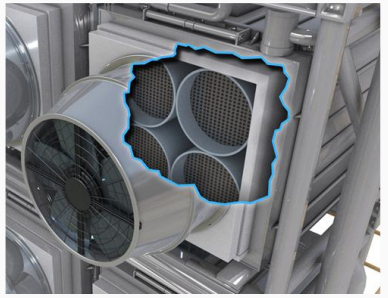
Business/Financial Plan

- Ownership Structure (0a)
- Business Plan
- Financial Plan



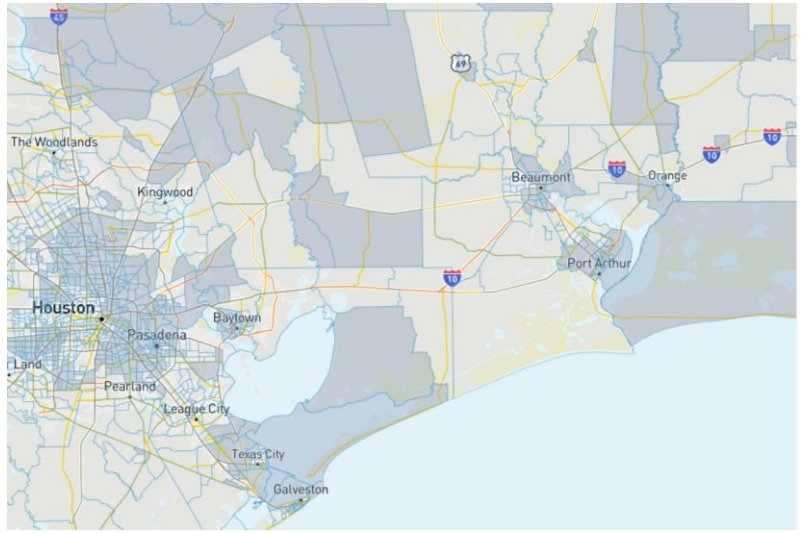
DAC Hub Concept

- GE Vernova Sorbent based DAC Technology
- GE Vernova Utilization Technology
- GE Hitachi Small Modular Reactor Design



Community Benefits

- Engaging Community and Labor
- Quality Jobs
- Advance DEIA
- Justice 40



Sorbent-based carbon capture system overview

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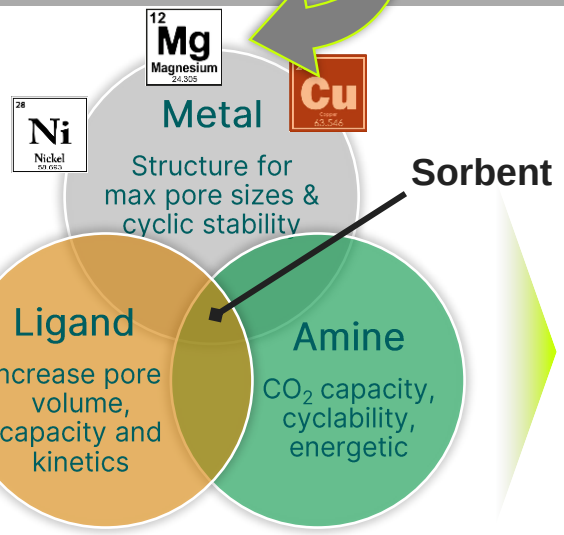
from "powder" to "plant"

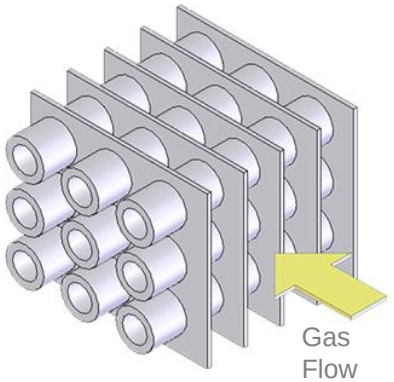
Sorbent → Binder → Contactor → *Indirect heating* or *Direct heating* → Capture Unit → Capture Plant

