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THE FUTURE OF TRANSPORTATION FUELS AND VEHICLES

WEDNESDAY, MARCH 7, 2018

House of Representatives

Subcommittee on Environment

Committee on Energy and Commerce

Washington, D.C.

The subcommittee met, pursuant to call, at 10:15 a.m., in Room 2322 Rayburn House Office Building, Hon. John Shimkus [chairman of the subcommittee] presiding.

Members present: Representatives Shimkus, McKinley, Barton, Harper, Johnson, Flores, Hudson, Walberg, Carter, Duncan, Walden (ex officio), Tonko, Peters, DeGette, McNerney, Dingell, and Pallone (ex officio).

Also present: Representative Loebsack.

Staff present: Mike Bloomquist, Deputy Staff Director; Daniel Butler, Staff Assistant; Kelly Collins, Staff Assistant; Adam Fromm, Director of Outreach and Coalitions; Ben Lieberman, Senior Counsel, Energy; Ryan Long, Deputy Staff Director; Mary Martin, Deputy Chief Counsel, Energy & Environment; Brandon Mooney, Deputy Chief Energy Advisor; Annelise Rickert, Counsel, Energy; Dan Schneider, Press Secretary; Jason Stanek, Senior Counsel, Energy; Hamlin Wade, Special Advisor, External Affairs; Everett Winnick, Director of Information Technology; Jeff Carroll, Minority Staff Director; Jean Fruci, Minority Energy and Environment Policy Advisor; Rick Kessler, Minority Senior Advisor and Staff Director, Energy and Environment; Alexander Ratner, Minority Policy Analyst; Andrew Souvall, Minority Director of Communications, Outreach and Member Services; and C.J. Young, Minority Press Secretary.

Mr. Shimkus. The subcommittee will come to order and the chair recognizes himself for 5 minutes for an opening statement.

We have experienced very gradual and incremental change in the transportation fuels and vehicles over the last several decades, but there are signs that the pace of change will accelerate in the years ahead. In the not-too-distant future we may see cars in showrooms and fuel choices at retail stations that are noticeably different than what is available today.

The purpose of this hearing is to provide an overview of the ongoing transition and learn more about what it all means for the American driving public. I welcome our distinguished panel of experts. While nobody's crystal ball is perfect, the individuals and organizations represented here have done some of the best thinking about the future of personal

transportation and I thank them for participating in this hearing.

Many factors are contributing to this evolving marketplace in transportation. One driver, no pun intended, is government policy. I should stress that this is not a hearing about the Renewable Fuels Standard, per se, or the Corporate Average Fuel Economy standards, or incentives for electrical vehicles. However, these and other federal policies are significant contributors to the changing fuels and vehicle marketplace and thus are an important part of the overall discussion.

For example, the Department of Energy is working with other agencies and national labs on its Co-Optima program to achieve breakthroughs in high octane fuels used in high compression engines. The program's goal is to cost effectively boost efficiency from the internal combustion engines and in so doing help reach a possible and possibly exceed the targets in both the RFS and CAFÉ. I look forward to hearing from Dr. Farrell on this and other research for which the National Renewable Energy Laboratory is a contributor.

But policy-driven change is only part of the picture.

We are also seeing technological advances, whether it is getting EVs closer to the point where they make economic sense for more people, further progress on natural gas-powered vehicles that can take advantage of our domestic natural gas abundance, continued improvement in fuel cells, or other avenues of research. And for every alternative vehicle breakthrough, there are alternative fueling infrastructure challenges for which solutions are being developed.

I might add that today's discussion is not just about alternative fuels and vehicles. Research is also underway to improve the efficiency of the internal combustion engine and help it remain a cost-effective choice in the decades ahead. I mentioned Co-Optima and its integrated approach to high octane fuels and internal combustion engines that are optimized for them, but other research is also achieving breakthroughs in getting more efficiency out of the conventional technologies.

I should also note that advances in autonomous vehicles, including passage of the SELF DRIVE Act, have been the subject of a lot of good work by the Digital Commerce and Consumer Protection Subcommittee under Chairman Latta.

Autonomous vehicles will also have an effect on the choice of fuels and vehicles that will be used in the future. It is all related, so we need to be mindful of everything going on in transportation research.

Of course, many factors are behind these transitions. Environmental considerations are certainly a factor, energy security is also a factor, but we can't lose sight of the most important thing and that is the impact on the consumer. We want to make owning, operating, and using a vehicle as affordable as possible for the American public and I hope this research helps in that regard.

In any event, change is happening in the transportation sector and I hope that today's hearing gives us all a better understanding of it. With that, my time, I am done with my opening statement. Anyone who wants a minute or a half on either side, seeing none, I yield back my time and now recognize the ranking member of the subcommittee, Mr. Tonko, for 5 minutes.

[The prepared statement of Mr. Shimkus follows.]

**********INSERT 1**********

Mr. Tonko. Thank you, Mr. Chair. I want to thank you for holding today's very important hearing, addressing the future of our nation's transportation fuels and vehicles. And thank you to all our witnesses for being here, Mr. Chair. I want to commend you on assembling an expert panel that can inform members of ongoing trends and impending changes to our nation's transportation sector.

It is beyond a doubt that our transportation sector is changing, that the mix of vehicles and fuels will be considerably different in 2050 than they are today. It will almost certainly be more diverse and cleaner. There are many benefits to reducing benefits on petroleum from improving national energy security to protecting consumers against the price volatility of the global oil market.

But the transportation sector is also key to addressing climate change. Vehicle miles traveled in the U.S. has continued to grow since the Great Recession and greenhouse gas emissions from transportation now exceed emissions from our power sector. It is clear that effective climate action needs to consider how to reduce transportation emissions.

Reducing emissions in the power sector has occurred much more quickly and can be done more cheaply, which is why

electrification of transportation has become a priority for achieving emissions reduction goals. In recent years, improvements in electric vehicles have been impressive, including reductions in battery cost, increased range and greater changing infrastructure options and, increasingly, utilities are embracing the tremendous opportunity for increase on electricity demand. We can imagine an exciting future where vehicles offer the potential to balance loads on the grid as energy storage resources.

While impediments still exist for further EV deployment, we are trending in the right direction. Despite the excitement around electric vehicles we need to acknowledge that this transition is not going to happen overnight. The internal combustion engine will continue to make up a significant portion of our nation's vehicle fleet in the coming decades.

We should also acknowledge that electrification will be more difficult to penetrate certain liquid fuel markets such as aviation, shipping, and potentially heavy duty vehicles, but we must make drastic reductions in greenhouse gas emissions immediately. Therefore, we need a multi-track approach backed by strong federal policies. This means

continuing to make significant R&D investments and provide tax incentives for electric vehicles as well as supporting the growth of an advanced biofuels market.

Alternative fuels such as biodiesel and compressed natural gas can be cleaner options and displace dirtier fuels for heavy duty vehicles which is important to not only reduce greenhouse gas emissions, but also other hazardous air pollutants. And regardless of the fuel choice, we should ensure that vehicles are using these fuels as efficiently as possible.

Undoubtedly, CAFÉ standards played a role in development of technologies to improve fuel economy. Unfortunately, EPA Administrator Pruitt is reconsidering the greenhouse gas standards for model year 2022 through 2025 light duty vehicles and questioning whether the Agency's initial assumptions about technology development and costs from 2012 are still accurate and reasonable.

It is clear from the technical assessment as well as the robust and conclusive public record that these standards should be maintained. They are feasible, can be met at lower cost than originally estimated, and can be achieved through a number of different technology pathways, many of which are

already commercially available. In addition to saving consumers at the pump, EPA projects that the model year 2022-2025 standards will reduce emissions by more than 230 million metric tons by 2050 and nearly 540 million metric tons over the lifetime of model year 2022 to 2025 vehicles.

Similarly, we know the Administration is considering whether or not to support changes to the Renewable Fuel Standard. Like CAFÉ, this is an area that this subcommittee has examined and I would caution against unilateral action by the Administration which may not benefit consumers, put us on the path towards reducing transportation, or increase domestic energy security. These federal policies along with tax incentives, R&D investments, and state policies are important pieces to shaping the future of transportation in our country.

Ultimately, other countries will continue to embrace electrification, low emissions liquid fuels, and fuel economy. They realize that their air quality depends on these developments and they recognize the threat of climate change as real and requires major commitments to reduce emissions from all sectors. The United States should continue to lead and innovate and ensure that our

manufacturers, our automakers, and our refineries are able to deliver cutting edge vehicles and fuels for the United States and markets around the world.

With that Mr. Chair, I yield back.

Mr. Shimkus. The gentleman yields back his time. The chair now recognizes the chairman of the full committee, Congressman Walden from Oregon, for 5 minutes.

The Chairman. Thank you, Mr. Chairman, appreciate it. Appreciate your leadership on this and so many other issues and I welcome our panelists here today.

As we explore the emerging trends of motor vehicles and the fuels that they use, across several federal agencies and national labs and throughout the private sector research as you all know is underway to make driving cleaner, safer, and more efficient. Regardless of whether this work is the result of government mandates or market forces, it nonetheless is going on and change is coming to the fuels and vehicles marketplace.

The purpose of this hearing is to get a better sense of this change and I welcome our witnesses as part of helping us better understand it. Today, we will hear about the environmental objectives, efficiency objectives, national

security objectives, and other policies behind the evolving fuels and vehicles marketplace. But as we have this discussion, let us not forget the one thing that matters most and that is the interest of consumers.

Family car, it is the second most expensive purchase after a house and the average price for a new vehicle has risen to more than $36,000, up nearly $600 just from a year ago according to Kelley Blue Book. Yes, that is the average price and it is quite a burden for households as well as millions of small business owners and farmers and ranchers who rely on their vehicles to make a living.

Naturally, the car buying public wants these sticker prices to go down rather than continue going up, same is true for fuels. The average household uses about a thousand gallons per year which makes fill-ups a very significant part of the family budget. Struggling families and businesses would like to see breakthroughs to bring down the cost of gasoline or alternative fuels. It is important to recognize that if new fuels and vehicles do not deliver consumer benefits then they likely won't deliver any environmental or other benefits either.

