Testimony of

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"Sharing the Road: Policy Implications of Electric and Conventional Vehicles in the Years Ahead"

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Good morning, Chairman Shimkus, Ranking Member Tonko, and Members of the Subcommittee. My name is Bob Dinneen and I am president and CEO of the Renewable Fuels Association (RFA), the national trade association representing the U.S. ethanol industry.

The RFA has been the leading trade association for America's renewable fuels industry for over 37 years. Our mission is to advance the development, production and use of renewable fuels by strengthening America's ethanol industry and raising awareness about the benefits of biofuels. Founded in 1981, RFA serves as the premier organization for industry leaders and supporters. With over 300 members we are working to help America become cleaner, safer, more energy secure, and economically vibrant.

RFA appreciates the opportunity to appear before the Subcommittee today. This is an important and timely hearing as we look to the future of mobility. We believe renewable fuels are a key component to the future. There is no disagreement that new technologies will coexist with conventional technology; they are not mutually exclusive. We believe the future is bright for U.S. produced ethanol and other emerging biofuel technologies and we look forward to working with you to create a policy environment that builds upon existing technology and program successes, while driving innovation and efficiency in ways that maximize consumer acceptance and cost effectiveness. We believe ethanol and other renewable liquid transportation fuels provide numerous benefits that will help achieve those policy goals going forward.

Background

Today, ethanol is blended into roughly 97 percent of the gasoline sold in the U.S., the majority as E10 (10 percent ethanol and 90 percent gasoline) – a blend component adding octane, displacing toxics and helping refiners and auto makers alike meet Clean Air Act specifications. Not only is ethanol a thoroughly tested, safe, and effective motor fuel, it is the lowest cost source of octane available to refiners today. Increasing the use of domestic renewable fuels like ethanol is the first, and arguably, the easiest step we can take to improve automotive efficiency with higher octane fuels, lower tailpipe emissions of toxic pollutants, and reduce greenhouse gases from transportation while saving consumers money at the pump.

Ethanol production has and will continue to contribute to our nation's financial well-being as well as that of American households. Overall, the production of 15.8 billion gallons of ethanol in 2017 directly employed 71,906 American workers. In addition, the ethanol industry supported 285,587 indirect and induced jobs across all sectors of the economy. The industry created $24 billion in household income and contributed $45 billion to the national Gross Domestic Product (GDP). Moreover, ethanol producers paid nearly $10 billion in federal, state and local taxes, and spent $32 billion on raw materials, inputs, and other goods and services.

I. While electric vehicles continue to make inroads into the U.S. automotive fleet, internal combustion engines will serve as the predominant propulsion technology for light duty vehicles for decades to come

It is broadly understood that internal combustion engines powered by liquid fuels will continue to serve as the most prevalent propulsion technology for light duty vehicles for decades to come. In fact, the U.S. Environmental Protection Agency (EPA) states that "very low levels" of full electrification (plug-in electric vehicles) are expected in the fleet by 2025.[1] Further, in a report released earlier this year, the Department of Energy's Argonne National Laboratory found that through 2017, just 750,000 plug-in EVs have been sold in the United States.[2] This represents about 0.3% of the 259 million registered motor vehicles in the U.S. automotive fleet.[3]

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[1] EPA, NHTSA, CARB. July 2016. Draft Technical Assessment Report, at ES-2

[2] Argonne National Laboratory. January 2018. Impacts of Electrification of Light-Duty Vehicles in the United Sattes, 2010-2017. http://www.ipd.anl.gov/anlpubs/2018/01/141595.pdf

[3] Federal Highway Administration. Highway Statistics 2016; State Motor-Vehicle Registrations – 2016. https://www.fhwa.dot.gov/policyinformation/statistics/2016/mv1.cfm (Excludes buses and motorcycles)

While annual sales of EVs are indeed accelerating[4], the massive scale of the U.S. automotive fleet and the relatively slow turnover rate means internal combustion engines and liquid fuels will play a critically important role in the lives of American families for decades to come.