Absorb / Cool / Desorb *(by heating)*

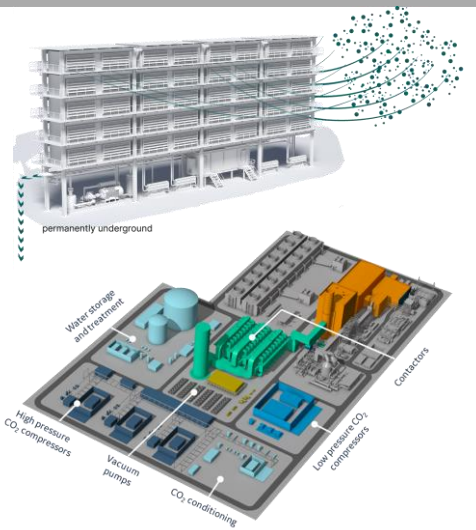


Solid Powder

Slurry = Solid Powder **+ Binder**



Coated Contactor = Slurry applied to the **Contactor**



CCUS Plant = Coated Contactors + BoP

Selecting direct vs. indirect drives all system design decisions

Carbon Capture & Atmospheric Water Extraction… “Powder to Plant”

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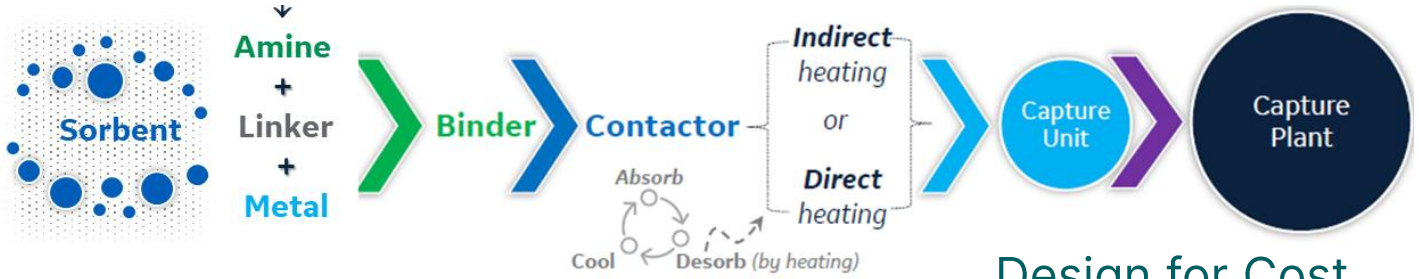
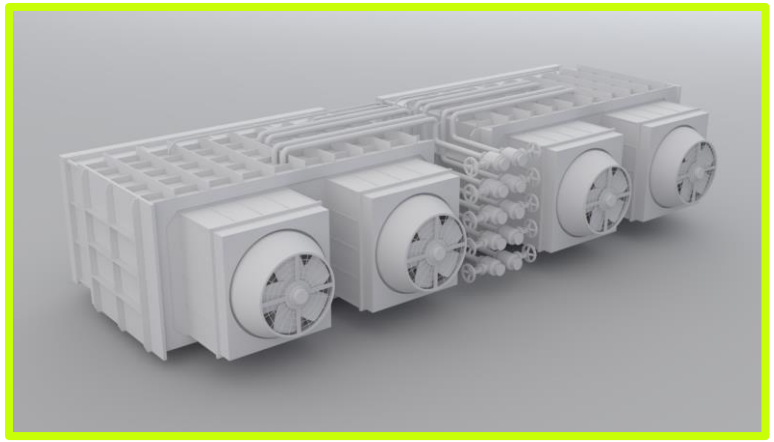