An auto dealer once told this subcommittee that even the

most eco-friendly car won't do any good if it just sits in the showroom, and nobody I know has ever refuted that logic. Bottom line, the sources of alternative fuels in the marketplace relies heavily upon the ability to bring down the cost per mile traveled and the success of alternative vehicles relies on avoiding sticker shock.

So the good news is, the breakthroughs in fuels and vehicles can be done in a way that benefits consumers while also achieving environmental and other objectives. As someone who owns and drives a hybrid on both coasts, I hope we can work together to a future that is cleaner, safer, and more efficient, and yes, perhaps even less expensive transportation modes. I welcome this discussion on how we get there. This committee is committed to this effort and my friend from Illinois is putting a lot of time into the fuels issue along with others and so we look forward to your testimony today.

And with that, Mr. Chairman, unless anybody wants the remainder of my time, I would be happy to yield back so you can move along with the hearing.

[The prepared statement of Mr. Walden follows:]

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Mr. Shimkus. The gentleman yields back his time. The chair now recognizes the ranking member of the full committee, Congressman Pallone from New Jersey, for 5 minutes. Mr. Pallone. Thank you, Mr. Chairman. This morning we will examine the future of transportation fuels and vehicles, a future that will be shaped by federal policy.

While we have made significant progress in reducing emissions and improving fuel efficiency, I believe the federal government can and should do more. Last month, the EPA released the latest inventory of greenhouse gas emissions. For the first time, the transportation sector has edged out the electric power industry as the largest emitting sector. Transportation now accounts for 28.5 percent of our greenhouse gas emissions, with passenger vehicles contributing most of these emissions. While the total emissions from transportation are lower for 2016 than for the peak year of 2005, the trend is still not good. Overall emissions from this sector increased between 2012 and 2016. History has shown that real progress in fuel efficiency and emission reduction from vehicles is a direct result of government policies.

CAFÉ standards and the emission control programs of the

Clean Air Act have delivered great gains and the Renewable Fuel Standard program has provided us a reliable source of domestic fuel that has reduced both our dependence on petroleum and emissions from fuel combustion. Similarly, federal tax incentives, research, procurement, and loan programs have helped spur the development and deployment of electric vehicles, battery technology, advanced biofuels, and other fuel and vehicle options.

But we must do more. Oil prices may be affordable and supplies may be abundant right now, but that situation can change. Experience demonstrates that the adjustments of rising prices is painful for everyone, from individual vehicle owners to auto manufacturers and all the businesses in their supply chains. A diverse fuel supply combined with enhanced fuel efficiency provides an important buffer against rising prices.

And if we do not do more to reduce transportation sector emissions, the effects of climate change are likely to accelerate and worsen. Moreover, vehicles are major purchases and reliable vehicles can remain on the road for up to 25 years, so it may take many years to see substantial changes in fuel consumption or emission reductions without

aggressive federal policies.

And all of this has implications beyond our own borders. Two countries with the largest market potential, India and China, have signaled their intention to move beyond the internal combustion engine. Meanwhile, a number of European countries are reducing or phasing out their use. U.S. auto manufacturers need to remain at the forefront of this industry and that will only happen if they maintain a diverse fleet of vehicles with improved fuel efficiency and reduce emissions. When U.S. auto succeeds, the country's economy also succeeds.

So let me say in closing that I am very concerned about the direction President Trump is taking on fuels and vehicle policies. Low fuel prices are already leading automakers and consumers to discount the importance of fuel economy as a consideration when making a vehicle purchase. The Trump administration's apparent intention to weaken the pending combined CAFÉ and greenhouse gas emission standards for light duty vehicles would take us in the wrong direction.

Meanwhile, the Administration's proposal to rescind EPA's glider truck rule which closes a gaping loophole in freight truck emission standards has rightly united both

truck manufacturers and environmentalists in opposition. We need to spur innovation and reward it. We need the transportation sector to be cleaner and more efficient. However, technologies to improve fuel efficiency, reduce emissions, and diversify fuel supplies will not appear on the market without the technology push provided by strong federal policy.

And rollbacks are, by definition, not a way to move forward. We can have cleaner, healthier air and vehicles that cost less to operate delivered by a globally competitive U.S. automobile industry if we stay the course.

And I don't think anyone else wants my time, so I will yield back, Mr. Chairman. Thank you.

Mr. Shimkus. The gentleman yields back his time. We now conclude with member opening statements. The chair would like to remind members that pursuant to committee rules, all members' opening statements will be made part of the record.

We want to thank all of our witnesses for being here today and taking the time to testify before the subcommittee. Today's witnesses will have the opportunity to give an opening statement. Your full statements are already submitted for the record and your opening statement is to

summarize that document and then followed by a round of questions from the members who will be remaining here.

Our witness panel for today's hearing will include Mr. John Maples, Senior Transportation Analyst, U.S. Energy Information Administration, thank you for being here; Dr. John Farrell, Laboratory Program Manager, Vehicles Technologies, National Renewable Energy Laboratory; Dr. Joshua Linn, Senior Fellow, Resources for the Future; Dr. Jeremy Martin, Senior Scientist and Fuels Lead, Clean Vehicles Program, Union of Concerned Scientists; and Mr. John Eichberger, Executive Director of the Fuels Institute.

We appreciate you all being here today. We will now begin with Mr. Maples, and you are recognized for 5 minutes. Thanks for being here.

STATEMENTS OF JOHN MAPLES, SENIOR TRANSPORTATION ANALYST, U.S. ENERGY INFORMATION ADMINISTRATION; JOHN FARRELL, LABORATORY PROGRAM MANAGER, VEHICLES TECHNOLOGIES, NATIONAL RENEWABLE ENERGY LABORATORY; JOSHUA LINN, SENIOR FELLOW, RESOURCES FOR THE FUTURE; JEREMY MARTIN, SENIOR SCIENTIST AND FUELS LEAD, CLEAN VEHICLES PROGRAM, UNION OF CONCERNED SCIENTISTS; AND JOHN EICHBERGER, EXECUTIVE DIRECTOR, FUELS INSTITUTE

STATEMENT OF JOHN MAPLES

Mr. Maples. Thank you. Chairman Shimkus, Ranking Member Tonko, and members of the committee, I appreciate the opportunity to appear before you today. The Energy Information Administration is the statistical and analytical agency within the Department of Energy. By law, EIA's data, analyses, and projections are independent, so my comments should not be construed as representing those of Department of Energy or any other federal agency.

My statement focuses on the Reference case of the EIA Annual Energy Outlook 2018 which presents projections for the U.S. energy system through 2050. The AEO 2018 Reference case is a business-as-usual, trend estimate using known technology

and technological and demographic trends and with the assumption that current laws and regulations remain unchanged throughout the projection period. My oral statement will focus on light duty vehicles, passenger cars, and light trucks, which accounted for 55 percent of total transportation energy use in 2017, the base year for the AEO 2018.

The Reference case includes the CAFÉ and greenhouse gas emission standards as issued by NHTSA and EPA for multi-years' 2017 through 2025, as well as the California Zero Emission Vehicle program adopted by nine additional states -- to see that map, see Figure 1 in my written statement -- and existing tax credits for alternative and advanced vehicles and fuels.

Total transportation energy consumption peaked in 2017 in the Reference case at 13.1 million barrels per day. With CAFÉ standards and advanced technologies, average new light duty vehicle economy rises from 33.4 mpg to 48.6 mpg by 2050. Total vehicle miles of travel grow 18 percent between 2017 and 2050, yet energy consumption decreases by 30 percent by 2042.

Starting with vehicle sales, sales of conventional

gasoline vehicles continue to dominate, but the share declines from 87 percent today to 71 percent in 2050. Electrified vehicles including battery electric, plug-in hybrid electric, and full hybrid electric grow strongly, rising from 4 percent of new sales in 2017 to 19 percent in 2050. Battery-only electrics grow to 12 percent due to policies such as California's ZEV regulation, declining battery cost, and longer-ranged models.

Hybrid electric sales rise to 5 percent from 3 percent, plug-in hybrid electrics from 1 percent to 2 percent, E85 flex-fuel vehicles reach 7 percent by 2050, sales of diesel, natural gas, propane, and fuel cell vehicles are all at 2 percent or less in 2050.

Now for fuel shares, while petroleum products remain dominant for light-duty vehicles to 2050, see Figure 5, gasoline with ethanol falls from 99.5 percent to 91 percent by 2050. The E85 share rises from 0.1 percent to 1.5 percent, electricity usage grows to 4.7 percent, diesel to 2 percent, and natural gas is negligible.

The key areas of uncertainty in the Reference case are fuel prices, the digital economy, consumer acceptance, and potential changes in policies. Higher or lower fuel prices

can change the relative attractiveness of all vehicle types. In the High Oil Price case, the sales shares of conventional gasoline vehicles declines to about 62 percent in 2050 compared to 71 percent in the Reference case. In the Low Price case, the shares go up a couple of percent. In all cases, High and Low Oil Prices and the Reference case, fuel consumption decreases.

On-demand ride-hailing is already affecting how consumers utilize personal vehicles and mass transit. At this point, the potential energy impact of autonomous vehicles is unclear and open to wide variation. Customer acceptance affects the future market success of vehicle types and alternative fuels. For example, cost and performance, alternative fuel prices, and the availability of refueling infrastructure are all going to have an impact.

Finally, the future regulatory environment is uncertain. The EIA is currently working on Issues in Focus articles associated with the AEO2018 that will cover potential impacts on future energy demand. This analysis will likely be released in late spring. This concludes my statement and I will be happy to answer questions from the committee.

[The prepared statement of Mr. Maples follows:]

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Mr. Shimkus. Thank you very much. The gentleman yields back his time. The chair now recognizes Dr. John Farrell. You are recognized for 5 minutes. Thanks for being here.