II. The efficiency of modern internal combustion engines can be significantly improved through increased adoption of incremental technologies that exist today or are near commercialization

Because the internal combustion engine will continue to serve as the primary means of mobility for decades to come, it is imperative that additional efforts be undertaken to improve the efficiency and environmental performance of these engines and the liquid fuels that are combusted in them. Contrary to conventional wisdom, neither internal combustion engines nor liquid fuel formulations are mature technologies. Both can be vastly improved.

According to EPA and NHTSA, even modest internal combustion engine improvements can enable compliance with MY2022-2025 fuel economy and GHG emissions standards: "The agencies' analyses each project that the MY2022-2025 standards can be met largely through improvements in gasoline vehicle technologies, such as improvements in engines…."[5] Indeed, the agencies project market penetration rates of just 2-3% or less will be necessary for full hybrids, plug-in hybrid electric vehicles, and battery electric vehicles to meet the MY2025 standards, while penetration rates of 33-54% are expected for certain advanced internal combustion engine technologies, such as turbocharging and higher compression ratios.[6]

The agencies' views that internal combustion engines will continue as the predominant powertrain technology through at least 2025, and that significant gains in engine efficiency are likely, are consistent with the positions of leading experts in the automotive engineering field. Moreover, the agencies' analysis showing that the costs of key advanced internal combustion engine technologies are lower than costs for other powertrain options is also generally aligned with stakeholder positions. According to Paul Whitaker, powertrain and technical director for AVL Power Train Engineering, "We see big efficiency improvements with internal combustion engines today and see the potential for lots more in the future, and they are very inexpensive relative to the other options."[7] Additionally, the U.S. Department of Energy (DOE) states that "…vehicles with internal combustion engines will continue to comprise a significant portion of the nation's vehicle fleet for

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[4] Argonne National Laboratory. January 2018. Impacts of Electrification of Light-Duty Vehicles in the United States, 2010-2017. http://www.ipd.anl.gov/anlpubs/2018/01/141595.pdf ("From 2011 to 2017, annual PEV sales grew from under 18,000 to nearly 200,000, equivalent to a year-over-year growth rate of 49%.")
[5] EPA, NHTSA, CARB. July 2016. Draft Technical Assessment Report, at ES-9.
[6] *Id.*, Table ES-3 at ES-10
[7] Detroit Public Television. Aug. 21, 2016. *Autoline with John McElroy*. Episode #2026 ("Deep Freeze for the ICE?")

the next several decades."[8] Further, the National Research Council (NRC) states, "…spark-ignition engines are expected to be dominant beyond 2025."[9]

III. Pairing advanced internal combustion engine technologies with high octane low carbon (HOLC) fuels would result in low-cost fuel economy and emissions benefits in the near term

Many of the emerging internal combustion engine technologies that are expected in the near term, including the ones with the highest expected penetration rates, could produce *greater* GHG and fuel economy benefits if paired with fuels offering higher octane ratings than what is typically available in the marketplace today.

Numerous studies by the automotive industry, DOE, and academia have examined the efficiency gains and emissions reductions that can be achieved when HOLC fuels are used in an internal combustion engine with high compression, turbocharging, and other advanced technologies. These studies have repeatedly shown that a high octane fuels (98-100 RON) used in high compression engines improves efficiency and reduces emissions by 4-10%, depending on drive cycle and other factors. Studies using a high octane mid-level ethanol blend also demonstrate that fuel economy and vehicle range using HOLC blends like E25 and E30 is equivalent or superior to performance using E10, even though the E25 and E30 blends have lower energy density.

IV. Ethanol's unique properties make it an attractive candidate for boosting octane in future HOLC fuel blends

Certain chemical properties, such as "sensitivity" and heat of vaporization, make some octane boosters more attractive than others. As researchers have examined different methods of boosting gasoline octane ratings, one option—increased levels of ethanol—has stood out as the most efficient and economical pathway.

