**Notice of Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments**

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RE: DME’s Role in Low NOx Engines

Oberon Fuels (Oberon) respectfully submits these comments in response to the California Air Resources Board’s proposed Heavy-Duty Engine and Vehicle Omnibus Regulation to be heard by the Board on August 27, 2020.

As noted on I-47 of the ISOR: “The emissions profile and long-term emissions performance of heavy-duty vehicles are dependent on proper integration of the engine, exhaust aftertreatment, and fuel as a combined system.”

**Role of fuels in emissions reductions.** Dimethyl ether’s (DME) clean-burning properties and versatility as a fuel can reduce greenhouse gas emissions and criteria pollutants in three different ways (see below). Thus, we believe DME has a role to play in CARB’s low-NOx strategy. DME can be produced from a variety of waste streams and renewable feedstocks and holds the potential to support the state’s additional goals of methane reduction (SB 1383) as well as fossil fuel replacement. Finally, DME also provides an economical pathway to the end goal of zero-emission mobility and carbon neutrality.

**DME as a Diesel Replacement.** To begin, DME has long been recognized as an excellent diesel replacement fuel. DME is a clean-burning, non-toxic, potentially renewable fuel. Its high cetane value (55-60) and quiet combustion, as well as its inexpensive fueling system, make it an excellent, inexpensive diesel alternative that will meet strict emissions standards and facilitate putting cleaner trucks, particularly Class 7-8 trucks, on the road.

Oberon Fuels is currently leading a project funded by the California Energy Commission to move DME production from pilot to demonstration scale and to test a new renewable feedstock at its plant in Brawley, California. CARB’s LCFS staff estimated the carbon intensity of renewable DME (rDME) from local dairy biomethane feedstocks could be as low as -278 (negative 278).

Because DME is soot-free, it allows the removal of the diesel particulate filter from the aftertreatment system. Because of that, Oberon believes it may be possible to recalibrate the engine to reduce NOx more than in a petrodiesel system while maintaining fuel economy and greenhouse gas reductions. In addition, such a low-NOx system would be less complex and less expensive than current diesel aftertreatment systems.

DME has been used for decades as an energy source in China, Japan, Korea, Egypt and Brazil, and can be produced domestically from a variety of feedstocks, including biogas from organic waste produced in cities or by agricultural operations, as well as natural gas. Ideal uses in North America are in the transportation, agriculture, emergency power and construction industries. DME can be made from a range of options that can make it extremely competitive if not significantly more affordable than traditional diesel.

DME is a gas under ambient conditions. However, because it can be stored as a liquid under moderate pressure, similar to propane (LPG), it eliminates the need for the high-pressure containers used for CNG or cryogenics, as in the case of LNG. DME’s easy handling properties make fueling and infrastructure relatively simple and inexpensive.

DME is approved as a renewable fuel under the U.S. Environmental Protection Agency’s Renewable Fuels Standard, making it eligible for RINs credits when made from biogas with the Oberon process. The EPA estimated that biogas-based DME offers a 68% reduction in greenhouse gases. DME has also been issued specifications by ASTM International and the International Organization for Standardization (ISO) to ensure that as DME is rolled out as a fuel the right standards and regulations are in place to ensure a robust supply chain.

**DME/Propane Blending.** The second way that DME can be used to put cleaner trucks on the road and decarbonize transportation is to blend it with propane for use in propane-powered vehicles. Up to 20% DME can be blended with propane with no changes to the vehicles or fueling infrastructure required. As mentioned, under ambient conditions, DME is a gas that can be stored as a liquid under moderate pressure, making it ideal for blending with propane.

The ISOR notes that eight LPG (propane) engines have been certified as low-NOx engines for use in California. In 2018, ROUSH CleanTech launched the first propane-powered engine certified to meet CARB’s optional low NOx standard for heavy-duty engines with 0.02 g/bhp-hr. A propane/rDME blend would add greenhouse gas reductions to an engine that already offers reduced criteria pollutants.

By blending propane with DME, the thousands of already clean-burning propane vehicles in California would continue to reduce its emissions while providing the most vulnerable populations – children on school buses, residents relying on paratransit services – access to affordable, clean transportation.

As calculated by the California Air Resources Board, the current carbon intensity (CI) score of propane is 83 gCO2e/MJ (ultra-low-sulfur diesel has a CI near 100 gCO2e/MJ). CARB has calculated that, when renewable DME (rDME) is made from dairy biogas (which itself has a CI of -150), rDME has a CI value of -278. With only a 5% (based on energy content) blend of rDME, propane’s baseline CI value decreases from 83 to 65, and at a 20% blend (based on energy content) the CI value decreases to just 11, enabling propane to approach carbon neutrality in an economic manner using the same vehicles and fueling infrastructure.

The combination of DME’s handling properties, its ability to be produced from diverse, abundant, renewable resources, and its significant greenhouse gas-reducing qualities make it an excellent choice for blending with propane in the transportation sector and beyond.

**DME as a Hydrogen Carrier.** The third way in which DME can decarbonize transportation is as a hydrogen carrier. DME are excellent carrier molecules for transporting hydrogen to power a new generation of light- and heavy-duty, fuel-cell electric vehicles and to provide increased supplies of renewable hydrogen:

* DME is particularly dense in hydrogen, with six hydrogen atoms on each DME molecule.
* DME can be made from a wide variety of renewable feedstocks, creating a new pathway for renewable hydrogen production.
* DME liquefies at low pressure (~73 psi), making it much easier and less expensive to transport than hydrogen, which can be compressed at up to 10,000 psi of pressure.
* Converting DME into hydrogen a simple, inexpensive process compared to natural gas to hydrogen conversion.

Having rDME-based renewable hydrogen will help support CARB’s Advanced Clean Truck rule by offering a cost-effective fuel pathway.

**Summary.** The qualities outlined above mean that with the roll-out of increased in-state rDME production already in progress, rDME-powered compression ignition (formerly diesel) trucks and vehicles using blended rDME and propane in low-NOx engines can also accelerate the drive to lower NOx and GHGs.

As California trucking fleets begin to use rDME as a diesel replacement, or blend it with propane, the same equipment and feedstocks can also be used to bring DME directly to hydrogen fueling stations, where it can easily be converted to power fuel-cell electric vehicles as well.

With DME engines and trucks in development now, DME/propane blending tests moving forward, and with hydrogen vehicles pushing into the market, these three fuels can quickly become natural allies – three different applications for the same molecule – DME.