

Yale University Carbon Containment Lab

The Yale Carbon Containment Lab (CC Lab) commends Washington State's leadership under the Climate Commitment Act, Chapter 70A.65 RCW, in addressing the climate crisis and prioritizing the needs of overburdened communities. The CC Lab appreciates this opportunity to comment on the Washington Department of Ecology's proposed final rule establishing a cap-and-invest program structured to achieve net-zero emissions of greenhouse gases in the State by 2050, Chapter 173-446 WAC. The CC Lab broadly supports Ecology's proposed final rule and offers comments for the Agency's consideration in the attached letter. Thank you.

Thursday, June 14, 2022

Joshua Grice
Department of Ecology
Air Quality Program
P.O. Box 47600
Olympia, WA 98504-7600

VIA ONLINE SUBMISSION

RE: *Formal Comments Regarding the Washington Department of Ecology's Proposed Rule for the State's Climate Commitment Act Cap-and-Invest Program, Chapter 173-446 WAC*

Dear Mr. Grice:

The Yale Carbon Containment Lab (CC Lab) commends Washington State's leadership under the Climate Commitment Act (CCA), Chapter 70A.65 RCW, in addressing the climate crisis and prioritizing the needs of overburdened communities. The CC Lab appreciates this opportunity to comment on the Washington Department of Ecology's proposed final rule establishing a cap-and-invest program structured to achieve net-zero emissions of greenhouse gases (GHGs) in the State by 2050, Chapter 173-446 WAC. The CC Lab broadly supports Ecology's proposed final rule and offers the following comments for the Agency's consideration.

I. BACKGROUND

A. Description of the Yale Carbon Containment Lab

The CC Lab helps tackle the climate crisis by contributing to the evolution of carbon credit markets and by developing novel, low-cost, safe, scalable, and verifiable methods of atmospheric carbon reduction, removal, and containment. The CC Lab analyzes and scales both natural and technical solutions for carbon removal and sequestration, with a goal of helping to contain at least 50 million metric tons (MT) of carbon dioxide by 2035.

The CC Lab's efforts in Washington State include: increasing and prolonging containment of carbon in woody biomass, thereby mitigating the risk of severe wildfires and ensuring healthier forests; storing carbon through rock weathering and petrification; and geologically sequestering carbon dioxide (CO₂) in volcanic rock. The CC Lab also supports the mitigation of other high-potency GHGs in the U.S., including methane emissions (from agricultural and coal mines), as well as fluorinated gases like hydrofluorocarbons (from refrigerants) as supported through compliance and voluntary carbon markets.

B. Geologic and Other Natural Resources in Washington Provide Significant Sequestration Opportunities

Washington is home to one of the world's largest potential resources for storing CO₂ permanently and safely, in the lava formation known as the Columbia River Basalt Group (CRBG). The CRBG spans 210,000 km² across eastern Oregon, Washington, Idaho, and California. When CO₂ is injected deep into these basalts, it reacts with water and the magnesium, calcium, and iron minerals naturally found in basalt—thereby permanently mineralizing and remaining safely underground. This mineralization process is analogous to the successful demonstration project operated by Carbfix in Icelandic basalts.

From 2009-2013, with the support of the U.S. Department of Energy, the Pacific Northwest National Laboratory (PNNL) and other partners drilled into the Columbia River Basalts and injected supercritical CO₂ into a pilot well in Wallula, WA. This pilot demonstrated rapid carbon sequestration in the CRBG via in-situ mineralization, with 60% of the injected CO₂ mineralizing within two years.¹ Researchers at PNNL estimated the storage capacity of the CRBG to be as much as 100 billion MT CO₂, though storage of even 1 billion MT would be a large portion of total U.S. annual emissions.² While showing great potential, further pilot testing is needed to characterize the best locations for sequestration, to better understand mineralization rates, and to accurately estimate total carbon storage capacity in the region.

The Carbon TrapRock Project is a CC Lab-led initiative that leverages the learnings of the Wallula pilot project to create an end-to-end climate solution for the Pacific Northwest. Carbon TrapRock envisions a solution that converts CO₂ from industrial sources, direct air carbon capture (DACC), and low-value woody biomass into carbonate minerals, alongside useful by-products.

One pathway of relevance to Washington is to convert into CO₂ the large amounts of dead and low-value wood that must be removed from State and national forestlands to mitigate future wildfire risk. As forests in the State struggle to adapt to climate change impacts such as increased droughts, disease, and pests, unhealthy forests are becoming net sources of emissions. Biomass energy with carbon capture (BECCS) facilities can help finance forest restoration treatments by creating a market for low-value and dead biomass while capturing CO₂ and subsequently storing it in the CRBG.

