Subcommittee on Environment and Climate Change

Hearing on

"Building a 100 Percent Clean Economy: Solutions for Planes, Trains and Everything Beyond Automobiles"

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Dr. Wayne Eckerle

Vice President, Research and Technology

Cummins Inc.

The Honorable Greg Walden (R-OR)

1. Would you please speak to innovation in the internal combustion engine; you see a strong future of clean and efficient diesel trucks, is that correct?

RESPONSE: Cummins is committed to the continued advancement and innovation of diesel technology, and we see a strong future of clean and efficient diesel vehicles in the near and long term for many markets, and in a range of applications. Cummins is a leader in advanced diesel technology that continues to significantly reduce emissions. In the near term, clean diesel is the combination of today's ultra-low sulfur diesel fuel, advanced engines and effective emission controls. Together, these elements result in a highly efficient engine, which can achieve extremely low emissions and reduce greenhouse gases (GHGs). Clean and efficient diesel benefits from low upfront costs and an existing and mature infrastructure. Truck and engine manufacturers like Cummins and other stakeholders are hard at work to develop products that meet EPA and NHTSA's Phase 2 Greenhouse Gas Standards for commercial vehicles. When fully implemented, those standards will lower CO_2 emissions by approximately 1.1 billion metric tons, save vehicle owners fuel costs of about $170 billion, and reduce oil consumption by up to two billion barrels over the lifetime of the vehicles sold under the program. Our ability to meet these goals is supported by cooperative research programs like the SuperTruck program at the Department of Energy. We are also actively working with the EPA, CARB and other stakeholders as they develop new engine standards for NOx. As we announced in November of 2019, Cummins is committed to and working toward a carbon neutral future.

Moving forward this decade, advanced diesel technology will be combined with hybrid technology in truck powertrains that will provide additional efficiency to reduce carbon footprints and to improve air quality. The hybrid technology, if integrated with appropriate batteries or fuel cells will enable a zero emissions operating mode within city limits.

Carbon emissions associated with trucks and equipment goes beyond tailpipe emissions. To address the carbon footprint, the total carbon emitted over the life cycle of the energy source must be considered. For example, the carbon emitted in the extraction and processing of

petroleum, or the production of electricity to charge a battery, or to produce hydrogen for a fuel cell is just as important as the tailpipe carbon emissions.

Transitioning to low-carbon and renewable fuels provides a significant opportunity for the internal combustion engine to continue to be the ideal power source of choice for trucks and equipment. Fuels that can be used in the internal combustion engine in the future include biodiesel, biomethane, cellulosic ethanol, renewable diesel, and biomass to diesel. These fuels either produce no tailpipe emissions, offset any carbon emitted in the tailpipe with reductions in naturally occurring carbon emissions, or the production process sequesters carbon from the atmosphere. Estimates are showing that moving to these fuels can abate the lifecycle carbon emissions in commercial vehicle applications by more than 80% from today's levels, while emitting ultra-low criteria pollutants. The added benefit is the architecture used in today's vehicle powertrains may be similar or more easily adapted to use these low-carbon or renewable fuels. Transitioning to these fuels will require alignment of research, regulations, and infrastructure development. The current efforts by the Department of Energy are identifying the pathways for the production low-carbon/renewable fuels. Extensive efforts will be required in infrastructure development to realize this opportunity.

a. The performance of diesel power for hauling loads is important for agricultural and ranching areas in my district—and the districts of other members on this Committee. What do you tell farmers and ranchers about the future of medium and heavy diesel engines?

RESPONSE: Farmers, ranchers, and others that rely on the power density, capability and economics that diesel engines provide can continue to expect superior performance from medium and heavy-duty diesel engines for decades to come. Cummins continues to innovate and advance the range of its diesel engines to lower emissions while improving performance, fuel efficiency and reliability.

In fact, the past decade, the 4.9 million new-technology diesel trucks on America's roads have removed more than 26 million metric tons of NOx and 59 million metric tons of carbon dioxide from the air. Currently, across the United States, more than 36% of all Classes 3-8 registered commercial trucks are of the newest, near-zero generation diesels, and that number grows each year. In addition, agricultural regions present a significant ecosystem to supply renewable fuels for power due to the availability of feedstocks for diesel and ethanol.

2. You indicate engine makers are investing billions of dollars to develop zero-emissions trucks. What type of trucks is this most likely to work most cost-effectively?

RESPONSE: Cummins has committed to investing $500M by the end of 2020 in the development of electrified power. We are committed to providing a broad portfolio of power solutions depending on truck application from advanced diesel, near-zero natural gas, fully electric, hydrogen, hybrids and biofuels. Different zero tailpipe emission technologies will work depending on the duty cycle, freight and route the truck is working. The adoption of battery

electric vehicle systems for heavy duty transportation is dependent on the availability of charging infrastructure capable of meeting the energy demands of heavy-duty applications. City bus and urban pickup and delivery trucks are great examples of applications where electrification technology works today. These duty cycles, with frequent stops and starts, are ideally suited for electrified powertrains and makes this technology viable for reducing emissions in traffic congested areas. Material handling applications are being electrified to reduce emissions in ports, distribution hubs and warehouses. And while the energy density of batteries continues to improve, it is not yet viable for all applications. Currently, the weight of batteries negatively impacts payload capacity, making electric trucks impractical for many applications. Creating hybrid technologies that combine diesel and electric can be part of the solution to help meet regulatory requirements for some applications.

