



California Direct Air Capture Hub Front-End Engineering Design and Planning

FE0032389



Joseph Swisher
Principal Technical Leader

2024 FECM/NETL Carbon Management Research Project Review Meeting
August 8, 2024

Acknowledgment

This material is based upon work supported by the Department of Energy under Award Number DE-FE0032389.

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Project Overview

DOE PM Andy Aurelio

Project period 24 months (estimating Oct 2024 start)

Funding	Federal	\$11,829,634
	Cost share	\$11,829,634
	<hr/>	<hr/>
	Total	\$23,659,268

Organizations Electric Power Research Institute
California Resources Corporation
Kern Community College District
Climeworks
Avnos
Southern California Gas Company
National Renewable Energy Laboratory
Lawrence Livermore National Laboratory
California State University, Bakersfield
University of Michigan

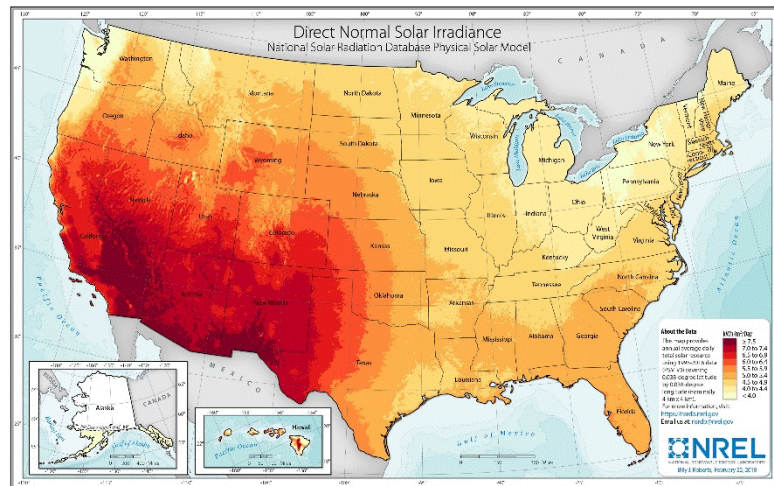
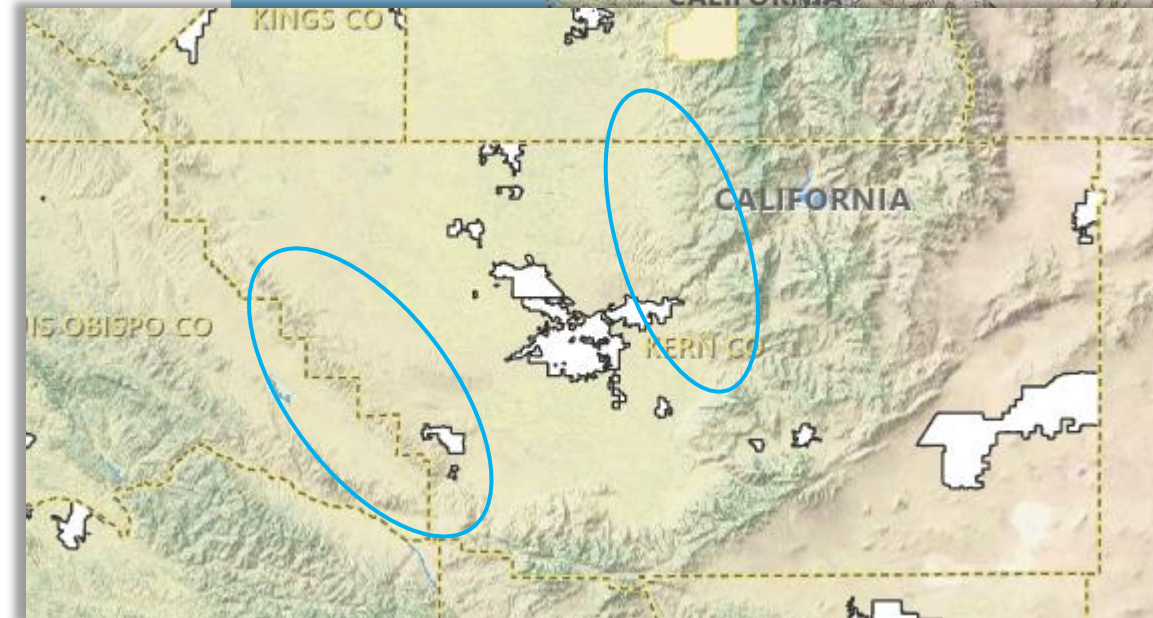
California Energy Commission (cost share only)

Overall objective

Design and plan a DAC Hub in the southern San Joaquin Valley of California to achieve an initial (Stage 1) capacity of 100 kt CO₂/y captured, expand that capacity to 1,000 kt CO₂/y captured (Stage 2), and deliver benefits to the local community.