In addition, Washington boasts extensive renewable energy capacity, including wind and hydropower, which could be used in off-peak hours to power Direct Air Carbon Capture (DACC) facilities. The State can consider co-locating DACC facilities with the CRBG to ensure that climate commitments can be met safely, efficiently, and quickly. Industrial sources of CO₂ may also be possible sources in the region, such as fertilizer manufacturing and ethanol facilities.

¹ White et al. 2020. "Quantification of CO₂ Mineralization at the Wallula Basalt Pilot Project." *Environmental Science and Technology* 14: 609–14,616.

² McGrail et al. 2006. "Potential for carbon dioxide sequestration in flood basalts." *Journal of Geophysical Research* 111: B12201.

Finally, Washington has other mineral resources that could prove critical for ex-situ carbon removal processes known as enhanced mineral weathering. Basalts and olivine mineral deposits are uniquely abundant in Washington and could be used to sequester CO₂.

C. The Role of Carbon Removal and Sequestration in Addressing the Climate Crisis

The United Nation’s Intergovernmental Panel on Climate Change (IPCC) warns that preventing an increase of 1.5°C above pre-industrial levels will be nearly impossible if humanity only reduces ongoing GHG emissions. We must also urgently remove existing CO₂ from the atmosphere. Carbon capture and sequestration (CCS) technologies, which remove CO₂ from the emissions of point sources (point-source carbon capture) or the atmosphere (CO₂ removal or “CDR”)³ and sequester it deep underground, will be critical for addressing the climate crisis and meeting both State and global climate commitments.

The Washington Legislature recognizes this reality. *See, e.g.*, RCW 70A.45.020, which notes (“[A]ll pathways to [1.5°C] rely on some amount of negative emissions through carbon sequestration.”). And it understands meeting the State’s climate commitments requires State support for “the economic vitality of ... business sectors capable of sequestering and storing carbon.” RCW 70A.45.090(b).

The Legislature thus announced a statewide policy of incentivizing carbon removal and sequestration (*quoting from* RCW 70A.45.100):

- (1) [I]t is the policy of the state to promote the removal of excess carbon from the atmosphere through voluntary and incentive-based sequestration activities in Washington[.]... It is the policy of the state to prioritize carbon sequestration in amounts necessary to achieve the carbon neutrality goal established in RCW 70A.45.020, and at a level consistent with pathways to limit global warming to [1.5°C].
- (2)(a) All agencies of state government ... shall seek all practicable opportunities ... to cost-effectively maximize carbon sequestration and carbon storage in their nonland management agency operations, contracting, and grant-making activities.

While the CC Lab strongly supports the proposed regulation, Chapter 173-446 WAC, the CC Lab recommends that Ecology modify it during this rulemaking or shortly afterwards, as described below, so the State’s cap-and-invest program encourages CCS offset projects consistent with the IPCC’s findings and the Legislature’s instructions.

³ “CDR” is defined in the CCA and proposed rule as “deliberate human activities removing [CO₂] from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products[.]” RCW 70A.65.010(14); *see also* WAC 173-446-020. CDR includes negative emissions technologies, such as direct air capture, biomass carbon removal and storage, ocean-based carbon removal, and enhanced mineralization, each coupled with sequestration.

II. COMMENTS

A. Strong Support for Environmental Justice and Additionality Components

Ecology's proposed rule rightfully builds upon the successful track record of the California Air Resources Board (CARB), its emissions cap-and-trade program, and its offsets protocols. The CC Lab supports the proposed contribution of all forest offsets projects to a buffer pool; as well as the proposed rule's strong focus on additionality; focus on credit issuances for projects of recent vintage (WAC 173-446-510); and Ecology's decision to retire future allowances in proportion to the number of offset credits used in a year so that offset projects cannot be used to excuse emissions exceeding the State's GHG budget (WAC 173-446-250). Investing in overburdened communities and creating an environmental justice council through the proposed Ecology rule will help to ensure equitable distribution of program benefits, and to avoid some of the controversies faced by CARB on this matter.

B. Definition of Sequestration

The CCA properly encourages both the reduction of GHG emissions and the removal of GHGs from the atmosphere. However, the proposed definition of "sequestration" is inappropriately limited to storage of CO₂ removed from the atmosphere alone. Proposed WAC 173-446-020 defines "sequestration" as "the removal of [CO₂] from the atmosphere and storage of carbon in GHG sinks or GHG reservoirs through physical or biological processes." This limitation presents a lost opportunity to abate significant emissions from polluting point-sources across Washington.

