SELF-DRIVING CARS: ROAD TO DEPLOYMENT

HEARING

BEFORE THE

SUBCOMMITTEE ON DIGITAL COMMERCE AND
CONSUMER PROTECTION

OF THE

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COMMERCE
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[1] Mr. Karrberg did not submit a response to questions for the record.
[2] Dr. Kalra did not submit a response to questions for the record.

SELF-DRIVING CARS: ROAD TO DEPLOYMENT

TUESDAY, FEBRUARY 14, 2016

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON DIGITAL COMMERCE AND CONSUMER
PROTECTION,
COMMITTEE ON ENERGY AND COMMERCE,
Washington, DC.

The subcommittee met, pursuant to call, at 10:15 a.m., in room 2123 Rayburn House Office Building, Hon. Robert Latta (chairman of the subcommittee) presiding.

Present: Representatives Latta, Harper, Burgess, Upton, Lance, Guthrie, McKinley, Kinzinger, Bilirakis, Bucshon, Mullin, Walters, Costello, Schakowsky, Luján, Clarke, Cárdenas, Dingell, Matsui, Welch, Kennedy, Green, and Pallone (ex officio).

Staff present: Mike Bloomquist, Deputy Staff Director; Karen Christian, General Counsel; Paige Decker, Executive Assistant & Committee Clerk; Blair Ellis, Digital Coordinator/Press Secretary; Melissa Froelich, Counsel, Digital Commerce and Consumer Protection; Giulia Giannangeli, Legislative Clerk, Digital Commerce and Consumer Protection/Environment; Katie McKeough, Press Assistant; Alex Miller, Video Production Aide and Press Assistant; Paul Nagle, Chief Counsel, Digital Commerce and Consumer Protection; Mark Ratner, Policy Coordinator; Dan Schneider, Press Secretary; Olivia Trusty, Professional Staff Member, Digital Commerce and Consumer Protection; Madeline Vey, Policy Coordinator, Digital Commerce and Consumer Protection; Gregory Watson, Legislative Clerk, Communications and Technology; Everett Winnick, Director of Information Technology; Michelle Ash, Minority Chief Counsel, Digital Commerce and Consumer Protection; Jeff Carroll, Minority Staff Director; Lisa Goldman, Minority Counsel; Caroline Paris-Behr, Minority Policy Analyst; Tim Robinson, Minority Chief Counsel; Matt Schumacher, Minority Press Assistant.

OPENING STATEMENT OF HON. ROBERT E. LATTA, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF OHIO

Mr. LATTA. Good morning. I'd like to call the subcommittee on Digital Commerce and Consumer Protection to order, and the Chair now recognizes himself for 5 minutes for an opening statement.

Again, good morning and welcome to the first hearing of the 115th Congress for the Digital Commerce and Consumer Protection subcommittee. It is a pleasure to be here with you all today.

Before we get started, I want to thank Chairman Burgess and Vice Chairman Lance for all the hard work they did in the last

Congress here on the subcommittee. I also want to recognize the new Vice Chairman of this subcommittee, the gentleman from Mississippi, and glad to have you board. Also look forward to working to advance an innovation agenda that creates jobs and puts consumers first, and I also want to recognize the gentlelady from Illinois, our Ranking Member. I appreciate we're going to be working with her this Congress. Also look forward to working in a bipartisan fashion to grow the economy and protect consumers.

Finally, as Chairman, I look forward to working with all the members of the subcommittee to continue exploring areas in the emerging digital economy that are creating new opportunities for economic growth, job creation, and consumer empowerment in America.

I recently had an opportunity to visit the auto show here in Washington, DC. The showroom floors were filled with vehicles equipped with innovative features and newly designed systems that promise to enhance the safety, mobility, and convenience of our drivers' experiences.

I was also greatly impressed with the creativity and ingenuity of the auto industry to build the vehicles that we could only dream about just a short time ago. The technological advancements in this sector are nothing short of amazing.

Today, this subcommittee will continue its focus on self-driving vehicles and their potential to completely transform our transportation system. We'll hear about what testing is happening, what testing needs to happen, and what the time frame is for that deployment.

In 2015, there were over 35,000 lives tragically lost on our nation's highways. Over 1,000 of these fatalities were in my home state of Ohio. Based on early estimates, traffic fatalities in 2016 are even going to be higher. Unfortunately, we also know that human error accounts for over 90 percent of all the traffic accidents. These are startling statistics; however, the emergence of automated vehicle technology and growing investments into fully self-driving vehicles promises a significantly reduced lives lost on the roads by decreasing traffic accidents making our roadways safer for all users.

As the auto industry works to make self-driving vehicles a reality, adequately testing these vehicles will be critical to refining their systems for commercial deployment and gaining consumer confidence that are safety.

Today, conventional vehicles undergo a range of tests in laboratories or proving grounds and on public roads before they are sold to consumers. In each of these settings, vehicle engineers and professional test drivers go through detailed assessments and inspections of vehicles to insure compliance with crashworthiness and crash avoidance standards, and to verify a vehicle's overall structural integrity. Cars are put through thousands, sometimes hundreds of thousands of miles of testing to insure that once the vehicle is on a dealer's lot it is safe for consumers and their families.

Unlike conventional vehicles, fully self-driving vehicles are intended to operate without the input or control of human drivers. No longer will manufacturing be able to rely on drivers to take corrective action in the event of an unexpected system failure, or an

unplanned roadway activity. Flexible and unregimented tests will be essential to certifying the safety and reliability of the technology empowering self-driving vehicles.

As we discuss this testing of self-driving vehicles today and steps to commercial deployment, I look forward to learning from the witnesses about how auto makers and other entities are testing these technologies in plans for future deployment.

I also look forward to hearing about how the existing testing environment can be improved to facilitate the innovation and development of potentially life-saving automated vehicle technology in this country.

Ohio's Transportation Research Center recently announced a significant investment into a Smart Mobility Advanced Research and Test Center in East Liberty, Ohio to allow for the testing of self-driving vehicles across thousands of acres of road courses. We need to understand how to insure more states take positive steps to move testing forward and to insure that testing doesn't become a roadblock to innovation.

Robust vehicle testing is essential to the successful and safe deployment of self-driving vehicles. Testing will not only provide auto makers and other entities with the data they need to make these vehicles as safe as possible, but it will help build consumer confidence in this technology which is central to realizing the future benefits of self-driving vehicles.

I thank the witnesses for taking the time to be with us today and I look forward to a thoughtful and engaging discussion. And at this time, I have about a minute left, and is there anyone on our side that would like to claim the minute? The Chair recognizes the Vice Chairman.

[The statement of Mr. Latta follows:]

PREPARED STATEMENT OF HON. ROBERT E. LATTA

Good morning and welcome to the first hearing of the 115th Congress for the Digital Commerce and Consumer Protection Subcommittee. It is a pleasure to be here with you today. Before we get started, I want to thank Chairman Burgess and Vice Chairman Lance for all the good work they did last Congress. I also want to recognize the new Vice Chairman of this Subcommittee, Gregg Harper. I look forward to working together to advance an innovation agenda that creates jobs and puts consumers first. I also want to recognize Ranking Member Schakowsky. I look forward to working in a bipartisan fashion to grow the economy and protect consumers. Finally, as Chairman, I look forward to working with all members of this Subcommittee to continue exploring areas in the emerging digital economy that are creating new opportunities for economic growth, job creation, and consumer empowerment in America.

I recently had the opportunity to visit the Auto Show here in Washington, DC. The showroom floors were filled with vehicles equipped with innovative features and newly-designed systems that promise to enhance the safety, mobility, and convenience of our driving experiences. I was greatly impressed with the creativity and ingenuity of the auto industry to build vehicles that we could only dream about a short time ago. The technology advancements in this sector are nothing short of amazing.

Today, this Subcommittee will continue its focus on self-driving vehicles and their potential to completely transform our transportation system. We will hear about what testing is happening, what testing needs to happen, and what is the timeframe to deployment.

In 2015, there were over 35,000 lives tragically lost on our nation's roadways. Over 1,000 of those fatalities were in my home State of Ohio. Based on early estimates, traffic fatalities in 2016 are likely even higher. Unfortunately, we also know that human error accounts for over 90 percent of all traffic accidents. These are

startling statistics; however, the emergence of automated vehicle technology and growing investments into fully self-driving vehicles promises to significantly reduce lives lost on our roads by decreasing traffic accidents and making roadways safer for all users.

As the auto industry works to make self-driving vehicles a reality, adequately testing these vehicles will be critical to refining their systems for commercial deployment and gaining consumer confidence that they are safe. Today, conventional vehicles undergo a range of tests in laboratories, on proving grounds, and on public roads before they are sold to consumers. In each of these settings, vehicle engineers and professional test-drivers go through detailed assessments and inspections of vehicles to ensure compliance with crashworthiness and crash avoidance standards, and to verify a vehicle's overall structural integrity. Cars are put through thousands—and sometimes hundreds of thousands—of miles of testing to ensure that once the vehicle is on a dealer's lot, it is safe for consumers and their families.

Unlike conventional vehicles, fully self-driving vehicles are intended to operate without the input or control of a human driver. No longer will manufacturers be able to rely on drivers to take corrective action in the event of an unexpected system failure or any unplanned roadway activity. Flexible and unregimented testing will be essential to certifying the safety and reliability of the technology powering self-driving vehicles.

As we discuss the testing of self-driving vehicles today and steps to commercial deployment, I look forward to learning from witnesses about how automakers and other entities are testing these technologies and plans for future deployment. I also look forward to hearing about how the existing testing environment can be improved to facilitate the innovation and development of potentially life-saving automated vehicle technology in this country. Ohio's Transportation Research Center recently announced a significant investment into its Smart Mobility Advanced Research and Test Center in East Liberty, Ohio to allow for the testing of self-driving vehicles across thousands of acres of road courses. We need to understand how to ensure more states take positive steps to move testing forward and to ensure that testing doesn't become a roadblock to innovation.

Robust vehicle testing is essential to the successful and safe deployment of self-driving vehicles. Testing will not only provide automakers and other entities with the data they need to make these vehicles as safe as possible, but it will help build consumer confidence in this technology, which is central to realizing the future benefits of self-driving vehicles.

I thank the witnesses for taking the time to inform us and I look forward to a thoughtful and engaging discussion.

Mr. HARPER. Thank you, Chairman Latta, for calling this hearing today to build on the subcommittee's previous efforts to examine and better understand the world of self-driving cars.

As many of you have noted today, the developments and innovation in self-driving cars has the potential to provide countless improvements to our transportation system, and invaluable safety enhancements that could save thousands of lives every year.

Of particular interest to me is the potential benefits and new opportunities that self-driving cars would provide to Americans with disabilities, including those with intellectual disabilities who are unable to obtain driver's licenses and must rely on friends, and relatives, and sometimes uncertain modes of public transportation in order to get about their daily lives, including running errands, or just getting to a job. In the disability world, lack of transportation is widely viewed as the top impediment to success at advancement in society.

Self-driving cars could offer the disability community a really tremendous opportunity. We're looking forward to hearing more about this. With that, I yield back.

Mr. LATTA. The gentleman yields back, and the Chair now recognizes the gentlelady from Illinois, the Ranking Member of the subcommittee, for 5 minutes for an opening statement.

OPENING STATEMENT OF HON. JANICE D. SCHAKOWSKY, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ILLINOIS

Ms. SCHAKOWSKY. Thank you so much, Mr. Chairman. This is the first hearing of the newly renamed Digital Commerce and Consumer Protection subcommittee. For me this has always been the Consumer Protection subcommittee, but I'm glad to see that the name consumer protection is now an official name where it belongs.

This subcommittee has important work to do on behalf of American consumers. We are kicking off the Congress with a hearing on auto safety which comes as the number of traffic deaths nationwide is increasing. In consumer product safety, we need to boost recall effectiveness and prevent safety issues before products are sold. Meanwhile, the emergence of new technologies poses new challenges for cyber security and personal privacy. The work of the subcommittee impacts Americans' everyday lives. We need to be watchdogs ensuring that innovation occurs to the benefit of American consumers.

Chairman Latta, I know that we'll be able to work together on a bipartisan basis to advance consumer interests over the course of the Congress, and I also want to take a brief moment to welcome two new Democratic members of our subcommittee, Ben Ray Luján and Debbie Dingell. I also want to welcome back to the subcommittee Doris Matsui and Gene Green, and of course our members from the last Congress, Joe Kennedy and Tony Cárdenas and Yvette Clarke. I'm very excited to work with all of you and the rest of our subcommittee colleagues.

Today's hearing continues our discussion of self-driving cars where we left off in November. Self-driving cars have the potential to greatly reduce the number of accidents caused by human error. However, we need adequate testing and oversight to insure that human error is not replaced with vehicle error.

I share auto manufacturers' optimism about the long term promise of autonomous vehicles, and today I want to focus on how we get there.

Testing is necessary before we can confidently put consumers in self-driving cars, and what is that testing? The "just trust us" approach simply doesn't work for passenger vehicles, not after the industry's failure that we've seen from Takata airbags, to the VW emissions scandal. The long term viability of self-driving cars depends on manufacturers and government working cooperatively to share data and promote safety.

As we think about testing, we need to figure out the specifics of how many waivers are necessary for test vehicles in the coming years, and how specific those waivers should be. We need to decide what safety tests or standards are necessary, and we need to determine how states and the federal government can best work together to insure safe roads.

I want to apologize that I have to step out for a moment, as I told the Chairman. I also have a Budget Committee meeting this morning. I hope to be back later to ask questions of our witnesses. I want to thank those that I met before this hearing for their time and their information, and I want to thank you all for being here today.

I now yield the remaining time to Congresswoman Matsui.

Ms. MATSUI. Thank you very much, Congresswoman Schakowsky, for yielding me time.

Autonomous vehicles have incredible potential to change so much more than just cars. This technology gives us a way to think about mobility. It has the potential to expand access to seniors, Americans with disabilities, and so much many more who may not be able to drive today. This technology allows us to rethink urban landscapes and public spaces we may no longer need for parking spaces. And perhaps most importantly, it promises safety benefits for American families.

All of this innovation will rely upon connectivity, placing new demands on our roads and highways, and the spectrum and infrastructure that powers wireless communications. We need a framework that insures we're building the connective future of the 21st century economy. Driverless cars will have an impact to both our local economies, communities, and our global competitiveness.

As we consider this new landscape there is an important role for state and federal regulators, technology companies, and traditional manufacturers, and Congress to play in deploying this future.

I look forward to working with all of you in this exciting area, and I yield back the balance of my time.

Mr. LATTA. Thank you very much. The gentlelady yields back. And right now, I don't believe the chairman of the Full Committee is here, so I will formally pass on the chairman's testimony at this time. And the chair would recognize for 5 minutes the gentleman from New Jersey, the Ranking Member of the Full Committee.

OPENING STATEMENT OF HON. FRANK PALLONE, JR., A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW JERSEY

Mr. PALLONE. Thank you, Mr. Chairman. I wanted to start by congratulating you on your new Chairmanship of this newly named subcommittee, and I'm hopeful that the subcommittee will use its mandate to watch out for the little guy. And I'm very pleased that the words "consumer protection" once again appear in the subcommittee's name.

Today's hearing on self-driving cars is an example of our consumer protection oversight obligation. I recently read something in Recode that I think can sum up where we are: "A decade ago, self-driving cars were a matter of debate. Today, they're an inevitability."

And since we know they're coming to the marketplace, I'm pleased that instead of talking again about the potential benefits achieved in the out years, we will actually get into the weeds a bit. And I look forward to hearing about where we are today in the testing, what needs to be done to establish that these cars are reliable and safe.

As I said at our self-driving cars hearing in November, we need these vehicles to be safe not just when all cars on the road are autonomous, but also during the decades of transition time when they share the road with human drivers.

I look forward to hearing how innovators are using testing, modeling, analytics, and other tools to demonstrate that these vehicles

are safe, that they meet the challenges of interacting with other common obstacles on our roads, such as bicyclists, pedestrians, and wet snow-covered pavement. I also want to hear about how they're insuring strong cyber-security and privacy protections are in place to defend against hackers.

Autonomous driving, like so many of the latest technologies has been created in this country by hardworking men and women, many of whom are immigrants who bring amazing skills to our workforce. We are a nation of immigrants, and any efforts to put up roadblocks to immigration will also put up roadblocks to our efforts to be ahead on the technology curve.

At the same time, with as many as 47 percent of American workers vulnerable to computerization, we need to find ways to tap these technologies to help workers find new opportunities through education and training.

So thank you again. I yield the remainder of my time to Representative Dingell. Oh, she's not here. Oh, she's right here. I'm sorry. How could I miss you with that beautiful dress?

Mrs. DINGELL. OK. I'm just going to talk loud. No one's ever said I didn't have a big mouth.

Thank you for yielding, Ranking Member Pallone. There's never been a more exciting time to be in the auto industry. And, Mr. Chairman, it's an honor to be a member of this committee. The Midwest is here. It's technology.

Mr. LATTA. Yes, but Digital Commerce——

Mrs. DINGELL. We're trying to stay at the forefront of innovation and technology.

There's never been a more exciting time to be in the auto industry. Automated vehicles are not just something you read about in a science fiction novel. In reality, they're already here, and helping transform mobility and the transportation of people and goods. Transportation is no longer the accurate word; mobility is.

In 2015, 35,092 people died on the road in this country. This would be a public health epidemic if it was in any other industry. Automated vehicles will help us save lives as many of my previous colleagues have noted, that since 94 percent of accidents are attributable to human error. It also an issue of international competitiveness.

Automated vehicles will be developed globally whether we like it or not. I think it's critical that America be at the forefront of innovation and technology by taking the lead in developing these potentially lifesaving advances or we'll lose our competitive edge in this critical space.

My home state of Michigan is leading the way in this area. I am proud that the American Center for Mobility at Willow Run is in the 12th District and will focus on testing, verification, and self-certification of automated vehicles, and was just designated as an automated vehicle proving ground by DOT.

Michigan in a very bipartisan way, my colleague, Mr. Upton, and the Governor, and others are dedicating considerable resources to automated vehicles, and I'm committed to helping it and the United States remain leaders in this vital area.

That being said, safety, including cyber security, has to be our top priority here. Nobody wants to let unsafe technologies on the

road, but we also don't want to prevent vehicles that improve safety from reaching consumers either.

I'm looking forward to working with committee and stakeholders to strike the right balance between supporting innovation and making sure that consumers are safe.

I yield back the balance of my time.

Mr. LATTA. The gentlelady yields back, and as I mentioned when the Chairman of the Full Committee arrives, he'll be afforded the opportunity to give his opening statement.

We now conclude with the members' opening statements. The Chair would like to remind members that pursuant to the committee rules all members' opening statements will be made part of the record.

We want to thank all of our witnesses for being with us today and taking the time to testify before the subcommittee. Today's witnesses will have the opportunity to give opening statements followed by a round of questions from the members. Our witness panel for today's hearing will include Mike Ableson, who's the Vice President of Global Strategy of General Motors; Mr. Anders Karrberg, the Vice President of Government Affairs at Volvo Car Group; Dr. Nidhi Kalra, Senior Information Scientist of Rand, and Co-Director at the Center for Decision Making under Uncertainty; Mr. Gill Pratt, Executive Technical Advisor and CEO at Toyota Research Institute; and Mr. Joseph Okpaku, who is the Vice President of Public Policy at Lyft.

We appreciate you all being here today, and when we begin the round of questions, we'll start with Mr. Ableson, and you will be recognized for 5 minutes. And we appreciate again you being with us today.

STATEMENTS OF MICHAEL F. ABLESON, VICE PRESIDENT OF GLOBAL STRATEGY, GENERAL MOTORS; ANDERS KARRBERG, VICE PRESIDENT OF GOVERNMENT AFFAIRS, VOLVO CAR GROUP; NIDHI KALRA, CO-DIRECTOR AND SENIOR INFORMATION SCIENTIST, RAND CENTER FOR DECISION MAKING UNDER UNCERTAINTY; GILL PRATT, EXECUTIVE TECHNICAL ADVISOR AND CEO, TOYOTA RESEARCH INSTITUTE; JOSEPH OKPAKU, VICE PRESIDENT OF PUBLIC POLICY, LYFT

STATEMENT OF MICHAEL F. ABLESON

Mr. ABLESON. Thank you, Mr. Chairman.

Good morning. My name is Mike Ableson. I'm the Vice President of Global Mobility Strategy for General Motors. I want to thank Chairman Latta, Ranking Member Schakowsky, Chairman Walden, and Ranking Member Pallone, subcommittee members for inviting me to tell you more about General Motors' vision for the coming transformation in mobility, and the opportunities that self-driving vehicles hold for the future safety of the American public.

If I could, though, I'd first like to relate a very personal story that has struck very close to the heart of myself and my General Motors colleagues. This last September, one of our colleagues, Steve Kiefer, suffered an incredible tragedy. His son was returning to college after spending a weekend at home when he was struck

and killed by a distracted driver. Watching Steve and his family go through this terrible avoidable loss has just increased the determination of all those that know Steve to make this technology available as soon as it's ready so that we can avoid these losses in the future. But, unfortunately, Steve is not alone. Ten percent of vehicle fatalities and 18 percent of injuries and crashes are due to distracted driving, more than 30 percent of fatalities involve a drunk driver, and 28 percent of fatalities are speed-related.

Vehicle crashes continue to be the leading cause of death for children and adults ages 4–34. With 94 percent of fatal crashes caused by human behavior, there's tremendous potential to do much better.

Self-driving cars won't drive while impaired by drugs or alcohol, they won't be distracted by a cell phone, they won't drive drowsy or recklessly, and their speed will always be appropriate to the conditions at hand.

For years, auto makers have committed our resources to protecting passengers when crashes do happen. Today, through the continuing development of this technology, we have the opportunity to avoid crashes all together. Not only are we committed to building safe and reliable self-driving vehicles, we also believe that self-driving vehicles will provide tremendous benefits to society in terms of convenience and quality of life. Such vehicles will provide unprecedented access to transportation to those who need it most, like people with disabilities, those in under-served neighborhoods with limited access to public transportation and the elderly.

General Motors is incredibly optimistic about the future of mobility. Auto makers are faced with a tremendous opportunity to create a new model for personal transportation that changes the way society thinks about the automobile, and we are rising to the challenge.

In June of last year, GM began testing self-driving Chevrolet Bolt EVs on public roads in Scottsdale, Arizona, the very challenging urban center of San Francisco, and in December we announced that we would begin testing in Metro Detroit. We have more than 50 self-driving vehicles testing in these three cities today, with more planned in the near future.

We also announced that GM will produce the next generation of our self-driving test vehicles at our Orion Assembly Plant in Michigan. The vehicles produced at Orion will allow us to accelerate the testing and validation of this exciting new safety technology.

Expansion of our real world self-driving vehicle testing program will allow us to deploy self-driving vehicles within carefully defined parameters and boundaries through controlled ridesharing projects. The safety of our customers is our driving principle. Developing self-driving technology to uphold this standard is our top priority.

Our test vehicles currently have a person behind the wheel to monitor and evaluate performance. The safety data gathered by these test vehicles will provide statistically significant data to prove that our vehicles are ready to operate without a human driver.

Current federal motor vehicle safety standards have served the motoring public well for years; however, as technology has evolved, standards which take years to develop have lagged behind. Current

FMVSS do not contemplate vehicles without human drivers. Without changes to those regulations, it may be years before the promise of today's technology can be realized, and in the meantime, thousands of deaths could have been prevented.

At the same time, we understand that we must be able to prove to our customers, our regulators, and the American public that our vehicles are safe. NHTSA has already begun a collaborative process with stakeholders to facilitate the safe testing and deployment of self-driving vehicles. While important regulatory work continues, it is imperative that manufacturers have the ability to test these vehicles in greater numbers to gather the safety data that will be critical to inform large-scale deployment of lifesaving self-driving vehicles.

One good way to accomplish this goal is to grant the Secretary of Transportation authority to grant specific exemptions for highly automated vehicle development. This authority would be similar to authority currently provided under existing law.

During this hearing alone, another eight people will have died on U.S. roads. Eight more families that have to experience the painful loss that our colleague and friend, Steve, did. This is far too great of a cost to our nation and our citizens, and we are within reach of a solution.

We look forward to working with the committee to help create the right policy framework to bring this lifesaving technology to our roads as quickly and as safely as possible. While we have more to learn, our self-driving Bolt EVs are getting smarter and better each week, and we are anxious for the public to be able to experience the technology firsthand.

Let me very clear. Our priority is and always will be the safety of our passengers and fellow road users.

Thank you for your time today, and I look forward to answering any questions the members of the committee might have.

[The prepared statement of Michael F. Ableson follows:]

Statement to U.S. House Energy and Commerce Committee
Subcommittee on Digital Commerce and Consumer Protection
Michael F. Ableson
Vice President, Global Strategy
General Motors Company
February 14, 2017

Good morning.

My name is Mike Ableson and I am General Motor's vice president of global mobility strategy. I want to thank Chairman Latta, Ranking Member Schakowsky, and the other subcommittee members for inviting me to tell you more about General Motor's vision for the coming transformation in mobility and the opportunities that self-driving vehicles hold for the future safety of the American public.

If I could first offer a personal story that recently hit very close to our GM family. One of our colleagues, Steve Kiefer, experienced an incredible tragedy last September. His son was returning to college after a weekend at home when he was hit by a distracted driver and killed instantly. Watching our friend and colleague experience such an avoidable and irreplaceable loss gave the technology that we will discuss today an even deeper purpose. But, unfortunately, Steve is not alone.

We often describe the over 35,000 deaths on our roadways each year as being equivalent to a fully loaded Boeing 747 crashing every single week.

10 percent of vehicle fatalities and 18 percent of injuries in crashes are due to distracted driving. More than 30 percent of fatalities involve a drunk driver, and 28 percent of fatal crashes were speed-related. Vehicle crashes continue to be the leading cause of death for children and adults ages four to 34.