Setting

- Southern San Joaquin Valley of CA
 - Historic oil producing region
 - Decades of steam flood operations for enhanced oil recovery
- Good potential for solar electric production



Sengupta, M., Y. Xie, A. Lopez, A. Habte, G. Maclaurin, and J. Shelby. 2018. "[The National Solar Radiation Data Base \(NSRDB\)](#)." *Renewable and Sustainable Energy Reviews* 89 (June): 51-60.

The National Map. United States Geological Survey.

CalHub advantages



- Brings together storage owner, DAC technology providers, academic institutions, national laboratories, non-profits, community organizations, and local government
- Kern County's population has the capacity as a historic oil production workforce for rapid deployment of DAC
- Class VI permit for the Hub storage wells has been submitted and is under technical review

Scope overview

A FEED study of Stage 1 of the Hub will be completed, setting the stage for moving to detailed engineering and construction planning

The groundwork will be set for delivering benefits of the project to the local community

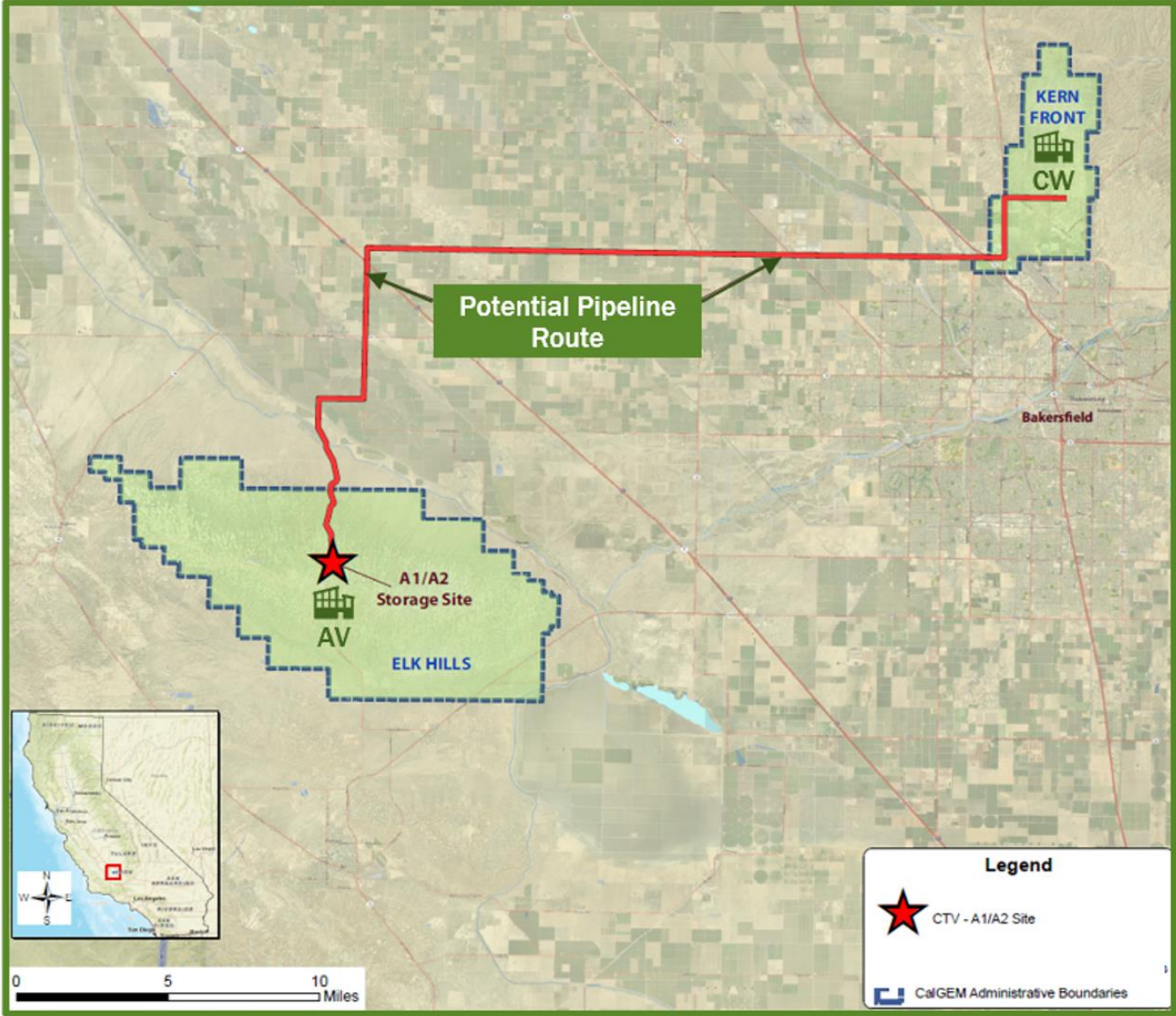
A Pre-FEED of the BOP systems for Stage 2 will be developed, laying out a clear set of systems to move to 1,000,000 metric tons of CO₂ removed per year