STATEMENT OF JOHN FARRELL

Mr. Farrell. Chairman Shimkus, Ranking Member Tonko, members of the subcommittee, thank you for the opportunity to address this hearing on the future of transportation. My name is John Farrell and I am the laboratory program manager for Vehicles Technologies at the Department of Energy's National Renewable Energy Laboratory in Golden, Colorado. I manage DOE's Co-Optimization of Fuels & Engines, or Co-Optima Initiative, and a range of other transportation R&D work at NREL. Prior to joining NREL, I worked for 15 years at ExxonMobil's Corporate Research Laboratory where I oversaw R&D focus on advanced fuels and vehicles in collaboration with several leading car and truck companies.

Mobility is foundational to our way of life. Today in the United States we are on the cusp of a wave of innovation that will dramatically transform our transportation sector. Innovations in vehicles, fuels, and infrastructure are being driven by a large extent by research led by DOE, NREL, other national laboratories, and our key industry partners. Our work holds the promise of providing mobility that is more convenient, affordable, and energy efficient, while at the

same time boosting our nation's economy and our overall global competitiveness.

It is often noted that transportation is poised to undergo simultaneous evolutions due to the advent of connected, autonomous, shared, and electrification technologies. While the impact of these advanced mobility technologies will indeed be wide-ranging, it is also true that vehicles with conventional internal combustion engines will remain an important component of our transportation system for decades to come.

That is why DOE and NREL are spearheading the Co-Optima Initiative which, in collaboration with eight other national labs and 13 universities, is conducting research that will help fuel producers and engine makers put the most efficient, high performance cars and trucks on the road. Much of our work to date has focused on identifying the benefits of fuel properties such as octane and enabling high efficiency gasoline engines and the role that blend stocks such as ethanol could play in providing these properties near term.

Co-Optima gives us the opportunity to save American consumers and commercial truck operators up to $35 billion a year in fuel expenses while maximizing vehicle performance

and efficiency, intelligently leveraging domestic resources such as non-food biomass, expanding job opportunities, and enhancing energy security. Research is also on the way on transportation connectivity and automation. By automating driving and other functions and enabling vehicles to communicate with each other and with the transportation network, this complex arena of new technologies foretells a future with reduce congestion and smoother traffic flows, saving us all a lot of time and money.

The Sustainable Mobility program at NREL is working to support and complement DOE's SMART Mobility initiative. A major goal of this effort is to fully integrate electrified vehicles with the electric grid to ensure that when large numbers of electric vehicles enter the marketplace they will work smoothly with renewable energy sources, with buildings, and with the entire expanse of our transportation infrastructure.

Fuel cell vehicles are now commercially available and have a range in refueling times comparable to conventional vehicles and achieve no tailpipe emissions. Our R&D has played a critical role in the advancement of technology for fuel cell vehicles and related hydrogen infrastructure needs.

For electric vehicle charging infrastructure, NREL and the DOE labs are working on technology that will help establish a national network of extreme fast-charging stations capable of recharging batteries in a fraction of the time currently required, and we are exploring wireless in-road charging options for the longer term.

Commercial trucking also stands to benefit greatly from the new technology. DOE and NREL are exploring fuel cell and battery strategies for truck electrification that could substantially reduce fuel expenses, lower maintenance costs, and reduce emissions. The lab has forged strong partnerships with industry leaders and numerous fleet operators. With fuel costs amounting to 40 percent of trucking expenses, greater fuel efficiency could save commercial fleet operators and you, as consumers, hundreds of millions of dollars annually.

It is increasingly clear that we will need huge amounts of data and super computers to analyze the model at all if we are to coordinate and optimize the myriad of new technologies that will comprise tomorrow's interconnected transportation network. NREL's portfolio of databases each maintain and provide access to a wealth of invaluable, real-world, on-road

transportation and energy systems data. These tools are already making a substantial contribution to the numerous R&D activities I have described.

As you can see, mobility R&D is critical to our nation's transportation future. And as we contemplate the resource portfolio needed to get us there, we can be assured that the global race for new technology solutions will only intensify. Maintaining our leadership and innovation is as important now as ever. Thank you.

[The prepared statement of Mr. Farrell follows:]

**********INSERT 4**********

Mr. Shimkus. Thank you. Now I would like to turn to Dr. Linn. You are recognized for 5 minutes and again thank you for being here.

STATEMENT OF MR. LINN

Mr. Linn. Thank you distinguished members of the subcommittee for inviting me to speak today. My name is Joshua Linn. I am an associate professor in the Department of Agricultural and Resource Economics at the University of Maryland and a senior fellow at Resources for the Future, a nonprofit and nonpartisan environmental economic think tank. The views I express today are my own.

New technologies are fundamentally changing the vehicles people buy and the way they travel. Each year, passenger vehicles become more efficient, safe, and fun to drive. New car buyers can choose among an expanding number of vehicle options. Information technologies continue to create new travel options such as ride sharing or ride-hailing services and bike share programs.

The future may bring ever increasing levels of automated driving. These are exciting technological developments, but their implications for energy security and the environment are complex. My central point today is that these innovations benefit the U.S. economy and that well-designed policies can foster innovation while ensuring that societal

objectives are met. I will make several specific points based on observations of recent consumer and automaker behavior.

First, tightening standards for fuel economy and greenhouse gas emission standards have imposed costs on both automakers and consumers. Following a long period of constant fuel economy standards, the National Highway Traffic Safety Administration and EPA have been tightening these standards. My research suggests that consumers undervalue recent improvements in fuel economy.

Over the past decade, automakers have gradually raised fuel economy to meet tightening standards. Based on data covering about a half million recent new vehicle buyers between 2010 and 2014, on average, consumers are willing to pay only about $50 for $100 worth of fuel savings. The fact that consumers do not want to pay the full hundred dollars implies that automakers cannot pass on all the costs to consumers.

The regulatory agencies assume that when automakers adopt fuel-saving technology, they raise vehicle prices sufficiently to cover costs. But if consumers only pay half the value of the fuel savings and the technology costs more

than consumers are willing to pay, automakers can't raise prices sufficiently to cover costs without harming their sales. Thus, undervaluation implies the cost of tighter standards are borne by both consumers and automakers.

My second point is that tighter standards have affected vehicle horsepower and other attributes as well as fuel economy. An automaker raises the vehicle's energy efficiency when it adopts fuel-saving technology. The automaker can then decide whether to use the additional efficiency to boost fuel economy, horsepower, or both.

Typically, consumers are willing to pay more for horsepower than for an equivalent amount of fuel economy. Consequently, in the 1990s and 2000s when standards were changing, or not changing, automakers adopted fuel-saving technology and added the efficiency, and used the efficiency to boost horsepower and increase vehicle size without affecting fuel economy.

During that time, horsepower tended to improve about 2 percent per year on average. Then, when standards began tightening, automakers used those energy-saving technologies to boost fuel economy rather than horsepower. In other words, consumers are foregoing the horsepower improvements

under tighter standards that would have occurred if the standards had been left untightened. These foregone improvements appear to be costing consumers several billion dollars per year as compared to about $20 billion in fuel savings that they are getting from the higher fuel economy.

The third point is that so far the total cost of the standards appear to have been modest. The costs are difficult to observe, but research by my RFF colleagues suggest that marginal costs may have been 40 to $60 per metric ton of carbon dioxide based on trades of compliance credits. These numbers are suggestive, but they are also modest because they are comparable to previous estimates of the social cost of carbon dioxide or the fines paid under the fuel economy standards for noncompliance.

The tightening standards for vehicle fuel economy and greenhouse gas emissions have induced technology adoption and probably some innovation. The automobile industry has demonstrated quite a lot of ingenuity which has kept the total cost of the standards to a modest level. As long as standards continue to provide automakers flexibility to figure out the best compliance strategies, I fully expect these patterns to continue in the future.

The fourth point is that gasoline powered vehicles are likely to continue dominating the market for some time. Many policies incentivize consumers to buy or lease plug-ins. These policies combined may amount to 10- to $20,000 per vehicle of direct subsidies or indirect subsidies that may be funding charging infrastructure and the like. Nevertheless, consumers appear to continue buying, preferring gasoline powered vehicles. Declining battery costs and other innovations will surely increase the plug-in market share, but just how much is difficult to say.

Finally, new information technologies are transforming the way people travel. This is generally reducing travel costs and likely to increase total travel as well as total vehicle use. Fortunately, these changes can be addressed by adjusting the way that the standards are set. Right now, they provide equal incentives for changes in fuel economy regardless of how much the vehicle is driven allowing for that possibility that vehicles are driven different amounts would correct this inefficiency of the standards that has existed all along, but which these changes in travel may be exacerbating.

So again I want to thank you for inviting me to speak

today and look forward to your questions.

[The prepared statement of Mr. Linn follows:]

**********INSERT 5**********

Mr. Shimkus. Thank you. The chair now recognizes Mr. Jeremy Martin and you are recognized for 5 minutes. Dr. Martin, I am sorry.

STATEMENT OF JEREMY MARTIN

Mr. Martin. Thank you very much. Chairman Shimkus, Ranking Member Tonko, and members of the subcommittee thanks for the opportunity to testify today.

As has been noted, it is an exciting time to work in transportation. We are entering a period of change more profound than any since the automobile era began a century ago. But while autonomous vehicles get a lot of the attention, changes in our fuels and vehicles also have important implications for our economy and our environment. So thanks for holding this timely hearing and inviting me to share my views.

The fuels of the future will be cleaner and more diverse and the transition to these fuels is already underway. Any examination of transportation fuels must start with oil. Petroleum-based fuels are the dominant source of global warming pollution in the transportation sector which recently surpassed the electricity sector to become the leading source of U.S. carbon dioxide emissions.

There is no path to climate stability that does not involve drastically cutting our oil use. The Union of

Concerned Scientists has developed a plan to cut projected oil use in half in 20 years through improvements in efficiency and innovative clean fuels including electricity and advanced biofuels. The largest near-term opportunity to cut oil use comes from efficiency improvements which are not only important to the climate but also protect consumers from oil price volatility.