Not only does ethanol offer extremely high octane (109 RON, 91 MON), it also features high sensitivity and high heat of vaporization. These are attractive properties that, when considered along with ethanol's lower "lifecycle" carbon intensity and lower cost relative to other octane options, make ethanol the clear choice for future HOLC fuels.

In addition to the tailpipe CO_2 reductions observed in several of the studies cited in these comments, ethanol-based HOLC fuels also offer important lifecycle GHG emissions benefits. That

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[8] U.S. Department of Energy. *Co-Optimization of Fuels & Engines for Tomorrow's Energy-Efficient Vehicles.* Available at: http://www.nrel.gov/docs/fy16osti/66146.pdf

[9] National Research Council, Committee on the Assessment of Technologies for Improving Fuel Economy of Light-Duty Vehicles. June 2015. *Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles,* at S-4.

is, the total "well-to-wheels" (WTW) emissions associated with producing and using ethanol are significantly lower per unit of energy delivered than the emissions resulting from petroleum production and use. The latest analysis conducted by DOE's Argonne National Laboratory found that today's corn ethanol reduces GHG emissions by an average of 34-44% compared to petroleum, while emerging cellulosic ethanol technologies offer GHG reductions of 88-108%.[10] These benefits are compounded when the ethanol is used in a HOLC fuel that achieves greater fuel economy and vehicle range (i.e., more miles with less energy) than today's marketplace fuels.

In a recent study, Argonne National Laboratory examined the WTW GHG emissions impacts of HOLC fuels (100 RON) containing 25% and 40% ethanol.[11] The analysis found that the inherent efficiencies resulting from using a high octane fuel in a high compression engine alone resulted in a 4-8% reduction in GHG emissions per mile compared to baseline E10 gasoline vehicles. Additional GHG reductions of 4-9% were realized as a result of corn ethanol's lower lifecycle emissions upstream, meaning total GHG emissions per mile were 8% and 17% lower for E25 and E40, respectively, compared to baseline E10. Meanwhile, E25 and E40 HOLC blends made with cellulosic ethanol were shown to reduce total WTW GHG emissions by 16-31% per mile compared to E10. While high octane fuels using petroleum-derived octane sources may provide similar tailpipe CO_2 reductions as ethanol-based HOLC fuels, they clearly do not offer the additional GHG reductions associated with ethanol's full WTW lifecycle.

Additional studies show that using ethanol as the source of octane in future high octane fuels has the potential to significantly decrease petroleum refinery GHG emissions by reducing the energy intensity of the refining process.[12]

V. Increasing octane should not come at the expense of air quality, carbon emissions, or human health

The potential for significant environmental, economic, and public health benefits from introducing higher octane fuels is obvious. However, the transition to higher octane fuels must be accompanied by requirements that octane sources improve air quality, reduce carbon emissions, and protect public health. Without such protections, there is the potential that increasing gasoline octane could

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[10] Wang, M.; Han, J.; Dunn, J. B.; Cai, H.; Elgowainy, A. Well-to-wheels energy use and greenhouse gas emissions of ethanol from corn, sugarcane and cellulosic biomass for US use. Environ. Res. Lett. 2012, 7, 1–13, DOI: 10.1088/1748-9326/7/4/045905

[11] Oak Ridge National Laboratory. July 2016. *Summary of High-Octane, Mid-Level Ethanol Blends Study*. ORNL/TM-2016/42

[12] See "Refining Economics of U.S. Gasoline: Octane Ratings and Ethanol Content", DS Hirshfeld, JA Kolb, JE Anderson, W Studzinski, and J Frusti. (2014) dx.doi.org/10.1021/es5021668 | Environ. Sci. Technol. 2014, 48, 11064-11071; and "Petroleum refinery greenhouse gas emission variation related to higher ethanol blends at different gasoline octane rating and pool volume levels", V Kwasniewski, J Blieszner, and R Nelson, DOI: 10.1002/bbb.1612; Biofuels, Bioprod. Bioref (2015)

result in unnecessary backsliding on criteria air pollutants, air toxics, and other harmful emissions linked to certain high-octane hydrocarbons. When it comes to air quality and human health, not all octane sources are created equal. Ethanol reduces criteria pollutants, and is the only source of octane that is truly renewable and results in a significant reduction in carbon. But much of the octane contribution in today's gasoline comes from petroleum-derived aromatic hydrocarbons such as benzene, toluene, and the C8 aromatics like xylene. Those sources of octane are far from benign.

