Charm Industrial Inc.,
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February 15, 2022

RE: Additional Comments Regarding Chapter 173-424 WAC, Clean Fuels Program Rule

TO: Washington State Department of Ecology

These comments follow up on our November 3, 2021 comment letter and our communication with the Washington State Department of Ecology (Ecology) regarding the Clean Fuel Standard (CFS). We continue to believe that Charm's technology and other innovative carbon removal technologies will play a critical role in meeting Washington's ambitious goal of achieving net-zero greenhouse gas emissions by 2050. For the reasons outlined below, carbon capture and sequestration (CCS), including carbon dioxide removal such as bio-oil sequestration, is essential to the success of the CFS program.

I. Background on Charm Industrial

Charm Industrial removes carbon from the atmosphere by utilizing carbon dioxide captured in plants, converting plant biomass into an injectable bio-oil, and permanently sequestering this bio-oil underground in geological storage. The agricultural biomass residues (e.g., corn stover, wheat straw) and forestry residues that Charm uses would otherwise decompose or burn, releasing the embodied carbon dioxide into the atmosphere. Charm uses fast pyrolysis to quickly heat the biomass to 500°C, breaking down the biomass into a carbon-rich bio-oil that can be easily transported and injected for permanent sequestration.

Charm uses custom-built, mobile pyrolyzers that move from field to field to follow the harvest season to process excess biomass into bio-oil. The bio-oil is transported from the field to a network of existing EPA and state-regulated injection wells, where the bio-oil is pumped underground for permanent storage. This small-footprint process enables Charm to operate across many geographies and significantly limits impacts of emissions associated with transport.

II. Charm Industrial's Sequestration Potential

In 2021, Charm sequestered more than 5,400 metric tons of CO_2e. Over the next 2-4 years Charm plans to sequester a cumulative total of ~200,000 metric tons of CO_2e through voluntary carbon removal markets to scale our technology and place downward pressure on our costs of operation. While this is an impressive start, it is only a small fraction of the carbon removal that will be needed to meet climate targets in Washington and elsewhere.

Washington is rich in biomass, and Charm believes that, with the appropriate guiding policies in place, there is a significant opportunity to establish local operations that could simultaneously contribute to the state economy and help reach emission goals, including those established through the Clean Fuels Program.

Charm's technology results in high-quality carbon sequestration that is additional and permanent. We ensure additionality by using biomass that would otherwise rot or burn. Our operation also enhances soil health and overall sustainability. For example, Charm simultaneously produces nutrient-rich bio-char alongside bio-oil and returns this to fields and forests to minimize soil erosion and maximize soil carbon. Unlike methods that force gaseous CO_2 underground, Charm's sequestration process benefits from the natural properties of bio-oil. Bio-oil is denser than most fluids, including brine and crude oil, so it sinks within a reservoir or well. Within days to weeks, a chemical reaction called auto-polymerization solidifies the bio-oil, locking it in place. Additionally, bio-oil's antiseptic properties prevent it from being consumed by bacteria. The net effect is the permanent sequestration of the CO_2 captured by plants.

III. Lessons from Other Jurisdictions

Oregon, California, and British Columbia have low carbon fuel standard programs that have been generally successful at reducing carbon emissions and driving new transportation technologies. However, each program is facing high credit prices and a likely credit/deficit imbalance going forward. No jurisdiction has achieved 1% annual reductions in fuel carbon intensity (let alone 1.5% or more) without relying heavily on banked credits. Oregon and California are incrementally moving toward accepting CCS and carbon removal technologies as a credit pathway to enable deeper carbon intensity reductions.

British Columbia: B.C. does not include CCS or carbon removal as a credit pathway and has run a credit deficit from 2017-2021.[1] The average credit price jumped from $250 in 2020 to nearly $450 in 2021 due to a credit shortage. B.C. recently set a new target of a 20% reduction in fuel

[1] British Columbia Ministry of Energy, *Low Carbon Fuel Credit Market Report* (2022). Available at https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/transportation/renewable-low-carbon-fuels/rlcf-017.pdf.

carbon intensity by 2030. However, from 2013-2019, B.C.'s program achieved only a 5.7% reduction (0.8% per year) and missed the 8% reduction target.[2]

California: In 2018, California became the first jurisdiction to adopt CCS as a credit generating activity. California adopted the CCS credit pathway in tandem with committing to a 20% fuel carbon intensity reduction by 2030.[3] However, California bet DAC would be the primary technology and set up the protocol to the exclusion of other permanent carbon removal technologies, like bio-oil.[4] In practice, no DAC projects have been certified and credit prices have continued to rise.[5] Charm is working with CARB to revise California's CCS protocol to adopt a technology-neutral approach that would include bio-oil sequestration. From 2011-2020, California achieved a 7.42% reduction (or ~0.8% per year) and relied heavily on banked credits from the early years of the program.