Oil price volatility remains a major risk. EIA's projections for a decade from now suggest that gasoline could cost anywhere from $2.19 a gallon to $5.21 a gallon, depending on the price of oil. This price risk is mitigated by the improving fuel efficiency of our fleet. No matter what the price of gas, consumers save because of cost-effective vehicle efficiency standards. The EIA forecasts that 10 years from now, thanks to these standards, the average driver will use a hundred gallons less to drive 10,000 miles than they do today. Using less oil is the best insurance against oil price volatility, so protecting vehicle efficiency standards is critically important.

But while oil is the largest part of the mix today, this is starting to change. For 50 years, from 1958 to 2008, oil supplied at least 95 percent of U.S. transportation energy.

But oil's hegemony began as the last coal-fired steam locomotives were replaced with diesels and it ended when refineries and gasoline distributors adopted a 10 percent blend as the main source of gasoline.

Ethanol used as a high-octane blending component of gasoline is less expensive and less polluting than the fossil fuel alternatives. But the rapid scale up of corn ethanol to supply this fuel also had negative consequences, putting pressure on agricultural commodity markets, exacerbating water pollution associated with corn farming, and land conversion as corn acreage expanded to meet the new demand.

More recently, the growth of biofuels has come mostly from biodiesel produced from soybean oil and other lower value fats and oils, and biomethane, a waste-based transportation fuel that displaces fossil fuels while supporting the capture and destruction of methane, a potent climate pollutant. Cellulosic ethanol from corn kernel fiber and corn stalks is also growing, albeit more slowly than originally hoped.

Looking into the future, the importance of electricity as a transportation fuel is no longer a matter of dispute, although how quickly this transition occurs remains

uncertain. Today, U.S. companies are leading the way on EV technology, but without the support of policies the U.S. will cede the field to economic competitors. This will not stop the inevitable transition to electric vehicles. However, this transition will take time and will proceed at different rates in different parts of the transportation sector. Petroleum and biofuels will remain an important part of our fuel mix for decades to come, so it is important to use them wisely.

Smart deployment of biofuels can support the progress of vehicle efficiency. The success of E10 demonstrates that ethanol is most valuable when it is used for its high-octane properties and the Co-Optima project shows the potential to build on this success. Automakers motivated by rising vehicle efficiency standards are currently putting engine technologies in the market such as turbocharging that would benefit from the deployment of high-octane fuels. However, until cost effective, high-octane fuel is reliably available, automakers won't sell cars with the higher compression and downsized engines required to realize the benefits of the co-optimized system.

Phasing in a new fuel gradually for use by optimized

vehicles will avoid shocks to the agricultural commodity markets and extend the useful lifetime of investments of ethanol production while making even deeper cuts in oil use than will be possible if we remain stuck at the E10 blend wall. Policies to support fuels and vehicles of the future should focus on cutting oil use and supporting the growth and innovation in the cleanest vehicles and fuels and this work is far from done. Thank you.

[The prepared statement of Mr. Martin follows:]

**********INSERT 6**********

Mr. Shimkus. Thank you very much. Now I would like to turn to John Eichberger, Executive Director of Fuels Institute, welcome. You are recognized for 5 minutes.

STATEMENT OF JOHN EICHBERGER

Mr. Eichberger. Thank you Mr. Chairman. And good morning, committee. Thank you for having me here today.

Real quick about the Institute, we founded in 2013 and we are nonprofit, collaborative, peer-reviewed research organization. We are unbiased. We do not advocate for any outcomes. Our goal is simply to deliver objective analysis of market conditions and trends to help decision makers make more informed decisions. That said, the comments I am delivering today are my own and they do not represent any specific position of anybody who is part of the Fuels Institute.

Let me start by noting I have read the written statements of all my co-panelists and there is almost nothing in their written statements with which I disagree. It is absolutely an exciting time to be part of this industry. There is so much going on. Every day there is new headlines and new reports to digest and analyze to where the market is heading. But the headlines don't always reflect reality and it is important to understand the fundamentals of the market if we want to appropriately anticipate the direction the

market might be heading.

I truly do believe the electric vehicles will represent a majority of vehicles in the future. Where I differ with a lot of other people is the definition of when that future might arise, and this is not because I don't believe the viability of the technology. It is because I look at the size of the market and I know it is going to take time to make a significant change.

To demonstrate my point I do have a chart. It is in my written statement, but I will have it on the screen here in a minute too. I wanted to take a look to see how long it takes for the market to evolve and so what I did is I plotted if we were to introduce a new feature into every vehicle sold as of January 1st, 2017, how long would it take to get to a significant share of the market?

The numbers I ran using IEA forecast for sales and scrappage rates means it would take 7 years before that feature was present in 50 percent of the vehicles on the road. That is a long turnaround to get something on the market. By contrast, battery electric and plug-in hybrid electric vehicles sold 1 percent of the vehicles last year. They represent 1 percent of the vehicles sold last year.

So we have got a long way to go. And that sales rate in 2017 was a 26 --

Mr. Shimkus. Will the gentleman suspend for a minute?

Mr. Eichberger. Sure.

Mr. Shimkus. Are we going to put his slide up?

Okay, thank you.

Mr. Eichberger. Thank you, Mr. Chairman.

[Chart.]

Mr. Eichberger. So if you take a look, that is the chart rate in terms of if every vehicle had a new feature, 100 percent market conversion, 7 years to get a 50 percent market share. EVs were 1 percent of sales last year, there is a 26 percent growth rate over 2016. And this next chart, if I can have that one up, I wanted to find out what would happen if we continued an aggressive sales rate.

[Chart.]

Mr. Eichberger. So this plots a 26 percent and a 20 percent annual growth rate for battery and plug-in hybrid

vehicles through 2035. This results in a potential market share of 43 percent of cars sold in 2035, but only 10-1/2 percent of vehicles on the road. That is the size and scope of this market. It is going to take a long time. Even with aggressive sales it is going to take time to get some turnover, which means in 17 years 90 percent of the vehicles on the road will still be powered by an internal combustion engine and fueled with liquid fuels.

The size of the market is enormous. We must not lose sight of that. Of course there are many factors that could accelerate the pace of change as outlined in my written testimony. But regardless, the internal combustion engine is going to dominate the market for decades to come and we are already seeing that market evolve. Downsized engines, start-stop applications, boosted engines, compression ignition, hybrids, variable compression ratio engines, auto engineers are charting new advancements all the time overseeing the benefits yielded to consumers.

Among the top as it has gained a lot of attention recently over the last several years is to design an engine optimized to run on a specific higher-octane fuel. I have seen numerous technical reports indicating that this could

provide a great benefit to efficiency, emissions, and performance for consumers. Fuels Institute, we have our own report coming out hopefully this May which seeks to answer some key questions about a high-octane fuel future.

These questions include how would we produce the fuel, what are the constituents that would go into building that fuel? What would be the cost and feasibility and scalability? What are distribution issues? What is the anticipated level of demand for the new fuel and how long might it make to reach market maturity? There is potential here, but tradeoffs are probably going to be required and the transition is going to take time.

The vehicles and fuels market is changing. Engines and fuels will become cleaner, more renewable and more efficient, but all transitions take time. I urge the committee to be suspicious of any prediction of eminent disruptive change. Most are focused on one causal factor and dismiss the numerous other factors that will influence consumer decisions. Changing today's transportation system will not be like introducing the car engine that replaced the horse and buggy. It will not be like introducing the smart phone which transformed pretty much all commerce and social

interaction as we know it.

Each example of a major, successful, disruptive event delivered compelling, immediate, and tangible value to the consumer that improved their quality of life in some real way and I question what options are we seeing in the transportation sector that could deliver similar value and cause transformative disruptive change? Whatever change is on the horizon, if the consumer cannot access it or does not want to buy it, it will not succeed and we wasted time and resources.

I believe change ultimately is coming, but for the foreseeable future the market is going to look remarkably similar to the market we have today and the transition to something different will be measured and incremental. Thank you very much for inviting me today.

[The prepared statement of Mr. Eichberger follows:]

**********INSERT 7**********

Mr. Shimkus. I thank all of you for the testimony. We will now move to the question and answer portion of the hearing and I will begin by recognizing myself for the first 5 minutes. I am going to go on my own, my own route here for a minute.

Dr. Farrell, they are always afraid when I start doing this. Two things, one is obviously I am very interested in the Co-Optima study and the potential for high-octane fuel which has been elaborated by many of you here today. In your opening statement you mentioned the terminology, non-food biomass. So being from a corn state, would you, is that just stover and stalk or would part of that definition be hybrid corn or GMO corn that is planted specifically for the fuel market?

Mr. Farrell. So the research that we have been doing on biomass-based routes to producing new fuels acknowledges that the current technology for producing ethanol from corn is well established and there are no real R&D challenges associated with that. When we start looking at cellulose to make ethanol as well I think we acknowledge that that technology is already commercial, albeit at low scale, but it also doesn't have the same resource to challenges.

Within Co-Optima we have been looking at the opportunities to look at a wide range of woody biomass, of energy crops, of stover, of waste residues to provide the feedstocks that will be able to provide high efficiency blend stocks including ethanol and other alcohols as well. So the research is really in focus where the greatest uncertainty lies.

Mr. Shimkus. Great, I appreciate that. Then I want to go to Mr. Eichberger and I appreciated the charts. That is why I wanted to get them up there. I think that is very helpful in just trying to figure out and there is public policy that probably bend that a little bit.

Mr. Eichberger. Of course.

Mr. Shimkus. But let's just take a short term window of 10 years, what a traditional -- and we have had this discussion before, there used to be we called them gasoline stations. In 10 years we may call them what and what would they look like?

Mr. Eichberger. In 10 years they are going to look a lot like they look today and we call them convenience stores, going back to my previous job. We are going to see some diversification. We may see additional fuel blends. We are

seeing some E15 on the market. That may increase. We may see some more electric vehicle charging stations on the market. Over the next 10 years we are not going to see a dramatic change in consumer behavior or the cars they are driving, so the market for fueling stations will evolve with the vehicle and the consumer. But we will see some diversification and new strategies coming forward to satisfy consumer demand.