The health impacts of aromatic hydrocarbons are well known. A 2015 study published in the *American Journal of Epidemiology* linked benzene found in traffic emissions to childhood leukemia. A 2012 study published by the University of California ties the risk of autism to toxics found in traffic pollution. And a 2015 study published in the *Journal of Environmental Health Perspectives* links microscopic toxic particles in car exhaust to heart disease. Aromatic hydrocarbons compose 20-50% of the non-methane hydrocarbons in urban air and are considered to be one of the major precursors to urban secondary organic aerosols (SOA). SOA is a form of fine particulate matter pollution (PM2.5), which is widely viewed as the most lethal air pollutant in the U.S. today. Moreover, new evidence is confirming that particulate matter from gasoline exhaust is a major source of black carbon, which is thought to be a significant contributor to climate change.

To date, EPA has been relatively quiet on the growing health and environmental threat posed by increased aromatics in gasoline. Because increasingly stringent fuel economy and GHG standards will likely result in increased use of higher octane fuels, the EPA must take into consideration the ancillary health and climate impacts of the various octane sources, and assure that no backsliding can occur.

VI. Policy and Regulations Should Ensure a Level Playing Field and Fair Market Access for Future Vehicle and Fuel Technologies

While EVs will undoubtedly play an expanding role in the future of our transportation sector, it is imperative that energy, environmental, and transportation policies are designed in a manner that ensures a level playing field and fair market access for all future vehicle and fuel options.

Unfortunately, a number of current federal and state policies put ethanol and other biofuels at a severe disadvantage relative to EVs, even though ethanol has a proven track record as a low-cost solution for reducing GHGs and displacing petroleum imports.

For example, the federal CAFE/GHG program contains many hidden subsidies and benefits meant to stimulate growth in EVs, while at the same time discouraging vehicle technologies designed for high levels of biofuels, such as flex fuel vehicles. In its original 2017-2025 CAFE/GHG rule, EPA finalized a GHG emissions compliance value of 0 for EVs, PHEVs (for the portion of operation that is electric), and fuel cell vehicles (FCVs). This implies that operating one of these vehicles results in no GHG emissions whatsoever, despite EPA/NHTSA's acknowledgement that "[d]epending on how the electricity and hydrogen fuels are produced, these fuels can have very high fuel production/distribution GHG emissions (for example, if coal is used with no GHG emissions control)…"[13] Indeed, on a full lifecycle basis, production of average electricity for use in EVs and PHEVs actually can generate *more* GHG emissions per unit of energy delivered than petroleum.[14]

Under the 2017-2025 CAFE/GHG standards, EPA also established a "multiplier" for all EVs, PHEVs, and FCVs, which would allow each of these vehicles to "count" as more than one vehicle in the manufacturer's compliance calculation. The agencies' reasoning for offering such a multiplier is that these vehicles, in their view, offer "the potential for game-changing GHG emissions and oil savings in the long term." If EPA/NHTSA feel it is their role to encourage the production of vehicles that potentially reduce GHG emissions and oil consumption, then they should extend favorable treatment under the rules to *all* vehicles that offer such potential.

While we strongly agree with EPA/NHTSA that automakers should be encouraged to produce vehicles that "[r]educ[e] petroleum consumption to improve energy security", "save the U.S. money" and "[r]educe climate change impacts,"[15] we believe incentives to stimulate the production of such vehicles should be constructed fairly and consistently.