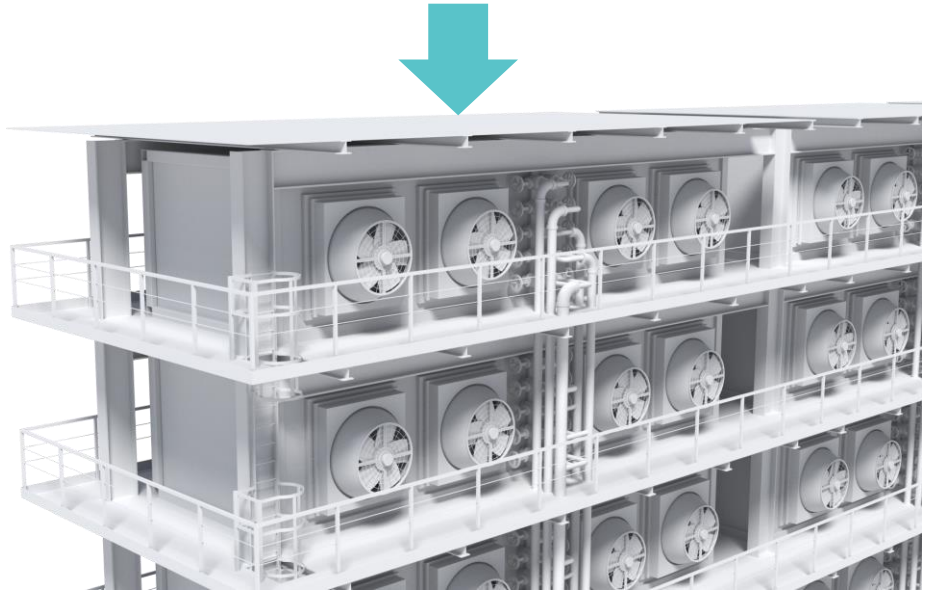
Materials Development

Rapid Testing

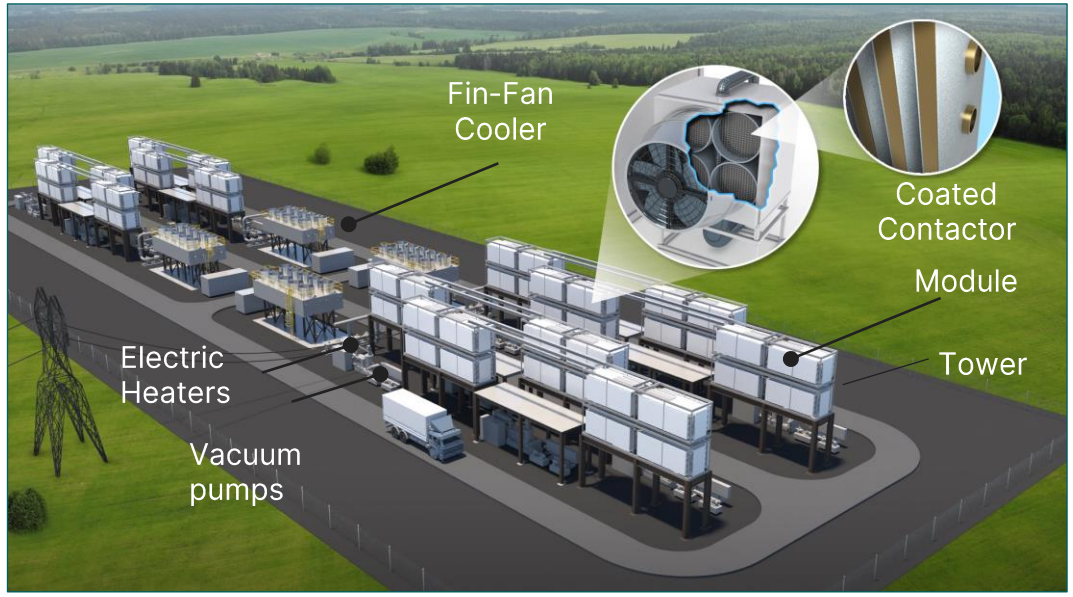
Design for Cost, Manufacturing and Maintenance



