

CCUS: The Final Path to Net-Zero

By John Benson

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1. Introduction

In case you are wondering what the above acronym means, it is Carbon Capture, Utilization, and Storage, and my home state (California) is embarking on an ambitious plan to develop this technology on a statewide scale. This emerging plan will even move ahead of the current environmentally-friendly federal administration.

The reason this is the “Final Path” is, that it can be used to either capture-and-store greenhouse gas (GHG) directly from a particular source, or offset emissions using negative emissions technology (NET). An example of the latter are highly-distributed GHG emissions, like from small internal-combustion engines used for gardening. If a totally emission-free fuel cannot be developed for legacy IC engines, a surcharge can be applied to available fuel. Then this charge will fund NET to offset any GHG emissions.

NET sequesters GHG emissions from near-zero net-emissions GHG like the CO₂ that comes burning woody biomass. The biomass absorbs as much CO₂ when growing as it emits when burning, thus there are negative emissions when you sequester the CO₂ from burning (less any from processing). For more information see the earlier paper summarized and linked below.

New NETWORKS, Part 1: BECCS: *This post covers sources of biomass that have the potential contribute to carbon dioxide sequestration while fulfilling other human needs.*

<https://energycentral.com/c/ec/new-networks-part-1-beccs>

Another NET-process is to capture GHG directly from the atmosphere and sequester it.

2. The Plan

In its latest ambitious roadmap to tackle climate change, California relies on capturing carbon out of the air and storing it deep underground on a scale that's not yet been seen in the United States.¹

The plan — advanced by Democratic Gov. Gavin Newsom's administration — comes just as the Biden administration has boosted incentives for carbon capture projects in an effort to spur more development nationwide. Ratcheting up 20 years of climate efforts, Newsom last year signed a law requiring California to remove as much carbon from the air as it emits by 2045 — one of the world's fastest timelines for achieving so-called carbon neutrality. He directed the powerful California Air Resources Board to drastically reduce the use of fossil fuels and build massive amounts of carbon dioxide capture and storage.

To achieve its climate goals, California must rapidly transform an economy that's larger than most nations, but fierce opposition to carbon capture from environmental groups and concerns about how to safely transport the gas may delay progress — practical and political obstacles the Democratic-led Legislature must now navigate.

¹ Michael Phillis and Kathleen Rona, Dan Diego Union Tribune via MSN, “Pipeline debate at center of California carbon capture plans,” Feb 25, 2023, <https://www.msn.com/en-us/weather/topstories/pipeline-debate-at-center-of-california-carbon-capture-plans/ar-AA17V9Oe>

Last year, the California state legislature passed a law that says no carbon dioxide may flow through new pipelines until the federal government finishes writing stronger safety regulations, a process that could take years. As a potential backup, the law directed the California Natural Resources Agency (CNRA) to write its own pipeline standards for lawmakers to consider, a report now more than three weeks overdue.

Author's comment: I searched the CNRA Site to see where they are with this project and they have a long way to go. Go through the links below for their current progress. Relative to the first linked site, note that SB 905 is the above mentioned law. Also note the sites linked below have additional links.

<https://resources.ca.gov/Initiatives/Transitioning-to-Clean-Energy>

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Transitioning-to-Clean-Energy/SB-905-First-Listening-Session-January-19.pdf>

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Transitioning-to-Clean-Energy/SB-905--CO2-Pipeline-Regulatory-Framework--Stds-March-2023.pdf>

While there are other ways to transport carbon dioxide gas besides pipelines, such as trucks or ships, pipelines are considered key to making carbon capture happen at the level California envisions. Newsom said the state must capture 100 million metric tons of carbon each year by 2045 — about a quarter of what the state now emits annually.

“We do not expect to see (carbon capture and storage) happen at a large scale unless we are able to address that pipeline issue,” said Rajinder Sahota, deputy executive officer for climate change and research at the air board.

State Sen. Anna Caballero (Dem, 14th District: Merced, Madera and Fresno Counties), who authored the carbon capture legislation, said the state’s goal will be to create a safety framework that’s even more robust than what the federal government will develop. But she downplayed any urgent need to move forward with pipeline rules, saying smaller projects that don’t require movement over long distances can start in the meantime...

Last year’s Inflation Reduction Act increases federal funding for carbon capture, boosting payouts from \$50 to \$85 per ton for capturing carbon dioxide from industrial plants and storing it underground...

The geology for storing carbon dioxide gas is rare, but California has it in parts of the Central Valley, a vast expanse of agricultural land running down the center of the state.