From an economic standpoint, for an electric vehicle system to offer an acceptable return on investment, battery prices must decline to a reasonable level that allows for payback without the use of incentives. Improvements to charging infrastructure, advances in cell chemistry that allow for increased energy density in combination with fast charging, and greater modularity of battery packs will all help accelerate the adoption of electric and hybrid vehicles. Continued investment in these areas by the Department of Energy can accelerate this development.

Globally, there is an increased focus on hydrogen-based technologies and infrastructure. Advancements in fuel cells have made the technology more suitable for commercial use. Improving proton-exchange membrane (PEM) and solid oxide fuel cell (SOFC) technology performance characteristics, life, efficiency and cold weather capabilities could make fuel cells a credible alternative for commercial and industrial applications. The application of PEM fuel cells to commercial vehicle applications is exciting, particularly in those applications with productivity or longer daily range needs that cannot be accomplished by batteries.

Finally, as noted previously, liquid and gaseous renewable fuels can be an important energy source for trucks to achieve significant life cycle carbon reduction from today's levels. For many of the commercial applications, the significant benefit of high energy density fuels which will be used in powertrains similar to today's system, will make liquid renewable fuels quite attractive.

a. What are the challenges to overcome for zero-emissions trucks to become an economical, and performance reality?

RESPONSE: The main challenges to adoption for zero tailpipe emissions vehicles are infrastructure, cost and outsourced emissions.

Trucks and machinery are our customers' livelihoods. Today, they depend on broadly available and easy to operate infrastructure for diesel fueling. Adoption of new technologies among fleets requires a similar ease of fueling along with comparable capital and operational costs. This requires infrastructure and the reduction of costs associated with the new technologies. While the costs of the new technologies will undoubtedly continue to improve as the technology and scale accelerate, subsidies, grants and tax policy must be aligned to accelerate the adoption curve.

To be clear, to reach carbon neutrality we must address it across the entire transportation ecosystem, not just at the tailpipe. If energy is being provided from the grid to produce hydrogen,

charge batteries, or produce renewable fuels, the grid needs to be either carbon neutral or offset in another manner, otherwise we are not solving the problem.

3. You make reference to the scale of the challenge for actually converting the commercial vehicle market-place to zero-emissions trucks. Is the technology available today to do this?

RESPONSE: The technology exists for many applications to convert to zero tailpipe emissions, but as mentioned previously, creating the infrastructure, reducing technology cost, and eliminating the outsourcing of carbon via regulation are central to that conversion. The more energy-dense an application is, the more difficult it is to decarbonize. Hydrogen fuel cell technology as compared to battery electric is very promising for these applications, like construction and mining equipment, as are renewable fuels. Producing hydrogen for fuel cell powered vehicles can be energy intensive. Ensuring a robust supply of zero-emissions electricity to produce hydrogen will ensure that zero-emissions trucks are truly not emitting. Creating an infrastructure for renewable fuels is also a key challenge we need to overcome.

   a. What would a major transformation look like in terms of performance of trucks, behavior change, routes, the cost of goods and services?

RESPONSE: Many factors are transforming the trucking industry. Increased capability of data analytics and predictive technology are making trucks and routes safer and more efficient. These technologies will also better enable trucks using new technologies such as batteries to better predict when and where to optimally charge, thus reducing the cost and strain on infrastructure. Improved communications are enabling an interactive engagement between fleets, depots, and customers. Hub and spoke approaches are becoming more prevalent which reduce the energy carrying capacity needs in vehicles and are more compatible with lower density energy sources like batteries. With continued investment by the government and private sector into infrastructure and technology adoption, scale will eventually minimize any cost increase in goods and services associated with the new technology.

   b. Given the benefits of power and efficiency from existing diesel engines, would the tradeoffs from forcing electric prematurely be worth it for the public?

RESPONSE: Cummins supports technology-neutral policy that would not force battery-electric powertrains on applications where the technology does not meet economic, performance, or environmental requirements. By setting technology-neutral environmental goals that fully encompass the carbon life cycle, technologies can be adopted to the applications where they are the most effective with the least, or zero, emissions. Cummins is committed to investing in a future where our customers have a broad portfolio of power options – including advanced diesel, natural gas, electrified power, fuel cell, hybrids and renewable fuel technology – so they can choose what works best for them. Further, investment in R&D to improve the weight and life of batteries, reduce cost for battery and fuel cell technologies, and ensure products are compatible

with renewable fuels can help overcome some of the challenges zero-emissions vehicles face in comparison to diesel or natural gas vehicles. Enacting policies that promote the power of choice for every market will help ensure this country and every community within it has the proven technology necessary to meet air quality and climate goals, and serve the economy.