Oregon: Oregon allows fuels to develop a pathway that relies on CCS to apply to be certified under the LCFS.[6] However, our understanding based on conversations with the Oregon Department of Environmental Quality (DEQ) is that it is not processing applications for CCS pathways although it would likely accept a project that would qualify under a California protocol. Oregon's program will require deeper reductions (1.5% per year) in upcoming years, after initially requiring modest reductions (0.5% per year). Oregon identifies a likely credit deficit in the 2020s-30s as annual reduction targets increase.[7] In 2019, Oregon ran a modest credit deficit and relied on banked credits to achieve a 1% annual reduction.[8]

IV. Statutory Basis for Including CCS (including Charm) in the Clean Fuels Program

The Washington State Legislature, in enacting the Clean Fuel Standard, sought to balance the need for CCS, including carbon removal, to ensure that aggressive Co2 reduction targets are met while also ensuring the program has a technology-forcing effect in the transportation sector. In RCW 70A.535.030, the legislature provided that:

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[2] Danniel Mazzone et. al., *Multijurisdictional Review of LCFS Programs 2010-2020 Q2: OR, CA, B.C.*, U.C. Davis, (2021) at 5. Available at https://escholarship.org/uc/item/080390x8.
[3] CARB, *CARB Amends Low Carbon Fuel Standard for Wider Impact* (2018). Available at https://ww2.arb.ca.gov/news/carb-amends-low-carbon-fuel-standard-wider-impact.
[4] CARB, *Carbon Capture and Sequestration Project Eligibility FAQ*, (2021) (CARB approved a limited set of CCS activities including direct air capture and practices capturing Co2 from existing industrial operations). Available at https://ww2.arb.ca.gov/resources/fact-sheets/carbon-capture-and-sequestration-project-eligibility-faq.
[5] Stillwater Associates LLC, *California LCFS Weekly Update* (2021). Available at https://stillwaterpublications.com/wp-content/uploads/2021/02/Stillwater_LCFS_Wkly_21-02-10-fw3ug.pdf.
[6] OR 340-352-0400(6).
[7] Oregon DEQ, *2021 Illustrative Compliance Scenarios* (2021). Available at https://www.oregon.gov/deq/ghgp/Documents/cfpIlluCompScenD.pdf.
[8] Julie Witcover and Colin Murphy, *Status Review of Oregon's Clean Fuels Programs 2016-2018 Q3* (2019) at 4. Available at https://escholarship.org/uc/item/0ct4m7gs.

> The rules adopted by the department to achieve the greenhouse gas emissions reductions per unit of fuel energy specified in RCW 70A.535.020 must include, but are not limited to, the following:
> (1) Standards for greenhouse gas emissions attributable to the transportation fuels throughout their life cycles, including but not limited to emissions from the production, storage, transportation, and combustion of transportation fuels and from changes in land use associated with transportation fuels **and any permanent greenhouse gas sequestration activities.**

In this section, the Legislature expressed a clear intent that when Ecology set forth rules calculating a fuel's carbon intensity, the rules should incorporate permanent CCS activities undertaken by the fuel provider. This should include practices that sequester carbon from Washington's forests and farms in connection with fuel production, which will also create rural jobs and revenue streams. For example, if a biofuel producer used its waste biomass to generate bio-oil with Charm's technology, and then sequestered that bio-oil, that practice should be incorporated into the fuel's carbon intensity evaluation.

The Legislature's use of the term "permanent" is also critical and distinguishes between sequestration projects that are less expensive to develop, but less certain to guarantee long-term carbon storage (e.g., forestry offset projects), from technologies like Charm's. An example of a regulatory definition that distinguishes the two is offered in Section V of this letter.

The legislature also granted Ecology the authority to include CCS as an activity that generates credits. RCW 70A.535.050 provides that:

> (1) The rules adopted under RCW 70A.535.020 and 70A.535.030 may allow the generation of credits from activities that support the reduction of greenhouse gas emissions associated with transportation in Washington, including but not limited to:
> **(a) Carbon capture and sequestration projects, including but not limited to:**
> (i) Innovative crude oil production projects that include carbon capture and sequestration;
> (ii) Project-based refinery greenhouse gas mitigation including, but not limited to, process improvements, renewable hydrogen use, and carbon capture and sequestration; or
> (iii) Direct air capture projects.