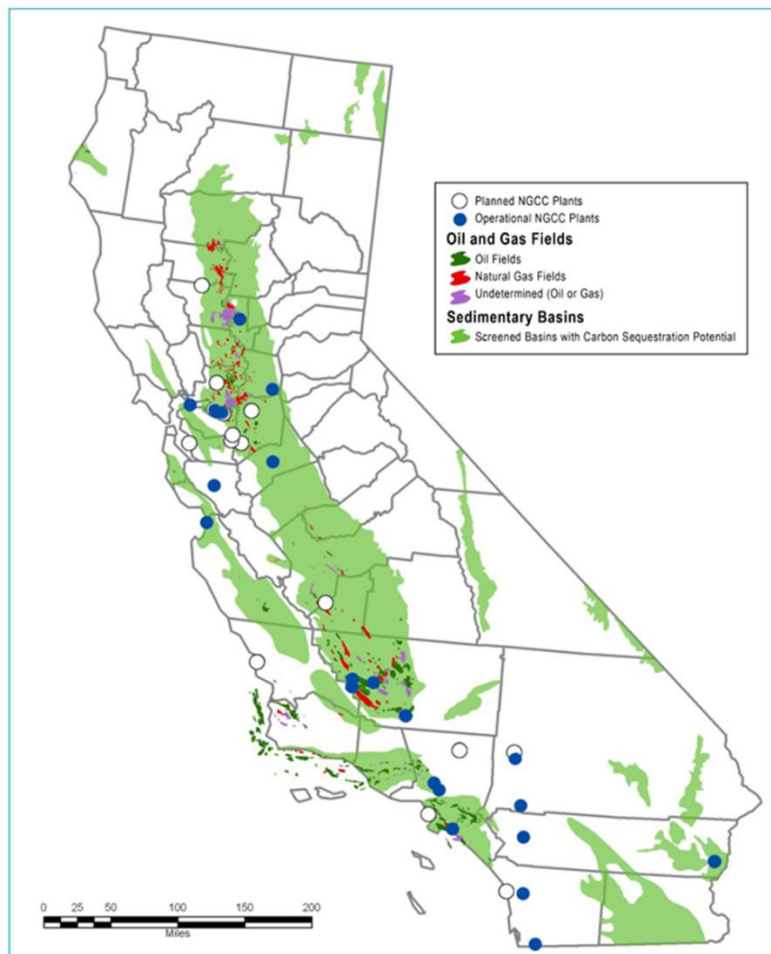
Author's comment: See the map below (next page), referenced here.² Note that Sen. Caballero is a Democrat, albeit from a conservative district (for California). Also, it is reasonable that she should be concerned about CO₂ pipeline safety as most of these pipelines will be in the Central Valley where her district is (on the map, the big green area in the middle of California is our Central Valley).

Oil and gas company California Resources Corp. is developing a project there to create hydrogen. It plans to capture carbon from that hydrogen facility and the natural gas plant that powers it. The carbon dioxide would then be stored in an old oil field. That doesn't require special pipeline approval because it's all happening within the company's property.¹

But the company also wants to store emissions from other industries like manufacturing and transportation. Transporting that would rely on pipelines that can't be built yet.

² WestCarb, Assessment of CCS for Gas-Fired Power Plants, <https://www.westcarb.org/ngcc-ccs-study.html>

Many of California's existing and planned NGCC plants are near sedimentary basins identified as having CO₂ storage potential (shown in green). CO₂ captured from in-state NGCC plants and other sources could also supply CO₂ for enhanced recovery operations in California's oil and gas fields (shown in dark green and red, respectively).



"These are parts of the economy that have to be decarbonized," said Chris Gould, the company's executive vice president and chief sustainability officer. "It makes economic sense to do it."

Safety concerns increased in 2020 after a pipeline in Mississippi ruptured in a landslide, releasing a heavier-than-air plume of carbon dioxide that displaced oxygen near the ground. Forty-five people were treated at a hospital, and several lost consciousness. There are thousands of miles of carbon dioxide pipelines operating across the country and industry proponents call the event an anomaly. But the Mississippi rupture prompted federal regulators to explore tightening the existing rules for carbon pipelines...

The oil and gas industry's emissions are a main cause of climate change and in the past the industry undermined sound evidence that greenhouse gases are deeply disturbing the climate. Now carbon capture — unproven as a major climate solution — will help the industry keep polluting in places that are already heavily polluted, environmentalists argue. Instead of shutting down fossil fuel plants, carbon capture will increase their profits and extend their life, said Catherine Garoupa, executive director of the Central Valley Air Quality Coalition.

But advocates of carbon capture say it's essential for Kern County oil and gas companies to find new ways to make money and keep people employed as California moves away from fossil fuels, an industry that is the "very fabric" of the region's identity, said Lorelei Oviatt, director of Kern County Planning and Natural Resources.

Without a new revenue source like carbon capture, "Kern County will be the next Gary, Indiana," she said, referring to the rust belt's years-ago collapse.

There are currently no active carbon capture projects in California. To demonstrate the technology is viable and people can get permits for it, it's essential to build the first projects, said George Peridas, director of carbon management partnerships at Lawrence Livermore National Laboratories.

Author's comment: I believe that we need to find alternatives for industries that are currently the source of most GHG emissions. The oil and gas industry is certainly one of these. If we identify and support a transition to a clean future for these industries, they become part of the solution, and have a future. If we do not do this they will fight the transition as hard as they can, and they have huge resources to do this.

Below is an earlier post where I identified a few alternative paths for the oil & gas industry (see subsection 4.2.2 in this post).