In the CAFÉ/GHG program and other federal regulations, EVs are effectively treated as "zero emissions" vehicles, which is not only inaccurate but provides EVs with an unfair incentive. In order to accurately portray the GHG emissions impacts of various fuel/vehicle combinations when determining emissions compliance values, EPA/NHTSA should include upstream ("lifecycle") emissions that are *directly* related to the production and use of the fuel. This is particularly important for electricity because, as EPA/NHTSA acknowledge, "…there is currently no national program in place to reduce GHG emissions from electric powerplants."[16]

While the bulk of lifecycle emissions for liquid combustion fuels occur at the tailpipe (i.e., as hydrocarbons are combusted in the internal combustion engine), the bulk of direct lifecycle

[13] 76 Fed. Reg. 75,011 (December 1, 2011)

[14] Lifecycle analysis conducted by the California Air Resources Board for the Low Carbon Fuels Standard found the well-to-wheels GHG emissions associated with "California average electricity" are 124.1 grams of CO2-equivalent per mega joule (g/MJ), compared to 95.85 g/MJ for gasoline. In CARB's analysis, electric vehicles offer GHG savings relative to gasoline only after "Energy Economy Ratios" are applied to EVs and PHEVs to account for energy efficiency differences between electric drivetrains and internal combustion engines. http://www.arb.ca.gov/fuels/lcfs/022709lcfs_elec.pdf

[15] 76 Fed. Reg. 75,164-75,165 (December 1, 2011)

[16] 76 Fed. Reg. 75,011 (December 1, 2011)

emissions for EVs and the electric operation portion of PHEVs occur upstream and are associated with the production of electricity. For biofuels, the bulk of net lifecycle emissions also occur upstream during biomass production and conversion, as the principles of lifecycle accounting hold that biogenic CO_2 emissions at the tailpipe are equivalently offset by the CO_2 that was removed from the atmosphere by the biofuel feedstock during growth. Basing compliance values on full *direct* well-to-wheels lifecycle emissions would allow for "apples-to-apples" treatment of the GHG emissions associated with different fuel/vehicle options, whereas the use of tailpipe-only emissions provides only a partial picture of the GHG impacts of various platforms. Impartial GHG accounting misrepresents the true climate impacts of the CAFE/GHG program.

In addition to the unfair benefits and incentives for the production of EVs embedded in the CAFE/GHG program, EVs benefit from a bevy of federal, state, and local subsidies and incentives. These include generous tax credits for consumer purchases of EVs, subsidies and incentives for producers of EVs, subsidization for expanding EV infrastructure, and other various benefits. One recent report found that the total cost of EV subsidies is substantial, with most of the financial benefit going to the wealthy.[17] According to the study, the federal tax credit subsidizing consumer purchases of EVs "…could end up costing as much as $15 to $20 billion, while the cost of state subsidies could be as high as $400 million to almost $500 million."

EVs will undoubtedly play a growing role in our transportation future, but we firmly believe all future fuels and vehicle technologies should compete on a level playing field that includes free and fair access to the marketplace.

VII. Biofuels and electrification can play complementary roles in the long-term future of our transportation sector, as important synergies exist between the two

While some suggest liquid fuels and electrification create an "either-or" dilemma for the future of our transportation sector, we believe ethanol and EVs can play complementary roles in the long term. Indeed, emerging technologies that utilize ethanol's unique properties in hybrid electric technology, and even fuel-cell powered vehicles, demonstrate that low-carbon ethanol and electricity can be a winning solution to address future climate and energy security issues.

In 2016, Nissan unveiled the prototype of a vehicle powered by a solid oxide fuel cell that uses ethanol as the fuel. The Nissan "e-Bio Fuel Cell" prototype vehicle runs on 100% ethanol to charge a 24kWh battery that enables a cruising range of more than 600 kilometers.