With 94 percent of fatal crashes caused by human behavior, there is tremendous potential in deploying technology that can do much better.

Self-driving cars won't drive while impaired by drugs or alcohol, they won't be distracted by a cell phone, they won't drive drowsy or recklessly, and their speed will be limited to that of the local laws and conditions.

For years, auto makers have committed our resources to protecting passengers when crashes do happen. Today, through the continuing development of technology, we have the further opportunity to avoid crashes altogether.

Not only are we committed to building safe and reliable self-driving vehicles, we also believe that self-driving vehicles will provide tremendous benefits to society in terms of convenience and quality of life. Such vehicles will provide unprecedented access to transportation to those who need it most, like the disabled community and those in underserved neighborhoods with limited access to public transportation.

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In June of last year, GM began testing self-driving Chevrolet Bolt EVs on public roads in Scottsdale, Arizona, and the challenging urban center of San Francisco. In December, we announced that we would begin testing in Metro Detroit, which will serve as GM's primary location for testing in cold weather and winter-driving conditions.

We have more than 50 self-driving vehicles testing in these three states today.

We also announced that GM will produce the next-generation of our self-driving test vehicles at our Orion Assembly facility in Michigan. They will be fully equipped with self-driving technology, including redundant systems of LiDAR, cameras, sensors and other hardware and software designed to assure safety. The vehicles produced at Orion will allow us to accelerate the testing and validation of this exciting safety technology.

Expansion of our real-world self-driving vehicle testing program will allow us to deploy self-driving vehicles within carefully defined parameters and boundaries

through controlled ride-sharing projects. We believe deploying in such a deliberate and controlled way will help to ensure that our self-driving vehicles meet the same strict standards for safety and quality that we've been building into our traditional vehicles for generations and help us gather additional performance data necessary to prove safety and inform policy making.

Our test vehicles currently have a person behind the wheel to monitor and evaluate performance. The safety data gathered by these test vehicles will lead to better, smarter self-driving vehicles. When we have gathered enough data to fully prove the safety benefits and are fully confident in the vehicle's ability to operate more safely than a human driver we plan to deploy vehicles without a human driver.

To truly realize the benefits of this opportunity, we have to ensure public policies and regulations match the rapidly changing pace of innovation that this technology has demonstrated.

Current FMVSS have served the motoring public well for years. However as technology has evolved, standards, which take years to develop, have lagged behind. As we have seen in many other industries of rapid technological change, the pace of regulation has not kept pace with rapid innovation. For instance, current Federal Motor Vehicle Safety Standards (FMVSS) do not contemplate

vehicles without human drivers. Without changes to those regulations, it may be years before the promise of today's technology can be realized and thousands of preventable deaths that could have been avoided will happen.

At the same time, we understand that we must be able to prove to our customers, our regulators and the American public that our vehicles are safe. NHTSA has already begun a collaborative process with stakeholders to facilitate the safe testing and deployment of self-driving vehicles. While important regulatory work continues, it is imperative that manufacturers have the ability to test these vehicles in greater numbers to gather the safety data that will be critical to inform large-scale deployment of life-saving self-driving vehicles. One good way to accomplish this goal is to grant the Secretary of Transportation authority to grant specific exemptions for highly automated vehicle development. This authority would be similar to authority currently provided under existing law. While we have more to learn, our self-driving Bolt EVs are getting smarter and better each week, and we are anxious for the public to be able to experience the technology first-hand. But let me be clear: our priority is, and always will be, the safety of our passengers and fellow road users.

During this hearing alone, another eight people will have died in vehicles on U.S. roads. Eight more families that have to experience the painful loss that our colleague and friend Steve did. This is far too great of a cost to our nation and our citizens, and we are within reach of a solution. We look forward to working with the committee to help create the right policy framework to bring this life-saving technology to our roads as quickly and safely as possible.

Thank you for your time today and I look forward to answering any questions that the members of the committee might have.

Mr. LATTA. Thank you very much, Mr. Ableson, for your testimony. And the Chair now recognizes for 5 minutes, Mr. Karrberg.

STATEMENT OF ANDERS KARRBERG

Mr. KARRBERG. Thank you.

Chairman Latta, Congresswoman Dingell, members of the subcommittee, my name is Anders Karrberg, and I'm Vice President of Government Affairs at Volvo Cars.

Volvo came to the U.S. in 1955, and last year we sold 81,000 cars here. Together with our dealers, we employ about 10,000 people with 300 direct employees in New Jersey. Next year we will open our first American factory in South Carolina. This will add up to 4,000 jobs during the years thereafter. Our factory will be the first all new American car factory in 10 years.

Safety is a founding principle for Volvo Cars. We invented the three-point safety belt, we waived the patent so that safety belts could save millions of lives. Our vision is that no one should be killed or seriously injured in a new Volvo by 2020. Therefore, we are very excited about the benefits that self-driving cars will bring.

Roads will be safer. It's been said many times but cannot be overstated, over 94 percent of all crashes are due to human error. Self-driving cars will be important to reduce crashes. Also, self-driving cars will free idle time for the driver to do something more productive while being in the car.

Our vision is to every year give back one week of quality time to Volvo commuters by 2025. However, going forward there are some very important preconditions. Technology must be safe, consumers must trust it, and the proper national framework must be in place. These preconditions are fundamental when we bring this technology to market.

The first self-driving Volvo will be an XC90 SUV. It will be offered to customers in selected cities in the U.S., Europe, and China in 2021. The cars will be capable to operate unsupervised SAE Level 4 during normal traffic conditions on designated commuter roads only. Our approach is not to provide unsupervised driving anywhere any time. Instead, we start with less complicated conditions wher e consumer benefits are the highest. Thereafter, step by step we open up for more complex traffic as technology matures.

When we develop these cars we take a comprehensive approach. Groundwork engineering is based on our extensive experience from developing active safety and driver support systems. We design systems that are critical for safety with redundancies. We perform virtual testing based on data from historical crashes. We will start behavioral testing with up to 100 real customers on real roads this year in Sweden. We plan to extend those to London and China, and we cooperate with Uber on engineering the hardware.

Our intention is to test ourselves also in the U.S., but the patchwork of state regulations is a concern. In just the last two months, at least 50 new bills have been introduced in 20 states. This started to become a problem already in 2015 when we publicly called for federal guidelines. Last year we got them, the Federal Automated Vehicle Policy, a very positive initiative even if it needs several improvements. So what could Congress do?

First, to accelerate traffic safety improvements, press avoidance technologies should be rated in NCAP. The U.S. is woefully behind other major markets having already done this. Active safety systems are building blocks of self-driving cars. They take partial control when cars risk a crash, and would help build consumer confidence in unsupervised driving.

Second, Congress should encourage NHTSA to update the FAVP with an explicit request that the states refrain from legislating and regulating self-driving cars.

Third, Congress should consider incentives for states to adopt the model state policy in the FAVP, as is. A patchwork will delay making roads safer in America. It's also a competitive disadvantage. This is a race for jobs. I've discussed lots of regulations with politicians in the U.S., Europe, and China. Six years ago, I put the U.S. in the lead; seeing the patchwork, I'm not so sure.

Thank you for the opportunity to testify. I will take any questions later.

[The prepared statement of Anders Karrberg follows:]

STATEMENT

OF

Volvo Car Corporation

BEFORE THE:

HOUSE COMMITTEE ON ENERGY & COMMERCE
Subcommittee on Digital Commerce and Consumer Protection

Self-Driving Cars: Road to Deployment

February 14, 2017

PRESENTED BY:

Anders Karrberg
Vice President Government Affairs

Chairman Latta and Ranking Member Schakowsky, thank you for inviting me today to testify on behalf of Volvo Car Corporation (VCC) on how to responsibly deploy self-driving cars.

Safety is the founding principle of VCC. VCC invented the safety belt and then gave away the global patent in order to save lives. It has been estimated that this one act could have saved over 1m lives globally. It is our vision that no one should be killed or seriously injured in a new Volvo by 2020. At VCC it has always been and it will always be – safety first.

According to the latest US crash causation study, 94% of all crashes are due to human error. In 2016, traffic fatalities remain at epidemic levels. At VCC, we are appalled that 1.2 million people around the world are killed in traffic crashes annually – with over 35,000 of those deaths occurring in the U.S. alone. Self-driving cars and active safety technologies save lives.

VCC and the US Market

VCC is headquartered in Gothenburg Sweden and was founded in 1927. In 2016, Volvo Cars had global sales of 534,332 cars in about 100 countries. VCC has been in the US since 1955 and currently has 296 dealers in 47 states that employ 9,634 people in the US. In 2016, Volvo Car USA (VCUSA), based in Rockleigh, New Jersey sold 82,724 units. VCUSA has 454 direct employees in the US and 296 employees in New Jersey.

In 2015, VCC announced its first US manufacturing facility and this plant will initially create 2,000 new Volvo car jobs and will be operational in 2018. The plant located just outside Charleston, South Carolina is an industrial investment of around $500 million and it underlines VCC's long term commitment to the US market. It will be an integral part of VCC's global manufacturing footprint and it will serve the US and export markets. The new plant will also have significant multiplier effects on the local area. VCUSA has operation in California where we employee 79 people.

The benefits of self-driving cars

VCC believes autonomous vehicles are an incredible opportunity to redesign the concept of personal mobility and to improve traffic safety. So it is critical that policymakers have a

legislative framework ready, before the technology arrives on the market. Thus, VCC has been working with key stakeholders (government, consumers and academia) in the US, China, and Europe to assure the necessary framework is in place.

Self-driving cars when operating autonomously will also create a smooth traffic flow. This will reduce congestion and carbon emissions. So there is a clear environmental benefit to these vehicles because they will improve air quality.

Self-driving cars can also park themselves, preferably outside city centers. Longer term this opens up for more efficient city planning. In the US, it is estimated that 1/3 of city centers in the US are parking spaces. In addition, AD (autonomous drive) vehicles significantly enhance mobility for those who cannot get a traditional driver's license.

Self-driving cars can also provide major benefits to the consumer. The average US commuter spends about 1 hour a day in monotonous highway commuting. Converting this time to something more productive and allowing the driver do something else while the car is responsible for the driving. These benefits will not be realized unless vehicles are truly autonomous (SAE level 4). At this technology level, the driver hands over control to the vehicle and the driver is no longer responsible for monitoring the system. The system does the driving and does not rely on the driver as a fall back. This will mean that the vehicle will not be dependent on getting the driver back in the loop and the car will be able to handle all situations that may occur on the road. These are major benefits.

Testing

Drive Me is a research collaboration between partners representing both the public and private sectors and academia. Drive Me has seven partners: the Swedish Transport Administration (Transportstyrelsen), the Swedish Transport Agency (Trafikverket), Lindholmen Science Park, Chalmers University, Autoliv, City of Gothenburg and Volvo Car Corporation.

The aim of our Drive Me project is to develop unsupervised autonomous cars (SAE level 4). The first batch of cars have already hit the roads of Gothenburg in 2017 and they will require driver supervision. Via this research we will learn about the technology and the human

behaviour. Based on the data and conclusions that this research will provide us, VCC will evolve towards unsupervised autonomous cars.

After comprehensive internal testing and risk assessment, real customers will operate these cars on public roads. Technology will be introduced in a step-wise manner. Initially it will be supervised and later it will be unsupervised. This will give us valuable customer input and insight in the early development phase so that we can fine-tune our systems. VCC believes it is critical to use real customers on public roads in order to capture all the human aspects of self-driving. Our goal is to define the technology based on the role of the driver – not the other way around. This is critical for AD advancement and it cannot be captured in closed designated test areas.

This program is likely to be the largest autonomous driving pilot to date and the only program with real customers driving autonomous cars. Drive Me will also provide integral insights into the societal benefits of making autonomous vehicles a natural part of the traffic environment. Similar Drive Me pilots are planned for London and China. VCC is also considering a US pilot but given the uncertainty regarding various US state proposals, laws and regulations, VCC is not at this point ready to commit to a similar project in the US.

Joint development with innovative partners

In addition to the Drive Me project, VCC has launched two joint development projects on AD technology. In August of 2016, VCC and Uber announced a partnership to develop next generation autonomous driving cars. Uber will add its own self-developed autonomous driving systems to the Volvo XC90. VCC will use the same base vehicle (XC90) for the next stage of its own autonomous car strategy, which will involve fully autonomous driving (SAE level 4).

Last month, VCC and Autoliv established a new joint venture called Zenuity to develop software for autonomous driving and also for driver assistance systems. Zenuity will develop new ADAS (advanced driver assist systems) products and AD technologies. The new company is expected to have its first driver assistance products available for sale to all

automakers by 2019. Shortly, thereafter Zenuity will follow with AD technology and this will also be for sale to entire auto industry.

Deployment of Self driving cars

VCC plans to offer customers in selected cities in Europe, the US and China unsupervised self-driving cars (SAE level 4) by 2021. These cars will be able to operate autonomously under normal traffic conditions on selected commuter roads. In the future as technology evolves, unsupervised driving in more complex traffic situations will be possible. It must always be 100 % clear to the driver who's driving and the vehicle should not be dependent on getting the driver back in the loop.

When these cars are in autonomous mode, VCC believes the product liability should no longer rest with the driver, but should be assumed by the manufacturer. Therefore, in 2015 VCC announced that Volvo Cars will assume liability for SAE level 4 vehicles if a crash or incident is a result of a defect in the AD technology. This is of course provided that the handover is conducted properly and the car has not been misused.

US Patchwork and NHTSA FAVP

However, despite these important developments and major technological advances, the US lacks the critical consistent national framework to advance these life-saving technologies. Currently in the US, there is a patchwork of varying state requirements and proposals that could deter AD technology.

In 2016 after several states took various approaches to AD regulation, NHTSA issued the Federal Automated Vehicles Policy (FAVP). This voluntary guidance applies to AD vehicles that are SAE level 2, 3, 4 and 5. Since fully autonomous vehicles (SAE level 4) are where we will see the benefits, VCC strongly supports the FAVP's inclusion of levels 4 and 5.

Section II of the FAVP provides a recommended structure for states that seek to pursue legislation or regulation of testing or deployment of AD vehicles. VCC supports the following NHTSA statement: "DOT strongly encourages States to allow DOT alone to regulate the performance of HAV technology and vehicles." Unfortunately, this section does

not discourage nor prevent states adopting modifications to this policy. Additionally, it does not prevent states from going in various other directions with regard to AD policy. Therefore, the NHTSA guidance does not effectively prevent a patchwork of state policies on testing and operation.

In fact after the issuance of the FAVP, there has been a dramatic uptick in state activity. In just the last two months, over 48 AD bills have been introduced in 20 states. See Attachment 1 map of the US. Thus, the US still runs the risk of slowing down the development and introduction of autonomous driving technologies by making it difficult for car makers to test, develop, certify, and sell AD cars.

The FAVP also creates uncertainty by requiring state sign-off before testing. The guidance requires that states submit the "voluntary" Safety Assessment letters as a pre-requisite for any AD testing at the state level. The current California proposal requires testing before deployment. If every state were to adopt this kind of proposal manufacturers would need to first test in all those states before deployment.

While the goal of the FAVP and its model state policy is to clarify the federal role vs state role on AD technology, the states are continuing to act at time when the federal and state roles are in flux. NHTSA regulates the car and its technology and states regulate drivers licenses, licenses plates etc. With automated driving when the AD system is engaged, the car is the driver and this creates uncertainty with regard to the traditional roles. VCC recommends NHTSA discourage state activity in order to prevent a patchwork and allow OEMs to self-certify to the NHTSA guidance rather than a separate state-by-state approval process.

The FAVP contains many ambiguities that need further clarification especially with regard to data sharing, notification of safety system performance and on the impact of our current systems already on the market. The FAVP was effective upon issuance and can be modified at any time without giving automakers lead time. This is particularly challenging because it is essential for VCC and the auto industry to have certainty and lead time for the auto manufacturing process.

US Government should promote the right technologies for self-driving cars

Congress and NHTSA should encourage and start by building confidence in crash avoidance technologies. These features which include systems that assist the driver or automatically act in order to prevent or mitigate crashes (such as automatic emergency braking systems, lane departure warning systems, pedestrian detection, and braking systems) are the precursors for self-driving cars. This will improve traffic safety well before self-driving technology reaches the market. The vast majority of the active safety systems sold on the market are the result of OEM voluntary action not regulation. VCC has an extensive list of these life-saving systems (See attachment 2 – VCC technologies)

Congress should encourage NHTSA to immediately update the New Car Assessment Program (NCAP) to include crash avoidance technologies in the rating system. The US NCAP program, as initiated by NHTSA in 1979, has for many years served as a role model for the creation of similar programs in Europe, Asia, Australia and Latin America. Most of these rating programs have already adopted or plan to adopt test procedures and assessments of active safety systems that have been or will be incorporated in the overall rating score. The US NCAP now stands out as an antiquated program among the other consumer rating programs around the globe.

NCAP is a market incentive and an effective method to accelerate market uptake. VCC, therefore strongly believes that crash avoidance performance evaluations should be included in NCAP and also in the 'Stars on Cars' rating (Monroney label). Vehicles that do not have crash avoidance technologies should not get 5 star crash ratings.

Congress and NHTSA should set the laws and regulations with respect to vehicle technology and vehicle performance. States should not adopt onerous OEM test requirements and should not ban or delay deployment of level 4 and 5 AD vehicles. Congress should encourage NHTSA to update the FAVP with an explicit request that states refrain from legislation and regulation of AD vehicles. VCC believes Congress should consider incentives for states that do not set any vehicle performance requirements or for states that stay within the parameters of the NHTSA model state bill.

Conclusion

Self-driving cars have major potential benefits for safety, society and the consumer. Active safety systems are precursors of self-driving technology and therefore should be promoted by inclusion in the US-NCAP safety rating system.

The current US patchwork of numerous and various state bills and laws on testing and deployment of self-driving cars could however discourage market entry and stifle AD development. It would also represent a competitive disadvantage for the USA in the global race to reap the benefits of job creation that this technology provides. In the US, autonomous vehicles should be allowed to seamlessly cross state lines.

Thank you for the opportunity to be here today. I am happy to answer any questions.

2017 Autonomous Vehicles

Confirmed
Possible
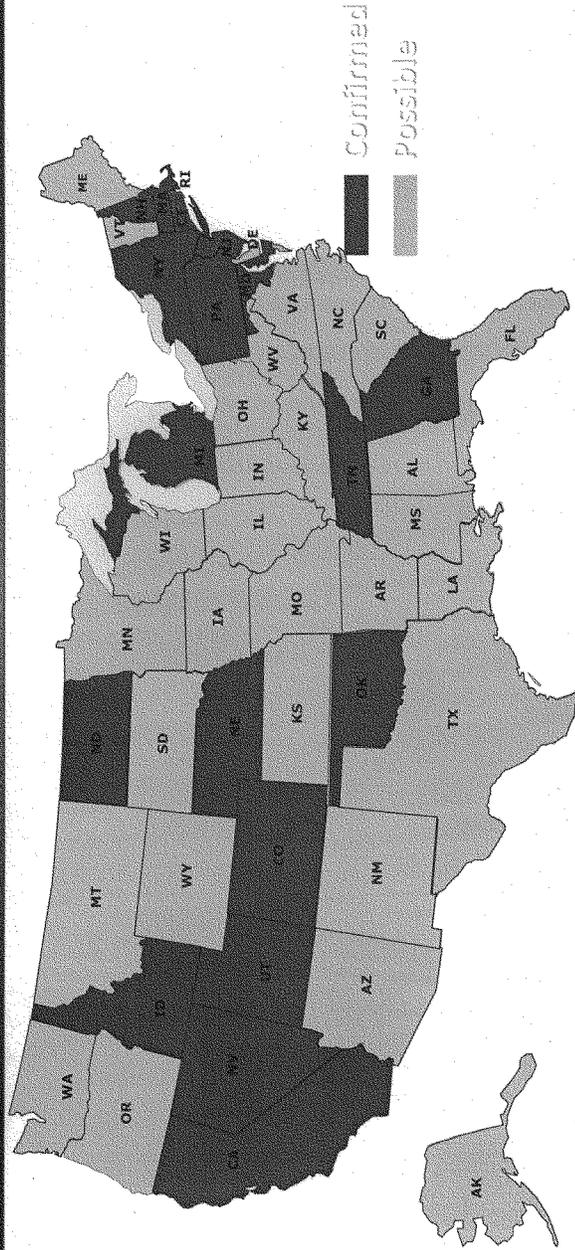
VOLVO STANDARD SAFETY SYSTEMS (S90/V90)

- **Pilot Assist <130Km/h**
- **Adaptive Cruise Control**
- **Distance Alert**
- **Lane Keeping Aid**
- **Driver Alert Control**
- **Road Sign Information**
- **Speed Limiter**

City Safety
Works day and night detecting:
- vehicles
- pedestrian
- cyclists
- large animals
1. Warning: light, sound and brake pulse preparing the driver
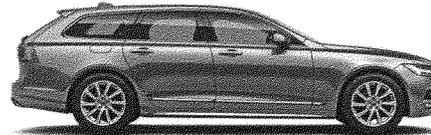2. Automatic braking

- **Run-off Road Mitigation**
- **Run-off Road Protection** incl. occupant safe positioning, front seat structure energy-absorbing, reducing the vertical forces
- **Safety cage** ~35% of total body weight is hot formed steel
- **Advanced Seat belts and Airbags**

HOLISTIC APPROACH IN FIVE PHASES

Systems in red: not mandated

Phase 1: Normal driving
- Pilot Assist
- Driver Alert Control
- Lane Departure Warning
- Lane Keeping Aid
- Road Sign Information
- Distance Alert
- Blind Spot Information System
- Cross Traffic Alert
- Active High Beam
- Active Bending Lights
- Cornering Lights
- Park Assist Pilot
- Park Assist Camera
- Visual Park Assist

Phase 2: Conflict
- Electronic Stability Control
- Roll Stability Control
- Collision Warning
- Rear Collision Warning
- Emergency Brake Lamps
- Trailer Stability Assist

Phase 3: Avoidance/Mitigation
- City Safety
- Rear Collision Warning
- Brake assist

Phase 4: Crash
- Reduction of impact speed
- Deformation zones
- Lower cross-member that helps protect lower cars
- Energy-absorbing front
- Safety belt pre-tensioners
- Side Impact Protection System
- Run-off road protection
- Whiplash Protection System
- Brake pedal release
- Laminated windows
- Integrated booster cushion
- Three-point safety belt and rear seat belt minder
- Airbags

Phase 5: Post-Crash
- Volvo On Call automatic collision alert and emergency support
- Post impact braking

Mr. LATTA. Well, thank you very much for your testimony today, and the Chair now recognizes for 5 minutes, Dr. Kalra. Thank you.

STATEMENT OF NIDHI KALRA

Dr. KALRA. Thank you. Chairman Latta, Congresswoman Dingell, and distinguished members of the subcommittee, thank you for the opportunity to testify today on the safety and testing of autonomous vehicles.

For those who may not know, RAND is a nonprofit, nonpartisan research institution committed to improving public policy through objective research and analysis. And in the interest of full disclosure, my spouse is the co-founder of a Silicon Valley startup working on autonomous vehicles, though his work has no bearing on my testimony, or vice versa.

Now, as you know, traffic crashes pose a public health crisis in the United States, and autonomous vehicles have the potential to mitigate this crisis. As a society, we want them to be as safe as possible, as quickly as possible, but they probably won't eliminate all crashes, and they may introduce new safety risks, particularly in the near term. So today I'd like to describe several challenges that stand in our way of realizing the safety benefits and mitigating the safety risks, and then I'll propose some solutions.

The first challenge is that there isn't yet a practical way to prove that autonomous vehicles are safe before they're allowed on the road for consumer use. The second challenge is that there is no consensus about how safe they should be before they're allowed on the roads, so together this means we neither know what tests autonomous vehicles should have to take, nor what should constitute a passing grade.

Now resolving this is urgent because real world driving experience is crucial for improving autonomous vehicle safety, but this presents a third risk. Learning in real world settings presents risks to early adopters and other road users from which late adopters would benefit. It's like allowing teenaged drivers on the road; they may not be safe drivers yet, but they need good driving experience to become safe drivers. In the meantime, they pose risks to themselves and to others, which we try to limit with age restrictions, and permit restrictions. We may need similar policies for autonomous vehicles and their teenagers.

Now, there's a clear and essential role for sound policy making, and I'll make three recommendations. I first recommend that we rapidly develop practical methods of testing their safety. These methods can be developed by industry, researchers and academics, federal regulators, but wherever they come from they need to be vetted, validated rigorously, objectively, and independently.

Now, it's not enough for testing methods to exist. Second, I recommend building them into a flexible, adaptive regulatory framework that specifies what level of safety performance autonomous vehicles need to meet before they're allowed on the roads. A lower threshold of safety might be OK for demonstration projects designed to improve their performance in controlled environments, but a higher threshold of safety might be warranted for widespread consumer use in uncontrolled environments.

As with teenage drivers, the framework should balance the need for real world driving experience with the need to protect the public from undue risk. And the framework should be revised as the technology evolves. Such a framework would likely fall under NHTSA's jurisdiction, but should be developed in collaboration with industry, state and local policy makers, and the public.

Now NHTSA has already released federal policies for autonomous vehicles, but these don't specify testing methods, or performance requirements, or develop such a framework. They're also not requirements but guidelines at this time.

Now, a regulatory framework like the one I'm proposing will take time, and in the interim, I thirdly suggest that strategic pilot studies and data sharing can help. Pilot studies could start with real world testing in controlled conditions, like operating vehicles in well maintained areas in favorable climates, and then could be expanded as safety is demonstrated.

Risks can also be lowered by designing and operating vehicles so that if a crash does occur, the risks are lower. For example, by limiting vehicle speed or insuring that all pilot study passengers buckle up.

