Capturing Carbon In California: Opportunities And Challenges

By **Brian Israel and Samuel Pickerill** (July 15, 2022)

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Carbon capture and sequestration, or CCS — which involves the physical capturing of carbon emissions and permanent storage of those emissions deep underground — is considered by many policy observers to be a critical component to achieving climate ambitions around the world.

California is situated as a potential CCS hub, with multiple projects announced within the state, and a regulatory landscape that has historically prioritized climate issues. Yet expansion of CCS faces several challenges, including both legal barriers and the need to build public trust through community engagement and responsible deployment.

This article briefly analyzes the current state of play for CCS projects in California, including several emerging issues.

The Potential Role of Carbon Capture in Achieving Climate Goals

The United Nations' Intergovernmental Panel on Climate Change has projected that to avoid the worst impacts of climate change, global temperature rise must be capped at 1.5 degrees Celsius, a goal incorporated into the Paris Agreement.[1]

According to the IPCC, achieving the 1.5-degree goal will require a sharp drop in greenhouse gas emissions, and reaching net-zero global emissions by 2050.[2] This is a substantial task — especially considering that global GHG emissions are still currently increasing.[3]

In addition, the U.S., through executive action, has set ambitious targets of 50%-52% emissions reductions below 2005 levels by 2030, and net-zero by 2050. California also has set ambitious climate goals, including a legislative mandate of a 40% emissions reduction below 1990 levels by 2030,[4] and an executive goal of net-zero by 2045.[5]

Whether on the state, national or global scale, many expert projections on the pathway to net-zero rely on the use of CCS. For example, in the IPCC's report, 88 out of 90 scenarios relied on carbon removal technologies such as CCS, while the International Energy Agency projects that CCS will need to capture 7.6 gigatons of carbon dioxide — or nearly 21% of current total global emissions — by 2050 to reach net-zero.[6]

Domestically, the U.S. long-term strategy for achieving net-zero embraces CCS as a key decarbonization strategy for both the electricity generation and industrial sectors, which combined account for 49% of total U.S. emissions.[7] A 2020 report from Stanford University and the Energy Futures Initiative stated that CCS is critical to achieving California's decarbonization goals, and capable of "pav[ing] the way for the state's transition to a net-zero emissions economy."[8]

However, the IPCC warns that, despite the "growing scientific consensus that … CCS technologies and permanent sequestration are likely needed to prevent the worst impacts of climate change,"[9] CCS deployment remains "far below those in modelled pathways limiting global warming to 1.5°C or 2°C."[10]

California is emerging as a potential CCS hub to bridge that gap, with suitable geologic features and an inflow of investment on early projects. However, further development of California's regulatory framework for CCS may be necessary to fully harness the state's CCS potential.

Notwithstanding the positive view by many regarding CCS, public trust will be essential to integrating CCS into California's climate programs. The various applications of CCS technology enjoy differing levels of public support, and legislators and regulators in California are currently grappling with how to prioritize CCS uses with the greatest climate benefits.

For example, there is greater agreement regarding the benefits of CCS on hard-to-decarbonize sectors, such as heavy industry — especially when the CCS equipment is powered by zero- or low-carbon fuels. Environmental justice advocates also raise important considerations regarding where CCS projects may be located in relation to overburdened communities, and whether CCS would allow operations that emit other pollutants to continue.

Current State of Play for CCS Projects in California

California is positioned to be an early hub in the build-out of CCS projects. Potential geologic sequestration capacity in the state is estimated to be 35-425 gigatons of CO2 equivalent — enough to store the entirety of California's current emissions for up to 1,000 years.[11]

This includes deep sedimentary rock formations in the Central Valley, which the California Air Resources Board, or CARB, describes as "world-class CO2 storage sites that would meet the highest standards."[12]

Over a quarter of Class VI injection permits currently pending before the U.S. Environmental Protection Agency are located in California: the San Joaquin Renewables project[13] and three permits for the Carbon TerraVault Elk Hills Field project,[14] both in Kern County.[15] At least three additional projects have been announced but are yet to apply for a Class VI permit: the Calpine Delta Energy Center project[16] in Pittsburg, the Redding Cement plant[17] in Shasta, and the Aemetis project[18] in Ceres.[19]