Life cycle analyses will help quantify the overall greenhouse gas impacts of the Hub across its Stages

An Environmental Information Volume will be developed

Financial and business plans will be matured to help secure resources for succession of the Hub to subsequent Phases

Hub overview



Map of western Kern County, California highlighting the two CRC facilities—Kern Front and Elk Hills—where DAC processes will be hosted, a hypothetical CO₂ pipeline route to move captured CO₂ from Kern Front to Elk Hills, and the CO₂ storage location within the Elk Hills site.

* Alternative under review to develop additional storage near Kern Front

Technology and energy supply plan

	Elk Hills (WSW of Bakersfield)	Kern Front (NEN of Bakersfield)
Stage 1 <i>100 kt CO₂/y</i>	Avnos DAC <ul style="list-style-type: none"> Fuel cells with CO₂ capture 	Climeworks DAC <ul style="list-style-type: none"> Solar PV electricity (with battery storage) Shallow geothermal heat
Stage 2 <i>1,000 kt CO₂/y</i>	Expanded Avnos DAC <ul style="list-style-type: none"> Fuel cells with CO₂ capture Post-combustion CO₂ capture at Elk Hills Power Plant 	Expanded Climeworks DAC <ul style="list-style-type: none"> Expanded solar PV electricity Deep geothermal heat and power Possible non-battery energy storage

Additional scope

- Pipeline to transfer CO₂ from Kern Front to Elk Hills
- Water from Avnos to local water district

Community Benefits Plan

Major Element	Key Activities Planned
Community and Labor Engagement	<ul style="list-style-type: none"> • Perform community engagement and feedback activities • Produce linguistically diverse materials to communicate the project to community stakeholders • Establish CalHub Advisory Committee
Investing in America's Workforce	<ul style="list-style-type: none"> • Perform JEDI model analysis to determine labor capacity gaps • Develop Workforce Development Roadmap
Diversity, Equity, Inclusion & Accessibility	<ul style="list-style-type: none"> • Develop DEIA inclusion plan with NREL's "DEI Building Blocks" • Create DEIA database to track impacts and support implementation of DEIA plan
Justice 40	<ul style="list-style-type: none"> • Develop J40 database and dashboard for tracking Hub impacts • Model potential air quality effects of the Hub



Schedule

Milestone/Deliverable	When
Project management plan	1 month
Technology Maturation Plans	3 months
Initial Engineering Design Package	6 months
Stage 1 FEED	21 months
Stage 2 pre-FEED	21 months
Life Cycle analysis	21 months
EH&S Risk Assessment	21 months
Storage field development plan	21 months
Environmental Information Volume	21 months
Integrated project schedule	21 months
Business and financial plans	21 months

Milestone/Deliverable	When
DEIA inclusion plan	4 months
Justice40 impact tracking dashboard	10 months
CalHub Advisory board formed	12 months
DEIA tracking data	12 months
Community feedback surveys	7 months and 19 months
Job impacts study	12 months
DEIA implementation and monitoring plan	18 months
Workforce gap analysis	21 months
Updated Community Benefits Plan	21 months
Air quality modeling	22 months
Draft Community Benefits Agreement term sheet	24 months



Summary

CalHub brings together...

geography with good CO₂ storage and low-to-zero energy sources,

two advanced DAC technologies,

a team covering the expertise needed to develop a good plan for the Hub, and

an actionable plan for delivering community benefits in this Phase and subsequent Phases.

Starting soon!



TOGETHER...SHAPING THE FUTURE OF ENERGY®