Mr. Shimkus. And then to everyone, 10 years, different question, going into an auto dealership, what do you think we will see as we walk around either the showroom or the get out into the lot?

Mr. Maples? Just a guess, I mean this is kind of a 35,000-foot view of where we think we are going to be in 10 years.

Mr. Maples. Well, in 10 years, I would agree with the rest of the panelists that this is going to be primarily a combustion engine environment. So the vehicles that you are going to see are going to be a lot more efficient, probably some level of hybridization whether that is a microhybrid which doesn't deliver motive power, or some other full hybrid, plug-in hybrids, and then of course EVs, and then I

think that will be driven primarily by the mandates.

Mr. Shimkus. Dr. Farrell?

Mr. Farrell. I agree with Mr. Maples. I would note that many OEMs are announcing intentions of producing far more models based on those provided power trains. So we will see more electrified options, but I think the showrooms will look predominately the same.

Mr. Shimkus. Dr. Linn?

Mr. Linn. Yes, thanks. So suppose we are on the same path of fuel economy and emission standards and California is pursuing the Zero Emission Vehicle program, and other states, in that case I certainly would agree we will see a lot more options and probably more effort, you know, to sort of broaden the market for those vehicles.

Mr. Martin. Yes. I would certainly expect more EVs. I think that is, you know, the most visible change. And there is, you know, some uncertainty about how much travel people will do in vehicles they own versus, you know, rides that they hire, in which case they wouldn't need to go to a dealer.

Mr. Eichberger. Mostly internal combustion engines, we will see a lot more battery electric vehicles. We have to

keep in mind a lot of the automotive industry's announcement of electrification is going to be dominated by hybrids, so a lot more hybrids.

Mr. Shimkus. Great. And my time is expiring, but the other thing that I was, drew my attention was Dr. Linn when you talked about, and this is my district, we will pay for more horsepower. We won't pay for more, you know, mileage. I am summarizing that research, but I think that correctly points to at least 33 counties in southern Illinois.

With that I will yield back my time and turn to the ranking member of the subcommittee, Mr. Tonko, for 5 minutes.

Mr. Tonko. Thank you, Mr. Chair. Thank you again to our witnesses. This morning we have covered a lot of ground. There are many federal and state policies, technology developments and global trends and other nations' mandates that will shape the future of fuels and vehicles.

So, Dr. Martin, in Mr. Eichberger's testimony he points out that because of the long time that a vehicle remains on the road, adoption of new engine technologies or fuels and increases in fleet fuel economy take decades to fully penetrate the transportation sector.

As was mentioned earlier, according to EPA's most recent

greenhouse gas emission inventory, the transportation sector has now overtaken the electricity sector as the largest emitter of greenhouse gases in the U.S. and in recent years, the trend is upward for emissions in this sector. I am concerned about the implications of this for all air emissions including greenhouse gas emissions.

To make significant emissions reductions in this sector don't we need both cleaner fuels and more electric vehicles?

Mr. Martin. Yes. We absolutely need to make progress on both fuels and vehicles and to do so quickly. The long term that the vehicles stay on the road means it is even more important to do this up front.

Mr. Tonko. So what do you see as our best options in the cleaner fuels category?

Mr. Martin. In cleaner fuels there is a range of low carbon fuels out there. Of course, I think it is important to recognize electricity as a transportation fuel as a piece of that story as well as the biofuels we have been deploying which, you know, are getting significantly cleaner over time. And there is a lot more potential for biofuels. There is ample feedstocks to scale that up and to do it in ways that are cleaner and cleaner over time.

Mr. Tonko. And how much cleaner is today's average electricity generation than gasoline?

Mr. Martin. My colleague is just updating the analysis that we do of the mile per gallon equivalent of cars, of electric vehicle in terms of total pollution, and I think in terms of a weighted average across the country we are up to about 90 miles a gallon equivalent for EVs when you weight that based on where the vehicles are actually being charged.

Mr. Tonko. And electric vehicle sales have been increasing, but they still make up a very small portion of the vehicles on our roadways. Should we be investing more in the infrastructure to support electric vehicles, public charging areas, for example, to further reduce range anxiety and other barriers to electric vehicles?

Mr. Martin. It is certainly important to invest in infrastructure for electric vehicles. I think one of the things that our experience is that range anxiety is a larger factor before people buy an EV than after they buy one, especially with the range increasing. So, you know, most people are finding that charging at home and charging at work is adequate to meet the vast majority of their needs.

Mr. Tonko. And I noticed in the executive summary of

your 2016 report that you referred, I quote, years of stagnation in the improvement of the efficiency of passenger cars. Would you agree that strong federal regulation, CAFE standards in particular, are needed to improve the efficiency performances in vehicles?

Mr. Martin. Yes, absolutely. I think the record is very clear and I think others alluded to that as well. Without strong standards the consumers won't see the benefits of improved efficiency and will remain vulnerable the next time oil prices go up.

Mr. Tonko. Well, the Trump administration may be moving toward weakening the combined CAFE and greenhouse gas standards that were proposed by the Obama administration in spite of a midterm review document that found there are technologies available now and some that will be ready soon that will allow them to meet the standards. I am very concerned that this will return us to the years of stagnation that we experienced before. Is that a fair assessment?

Mr. Martin. Yes, absolutely. That is a very real risk. And, you know, I think what we saw before was that American automakers become less competitive when they allow their fleets to stagnate and don't invest in improving efficiency

and reducing oil use.

Mr. Tonko. So what are some of the most effective ways to accelerate the transition to cleaner fuels and vehicles?

Mr. Martin. Well, I think the standards that we have in place making sure those are strong and remain strong through 2025, the technical assessment report makes a very strong case for leaving them as they are and setting stronger standards that go further beyond 2025, and looking for ways to support electrification, advanced biofuels, and integrating these things thoughtfully together as we move forward.

Mr. Tonko. Well, in the debates about the lifecycle effects of different fuels and vehicles it is often pointed out that although electric vehicles do not emit anything directly, they may be drawing power from electricity sources that produce emissions. There is certainly a lively debate about the direct and indirect emissions associated with different biofuels, but we tend to assume all gasoline is equal in terms of its associated emissions.

Dr. Martin, is all oil the same in terms of its emissions?

Mr. Martin. Yes, it is a great point. There is a huge

variability in different sources of oil, different extraction methods, and different refining processes in terms of the extent of emissions in the production of oil and gas. And since we use and will continue to use such a large amount of gasoline and diesel, these emissions from the oil and gas sector are quite large and there is a lot of opportunity to reduce those or opportunity for them to go up if they are not attended to carefully.

Mr. Tonko. All right. With that, Mr. Chair, I yield back.

Mr. Shimkus. Man, you got full use of that 5 minutes, man. That was very efficient.

Mr. Tonko. I think we call it Tonko time. Thank you, Mr. Chair.

Mr. Shimkus. The chair now recognizes the gentleman from Texas, Mr. Flores, for 5 minutes.

Mr. Flores. Thank you, Mr. Chairman. I would love to have 10 minutes because this has been a fascinating discussion. I would like to thank the panel for being here.

Mr. Eichberger, let me start with you, two quick questions. One is, you know, today most gas stations carry some combination of regular, a mid-grade, and then a premium

grade. What do you think the opportunity is in terms of giving consumers choices in the future where they could dial in from EZ row to E85? Is there anything technologically that would prevent that?

Mr. Eichberger. I have not seen any units entering in the market to do that. There is nothing technologically to prevent them from it. I think there are some logical reasons why we wouldn't want them to do that in terms of controlling the emissions profile of the fuels. Having consumers make their own gasoline at the dispenser I don't think is a great idea.

Mr. Flores. Oh, you would have to put limits on it, of course, so that you wouldn't hurt the emissions restriction or the emissions profile that you are trying to achieve.

The next question I have for you is what are the challenges of facing the use of ethanol above E10 and can these challenges be overcome?

Mr. Eichberger. So there is compatibility issues. Every piece of equipment that a retailer uses to dispense fuel has to be listed as compatible with that fuel and up until about 10 years ago there were no dispensers listed for above E10. Some underground equipment is not listed. The

transition is getting easier, but the challenge becomes that a lot of retailers aren't the original investors in the underground storage tank systems so they may not even know what equipment they have underground. If they can't certify what is underground they can't move forward with that higher fuel.

Dispensers are fairly easy to upgrade. You can get E25 dispensers for about the same price as an E10 dispenser. But you have to be absolutely certain that what you have underground is compatible as well.

Mr. Flores. Okay, thank you.

Dr. Farrell, in the past, policymakers have sort of talked about fuels policy and vehicles policy separately, so we have heard a lot of chatter about EVs. We have talked about the Renewable Fuel Standard even though this hearing is not about that. We have talked about vehicle mileage standards and so forth.

Tell me about what your thoughts are in terms of integrating all policies, fuel policy and vehicle policies, into one coherent comprehensive policy.

Mr. Farrell. I think the opportunity that we are exploring within the Co-Optima program is really to

understand from the technology standpoint what the options are. So that is one of the key benefits that we have been able to apply is understanding where those tradeoffs are in the way we are unconstrained by what is currently available in the marketplace. Our hope is that that will be the basis for an informed policy discussion which we are not participating in but we fully hope to inform.

Mr. Flores. And I just, you didn't say this, but I am getting the inference or the implication that you think these policies should be combined from a policymaker's perspective.

Mr. Farrell. I think from the consumer standpoint, if the goal is to get higher performing fuels and vehicles in the marketplace then looking at these as an integrated system is the most effective way.

Mr. Flores. Okay. Thank you very much. The next question for you is you are researching alternatives to the internal combustion engines. You are also looking at ways to improve the efficiency of the internal combustion engine. How much better, let's say, if you look 10 years in the future what would the internal combustion engine look like and what would the efficiency improvement be versus a 2018 engine?

Mr. Farrell. Sure. If we look at the Department of Energy's goals for the internal combustion engine operating on today's fuels, by 2030 --

Mr. Flores. You could assume they don't have to operate on today's fuels. Again we are integrating all policy, but go ahead.