On the regulatory side, California has historically been a first mover with regard to climate-related legislation, including the Global Warming Solutions Act, or A.B. 32, passed in 2006, under which many of California's emissions-reduction mechanisms are housed.[20]

Recently, CARB published a pathway to achieve carbon neutrality in California by 2045.[21] This plan relies on CCS as a necessary tool to mitigate climate change, and includes sector-specific targets including deployment of CCS on the majority of petroleum refining operations by 2030, and all stone, clay, glass and cement facilities by 2045.[22] The plan also views CCS as a shorter-term solution for the power sector and hydrogen production, until sufficient renewable power is available.[23]

Despite this, CCS has so far only been partially implemented into California's regulatory framework for addressing climate change. Two programs that do address CCS in certain

respects are the California Low Carbon Fuel Standard CCS Protocol, and the Carbon Sequestration and Climate Resiliency Project Registry.

Outside of these CCS-focused mechanisms, a storage operator will also likely need to engage with a variety of California regulatory agencies relating to more generalized state environmental protections.

Low Carbon Fuel Standard Protocol

The California LCFS is a market-based mechanism introduced in 2007 to help reduce carbon emissions from California's transportation sector. The program sets carbon benchmarks that gradually decrease over time.

Producers whose fuel falls below these benchmarks generate credits, which can then be sold to producers of fuels exceeding the benchmarks, thereby creating an incentive for producers to reduce the carbon intensity of their fuels in the California market.[24] In 2018, CARB expanded the LCFS by promulgating the CCS Protocol.[25]

CCS activities can now generate LCFS credits in two ways: the fuel pathway method or the project-based method. Under the fuel pathway method, CCS is used to reduce the carbon intensity of transportation fuels.

For example, an ethanol facility that installs CCS will have a lower carbon intensity than an ethanol facility without CCS, and therefore will generate more credits. Alternatively, CCS projects in the petroleum supply chain or using direct air capture can opt in to project-based credits, which award credits equal to the emissions reductions that the project achieves.

Under either method, the carbon can be captured and stored anywhere in the world, so long as the transportation fuel is sold in California.[26]

The CCS Protocol also prescribes technical requirements that a CCS project must comply with to take advantage of LCFS credits. Many of these requirements mirror federal standards set by the EPA's Underground Injection Control, or UIC, Program, but there are also some key differences.

For example, in California the period in which the storage operator must monitor the facility after injections cease is double that of the national standard.[27] Other distinctions include a reduced limit on injection pressure[28] and broader financial assurance requirement.[29]

California Carbon Sequestration and Climate Resiliency Project Registry

In September 2021, California enacted legislation to establish the California Carbon Sequestration and Climate Resiliency Project Registry.[30] The purpose of this registry is to connect carbon sequestration projects with potential public and private funding sources. However, there are certain important limitations.

First, the registry is limited to a subset of CCS project types, including direct air capture and land-based carbon removal. Additionally, all projects on the registry are barred from receiving credits through California's market-based emission reduction mechanisms, such as the LCFS or the cap-and-trade program.[31]

Other State Regulatory Actions

A proposed CCS project will also likely need to seek authorization from a variety of California agencies relating to state environmental laws.

For example, an operator may need to engage with:

- The State Lands Commission regarding pore space ownership or pipeline siting;
- The California Department of Fish and Wildlife for endangered species impacts;
- CARB for GHG reporting requirements;
- The Water Resources Control Board for any discharges to water;
- Local air districts for air emissions; and
- The Geologic Energy Management Division and Water Resources Control Board for state review of injection permits.[32]

Emerging Legal Issues

There are several emerging legal and regulatory issues related to the deployment of CCS. These include:

- The potential inclusion of a CCS protocol within the state's cap-and-trade program;
- Potential CCS legislation to clarify the regulatory framework that a potential CCS operator would be subject to in the state;
- Development of offshore CCS projects in a manner similar to California's current support for offshore wind generation; and
- Obtaining primary enforcement authority, or primacy, for Class VI wells under the EPA's UIC Program.

