February 15, 2022 Informational Hearing

Clean Transportation Program: Trucks and Off-Road Vehicles

BACKGROUNDER

Introduction

The transportation sector of California’s economy is responsible for more than 50% of greenhouse gas (GHG) emissions, 80% of NOx emissions, and 95% of diesel particulate matter emissions. Reducing these emissions is essential to meeting our GHG reduction goals and improving air quality for all Californians.

California has numerous programs to achieve this. Guiding this effort are Executive Orders by three Governors going back to 2004. Most pertinent are Executive Order B-48-18 by Governor Brown establishing a goal of 5 million zero emission vehicles (ZEVs) on the road by 2030, and Executive Order N-79-20 by Governor Newsom establishing a state goal that 100% of in-state sales of new passenger cars and trucks will be zero emission by 2035 and that 100% of medium- and heavy-duty vehicles be zero-emission by 2045 with drayage trucks meeting that goal by 2035.

Most of the effort and expenditures to date have focused on passenger vehicles and light duty pickup trucks, which this committee examined last year.[[1]](#footnote-1) This hearing will focus on the other transportation segments: medium- and heavy-duty trucks (MHD), off road equipment, trains and vessels.

Three Technologies

A critical step to meeting our economy-wide GHG emission reduction goals is to transition vehicles away from combustion technology and towards electricity. Unlike the passenger car market, the zero-emission MHD truck market is in its infancy with only 738 vehicles deployed in California as of December 2021;[[2]](#footnote-2) the focus in most of the truck market segments is on pilot projects and demonstrations.

Vehicles -- Battery electric vehicles are the most commercially available technology for MHD ZEVs, but their availability lags behind their availability in the passenger vehicle market. Hydrogen powered vehicles are also ZEVs. The hydrogen feeds a fuel cell that creates electricity and emits only water vapor, a promising path that has yet to overcome important technology hurdles. Some have touted natural gas powered vehicles as a solution. While they are not ZEVs, they are commercially available today and less costly.

The MHD ZEV market is really several different markets with varying progress in ZEV readiness. CARB has examined this[[3]](#footnote-3) and found that transit buses, powered either by batteries or fuel cells, are the market where ZEV technology is the most advanced and at the stage of early commercially availability. Battery electric drayage trucks, delivery vans and heavy-duty delivery trucks are a bit further behind while hydrogen fuel cell trucks are in the demonstration and pilot project phase.

Electric Infrastructure -- Looking at vehicle technology is only part of the analysis. As important is the sourcing of the fuel and the charging and refueling infrastructure. For battery electric vehicles the source of electricity is the existing electric grid. California’s electricity is exceptionally clean and low-carbon, a result of California’s longstanding preference for renewable power as well as California’s reliance on nuclear and hydro-power, and so is a good choice for fuel. But there are questions about whether California can add enough renewable power to support strong growth in electric transportation. Just meeting California’s goal of 5 million light-duty ZEVs by 2030 will increase electricity usage by around 5%-7%; medium- and heavy-duty vehicles will add more. Also, substantial new electric infrastructure will be needed to recharge fleets of battery-electric trucks. A single fast charger for a truck will draw the same electricity as 200 homes, and could go higher. Adding a charging depot of 10 or 20 chargers will be like adding a small city. This will require unprecedented upgrades to utility distribution and transmission systems which often takes years to do. While this does not require any technology breakthroughs, the implementation will require much coordination among multiple regulators and between utilities, regulators and local governments.

Hydrogen Infrastructure -- The barriers for widespread hydrogen fueling are higher. Start with sourcing the hydrogen: Where does it come from and how is it made? Most hydrogen today is produced from fossil fuels using electricity that isn’t particularly clean, consuming 6% of the world’s natural gas and 2% of its coal[[4]](#footnote-4), making it a questionable solution for meeting our GHG reduction goals. (There are efforts to capture and sequester the carbon emissions from this type of hydrogen production.) But hydrogen can also be produced from water using renewable electricity, so called “green” hydrogen. Unfortunately, green hydrogen is prohibitively expensive, costing five times what traditional hydrogen costs.[[5]](#footnote-5) Global efforts are underway to reduce that cost, including by the U.S. Department of Energy from funding provided by the recently passed federal infrastructure bill.

