

January 6, 2022

California Air Resources Board  
Low Carbon Fuel Standard Program  
1001 I Street  
Sacramento, CA 95814

**Remora Comments on the LCFS Workshop – Potential Future Changes to the  
LCFS Program (December 7, 2021)**

Dear California Air Resources Board Staff,

**Summary—**

Remora has developed a device that retrofits onto a semi-truck and captures at least 70% of its CO<sub>2</sub> emissions, directly from the tailpipe (“mobile carbon capture”). During preliminary conversations, CARB staff have expressed interest in the potential of the technology to further the state’s transportation emissions goals. We ask that the Board consider mobile carbon capture for inclusion in the LCFS program, either as a new Program Type or as a Tier 2 fuel pathway.

**Full Text—**

Remora is a climate technology company based just outside of Detroit, Michigan that designs and manufactures a device that captures carbon dioxide from the exhaust of Class 8 heavy-duty trucks (“semi-trucks”). It captures over 70% of the CO<sub>2</sub> that would otherwise be emitted while minimally affecting overall vehicle fuel economy and engine performance.

The device works by passing exhaust gas through a packed bed of CO<sub>2</sub> adsorbing pellets. To ensure continuous operation, the packed beds cycle between adsorption and desorption; for the latter, waste heat is recovered from the exhaust to release adsorbed CO<sub>2</sub>, which is collected in on-board storage tank before offloading into stationary tanks. The captured CO<sub>2</sub> can then be sold to end users who permanently sequester the CO<sub>2</sub> through their use or stored via geologic sequestration. (The document included entitled “Remora\_Renderings\_Offloadtank.pdf” shows demonstrations of the device and off-load tank.)

While passenger vehicle emissions are projected to decrease in the coming decades, there is no clear decarbonization path for heavy duty trucks, which account for only 5% of vehicles but account for 22.8% of on-road CO<sub>2</sub> emissions (in total emitting 340 million tons of CO<sub>2</sub> annually). Electrification of heavy duty vehicles is challenging to private industry for many reasons; the most notable problems are the need for extensive

new infrastructure and lack of investment capacity to fund it, the requirement to entirely replace existing fleets, and the high weight of existing options.

Mobile carbon capture is a new approach with clear advantages over existing alternatives. Our technology retrofits onto existing vehicles, requires less infrastructure at a lower cost, and weighs significantly less than electric and hydrogen alternatives. The technology also compares very favorably to other carbon capture technologies. It is more efficient than direct air capture (DAC) because it captures emissions from a more carbon-intensive source (diesel exhaust versus ambient air). It is more scalable than power plant capture because the device is designed to retrofit onto any semi-truck and can be manufactured efficiently at high volumes.

As a result of these considerations, key stakeholders in the freight transportation industry believe Remora's technology will be an essential part of reducing their carbon emissions. Remora has raised \$40 million from top investors like Union Square Ventures, Lowercarbon Capital, and First Round Capital, and 16 multibillion-dollar companies have signed up to pilot the device. These include some of the largest companies in the US (in the Fortune 10) and many of the largest trucking companies, like Cargill, Ryder, Werner, NFI, and ArcBest. Pilots will launch in February 2022 in Kentucky, Pennsylvania, and Texas. We expect to launch pilots in California in late 2022 or early 2023. The strong support we have received from private industry indicates that the solution is primed for success.

Government—local, state, and federal—has also responded positively to the technology. The device was developed from research initially funded by the EPA and tested at the National Vehicle & Fuel Emissions Lab. Teams in the DOT, DOE, and state governments of our pilot states have expressed interest in amending existing programs to support and incentivize further research and innovation of mobile carbon capture processes.

We have also spoken with numerous teams in California, including at the Governor's Office of Business and Economic Development (GO-Biz), the Air Resources Board (CARB), and the South Coast Air Quality Management District (SCAQMD). All responded positively to the potential of the technology in aiding the state's emissions goals, especially in such a difficult sector to decarbonize. Teams at CARB and SCAQMD even reached out to us to request that, in the future, we explore retrofitting the technology for cargo ships at berth.

Unfortunately, despite this positive reception, we have been informed the device does not currently qualify for LCFS credits. Alexander (Lex) Mitchell suggested that a new "Project Type" could be created to accommodate mobile carbon capture. Others suggested perhaps mobile carbon capture could be included as a Tier 2 pathway.

The Low Carbon Fuel Standard (LCFS) program is designed to reduce greenhouse gas emissions associated with the life cycle of transportation fuels used in California. Mobile carbon capture fits the intent of the program. More importantly, the technology achieves the targets and criteria laid out by the LCFS program and its accompanying CCS Protocol.

For example, the presently-accepted diesel alternatives (various biodiesels and renewable diesels) reduce the carbon intensity (CI) of diesel by 20-80%. Our device, which captures over 70% of the CO<sub>2</sub> from diesel exhaust, falls within this range – with all factors of the LCA considered. Furthermore, we have identified sequestration partners in California who are able to satisfy the permanence certification requirements.

Accommodating mobile carbon capture within the LCFS program will help the State of California fulfill the spirit of other CARB programs (including the Advanced Clean Fleet program), numerous national programs, and its broader goal of climate leadership. The inclusion of mobile carbon capture will direct attention to the technology and thereby help spur competition and innovation in the industry. There are many exciting future avenues for the technology.

For example, pairing existing LCFS biofuels with carbon capture and storage (CCS) offers the possibility of a carbon negative pathway in the transportation sector. Our device could make this a near-term reality, which would make currently-accepted alternative fuels even more impactful. Additionally, the technology can likely be applied to locomotives, mining-haul trucks, cargo ships, and other hard-to-decarbonize vehicles, as already discussed with CARB staff.

California could tangibly help accelerate these innovations and hasten the decarbonization of transportation through only slight amendments to the LCFS program – changes that align directly with the stated goals of the program. We look forward to future correspondence.

Sincerely,

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