Storage of CO₂ captured at point sources prevents new CO₂ emissions from reaching the atmosphere and is just as important as DACC to achieving the State's climate and environmental justice commitments. Capturing emissions from point sources would allow many more tons of CO₂ to be captured and sequestered than current DACC technologies, which are only able to capture tens of thousands of MT CO₂ per year, rather than hundreds of thousands or millions of tons. Many energy-intensive and trade-exposed industries with hard-to-abate emissions, such as nitrogen fertilizer, cement, or steel manufacturing, will utilize point-source carbon capture to meet their compliance obligations, and this carbon can be sequestered, for example, in nearby geologic formations or through enhanced mineral weathering processes. The CC Lab therefore recommends Ecology revise its proposed definition of "sequestration" to include storage of captured CO₂:

"Sequestration means the removal of CO₂ from the atmosphere, or the capture of CO₂ at an emission point source, and storage of carbon in GHG sinks or GHG reservoirs through physical or biological processes."

If our shared goal is to reduce GHG emissions to zero and to maximize capture and sequestration, this revised definition is preferable to the Agency's proposed definition.

As written, the proposed definition of sequestration is also inconsistent with the proposed definition for “GHG reservoir” and the existing definition for “permanent sequestration.” Neither of those definitions restricts the source of CO₂ to the atmosphere. WAC 173-446-020 defines “GHG reservoir” as “a physical unit or component of the biosphere, geosphere, or hydrosphere with the capability to store ... a GHG removed from the atmosphere by a GHG sink or a GHG captured from a GHG emission source.” (emphasis added). Existing WAC 173-407-110 defines “permanent sequestration” as “the retention of [GHGs] in a containment system using a method that is in accordance with standards approved by Ecology and that creates a high degree of confidence that substantially ninety-nine percent of the [GHGs] will remain contained for at least one thousand years.” This definition covers both GHGs that are captured from the atmosphere and those captured at emission point sources.

The revised definition also better aligns with WAC 173-446-040(2)(a)(iii), which lowers a covered entity’s total compliance obligation by the amount of CO₂ it captures and sequesters. *See* WAC 173-446-040(2)(a)(iii) (exempting permanently sequestered CO₂ from the total covered emissions for which a covered entity has a compliance obligation). Using Ecology’s proposed definition could hinder the goal of maximizing sequestration.

C. Developing Offset Protocols for Other Project Types That Demonstrably Reduce GHG Emissions

The CCA instructs Ecology to “[e]ncourage opportunities for the development of offset projects in this state by adopting offset protocols ... that support the development of [CO₂] removal projects.” RCW 70A.65.170(4)(b). However, Ecology’s proposed rule adopts offset protocols issued by CARB for four types of projects: those involving livestock, U.S. forests, ozone-depleting substances (namely chlorofluorocarbons or CFCs), and urban forests. Quickly adopting additional protocols will be critical for meeting State and global climate commitments.

Promoting the development of other proven emissions reduction methods would increase the pool of high-quality potential offsets, reduce reversal risk from a disproportionate concentration of forest-based offsets, incentivize emissions reductions across additional sectors, and encourage local economic development and innovation. For example, in 2017, CARB approved additional projects focused on short-lived climate pollutants, namely fugitive emissions of methane from sources other than livestock, black soot, and abatement of high global warming potential gases found in air conditioning and refrigeration systems (including hydrofluorocarbons or HFCs, which are used to replace CFCs and other ozone-depleting substances but are themselves potent GHGs). Methane, black carbon, and HFCs have larger radiative forcing potential than CO₂, and these short-lived pollutants are responsible for 45% of the current climate forcing.

Apart from methane livestock emissions, Ecology’s proposed rule focuses predominantly on CO₂ regulation and removal. By contrast, CARB regulates methane (CH₄), nitrous oxide (N₂O), sulfur hexafluoride (SF₆), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and nitrogen trifluoride (NF₃) in addition to CO₂. Failing to include these gases in Ecology’s proposed cap-and-invest system would be a missed opportunity for emissions reductions and greater ability to meet state net-zero targets. Washington’s 2018 emissions inventory estimated that ozone-depleting substance substitutes (namely HFCs) account for 4% of state emissions, the largest single source outside of fossil fuels, and larger than industrial emissions.⁴

Beyond reducing emissions of other gases, Ecology may consider including additional project types as methodologies are developed and projects are registered, particularly for projects that are uniquely suited to both reducing Washington’s emissions and creating local jobs in lower-income areas of the State. For example, such projects can include enhanced mineral weathering using olivine, a mineral occurring in high concentrations in the Washington Cascade Range; using peat alternatives in nurseries to prevent further peat extraction and emissions; and forest health treatments to reduce wildfire emissions and contain carbon via wood burial or storage mechanisms.