Inclusion of CCS Within State Cap-and-Trade Program

California's cap-and-trade program is another market-based emissions reduction program that California uses to limit GHG emissions. Launched in 2013, the California cap-and-trade program is now the fourth largest emissions trading scheme in the world.[33]

The program, which applies to major GHG-emitting sources such as electricity generation and industrial facilities, sets carbon benchmarks that gradually decrease each year. Covered emitters must either reduce their emissions below this benchmark or purchase allowances at auction, thereby creating a price signal to incentivize investment in lower-emissions technologies.[34]

However, unlike the LCFS, CARB has not yet recognized CCS as a pathway under the cap-and-trade program. Until a CCS protocol is adopted, the program considers GHG emissions sequestered using CCS to be no different than unabated emissions.

The program also does not yet include CCS within its compliance offset projects, a smaller

portion of the program that awards credits to other types of carbon removal projects, including methane capture and reforestation. Inclusion of CCS within the cap-and-trade program — which covers approximately 80% of California's GHG emissions — could be a major step forward toward incentivizing CCS investment in the state.

Comprehensive CCS Legislation

To provide regulatory clarity on important issues relevant to CCS development, a growing number of states have enacted comprehensive CCS legislation.[35] This approach can resolve a number of emerging legal issues that are unsettled or unclear under existing state law in one easily locatable statute.

For example, states have used comprehensive CCS legislation to address questions regarding who owns the pore space underneath a given plot of land; how to efficiently consolidate multiple ownership interests within a proposed storage area; technical requirements necessary to obtain a state injection permit; and whether to establish a long-term state stewardship plan for site monitoring and management after closure.

2022 has already been an active period for this type of legislation, with Utah, Indiana and West Virginia each enacting new comprehensive CCS bills, and Wyoming significantly expanding its CCS statute.

California does not yet have comprehensive legislation which addresses these issues. However, more limited CCS legislation is currently being considered in the California Legislature.

As initially introduced, S.B. 1101 addressed a variety of CCS-related issues, including pore space ownership, long-term liability and monitoring requirements. Through amendment, this proposal was significantly reduced in scope, with the Senate's final version limited to establishing a Geologic Carbon Sequestration Group to advise CARB on locations suitable to Class VI wells, appropriate subsurface monitoring and identification of potential hazards.[36]

S.B. 1101 passed the Senate on May 25, alongside S.B. 1399, which would establish a grant program for CCS demonstration projects, and S.B. 1314, which would prohibit the more controversial use of captured carbon in enhanced oil recovery operations.[37] Each of these bills is currently being considered by the Assembly.

Another CCS-related bill, A.B. 2944, passed the Assembly on May 23, and is currently being considered by the Senate. A.B. 2944 would require annual reports evaluating how CCS technologies are contributing to the state's climate goals.[38]

In addition, the LCFS CCS protocol could be used as a starting point from which comprehensive legislation is developed, as the protocol addresses several important legal issues relating to CCS development.

Offshore CCS

The Infrastructure Investment and Jobs Act recently opened up a pathway for the development of offshore CCS projects in federal waters — more than 3 nautical miles off the coast of California — which would fall under the leasing and permitting authority of the Bureau of Ocean Energy Management.[39]

Offshore CCS projects in state waters — within 3 nautical miles of the coast — would be regulated by the state of California, in coordination with the EPA's UIC Program.

With the third most coastline of any U.S. state, offshore CCS is particularly relevant to California. The state has not yet given an explicit indication as to whether it would consider granting permits for offshore CCS projects within state waters. However, it is noteworthy that the existing LCFS Protocol for CCS is specifically limited to onshore sequestration.

