WORLD RESOURCES INSTITUTE

3/28/2025

World Resources Institute
10 G St NE, Suite 800
Washington, DC 20002

Public Feedback for Carbon Capture, Removal, Utilization, and Storage Program (SB 905)

Thank you for the opportunity to provide input on this request for public feedback for Carbon Capture, Removal, Utilization, and Storage Program (SB905). The following responses are submitted on behalf of the World Resources Institute, a global nonprofit research organization focused on global challenges at the intersection of climate change and sustainable development.

Financial Responsibility

In addition to the instruments listed in §146.85 of Title 40, are there other existing financial responsibility instruments CARB staff should consider?

SB 905 determines that project operators are to demonstrate financial responsibility for a geologic CO_2 sequestration site by submitting a plan to cover short and medium-term costs associated with several project phases and measures. Operators are to maintain financial responsibility for a period of time that is safe and terminates no earlier than 100 years after the last date of injection of carbon dioxide into a geologic storage reservoir. Under such provisions, the long-term liability over potential impacts and costs associated with the site (after the 100 years of post-injection) falls on the state of California, as well as taxpayers.

In addition to the short and medium-term instruments listed in §146.85 of Title 40, CARB should consider the establishment of a long-term financial responsibility instrument that would serve to cover potential costs that arise beyond the 100-year timeframe.

Although long-term financial responsibility instruments do not yet exist in California, or at the federal level under the Class VI rule, they have been discussed throughout literature, proposed by NGOs and implemented in other jurisdictions. Amongst other options, CARB could consider a state-managed trust fund:

State-Managed Trust Funds

A state-managed trust fund is a financial mechanism designed to ensure long-term stewardship of geologic CO_2 sequestration sites beyond an operator's liability period. These funds typically collect fees from operators based on the volume of CO_2 injected during the active injection phase of the project, which are then used exclusively for post-closure monitoring, site management, and, if necessary, remediation. Some experts have referred to this as a long-term MRV (monitoring, reporting, and verification) trust.

The fees are generally small and fixed per metric ton of stored CO_2, determined either by a regulatory authority or through legislative rule. For instance, Indiana's fee is codified in state law at $0.08 per metric ton, aligning with published estimates of the cost of long-term monitoring over a project's full life cycle. The fee could be adjustable and would likely require regular assessment during the operational lifetime of the sequestration well.

Examples of state-managed trust funds, or similar financial mechanisms, include:

- Indiana: The state imposes a small, fixed per-ton storage fee, which is exclusively allocated for long-term monitoring and management of sequestration sites.
- North Dakota: Operators are required to contribute to the Carbon Dioxide Storage Facility Trust Fund, which is specifically designed to cover post-closure monitoring and management costs. The fund is sourced from fees that operators pay based on the amount of CO_2 injected, ensuring that sequestration sites remain secure and in regulatory compliance after the closure phase.
- European Union: The EU's 'financial mechanism' under the CCS Directive involves a financial contribution from the operator before the transfer of responsibility, covering monitoring costs for 30 years, once the responsibility obligations have been transferred to the state. This contribution is designed to encompass liabilities transferred to the state under the Directive's transfer provisions, including monitoring, corrective measures, emissions trading obligations, and preventive and remedial actions. The financial contribution helps ensure that the competent authority can manage the long-term containment of CO_2 in geological storage sites after liability has been transferred.
- Alberta, Canada: The Post-Closure Stewardship Fund is a state-managed financial mechanism that covers long-term monitoring costs, addresses potential orphan facilities, and ensures compliance with environmental regulations. Contributions to the fund are based on a project-specific rate per ton of CO_2 sequestered annually. The fund is structured in a similar way to Alberta's oil and gas orphan well fund, which is financed by an orphan levy on all well licensees and can be used to meet statutory liabilities for these wells.

For California to implement a state-managed trust fund, the state would need to establish clear rules on which liabilities the fund covers, how long the fund would be active for and what the unused funds could eventually be used for (e.g., for instance state procurement of carbon dioxide removal), determine the agency responsible for its administration, and set an appropriate fee structure that ensures long-term financial sustainability without placing excessive burdens on operators. A well-designed fund would provide lasting oversight and maintenance of sequestration sites, cover monitoring costs and ensure site integrity while preventing potential future liabilities from falling on taxpayers.

There are several reasons to consider a long-term financial responsibility instrument:

The science of geologic sequestration of CO_2 is well understood today, with the risks expected to be minimal if sites are well-selected, managed and monitored. However, uncertainties remain about the long-term behavior of CO_2 in the subsurface over thousands of years as we do not have direct experience with CO_2 sequestration over such long periods and therefore rely on modeling. Ongoing RD&D will still be needed to improve monitoring, site characterization and secondary trapping mechanisms. The contributions for a state-managed trust fund could be designed to evolve over time, adjusting as more experience is gained with CO_2 sequestration and as deployment demonstrates long-term safety.