Mr. Farrell. Yes. We will build upon.

Mr. Flores. Okay. I am with you.

Mr. Farrell. So based on current fuels we are looking at 25 percent fuel economy benefit by 2030. By --

Mr. Flores. What percent again?

Mr. Farrell. 25 percent.

Mr. Flores. Okay.

Mr. Farrell. By co-optimizing it and allowing additional benefits to be realized we can get an additional 10 percent or 35 percent versus today. So that is a significant benefit that is available.

Mr. Flores. Okay, great. And what would, do you have a feel for what the cost differential would be in terms of cost per vehicle to get there?

Mr. Farrell. Since we are looking at something 10 years down the road, the cost implications are difficult and the

OEMs basically have the opportunity to trade off costs with some other areas, so we don't have good cost estimate at this point.

Mr. Flores. Okay, thank you. I look forward to following the research as you move forward.

In terms of one of the biggest challenges to the adoption of electric vehicles is their high upfront cost, also the limitations of current battery technology. Tell me a little about if you have done any research on this in terms of moving beyond lithium, what that implies for cost. I mean lithium has a huge environmental impact that is negative, so tell us about where you think the EVs could go moving beyond lithium.

Mr. Farrell. Sure. For the near term, I think everybody thinks that lithium-based batteries will be the main source of battery power for vehicles. The cost targets that the DOE has set for the 2022, 2023 time frame can be achieved with improvements to current lithium technologies, but to get cost parity with ICEs requires varied costs that are about a factor 3 lower than they are today. That will require new battery chemistries. Some of those may still rely on lithium, but some of the more expensive materials

such as cobalt, which has some strategic element constraints to it, will have to be removed in order to get those cost constraints down.

Mr. Flores. Okay. I would love to have more time, but I have run out of time. Thank you for your answers.

Mr. Duncan. [Presiding] I thank the gentleman and the chair will now go to Mr. Pallone for 5 minutes.

And I guess Mr. Peters would be next.

Mr. Peters. I will assume my best New Jersey accent to fill in for Mr. Pallone. Thank you, Mr. Chairman, and thank the witnesses for being here.

I had a question for Mr. Linn. So there is a company called Achates Power in my district that received one of the largest ARPA-E grants to do an efficient opposed-piston engine. They are doing a lot of that for defense. It has implications for a larger use. It boosts fuel economy, decreases emissions and also, for the benefit of Mr. Shimkus, his residents, it increases horsepower.

I wonder what the ability or what you would expect in terms of innovations like that absent government intervention through front end research grants or through some other regulatory approach that would make sure that we do these

incentives here in the United States?

Mr. Linn. All right. So there are already incentives just from, you know, consumers and what they want, right, to improve vehicles. I mean we see that over decades, vehicles today are a lot different and a lot better than they were, you know, 30 years ago in all sorts of dimensions.

The way that the sort of policies can affect things are really in two ways, right. One is sort of providing greater incentive to target those innovations towards improving fuel economy, reducing fuel consumption and emissions. The other is sort of on the sort of more basic research side to, you know, address the fact that, you know, there may be various reasons why the sort of private actors aren't conducting as much research and innovation as they should be.

And so there are, you know, reasons to do both of those and that would sort of encourage more innovation and then also sort of direct it towards meeting these public social objectives.

Mr. Peters. I am sort of wondering too like what is the -- well, what would be the incentive of if you expected higher prices from something like a carbon tax obviously I think people would be more incentivized to invest in these

kinds of things. Isn't that -- do you agree with that?

Mr. Linn. Yes, certainly. I mean we see, you know, when gas prices change we see the way consumers make decisions about what vehicles to buy certainly changes. And so, you know, by implication, you know, carbon price, you know, would sort of provide similar types of signals.

Mr. Peters. Maybe ask Mr. Maples what sort of assumptions you made about the price of fuel as you have sort of calculated the deployment of electric vehicles what assumptions you made about future costs of fuel?

You have to turn your microphone on. Want to turn your microphone on again, please?

Mr. Maples. Oh, sorry. In our Reference case, I think we have fuel prices going up to $3.47 a gallon by 2050. Again EVs do get a benefit on the fuel side. The problem with the CAFÉ standards or not the problem, but the issue with the CAFE standards and how that affects EV sales, you have an incumbent technology that is improving by, say, 30 percent in which, in effect, means a reduction in fuel cost of 30 percent. So that payback differential when comparing a gasoline vehicle to an EV, for example, is getting smaller.

Mr. Peters. Right.

Mr. Maples. So it is making it more difficult for the EV to compete against the gasoline vehicle over that projection. So while there are fuel savings that are available for EVs, it is really the incremental cost of the vehicles that matter.

Mr. Peters. California's Air Resources Board has simply set a level of cars that have to be on the road, electric cars that have to be on the road in the state by a certain time. That is essentially letting the car manufacturers decide how they are going to get to that point, but it has obviously created a lot of deals on hybrids and EVs that have attracted customers.

You didn't make any assumptions in your analysis about the government doing anything like that nationwide, correct?

Mr. Maples. That is correct. So we only have the eight states that have currently or, excuse me, the nine states plus California have currently adopted. We do allow credit trading among those states, so there is an optimization, if you will, to achieve that standard.

Mr. Peters. Right. And that would be much more efficient for California too if we were able to expand that beyond, and I certainly think if we could get the rest of the

country on board we would be willing to talk about that.

The other thing is, I wonder if you have made any assumptions about what foreign automakers are going to do in this space. I mean we have heard the Chinese announce that they want to do, I think it was 20 percent of all car sales to be or 20 percent of all cars to be electric. Did you consider that and would that kind of action by other countries and our competitors affect your analysis in terms of the rate of deployment?

Mr. Maples. So we don't specifically address that in the AEO, but we do have a feedback, a function in the model that as you build more of these vehicles there are economies of scales that occur. So we get pretty significant reductions in battery costs and improvements in our performance of batteries for those vehicles over the projection, so they are getting far more cost effective than they are today.

Mr. Peters. Right. And I would just finally just conclude by saying to Mr. Shimkus whose move is that if you drive a Tesla it is American made, it goes pretty fast. I think you would enjoy it. Thank you. I yield back.

Mr. Duncan. I thank the gentleman and apologize for the

name mixup. I will now go to the gentleman from Michigan, Mr. Walberg.

Mr. Walberg. Thank you, Mr. Chair, and thanks to the panel for being with us. Coming from Michigan we are pretty proud and committed to internal combustion engines. We appreciate some of the research that is going on. The University of Michigan is doing some great research on various things including autonomous. There are other options that probably assist in reducing the use of fuels including ride sharing and things like that, but at this present time the internal combustion engine is in a pretty good place and having a NASCAR track in my district I kind of like it as well.

Mr. Maples, you mentioned in your testimony that there are several technologies available to improve the fuel economy of internal combustion vehicles. For instance, you mentioned microhybrid or stop-start technology which feels really weird at times if you are not used to that. That is for sure. You project that will be included in about 20 percent of the gasoline vehicles by 2025. By some estimates, this technology can improve fuel economy by 5 percent.

Why is it that it only being offered to a small

percentage of vehicles according to your understanding?

Mr. Maples. So within our evaluation and projection of technology penetration we have a menu of probably 83 technologies that are available to improve the efficiency of gasoline vehicles over the projection and so the extent to which any of these technologies are successful or how competitive they are against other options that are available to manufacturers to improve efficiency.

So engine downsizing, turbocharging, some of what has been discussed here, improved valve train designs and how those designs operate within the engine can make a big difference and then there is transmissions and then lightweighting. And so we have a considerable amount of lightweighting that also occurs in the vehicle that again has an impact on the amount of efficiency improvement that is being gained across this menu of technology.

Mr. Walberg. So because of those multiple options, options like the stop-start technology, that is the reason why it is not included in a larger percentage because we have better approaches for various vehicles than that?

Mr. Maples. That is correct. So it is getting employed in those vehicles that where it is most cost-effective to do

the microhybrid, the integrated start-stop.

Mr. Walberg. What are some -- okay, go ahead.

Mr. Maples. So for others like the pickup trucks we see a lot more lightweighting in the aluminum, other high strength steel, transmissions being employed and turbocharging downsizing, you see more penetration there.

Mr. Walberg. And the cost factors there are justified? You know, turbocharging, I assume, is a more expensive approach, but you are getting performance out of it?

Mr. Maples. Correct.

Mr. Walberg. Okay. Are Corporate Average Fuel Economy standards enough to encourage greater fuel efficiency or are additional incentives or requirements necessary?

Mr. Maples. Well, yes. EIA doesn't comment on policy, so I will --

Mr. Walberg. Any other members of the panel that could comment on that? Yes, sir?

Mr. Martin. I think on the previous point, the fact that the standards could be met without the full penetration of some of these cost-effective technologies like stop-start technology reflects the ability to hit higher standards. And so, you know, I think there is certainly opportunities to go

beyond what is in the CAFE standards either by setting more stringent standards or additional policies to support rollout of oil saving fuel efficiency technology sooner.

Mr. Walberg. Thank you. I yield back, Mr. Chairman.

Mr. Shimkus. The gentleman yields back his time. I think the next colleague to turn to is my friend from California, Mr. McNerney, for 5 minutes.

Mr. McNerney. Well, I thank the chairman for your generous yielding and I thank the ranking member. But also the panelists, I have enjoyed your discussion.

So, history has shown that the petroleum industry is very volatile over about a 10 or 12 years' time cycle. We have been at a kind of a low point for a number of years now. Mr. Maples, do you see the -- I mean you can't foresee what is going to cause these shifts usually. Do you see a change in the cycle coming and what effect that would have?

Mr. Maples. So we do project that oil prices are going to increase in our AEO projection, but we also offer scenarios that show different potential outcomes of the Low Oil Price case and the High Oil Price case to try to bound at an upper level and a lower level what those oil prices could be.

Mr. McNerney. What is your upper bound?

Mr. Maples. Could I get back to you to --

Mr. McNerney. Sure.

Mr. Maples. Yes.

Mr. McNerney. Absolutely.