Support for offshore activities in California has historically been mixed. New offshore oil leases in California state waters have been banned since 1994, and although California does not control oil leasing in federal waters, opposition from the state has been a factor in BOEM declining to issue any new leases off the coast of California in the past 20 years.[40]

In contrast, California has made significant efforts to advance the development of offshore wind through legislative action, research funding and coordination with BOEM.[41] If California chooses to adopt a similar position with regard to offshore CCS as it has taken with offshore wind, this could amplify the state's storage potential.

Class VI Primacy

The federal UIC Program, which handles permitting for CCS injection wells, has a mechanism to transfer primacy to a state agency. California, like most states, currently has primacy under this program for injection wells used in oil and gas extraction, known as Class II wells.

North Dakota and Wyoming became the first states to receive primacy for CCS injection wells, known as Class VI wells, in 2018 and 2020, respectively.[42] Arizona, Louisiana, Texas and West Virginia are also currently seeking primacy.[43]

Benefits of receiving state primacy include a potentially shorter permit application period and greater flexibility for the state. While many factors can affect the length of a permit application, states may prefer primacy if they are able to process applications faster than the EPA, which has so far taken several years to review each Class VI application.[44]

States with primacy also may implement their own environmental standards under the program, so long as they are not any less stringent than the federal standards.[45] In addition, the Infrastructure Investment and Jobs Act has authorized $50 million in grants over five years to states who receive Class VI primacy.[46]

California may wish to consider seeking Class VI primacy to gain increased autonomy over the speed and rigor of CCS permitting.

Conclusion: Capturing the Potential of Carbon Capture in California

Among California's many natural resources is vast potential to sequester carbon emissions — including the possible permanent storage of a thousand years of emissions at current emission rates, and even longer as emission rates decrease with the proliferation of renewable energy sources.

California has the potential to play a leading role in the development of carbon capture and sequestration at scale. But there remain many obstacles, including at the policy and regulatory levels.

Policymakers and stakeholders will be grappling with the complexities of these issues, including addressing concerns raised by potentially affected communities, as they chart a path forward on the drive toward net-zero.

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[1] Special Report: Global Warming of 1.5°C, IPCC (Oct. 2018), https://www.ipcc.ch/sr15/chapter/spm/; Paris Agreement to the United Nations Framework Convention on Climate Change, Art. 2.1(a) (Dec. 12, 2015).

[2] Special Report: Global Warming of 1.5°C, supra n. 3.

[3] Global CO2 emissions rebounded to their highest level in history in 2021, International Energy Agency (March 8, 2022), https://www.iea.org/news/global-co2-emissions-rebounded-to-their-highest-level-in-history-in-2021.

[4] Cal. Health & Safety Code § 38566.

[5] Cal. Exec. Order B-55-18, To Achieve Carbon Neutrality (Sept. 10, 2018).

[6] Special Report: Global Warming of 1.5°C, supra n. 3; Special Report on Carbon Capture Utilisation and Storage, International Energy Agency (Sept. 2020), https://www.iea.org/reports/ccus-in-clean-energy-transitions; Net Zero by 2050: A Roadmap for the Global Energy Sector, International Energy Agency (May 2021), https://www.iea.org/reports/net-zero-by-2050.

[7] The Long Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050, U.S. Dept. of State and Exec. Office of the President (Nov. 2021), https://www.whitehouse.gov/wp-content/uploads/2021/10/US-Long-Term-Strategy.pdf; Greenhouse Gas Inventory Data Explorer, EPA (data for 2020), https://cfpub.epa.gov/ghgdata/inventoryexplorer/.

[8] An Action Plan for Carbon Capture and Storage in California: Opportunities, Challenges, and Solutions, Energy Futures Initiative and Stanford University (Oct. 2020), at 1 https://static1.squarespace.com/static/58ec123cb3db2bd94e057628/t/5f91b40c83851c7382efd1f0/1603384344275/EFI-Stanford-CA-CCS-FULL-10.22.20.pdf.

[9] 87 Fed. Reg. 8,809, Carbon Capture, Utilization, and Sequestration Guidance, Council on Environmental Quality (Feb. 16, 2022).