Capture Unit



Stacks of Units



Capture Plant

Key Solid-oxide Co-electroysis Features

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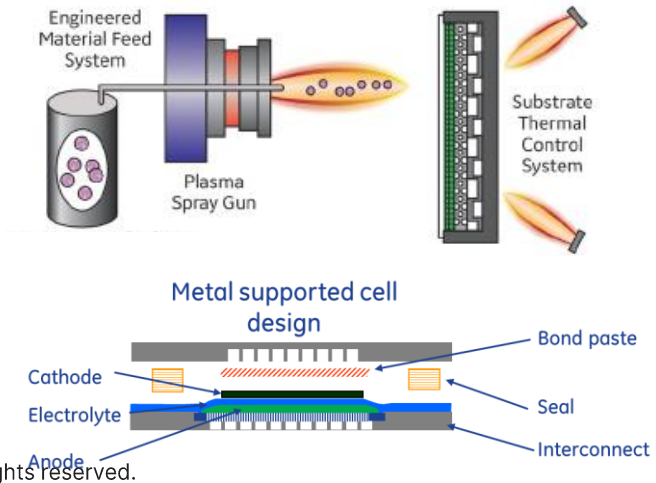
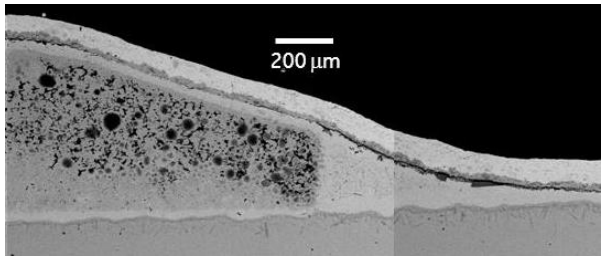
Feature	Technical Advantages	System Advantages	Next-Best Alternative
High temperature reaction	• Highest Efficiency (>99% with steam) • High reaction rate	• Lowest power requirement • Small footprint	Low temperature PEM H_2 electrolyzer + Reverse Water Gas Shift Reactor
Thermal spray coated onto metal substrate	• Integral fuel-side sealing • Scalable to large area	• Small footprint • Reduced controls complexity	SOCC with ceramic substrate and bulk ceramic processing.

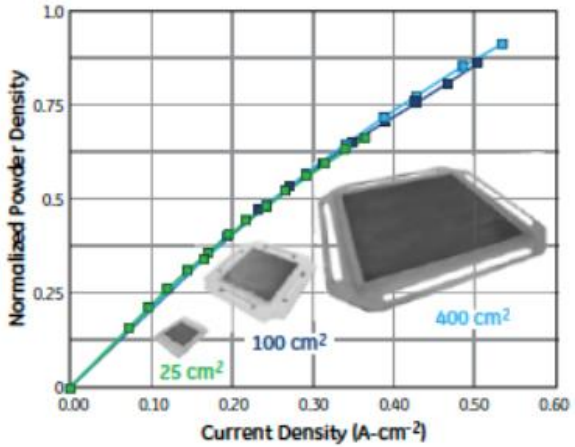
Thermal Spray Process – High deposition rate and area-scaleable