As for data sharing, developers already use the experiences of a single vehicle in their fleet to improve the performance of the entire fleet. This could occur faster if experiences could be shared across the industry to improve the entire technology.

Now, there are certainly nontrivial concerns about protecting trade secrets, and also about insuring that the right data is shared and that it's truly useful, but these concerns could be addressed, and they should be addressed so that they can be balanced with the need for safe autonomous driving.

So to conclude, we can't predict what the future of this technology will be, or what its impact will be on American transportation safety, but we can shape that trajectory with well-designed policies.

So I want to thank you for the opportunity to testify today. Thank you for allowing me to appear before you, and I look forward to your questions.

[The prepared statement of Nidhi Kalra follows:]

Challenges and Approaches to Realizing Autonomous Vehicle Safety

Nidhi Kalra

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Challenges and Approaches to Realizing Autonomous Vehicle Safety

Testimony of Nidhi Kalra[1]
The RAND Corporation[2]

Submitted to the Committee on Energy and Commerce
Subcommittee on Digital Commerce and Consumer Protection
United States House of Representatives

February 14, 2017

C hairman Latta, Ranking Member Schakowsky, and distinguished members of the subcommittee, thank you for the opportunity to testify on the safety and testing of autonomous vehicles. As you know, traffic crashes pose a public health crisis in the United States, and autonomous vehicles have the potential to mitigate this crisis. As a society, we want autonomous vehicles to become as safe as possible as quickly as possible so that their potential is realized and we can usher in a new era of safer transportation.

Today I would like to discuss three challenges that currently stand in the way of this vision:

1. There is currently no proven, practical way to test autonomous vehicle safety prior to widespread use.
2. There is no consensus on how safe autonomous vehicles should be.
3. Real-world driving experience is an essential ingredient for improving safety, but it also exposes people to the very safety risks we hope to reduce.

The enormous potential benefits of autonomous vehicles—not only for safety but for other transportation goals—makes it urgent that we overcome these challenges. I will describe how it is important to develop and validate methods of demonstrating safety and incorporate these methods into a regulatory framework that gradually increases the use and exposure of autonomous vehicles as increasingly stringent safety criteria are met. I will also describe how, until such a framework is developed, regulators and industry can use pilot studies and data-sharing to manage the risks of the technology while fostering its development.

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[1] The opinions and conclusions expressed in this testimony are the author's alone and should not be interpreted as representing those of the RAND Corporation or any of the sponsors of its research.

[2] The RAND Corporation is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier and more prosperous. RAND is nonprofit, nonpartisan, and committed to the public interest.

Traffic Crashes Pose a Public Health Crisis

In the United States, roughly 32,000 people are killed and more than 2 million are injured in motor vehicle crashes every year.[3] Although safety has generally improved over the past several decades, 2015 saw 35,000 road fatalities, the largest percentage increase in fatalities in this country in more than 50 years. This occurred partly because Americans drove more and partly because they drove worse. While vehicles in general are becoming safer through better safety equipment (airbags, anti-lock brakes, driver assistance systems, etc.), increases in driver distractions (e.g., from mobile phones and other devices) are among the factors that have recently offset those gains.[4]

U.S. motor vehicle crashes as a whole can pose enormous economic and social costs—more than $800 billion in a single year.[5] And more than 90 percent of crashes are caused by human errors,[6] such as driving too fast and misjudging other drivers' behaviors, as well as alcohol impairment, distraction, and fatigue.

Autonomous Vehicles Present Benefits and Risks to Safety

Autonomous vehicles have the potential to significantly mitigate this public safety crisis by eliminating many of the mistakes that human drivers routinely make.[7] To begin with, autonomous vehicles cannot be drunk, distracted, or tired; these factors are involved in 29 percent, 10 percent, and 2.5 percent, respectively, of all fatal crashes.[8] Autonomous vehicles could also perform better than human drivers because of better perception (e.g., no blind spots),

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[3] Bureau of Transportation Statistics, *Motor Vehicle Safety Data*, Washington, D.C.: Research and Innovative Technology Administration, U.S. Department of Transportation, 2015, Table 2-17.

[4] National Highway Traffic Safety Administration, "2015 Motor Vehicle Crashes: Overview," *Traffic Safety Facts: Research Note*, Washington, D.C.: National Center for Statistics and Analysis, U.S. Department of Transportation, DOT HS 812 318, August 2016. As of January 18, 2017:
https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812318

[5] Lawrence Blincoe, Ted R. Miller, Eduard Zaloshnja, and Bruce A. Lawrence, *The Economic and Societal Impact of Motor Vehicle Crashes 2010*, Washington, D.C.: National Highway Traffic Safety Administration, DOT HS 812 013, May 2015.

[6] National Highway Traffic Safety Administration, *Traffic Safety Facts, A Brief Statistical Summary: Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey*, Washington, D.C.: National Center for Statistics and Analysis, U.S. Department of Transportation, DOT HS 812 115, February 2015.

[7] James M. Anderson, Nidhi Kalra, Karlyn D. Stanley, Paul Sorensen, Constantine Samaras, and Oluwatobi A. Oluwatola, *Autonomous Vehicle Technology: A Guide for Policymakers*, Santa Monica, Calif.: RAND Corporation, RR-433-2-RC, 2014; and Daniel J. Fagnant and Kara Kockelman, "Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations," *Transportation Research Part A: Policy and Practice*, Vol. 77, July 2015, pp. 167–181.

[8] National Highway Traffic Safety Administration, 2016; and National Highway Traffic Safety Administration, "Drowsy Driving," *Traffic Safety Facts: Crash Stats*, Washington, D.C.: National Center for Statistics and Analysis, U.S. Department of Transportation, DOT HS 812 449, March 2011. As of January 18, 2017:
https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/811449. This does not mean that 41.5 percent of all fatal crashes are caused by these factors, because a crash may involve, but not be strictly caused by, one of these factors, and because more than one of these factors may be involved in a single crash.

better decisionmaking (e.g., more-accurate planning of complex driving maneuvers), and better execution (e.g., faster and more-precise control of steering, brakes, and acceleration).

However, autonomous vehicles likely will not eliminate all crashes. For instance, inclement weather and complex driving environments pose challenges for autonomous vehicles, as well as for human drivers, and autonomous vehicles might perform worse than human drivers in some cases, particularly at early stages of testing and deployment.[9] There is also the potential for autonomous vehicles to pose new and serious crash risks—for example, crashes resulting from cyber attacks.[10] Clearly, autonomous vehicles present both potential benefits and potential risks to transportation safety. Several challenges stand in the way of managing those safety risks and maximizing the benefits.

There Is Currently No Proven, Practical Way to Determine Autonomous Vehicle Safety Prior to Widespread Use

Road Tests Cannot Prove Safety

A road test that a person takes at the Department of Motor Vehicles assesses whether the person can perform a specific set of driving skills under regular traffic situations. Passing the test does not prove that the person will be a safe driver but is nevertheless viewed as adequate for granting a permit or a license.

Such road tests could similarly demonstrate that an autonomous vehicle can perform basic driving skills but would not be able to prove their safety. Doing so would require demonstrations of safe performance under the full range of conditions in which the vehicle is expected to drive.

Extensive Test-Driving Is Statistically Powerful but Impractical

A logical alternative is to test-drive autonomous vehicles extensively in real traffic and analyze their performance. Developers of autonomous vehicles rely on this approach to evaluate and improve their systems,[11] typically with trained operators behind the wheel who are ready to take control in the event of an impending failure incident. Developers can analyze the failure incident after the fact to assess what the autonomous vehicle would have done without

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[9] Lee Gomes, *Hidden Obstacles for Google's Self-Driving Cars: Impressive Progress Hides Major Limitations of Google's Quest for Automated Driving*, Massachusetts Institute of Technology, August 28, 2014.

[10] Anderson et al., 2014.

[11] Extensive testing on public roads is essential for developing and evaluating autonomous vehicles, given their great complexity and the diversity and unpredictability of conditions in which they need to operate. In contrast, typical automobile components are significantly simpler and their operating conditions can be well defined and recreated in controlled settings, which enables laboratory testing and verification. For example, curtain-style airbags are tested to assess inflation time, fill capacity, and other responses in a range of temperature conditions and impact configurations; they are also tested in laboratory crashes to evaluate their performance in collisions. See Helen Kaleto, David Winkelbauer, Chris Havens, and Michael Smith, "Advancements in Testing Methodologies in Response to the FMVSS 201U Requirements for Curtain-Type Side Airbags," Society of Automotive Engineers International, Technical Paper 2001-01-0470, 2001.

intervention and whether it would have resulted in a crash or other safety issue. Developers have presented data from test-driving to Congress in hearings about autonomous vehicle regulation.[12]

This approach has statistical merits: Data about the number and types of miles traveled and the number of crashes, injuries, and fatalities can be used to assess safety.[13] However, this approach is largely impractical for pre-market testing: even though the number of crashes, injuries, and fatalities from human drivers is high overall, the rate of these failures is low *in comparison with the number of miles that people drive*. Americans drive nearly 8 billion miles every day and 3 trillion miles every year.[14] The 35,092 fatalities and 2.44 million injuries in 2015 correspond to a rate of 1.12 fatalities and 78 injuries per 100 million miles driven. Given that current traffic fatalities and injuries are rare events compared with vehicle miles traveled, fully autonomous vehicles would have to be driven hundreds of millions of miles, and sometimes hundreds of billions of miles, to demonstrate their reliability in terms of fatalities and injuries.[15] Under even aggressive testing assumptions, existing test fleets would take tens and sometimes hundreds of years to drive these miles—an impossible proposition if the aim is to demonstrate their performance *prior* to releasing them on the roads for consumer use.[16] It is important to note that safety could probably be readily demonstrated once autonomous vehicles are released on the roads and consumer use is widespread, given how much Americans drive.

The available data on autonomous vehicle driving performance illustrates the impracticalities of test-driving as a means of assessing their safety. As one example, Google's autonomous vehicle fleet was test-driven approximately 1.3 million miles in autonomous mode and was involved in 11 crashes from 2009 to 2015.[17] Blanco and colleagues compared Google's fleet performance with human-driven performance.[18] They found that Google's fleet might result in fewer crashes with only property damage, but they could not draw conclusions about the relative performance in terms of injuries and fatalities. Given the rate of human and autonomous vehicle failures, there were simply not enough autonomously driven miles to make statistically meaningful comparisons.

[12] Chris Urmson, "Hands Off: The Future of Self-Driving Cars," testimony before the Senate Committee on Commerce, Science and Technology, Washington, D.C., March 15, 2016. As of March 22, 2016: https://www.commerce.senate.gov/public/_cache/files/5c329011-bd9e-4140-b046-a595b4c89eb4/ BEADFE023327834146FF4378228B8CC6.google-urmson-testimony-march152016.pdf

[13] Nidhi Kalra and Susan Paddock, *Driving to Safety: How Many Miles of Driving Would It Take to Demonstrate Autonomous Vehicle Reliability?* Santa Monica, Calif.: RAND Corporation, RR-1478-RC, 2016. As of February 9, 2017: http://www.rand.org/pubs/research_reports/RR1478.html

[14] Bureau of Transportation Statistics, 2015.

[15] The number of miles depends on the metric of concern (fatalities or injuries), the performance of the technology, and the level of statistical confidence desired.

[16] Kalra and Paddock, 2016.

[17] Two of these crashes involved injury and none involved a fatality. Seven of the crashes did not reach a level of severity that would warrant a Department of Motor Vehicles report.

[18] Myra Blanco, Jon Atwood, Sheldon Russell, Tammy Trimble, Julie McClafferty, and Miguel Perez, *Automated Vehicle Crash Rate Comparison Using Naturalistic Data*, Virginia Tech Transportation Institute, January 2016. As of February 9, 2017: http://www.vtti.vt.edu/PDFs/Automated%20Vehicle%20 Crash%20Rate%20Comparison%20Using%20Naturalistic%20Data_Final%20Report_20160107.pdf

As another example, in its review of the fatal crash involving a Tesla in May 2015,[19] the National Highway Traffic Safety Administration (NHTSA) found that Tesla vehicles equipped with Autopilot were involved in 40 percent fewer crashes in which airbags deployed than pre-Autopilot Tesla vehicles.[20] However, the investigation reports neither the statistical significance of this difference nor the number of miles driven by each group of vehicles, from which statistical significance could be computed. It is therefore not possible to judge from this evidence whether Tesla vehicles with Autopilot are indeed safer than those without.[21]

Testing in Partial Simulation Has Merits but Remains Unproven

Another approach is to test in partial simulation. For example, Tesla announced last year that all of its vehicles would be equipped with hardware and sensors to allow for fully autonomous driving. However, this feature would not be enabled and instead operate in a "shadow" mode.[22] In shadow mode, the autonomous system gathers sensor data and makes driving decisions as though it were in control of the vehicle, but those decisions are not executed. Instead, the human driver maintains control of the vehicle and the *simulated* decisions of the shadow autonomous system are compared with the executed decisions of the driver in order to detect errors and anomalies.[23] In aggregate across the fleet, these errors and anomalies can be used to validate the autonomous system's performance. This approach enables autonomous vehicle performance to be demonstrated in only weeks or months because of the scale of deployment, rather than decades or even centuries with small fleets of test vehicles. Additionally, it enables learning during market deployment—which may be crucial for achieving safety—but without putting early adopters and the public at undue risk. However, the partial simulation approach must still be analyzed and validated as a method of testing the performance of autonomous systems. Furthermore, it may not be an option for developers who do not have a non-autonomous fleet deployed, and it may be expensive.

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[19] Office of Defects Investigation, "ODI Resume: Automatic Vehicle Control Systems," investigation PE 16-007, National Highway Traffic Safety Administration, January 19, 2017. As of February 9, 2017: https://static.nhtsa.gov/odi/inv/2016/INCLA-PE16007-7876.PDF

[20] There is debate about whether Tesla's Autopilot system qualifies as an autonomous system or a very sophisticated driver assistance system.

[21] It is worth pointing out that Tesla's Autopilot system has been driven many millions of miles on real roadways, so the difference in performance between Autopilot-equipped and pre-Autopilot vehicles could be statistically significant. However, the data provided in NHTSA's investigative report is inadequate for determining this. See Ken Yeung, "Elon Must Says Tesla's Autopilot Has Driven 222 Million Miles," *Venture Beat*, October 7, 2016. As of February 9, 2017: http://venturebeat.com/2016/10/07/elon-musk-says-teslas-autopilot-has-driven-222-million-miles/

[22] Alex Nishimoto, "All New Tesla Models Will Feature Level 5-Capable Autopilot Hardware," *MotorTrend*, October 19, 2016. As of January 17, 2017: http://www.motortrend.com/news/new-tesla-models-will-feature-level-5-capable-autopilot-hardware/

[23] This approach can also be used to test a new, pre-market autonomous technology against an earlier autonomous technology. Tesla will likely be comparing the performance of its autonomous system not only with human drivers but also with its deployed Autopilot systems.

Existing Functional Safety Standards Are Not Designed for Autonomous Vehicles

Another question is whether existing functional safety standards can provide assurances of safety.[24] Such discussions often raise ISO 26262, an international standard for functional safety of electrical and electronic systems in production automobiles.[25] But such standards as this were not designed with autonomous vehicles in mind, and applying them to autonomous vehicles is difficult for a variety of reasons,[26] including but not limited to the following:

- Such standards are intended for vehicles in which the human driver can ultimately correct for errors, which is inapplicable to fully autonomous vehicles that require no human intervention.
- The standards work well when system inputs and outputs can be well specified, but this is probably not possible with large amounts of diverse, high-speed data coming from vehicle sensors.
- It is difficult to apply formal methods to machine learning techniques, which are the cornerstone of rapid improvement in autonomous driving but which often result in decision rules that are difficult for humans to interpret.[27]

This is not to suggest that functional safety standards cannot help; rather, further work is needed to adapt them to the unique challenges that autonomous vehicles pose.

In sum, the transportation industry and policymakers do not yet have a method that is both practical and sound for testing autonomous vehicle safety. The question, "How safe is an autonomous vehicle?" may be unanswerable prior to widespread use. This does not mean that their use should be prohibited; the technology has too much potential to save lives. Instead, it suggests that the race to develop autonomous vehicles needs a parallel race to develop methods for demonstrating and managing their safety.

There Is No Consensus on How Safe Autonomous Vehicles Should Be

The issue of how safe autonomous vehicles should be is worth considering, even if their degree of safety cannot yet be fully proven. Some will insist that anything short of totally eliminating risk is an unacceptable safety compromise. The argument is that it is acceptable if humans make mistakes, but not if machines do. But, again, waiting for autonomous vehicles to

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[24] *Functional safety* is essentially the ability of a system to operate correctly in response to inputs, including recognizing and handling internal and external failures.

[25] International Organization for Standardization, "Road Vehicles—Functional Safety—Part 1: Vocabulary," ISO 26262-1:2011, 2011. As of February 9, 2017: http://www.iso.org/iso/catalogue_detail?csnumber=43464

[26] Philip Koopman and Michael Wagner, "Autonomous Vehicle Safety: An Interdisciplinary Challenge," *IEEE Intelligent Transportation Systems Magazine*, Vol. 9, No. 1, Spring 2017, pp. 90–96.

[27] *Machine learning* is a branch of artificial intelligence that enables computers to change their behavior and learn when introduced to new data. For example, a legged robot can learn to walk without being explicitly programmed to do so, by testing different leg motions, observing the resulting change in its position, and using those observations to refine its gait. These techniques can enable computers and robots to improve performance faster or reach better performance than if improvements could be made only directly by human programmers. See Nate Kohl and Peter Stone, "Machine Learning for Fast Quadrupedal Locomotion," *Nineteenth National Conference on Artificial Intelligence*, San Francisco, July 2004, pp. 611–616.

operate nearly perfectly misses opportunities to save lives because it means the needless perpetuation of the risks posed by human drivers.

It seems sensible that autonomous vehicles should be allowed on America's roads when they are judged safer than the average human driver, allowing more lives to be saved and sooner while still ensuring that autonomous vehicles do not create new risks. An argument can be made that autonomous vehicles could be allowed even when they are not as safe as average human drivers if developers can use early deployment as a way to rapidly improve vehicle safety. The vehicles could become at least as good as the average human sooner than they would otherwise—and thus save more lives over the long term. Moreover, there might be significant non-safety benefits, such as allowing people to do more-productive things while they are in a vehicle, that could outweigh safety drawbacks.

The lack of consensus on this point is not a failure but rather a genuine expression of Americans' different values and beliefs when it comes to humans versus machines. But it complicates the challenge of developing safety benchmarks for the technology.

Real-World Driving Experience Is Needed for Safety but Poses Risks

Resolving the above challenges is urgent because real-world driving experience may be one of the most important tools for improving autonomous vehicle safety and, by extension, road safety. This is because, unlike most humans, autonomous vehicles can learn from each other's mistakes. When a human driver makes a mistake on the road, typically only that individual can learn from that experience to improve their driving habits. Other drivers are unaffected. This is not the case with autonomous vehicles. Autonomous vehicle developers use the driving experience of individual vehicles to improve the state of the art in autonomous vehicle safety. The machine learning algorithms that govern autonomous vehicle perception, decisionmaking, and execution rely largely on driving experience to improve. Therefore, the more (and more-diverse) miles that autonomous vehicles drive, especially in diverse conditions, the more potential there is for improving the state of the art in autonomous vehicle safety performance.

As one example of improvement already taking place, Google reported to the California Department of Motor Vehicles that in the fourth quarter of 2014, its vehicles disengaged approximately once every 600 miles, compared with once every 2,800 miles in the fourth quarter of 2015.[28] As another example, Tesla first made its Autopilot technology active in Model S vehicles in October 2015 and subsequently upgraded the associated firmware in December 2015 and then August 2016 to include, among other things, better safety performance based on experiences of existing vehicles. Tesla calls this "fleet learning,"—that is, when an entire fleet is able to learn from the experiences of each deployed vehicle in that fleet.

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[28] Google, *Google Self-Driving Car Testing Report on Disengagements of Autonomous Mode*, December 2015. As of February 9, 2017: https://www.dmv.ca.gov/portal/wcm/connect/dff67186-70dd-4042-bc8c-d7b2a9904665/google_disengagement_report.pdf?MOD=AJPERES. The disengagements reported by Google reflect cases in which the autonomous vehicle software detected a technology failure and turned over control to a human operator or the operator took over control to ensure safe operation of the vehicle. It is difficult to use disengagements as a metric for safety because it is unclear what standards of risk are used and whether they are homogenous across all test drivers.

Yet having autonomous vehicles learn from real-world driving experience presents its own problem: Learning in real-world settings implies risks to early adopters or to other road users, from which late adopters would benefit. This is analogous to the risk of allowing teenage drivers on the road: They may not be good drivers yet, but they need experience to become good drivers. However, until then, they pose risks to themselves and to others. We have policies in place to try to limit risks from inexperienced young drivers, such as a minimum driving age and restrictions on learner's permits. Those policies seek to balance the goal of long-term improvement with the need for near-term experience.

The same will be true for autonomous vehicles. Choices made now about when and how autonomous vehicles are introduced will affect not only safety in the near term but also how quickly the vehicles improve, at what near-term cost, and how safe they ultimately become in the future. For instance, a policy that requires autonomous vehicles to be nearly perfect before they are allowed on the roads for widespread use could prevent them from achieving near perfection in any practical time frame because it would deny them the driving experience necessary to reach that level of performance. However, if autonomous vehicles are allowed on the road even when there are widespread safety concerns in the near term or when the technology is demonstrably unsafe, there may be little market for the technology. The public may even demand that autonomous vehicles be removed from the road, resulting in much slower adoption and delays in the experience needed to improve.

The History of Airbag Technology and Regulation Is Instructive

The history of airbag technology development and regulation illustrates the challenges of inaccurate assessments of safety impacts, of conflicting views about what constitutes adequate safety, and of the risks of learning through experience.

Airbags were initially introduced in the early 1970s in higher-end vehicle models.[29] At that time, seat belt use was low and airbags were marketed as alternatives, rather than supplements, to seat belts. Using the logic that airbags would make seat belts unnecessary, NHTSA initiated efforts in the 1970s to pass regulations requiring airbags in all U.S. automobiles. Such regulations met with significant resistance from most automobile manufacturers, who did not want either the responsibility or the liability for the losses resulting from crashes and did not believe these safety features would sell. It was not until 1991 that regulations passed requiring the use of airbags in model years 1999 and later.[30]

The pre-market methods used to assess airbag safety significantly overestimated their effects. In 1977, NHTSA estimated that airbags would save on the order of 9,000 lives per year and based its subsequent regulations on these expectations.[31] While airbags have certainly saved

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[29] Murray Mackay, "Liability, Safety, and Innovation in the Automotive Industry," in Peter W. Huber and Robert E. Litan, eds., *The Liability Maze: The Impact of Liability Law on Safety and Innovation*, Washington, D.C.: Brookings, 1991, pp. 191–223.

[30] Public Law 102-240, Intermodal Surface Transportation Efficiency, 1991.

[31] Kimberly M. Thompson, Maria Segui-Gomez, and John D. Graham, "Validating Benefit and Cost Estimates: The Case of Airbag Regulation," *Risk Analysis*, Vol. 22, No. 4, August 2002, pp. 803–811.

many lives, they have not lived up to original expectations. NHTSA calculates that airbags saved a total of 8,369 lives in the 14 years between 1987 and 2001,[32] and in recent years saved between 2,000 and 3,000 lives annually.[33] The true effects of airbags were understood only after they were widely used, not before.

Airbag technology improved with real-world use, but that improvement came, in part, because of the lives that were lost in vehicles using early versions of the technology. It became evident that first-generation airbags posed a risk to many passengers, particularly more-vulnerable passengers, such as women of small stature, the elderly, and children. NHTSA determined that 291 deaths were caused by airbags between 1990 and July 2008, primarily because of the extreme force necessary to meet the performance standard of protecting the unbelted adult male passenger.[34] Despite their overall benefits, there was a backlash against airbags and airbag regulations because many viewed them as saving healthy adults at the expense of children and the elderly.[35] Although, overall, airbags have saved tens of thousands of lives, the road to that success is winding.

The full history of airbags reveals a complex interaction of technology, policy, and social behavior. Therefore, that history may be instructive in how we approach autonomous vehicle safety. First, it may be appropriate to have modest expectations of autonomous vehicle performance and impact. Few anticipated that use of seat belts would rise as much as it has and that airbags would eventually be used more as a *supplement* than a substitute for seat belts, thus limiting their life-saving potential. Similarly unexpected developments are likely to arise with autonomous vehicles. For example, driver assistance technologies could significantly improve safety, lessening the marginal benefits of full autonomy. As another possibility, human behavior could change to undermine the benefits of the technology in unforeseen ways. Perhaps drivers of vehicles or pedestrians will behave more recklessly with the expectation that autonomous systems will avoid the consequences. While this example is speculative, the point remains: We don't know what we don't know. And there will almost surely be unexpected detours along the way.