When RCW 70A.535.050 and RCW 70A.535.030 are read in tandem, the legislature is directing Ecology to include CCS in the lifecycle analysis of the carbon intensity of fuels, while simultaneously granting the authority for CCS projects to independently participate in the credit marketplace. CCS projects that provide permanent carbon removal are essential to meet the CFS's goal of 20% by 2038. <u>This is also an opportunity to learn from the experience of other jurisdictions that have excluded or significantly limited the role of CCS technologies and as a</u>

result, have not achieved a 1% annual reduction (let alone 1.5% or 2.5%) and are facing long-term credit deficits.

We are aware of the dual mission of the CFS to drive affordable emission reductions and advance transportation technology. We are open to a reasonable cap on CCS credits as permitted under RCW 70A.535.050(4). We believe a cap, rather than limiting CCS to a handful of technologies as California has, is the best way to manage CCS credits in the marketplace.

V. Suggestions for the CFS Rulemaking

A successful CFS program requires achieving significant carbon reductions, supporting new technologies, and maintaining reasonable credit prices. Achieving each of these goals is not possible without including credits from permanent, high-quality CCS projects. Based on the experience of other jurisdictions, Washington's CFS will likely not achieve a 1.5% annual reduction without CCS credits, including those from emerging carbon removal technologies. Charm also understands that Ecology must support new transportation technologies and does not want low-cost, low-durability carbon offset projects in the CFS credit marketplace. Below, we offer two examples of regulatory provisions that strike this balance:

i. Define carbon capture and sequestration (CCS):

A regulatory definition of qualifying CCS activities will allow Ecology to set forth technology-neutral criteria that separates low-cost, low-durability offsets from the permanent CCS projects. Charm proposes the following definitions as an example:

> "Carbon capture and sequestration" means any process that removes carbon dioxide or carbon dioxide equivalent greenhouse gases that would otherwise be emitted to the atmosphere and durably stores the associated carbon dioxide or carbon dioxide equivalent greenhouse gases in geological, terrestrial, or ocean reservoirs, or in products.
> "Durable" means greater than 1000 years.[9]

Defining durable to mean long-term storage would provide a distinction from projects like forestry offsets, that are better positioned to participate in the Climate Commitment Act (CCA) offset marketplace. Permanent carbon removal (like Charm) will not be competitive in the CCA offset market because lower-durability land management offsets can be provided at a significantly lower cost than permanent CCS.

[9] CARB's permanence standard for CCS projects is 100 years. However, a stronger standard would meet our obligation to future generations and ensure permanent storage. We are not proposing that a project must be monitored for 1,000 years but that storage and leakage be modeled over 1,000 years. The private sector is increasingly using 1,000 years as a standard for permanence. *See* e.g., https://stripe.com/blog/first-negative-emissions-purchases.

ii. Provide multiple pathways for CCS activities to qualify:

The CFS rules should also allow for a dynamic CCS credit market that does not attempt to predict which CCS technology will win or lose. This matches the Legislature's "including but not limited to" description of carbon capture and sequestration projects in RCW 70A.535.050. Therefore, Charm suggests creating three pathways for a CCS project to qualify to generate credits:

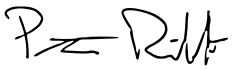
> To qualify as a credit generating activity a carbon capture and sequestration project an applicant must comply with one of the following:
>
> (a) A technology-neutral carbon capture and sequestration protocol developed by the Department;
> (b) The California Air Resources Board Low Carbon Fuel Standard Carbon Capture and Sequestration Protocol;
> (c) In the event neither the Department nor the California Air Resources Board has developed an applicable protocol, the applicant may submit for the Department's approval a life cycle carbon analysis and analysis of the project's additionality and durability and other information requested by the Department. The Department must approve projects that demonstrate they meet the definition of "carbon capture and sequestration."

The three pathways would enable Ecology to develop a technology-neutral protocol that applies durability, permanence, and monitoring standards to any CCS project under Sec. (a). Sec. (b) would allow Washington to incorporate the existing CCS protocol developed by California, which would harmonize the California and Washington programs. Finally, Sec. (c) would create a pathway for new CCS technologies to apply if resource constraints prevent Ecology from establishing a protocol under Sec. (a), while granting Ecology's discretion to require the information necessary to evaluate a new CCS technology.

VI. Conclusion

Charm applauds Washington for establishing a Clean Fuels Program that will meaningfully accelerate our transition to a carbon-free economy. We believe that technology such as Charm's will play a critical role in the success of Washington's CFS. We appreciate the thoughtful consideration of these comments, and we look forward to working with Ecology staff as the protocols for credits are developed in the rulemaking process.

Sincerely,



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