Integral fuel-side sealing

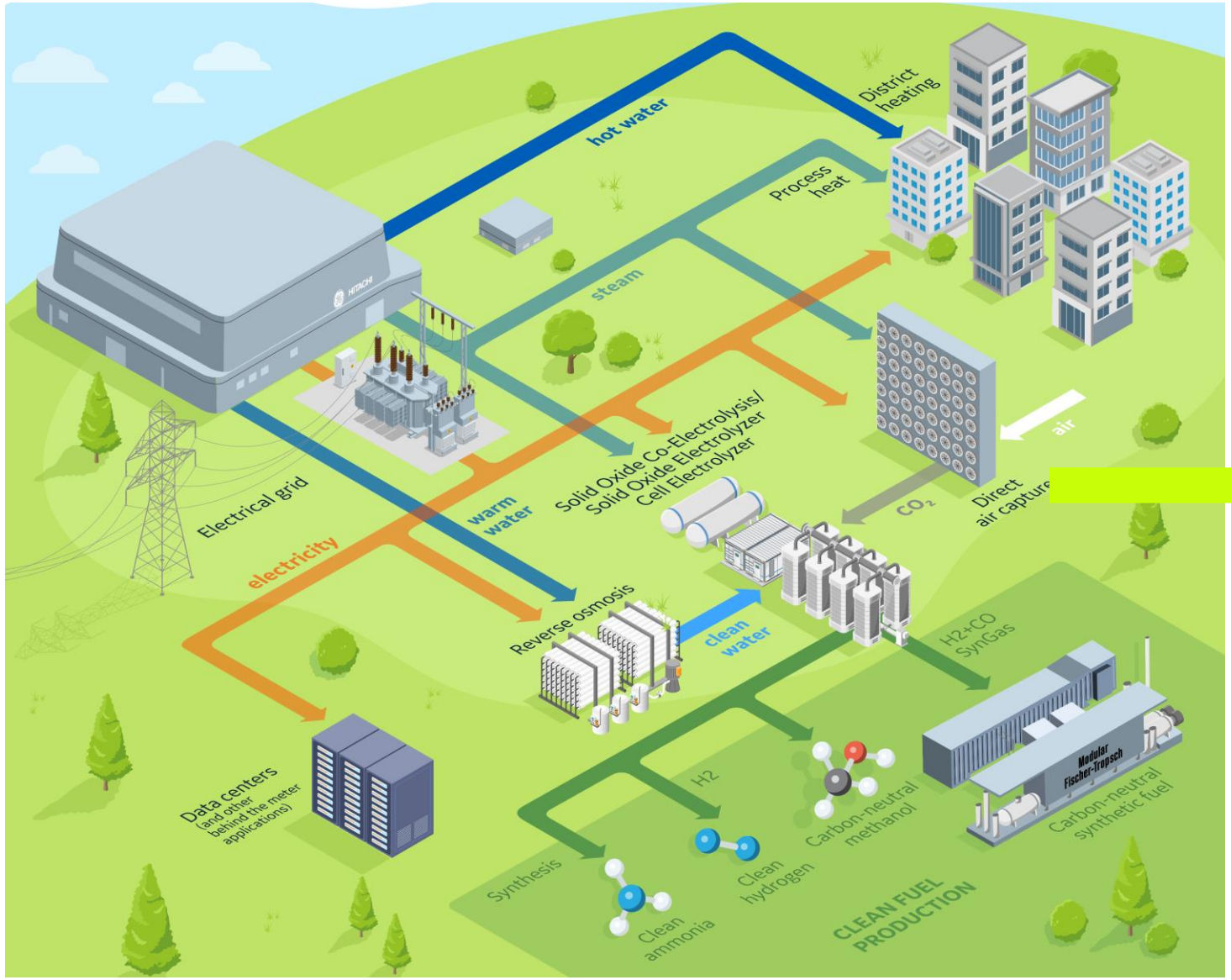


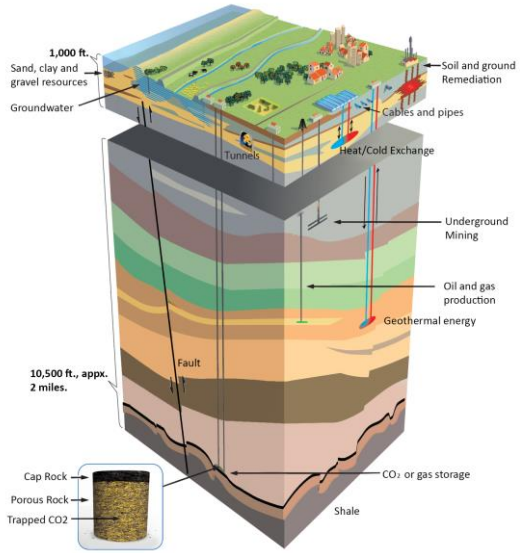
No change in performance with scaling



GE Vernova DAC + SOCC = Lowest Cost of Syngas

Integrated System for Carbon Removal and Conversion





Risk Management

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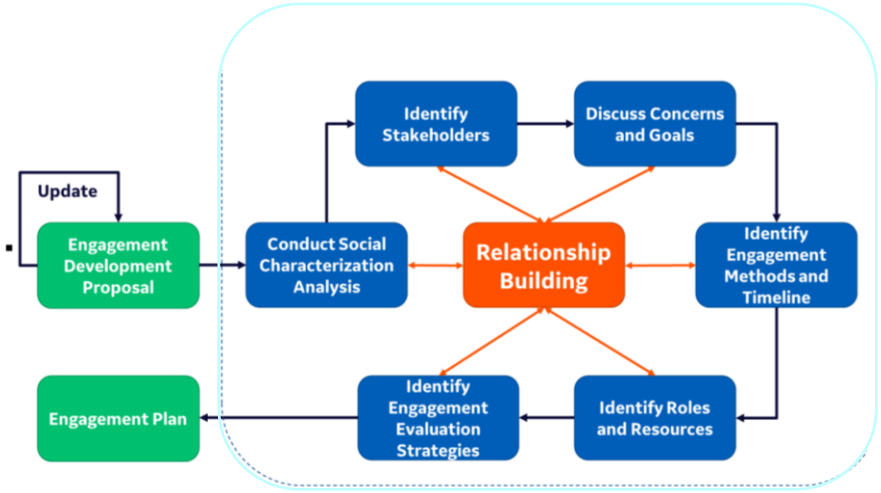
Perceived Risk	Probability	Impact	Overall	Mitigation/Response Strategy
Team unable to form an acceptable ownership structure for the DAC Hub	MED	HIGH	HIGH	If this occurs, it will be very difficult for the team to continue with this DAC Hub approach. The team will need to regroup, get reorganized and prepare to apply to the new FOA in 2025 with a different approach
DAC technology is not at TRL by the end of Phase 0b	LOW	MED	LOW	The team will continue to engage other DAC companies that could be part of the Hub and take over the anchor position if necessary.
A sound business case cannot be developed	MED	MED	MED	Given the immaturity of the DAC technologies it maybe that the initial high-level economics are challenging but there will be opportunities to continue to improve the technology to improve the economics