[10] Climate Change 2022: Mitigation of Climate Change, IPCC (April 2022), at SPM-37.

[11] Achieving Carbon Neutrality in California, Energy and Environmental Economics

developed for the California Air Resources Board (Oct. 2020) at 65, https://ww2.arb.ca.gov/sites/default/files/2020-10/e3_cn_final_report_oct2020_0.pdf; 2000-2019 GHG Inventory (2021 Edition), California Air Resources Board (April 2021), https://ww2.arb.ca.gov/ghg-inventory-data.

[12] Draft 2022 Scoping Plan Update, California Air Resources Board (May 10, 2022) at 67, https://ww2.arb.ca.gov/sites/default/files/2022-05/2022-draft-sp.pdf.

[13] https://sjrgas.com/the-project/.

[14] https://crc.com/our-business/where-we-operate/san-joaquin-basin/elk-hills-field.

[15] As of July 7, 2022. See https://www.epa.gov/uic/class-vi-wells-permitted-epa.

[16] https://calpineactsonclimate.com/doe-invests-45-million-to-decarbonize-the-natural-gas-power-and-industrial-sectors-using-carbon-capture-and-storage/.

[17] https://www.globalcement.com/news/item/12123-lehigh-hanson-and-fortera-to-install-carbon-capture-and-storage-system-at-redding-cement-plant-in-california.

[18] https://www.aemetis.com/products/carbon-capture/#:~:text=In%20addition%20to%20our%20efforts,at%20each%20of%20our%20facilities.

[19] An additional Class VI permit application from Mendota Carbon Negative Energy Project in Fresno was recently withdrawn in April 2022. Project backers have stated that they are continuing to "gather and evaluate project information" after the withdrawal. Chevron, Schlumberger withdraw request for California carbon-capture permit, Reuters (May 18, 2022), https://www.reuters.com/markets/commodities/chevron-schlumberger-withdraw-request-california-carbon-capture-permit-2022-05-18/.

[20] Cal. Health & Safety Code Division 25.5.

[21] Draft 2022 Scoping Plan Update, California Air Resources Board (May 10, 2022) at 66, https://ww2.arb.ca.gov/sites/default/files/2022-05/2022-draft-sp.pdf.

[22] Id. at 59-66.

[23] Id. at 68.

[24] For more information on the California LCFS, see https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard.

[25] Carbon Capture and Sequestration Protocol under the Low Carbon Fuel Standard, California Air Resources Board (Aug. 2018).

[26] For direct air capture, no California nexus is required.

[27] Under the EPA's regulations, a storage operator's post-injection monitoring obligations finish once the operator can show that the carbon dioxide plume is stable and will not endanger drinking water sources. The default time period for this is 50 years, but it could be shortened if this demonstration can be made earlier. See 40 CFR 146.93. In California, the monitoring period has a minimum of 100 years and cannot be shortened, although the

frequency and intensity of the monitoring requirements can be reduced once the plume is determined to be stable. See Protocol Section 5.2(b)(2).

[28] In California, injection pressure may not exceed 80% of the maximum, whereas the EPA limits injection pressure to 90%. Cf. Protocol Section 3.3(b); 40 CFR 146.88(a).

[29] In California the operator's financial responsibility instrument must be sufficient to cover costs to the environment and public health in the event of atmospheric leakage, whereas the EPA requires the instrument to be sufficient to cover the costs of endangerment of drinking water sources. Cf. Protocol Section 7(a)(3); 40 CFR 146.85.

[30] Cal. Health & Safety Code § 39740.

[31] Id. at § 39740.7(b).

[32] See Figure 1, Permitting Carbon Capture & Storage Projects in California, Lawrence Livermore Nat'l Laboratory (Feb. 2021).

[33] Behind that of China, the European Union and South Korea. See California Cap-and-Trade, Center for Climate and Energy Solutions, https://www.c2es.org/content/california-cap-and-trade/#:~:text=California's%20cap%2Dand%2Dtrade%20program%2C%20launched%20in%202013%2C,and%20the%20Republic%20of%20Korea.

