Teras “Monster” DAC

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Teras DAC: Project Overview

- DE-FOA-0002735 TA-1 Feasibility Study
- Project budget **$3.70M** ($2.95M Federal and $0.75M Cost Share)
- Overall Project Performance
  - planned start September 2024 and planned end May 2025
- Project Participants include
  - **Siemens Energy** (prime) – DAC and energy system technology provider
  - **Carbon TerraVault** – Land access, CO2 storage development, and community benefits
  - **UC Berkeley** – Overall life-cycle analysis and CO2 conversion technologies
  - **Battelle Memorial Institute** – CO2 transport development and CO2 storage development support

Teras DAC: Project Overview

- Overall project objective is to determine DAC Hub Feasibility
  - Down select project location, planned ownership structure, site development plan including permitting
  - Preliminary engineering and life-cycle analysis on the DAC plant including BOP and integration with CO2 geothermal energy system
  - Community benefits plan based on down selected project location
  - Preliminary business plan including off-take
  - Complete plans for next steps including financing of Phase 1 and high-level plans for Phases 2-4

Teras DAC: Current Status of Project

Project Location – Illinois

Energy System – Existing Nuclear

CO2 Storage – no previous geologic storage development work

- Project Location – California
  - Updated CBP strategy required
- Energy System – New build CO2 geothermal from Siemens Energy
  - Potential energy cost increase, but strong additionality & synergy with DAC
- CO2 Storage – geologic storage sites in permitting process
  - Reservoir conditions appear adequate for CO2 geothermal
  - Supplementary CO2 storage planned

NOTE: Project changes shown are pending DOE review and approval

Teras DAC: Technology Background

Siemens Energy's DAC technology will anchor the hub

- Solid sorbents with amine functionalization in temperature-pressure swing batch process
  - Flexible design can be altered for sorbents with different kinetics/capacities
- Low temperature (below 90C) desorption allows use of heat pumps or low-quality heat integration
- Radial design with central swing arm for reduced rotating mass and circular contactors for simplified sealing
- Desorption via steam heating simplifies product gas separation

Teras DAC: Technology Background

Demonstration

< 25 tpa

- First CO_2 capture May 24
- Process demonstration and validation
- Structured sorbent performance and durability testing
- Customer demonstration unit FAT completed CY24

Piloting

1,000 - 20,000 tpa

- Validation of economic viability and de-risking
- Initial feasibility studies completed for medium scale pilot.
- RFDS/FEED study for single pilot unit plant in CY24

Commercialization

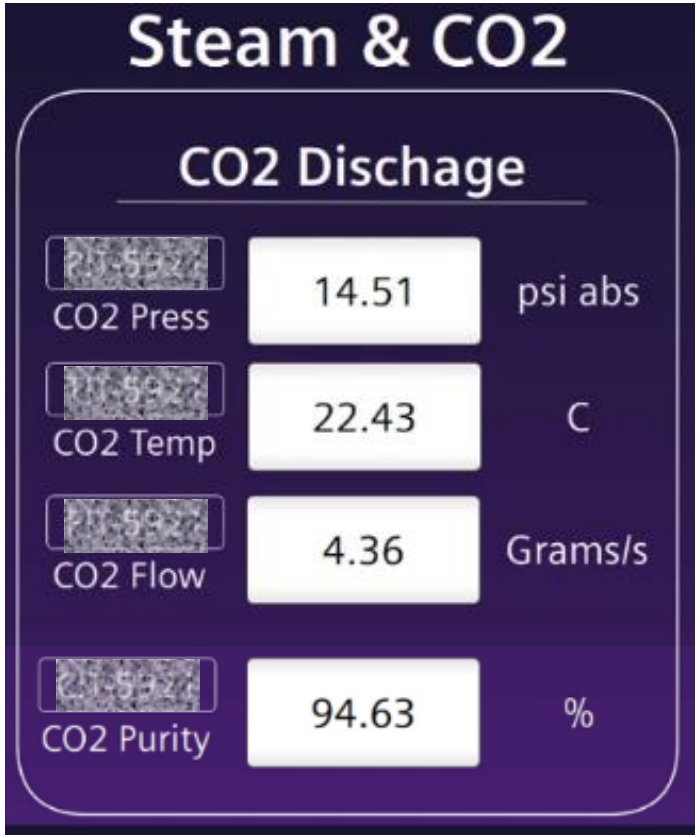
50,000 + tpa

- Conceptual design completed.
- DAC Hub feasibility study to advance plant engineering and economics
- Megaton Hub targeted as next step.