Team is unable to secure cost share for Phase I	MED	HIGH	HIGH	While the team might be able to successfully complete Phase 0b, without follow on commitment Phase 1 will not be possible. The team will make every effort to secure follow-on funding for this Hub.
Team members back out pre-award or post-award	MED	MED	MED	With a diverse set of participants, there may be a change in business priorities. The team will need to continue to engage a range of companies about the possibility of joining the Hub in order ensure a stable team can see this program through to the end.

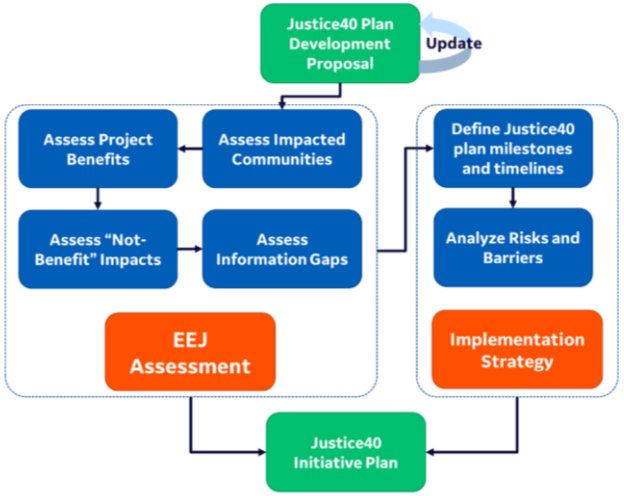
COMMUNITY BENEFITS

Community Benefits Plan

Community Benefits Plan Development Proposal (CBPDP) -> Community Benefits Plan (CBP)



Community Engagement Workflow



Justice 40 Workflow

- DEIA Goals and Outcomes
- DEIA Partnerships
- Implementation Strategies

DEIA

- Workforce hiring assessment
- Creation and Retention of Jobs
- Outreach and Engagement