Mr. Eichberger, your projections seem realistic based on just the size of the fleet out there and the inertia that it has, but have you looked at what fuel prices will do in terms of accelerating the fleet turnover?

Mr. Eichberger. Yes. Fuel prices would accelerate it. We can take a look at that trend of hybrids. In the past, when fuel prices were 3.50 interest in hybrids of people in the market to buy a car was 82 percent. When prices dropped down below 2, it dropped down to 41 percent and sales of hybrids dropped as well. So fuel prices is a signal to consumers to start shopping around for something different.

Mr. McNerney. Thank you.

One of the things that I want to drill down a little bit is standards. Mr. Linn, you talked a little bit about standards. Do you think that higher CAFE standards is beneficial to the American economy and the American consumer and the auto industry or any of the three or all of the

three?

Mr. Linn. So I would say based on the research I have done that so far the standards to the sort of individual consumers and to automakers themselves have been more or less a wash. There are benefits and costs and they sort of even out. That is just narrowly on the benefit and cost to the industry itself and then there are the societal benefits for reducing oil consumption, you know, reducing emissions. Once you add in those then, you know, benefits would seem to outweigh the costs.

Mr. McNerney. Yes.

Mr. Martin, you had a little different take on that. Could you elaborate?

Mr. Martin. Well, I think that there is a large benefit from fuel economy standards and the consumer savings in fuel dramatically outweigh the additional cost of the vehicle over the lifetime of the vehicle. In fact, for a vehicle that is financed the costs probably outweigh, the fuel savings offset the costs basically on the day you drive off the lot. So that is what that our analysis reflects, substantial benefits to consumers from fuel economy standards even under low oil prices and if oil prices go up substantially larger benefits.

Mr. McNerney. Well, I mean it seems that the auto industry is always fighting these standards and in my mind it is essentially harming itself by doing so. Would you agree with that?

Mr. Martin. Yes, absolutely. I mean if they, you know, they may have a preference not to invest in new technology and to keep selling the technology they have, but this will leave them vulnerable to oil price changes in the future. And particularly in a moment when electrification is accelerating, you know, getting behind the curve on technology and oil saving technology, I think, is more critical in a moment of rapid change then it might have been in decades past.

Mr. McNerney. Well, you mentioned that the U.S. is leading in the EVs and car technology now. Is that partly due to the CAFE standards? Then what is going to happen if the CAFE standards go away?

Mr. Martin. I think in fuel efficiency technology for the fleet the CAFE standards are certainly very important. You know, EVs have other drivers in addition to fuel economy standards, but I think, you know, the range of support for electric vehicles whether it is support for research, support

for, you know, tax incentives, or standards, you know, without those, you know, one would expect less investment and, you know, less progress from the U.S. industry which could put it in a less competitive position over time.

Mr. McNerney. All right, thank you.

I am not going to try to be more efficient with my time. Mr. Chairman, I yield back.

Mr. Shimkus. The gentleman yields back his time. The chair now recognizes the gentleman from South Carolina, Mr. Duncan, for 5 minutes.

Mr. Duncan. Thank you, Mr. Chairman. And there is a lot of focus on infrastructure, an infrastructure package that the White House is working on that we will be taking up, and I think a big part of infrastructure should be our electrical grid. That is hardening, but that is also getting ready for the EVs of the future.

So, Mr. Farrell, what are the challenges for the electric grid, thinking of a future of considerably more EVs, and does our grid have the capacity to handle it at this point and what suggestions might you have going forward?

Mr. Farrell. I think estimates of the projections of EVs into the marketplace suggest that the impact on the grid

will be manageable. The overall change in load is a small percentage of the currents because of the large base in which we are building. So the challenge is not necessarily global, it would be local, especially if we adopt fast-charging technologies which are going to be required to give very rapid fills of batteries on passenger cars, or even especially on trucks and buses the local impacts could be substantial.

So most of the work that we are doing right now, in terms of key research in these, are identifying from the infrastructure standpoint what are the impacts of putting several megawatts of power into vehicles on a very rapid on-off cycle how to manage that in terms of the grid reliability.

Mr. Duncan. Right. Generally, looking at infrastructure in this country I have to ask how we are going to pay for it. South Carolina just had a massive gas tax increase in our state to pay for infrastructure roads and bridges needs there in the state. EVs don't pay any gas tax when they refuel and therefore they could arguably not contribute to the upkeep of the highways even those they are using those roads.

So, Mr. Maples, are we not already subsidizing EVs because they are not subject to the gas tax, and what are your thoughts on this and should EVs be charged something for maintenance and infrastructure? Should they be subject to some sort of gas tax, so to speak?

Mr. Maples. So currently in our analysis that is correct. We are using basically a residential electricity price for the cost of fuel for electric vehicles. So I am aware that some states have registration fees to try to cover the gasoline taxes that aren't currently being paid by electric vehicles so that could be an option, but otherwise there would have to be something implemented at either a refueling site, a public refueling site, or somehow that electricity metered differently within the home when they are recharging to capture whatever those taxes should be.

Mr. Duncan. Right. I mean I can make the argument that there is not enough EVs on the road right now to have a dramatic impact but, as Mr. Peters was saying earlier, the car companies are getting prepared for this massive increase in the number of electric vehicles that we will see in this country and I think we need to prepare for their impact on the roads and bridges and they ought to pay their fair share.

Now the electrical suppliers, the companies like Duke Energy and others, are collecting taxes from the ratepayers, but I don't see how that is translating to the infrastructure needs so I think that is something that Congress needs to work on.

I want to talk more on the rise of electric vehicles and highlight the research work that International Transportation Innovation Center is doing in tandem with my alma mater, the Clemson University, in the Greenville, South Carolina area. They are building a global market of open and closed automotive test beds for the most advanced innovations in connected, automated, and sustainable mobility.

Clemson University and ITIC collaborate on a variety of research activity with the Department of Energy, and Clemson also has a project under the DOE's Office of Energy Efficiency and Renewable Energy called Boosting Energy Efficiency of Heterogeneous Connected Automotive Vehicle Fleets. That is a big title for something, golly. That is government at its best, in my opinion, or worst maybe. They utilize their partnership to develop anticipative and collaborative traffic and vehicle control algorithms to achieve 10 percent energy savings.

Mr. Farrell, what are the challenges that you see with integrating, I guess, not only, I guess I am thinking more autonomous vehicles than I am just electric vehicles in general. But as we think holistically about EVs and driverless cars and traffic signals, recharging stations, this is a tremendous investment on somebody's part maybe not necessarily the federal government and the taxpayer.

Are you all thinking, Mr. Farrell, about that and how are you all involved in that just real quickly because you have got 10 seconds.

Mr. Farrell. So our primary role is to understand the energy implications of an expanded autonomous and connected fleet, and analyses that we have done showed that under some conditions in the worst case scenarios you could triple energy consumption or you could get a 60 percent reduction. So the key is how to integrate it in an effective way to minimize the energy impacts.

Mr. Duncan. And you are working with research universities along those -- yes.

Mr. Farrell. That is right. Mr. Duncan. Thank you, Mr. Chairman. I yield back.

Mr. Shimkus. The gentleman yields back his time. The

chair now recognizes the gentleman from Georgia, Mr. Carter, for 5 minutes.

Mr. Carter. Thank you, Mr. Chairman. Thank all of you for being here.

Gentlemen, I have the honor and privilege of representing the entire coast of Georgia, from South Carolina all the way down to the Florida state line, about 110 miles of coastline. As you can imagine, marine travel and boats are important to us. And very important, as all of you know and as anyone who owns an outboard motor knows, fuels can be very damaging to marine vehicles, to marine boats and outboard motors. It causes a lot of deterioration, a lot of wear and tear and that is something I am concerned about.

Mr. Maples, I will go to you first and just ask you, is the EIA doing anything to look at marine engines and are you factoring anything in to the future of transportation as a result of the fuels that we are having and being forced to use in marine vessels like this?

Mr. Maples. So we do, so we look at the freight industry marine sector and then we also look at recreational boating and we make projections of energy consumption in both, and we do track the gasoline and diesel consumption in

recreational boating separately from that of the rest of the transportation sector.

Mr. Carter. What is biobutanol? Tell me about that. Are you familiar with it?

Mr. Maples. I am not that familiar with it.

Mr. Carter. Anyone on the panel familiar with it a little bit? As I understand it, it is an alcohol produced from renewable plant-based energy sources or advanced feedstocks such as cellulosic biomass like wood residues. And from what I understand, at a 16.1 percent volume blend it actually has positive impacts on engines and it is less corrosive.

Does anyone know, have we looked at this as a possible fuel? I am open to anyone who is willing to --

Mr. Eichberger. So biobutanol has been discussed for quite a while. It is sometimes labeled with the moniker of a drop-in ready fuel, so compatibility issues are not a big issue supposedly. It has had a little trouble getting some market share and there is some limitation in terms of its --

Mr. Carter. Can you tell me why? Is it --

Mr. Eichberger. Quite frankly, I think it is a lobbying thing.

Mr. Carter. A lobbying thing.

Mr. Eichberger. There is a lot of stakeholders looking for a piece of this pie and this is another ingredient trying to get a piece of the fuels market and there is a lot of competition for it and I think there is some regulatory hurdles maybe to be overcome. I am not --

Mr. Carter. Okay. What are the regulatory hurdles? Can we help with that? Because if it is, you know, if actually as it says, if it has positive impacts on engines and is less corrosive this is what we need to be looking for. I mean, listen, I get calls all the time in my office about marine engines and about having to use this fuel corroding these engines.

Mr. Eichberger. I mean the EPA has looked at it. You can ask EPA specifically what is their criteria for considering biobutanol and blend levels and its interaction with other constituents in fuels. It is going to come from the EPA analysis of how it interacts.

Mr. Carter. Okay. But the regulatory hurdles that have to be overcome, is there anything we can do in Congress to assist this?

Mr. Eichberger. I have been told there are. I do not

know specifically what they are.