Long-term financial responsibility is also crucial for ensuring responsible stewardship of geologic sequestration sites. Many communities remain skeptical about geologic sequestration due to uncertainties around potential leakage, induced seismicity, and other risks that could emerge over the coming centuries. Implementing a long-term financial assurance instrument – one explicitly dedicated to covering the costs of post-closure monitoring, corrective measures, and unforeseen liabilities – can help standardize best practices and strengthen the industry's social license to operate. Sustained monitoring and financial assurances are crucial in maintaining public trust and regulatory certainty.

Without adequate safeguards, there is a risk that operators may not prioritize long-term site integrity, knowing that liability will eventually transfer to the state. A well-designed long-term financial instrument can ensure that financial resources are available to address any issues that arise post-injection, without shifting the burden onto future taxpayers.

Criteria and Toxic Monitoring

What specific criteria pollutants or toxics emissions should be prioritized for monitoring and where along CCUS/CDR project (i.e. capture, transport, injection/utilization)?

Capture: The expected impacts and safety considerations of CCS and CDR projects will vary greatly depending on facility type and design, capture technologies used and energy sources. The most common and developed carbon capture technologies rely on amine solvents for post-combustion CCUS systems. Direct air capture (DAC) systems often rely on a similar amine chemistry but different separation process that uses solid sorbents in place of liquid solvents. Since many CCS and CDR processes are technologically nascent and not yet widely deployed, it is important that CARB prioritize caution and transparency of co-pollutant emissions in their rulemaking for SB905 to increase understanding of the potential health, safety, and environmental impacts of carbon dioxide capture and removal.

Though CCS is a promising process to avoid both greenhouse gas emissions and some criteria air pollutants, it is not without risk of negative air pollution impacts. For amine-based post-combustion carbon capture units to operate effectively, emitters typically remove common criteria air pollutants such as particulate matter, sulfur dioxide, and nitrogen dioxide from the flue stream. However, alongside these likely criteria pollutant reductions, amine-based post-combustion capture units may increase emissions of ammonia, volatile organic compounds (VOCs), and nitrosamines, with some of the latter two chemical families not regulated by the Clean Air Act. And, while ammonia releases are federally regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), *continuous releases* of ammonia, as would likely be the case in CCS and DAC applications, are subject to less stringent reporting requirements under CERCLA. These pollutants have possible health and safety impacts such as cancer and pulmonary disease.

Other forms of CCS and CDR may have different health and safety implications than those associated with amine-based capture and removal. For example, some research has found that biochar production from pyrolysis — an upstream step in both bioenergy with CCS (BECCS) and biomass carbon dioxide removal and sequestration (BiCRS) projects — may result in increased emissions of particulate matter, VOCs, carbon monoxide, and nitrous oxides.

Since different types of CCS and CDR projects will have unique pollution considerations, CARB should holistically investigate the unique environmental and health impacts — both positive and negative — of different CCS and CDR projects. For amine-based post-combustion CCS and DAC facilities, WRI recommends monitoring the emissions of ammonia, volatile organic compounds (e.g. acetaldehyde, formaldehyde, and acetone) and nitrosamines, as well as criteria air pollutants at all stages of the carbon capture or DAC system.

The potential air pollution impacts of CCS and CDR approaches like DAC, BiCRS, and BECCS are not inherent nor unavoidable. Around the world, companies, research organizations, and regulatory authorities like CARB are pursuing technology and policy measures to reduce both GHG and non-GHG emissions from CCS and CDR. For amine-based post-combustion carbon capture, these technology measures include water washes, acid washes, and UV treatment. In pyrolysis for BiCRS and BECCS, these measures include improved reactor designs, catalytic converters, biochar activation, and advanced gas-cleaning systems. Across CDR and CCS approaches, the use of dedicated and additional renewable energy in lieu of increased fossil fuel energy will also minimize adverse emissions impacts from carbon capture and carbon dioxide removal processes. Practical research based on concrete pollution data from comprehensive emissions monitoring will provide greater clarity on the nature and scope of these issues.

Transport: Transporting CO_2 via pipeline is generally safer than transporting other substances like oil and gas, but there are still important regulatory considerations to ensure intrastate pipeline safety. Inadequately managed CO_2 transportation risks leaks, tank ruptures and other mechanical failures that pose health and environmental risks from leakage and escape of CO_2, criteria air pollutants, and other chemical impurities.

The presence of chemical impurities such as nitrous dioxide and sulfur dioxide in CO_2 streams can corrode pipelines and increase the risk of pipeline leaks and ruptures. Interactions between individual chemical impurities within CO_2 streams can form corrosive acids, even in minuscule amounts. When CO_2 is being prepared for transport via pipeline, it is important to rigorously monitor and regulate the chemical composition of CO_2 streams to verify that corrosive acids will not form in CO_2 pipelines — either in isolation or as a result of combination with CO_2 streams from other sources (in the case of CO_2 pipeline networks).

In addition to monitoring and strictly regulating the composition of CO_2 streams for transport via pipeline, WRI recommends investigating ways to make leaks more detectable during transport, such as the use of odorants and colorants.