Second, the question of how the benefits and risks of autonomous vehicles are distributed is important. Even if the technology saves lives overall, it may increase safety for some while reducing it for others, as airbags did. If this distribution of risk is inequitable or exacerbates

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[32] Donna Glassbrenner, *Estimating the Lives Saved by Safety Belts and Air Bags*, Washington, D.C.: National Center for Statistics and Analysis, National Highway Traffic Safety Administration, Paper No. 500, undated. As of February 9, 2017: http://www-nrd.nhtsa.dot.gov/pdf/nrd-01/esv/esv18/CD/Files/18ESV-000500.pdf

[33] National Highway Traffic Safety Administration, "Lives Saved FAQs," Washington, D.C.: National Center for Statistics and Analysis, U.S. Department of Transportation, DOT HS 811 105, December 2009. As of February 9, 2017: https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/811105

[34] National Highway Traffic Safety Administration, *Special Crash Investigations: Counts of Frontal Air Bag Related Fatalities and Seriously Injured Persons*, Washington, D.C.: National Center for Statistics and Analysis, U.S. Department of Transportation, January 1, 2008. As of February 9, 2017: http://www-nrd.nhtsa.dot.gov/Pubs/AB0108.PDF

[35] David J. Houston and Lilliard E. Richardson, Jr., "The Politics of Air Bag Safety: A Competition Among Problem Definitions," *Policy Studies Journal*, Vol. 28, No. 3, August 2000, pp. 485–501.

existing inequities in transportation safety, this raises ethical questions. There may be a backlash against the technology, particularly if the harms are viewed as avoidable.

Finally, the airbag experience is instructive because there was a long lag between when the technology was developed and when it was became widespread. The first airbag patents were issued in the early 1950s; by the early 1970s, airbag-manufacturing companies existed and the technology was reasonably mature, yet they were in very few cars.[36] It was not until 1999, nearly 20 years later, that airbags were ultimately required in all cars. Thousands of deaths might have been prevented by airbags in the interim. Developing the technology was a necessary but not sufficient condition for the technology to be widely used.

Recommendations

Feasible, Sound Methods of Testing Safety Are Urgently Needed

There is a clear and essential role for sound policy in addressing the above challenges. First, feasible and sound methods of testing safety are urgently needed. These methods can be developed and proposed by industry, researchers and academics, or federal regulators. Importantly, it is not enough to simply propose or develop testing methods. The methods need to be validated rigorously, objectively, and independently both to assess their statistical soundness, relation to existing safety and performance standards, and engineering and social considerations and to build confidence in the methods among diverse stakeholders.

These Methods Should Be Built into a Flexible Regulatory Framework

Second, it is not enough for testing methods to simply exist. They should be built into a regulatory framework that defines what safety performance thresholds must be met in order to put autonomous vehicles on the road. Importantly, conventional regulatory methods may not work. Currently, there are two distinct phases to bringing automotive innovations to market: pre-market development and market deployment. In the pre-market phase, the technology's performance is tested in simulations, laboratory settings, and limited real-world experiments. Once an innovation is judged safe and effective and meets regulatory requirements, the market deployment phase begins. The innovation is made available in the automotive market where it may be incorporated into millions of new vehicles very quickly. Little performance data are collected in the market phase, except through consumer feedback or in crash reports, and improvements to vehicle technologies are usually introduced through new vehicle sales rather than through improvements to vehicles already in the fleet.

This paradigm poses challenges to bringing autonomous vehicles to the market. First, as described, conventional pre-market testing methods make it difficult to judge whether these technologies are sufficiently safe. Second, the two-phase approach overlooks the fact that autonomous vehicles can use real driving experience to improve performance, not just for an

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[36] Jerry L. Mashaw and David L. Harfst, *The Struggle for Auto Safety*, Cambridge: Harvard, 1990.

individual vehicle but for the entire fleet, in real time by using over-the-air updates of vehicle software. This may be essential for achieving high levels of safety.

For these reasons, the framework should balance the need for real-world autonomous vehicle testing with the need to protect the public from undue risk. For example, a lower threshold of safety may be acceptable for early demonstration projects intended to improve autonomous vehicle performance in controlled environments. A higher threshold of safety would be warranted for widespread consumer use in uncontrolled environments. Developing the appropriate thresholds of safety should be informed by research on levels of tolerable risk in automotive and other environments, historical safety regulation and performance criteria, stakeholder values and preferences, and an assessment of how different safety levels could shape the arc of transportation safety over the long term. Thus, establishing these thresholds requires a combination of objective evidence and subjective values.

Several states are already taking the first step in such a graded approach by developing requirements for testing autonomous vehicles on public roads.[37] Many regulations allow autonomous vehicles to be tested on public roads with no demonstration of safety as long as there is a trained human driver behind the wheel. These regulations include requirements related to registration, insurance and liability, data reporting, and so on to explicitly align developers' and the public's safety goals and to enable oversight. More-stringent requirements are in place for testing without a human driver. Pennsylvania's policy, for example, requires demonstrating that the autonomous system can fully control the vehicle under all driving conditions.[38] However, regulations to allow autonomous vehicles on the road for non-testing consumer use have stymied many policymakers because it is not clear how public safety can be best achieved unless the safety of autonomous vehicles is known.

Having individual states develop safety frameworks is problematic because it gives rise to a patchwork of regulations. There are also practical issues: Developing such a framework requires extensive resources and technical expertise. Such development would likely fall under NHTSA's jurisdiction as a regulating body for transportation and vehicle safety, but the framework should be developed in consultation with industry, state and local policymakers, and the public. NHTSA has already released federal policies for autonomous vehicles, but these do not specify testing methods or develop a safety framework. The policies are also guidelines for technology development and use, not requirements that automakers must follow.[39]

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[37] Pennsylvania Department of Transportation, *Pennsylvania Autonomous Vehicle Testing Policy: Final Draft Report of the Autonomous Vehicle Policy Task Force*, November 2, 2016. As of February 9, 2017: http://www.penndot.gov/ProjectAndPrograms/ResearchandTesting/Documents/AV%20Testing%20Policy%20DRA FT%20FINAL%20REPORT.pdf; and California Department of Motor Vehicles, "Express Terms: Autonomous Vehicles," undated. As of February 9, 2017: https://www.dmv.ca.gov/portal/wcm/connect/ 211897ae-c58a-4f28-a2b7-03cbe213e51d/avexpressterms_93016.pdf?MOD=AJPERES

[38] This does not constitute a demonstration of safety; instead, it functions more like a road test. See Pennsylvania Department of Transportation, 2016.

[39] National Highway Traffic Safety Administration, *Federal Automated Vehicles Policy: Accelerating the Next Revolution in Roadway Safety*, Washington, D.C.: U.S. Department of Transportation, September 2016. As of February 9, 2017: https://one.nhtsa.gov/nhtsa/av/pdf/Federal_Automated_Vehicles_Policy.pdf

There are existing analogues to a phased approach. The Food and Drug Administration's regulations for approving drugs are one example, where drugs must go through several phases of animal testing, human testing, and post-market monitoring.[40] Each phase requires increasingly stringent requirements to be met, while also increasing the number of people exposed to the treatment. There are many legitimate concerns with the process, including its high cost and long duration,[41] as well as whether it stagnates the development of new life-saving treatments. However, there are also compelling proposals to address those shortcomings, particularly through adaptive processes designed to facilitate rapid learning and improvement over time.[42] In contrast, there are few who would propose that the government should not regulate drugs at all or that they should be allowed on the market before being evaluated.

It is also important to acknowledge legitimate concerns about the government's ability to effectively regulate a rapidly evolving and disruptive technology. This task is daunting. But it is important to note historical precedents in which the government has been at the leading edge of safety in new technologies. The early history of aviation offers a useful example.[43] The Wright brothers made their first sustained flight in 1903. The National Air Mail Service began in 1918 and in 1924 inaugurated 24-hour service between New York and San Francisco. Commercial aviation began around the same time but was much riskier. The fatality rate for commercial aviation in this era was one fatality per 13,500 miles. In contrast, the Air Mail Service was nearly 60 times safer, with a fatality rate of one per 789,000 miles. According to the Federal Aviation Administration, this was due to the government's prioritization of safety and implementation of a strict safety program for pilots, aircraft, and flights. The safety record of the Air Mail Service was one of the factors motivating the commercial aviation industry to request government oversight and regulation, which subsequently began in 1926 with the Air Commerce Act and involved decades of iteration. The Federal Aviation Administration we know today was not created until more than 30 years later, in 1959. Today, the gains in aviation safety are clear: There were no fatalities among U.S. commercial air carriers in 2014, although they traveled more than 7.6 billion aircraft miles. The average fatality rate from 2011 to 2014 (the five most-recent years for which the Bureau of Transportation Statistics has data) was 0.29 fatalities per 1 billion aircraft miles.[44]

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[40] U.S. Food and Drug Administration, "Drug Approval Process," undated. As of February 9, 2017: http://www.fda.gov/downloads/drugs/resourcesforyou/consumers/ucm284393.pdf

[41] Joseph A. DiMasi, Ronald W. Hansen, and Henry G. Grabowski, "The Price of Innovation: New Estimates of Drug Development Costs," *Journal of Health Economics*, Vol. 22, 2003, pp. 151–185.

[42] H. G. Eichler, K. Oye, L. G. Baird, E. Abadie, J. Brown, C. L Drum, J. Ferguson, S. Garner, P. Honig, M. Hukkelhoven, J. C W Lim, R. Lim, M. M. Lumpkin, G. Neil, B. O'Rourke, E. Pezalla, D. Shoda, V. Seyfert-Margolis, E. V. Sigal, J. Sobotka, D. Tan, T. F. Unger, and G. Hirsch, "Adaptive Licensing: Taking the Next Step in the Evolution of Drug Approval," *Clinical Pharmacology and Therapeutics*, Vol. 91, No. 3, March 2012, pp. 426–437.

[43] Federal Aviation Administration, *History of Aviation Safety Oversight in the United States*, Washington, D.C.: U.S. Department of Transportation, DOT/FAA/AR-08/39, July 2008.

[44] Bureau of Transportation Statistics, "U.S. Air Carrier(a) Safety Data," Washington, D.C.: U.S. Department of Transportation, undated, Table 2-9. As of February 9, 2017: https://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_02_09.html

The histories of both aviation and drug regulation are long and complex. They suggest that government can and should effectively regulate industries that pose enormous benefits and risks, not only for the benefit of the public but also for the growth of the industry. They further suggest that creating effective regulation is neither easy nor fast and will require revision and adaptation over time.

In the Interim, Risk Should Be Managed with Pilot Studies and Data-Sharing

A regulatory framework will take time and depends on the development of testing methods and safety thresholds, which must also be studied and developed. In the interim, the industry should be allowed to continue development of the technology with safeguards in place to realize the benefits that the technology presents. This raises an important question: How do we enable autonomous vehicles to improve as quickly as possible while lowering the risks they pose, even while those risks may be difficult to quantify? There are several tactics policymakers could consider to accelerate autonomous vehicles' improvement.

A first step is to conduct real-world but lower-risk pilot studies of autonomous vehicles for limited uses and in constrained environments. Risk can be lowered first by operating autonomous vehicles in conditions in which crashes are less likely. This can include limiting autonomous vehicle pilot studies to areas with less-complex terrain, to routes that are well maintained and easy to navigate, to nondangerous weather conditions, or to some combination of these controls. It can also include educating communities about safe behavior in and around autonomous vehicles. Furthermore, risk can be lowered by designing and operating vehicles so that when a crash occurs, the consequences of the crash to passengers and bystanders are fewer. This could be accomplished by limiting vehicle speed, ensuring that all pilot-study passengers wear seat belts, and so forth. These strategically limited pilot studies can then be expanded as safe operation of autonomous vehicles is demonstrated.

A second consideration is sharing driving data across the industry and with policymakers. Autonomous vehicle developers already use the experiences of a single vehicle to improve the safety of their respective fleets. This improvement could occur even faster if the experiences of each vehicle in each fleet could be used across all developers to improve the entire industry.[45] There are certainly nontrivial concerns about protecting trade secrets, but these concerns could be addressed and must be balanced with the societal need for safe autonomous vehicle technology. Data-sharing should also involve regular information about miles traveled, crashes, failures, and other information that can help provide early evidence of safety and safety concerns.

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[45] The kind of data that are shared must be carefully considered. Different developers have very different autonomous vehicle technology designs, which may limit the lessons that can be learned from data-sharing across fleets.

Conclusions

In sum, autonomous vehicles hold enormous promise for transportation safety, but realizing the safety benefits is not guaranteed. This is, in part, because it is difficult to know how safe autonomous vehicles are and because Americans may not agree on how safe they should be. Concerted and immediate effort should be made to develop sound and feasible testing methods and to develop those methods into a regulatory framework that balances the need for development and deployment of the technology with appropriate levels of safety at each stage of exposure. While this is taking place, policymakers should pursue ways of fostering the development of autonomous vehicles while lowering their risks.

Mr. LATTA. And thank you very much for your testimony today, and the Chair now recognizes for 5 minutes, Dr. Pratt.

STATEMENT OF GILL PRATT

Mr. PRATT. Chairman Latta, Congresswoman Dingell, and members of the subcommittee, thank you for the opportunity to appear before you today.

My name is Gil Pratt. I'm the CEO of the Toyota Research Institute. Before working for Toyota, I was a Program Manager in the area of Robotics are DARPA, which is the U.S. Defense Advanced Projects Agency.

Now, TRI focuses on the development of artificial intelligence and related technologies. It was formed in January of 2016 with a 5-year, $1 billion commitment from Toyota. TRI is located wholly within the United States, with its headquarters in Palo Alto, California, and additional teams in Ann Arbor, Michigan, and in Cambridge, Massachusetts.

TRI is intensely focused on the development of autonomous vehicles. We're currently pursuing two paths to autonomy, a system called "Guardian", and a system called "Chauffeur." Under Guardian, the autonomous technology operates in the background and it's constantly monitoring the environment stepping in only when a collision is imminent. Under Chauffeur, the technology takes over the driving task from the human driver.

We are currently testing and refining both Guardian and Chauffeur. Because they have the potential to save lives, our hope is to deploy these systems as soon as possible, but only once we know that they can be deployed safely, and responsibly.

Society tolerates a significant amount of human error on our roads. We are all, after all, only human; yet, human beings show nearly zero tolerance for injuries or deaths caused by flaws in machines. So the question is, how safe is safe enough for this autonomous technology to be deployed?

As we sit here today, it is not clear how this measure will be devised or by whom. Before developers can complete testing of these systems and deploy the technology, policy makers such as yourselves will need to answer this foundational question.

Policy makers must also keep in mind that testing is a necessary means to an end. The goal is to develop a vehicle that can save lives and improve the efficiency of our roads. We cannot reach that goal unless we are able to test our technology in real world environments, including on public roads. Testing is what will allow us to determine when our technology achieves a sufficient level of performance, and is ready for deployment.

One of the most significant challenges that we face is the patchwork of policy initiatives at the state level. Many of the other witnesses have referred to the same thing. Under a patchwork of inconsistent state laws, autonomous vehicle technology may meet performance requirements in one state and not another state. Such a situation will impede the ability of a developer to test the same system across multiple states, slowly the development and deployment to the technology. Policy makers should work to promote and advance a single national framework with appropriate safeguards.

We believe that the Federal Automated Vehicle Policy that was released by NHTSA was an important step in cementing federal leadership in this area. However, we also believe that there are several areas that should be addressed before the policy is fully implemented. This includes clarifying in the FAVP itself that NHTSA does not intend for states to regulate vehicle performance, reconsidering the applicability of the safety assessment to the testing of autonomous prototype vehicles by traditional auto makers, and reassessing the need to submit a new assessment for each significant update to a prototype. The reason for that last comment is that we develop these systems very quickly, and it will create tremendous red tape to have to submit that assessment every single time that a change is made.

There has also been growing discussion of the need for data sharing. We support the goals of data sharing, but we also believe that there's a significant amount of work to be done to insure that it does not create paradoxical incentives to avoid difficult test conditions, which would actually worsen safety, not improve safety. We look forward to working with other stakeholders to determine how to share data in the most practical and effective manner.

Before closing, I would like to provide a couple of additional observations. First, with regard to testing, the truth is that millions of physical test-driven miles are necessary but they are probably not sufficient to achieve the reliability that we need for autonomous vehicle technology, particularly if those test-driven miles are through easy or predictable routes. All testing miles are not created equal, and developers should be focused on testing scenarios where driving is challenging, or even exceedingly difficult. We believe that with adequate evidence of validity, computer simulation of billions of test miles are needed to accelerate and expand the range of testing of these systems, and that these simulated miles, if they're valid, should be an acceptable equivalent to real world testing.

Finally, it's important that the federal government begin looking beyond testing to deployment of these systems. This includes updating the Federal Motor Vehicle Safety Standards to address the handful of standards that are inconsistent with, or incompatible with autonomous vehicle technology.

I thank you very much for your time, and look forward to working with you to advance this important technology. Most of all, I look forward to taking your questions. Thank you.

[The prepared statement of Gill Pratt follows:]

TOYOTA

Statement of

Gill Pratt

CEO

Toyota Research Institute

on

"Self-Driving Cars: Road to Deployment"

before the

U.S. House of Representatives

Committee on Energy & Commerce

Subcommittee on Digital Commerce
and Consumer Protection

February 14, 2017

Chairman Latta, Ranking Member Schakowsky, and members of the subcommittee, thank you for the opportunity to appear before you today on this important topic.

My name is Gill Pratt, and I am the CEO of the Toyota Research Institute (TRI). Before joining Toyota, I was a professor at MIT, a founder of Franklin W. Olin College of Engineering, and a Program Manager at DARPA (the U.S. Defense Advanced Research Projects Agency), where I led the DARPA Robotics Challenge. As you may be aware, prior to my tenure at DARPA, in 2004, 2005, and 2007, the DARPA Grand and Urban Challenges developed fundamental technology to show the world that autonomous driving was feasible.

TRI was formed in January of 2016, and is focused on the development and advancement of artificial intelligence and related technologies. At TRI, we have four goals: (1) to greatly enhance vehicle safety and someday create a car that is incapable of causing a crash; (2) to greatly increase mobility access for those who cannot drive; (3) to develop robots to improve quality of life, particularly for older people; and (4) to accelerate discovery in materials science. TRI is located wholly within the United States, with its headquarters in Palo Alto, California, and additional teams in Ann Arbor, Michigan, and Cambridge, Massachusetts. Our initial 5-year budget commitment from Toyota is $1 billion. In addition to our own work, we sponsor approximately $20 million of research every year at U.S. universities, including Stanford, the University of Michigan, MIT, and many others.

In order to achieve our goals, TRI is intensely focused on the development of autonomous vehicle technology. TRI's focus builds on Toyota's long history with autonomous technology. In fact, Toyota has been generating vehicle patents in the autonomy field in the U.S. since 2006.

According to a report last year by the Intellectual Property and Science division of Thomson Reuters, Toyota is – far and away – the global leader in the number of self-driving car patents.

Autonomous vehicle technology is expected to significantly improve vehicle safety. In 2015 alone, approximately 1.25 million people died globally in automobile crashes, including 35,092 people in the U.S. This means that about the same number of people who died on 9/11 die every day around the world in car crashes. Many, many more are injured. Because more than 90% of crashes are caused by human error, autonomous vehicle technology has the potential to dramatically reduce these numbers. In addition, a decline in traffic-related deaths and injuries is likely to have significant economic benefits, such as reduced medical costs and less time and productivity wasted in traffic jams. By one estimate, the traffic congestion that could be alleviated by autonomous driving technology would save the U.S. economy $124 billion, or $1700 per American household. Reduced traffic congestion will also have environmental benefits by increasing fuel economy and reducing greenhouse gas emissions.

We also anticipate that autonomous vehicle technology will have a profound positive impact on older people and people with disabilities. Providing mobility options to those who cannot drive is likely to deliver important social and economic benefits. These include fostering independence, providing opportunities to participate in community and social activities, and reducing barriers to employment.

Two Paths to Autonomy

TRI is currently pursuing two paths to autonomy – a system called Guardian and a system called Chauffeur. Under Guardian, the autonomous vehicle technology acts as an always-watching crash mitigation system. Guardian operates in the background and is constantly monitoring the

environment, stepping in when it perceives a collision is imminent. Simple examples of the Guardian approach include automatic emergency braking, which is standard equipment in almost every Toyota model that will be sold in the U.S. this year. Automatic emergency braking attempts to prevent or mitigate frontal crashes by applying the brakes if a frontal collision is imminent.

Under Chauffeur, the autonomous technology takes over the driving task from the human driver. Because the technology – rather than a human driver – is driving the vehicle, Chauffeur is an important step in achieving mobility for people who cannot currently drive.

Much of the hardware and software being developed for Guardian and Chauffeur is the same. The difference is that Guardian only engages when needed, while Chauffeur is engaged at all times during autonomous driving. Nevertheless, we believe there is an important role for both systems. For example, the Guardian approach enables us to introduce higher levels of driver assistance into our production vehicles in the near-term, helping to save more lives sooner, as we continue our progress towards Chauffeur.

We are currently testing and refining both Guardian and Chauffeur. To date, most of our testing of Chauffeur has been done on closed courses in a number of states. We are testing on public roads in Michigan, and have plans to test on public roads in California and Massachusetts after we receive regulatory approval from the states to do so. Because these systems can save lives, our hope is to deploy our systems as soon as possible, but we will only do so when we know that they can be deployed safely and responsibly.

Common Vocabulary

At present, there is quite a bit of confusion among the media, policymakers, and the public about autonomous vehicle technology. Before embarking on a discussion of the opportunities and

challenges associated with testing and deploying these systems, it is important to take a few moments to make sure that we share a common understanding and vocabulary.

Under the SAE International Recommended Practice J3016, there are five demarcated levels of autonomy. All automakers are aiming to achieve Level 5, where the system can drive under any traffic or weather condition in any place and at any time. Although this is a wonderful goal, none of us in the automotive or information technology industries are close to achieving Level 5. Current prototype vehicles can handle many situations, but there are many other scenarios that are simply beyond current machine competence. It will take many years of research and development and many more miles of machine learning and testing to achieve the performance and reliability required for Level 5.

Level 4 is less capable than Level 5 because the autonomy only operates in specific situations. This may include limited areas of operation, limited speeds, limited times of day, or limited weather conditions. When companies say that they hope or intend to deploy fully autonomous vehicles in the next few years, they are typically referring to Level 4.

Level 3 is similar to Level 4, but the autonomy must sometimes hand off control to a human driver. Hand-off is a difficult challenge because the human driver may be engaged in other tasks and not paying attention. As defined by the SAE, in Level 3, the autonomy must give the driver sufficient warning of the need for a hand-off and must detect any condition requiring a hand-off. Because both of these requirements are extremely difficult to guarantee, it is possible that Level 3 may be as difficult to accomplish as higher levels of autonomy.

In Level 2, a vehicle hand-off to a human driver may occur at any time with only a second or two of warning. This means that the human driver must be able to react, mentally and physically,

at a moment's notice. Moreover, a Level 2 system does not guarantee that it will always detect when a disengagement is necessary, so the driver must remain vigilant and monitor the road ahead – even when the autonomy is engaged. For example, a Level 2 system may fail to recognize and react to certain types of debris that fall from a vehicle traveling in front of it. It would be the responsibility of the human driver to not only notice the falling debris, but take over operation of the vehicle from the autonomy system – all in a split second. As you may be aware, some Level 2 systems have already been put in consumer vehicles.

Level 1 encompasses the driver assistance features we see in many vehicles today, such as adaptive cruise control, parking assistance with automatic steering, and lane keeping assistance. Under Level 1, most driving functions are still controlled by a human driver, but a specific function (such as steering or accelerating) can be done by the vehicle. Level 1 systems can be very sophisticated, such as our Guardian concept, or very simple, such as cruise control. In Level 1, the human driver is always engaged in the driving task.

As policy is developed to govern autonomous vehicle technology, it is important that all stakeholders share a common vocabulary. We appreciate that the National Highway Traffic Safety Administration (NHTSA) adopted the SAE's definitions in its recent Federal Automated Vehicle Policy. To ensure consistency and clarity, we urge all legislators and regulators – at both the state and federal level – to use the SAE definitions and taxonomy in their policymaking efforts relating to both the testing and deployment of autonomous vehicle technology.

How Safe is Safe Enough?

Society tolerates a significant amount of human error on our roads. We are, after all, only human. On the other hand, we expect machines to perform much better. Humans show nearly zero

tolerance for injuries or deaths caused by flaws in a machine. However, the artificial intelligence systems on which autonomous vehicle technology will depend are presently and unavoidably imperfect. So, the question is "how safe is safe enough" for this technology to be deployed.

As I mentioned previously, there were more than 35,000 fatalities on U.S. roads involving vehicles controlled by human drivers. What if we could create an autonomous vehicle system that was as safe, on average, as human drivers? Would that be safe enough, particularly if it resulted in greater convenience, less traffic, and less impact on the environment? Because we judge machines more critically than we judge each other, the answer is probably no.

What if the machine was twice as safe as human-driven cars and only 17,500 lives were lost in the U.S. every year? Would we accept such autonomy? The answer is probably still no.

Policymakers – working with industry and relevant stakeholders – must determine what constitutes a sufficient level of safety for autonomous vehicle technology. As we sit here today, it is not clear how this measure will be devised or by whom. Perhaps as important, it is not currently clear whether it will be consistent across the entire U.S., let alone the entire world. However, before developers can complete testing of these systems and deploy the technology, this foundational question will need to be answered.

Technology Development and Testing

Policymakers must keep in mind that testing is a necessary means to an end. The goal for all developers of this technology, including TRI, is to develop a vehicle that can be deployed safely and responsibly. We cannot reach that goal unless we are able to test our technology in real-world environments, including on public roads. Testing is what will allow us to determine when our technology achieves a sufficient level of performance and is ready for deployment. Without

making public roads available for extensive testing, we risk companies or entities deploying autonomous vehicle technology that is not yet ready for prime time.

Policymakers cannot expect that a system in development will perform at the same level as a finished system that is ready for deployment, but should expect a developer to take reasonable steps to protect the public when a system in development fails or does not achieve required performance. This could include requirements for a trained safety driver or operator who can monitor and - if necessary - take over operation of the vehicle being tested, as well as the ability to achieve a minimal risk condition or failsafe mode should the driver or operator be unable to take over operation.