Once a reliable supply of green hydrogen is available it will need to be distributed to refueling stations. No pipeline system exists to do that – some hope that the natural gas distribution system might be suitable – so for now it is distributed by trucks. Storage is also a concern as neighborhoods may be reluctant to house large highly pressurized hydrogen tanks. Yet for all these technological hurdles, the promise of hydrogen is that it can decarbonize some of our hardest-to-decarbonize transportation segments, such as trains, vessels and long-distance trucking, as well as industrial processes such as cement- and steel-making.

Zero emission v. near-zero emission -- The still-developing MHD ZEV technology has left an opening for natural gas trucks. While not zero-emission, they are substantially cleaner, though more expensive, than diesel trucks and are cheaper and more available than battery-electric and hydrogen trucks. Many models meet CARB’s more stringent 2024 and 2027 emission standards. As with the other technologies, consideration of natural gas trucks must account for impacts from the fuel sourcing and developing a distribution and storage network.

Policy Responses

Deploying MHD ZEVs is costly. Natural gas trucks are roughly 20% more expensive than diesel trucks, battery-electric trucks two to three times more expensive than that, and hydrogen trucks more expensive still. Over time the higher purchase costs will be offset by lower operating costs for fuel and maintenance. Innovation and scale economies will also drive down the cost of the vehicles. But at this time the economics of MHD ZEVs and near-ZEVs will not drive adoption. Consequently, California has numerous MHD vehicle programs to encourage and require their use.[[6]](#footnote-6) Among the most notable:

* Innovative Clean Transit regulation – Requires all transit agencies to fully transition to ZEV fleets by 2040.
* Advanced Clean Truck regulation – Requires the sale of specified numbers of zero-emission trucks beginning in 2024.
* Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project – Provides vouchers to reduce the upfront costs of advanced technology vehicles.
* Carl Moyer Memorial Air Quality Standards Attainment Program – Grant program which funds the incremental cost of cleaner-than-required vehicles.
* Low Carbon Fuel Standard – Provides financial incentives to use low- and zero-carbon fuels, creating an ongoing subsidy for ZEVs and near-ZEVs.
* Various pilot programs, including Project 800 for ZEV drayage truck deployment in ports.

These programs are accompanied by substantial financial support. The 2021 Budget Act provided $2.0 billion over three years to deploy 1,000 ZEV drayage trucks, 1,000 ZEV transit buses, and 1,000 ZEV school buses and associated recharging/refueling infrastructure. In addition, the Administration’s proposed 2022-23 budget provides more funding:

* $935 million for an additional 1,000 ZEV drayage trucks and 1,600 ZEV transit buses and related infrastructure
* $1.1 billion for ZEV trucks, busses and off-road equipment and associated recharging/refueling infrastructure
* $400 million for port electrification

The federal government also supports MHD ZEVs through the Infrastructure Investment and Jobs Act, which provides $7.5 billion nationwide for EV charging/refueling infrastructure. And 15 states, including Oregon, Washington, Pennsylvania, New York, and New Jersey, have entered into a Memorandum of Understanding with a goal of 30% ZEV truck purchases by 2030 and 100% by 2050.

Conclusion

California is making an unprecedented commitment to decarbonizing trucks that is being accompanied by efforts in other states, the federal government, and internationally. The scale and pace of commercial deployment of MHD ZEVs will vary depending on the type of truck, the application, the power train and the fuel source. The technology necessary to move forward is still developing with many technological and implementation uncertainties for the vehicles, recharging/refueling infrastructure and fuel sourcing.

1. April 9, 2021 informational hearing. [↑](#footnote-ref-1)
2. “Zeroing in on Zero Emission Trucks”; CALSTART, January 2022. [↑](#footnote-ref-2)
3. Long Term Heavy Duty Investment Strategy [↑](#footnote-ref-3)
4. “The Hydrogen Economy”; Economist, October 9, 2021. [↑](#footnote-ref-4)
5. *Ibid*. [↑](#footnote-ref-5)
6. See CARB’s “Assessment of CARB’s Zero-Emission Vehicle Programs per Senate Bill 498”, July 2020, Appendix B for a complete program list and description. [↑](#footnote-ref-6)