While fuels reduction treatments for wildfire prevention are included within the scope of the US Forests Protocol and have approved methodologies for measurement and verification (such as the American Carbon Registry’s Improved Forest Management Methodology for Reduced Emissions from Decreased Wildfire Severity and Forest Conversion), these types of projects are uncommon, and should be explicitly encouraged to reduce Washington State wildfire costs, emissions, and health impacts. Beyond adapting CARB methodologies, Ecology could be an early adopter of protocols that encourage novel containment and mitigation techniques.

Finally, The CC Lab recommends Ecology add a protocol for CCS projects to advance the State’s policy of incentivizing carbon removal and sequestration. CARB’s *Carbon Capture and Sequestration Protocol Under the Low Carbon Fuel Standard*, August 13, 2018, could serve as a starting point for Ecology, though the protocol would need modifications for use in a cap-and-invest program. It should also be modified to reflect Washington’s unique geology and mineral resources, which includes basalt reservoirs in addition to more-typical saline reservoirs; as well as other minerals critical to enhanced mineral weathering, such as ground-up basalt or olivine.

D. Offset Projects on Tribal Land

The CC Lab supports Ecology’s encouragement of offset projects benefitting tribal communities and offers two related comments for the Agency’s consideration.

⁴ Washington State Department of Ecology, Air Quality Program. “Washington State Greenhouse Gas Emissions Inventory 1990–2018.” January 2021, Publication 20-02-020.

First, during the initial compliance period, the CCA restricts a covered or opt-in entity's use of offsets credits to "no more than five percent" of its total compliance obligation; however, a covered or opt-in entity may utilize offset credits for an additional three percent of its compliance obligation if the offset project is "on federally recognized tribal land." RCW 70A.65.170(3)(a), (e). During the second compliance period, a covered or opt-in entity may use offset credits for "no more than four percent" of its compliance obligation, though a covered or opt-in entity may utilize offset credits for an additional two percent of its compliance obligation if the offset project is "on federally recognized tribal land." RCW 70A.65.170(3)(b), (e).

The proposed rule attempts to reflect this language but is written with some opacity. See WAC 173-446-600(6)(a), (b). The proposed language creates ambiguity because it could be read to suggest a covered or opt-in entity may use offset credits from projects on tribal lands to satisfy 98% of the entity's compliance obligation during either compliance period, rather than to restrict a covered or opt-in entity's use of offset credits to a maximum of 8% and 6%, respectively. The CC Lab therefore recommends Ecology redraft WAC 173-446-600(6)(a) and (b) to have increased consistency with RCW 70A.65.170(3)(a), (b), and (e), as demonstrated:

(a) For the first compliance period ..., no more than five percent of a covered entity's or opt-in entity's compliance obligation may be satisfied by offset credits ~~not from projects on federally recognized tribal land. In addition to, but separate from, this limit; however,~~ a covered entity or opt-in entity may satisfy up to an additional three percent of its compliance obligation ~~using~~ with offset credits generated from offset projects on federally recognized tribal land.

...

(b) For the second compliance period ..., no more than four percent of a covered entity's or opt-in entity's compliance obligation may be satisfied by offset credits ~~not from projects on federally recognized tribal land. In addition to, but separate from this limit; however,~~ a covered entity or opt-in entity may satisfy up to an additional two percent of its compliance obligation ~~using~~ with offset credits generated from offset projects on federally recognized tribal land.

Second, the CCA instructs Ecology to "establish an assistance program for offset projects on federally recognized tribal lands in Washington." RCW 70A.65.180.⁵ The CC Lab recommends Ecology expand this assistance program by rule to include funding for tribal governments to evaluate offset projects potentially affecting tribal resources and to participate as an offset project developer, operator, or partner, regardless of whether the

⁵ "Tribal lands" are defined to have "the same meaning as 'Indian country' as provided in 18 U.S.C. Sec. 1151 and also [to include] sacred sites, traditional cultural properties, burial grounds, and other tribal sites protected by federal or state law." RCW 70A.65.010(65) (referencing RCW 70A.02.010).

project is located on tribal lands. Doing so would ensure tribal treaty rights are not violated, encourage meaningful and early engagement, and create additional opportunities for Tribes desiring to participate in the State's cap-and-invest economy to generate revenue.

III. CONCLUSION

The CC Lab shares Washington State's understanding that time is of the essence to stabilize the climate. Humanity cannot do so without carbon removal.

The CC Lab urges Ecology to revise Chapter 173-446 WAC to ensure Ecology appropriately supports and rewards those that site and operate carbon sequestration facilities in Washington. Washington's basalts and other natural resources provide a globally significant opportunity to capture and permanently contain CO₂. We believe that the changes requested here position the State to lead on carbon removal and sequestration.

Sincerely,



Dr. Anastasia O'Rourke
Managing Director, Yale Carbon Containment Lab