It is important to remember that, for decades, automakers have been allowed to test advanced safety technologies on public roads. This includes the testing of sophisticated automated technology, such as adaptive cruise control and automatic emergency braking. While we appreciate that autonomous vehicles are of greater interest to the media and the public, we do not believe that it is necessary to entirely transform the process that governs how automakers test their new safety technologies. We recognize that autonomous vehicle technology is being developed by companies and entities other than traditional automakers that lack the same track record of safely testing on public roads. We also understand that policymakers and regulators want confidence that all testing will be conducted responsibly and safely. The challenge for policymakers is to enable companies that have demonstrated themselves to be responsible developers and testers of automotive safety technology, while also creating appropriate safeguards with respect to those that are less experienced.

State Patchwork

One of the most significant challenges that we face today with respect to the testing of autonomous vehicle technology is the patchwork of policy initiatives at the state level. More and more states are developing legislation and regulations that are unfortunately creating impediments to the development of autonomous vehicle technology.

We appreciate the good intentions behind most of these efforts. We understand that many policymakers are trying to spur innovation in their state or to prevent their state from being left behind as the technology flourishes elsewhere. However, these legislative proposals are likely to have the unintended and opposite result of discouraging development or investment in favor of a state with a less restrictive or more permissive regulatory framework. For example, as I noted previously, we are currently testing our systems on public roads in Michigan – which has implemented a very supportive regulatory framework – but have not yet initiated public road testing in California or Massachusetts – which have both implemented a more restrictive regulatory framework.

A number of proposed state regulatory frameworks veer into territory that has traditionally been the purview of the federal government – namely, vehicle safety performance standards. Traditionally, the driver has been the responsibility of the states and the vehicle has been the responsibility of the federal government. We recognize that the simplicity of this traditional dividing line is challenged as vehicles become more automated and the vehicle itself becomes the driver. We also understand that, without clear or certain direction from the federal government, some states may wish to take action to regulate the safety of these systems. However, we firmly believe that the establishment of vehicle performance standards for autonomous vehicle technology should take place at the national level.

Encouraging and incentivizing manufacturers to test autonomous vehicle technology in a wide variety of environments should be a primary objective of policymakers concerned with the safety of these systems. Driving in Silicon Valley is not the same as driving in Boston. Driving in a crowded city is not the same as driving in a rural area. Driving through the snowy mountains is not the same as driving through a dusty desert or on a winding road along the ocean. If our societal goal is to ensure that autonomous vehicle technology is ultimately capable of performing in all parts of the country, developers must be able to test the technology in multiple states. However, under a patchwork of inconsistent state laws, technology may meet performance requirements in one state and not in another state. Such a situation will impede the ability of a developer to test the same system across multiple states, slowing the development and deployment of the technology. Policymakers should therefore work to promote and advance a single, national framework with appropriate safeguards.

Allowing states to set state-specific vehicle performance requirements for testing could also open the door to state-specific vehicle performance requirements at the time of deployment. Owners or drivers of autonomous vehicles should not be unnecessarily restricted in their ability to travel from state to state, as they can with current vehicles. This is a clear example of why matters of interstate commerce were constitutionally assigned to the federal government. Fifty distinct regulatory frameworks for automated vehicle performance would impede interstate travel and make deployment of a common autonomous vehicle fleet impossible.

Federal Automated Vehicle Policy

By establishing a process that provides consumers and other stakeholders with a level of confidence that autonomous vehicle technology on public roads is safe, the Federal Automated Vehicle Policy ("FAVP") released by NHTSA in September of last year was an important step in

cementing federal leadership on automated vehicle policy. While the FAVP was welcomed by the automotive industry, there are several areas of the FAVP that we believe should be addressed before the policy is fully implemented. We look forward to working with Congress and the Administration to address these areas.

First, the FAVP document provides unclear or even conflicting direction to states on their regulatory activity regarding vehicle performance. In Section 2 of the FAVP, which relates to State Model Policy, NHTSA "strongly encourages States to allow [U.S.] DOT alone" [*emphasis added*] to regulate the performance of highly automated vehicles. However, just a few pages later, NHTSA encourages states to require compliance with NHTSA's proposed safety assessment for the technology. While NHTSA has attempted to provide some clarity on this conflicting language, the steady stream of state legislative proposals that regulate vehicle performance indicates that it may not have been entirely successful. We urge NHTSA to clarify in the FAVP itself that it does not intend for states to require compliance with the voluntary safety assessment or to regulate vehicle performance. In fact, a clear and unequivocal statutory or regulatory prohibition on states regulating vehicle performance of autonomous vehicle technology would help to halt or prevent the emergence of a patchwork of state laws.

Second, the FAVP treats testing and deployment of autonomous vehicle technology largely the same. There is an important distinction between developmental testing and public deployment of these systems and the FAVP, particularly as it relates to the applicability of the safety assessment, should appropriately account for that distinction.

For example, under current law, traditional automakers have permission to test prototype vehicles on public roads. However, under the FAVP, all developers - including traditional automakers – are expected to submit a safety assessment for testing autonomous prototype

vehicles. We feel that this provision, which seems to conflict with existing law, should be reconsidered.

The submission of a new assessment for each "significant" change or update to the system during testing, as laid out in the FAVP, is likely to hinder the development of the technology. The research, development and testing of these systems is a highly iterative process and involves regular changes and updates. The FAVP should recognize and account for this without sacrificing the transparency that NHTSA seeks. Options for accomplishing this include:

- Establishing a more narrow and targeted safety assessment for testing involving trained safety drivers. An expansive safety assessment could be reserved for testing of systems using members of the public or testing without a trained safety driver in the vehicle.

- Permitting developers to test various features and conduct various phases of testing without the need to submit updated safety assessments with each significant update. This permission could be contingent on the company providing some basic information and assurances that the developer will test these systems responsibly and safely.

- Providing developers the opportunity to submit a general testing plan to NHTSA before commencing testing that could cover various phases of testing for a particular system or feature.

Data Sharing

There has been growing discussion on the need for data sharing in the context of autonomous vehicle testing. There are many goals associated with data sharing. They include sharing data with the government to improve understanding of autonomous vehicle technology, sharing data with the government or public for evaluation of the safety of a particular system, sharing data among developers to help improve the performance of systems, and sharing data for

crash reconstruction purposes. While we support the various goals of data sharing, we believe that several important factors should be considered.

If the sharing of data, such as disengagement data, is intended to be used in making a judgment about how "good" an autonomous vehicle system is, it may not accomplish that goal. During research and development, engineers will often intentionally push a system to its limits until it "breaks". These "edge cases" or "near misses" are specifically sought out to make the systems more robust. Using the number of failures as an indicator of the effectiveness of a system may actually create a perverse incentive to run the technology through easier scenarios in order to make a system appear better to the government and the public. It may discourage developers from testing the scenarios that are needed to make the technology safer.

If the sharing of data is intended to provide "edge case" or "corner case" data that can be utilized by other developers to make their systems smarter, there are a number of important details that need to be worked out. This includes identifying what data should be shared, ensuring that the source of the data is anonymized, deciding where the data will be compiled, and determining who should have access to the data and for what purposes. At the same time, it is important to note that this type of data sharing may not reap the benefits that are intended. Differences between each manufacturers' sensor configurations may make it difficult to effectively share data, and what might be an "edge case" for one system might be mundane to another.

Therefore, although Toyota agrees with the goals of data sharing, we believe that there is a significant amount of work to be done to ensure that it does not unintentionally delay innovation or worsen safety. We very much look forward to working with other stakeholders to determine how to share data in the most practical and effective manner.

Additional Considerations

Before closing, I would like to provide a couple of additional observations that may prove useful to the Committee on these issues going forward.

First, as previously noted, developing truly reliable autonomous vehicle technology will require extensive testing. The complexities involved in the development, testing, and deployment of autonomous vehicle technology requires a significant amount of public road testing in order to address not only the thousands of traffic scenarios that human drivers will encounter on a regular basis, but also to identify and address as many "edge cases" or "corner cases" as possible. Millions of test-driven miles are necessary, but probably not sufficient, to achieve the reliability that we need for autonomous vehicle technology, particularly if those test-driven miles are through easy or predictable routes. The truth is that all testing miles are not created equal, and developers should be focused on testing scenarios where driving is challenging or even exceedingly difficult. Computer simulation can accelerate and expand the range of testing of these systems, and should – with adequate evidence of validity - be an acceptable equivalent to real-world testing to achieve the billions of test-driven miles that will likely be needed to accomplish this.

Second, it is important that the federal government begin looking beyond testing to deployment of these systems. This includes updating the federal motor vehicle safety standards to address the handful of standards that are inconsistent with or incompatible with autonomous vehicle technology, including those systems that may not require a human driver or human operator in the vehicle. In March of last year, the U.S. DOT Volpe Center released a review of federal motor vehicle safety standards. The report identified safety standards that pose potential barriers and challenges for the certification of autonomous vehicles. While we believe that the report is quite comprehensive, we believe that it would be wise for NHTSA to review this report

and carefully consider and solicit feedback on whether there are any other motor vehicle safety standards that could pose a barrier or challenge for autonomous vehicle technology. We also believe that NHTSA should promptly move to update or otherwise address the standards identified in the Volpe Center report, as well as any other standards it identifies as part of its supplemental review.

Thank you for the opportunity to testify before you today. I look forward to your questions.

Mr. LATTA. Thanks very much for your testimony today, and the Chair now recognizes Mr. Okpaku for 5 minutes. And thanks very much for being here today.

STATEMENT OF JOSEPH OKPAKU

Mr. OKPAKU. Thank you, Chairman Latta. And thank you, Congresswoman Dingell, and members of the subcommittee.

My name is Joseph Okpaku, and I am the Vice President of Government Relations for Lyft. Thank you, again, for the opportunity to testify today on this very important topic.

Lyft was the first company to establish peer-to-peer on-demand ride sharing and currently is the fastest growing ride share company in the United States. Today, Lyft connects nearly 18 million people per month with efficient, affordable, and safe rides in over 250 communities across the state, across the country.

Lyft was founded with the mission of improving lives by offering the world's best transportation, and in less than five years we have proven to be a powerful driver of positive change with respect to economic empowerment, enhancing the efficiency of public transportation, and connecting communities that were previously underserved by prior transportation options.

The proof is in the data. Since our launch in 2012, Lyft has worked to reduce traffic and congestion, increase mobility options, prevent DUIs, stimulate local economies, and provide economic opportunities to our drivers. And this is only the beginning.

Autonomous vehicles hold a tremendous potential to not only further improve the quality of life for our users, but also to literally save the lives by decreasing the frequency and severity of motor vehicle accidents. Lyft's commitment to testing and deploying AVs is rooted in the belief that the inherent safety benefits of autonomous vehicles should be affordable and available to all segments of the public regardless of income, geography, or disability.

Furthermore, Lyft believes that the introduction of AVs via a ride sharing network will fundamentally transform cities and the way that people move around them. The convergence of ride sharing and AVs provides Lyft with the tools to create a perfectly efficient transportation network that will greatly reduce the need and demand for car ownership and significantly expand transportation options, particularly for segments of the population that currently have limited access to transportation options due to age, infirmity, or disability.

As vehicle ownership rates decline and consumers continue to engage with the Lyft platform, we will see fewer cars on the road, less congestion, and increased positive environmental impacts. A world with fewer cars provides a tremendous opportunity to reorient, re-imagine, and redesign our urban fabric. Cities in the not too distant future could be built around people instead of cars. They could and should be defined by communities and connections, not pavement and parking spots. They could and should include common spaces where culture can thrive, and where new ideas can be shared in the very places where cars previously stood parked and empty.

Lyft stands at the center of this coming transportation revolution as we believe that the transition to an autonomous future will not

only occur through individually owned cars; rather, it will be both more practical and appealing to rely on autonomous vehicles when they are part of a ride sharing network fleet. To this end, it is our goal to operate a pilot in a major city this year that will permit consumers to enjoy for the very first time a Lyft in an autonomous vehicle. However, there are very serious challenges to be faced in binging the full value of autonomous vehicles to market for mass consumption, and the greatest potential obstacle is constrictive legislation and regulations.

The worst possible scenario for the growth of autonomous, as some of the members of this panel have already stated, is an inconsistent and conflicting patchwork of state, local, municipal, and county laws that will hamper efforts to bring AV technology to the market. This scenario is well on its way to becoming reality.

Since the beginning of the year, over 20 states have filed nearly 60 bills to regulate the testing and deployment of AVs; and while most of the bills are well-intentioned, it is our position that states should not rush to regulate this technology.

It's our view that if a state does choose to take legislative or regulatory action with respect to autonomous vehicles, such action should be premised on removing impediments in current law to the safe testing and deployment of such vehicles, and creating a pro-competitive and technology-neutral playing field.

In order to facilitate the continued innovation, testing, and development of AVs by all industry participants, I would urge Congress to examine two potential avenues for action. The first is revising NHTSA's exemption authority to allow for a greater number of autonomous vehicles to be allowed on the road for testing and deployment purposes. The second is directing NHTSA to begin a rule-making process to update current FMVSS standards to accommodate the development, deployment, and introduction into commerce of AVs at a commercial scale.

Lyft looks forward to working with the members of this committee to insure that AVs can be tested and deployed safely and efficiently in communities all across the country. The tremendous potential that AVs offer to save thousands of lives, to increase access to transportation for so many, to reduce congestion, and to re-orient our communities for the better around people, not cars, is an achievable near term reality. With a collective effort, we can all insure that this potential is reached.

Thank you again for the opportunity to testify today, and I'm happy to answer any questions that you might have.

[The statement of Joseph Okpaku follows:]

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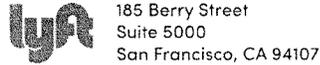
TESTIMONY OF JOSEPH OKPAKU

VICE PRESIDENT, GOVERNMENT RELATIONS, LYFT, INC.

COMMITTEE ON ENERGY AND COMMERCE – SUBCOMMITTE ON DIGITAL

COMMERCE AND CONSUMER PROTECTION

FEBRUARY 17, 2017

Chairman Latta, Ranking Member Schakowsky, and members of the Digital Commerce and Consumer Protection Committee, my name is Joseph Okpaku and I am the Vice President of Government Relations for Lyft. Thank you for the opportunity to testify today on this very important topic.

Lyft was the first company to establish peer-to-peer, on-demand ridesharing, and is currently the fastest growing rideshare company in the United States. Today, Lyft connects nearly 18 million people a month with efficient, affordable and safe rides in over 250 communities across the country.

Lyft was founded with the mission of improving lives by offering the world's best transportation, and in less than five years we have proven to be a powerful driver of positive change with respect to economic empowerment, enhancing the efficiency of public transportation, and connecting communities previously underserved by prior

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transportation options. The proof is in the data. Since our launch in 2012, Lyft has worked to reduce traffic and congestion, increase mobility options, prevent D.U.I.s, reduce assault related arrests, stimulate local economies, and provide economic opportunities to our drivers. And this is only the beginning.

Autonomous vehicles hold tremendous potential to not only further improve the quality of life for our users, but also to literally save their lives by decreasing the frequency and severity of motor vehicle accidents. Nearly 35,000 people perish in the United States each year in motor vehicle related accidents, which is the equivalent of nearly 700 deaths every single week. And nearly 90 percent of those accidents are blamed on human error, which include such issues as reckless driving, drunk or impaired driving, distracted driving, and fatigued driving. Autonomous vehicles offer the potential to dramatically reduce these type of accidents and save lives.

Lyft's commitment to testing and deploying AVs is rooted in the belief that the inherent safety benefits of autonomous vehicles should be affordable and available to all segments of the public, regardless of income, geography, or disability.

Furthermore, Lyft believes that the introduction of AVs via a ridesharing network will fundamentally transform cities and the way that people move around them. The

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convergence of ridesharing and AVs provides Lyft with the tools to create a perfectly

efficient transportation network that will greatly reduce the need and demand for car

ownership and significantly expand transportation options, particularly for segments of

the population that currently have limited access to transportation options due to age,

infirmity, or disability.

As ownership rates decline and consumers continue to engage with the Lyft platform,

we will see fewer cars on the road, less congestion, and increased positive

environmental impacts, such as reduced carbon emissions. A world with less cars

provides a tremendous opportunity to reorient, reimagine, and redesign our urban

fabric. Cities of the not too distant future could be built around people, instead of cars.

They could and should be defined by communities and connections, not pavement and

parking spots. They could and should include common spaces where culture can

thrive—and where new ideas can be shared in the very places where cars previously

stood, parked and empty.

Lyft stands at the center of this coming transportation revolution, as we believe that the

transition to an autonomous future will not occur primarily through individually-owned

cars. Rather, it will be both more practical and appealing to rely on autonomous vehicles
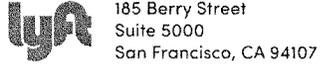
when they are part of Lyft's networked fleet. To this end, Lyft has been working both on its own and with trusted partners, such as General Motors, to test and validate the safe performance and operation of AV technology, most recently in California and Arizona. It is our goal to operate a pilot in a major city this year that will permit consumers to enjoy, for the first time, a Lyft in an autonomous vehicle.

However, there are very serious challenges to be faced in bringing the full value of autonomous vehicles to market for mass consumption, and the greatest potential obstacle is constrictive legislation and regulations. The worst possible scenario for the growth of autonomous vehicles is an inconsistent and conflicting patchwork of State, local, municipal and county laws that will hamper efforts to bring AV technology to market.

This scenario is well on its way to becoming reality. Since the beginning of the new year, over 20 States have filed nearly 60 bills to regulate the testing and deployment of AVs. While most of the bills are well-intentioned, it is our position that States should not rush to regulate this technology.

It is our view that if a State does choose to take legislative or regulatory action with respect to AVs, such action should be premised on removing impediments in current

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law to the safe testing or deployment of such vehicles, and creating a pro-competitive

and technology-neutral playing field.

In order to facilitate the continued innovation, testing, and development of AVs by all

industry participants, I would urge Congress to examine two potential avenues for

action. The first is revising NHTSA's exemption authority to allow for a greater number

of autonomous vehicles to be allowed on the road for testing and deployment purposes.

The second is directing NHTSA to begin a rulemaking to update current FMVSS

standards to accommodate the development, deployment, and introduction into

commerce of AVs at commercial scale.

Lyft looks forward to working with the members of this Committee to ensure that AVs

can be tested and deployed safely and efficiently in communities all across this country.

The tremendous potential that AVs offer to save thousands of lives, to increase access

to transportation for so many, to reduce congestion and to reorient our communities for

the better around people, not cars, is an achievable near term reality. With a collective

effort, we can all ensure that this potential is reached.

Thank you again for the opportunity to testify today, and I'm happy to answer any

questions that you might have.

Mr. LATTA. And thank you very much for your testimony today. We appreciate it, and that will conclude the opening statements from our witnesses. And the Chair now recognizes himself for 5 minutes to begin the questioning of our witnesses. And again, we appreciate you all for being here.

Mr. Ableson, I'd like to start my questions with you. Can you discuss GM's timeline for deploying self-driving cars? If you'd pull that mic right up there.

MR. ABLESON. Yes. We currently have deployed in three cities vehicles that are operating at a Level 4 automation with drivers in them. We are collecting data on how the vehicles operate. When we have convinced ourselves that the vehicles are operating properly and are at a level that would inspire confidence in the technology, we will then make those vehicles available for members of the public to experience still with drivers.

At that point, we will continue to collect data on a wider scale, and only when we have collected enough data to convince ourselves that we're truly ready to go driverless, will we then remove the drivers from the vehicles and let them operate as self-driving vehicles.

Mr. LATTA. Follow-up; cyber security is a huge issue out there across what we deal with in this subcommittee, and across the Congress today. Can you tell me or go into some detail as to how you're looking at insuring against cyber threats?

MR. ABLESON. Again, cyber security is an issue that General Motors takes very seriously. We have, of course, had the OnStar Service for 20 years, and so we are not new to the connected vehicle space. But specifically around cyber security, we were also the first auto maker to appoint a Chief Product Cyber Security Officer, who reports both to the CEO and to the Board of Directors. We were also a founding member of the Auto ISAC, an industry committee to share best practices and learnings on cyber security.

Jeff Massimilla is our Chief Product Cyber Security Officer, and is also the Vice Chairman of the Auto ISAC, so it's an area that we've been very active in. We work with companies from other industries from the defense industry, the aerospace industry to make sure we have the most current learnings not just in the auto space, but in industrial spaces wherever they are.

Mr. LATTA. Thank you.

Mr. Pratt, in Toyota's comments for NHTSA on its Federal Automated Vehicles Policy, Toyota mentioned that it would be deploying automated driving systems in a step-by-step manner as the technology matures and becomes available.

Would you walk us through what that step-by-step process looks like, and how long you think it would take for that technology to mature to a point where it might be ready to be deployed?

Mr. PRATT. Sure, I'd be glad to.

First of all, we have a number of automated vehicle technologies that are already in our cars today, and these include the Toyota Safety Sense system, and the Lexus Safety Sense system. In particular, automatic emergency braking is one of the types of this Guardian system that I spoke about before where the autonomy intervenes when the human is driving in order to prevent an acci-

dent. So that's already happening now, and we believe we're saving many lives as a result of doing so.

Now, as you desire to have the human being take less and less control of driving and have the autonomy take over more control, you ascend up the SAE levels that you may know about. And our plan is to be self-timed in this regard. We don't have a specific date for when we're going to remove the driver from the car, very much like GM; but rather, we are going to test and to see when the system is safe enough to do so. And, of course, this doesn't happen all of the time, it happens at the beginning only some of the time in certain areas, certain weather, certain traffic conditions at the beginning with human beings supervising the autonomy and in the end where you can trust it enough so that you don't need a human being.

So there's no definitive date for those steps, but a step-by-step process of gradually removing the amount of supervision that's necessary by the driver, eventually with the goal that no supervision is necessary, but checking each stage that the system is safe enough.

Mr. LATTA. Thank you.

Mr. Karrberg, a large part of Volvo's brand has always been about safety. How does this impact what Volvo is doing before it puts a self-driving car on the street for testing and deployment?

Mr. KARRBERG. Yes, safety is clearly a priority throughout the whole development process for these cars. So we're targeting 2021 for this, and in order to make the safety to come at the right point, we are doing a number of different approaches when it comes to engineering.

First of all, we will engage fully in major part into computer simulations. So we have a database of about 40,000 traffic accidents that has happened in the past in Volvo cars. We'll take those, and we'll combine them with data from the U.S., data from Germany, so that will be about 50,000 traffic accidents we will put into the computer. And we will ask the computer how can you avoid this accident when you have AV technology? So that is one input when we go forward.

Moreover, you have to test this in public roads to learn about the behavior on how customers really interact with this. And so we will step-by-step introduce to these drivers more and more advanced technologies, so we will plan to be ready by 2021.

Mr. LATTA. Thank you very much. My time has expired, and the Chair now recognizes the gentleman from New Jersey, the Ranking Member of the Full Committee, for 5 minutes.

Mr. PALLONE. Thank you, Mr. Chairman.

We've heard concern about the period before cars are fully autonomous, when there's still a driver, that that driver doesn't need to be active all the time. And even if the driver is in front of a steering wheel and trying to pay attention, if the car is doing most of the work, we know it's hard for the driver to stay engaged. And some have suggested that we could see an uptick in accidents with vehicles that are relying on drivers to re-engage in a split second. So let me start with Mr. Karrberg.

Volvo has said that it will skip Level 3 automation, as I just described, and go from Level 2 to Level 4. Can you explain that decision, and is it due to the fears that I just mentioned?

Mr. KARRBERG. We pretty much agree with you. At Level 3, the driver—the car is doing the driving. The car is doing the monitoring, but the driver is the fallback. So you could end up in situations where the driver has to take back the control; that could happen within seconds. So we are concerned about the Level 3 stage within SAE and, therefore, we are targeting Level 4 as the end game.

Mr. PALLONE. OK, thank you.

And Dr. Kalra, did you want to comment on that?

Dr. KALRA. I agree. There is evidence to suggest that Level 3 may show an increase in traffic crashes, and so it is defensible and plausible for auto makers to skip Level 3. I don't think there's enough evidence to suggest that it should be prohibited at this time, but it does pose safety concerns that a lot of auto makers are recognizing and trying to avoid.

Mr. PALLONE. All right, thanks.

Let me go back to Mr. Karrberg. Volvo has said that it will take complete liability at Level 4. Can you explain that decision?

Mr. KARRBERG. OK. It is really not that strange. Car makers should take liability for any system in the car, so we have declared that if there's a malfunction to the AV system when operating autonomously, we would take the product liability.

Mr. PALLONE. OK. Now, researchers and investigators have demonstrated that the threat of a hacker accessing and controlling a connected car is real. In these reports after vehicles have been accessed remotely, drivers are shown losing control of the horn, brakes, steering wheel, windshield wipers, and more.

So I just wanted to ask how real is the threat of vehicle hacking, especially in the autonomous context? And do you expect the nature of the threat to evolve as the technology develops? Well, did you talk about this at all yet? No. If you, Dr. Kalra, yes; would you respond to that?

Dr. KALRA. Sure, I'd be happy to.

It is a very real threat. Transportation is one of the areas that receives a lot of attention from hacking because it is a way to disrupt our transportation system, so there's a great concern there. And cyber security is not something that can be shrink wrapped on top of the vehicle because there's so many parts that contribute to the ultimate vehicle that it has to be baked in from the ground up. And it's not only hacking for fun and profit, but autonomous vehicles provide an avenue for terrorism, as well, because there's a way to use these vehicles to—the threat is no longer sort of suicide bombers that blow themselves up, but now we have vehicles that can drive around. So I don't want to overstate the risk at this time, but we need to think very broadly about cyber security not only as a hacking opportunity, but also as a terrorism opportunity.

Mr. PALLONE. All right. Did you want to——

Mr. ABLESON. If I could add a comment.

Mr. PALLONE. Yes, sure.