Next Gen:

tpa – tonnes per annum FAT – factory acceptance test CY – calendar year
RFDS – research feasibility and design study FEED – front end engineering and design

Teras DAC: Technology Background



Teras DAC: Project Location

- Two California site locations under consideration
  - Adequate land use rights for capture and geothermal energy system
  - Preliminary review of geologic condition favorable for CO2 storage and CO2 geothermal development
  - Supplementary CO2 storage expected to be adequate for initial powering of the 50ktpa and 1,000ktpa DAC hub deployments

ktpa – killo-tonnes per annum

Teras DAC – Project Scope (part 1 of 3)

UC Berkeley - CTV - Battelle

	Phase 0A	Phase 0B
Business Development And Management	• Preliminary Hub Ownership • Preliminary CO2 capture site • Preliminary CO2 storage site • Preliminary CO2 convers. Site • Preliminary CO2 transport	• Finalize Hub Ownership and site locations including 12y of transport and storage • Finalize Financial Plan for Phase 1 (FEED study) • Finalize Business Plan • Finalize Phase 1-4 plan
Engineering, Procurement, Construction, and Operations	• Select DAC anchor technology(s) • DAC TMP meets min. TRL • CO2 conv. TMP meets min. TRL • Finalize DAC plant design • Initial hub BOP design	• DAC TRL 5 (with sup. Data) • DAC Hub TPC Class 4 (+/-30%) • Finalize hub BOP conceptual design (Pre-FEED) • Finalize storage field development plan (12y) and/or CO2 offtake agreement • Finalize capacity build out plan

UC Berkeley - CTV - Battelle

Teras DAC – Project Scope (part 2 of 3)

	Phase 0A	Phase 0B

Safety, Security, and Regulatory Requirements	• Safety history and culture description (for construction)
	  • OSHA 300A
	  • Hub Cybersecurity plan
	• Preliminary permitting workflow overview
	  • Federal, State, and Local
		• Finalize permitting workflow overview
		  • Construction and Operation
		• Environmental, Health, and Safety analysis

Risk Analysis and Mitigation	• Develop a Risk Management Plan • Technical, commercial, resource, and management risks	• Finalize Risk Management Plan • Develop project Risk Register

Teras DAC – Project Scope (part 3 of 3)

UC Berkeley - CTV - Battelle

	Phase 0A	Phase 0B

Technical Data and Analysis	• Finalize CO2 capture Data Tables
	• Preliminary CO2 conv. Data Tables
	• Preliminary Life-Cycle Analysis
	  • Net-CO2 removal
	  • ISO 14040 and 104044
		• Update CO2 capture Data Tables
		• Finalize CO2 conv. Data Tables
		  • Min capacity 1 TPY CO2
		• Finalize Pre-LCA

Community Benefits	• Develop a Community Benefits Plan Development Proposal • Labor engagement, American workforce investment, advancement of DEIA	• Finalize Full Community Benefits Plan

Teras DAC: Community Benefits Plan

- Form consortium of local community members (e.g. labor, academia, government, non-profits, veteran organizations, and youth organizations)
  - Quarterly meetings between the Team and community stakeholders
- Work with local schools to offer information sessions and tours
- Local labor studies and skills training programs (including potential internship/co-op opportunities)
- Diversity training for project team
- Perform community surveys to collect broader feedback for community needs
- Target local SMOB for relevant equipment, material, or service supply

Teras DAC: Summary & Lessons Learned

- Securing high capacity factor, low/no CO2 emissions, relatively low-cost electricity is critical to maximizing the cost effectiveness of DAC equipment

- Things do not always go according to plan, but the DOE and NETL in our case, are a part of the team!

- The Teras DAC team is moving forward with the rescope and is looking forward to examining the feasibility of the proposed capture, storage, and energy production DAC hub concept

Thank you. Questions?

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