Tough Love – Part 1: *This is a two-post paper in Part 1 we will focus on top three greenhouse gas emitters: transportation, electricity production, and industry.*

We already have the technologies and most of the products we will need to substantially roll back our greenhouse gas (GHG) emissions, although we should continue the research and development to improve these. The competitive forces and for-profit firms in our markets are capable of funding most of this R&D. Many of the low-GHG products are more competitive in a free economy than the older high-GHG products. The U.S. and state governments will have roles, but possibly not what you would expect.

<https://energycentral.com/c/ec/tough-love-%E2%80%93-part-1>

3. Related Plans

Late last year the California Air Resources Board (CARB) approved a plan to achieve carbon neutrality by 2045.

California air regulators voted unanimously Thursday to approve an ambitious plan to drastically cut reliance on fossil fuels by changing practices in the energy, transportation and agriculture sectors, but critics say it doesn't go far enough to combat climate change.³

The plan sets out to achieve so-called carbon neutrality by 2045, meaning the state will remove as many carbon emissions from the atmosphere as it emits. It aims to do so in part by reducing fossil fuel demand by 86% within that time frame.

California had previously set this carbon neutrality target, but Gov. Gavin Newsom signed legislation making it a mandate earlier this year. The Democrat has said drastic changes are needed to position California as a global climate leader...

³ Sophie Austin, AP, "California approves roadmap for carbon neutrality by 2045," December 19, 2022, <https://apnews.com/article/california-agriculture-climate-and-environment-2591f7c60f1a143e08b599610dc49fce>

But the plan's road to approval by the California Air Resources Board was not without criticism. Capturing large amounts of carbon and storing it underground is one of the most controversial elements of the proposal. Critics say it gives the state's biggest emitters reason to not do enough on their part to mitigate climate change.

4. Federal Initiative

After digging around a bit, I found a site that provided a reasonable description of actions that the Federal Government is taking, but it looks like this will be a long process.

The U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) today announced it is taking steps to implement new measures to strengthen its safety oversight of carbon dioxide (CO₂) pipelines around the country and protect communities from dangerous pipeline failures. The new measures, as well as an enforcement action taken today are a result of PHMSA's investigation into a CO₂ pipeline failure in Satartia, Mississippi in 2020 that resulted in local evacuations and caused almost 50 people to seek medical attention.⁴

To strengthen CO₂ pipeline safety, PHMSA is undertaking the following:

- initiating a new rulemaking to update standards for CO₂ pipelines, including requirements related to emergency preparedness, and response;*
- issuing a Notice of Probable Violation, Proposed Civil Penalty, and Proposed Compliance Order (NOPV) to Denbury Gulf Coast Pipeline, LLC for multiple probable violations of Federal pipeline safety regulations (PSRs). The proposed civil penalties amount to \$3,866,734.*
- completing a failure investigation report for the 2020 pipeline failure in Satartia, Mississippi;*
- issuing an updated nationwide advisory bulletin to all pipeline operators underscoring the need to plan for and mitigate risks related to land-movements and geohazards that pose risks to pipeline integrity like the 2020 incident in Satartia, Mississippi; and*
- conducting research solicitations to strengthen pipeline safety of CO₂ pipelines.*

"I recently visited with the first responders in Satartia to hear firsthand of the pipeline failure so that we can improve safety and environmental protections for CO₂ pipelines and work to protect communities from experiences like this," said PHMSA Deputy Administrator Tristan Brown. "The safety of the American people is paramount and we're taking action to strengthen CO₂ pipeline safety standards to better protect communities, our first responders, and our environment."

PHMSA's investigation identified a number of probable violations in connection with the 2020 accident, including the following alleged failures:

- the lack of timely notification to the National Response Center to ensure the nearby communities were informed of the threat;*

⁴ Pipeline Hazardous Materials Safety Administration, "PHMSA Announces New Safety Measures to Protect Americans From Carbon Dioxide Pipeline Failures After Satartia, MS Leak," May 26, 2022, <https://www.phmsa.dot.gov/news/phmsa-announces-new-safety-measures-protect-americans-carbon-dioxide-pipeline-failures>

- *the absence of written procedures for conducting normal operations, as well as those that would allow the operator to appropriately respond to emergencies, such as guidelines for communicating with emergency responders; and*
- *a failure to conduct routine inspections of its rights-of-way, which would have fostered a better understanding of the environmental conditions surrounding its facilities that could pose a threat to the safe operation of the pipeline.*

PHMSA has longstanding and comprehensive guidance on its enforcement of PSRs as well as its civil penalties, which are calculated using a range of criteria and based on statutory limitations. Under the authorities granted by Congress, PHMSA may propose civil penalties, with the recipient of the NOPV being able to contest, contest in part, or accept them. A pipeline operator that receives a proposed civil penalty may also request and receive an informal hearing before a presiding official of the agency and prior to a proposed civil penalty being finalized...

Final author's comment: The PHMSA Report on the above mentioned incident is linked below.

<https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2022-05/Failure%20Investigation%20Report%20-%20Denbury%20Gulf%20Coast%20Pipeline.pdf>