Mr. ABLESON. I completely agree with the point that because of the cyber security threat, as we contemplate self-driving vehicles

we need to design the vehicles from the ground up with that threat in mind. And, certainly, in our case as we deploy the self-driving Chevy Bolts, they look like the Bolts that we sell to retail customers, but we've gone very deep into the systems of the vehicle to make changes appropriate to insure the cyber security in those vehicles.

Mr. PALLONE. Sure, go ahead.

Mr. PRATT. And I wanted to add a little bit to that, too. So, Toyota Connected is a subsidiary of our company that's primarily focused on this. Zach Hicks is the CEO. Toyota is presently the Chair of the Auto ISAC that was described before for sharing information about cyber security threats.

I think it's important to understand that as serious as this threat is, there are also mitigations that we can employ. And, first of all, is to make sure that the safety technology on the car does not depend on the wireless network in order to operate. So our philosophy is that all of the safety functions have to be self-sufficient on the car itself, and only information over the wireless network used to improve the efficiency of operation.

Mr. PALLONE. Mr. Karrberg, sure.

Mr. KARRBERG. I just fully agree with the previous speakers. I just want to add that the comprehensive approach you need to take to cyber security also encompasses suppliers and dealers.

Mr. PALLONE. All right. My time is out, so thank you, Mr. Chairman.

Mr. LATTA. The gentleman's time has expired, and the Chair now recognizes the Vice Chairman of the subcommittee, the gentleman from Mississippi, for 5 minutes.

MR. HARPER. Thank you, Mr. Chairman. And thanks to each of you for being here. What an exciting topic. I mean, this is remarkable now.

Mr. Ableson, I've got just a not too technical question, but let's say you've got your driver out of the self-driving car, it is self-driving, and I'm driving along and I come across it, and I honk my horn. Will it do any good?

Mr. ABLESON. We haven't reached that point of deciding whether—how and whether it would be appropriate for vehicles to react, and in what way, to honking a horn, so I'd have to go back and ask the technical folks.

Mr. HARPER. Well, that's—there's so many interesting scenarios as you go through these——

Mr. ABLESON. There are a lot of scenarios.

Mr. HARPER [CONTINUING]. On what's going to happen, and whether or not you—another car with a driver comes across a self-driving car without a driver in there, and they realize that. It will freak some people out, so how that's going to be dealt with will be part of the fun part of this process.

Mr. ABLESON. Absolutely.

Mr. HARPER. For me, this is so exciting on a personal level, because my wife and I have a son with special needs. He's 27, he works Monday through Friday, but he's completely dependent upon us for his transportation, either myself or almost always my wife because I'm here, or our daughter, if so some reason she's out of town, so the possibilities are so good here for people in the dis-

ability community, particularly those like my son with an intellectual disability, that is great, very social individual, but limited in many ways to what he can do. So what this opens up for whether it's running errands, whether it's going to the grocery store, the bookstore that he loves, or getting to and from work. So as you look at that, can you elaborate on the work that GM is doing to provide this type of transportation, this access in the future? I know you have discussed it.

Mr. ABLESON. We have, and I agree with you, it's a very exciting opportunity for some of these communities. And while we recognize the potential benefits, there's a whole lot more work, obviously, that still needs to be done.

However, inside General Motors, we have a specifically designated employee resource group committed, or composed of people with various physical challenges, and they're already working with our engineering group on the potential for self-driving vehicles going forward. So we look forward to continue to engage, obviously, internally with our own employees, but also with external groups on how to realize this potential for those communities.

Mr. HARPER. All right, thank you. And thank you for that work.

Dr. Pratt, can you also comment how your company is considering the needs of the disability community in the development and deployment of self-driving cars?

Mr. PRATT. Yes, I'd be very glad to.

In fact, our President, Akio Toyoda, decided to change the company's policy on autonomous driving as a result of a meeting with a blind person who asked him, "Can I enjoy the mobility of your cars, as well?" And suddenly the whole company decided to change its policy.

I wanted to add one more part to this thing, too, because we have to not forget about aging society. Right now in the United States, 13 percent of our population is over age 65. Because of the baby boom, in 15 years that fraction will from 13 percent to 20 percent. And this is an extraordinary thing.

My sister and I had the experience of having to take away the car keys from my father because he was now too elderly to drive. That's something I don't think anybody should have to go through both, of course, for my father, and also for the parent's children. Our goal is to make that not have to happen in the future.

Mr. HARPER. That's great. Thank you very much.

Mr. Karrberg, can you answer that question about what Volvo is doing for those with disabilities?

Mr. KARRBERG. We fully recognize the potential for self-driving cars to bring a happier life to disabled people, and blind people, and so on. Every Sunday, I meet my father. He just turned 100 years, and he asks me every time, "When can I have this car?"

For Volvo, initially, we are targeting commuters, commuting because that's where we think the biggest benefit for and interest from the consumers are.

Mr. HARPER. That's great.

Mr. Okpaku, tell us about how this works from a ride sharing perspective.

Mr. OKPAKU. Sure, and thank you for the question, Vice Chairman.

One of the things that we've been really pleased to see with Lyft and with ride sharing generally is the ability to provide options for the disabled community, and for the elderly community.

One of the initial challenges, especially with the elderly community, was that not everyone had a smartphone or felt comfortable using a smartphone, but we've recently adapted that process so that you don't even have to have a smartphone to request a Lyft. So we've already seen and heard from a lot of the disabled community about how much ride sharing has increased their quality of life, increased their mobility, same thing for the senior population. And in terms of the potential to have that same impact with autonomous vehicles, again, the role that ride sharing plays is the ability to bring AVs to the market at a scale that would really address this issue in a broad and sweeping way. So Lyft and ride sharing, we believe, do play a very specific role and a very important role in insuring that AV technology can be deployed and used by those who most critically need it.

Mr. HARPER. Thank you each so much. It's an exciting moment, and we look forward to the development.

I yield back.

Mr. LATTA. The gentleman yields back the balance of his time, and the Chair now recognizes for 5 minutes the Ranking Member of the subcommittee, the gentlelady from Illinois.

Ms. SCHAKOWSKY. So even though we're some time away, I think, for fully self-driving cars on the road, but manufacturers have developed some very exciting safety technologies right now from blind spot detection, to rear seat notification. And I want to focus for a few minutes on those discrete technologies.

Last year, 39 children died from heat strokes in cars. These are tragic accidents, and I've heard devastating stories from parents who will absolutely never be able to forgive themselves.

Last year, Representative Tim Ryan, Peter King, and I introduced Hot Cars, a bill to equip new vehicles with rear seat notification to warn drivers that a passenger may be left behind.

So, Mr. Ableson, what is GM doing to prevent child heat deaths?

Mr. ABLESON. As you said, these are tragic circumstances, and General Motors has moved aggressively. We've already announced that we're implementing on 2017 and 2018 models a rear seat reminder system that's monitoring when a rear door is open on the vehicle. Then when the ignition is turned off at the end of the journey, chimes sound and a message is put up on the instrument cluster reminding the driver to check the rear seat. And we think this has been a very effective system to implement, and one that I'd say is already in production on many models.

Ms. SCHAKOWSKY. Thank you.

Dr. Pratt and Mr. Karrberg, are your companies working on technologies to prevent child heat deaths?

Mr. KARRBERG. Thank you for raising this important issue. These are, of course, very tragic accidents. First of all, consumer education is very important in this field. However, what we have recently introduced as an option in our cars is a motion sensor. It cannot sense heartbeats but it can sense if an animal or if a child moves. It's a first step to this, and I would be happy to provide for

the protocol later on exactly how efficient these technologies are to protect our children.

Ms. SCHAKOWSKY. Yes. The problem, of course, is that often the baby is sleeping, and so there is no movement. Dr. Pratt?

Mr. PRATT. So I run the research lab, so I don't know the particular details of the implementation, but I can speak to what we're doing research on. And so we are working on this issue and, in particular, we're working on systems that monitor the insides of the occupants in a car for any number of things. Even if a person is sleeping it turns out that there is research technology; again, I don't know when it will be fielded, which can amplify the very small motions that happen as a result of heartbeat and changes in skin temperature, as well. So there are ways that in the future we might do it, but I'd be glad to get you more information from the company in terms of when we're planning to field such things.

Ms. SCHAKOWSKY. We're going to reintroduce our legislation, and I'd really appreciate all the manufacturers to take a look at our bill that would first begin with a study, and then move into regulation.

Automatic emergency braking is another important safety technology. Dr. Pratt, in your testimony you said that automatic emergency braking will be standard in almost every Toyota model sold this year. How soon will Toyota get to 100 percent?

Mr. PRATT. I'm not exactly sure. I believe that it's a very small minority of models, some of which are in very unusual sizes, so very large trucks and things like that. So I don't know the answer, but I'd be glad to get it to you.

Ms. SCHAKOWSKY. And, Mr. Ableson and Mr. Karrberg, what are your companies' timeline for automatic braking?

Mr. ABLESON. So at General Motors, we agreed with the voluntary rollout that was proposed last year by NHTSA, and we're working aggressively to execute that. I don't know the exact date by when it's complete in our company, but I'd be happy to get people to our people and send you the details.

Ms. SCHAKOWSKY. Mr. Karrberg?

Mr. KARRBERG. We've had automatic emergency braking standard globally since 2013. And on our large platform, the new cars coming out there, it is a very involved system that brakes for not only vehicles, pedestrians, but also cyclists, and large animals day and night.

Ms. SCHAKOWSKY. So I had a couple of other questions about various technologies, but I guess the point I really want to make is that, obviously, some of these are available, in one manufacturer, not available in another manufacturer. Sometimes it's optional, sometimes it's standard. It seems to me that it would be great if we could harmonize these safety features and make sure that if they really are saving lives, that they are standard. I'm not saying it always has to be exactly the same technology, but the same goal at the end of the day so that we do develop these safety features. And I yield back. Thank you.

Mr. LATTA. Thank you. The gentlelady yields back. The Chair now recognizes for 5 minutes the gentleman from New Jersey.

Mr. LANCE. Thank you, Mr. Chairman, and good morning to the distinguished panel.

Mr. Karrberg, once automated driving systems or fully self-driving automobiles are ready for use by the American people, how should manufacturers provide instructions and education to consumers about the proper use and limitations of these systems or vehicles?

Mr. KARRBERG. Yes, that is clearly a priority, and that's why we start to introduce these vehicles supervised levels already this year to about 100 real customers on real roads to learn how they interact with the cars, what supports they need in order to fully understand it. And we will design the cars accordingly.

Mr. LANCE. Would that require further testing of the public? Would I have to go back to the State of New Jersey and be tested further in this regard?

Mr. KARRBERG. We will do tests of how people behave in different areas, so we'll do tests in Sweden right now. We plan to move on to London and China, and hopefully will do it in U.S., as well, to learn how different types of drivers interact with the cars.

Mr. LANCE. Mr. Ableson, GM?

Mr. ABLESON. I think it's a very important question. And I would say, at General Motors we intend to roll out autonomous vehicles first in ride sharing fleets. We think when——

Mr. LANCE. In ride sharing, did you say?

Mr. ABLESON. Ride sharing, yes; similar to a Lyft fleet.

Mr. LANCE. Yes.

Mr. ABLESON. One of the advantages is that it gives the public the opportunity to experience the technology without having to necessarily buy and own an autonomous vehicle. It also gives you the opportunity then when you book the ride to provide the user the information they need on the autonomous vehicle operation.

Mr. LANCE. When do you estimate that this might be in use in GM's vehicles?

Mr. ABLESON. So as I said, we're doing testing on public roads right now, but to be honest, the exact date is going to depend on how quickly the data can be gathered. And we have to prove, as I said, to both ourselves and our regulators that we're ready before we go driverless.

Mr. LANCE. To the distinguished panel, do you believe that these automobiles will be used on all of our roads, or will they first be used on limited access highways, the Interstate highway system, for example, or other similar roads? Dr. Pratt?

Mr. PRATT. I'd be glad to take that. First, let me just add onto that last question with regard to driver education. I think education is absolutely key, and some of the issues are having to do with how much trust a driver puts in the system, and learning not to either under-trust or over-trust the autonomy that's there.

Whether or not it will need changes to the requirements for a license, we don't know yet. We'll still learn, but also keep in mind that we need to educate that public in terms of how they interact with these cars. Think of a pedestrian choosing to cross the road, what should they expect the autonomous vehicle is going to do?

Mr. LANCE. Yes.

Mr. PRATT. So we think that that's very important, as well.

Mr. LANCE. I was taught Driver Ed in gym class in high school, but the year I was taught that is a national security secret.

Mr. ABLESON. I'd like to address your question——

Mr. LANCE. Yes, Mr. Ableson. I'm sorry.

Mr. ABLESON [CONTINUING]. About will they expand to all roads? I believe over time you will see them used on all roads. We're starting with the urban environments and speeds are——

Mr. LANCE. New Jersey is the most densely populated state in the nation and, obviously, this is of interest to me representing New Jersey because of the congestion that exists in this most heavily densely populated state in the country.

Yes, Dr. Pratt.

Mr. PRATT. So, I grew up in Springfield, New Jersey, so I know that.

Mr. LANCE. It's in my congressional district. Darned glad to meet you.

Mr. PRATT. A wonderful place. I think that that is very important. It is important, however, to realize that the ability of an autonomous car to go anywhere at any time no matter what the weather or the traffic, is what we call Level 5. And we, as an industry, believe it'll be sometime before we get to Level 5.

Believe it or not, there are places in the world that are worse in terms of traffic congestion than New Jersey, and so I think that we'll hit New Jersey before we handle the whole world. But it is going to be in stages with the easier cases coming first.

Mr. LANCE. All right, thank you. And before I yield back my time, I assume Mr. Karrberg from Sweden, you did not grow up in my Congressional district. I yield back 10 seconds, Mr. Chairman.

Mr. LATTA. The gentleman yields back the balance of his time, and the Chair now recognizes for 5 minutes the gentlelady from Michigan.

Mrs. DINGELL. Thank you, Mr. Chairman.

As I mentioned in my opening statement, it's critical to insure that automated vehicles are truly safe before they're available to consumers, but we also need to insure that there aren't any barriers that would prevent lifesaving technologies from bringing benefits to society as a whole. And I want to be really clear here. We should never let an unsafe or unproven vehicle hit the road, so that our challenge as Congress is how to strike the right balance between supporting innovation and making sure that consumers are safe.

So I know all of my colleagues are asking all the questions on the other side, so I do want to just get the record here on some things. So I have a few questions for all the members of the panel since I have limited time, and I would ask you to just answer yes or no. Yes, the famous Dingell, yes or no.

Do you agree that Federal Motor Vehicle Safety Standards need to be updated in order to support the deployment of automated vehicles? And let's just go down the row.

Mr. ABLESON. Yes, we do.

Mr. KARRBERG. We do.

Dr. KALRA. Yes.

Mr. PRATT. Yes.

Mr. OKPAKU. Yes.

Mrs. DINGELL. All right. It's my understanding that a rulemaking by NHTSA to update Federal Motor Vehicle Safety Stand-

ards will take several years. If that rulemaking were to commence today, it's likely not to be completed by the time many in the industry have announced that you want to deploy automated vehicles. Is that correct?

Mr. ABLESON. Yes, that's correct.

Mr. KARRBERG. Yes.

Dr. KALRA. Yes.

Mr. PRATT. I'm not sure. And the reason I'm not sure is that I would hope that NHTSA, if the need were great enough, could speed up its actions. But if they couldn't, the answer is yes.

Mr. OKPAKU. Yes.

Mrs. DINGELL. Thank you. Love your faith in government. I understand NHTSA has the authority to exempt motor vehicles from safety standards based on a number of factors, but this exemption authority is limited by law in amount and duration. Could expanding this exemption authority provide an interim path to automated vehicle deployment during the rulemaking we just discussed?

Mr. ABLESON. Yes, absolutely.

Mr. KARRBERG. Yes.

Dr. KALRA. Maybe. It's more complicated than the number of vehicles right now. There's no reason to believe that that limit is going to be hit, and equally important is to think about on what basis those exemptions would be granted given that most of the time it's—when one requests an exemption, it's on the argument that the vehicles that are seeking exemption are just as safe or safer, and there's no way to show that. So that would be an equal concern with the number of vehicles.

Mrs. DINGELL. It's an important point.

Mr. PRATT. We have the same concerns as the previous witness.

Mr. OKPAKU. I would say the answer is yes. And very quickly, I would say that the development and the expansion of the ride sharing industry where in 2012 there were maybe only a few thousand rides being completed, and the next year, millions of rides, shows the demand for resources like this. So I think it's a wholehearted yes.

Mrs. DINGELL. Thank you.

This question is for all the panelists, but you're allowed more than yes or no. We had already drifted that way.

We've had a good discussion about a few proactive things that the federal government should be doing here, but in your opinion are there any specific things that Congress should avoid doing that would stifle the development of automated vehicles?

Mr. ABLESON. Speaking for General Motors, we wouldn't want to see the government taking steps to specify a specific technology or specific solution. I think as long as we keep in mind that the goal is to prove that the vehicles are safer than drivers today. I think the NHTSA guidelines published last year are a very good step in that direction in that they don't specify a technology, but specify what the expectations are before vehicles are deployed in a driverless fashion.

Mrs. DINGELL. Mr. Karrberg, you all have a minute and 9 seconds.

Mr. KARRBERG. Yes, we would not like Congress to engage in traditional rulemaking because that would stifle development, that

would take much longer time because this is an area where technology is developing very fast, as you know. Also, I agree with the gentleman from General Motors, it's clear that technology-neutrality is important. Politicians should not pick solutions when it comes to technology. That should be done by the industry.

Dr. KALRA. Technology-neutrality is important, and so is developing regulations that are adaptive and flexible, and designed to keep up. In terms of what they shouldn't do, I'm not specifically sure.

Mr. PRATT. I would agree with all the witnesses before that an evidence-based approach is really the best one where the government sets what the criteria are for performance, and that that's done at the federal level, but does not dictate what the ways are to meet that particular level of performance.

Mr. OKPAKU. I concur with the general statements of the rest of the panel that it has to be very concerned about, even with the most well-intended law, inadvertently precluding or restricting potential innovation to make this technology even safer.

Mrs. DINGELL. I'm out of time. Thank you.

Mr. LATTA. The gentlelady's time has expired, and the Chair now recognizes the gentleman from Kentucky for 5 minutes.

Mr. GUTHRIE. Thank you, Mr. Chairman. Thank everyone for being here.

It's very interesting to me. I kind of follow the automobile industry, and I understand, I can conceptually figure all this out even with driverless cars when everything standards conditions, everybody drives the speed limit, nobody blocks the left lane. But you've got to wonder how it's going to work if you're going to turn left, and you're out in the middle of the intersection, and the oncoming traffic uses up all the yellow, or if—maybe this happened to somebody here. You're on the Parkway coming from the airport, lined up to get on 395 like the good citizen, and somebody comes at the last minute and forces themself right in front of you because they don't want to wait in line. Nobody here does that, I'm sure.

But the question is, I guess my question first, Mr. Ableson, does a car have to be perfect? Do self-driving cars have to be perfect to allow them on the highway? And how do we get to the point where they're safe enough, safe enough that we allow them on the highway?

Mr. ABLESON. So I think the point is, there's no way to prove statistically that something is perfect. We have to agree on the metrics by which we're going to use to show that the vehicle is better than human drivers and it's, therefore, appropriate to start deploying without drivers, to your point.

I think that's why this testing in real world is so important because you'll see those real life conditions that we all deal with on a daily basis as human drivers, and we'll make sure that the vehicles can react appropriately.

Mr. GUTHRIE. And, Mr. Karrberg, if you'd like to comment on that; and particularly, what is your view on what level the vehicles are safe? For example, a Level 3 car, what about Level 3 cars?

Mr. KARRBERG. Yes. First, what I'd just like to comment on, the traffic conditions you initially described here. That's not where we're going initially. Those are complicated traffic conditions, so we

are targeting commuter roads in the beginning because that's where the consumer interest is, and that's where the technology will arrive in 2021.

Sorry, your next question was?

Mr. GUTHRIE. Just comment on the Level 3 cars, for example, what do you consider safe?

Mr. KARRBERG. Yes, exactly. Now as I stated, at Level 3 the car is driving, the car is doing the monitoring; however, the driver is still fallback. And the driver may have to be able to take back control in very short time. And that is far less safe than if you go to a Level 4 car where the Level 4 car should be able to put the car into a safe mode, unless the driver takes over the control. And should be able to predict the traffic so that that can be done in a safe manner.

Mr. GUTHRIE. Mr. Okpaku, I guess the nature of your business is picking people up and running them around town, so it really wouldn't be the commuter—I mean, I know people use you, too, on commuter highways. I get that, but what you're talking about, Mr. Karrberg, are people commuting into work every day and being able to do things, and not be distracted because the car is taking care of that issue. But your guys are picking people up in hotels and dropping them off at Capitol Hill. Those are the kind of things—so how do you see this working with driverless cars in that kind of environment?

Mr. OKPAKU. Sure, and thank you for the question.

So, Lyft is looking at this from the viewpoint of a network. One of the things that we have the expertise in is how to manage literally thousands of cars that are all transporting different people around a particular city, and making sure that they're doing so in the most efficient manner. For example, is a car that is two blocks away from you but going away going to get you quicker than a car that's four blocks away from you but headed your direction, things of efficiency of that nature.

So I think, number one, that's one of the areas of expertise that we can bring to the AV revolution, if you will, is making sure that it's operating in the most efficient manner, and that knowing how all the vehicles can interact with each other most efficiently and most safely to get passengers where they're going. And if you think about the reductions in traffic and the reductions in congestion, I think that a ride sharing platform is going to be very instrumental in insuring that those benefits are gained.

Mr. GUTHRIE. OK, thank you. And, Dr. Pratt, my home state company. Would you like to comment on how safe does it have to be to be safe?

Mr. PRATT. Sure. Well, this is a question that we're thinking about extremely deeply now, and we feel that there may need to be a safety factor multiplying human performance. In other words, if an autonomous car is only slightly better than the average human driver, that may not be good enough, because emotionally we can empathize with a human driver that has an accident because that could have happened to us. On the other hand, when a machine makes a mistake, our empathy is much less.

We don't know what the safety factor has to be, and what we would like is to work collaboratively with government to try to fig-

ure out what that answer is, but we worry that it may not be one. It may be that the public will not accept, if let's say there are 35,000 fatalities a year because of human driving, would the public accept 34,999 because of a machine? I think the answer might be no, and so we don't know what factor needs to be there.

Mr. GUTHRIE. All right, thank you. I had some more questions. I'm out of time. I yield back 7 seconds.

Mr. LATTA. Thank you. The gentleman yields back the balance of his time, and the Chair now recognizes for 5 minutes the gentlelady from California.

Ms. MATSUI. Thank you, Mr. Chairman.

I want to switch a little bit here. Many of you express concern with a potential for a patchwork or different state standards for autonomous vehicles. As our state often is, California has been a leader in trying to develop a framework for safe testing and deployment of this technology.

I do understand the need for laws and regulations to be flexible, and do encourage innovation, and California's North Star is always innovation. But at the same time, I would be concerned about undermining safety and accountability standards, which I believe, ultimately, would harm not only the driving public, but consumer confidence in your products and services.

I think that we could all agree that we need some rules of the road. Can each of you provide your perspective on where regulation might be needed at both the state and federal levels, starting here?

Mr. ABLESON. I would say at General Motors, we recognize that if a patchwork were to develop, especially on the technical sides of the issue that would be an issue for the industry. However, we've also seen some states pass some very thoughtful legislation that supports the development, like Michigan did recently.

With NHTSA, we recognize that both the states and the federal government have a role to play going forward, and we look forward to working with the governments at all levels on rolling out the technology.

Mr. KARRBERG. The way forward we think is really the approach that NHTSA now has taken with the Federal Automated Vehicle Policy. It's flexible, it's not traditional rulemaking which will go very slow. It's something in between. It's not perfect, but I think that is the way forward.

Dr. KALRA. I think federal regulations are needed to set both testing methods and what thresholds of safety are needed for different levels of deployment of autonomous vehicles. Until those are in place, states really are on the forefront of balancing the competing needs associated with this technology, and so in the interim for those federal regulations, I think it would be important for the federal government to provide supports to states in developing regulations that aren't contradictory, and that pave the way for those federal regulations. And the policies that were put forward last year take a first step towards that.

Ms. MATSUI. Thank you.

Mr. PRATT. I agree with some of the members of the panel here that really it's the federal government that we believe should take the leading role. To be very clear, we totally support very rigorous regulation of this, very high standards for safety, but we think it's

important that there be one standard, that it not be a patchwork of different ones.

I want to give an example of what might go wrong, and it actually comes from California, where we have one of our labs. And as you may in California, there is a requirement if you're doing autonomous car development, that you report to the government what your disconnection rate is every time that the car has a failure of a certain kind. That's not such a bad idea, but that information then becomes publicly available, and it creates a perverse incentive, and the incentive is for companies to try to make that figure look good because the public is watching. And that perverse incentive then causes the company to not try to test the difficult cases, but test the easy cases to make their score look good.

We think it's very important that there be deep thought about this kind of issue before these rules are made. And we think that concentrating that thought in the federal government is the best idea.

Mr. OKPAKU. Thank you for the question. And if I can just touch really briefly on the patchwork of state legislation really quickly. This is something where ride sharing has a really unique experience, and a recent experience in this because over the last 3 or 4 years we've seen the ride sharing industry go from unregulated to wholly regulated. And what we were seeing were cities that were next to each other literally implementing ordinances that conflicted with each other where a vehicle could not pick up a passenger in one city and drop them off in the other city. This is a very real situation that we were facing for years, and luckily, that's a situation that has been resolved. So the concern that the members of this panel are expressing with respect to a patchwork of regulations is a very real one, and one that we experienced very recently.