Mr. Carter. Okay, fair enough. Fair enough. While I have you, while I am talking to you I will skip over to the question I have for you. The marine manufacturers again have, they have raised some concerns about how the fuel blends are marketed to consumers. For instance, one of them, E15 fuel blends in some scenarios are being marketed as unleaded 88. Are you familiar with that?

Mr. Eichberger. I am familiar with that, yes.

Mr. Carter. What is going on with that? Why are they being labeled like --

Mr. Eichberger. The retailers who are selling E15 blended fuels are seeking an opportunity to grow their sales and because E15 has an octane rating of 88 they are able to market it as 88. They do affix the EPA-required label for which vehicles E15 is allowed to be used in according to EPA. But they are --

Mr. Carter. Do you think that causes some confusion among the --

Mr. Eichberger. There is a lot of confusion with consumers on all fuels. They like to not think about what fuels they are buying, so when we are thinking about bringing

new fuels to the market we have to really think about how we educate the consumer. There is no consistency in terms of how the retailers are selling their E15 other than affixing that EPA-required label advising consumers which vehicles they can use them in.

E15 is not approved for marine vessels and so that is specifically labeled on that fuel it is only for 2001 and newer vehicles and not these other vehicles.

Mr. Carter. Let me ask you all. Do you all think we can make it any more confusing? I mean can we all get together and see if we --

Mr. Eichberger. We can make it more confusing, absolutely.

Mr. Carter. Gee. Well, we are doing a pretty good job right now, I guarantee that.

Let me skip over and, Mr. Farrell, I will go to you and ask you this question. Again I represent South Georgia so, you know, plenty of pine trees. What about cellulosic fuels? Are we doing anything with that?

Mr. Farrell. Yes. The Department of Energy is indeed looking at advanced cellulosic routes to produce biofuels that could have advantageous energy and emissions profiles,

so that is an active area of interest.

Mr. Carter. Right. Thank you very much.

Thank you, Mr. Chairman. I will yield back.

Mr. Shimkus. The gentleman yields back his time. I am going to ask unanimous consent, Mr. Johnson, if you wouldn't mind, for us to go to Mr. Loebsack because he is patiently waiting and Buddy Carter went over time before you got in the door. So with that I will recognize the gentleman from Iowa who has waited patiently, for 5 minutes.

Mr. Loebsack. Well, thank you very much, Mr. Chairman, and thanks for holding this hearing today and for allowing me to waive on. I really do appreciate this on the subcommittee today. There is a heck of a lot that has been talked about today, very fascinating stuff.

My main concern as you might imagine being from Iowa is the RFS so I am going to talk about that for a second. But I do want just a couple of quick notes. Mr. Walberg talked about having a NASCAR track in his district. I have one in Newton, Iowa, but they also host every year the Iowa Corn Indy 300 at that NASCAR track, so I had to get that in. We also have a National Advanced Driving Simulator at the University of Iowa. They do a lot of great work on the

issues related to what you folks are talking about.

And I recently had a ride inside Iowa City with a Tesla that is advanced to be autonomous. I had a few worries as we were going through town, braking in time and all the rest, but it was actually pretty fascinating. So there is a lot to look forward to, I think, in the future as far as research on these different vehicles is concerned.

As Mr. Shimkus might expect, I do want to talk about the RFS a little bit today. It is a hotly debated topic, obviously. And I know that this is not about the RFS, but as Mr. Shimkus said, per se, it is not about that today. But it is going to be important going forward, I think, when it comes to fueling our automobiles and other vehicles down the road. There are a number of changes, I think, that are being discussed with respect to the RFS right now in Congress and I think a lot of them would be very harmful to rural America to farmers.

And I do appreciate the fact that Dr. Martin mentioned it is not just ethanol we are talking about here, it is biodiesel as well and it is advanced cellulosic, so it is a variety of things that we are talking about. But the RFS really has substantially benefited, I think, the U.S. economy

over the years. It has created jobs in both renewable fuels and industry and overall agricultural industry as well, led to a pay raise for American farmers, about $6,800 per American farm it has been estimated, and has directly affected folks living in rural communities. It has lowered gas prices, I think, by giving consumers choice at the pump which we all know leads to more money in the pocket of our constituents, so that is very important.

My home state of course leads the nation in biofuels production, Iowa, and I am very proud of that. It supports probably close to 50,000 jobs in Iowa alone and accounts for a sizable proportion of our economy. Biofuels, I think, are a clean, homegrown and high-octane alternative to fossil fuels which is very important that we have an alternative to fossil fuels, I think, for national security as much as anything as well.

The EPA has estimated as biofuel production has increased since 2007, total cropland acreage has actually dropped not risen, as some say. And, additionally, the USDA reports that demand has never been higher for conservation programs as well. I think there is some myths out there that we have to be very careful when we talk about the RFS that we

set people straight on this.

Americans are consuming more and more gasoline. Gasoline consumption set a new record high in 2018 of 9.35 million barrels per day with further increases expected in 2019, and yet another reminder, I think, why we have to maintain a strong RFS. I know that domestic oil production is soaring, but we all know that production won't last forever and that falling oil prices are not going to last forever as well.

I am running short on time. I could talk about a lot of, give a lot more facts and figures, but I think in the interest of time and given the fact that I am waived to this committee today, this subcommittee today, I do just want to ask Mr. Martin. With all the different statistics that we know in mind, how would you say the RFS and strong CAFE standards help to address continued increase in gasoline consumption and carbon emissions?

Mr. Martin. Right. So I think vehicle fuel, vehicles policy to make vehicles more efficient, fuels policy, and also to get electric vehicles going, these things work together to cut oil use and, you know, reduce all the burdens that high oil use has on the U.S., saving consumers money and

reducing greenhouse gas pollution and all the other challenges associated with oil pollution. So I think the RFS of course is supporting the development of alternative fuels, but, you know, all those pieces fit together.

Mr. Loebsack. Right, I appreciate that. And I do appreciate the comments about E15 that were mentioned too, because it is the case that I know some folks have concerns about that. Mr. Carter did. But the fact of the matter is that, you know, we can make sure that we label this correctly so that people do not have problems with their engines. And I know that Senator Cruz has some concerns about that as well.

But I want to continue to work forward with the President, with the Administration, with the relevant folks to make sure that we do have a strong RFS and that we do in fact continue to contribute to our rural economies. I think it is just absolutely essential and I think we can have cleaner air and I think we can reduce our dependence on fossil fuels and make sure that we have better security for our country as well so we are not fighting wars for oil down the road.

So thank you again, Mr. Chair, for having me and I

appreciate it. Thanks so much.

Mr. Shimkus. The gentleman's time is expired. Again the chair wants to thank the gentleman from Ohio and then recognize him for 5 minutes.

Mr. Johnson. Okay. Thank you, Mr. Chairman. I appreciate that and I was happy to yield.

Mr. Eichberger, many of us that are not from California are not big fans of the state's disproportionate role in dictating fuels and vehicle policies. Could you talk a bit about California's role in technology forcing with regards to fuels and vehicles and what it may mean for the rest of us?

Mr. Eichberger. Probably not to that extent. What I can articulate is of the electric vehicles that are being sold in the market, half of them are being sold to California. I think that is encouraged a lot by the Zero Emission Vehicle program they have and the other states that have the ZEV program, and it does drive some decisions by the automakers to satisfy the largest market in the union.

Mr. Johnson. Okay, all right. Well, thank you.

Mr. Maples, the Annual Energy Outlook for 2018 has projections out to 2040 and you see the gasoline powered internal combustion engine remaining the most popular choice

over that span. Can you explain the staying power of the internal combustion engine?

Mr. Maples. Sure. So again I think this really comes down to, for the alternatives to the internal combustion engine the cost of those alternatives and then the availability of alternative fuels in that refueling infrastructure, in general, just a consumer acceptance.

The gasoline vehicle is going to get much better. I think we have talked about that some here today. You are going to see significant improvements in fuel economy there, significant reductions in fuel costs for consumers of those vehicles, which I think is going to make it even more difficult for some of these alternatives to compete against it.

Mr. Johnson. Yes. You know, I am not a, I don't rebuild cars myself, but I know that here in America ever since the automobile was first developed it began creating an enthusiastic consumer base for old cars, rebuilding cars, automobile enthusiasts, and so I think consumer acceptance for a lot of the new technologies is a big part of this factor that is keeping the combustion engine as the mainstay. Would you agree with that?

Mr. Maples. I think that is correct. OEMs right now, for example, I don't think there are any propane vehicles that are available produced from an OEM, or natural gas.

Mr. Johnson. Right.

Mr. Maples. But they do sell them as convertible if a consumer wanted to go and have those converted over. So otherwise we have plug-in vehicles as an option and then flex-fuel vehicles.

Mr. Johnson. Sure, okay.

Also to you, Mr. Maples, to what extent is fueling infrastructure an impediment to increased market penetration of alternatives?

Mr. Maples. I think with any of these alternative vehicles there are hurdles and the question is how many hurdles have to be overcome in order for these options to be successful. Policy plays a role, but certainly one of the, I think the biggest hurdles is availability of refueling of those vehicles.

Mr. Johnson. Okay, all right.

Mr. Chair, with that I yield back a whole minute and 33 seconds.

Mr. Shimkus. The gentleman yields back his time.

Seeing that there are no further members wishing to ask questions for this panel, I would like to thank all of our witnesses again for being here today. Before we conclude, I would like to ask for unanimous consent to submit the following documents for the record: A letter from VNG, which is a natural gas vehicle group; and this, Fueling a Clean Transportation for the Future from the Union of Concerned Scientists. Without objection, so ordered.

[The information follows:]

**********COMMITTEE INSERT 8**********

Mr. Shimkus. In pursuant to the committee rules, I remind members that they have 10 business days to submit additional questions for the record and I ask that witnesses submit their responses within 10 days if possible upon receipt of the questions.

Without objection, the committee -- before I do that, I really appreciate it. I think it was a great hearing. Members were very participative and we learned a lot. So I do appreciate and, without objection, this committee is adjourned.

[Whereupon, at 11:49 a.m., the subcommittee was adjourned.]