[34] For more information on the California cap-and-trade program, see https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program.

[35] See, e.g. Indiana Code 14-39-2; Kentucky Rev. Stat. 353.800; Louisiana Rev. Stat. 30:1101; Mississippi Code 53-11; Montana Code Ann. 82-11-180; Nebraska Rev. Stat. 57-1601; North Dakota Century Code 28-22; Utah Code Ann. 40-11; West Virginia Code 22-11A; Wyoming Stat. 35-11-313.

[36] California S.B. 1101 (Caballero), Carbon sequestration: Geologic Carbon Sequestration Group (2021-2022 Session).

[37] California S.B. 1399 (Wieckowski), Carbon Capture Technology Demonstration Project Grant Program (2021-2022 Session); California S.B. 1314 (Limon), Oil and gas: Class II injection wells: enhanced oil recovery (2021-2022 Session).

[38] California A.B. 2944 (Petrie-Norris), Greenhouse gases: carbon capture, utilization, and sequestration (2021-2022 Session).

[39] Infrastructure Investment and Jobs Act of 2021 § 40307.

[40] See Oil and Gas, California State Lands Commission, https://www.slc.ca.gov/oil-gas/.

[41] See Cal. AB-525, Energy: offshore wind generation (Sept. 23, 2021) (requiring state agencies to develop a strategic plan and permitting road map to advance the development of offshore wind in federal waters); 2022-2023 Governor's Budget, California Dept. of Finance (Jan. 10, 2022), https://www.ebudget.ca.gov/budget/2022-23/#/BudgetSummary (allocating $45 million for offshore wind development); California Announces Historic Agreement with Federal Partners to Advance Offshore Wind Development, Office of Governor Gavin Newsom (May 25, 2021) (identifying a 399-square-

mile area for offshore wind development). Despite the state's support, offshore wind projects have at times still faced local opposition. See Louis Sahagun, A Chumash tribe and conservationists are fighting a controversial offshore wind power plan, L.A. Times (March 21, 2022), https://www.latimes.com/environment/story/2022-03-21/nobody-seems-to-like-this-california-wind-power-proposal.

[42] See 83 FR 17,758, State of North Dakota Underground Injection Control Program; Class VI Primacy Approval (April 24, 2018); 85 FR 64,053, Wyoming Underground Injection Control Program; Class VI Primacy (Oct. 9, 2020).

[43] Louisiana has had a Class VI primacy application pending before the EPA since March 2021, while Arizona, Texas and West Virginia are each in the preapplication phase. See State of Louisiana Class VI EPA Primacy Application, http://www.dnr.louisiana.gov/assets/OC/im_div/uic_sec/ClassVIPrimacyApplicationstamped.pdf; Proposed Amendments to 16 TAC Chapter 5 and Pre-Application for Class VI Primacy from EPA, https://rrc.texas.gov/media/nvkjyh0l/prop-amend-ch5-hb1284-sig.pdf; Primary Enforcement Authority for the Underground Injection Control Program, EPA, https://www.epa.gov/uic/primary-enforcement-authority-underground-injection-control-program#who_loop.

[44] To date, the EPA has approved six Class VI permits from three separate applications. The time from submission of a complete application to permit approval has ranged from 26 to 40 months. See Table of Class VI Wells Permitted by EPA, https://www.epa.gov/uic/class-vi-wells-permitted-epa; FutureGen Alliance 2.0 Permit Application, https://archive.epa.gov/region5/water/uic/futuregen/web/html/index.html#:~:text=The%20U.S.%20Environmental%20Protection%20Agency,called%2C%20%E2%80%9Ccarbon%20sequestration.%E2%80%9D.

[45] See Safe Drinking Water Act § 1422; Geologic Sequestration of Carbon Dioxide — Underground Injection Control Program Class VI Primacy Manual for State Directors, EPA (April 2014) at 5.

[46] Infrastructure Investment and Jobs Act of 2021, Pub. L. No. 117-58, § 40306(c).