To the heart of your question, I agree with the general sentiment of this panel that some of the state bills and proposed regulations that we're already seeing, we're seeing proposals that would infringe upon the federal government's realm and expertise in regulating safety standards. I think that's something that's rather dangerous, so if I was going to encourage a state to focus on anything, it would be focusing on making sure that they were not infringing upon that which is the province of the federal government.

Ms. MATSUI. OK. I also understand what you're talking about, but I always believe that states should be the test bed for innovation to a great degree here. Other than what you said, are there any specific concerns about California's testing regulations? I live in Sacramento, so I live where the governor lives, so it would be kind of nice to have this information.

Mr. PRATT. So from my perspective, the reporting of disconnections is the number one issue.

Ms. MATSUI. OK. And I think I've heard that, yes.

Mr. ABLESON. I just wanted to say, I don't agree that necessarily the reporting in California would encourage companies to do easier testing. We certainly are testing in a very difficult environment, making the data public anyway.

Mr. KARRBERG. I'm unaware of the details of California, but it is an onerous reporting. It is a very, very comprehensive data sharing requirement, and also a costly deposit per car.

Ms. MATSUI. All right, yes. I think I've heard from you, and I've run out of time, so thank you very much.

Mr. LATTA. Thank you very much. The gentlelady's time has expired. The Chair now recognizes for 5 minutes the gentleman from West Virginia.

Mr. MCKINLEY. Thank you, Mr. Chairman.

As one of just two licensed engineers in Congress, this is an intriguing process that we're going to undergo. I'm fascinated with that, but I've got a series of questions. I don't know how the time frame we're going to be able to get through all of them. But one of them is, since I've learned that we were going to have this hearing, I've tried to do a little bit more reading about this. And I don't see so far, I don't see anything about third party certification for public safety, putting public safety first overriding competitive pressures.

Do we have some provision that will require a third party, like an IVNV that we have here before this process advances much further? Quick answers, if you could.

Mr. ABLESON. I'm not aware that there's any requirement at the moment for a third party.

Mr. MCKINLEY. Second. OK. The second, are there going to be global standards, because I've heard mention that Europe and China would be—are we going to adopt standards that are comparable, and is that underway so that we would be to sell American cars in China, AVs over there?

Mr. PRATT. I would have to say our experience in the automotive industry over some time is we don't get global standards, that the regulating bodies tend to move in similar but differ in the detailed directions.

Mr. MCKINLEY. One thing I've not heard also is—so I'm a little concerned about lack of global standards, is cost. No one has mentioned cost up here. What is the projected additional cost per vehicle that could be—now I guess you could probably answer it well, that depends upon whether you're going to go to Level 2, 3, or 4. I understand that, but let's just say it's fundamentally, not Level 1 where we are right now. What are some cost projections that we're facing, and is the overall goal that it will be universal, or will it be an option that I, as a buyer, can choose not to have automated? Dr. Pratt?

Mr. PRATT. So, the costs presently are very high, in the many thousands, if not tens of thousands of dollars. Part of the reason that you're seeing a push to use it in ride share systems at the beginning is because there you can amortize the cost over a higher utilization of ride share vehicles. However, we should keep in mind the incredible rate of decreasing costs in the electronics industry particularly with scale. Think about your cell phone and the cost of the camera that's inside of your cell phone which rivals some of the best cameras that you could buy for personal or professional use in the past, these now cost pennies to put inside of a cell phone. So we don't know the actual numbers, but we are confident the cost will decrease very rapidly.

Mr. MCKINLEY. Do you see, Dr. Pratt, maybe at the end, do you see this as something that is going to be universal, or is this always going to be an option for your car?

Mr. KARRBERG. It will start as option, and eventually, 10, 15 years out some functions will be standard.

Mr. MCKINLEY. It'll be standard. OK.

The last, because I heard some very interesting arguments, very heart wrenching and the like, so is the automobile through this autonomous process, would that put us into entitlement program, or is this something that's a privilege to be able to have a car?

Mr. OKPAKU. If I may, that's one of the reasons why, again, Lyft is really intrigued about autonomous vehicle technology, because we believe that the only way to insure that it can be equitably provided to all segments of society is to have ride sharing exist on a ride sharing platform. So that is Lyft's interest in this committee hearing today, and the——

Mr. MCKINLEY. And I think you said that—I think maybe it was in your testimony that everyone should have this available to them.

Mr. OKPAKU. Exactly.

Mr. MCKINLEY. That sounds like an entitlement, and my concern, of course, with that would be—I'm just, in the very short time I have left. I'm just curious; everyone has been talking from 30,000 feet. I don't understand, is someone going to get in one of these cars? Let's just say they're going to Level 4 or Level 5, and they're going to program something and take me to Destination X, and this gets you there? You sit back and enjoy. Is that really——

Mr. ABLESON. Yes, that's basically the goal. And as we said, it will take a long time before it gets everywhere for everyone.

Mr. MCKINLEY. Will you be able to interact with your car? You see that visually as you're driving down, you get a phone call, or an e-mail, or something, and pick up milk on the way, and you have to stop and go get milk. Will you be able to tell your machine to pull into that——

Mr. ABLESON. Absolutely. In fact, your machine may know the closest place to get milk and suggest a destination to you.

Mr. MCKINLEY. Fascinating. As I said, I think this is intriguing, and as one of the two engineers, I'll be fascinated to follow how it proceeds with this, but also getting the cost down so that it is affordable for more people and not—yes?

Mr. KARRBERG. Just a comment on cost. Yes, the systems will be expensive at start, but come down in cost in the outer years. But you should also know that you save cost on fender benders, car insurance is likely to go down, also, and fuel economy is going to be improved.

Mr. MCKINLEY. Just in closing, I hope you also would take a look at the fuel efficiency, because I know from engineering perspective, the people who use cruise control use more gas than otherwise. And I would assume that one of the fundamental focuses on this will be using a form of cruise control in your car and, therefore, I'm questioning whether or not this is going to be fuel efficient. It may save lives, but I'm not buying yet into the argument of fuel efficiency.

Mr. ABLESON. I would just add, that's one of the reasons we're rolling out the technology on electric vehicles. We think self-driving technology in electric vehicles make a lot of sense.

Mr. MCKINLEY. And I've gone over time, and I apologize. I yield back.

Mr. LATTA. The gentleman's time has expired, and the Chair now recognizes the gentleman from Texas for 5 minutes.

Mr. GREEN. Thank you, Mr. Chairman, and thank you and the Ranking Member for this hearing today because a lot of us have heard about self-driving cars. I think my wife might be the one because she always complains about my driving. I guess we wouldn't have to use ways to find out where we need to get the closest milk.

But ensuring the safety of our constituents is our primary concern, and what used to be science fiction is fast approaching reality. But for the last 50 years we've seen so many different changes. While the technology potential for massive benefit to society like any other new groundbreaking device, there are risks and precautions that need to be considered, and I look forward to talking about this.

Dr. Kalra, in your testimony you talk about the many different approaches to testing this vehicles, and that real world driving experience may be one of the most important tools for improving autonomous vehicle safety. The sharing of data between large groups of vehicles can quickly improve the overall safety of the group based on the knowledge accumulated by each individual car.

You mentioned that Tesla calls this fleet learning. Can you tell us more about what fleet learning is, and what it can play in a role of improving autonomous vehicle safety?

Dr. KALRA. Sure, thank you for the question.

The idea of fleet learning is—essentially, what's fundamental to autonomous vehicles is that they're improved by a process of machine learning, which is where computers are designed to learn better ways of behaving or performing without being explicitly programmed to do so. And to do that, they gather enormous amounts of data and use learning algorithms to try to improve their performance. And the more data one can feed into machine learning, the better the performance can become, and the faster it can improve.

So companies like Tesla are using this so that every experience that an individual vehicle has is being fed back into the system and the entire fleet can be upgraded continuously. And, in fact, most developers of this technology are using that technique.

And the question is whether that kind of learning is limited to an individual developer, or whether there are opportunities for learning across developers. I agree with Dr. Pratt that that kind of data sharing needs to be thought through carefully, but just as the aviation industry has shown us, sharing experiences can be an essential tool in improving safety quickly.

Mr. GREEN. You compare risk of the early autonomous vehicles learning from the real world experience of teenage drivers. They may not be good drivers yet, for the experience and practice they develop into good drivers. Although, I would probably submit today that with our distracted driving we could all be 15- or 16-year olds trying to drive because we have so many options today for distraction. Restrictions on learner's permits, and minimum age driver requirements are instituted to mitigate the risk of teenage drivers, and you say similar requirements for early autonomous vehicles would be needed. What do you imagine some of the safety require-

ments or restrictions would look like when it comes to self-driving cars?

Dr. KALRA. Well, it doesn't necessarily need to be requirements, but many of the things that my colleagues here have described; for example, limiting their driving to commuter roads or at low speeds. There are many ways to reduce risk, either reducing the likelihood that a crash occurs, which means restricting their operation, for example, to good weather, or reducing the consequences of a crash. And these can be sort of industry-developed ideas and choices, or it may be something that down the line is done through regulation to say these are the ways in which we're going to start rolling out. That's an open question, but essentially reducing risk, even if we can't quantify what the risk of autonomous vehicles right now is an important step.

Mr. GREEN. In your mind, what does the history of the airbag regulation teach about safety regulations for autonomous vehicles? Obviously, I think we share, you create a bureaucracy that may not be effective, and it may take a long time to get to correct things.

Dr. KALRA. If anything, airbag regulations tell us this is extremely complicated. It's difficult to get right, but it's also very important. Airbags were developed in the 1950s, patented. They were first introduced in high end models from the '70s, and it wasn't until the '90s that they were first required in 1999. That took a long time, and one can argue that some mistakes were made along the way because airbags were not smart. The airbags that we have today, they were designed to protect an unbelted male passenger, and the force of doing so would have, for example, killed someone like me. And now we know better.

The difficulty is that that was learned through experience and deployment of the technology that was available at the time. And so there's this conflict between getting safe technology on the road and then learning the ways in which it's not safe. And so airbag regulation is instructive in that it suggests we should temper our optimism, and it's that we need to proceed very carefully and thoughtfully.

Mr. GREEN. Mr. Chairman, with my one second left, obviously, we have some problems with our airbags, but I yield back my time.

Mr. LATTA. Thank you very much. The gentleman's time has expired, and the Chair now recognizes the gentleman from Florida for 5 minutes. I'll let you get to your chair.

Mr. BILIRAKIS. Thank you very much.

Mr. Pratt, we've heard a lot about vehicle-to-vehicle communication in previous hearings on this subject of autonomous vehicles. Where does the work you are doing on V2V communication fit into the overall blueprint of deploying self-driving cars?

Mr. PRATT. Vehicle-to-vehicle, as well as vehicle-to-infrastructure communication is of critical importance to autonomous vehicles. Of course, we drive using our own eyes to see other vehicles, but the potential is there for autonomous vehicles to use not only the sensors on the vehicle itself, but also sensors on neighboring vehicles in order to see the world better. And so, for example, if you're going around a corner and there's some trees or a building that's blocking a view, vehicle-to-vehicle communication can give you the equiva-

lent of x-ray vision, because you're seeing not only your view, but also the view from other cars, as well.

It's going to be pretty hard to make a vehicle that is safe in all conditions. That's this Level 5 vehicle that we keep talking about. And the standards may be very high because, again, it's a machine that's going to be running this, not a human being, so our ability to empathize and forgive will be low. So we have to give ourselves every possible tool in the tool chest in order to try to solve this problem, so I think that vehicle-to-vehicle, vehicle-to-infrastructure is extremely important, and that saving the spectrum for that use is also very important.

Mr. BILIRAKIS. Thank you very much.

Mr. Okpaku, forgive me if I mispronounce your name, the problem of safety benefits of self-driving cars are significant. We've already talked about the potential benefits in the disability community, which could apply to the elderly community, as well, especially in our community. I represent the Tampa Bay area in the State of Florida. There are many veterans and elderly individuals that could benefit from this technology. Well, maybe they want to get to their medical appointment, so I can see a lot of benefits there.

In Lyft's view, what are some other societal and economic benefits we could expect to see from the deployment of self-driving cars?

Mr. OKPAKU. Thank you for the question.

We often talk about the benefit that Lyft in its current form as a ride sharing platform has financially for drivers, but one of the things that I think often gets lost in the conversation is how important transportation is for economic upward mobility on the passenger side; meaning that one of the biggest factors for economic opportunity is access to reliable and quick transportation. So we've already seen some of the impacts that we've had, we believe, on the customer side just by providing safe, and quick, and reliable options to jobs, to get to and from work that previously didn't exist. So if you buy that concept and you apply it across a grand scale that an AV platform can provide, then I think the economic opportunity that it confers is really significant, and it can really help a lot of people who are in economic need get to and from their jobs that they otherwise would take maybe an hour or two to get to just because they have to rely on insufficient public transportation options, in addition.

But I would also echo what you've already mentioned in terms of the ability for non-emergency medical transportation. We've seen ride sharing start to partner with organizations on that front already. I think the ability to do that at an even greater rate and a more efficient rate expands once you include autonomous vehicle technology into the mix.

Mr. BILIRAKIS. Very good, thank you.

Mr. Karrberg, it has been suggested that NHTSA's Federal Automated Vehicle Policy, while a welcome action and show federal leadership, it may contain guidance that has unintended consequences of delaying the development, testing, and deployment of self-driving cars in the United States. Can you comment on that, and how the ambiguities in the guidance document should be resolved?

Mr. KARRBERG. There are a number of issues and questions regarding the FAVP. First of all, I have a comment on the patchwork, the FAVP does not deter sufficiently from the patchwork. Also, requirements on reporting on hardware and software changes that you do during the course of the testing, that is difficult because in engineering you do iterations all the time, and if you report every one of those, that's practically impossible. So these reporting requirements should be limited to major changes.

There is also a waiting period for you hand in your change, and there's a 4-month waiting period. That's also onerous. It also calls for third party certification, preapprovals. We are pro self-certification. It's worked for 30 years, and we see no reason to change that. And we also think that for this FAVP, NHTSA should enhance its expertise, also its staffing to cater for and be able to judge on the AV development so that NHTSA itself will not be a part of the potential delays.

Mr. BILIRAKIS. Thank you very much. Well, I know my time has expired, but if Dr. Pratt wanted to say something, I don't know, Mr. Chairman, is it permissible?

Mr. PRATT. So I would make it short. We agree very much with what the last witness said.

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

Mr. LATTA. The gentleman yields back. The Chair now recognizes the gentlelady from California for 5 minutes.

Mrs. WALTERS. Thank you, Mr. Chairman.

We've talked a lot about the need to prevent a state-by-state patchwork of laws and regulations for autonomous vehicles, which would inevitably slow innovation and stifle this important technology. While I appreciate Ms. Matsui's concerns about California regulations, I think we need to consider the negative impact on the state regulations.

My entire life, I have seen my state, California, and its over-regulation. I saw it up close in my 10 years in the California State Legislature, and I've seen thousands of our most productive businesses and citizens flee for more friendly states. Within these last few months, the trend was extended to AV when Uber moved its testing to Arizona, after California took action to make the state's regulatory regime less hospitable. The ironic thing is that I can think of few states that would benefit more from this technology considering its promise congestion mitigation and the ability to move products inland from the West Coast ports. Even at the federal level, NHTSA suggested model state regulations are cited as the cause of some states pulling back welcoming regulatory environments for AV.

Mr. Okpaku, can you give me a practical example where a state or local law or regulation impacted Lyft's AV testing?

Mr. OKPAKU. Well, thank you very much for the question.

I can give you examples of where we're concerned about the ability of these local legislation and local regulations to impact testing. For example, as of right now, in California there is only one explicitly allowed location, or there's a proposal that would make testing limited to one part of California. And if that legislation were to pass, then the ability to test AV in different environments and different situations would be extremely hampered. So that's one ex-

ample. That bill hasn't passed yet, but it has been introduced, and that's cause for concern.

We're not at the point yet where any of the legislation that we're concerned about has actually been enacted, but we've seen enough proposed legislation all across the country, whether it's in Massachusetts, all the way from Massachusetts, California, that does raise that exact concern that if enacted, it would unintentionally but definitely inhibit our ability to roll out, and test, and deploy.

Mrs. WALTERS. OK. Thank you very much. And I yield back the balance of my time.

Mr. LATTA. The gentlelady yields back the balance of her time. The Chair now recognizes the gentleman from Pennsylvania for 5 minutes.

Mr. COSTELLO. Thank you, Mr. Chairman, and thank you to all of you who have testified here.

I've spent a fair amount of time reading up on this subject, and I must commend each of you because I feel that your testimony, which I have had the time to read through, really does lay out the issues that are in front of us as policy makers in a very thoughtful way, so that we can go about facilitating this technology with you to the public's benefit. And each of you, I think, lay out what the various public benefits that inure from this.

I think each of you also lay out a little bit differently but, nevertheless, the central question here as being are we erecting, or are there regulatory barriers, or is the regulatory framework that's in place facilitative for your technology to be tested so that we can expedite increasing safety, reducing carbon emissions, et cetera, et cetera?

My question, my first question which I will just sort of lay out to all of you is similar to Mrs. Walters, but a little bit differently, and that is with respect to the state patchwork, which I think most of us think would head in the wrong direction, and mindful that I think preemption occurs here, but perhaps the regulatory language maybe is a little too opened-ended and enables some states to stick their head in a window which they're not allowed to stick their head into that window because they should be focused on the drivers, not on the vehicle.

Are you aware of any reciprocity agreements between states to facilitate testing or deployment of self-driving cars across state lines? That's the first question. I think that's important, too, because as some of the testimony has reflected, you need to test this technology in a lot of different topographical climate, and urban/rural circumstances in order to know how effective it could be. So that's my first—and if you have not engaged in reciprocity agreements, is it something that would be helpful to the development of the technology? Go ahead and jump on it first.

Mr. PRATT. So if I might answer first, we have three sites in the United States: one in California, one in Michigan, and one in Massachusetts. We do most of our testing Michigan, and the reason that we do that is because of the different regulatory environments in the three states, and so the answer is no in terms of our utilization of any sort of reciprocity.

Mr. ABLESON. We also test in three locations, as I said earlier, in San Francisco, Scottsdale, Arizona, and Michigan. I'm not aware

of any reciprocity arrangement between the states. We've worked with the individual states to make sure that we have the understanding to allow the testing to go forward.

Mr. COSTELLO. So does that mean it's not been limiting?

Mr. ABLESON. So far we have not had an issue in conducting the testing in those three locations.

Mr. KARRBERG. So we are unaware of any reciprocity between states, and also it would be, of course, very beneficial to be able to test across state lines.

Mr. COSTELLO. It would be beneficial. I guess that would really only come about if you did have a patchwork. If you didn't have a patchwork, we wouldn't have to address that.

Mr. ABLESON. I agree with that. It becomes a problem if a patchwork does develop.

Mr. COSTELLO. What can Congress do to facilitate the testing and deployment of self-driving cars? And that can be directly related to the NHTSA language, or insuring that states don't get in the way, it could be related to the data sharing, double edge sword, if you will, that I think was part of the analysis that some of you laid out, which I find to be very compelling. It could be things unrelated to those two issues.

Mr. PRATT. So I think to begin with, as we spoke before, I think that the Federal Government really needs to help the states understand that it's not in their self-interest to try to make their own rules, and they should leave that to the Federal Government.

The second thing is that the NHTSA guidelines were put out as guidelines. They were not put out as rules to be fully accepted yet, and there still needs to be some work to improve those guidelines. And I think that we spoke before about particular areas that we feel could be improved. A lot of this has to do with understanding the difference between development and deployment.

During development, it's important that there be a very low overhead, low red tape way of making changes. During deployment, that's actually where you want things to be more official, and it's OK to take more time.

Mr. COSTELLO. Insuring that we do not erect barriers on the development side, I think is the point that you're trying to focus on.

Mr. PRATT. That's exactly right. Exactly, thank you.

Mr. COSTELLO. My time is up.

Mr. LATTA. Thank you very much. The gentleman yields back, and seeing no further witnesses, I'm sorry, members asking to question the witnesses.

Ms. SCHAKOWSKY. Would you——

Mr. LATTA. Oh, absolutely. The gentlelady is recognized.

Ms. SCHAKOWSKY. Thank you.

I think the best way to keep defective vehicles off our roads is to prevent the sale of used cars under recall until the recall is repaired.

Mr. Ableson, am I correct that General Motors has committed to not selling used vehicles as certified pre-owned when they have open recalls?

Mr. ABLESON. All vehicles that we sell through our certified pre-owned program have been updated for all appropriate recalls.

Ms. SCHAKOWSKY. Mr. Karrberg, is that also true in your company?

Mr. KARRBERG. I'm sorry, I could not comment on that. I don't know the answer, but I will be happy to submit for——

Ms. SCHAKOWSKY. I'd really like to know that. We've been looking at that. And, Dr. Pratt?

Mr. PRATT. And this is Gil Pratt from Toyota. I, myself, don't know since I'm the head of the Research Lab, but I'm glad to find out for you.

Ms. SCHAKOWSKY. OK. We certainly want to make sure that cars that are sold also often have some sort of statement that they've been pre-checked, but really also have open recalls are permitted for resale. So I'd like to hear from that.

Thank you very much, Mr. Chairman, and witnesses.

Mr. LATTA. Thank you very much. And, again, seeing no further members asking——

Mrs. DINGELL. May I——

Mr. LATTA. Oh, I'm sorry.

Mrs. DINGELL. May I just ask unanimous consent to put comments from Ford Motor Company in the record of this hearing?

Mr. LATTA. Thank you very much. We'll submit that with unanimous consent.

Mrs. DINGELL. Thank you.

Mr. LATTA. No objection.

Again, thanks very much for our witnesses today. You can see from the folks that were here in the audience today, it's a topic that's on everybody's mind, and seeing where the technology is going, safety factors, also making sure that the folks out there that—citizens seniors, as we heard, or folks that might have a disability have more mobility to get around. This is a topic that people are looking forward to, especially in the next few years, seeing these vehicles on the road.

And, also, I would like to also submit the following letters for the record by unanimous consent: a letter from the National Association of Mutual Insurance Companies, a letter from the National Council on Disability, a letter from Ford Motor Company, a letter from Global Automakers, a letter from the Auto Care Association, letter from Epic, a letter from Competitive Carriers Association, a letter from Advocates for Highway Safety, and a letter from SAFE.

And pursuant to committee rules, I remind members that they have 10 business days to submit additional questions for the record, and I ask the witnesses to submit their response within 10 days, business days upon receipt of the question.

Seeing no further business to come before the committee, this subcommittee is adjourned. And, again, thank you very much for our witnesses.

[Whereupon, at 12:14 p.m., the subcommittee was adjourned.]

[Material submitted for inclusion in the record follows:]

PREPARED STATEMENT OF HON. MICHAEL C. BURGESS

Good morning. I want to thank Chairman Latta and Ranking Member Schakowsky for holding this hearing today. When I was Chairman of the Commerce, Manufacturing, and Trade Subcommittee we dedicated a lot of time to self-driving

cars and their ability to save lives. It is important that we continue to focus on these vehicles as they become more present on our roadways.

In particular, it is important that the commercial use of self-driving cars not be hindered by a patchwork of state regulations on testing and deployment of these vehicles. Throughout my life I have seen the life-saving effects of advancements in vehicle technology, from the seat belt, to the air bag, to automatic emergency braking. Self-driving vehicles are the next step in this trajectory.

Last year, automobile related fatalities were around 35,000 and rose for the first time in nearly a decade. In my home state of Texas, the number was 3,516. The vast majority of those fatalities are still related to human behavior. Already, we have heard that fatalities are up again in the first half of this year.

NHTSA's recent Federal Automated Vehicle Policy guidance is a good first step, but questions remain about its implementation. We must remain vigilant in ensuring government does not get in the way of the very innovation that can keep us safe.

I look forward to the witness testimony and continuing the discussion on the road to self-driving cars.

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PREPARED STATEMENT OF HON. GREG WALDEN

In the last Congress, this subcommittee examined multiple emerging technologies that are creating new opportunities for economic growth, job creation, and increased consumer choice in today's growing digital economy. From the Internet of Things and health apps, to drones and robotics, and the revolutionary capabilities of 3–D printing, many of these technologies are transforming commerce and creating new opportunities for economic prosperity in America for generations to come.

Without question, one of the most exciting developments in 21st century commerce is self-driving cars. As traffic accidents are on the rise, automated driving systems have the potential to transform our transportation system into one that is safer and more secure for everyone on the roadways. The promise of self-driving cars to save thousands of lives in the United States and around the world cannot be understated. And we should remember that this technology doesn't have to be perfect to significantly improve safety.

But, the benefits of self-driving cars do not stop at safety. This technology can increase transportation access to underserved communities, expand labor productivity, improve mobility, reduce congestion, and drive new efficiencies and cost savings into businesses. In turn, increasing opportunities for job creation and investment.

However, the realization of these benefits starts with ensuring that the technology powering self-driving cars is safe and ready for consumer adoption. This will require testing. As this committee continues to encourage the deployment of this life-saving technology, our goal is to foster an environment allowing companies the flexibly to test self-driving cars at home, so that the innovation, investment, and development of these vehicles occurs in the United States. Never has there been a more opportune time to lead in the development of this technology, as it has a beneficial effect on every individual in this country.

In laying the groundwork for this committee's agenda, it does not mean that we issue a blank check for testing and deployment anywhere across the country. As with any new innovation and developing technology, proper oversight is key. Rather, this is a call to create a framework that allows this technology to safely develop and a call for innovation to flourish without the heavy hand of government. Overly prescriptive regulations on self-driving cars will stop the very thing we are trying to create: an accident-free transportation system that is safe and secure for all roadway users. That said, we will be monitoring the industry closely and will move quickly if a technology is proven unsafe.