Investing in American Workforce

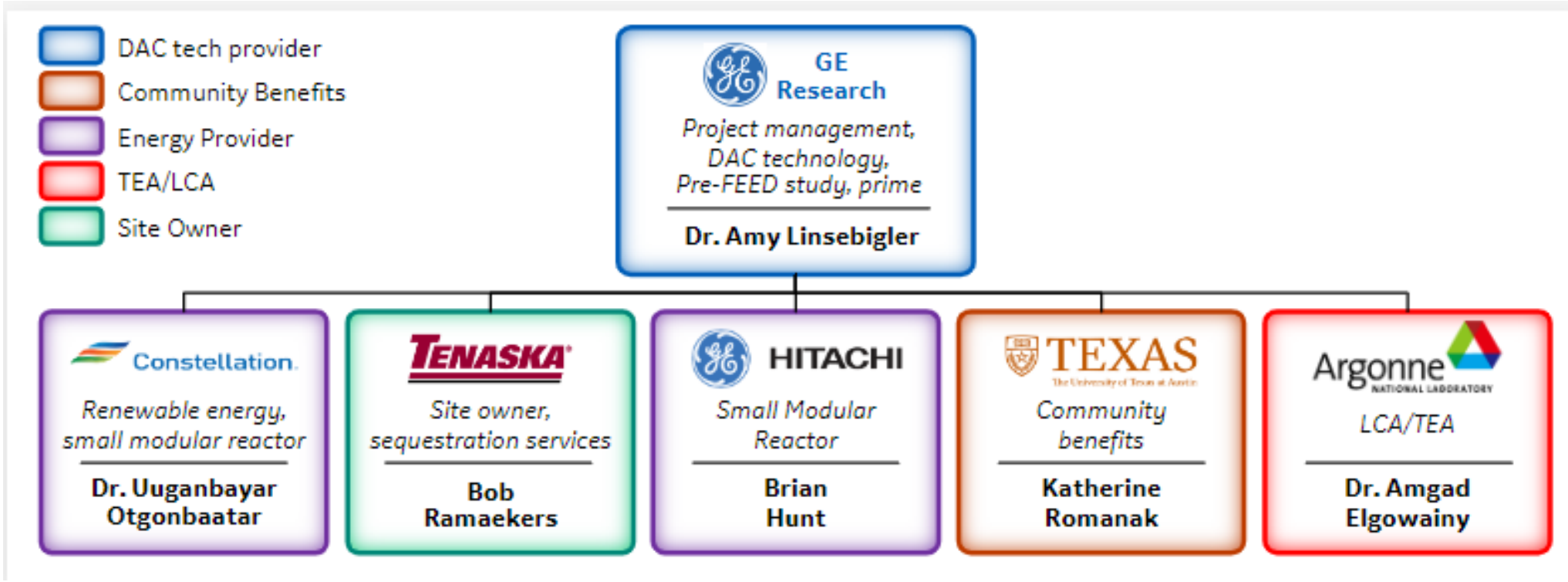
University of Texas Bureau of Economic Geology will sub-contract with Lamar University to develop a plan for community outreach, quality jobs plan, DEIA training and Justice40 Initiative.

BACKUP

High Level Tasks

Task 1	Project Management	
	Task 1.1	Project Management Plan
	Task 1.2	Business Plan
	Task 1.3	Financial Plan
	Task 1.4	Tech Maturation Plan
	Task 1.5	Community Benefits Plan
Task 2	Safety, Security, Reg	
	Task 2.1	Safety history/culture/EHS
	Task 2.2	Permitting Workflow
Task 3	LCA/TEA	
Task 4	DAC Hub Concept	
	Task 4.1	DAC Hub Description
	Task 4.2	DAC Tech Selection
	Task 4.3	DAC Conversion Selection
	Task 4.4	DAC Hub Data Table
Task 5	DAC Hub Design	
	Task 5.1	DAC Hub Concept
	Task 5.2	DAC Tech Description
	Task 5.3	CO2 Conversion Tech Desc
	Task 5.4	DAC Hub Table
	Task 5.5	pre-FEED study
	Task 5.6	DAC Hub BOP Design
	Task 5.7	Storage Field Status
	Task 5.8	Inegrated project schedule

DAC Hub Team


DAC tech provider
Community Benefits
Energy Provider
TEA/LCA
Site Owner
GE Research
Project management, DAC technology, Pre-FEED study, prime
Dr. Amy Linsebigler
Constellation
Renewable energy, small modular reactor
Dr. Uuganbayar Otgonbaatar
TENASKA
Site owner, sequestration services
Bob Ramaekers
HITACHI
Small Modular Reactor
Brian Hunt
TEXAS
Community benefits
Katherine Romanak
Argonne NATIONAL LABORATORY
LCA/TEA
Dr. Amgad Elgowainy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