[17] Strata. October 2017. The Current State of Electric Vehicle Subsdies: Economic, Environmental, and Distributional Impacts. https://strata.org/pdf/2017/ev-full.pdf

And just last month, Toyota revealed its first prototype of a hybrid electric vehicle powered by a flexible fuel internal combustion engine that can run on any blend of ethanol and gasoline. According to news reports, Toyota plans to sell the flex fuel hybrid EV commercially by 2020. Ford has also experimented with ethanol flex fuel hybrid EV technology.

Unfortunately, both of these exciting new automotive technologies are being piloted in Brazil rather than the United States. However, in the long run, we believe these technologies have a future in the U.S. if smart policies are designed to establish a fuel-neutral framework that incentivizes desired performance rather than specific technologies.

VIII. In the near-term, existing fuel policies need to be implemented as designed to maximize renewable energy technologies.

This Committee deserves great credit for authoring the world's most aggressive and effective renewable energy policy – the Renewable Fuels Standard (RFS). By any measure, the RFS has been a success. It has lowered our dependence on imported gasoline and petroleum. It has lowered consumer gasoline prices. It has rejuvenated rural America with the single most important value-added market for farmers, allowing significant reductions in federal farm program costs. And it has reduced pollution in our nation's cities while reducing carbon from transportation fuels.

But EPA is currently undermining the program's effectiveness by systematically destructing biofuel demand at the expense of consumers demanding choice and savings at the pump and farmers facing economic peril as the cost of production increasingly exceeds market prices. The beneficiaries of EPA's demand destruction are highly profitable oil companies, many of whom have simply steadfastly refused to make the investments necessary for them to comply with the RFS cost-effectively.

In testimony before this Committee a week ago, EPA Administrator Pruitt acknowledged he has provided waivers to the RFS at an unprecedented rate. He did not, however, acknowledge how deeply these waivers have cut biofuel use. A review of EPA data by the RFA has demonstrated EPA's small refinery "hardship" waivers reduced 2016 RFS demand by 523 million gallons and 2017 RFS demand by an astounding 1.1 billion gallons!

There is simply no justification for EPA to have eviscerated the RFS with more than a billion gallons of demand destruction. Hardship waivers were intended for refineries experiencing disproportionate economic hard as a consequence of the RFS, not because of economic factors unrelated to the RFS. Ethanol is priced lower than gasoline today. It is the lowest cost octane on the market. Blending more of a lower cost product creates an economic hardship for no one.

Beyond the completely unjustified "hardship" waivers being granted with no apparent demonstration of hardship being shown, EPA has further undermined the program by forgiving

329 million gallons in RFS obligation for a bankrupt refinery in Pennsylvania whose financial problems are rooted in its own failed business decisions, not the RFS. And the Agency's failure to as yet address a court-ordered remand of 500 million gallons of 2016 RFS obligations further reflects an inexplicable disregard for the statute, the President's support for the RFS, and consumers across this country who deserve savings at the pump.

EPA's attack on the RFS must end. The Agency should work toward demand creation by allowing the year-round use of higher ethanol blends and cease its demand destruction campaign.

IX. In the long-term, a level playing field will empower consumers to make wise choices for their transportation needs, including a variety of electric and renewable liquid motor fuel options.

Without a doubt tremendous advances have been made in the automotive industry, all of which are commendable. That said, recognizing these improvements, we must not overlook the advantage of the renewable fuels we have readily available today. These new technologies can be paired with today's renewable fuels while improving both cost and convenience for the consumer.

As discussed above, we believe there is potential for new technologies to be harmonized with renewable fuels in future vehicle technology. A global policy shift is taking place driving transportation towards low-carbon technologies. We see that here in the U.S. in states such as California and it is accelerating worldwide. Renewable fuels have a key role to play in the development of new mobility. We believe a combination of technologies with ethanol could be the answer, so long as there is a level playing field. Together we can work together to increase efficiencies and reduce costs for consumers. It does not have to be one or the other.

Thank you for your time and interest in this matter of mutual consideration. I look forward to your questions.