This hearing today will help us better understand how to achieve that goal. It will inform us of manufacturers and developers' testing efforts and how to support plans for the deployment of self-driving cars. Our witnesses will also help us to understand the challenges of testing and deployment and how to address those challenges in a way that fosters innovation and protects American consumers.

Safety is critical here. Manufacturers and other entities developing self-driving cars have every incentive to get this right. There are tremendous economic and societal opportunities ahead for consumers if we lay the proper foundation for the success and advancement of this technology.

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NAMIC®

NATIONAL ASSOCIATION OF MUTUAL INSURANCE COMPANIES

Statement

of the

National Association of Mutual Insurance Companies

to the

United States House of Representatives

Committee on Energy and Commerce's Subcommittee on
Digital Commerce and Consumer Protection

Hearing on

Self-Driving Cars: Road to Deployment

2123 Rayburn House Office Building
February 14, 2017

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Background

NAMIC is the largest property/casualty insurance trade association in the country, with more than 1,400 member companies that represent 40 percent of the total market. NAMIC member companies write nearly $225 billion in annual premiums, accounting for 43 percent of automobile, 54 percent of homeowners, and 32 percent of the business insurance markets. Through our advocacy programs we promote public policy solutions that benefit NAMIC member companies and the policyholders they serve and foster greater understanding and recognition of the unique alignment of interests between management and policyholders of mutual companies.

NAMIC is the property/casualty insurance industry leader in terms of autonomous vehicles (AVs). The association has recently served on a panel hosted by the National Traffic Highway Safety Administration (NHTSA) on issues relating to state jurisdiction and pre-market approval; served as a Board Member and AV thought leader at Advocates for Highway and Auto Safety; and working with the Insurance Institute for Highway Safety (IIHS) supporting the Virginia Tech Transportation Institute (VTTI) as part of the National Cooperative Highway Research Program. In collaboration with IIHS and VTTI, NAMIC is assessing the impact of automated driving systems on motor vehicle codes and other related domains, and developing guidance and resources to assist with the legal changes that will result from the rollout of connected/automated vehicles.

NAMIC's members are also leaders on AV research and development. NAMIC companies serve as founding members of the Ford and University of Michigan's Mobility Transformation Center, whose test facility, MCity, utilizes a highly advanced, 32-acre outdoor lab to evaluate the capabilities of connectedness of AVs. Additionally, other NAMIC members support the "NW US 33 Smart Mobility Corridor" AV testing facility in conjunction with Honda and The Ohio State University's Transportation Research Center.

The Role of Insurance in the Development of AVs

As with the dawn of the automobile, property/casualty insurance will be essential to the development of AVs. Autonomous vehicle technology has the potential to increase automobile safety while reducing accidents and fatalities on our nation's roads. But despite the litany of expected benefits associated with the fast-developing technology, accidents are inevitable. As the technology is more widely adopted and AVs become more readily available, insurers will need to play the critical role of developing sound risk management practices that ultimately protect operators, manufacturers, and passengers.

The auto insurance industry adds critical value today to the development and deployment of vehicles. The insurance industry continually develops and makes public the best detailed auto

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accident data and models[1], which have been continuously improved by the insurance industry's century of leading risk management expertise. Auto insurance providers have proven to have the deepest understanding of all state and local driving regulations and the widest and best understanding of product and general liability. Our work to minimize losses is bolstered by our proven commitment to provide policyholder protection at fair and reasonable rates.

As such, the auto insurance industry will be vital to addressing the many unanswered questions surrounding liability and safety needed for the continued growth in the deployment of AVs, and is already working to test and analyze the safety of existing and developing AV fleets, as well as identifying appropriate standards of safety. Our ability to protect our policyholders is predicated on an appreciation and understanding of liability, particularly, knowing how to determine who is liable in the event of an accident and how liability should be assigned. But in order to answer the unaddressed issues pertaining to liability and safety in the current and evolving regulatory landscape, a basic question must be answered: what regulators and what regulations should govern the testing and driving of these cars?

P/C Insurance Industry Priorities
In this rapidly evolving technological and regulatory environment, NAMIC has several priorities for the property/casualty insurance industry to work in harmony with the development of autonomous vehicles:

- Ensure the development of legal and regulatory clarity for developing issues of liability, data privacy, and safety

- Be an active part of the technical and regulatory evolution towards AVs to ensure that insurers can continue to provide policyholder protection

- Retain appropriate civil and regulatory responsibilities for motor vehicle insurance and liability

Conclusion
In seeking to strike the balance of enabling the continued innovation of AVs while simultaneously ensuring the safety and protection of policyholders, NAMIC is working with legislators and regulators at the federal, state, and local level on the important insurance considerations that are paramount to the development, testing, and use of AVs. We have greatly appreciated the time and consideration of the staff of this Subcommittee in sharing and

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[1] Funded by NAMIC and other insurance trades associations, the Insurance Institute for Highway Safety (IIHS), the folks who use crash test dummies in cars, is the independent, nonprofit scientific and educational organization dedicated to reducing the losses from crashes on the nation's roads.

developing information and policies and we look forward to continuing that very positive relationship.

National Council on Disability

Testimony of Clyde Terry
Chair, National Council on Disability

"Self-Driving Cars: Road to Deployment"

Hearing of the Digital Commerce and Consumer Protection Subcommittee of the House
Energy and Commerce Committee

U.S. House of Representatives

Tuesday, February 14, 2017,
10:15 A.M.

2123 Rayburn House Office Building

Chairman Latta, Ranking Member Schakowsky, and Esteemed Members of the
Subcommittee:

Introduction

Thank you for the opportunity to provide brief written testimony for this timely and
important hearing on autonomous vehicle technology. The National Council on Disability
(NCD) is an independent federal agency charged with providing the Administration,
Congress, and other federal agencies with advice and recommendations regarding
disability policy to improve the lives of people with disabilities. We applaud the
Committee for examining this topic at today's hearing and we offer ourselves to the
Committee as an ongoing resource as you examine this topic and consider appropriate
legislative responses.

An Exciting Innovation for Everyone, But a New Era for Some

Aside from being one of the most exciting innovations in transportation since the Model
T began rolling off the assembly line in 1913, autonomous vehicle (AV) technology
holds tremendous promise for many people with disabilities and seniors who currently
lack access to independent transportation. In our 2015 report, "Self-Driving Cars:

Mapping Access to a Technology Revolution,"[1] NCD examined the challenges and advances associated with this revolution in transportation technology and proposed directions in research and development that will most benefit those people with disabilities who are the most transportation disadvantaged because their disabilities prevent them from driving even a modified conventional vehicle. Autonomous vehicles hold great promise to advance social inclusion by offering people with disabilities independent mobility to get to school, jobs, and all places that Americans go each day. They also offer the possibility of ending the isolation that many people who are aging experience by keeping them connected with others and to activities that are often lost when we lose the ability to drive.

An Opportunity the Disabled Can't Afford to Miss

These remarkable benefits will not come at once and will not occur without cooperation among federal and state governments, research institutions, and private industry. Benefits will not emerge if the technology develops without universal accessibility for people with diverse disabilities, including intellectual and developmental, sensory, and physical disabilities. The National Highway Transportation Safety Administration (NHTSA)'s "Federal Automated Vehicles Policy," released in September of last year, constituted an important first step in establishing national guidelines for this emerging technology. NCD was particularly pleased that the guidelines stated unequivocally that, "…HAV (highly automated vehicle) systems should be designed to perform the complete driving task and monitor the environment within their ODD (operational design domain) without any expectation of involvement by a human driver."[2]

Achieving this goal would advance the nation's disability policy goals: equality of opportunity, full participation, and independent living, but only if accessibility is infused in the research and development of AVs. Without explicit inclusion of accessibility in the development of AV technologies, the potential for opportunity wanes.

As an example of the importance of forethought as technology evolves, during the early days of the Internet, and still today, accessibility for people with disabilities was not considered by web developers, and many people with disabilities experienced and even now still do experience unnecessary obstacles to information (e.g., text that is inaccessible to screen reader software, lack of captions on audio content, keyboard-only navigation). Those obstacles diminish the opportunities available to people with disabilities that the Internet presents for people without disabilities, and provides a practical lesson for AV researchers and engineers to commit now to including

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[1] National Council on Disability, "Self-Driving Cars: Mapping Access to a Technology Revolution," released November 2, 2015, accessed February 10, 2017, at: http://ncd.gov/publications/2015/self-driving-cars-mapping-access-technology-revolution.
[2] National Highway Transportation Safety Administration (NHTSA) "Federal Automated Vehicles Policy: Accelerating the Next Revolution in Roadway Safety" Released September 2016, accessed February 10, 2017.

accessibility into development. If controls and interfaces necessitate one being sighted or having specific dexterities – as just two examples – the technology's design will foreclose its use by scores of people who would otherwise be among the greatest beneficiaries of the technology.

From what we've seen so far, many in the industry understand the potential that autonomous vehicles have to change the lives of people with disabilities, and that people with disabilities are a primary sales market for this technology. It's important to make sure that accessibility stays at the forefront of this conversation so that people with disabilities don't get left behind. Decisions that are made by policymakers, innovators, regulators and marketers will all impact how this technology is adopted and whether it achieves the potential it has to change the lives of people with disabilities who are transportation disadvantaged. We look forward to working with industry, advocates, and policymakers to shepherd this technology so as to result in a new era of inclusion for people with disabilities. Accordingly, we encourage you to include discussions of the needs of this population as you convene future hearings on the topic of AV and to seek out the views and experiences of people with disabilities in those discussions, and we are very glad to assist in identifying suitable individuals to that end.

Conclusion

NCD is grateful to the Committee for elevating this important topic through today's hearing and we encourage Committee members and their staff to review our report on this topic, "Self-Driving Cars: Mapping Access to a Technology Revolution" which is available on our website at: https://www.ncd.gov/publications/2015/self-driving-cars-mapping-access-technology-revolution. We look forward to providing further testimony at future hearings on this topic.

Statement of
Ford Motor Company

Committee on Energy and Commerce
Subcommittee on Digital Commerce and Consumer Protection
Hearing on
"Self-Driving Cars: Road to Deployment"

February 14, 2017

Ford Motor Company believes autonomous vehicles have significant potential to improve mobility and safety, as well as reduce traffic congestion. Our CEO, Mark Fields, announced last year that Ford intends to deploy an SAE Level Four vehicle to move goods and people, such as ride sharing, ride hailing, or package delivery fleets in geo-fenced areas in 2021. That vehicle, which will be built at our Flat Rock Assembly Plant in Michigan, will not have a steering wheel or accelerator and brake pedals. We are working hard toward that goal, and – as with everything Ford does – safety is top of mind.

Ford has over a century of experience designing, manufacturing, and selling safe cars and trucks. We are applying that expertise to our autonomous vehicle program. We currently have 30 autonomous vehicles in our development fleet. The vehicles are used on closed test tracks, where we create and control specific traffic situations, as well as on public roads in Arizona, California, and Michigan, using a trained safety driver and engineer to serve as spotter in each vehicle. Ford is working collaboratively with major research institutions, like the University of Michigan, Stanford, and MIT, as well federal and state regulatory bodies, to contribute to and benefit from a community of shared learning.

Having the right policies in place should be a common goal. We commend the National Highway Traffic Administration (NHTSA) for the great step forward it took in the Federal Automated Vehicles Policy (FAVP) last year. Nevertheless, it does not solve statutory or regulatory impediments to autonomous vehicle testing and deployment. Moreover, many states are considering policy changes that go beyond traditional state roles with respect to driver licensing and vehicle registration, traffic laws and regulations, safety inspections, and regulating vehicle insurance and liability. The most concerning of these are disparate vehicle testing and performance standards, which could ultimately hinder innovation.

With this in mind, two federal policy actions would be beneficial. First, NHTSA should commence a rulemaking to amend existing Federal Motor Vehicle Safety Standards (FMVSS) that currently mandate human operator controls to allow automated driving systems, as well as update prohibitive FMVSS test procedures. Second, Ford suggests Congress could consider increasing the statutory Safety Act exemption cap to permit autonomous vehicle deployment while this rulemaking is underway.

Ford wants to continue working collaboratively with policymakers to ensure the proper groundwork is laid today for the future deployment of safe autonomous vehicles. We stand ready to assist you and appreciate your interest in these issues, which are vital to the future of our company.

GlobalAutomakers ⊙

**Statement for the Record of John Bozzella
President and CEO, Association of Global Automakers, before the
House Committee on Energy and Commerce
Subcommittee of Digital Commerce and Consumer Protection
Hearing on "Driverless Cars: Road to Deployment"
February 14, 2017**

On behalf of the Association of Global Automakers ("Global Automakers"), I am pleased to provide the following statement for the record to the House Energy and Commerce Committee Subcommittee on Digital Commerce and Consumer Protection hearing on "Driverless Cars: Road to Deployment."

Global Automakers represents international automobile manufacturers that design, build, and sell cars and light trucks in the United States. These companies have invested $56 billion in U.S.-based facilities, directly employ nearly 100,000 Americans, and sell 47 percent of all new vehicles purchased annually in the country. Combined, our members operate more than 300 production, design, R&D, sales, finance and other facilities across the United States.

The United States auto industry now stands at the leading edge of a technological revolution in which connected and automated vehicles are redefining how we think about transportation, and the Committee's continued focus on this topic is important, valuable, and welcomed. Connected and automated vehicles can greatly improve safety, reduce energy consumption and enhance mobility, and this innovation will fuel the jobs of the future.

The task before policymakers, on this Committee and at other branches and levels of government, is to foster the proper legal, regulatory and market environments to enable the benefits of connected and automated vehicles. Accordingly, we need clear federal leadership to ensure that we have a uniform vehicle safety policy that promotes innovation, allows thorough testing, and leads to the responsible deployment of these revolutionary technologies.

In 2016, the Department of Transportation took important steps with the publication of the Federal Automated Vehicle Policy and the issuance of a proposed rule on vehicle-to-vehicle

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communications. Now, the new Administration must continue that work. Congress has the opportunity to move the ball forward by (a) directing the National Highway Traffic Safety Administration (NHTSA) to update Federal Motor Vehicle Safety Standards to accommodate automated technologies, and (b) clarifying that vehicle design and performance standards are the exclusive responsibility of the federal government by preempting state laws in these areas.

Connected and automated vehicles represent the next giant step in motor vehicle safety. Over the past several decades, our members have made tremendous strides in advancing safety through the design of enhanced occupant restraint systems and improved vehicle crashworthiness. Today, we are moving from mitigating the consequences of crashes to preventing them altogether. Our members are at the forefront of this innovation. They have made, and continue to make, substantial investments in the research and development of automated vehicle systems and other advanced automotive technologies in the United States supporting quality jobs for American workers.

It is important to note that automated vehicle technologies are much broader than the concept of a self-driving car. For example, a number of vehicles on the road today provide some automated functionality through advanced crash-avoidance and convenience features such as crash-imminent braking, lane keeping assist, and adaptive cruise control. These systems are designed to provide support to the driver only in certain situations, and vehicle-only control is not typically sustained over an extended period of time. Global Automakers believes that all levels of automation should be allowed to advance to move these technologies forward. Consequently, appropriate frameworks must be in place to encourage both the evolution of existing systems as well as the testing and deployment of "driverless" systems.

The development and deployment of automated driving systems is a challenging task, requiring comprehensive testing to evaluate how the technology will perform in a complex real-world driving environment. This testing will involve computer simulation, closed track, and public road testing to validate and verify the performance of vehicle sensors and decision algorithms. Understandably, the testing of "driverless cars" on public roads raises several questions and has led to a significant policy debate at both the federal and state level. While all parties agree testing

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must be conducted in a safe and transparent manner, we must also ensure that a patchwork of state standards does not hinder the testing and deployment of automated technologies.

Despite NHTSA's efforts to provide direction and guidance through the Federal Automated Vehicle Policy, Global Automakers members remain concerned that states continue to push legislation and regulations that will threaten nationwide deployment of automated vehicles. This concern is borne out by the fact that although the federal guidance is intended to provide a national approach to automation that can adapt to the pace of technology, many states nevertheless have introduced, debated and, in some cases, enacted legislation addressing automated vehicles. This year alone, more than 40 legislative proposals related to automated vehicles have been introduced in the states. These laws often include conflicting definitions of what constitutes an automated vehicle as well as various vehicle requirements that can dictate the way automakers must design and manufacture systems.

A patchwork of state laws establishing inconsistent design and performance criteria for automated vehicles will delay the delivery of real-world safety benefits to the American public and would be unworkable for the industry. It could in theory even mean that people in different states will not have the same access to the latest crash-avoidance technologies. For that reason, we believe that NHTSA should lead, as it is the expert federal agency charged with ensuring that motor vehicles are designed and manufactured to meet national safety performance standards. Such leadership will enable the safe and consistent development of automated vehicles that can be safely driven across the 50 states. State governments also can play a role but, in contrast to the federal government, need to focus on issues related to the safe operation of those vehicles on their roads, such as driver licensing, vehicle registration, and insurance.

Congress can act to ensure that there is a workable, national framework for the development, testing and deployment of automated vehicles. First, Congress can spur innovation by directing NHTSA to evaluate existing Federal Motor Vehicle Safety Standards and other regulations to ensure that there are no unnecessary barriers to the safe deployment of automated systems. Second, Congress can clarify that individual states do not have authority to issue policies related to vehicle design and performance by preempting such standards.

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The automobile industry continues to provide innovative technologies with demonstrable safety, mobility, and efficiency benefits. To achieve these benefits, there must be close collaboration and coordination among government, industry, academia, and other stakeholders. We must also ensure the policy environment supports a national approach. Global Automakers and our member companies believe that connected and automated vehicles represent a critical step towards our shared long-term goal of safer, cleaner, and more efficient vehicle transportation. Right now the United States is leading the way in connected automation innovation; we must ensure that our policy frameworks allow our country to stay in the lead.

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February 14, 2017

Congressman Bob Latta   Congresswoman Janice Schakowsky
Chairman   Ranking Member
Subcommittee on Digital Commerce   Subcommittee on Digital Commerce
and Consumer Protection   and Consumer Protection
2125 Rayburn House Office Building 2125 Rayburn House Office Building
Washington, DC 20515   Washington, DC 20515

Dear Chairman Latta and Ranking Member Schakowsky:

The Auto Care Association, representing the nearly 500,000 business locations that make-up the $356.5 billion independent vehicle maintenance and repair industry, thanks the House Energy & Commerce subcommittee on Digital Commerce & Consumer Protection, for holding their hearing on the deployment of self-driving cars. As the vehicle technology advances, consumers are continually more exposed to the issues of vehicle data ownership as well as cybersecurity threats. The auto care industry believes there is much more that can be done to protect car owner privacy and safety as vehicles become more connected and are equipped with autonomous and semi-autonomous features.

Vehicle owners are still vastly unaware of the amount of information being transmitted by their vehicles. Much of this data is being collected without the vehicle owner being able to control what is collected, by whom, and for what purpose. Recent Auto Care research shows that 81% of vehicle owners believe that they should decide who has access to this data. Additionally, 7 out of 10 believe the data being transmitted to the vehicle manufacturer is a problem and demand a change.

The auto care industry believes innovations on behalf of driver safety are an important step forward toward minimizing injuries and fatalities sustained in vehicle crashes. The technology systems in vehicles and those that connect to these systems - including auto care industry solutions – should all be inclusive of a secure vehicle interface compliant protocol that minimizes cybersecurity threats while providing the vehicle owner with the ability to control whether and to whom data transmitted by their vehicle is sent.

With this in mind, we urge the subcommittee to explore solutions for protecting vehicle owner data, minimizing cybersecurity threats on vehicle systems, and providing full control to the consumer over the data sent by their vehicle.

Thank you again for holding the hearing on self-driving cars and we look forward to working with the members of the subcommittee to protect consumers and their vehicle data.

Sincerely,

Aaron Lowe
Senior Vice President, Government and Regulatory Affairs

epic.org ELECTRONIC PRIVACY INFORMATION CENTER

February 13, 2017

The Honorable Robert Latta, Chairman
The Honorable Janice Schakowsky, Ranking Member
U.S. House Committee on Energy and Commerce
Subcommittee on Digital Commerce & Consumer Protection
2125 Rayburn House Office Building
Washington, DC 20515

RE: Hearing on "Self-Driving Cars: Road to Deployment"

Dear Chairman Latta and Ranking Member Schakowsky:

We write to you regarding the upcoming hearing on connected vehicles.[1] New vehicle technologies are being quickly implemented by car manufacturers. But these new technologies also raise serious safety and privacy concerns that Congress needs to address. Current approaches, based on industry self-regulation, are inadequate and fail to protect driver privacy and safety. Increased congressional oversight is imperative, as this fast-evolving industry affects the safety and privacy of millions of Americans.

The Electronic Privacy Information Center was established in 1994 to focus public attention on emerging privacy and civil liberties issues. EPIC engages in a wide range of public policy and litigation activities. EPIC testified before this Committee in 2015 on "the Internet of Cars."[2] While we appreciate that legislation was adopted subsequently to gather data on the privacy impact of connected vehicles, we believe more should be done.[3] Recently, EPIC urged the Ninth Circuit of Appeals to protect the right of consumers to pursue safety issues with connected vehicles.[4]

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[1] *Self-Driving Cars: Road to Deployment* before the House Committee on Energy & Commerce, https://energycommerce.house.gov/hearings-and-votes/hearings/self-driving-cars-road-deployment.
[2] Statement of Khaliah Barnes, hearing on *The Internet of Cars* before the House Committee on Oversight and Government Reform, November 18, 2015, https://epic.org/privacy/edrs/EPIC-Connected-Cars-Testimony-Nov-18-2015.pdf.
[3] Driver Privacy Protection Act of 2015.
[4] Brief of *Amicus Curiae* EPIC, *Cahen v. Toyota Motor Corporation*, No. 16-15496 (9th Cir. Aug. 5, 2016), https://www.epic.org/apa/comments/EPIC-NHTSA-AV-Policy-comments-11-22-2016.pdf.

"Connected cars" are connected to the Internet, which creates safety and privacy risks. For example, researchers have already been able to hack into and take control of connected cars.[5] Furthermore, cars with telematics transmits location data from a car and a service provider.[6] This leads to the collection of vast amounts of location information that exposes extensive private information on driver habits such as where a driver lives and works or where they go on a Friday night.[7]

Many consumers who rent vehicles are also confronting bluetooth enabled systems that collect their entire address books from their cellphones.[8] This also raises serious privacy concern.[9]

The recent trend by federal agencies to issue voluntary guidance and allow manufacturers to self-regulate is not working.[10] While this guidance is a helpful starting point, consumers would be safer if there were concrete minimum safety and privacy requirements for connected cars.

A nationwide standard is needed to ensure the safe deployment of connected vehicles. Currently, several states have adopted laws for connected vehicles, but they vary from state to

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[5] Dr. Charlie Miller & Chris Valasek, Adventures in Automotive Networks and Control Units, IOActive (2014) http://www.ioactive.com/pdfs/IOActive_Adventures_in_Automotive_Networks_and _Control_Units.pdf; Steve Henn, With Smarter Cars, The Doors Are Open To Hacking Dangers, NPR (July 30, 2013), http://www.npr.org/sections/alltechconsidered/2013/07/30/206800198/Smarte r-CarsOpen-New-Doors-To-Smarter-Thieves; Andy Greenberg, Hackers Remotely Kill a Jeep on the Highway – With Me in It, Wired, Jul. 21, 2015, https://www.wired.com/2015/07/hackers-remotelykill-jeep-highway/; Bruce Schneier, Hackers Stealing Cars, Schneier on Security, Aug. 11, 2016, https://www.schneier.com/blog/archives/2016/08/hackers_stealin.html; Bruce Schneier, Autonomous Vehicles as Bombs, Schneier on Security, Oct. 6, 2015, https://www.schneier.com/blog/archives/2015/10/autonomous_vehi.html.
[6] 8 U.S. Gov. Accountability Office, GAO-14-649T, Consumers' Location Data: Companies Take Steps to Protect Privacy, but Practices Are Inconsistent, and Risks May Not be Clear to Consumers (2014), http://gao.gov/products/GAO-14-649T.
[7] Id. at 2
[8] Lisa Weintraub Schifferle, What Is Your Phone Telling Your Rental Car?, Federal Trade Commission, Aug. 30, 2016, https://www.consumer.ftc.gov/blog/what-your-phone-telling-your-rental-car; Cale Guthrie Weissman, Watch Out For This Incredibly Easy Way That Rental Cars Can Intercept Your Smartphone Data, Business Insider, Jul. 6, 2015, http://www.businessinsider.com/rental-car-bluetooth-hands-free-devices-can-intercept-your-smartphone-data-2015-7.
[9] Jeff John Roberts, Watch Out That Your Rental Car Doesn't Steal Your Phone Data, Fortune, Sep. 1, 2016, http://fortune.com/2016/09/01/rental-cars-data-theft/; Bruce Schneier, Tracking Connected Vehicles, Schneier on Security, Oct. 29, 2015, https://www.schneier.com/blog/archives/2015/10/tracking_connec.html ("Researchers have shown that it is both easy and cheap to surveil connected vehicles.")
[10] Nat'l Highway Traffic Safety Admin., Federal Automated Vehicles Policy (Sep. 2016), https://www.transportation.gov/sites/dot.gov/files/docs/AV%20policy%20guidance%20PDF.pdf

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Consumer Protection

state.[11] Consumers nationwide deserve these protections. A national minimum standard is needed. Stronger privacy safeguards should also be established.

We ask that this letter be entered in the hearing record. EPIC looks forward to working with the Subcommittee on these issues.

Sincerely,

Marc Rotenberg
Marc Rotenberg
EPIC President

Caitriona Fitzgerald
Caitriona Fitzgerald
EPIC Policy Director

Kim Miller
Kim Miller
EPIC Policy Fellow

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[11] Ark. Code § 23-112-107; Cal. Vch. Code § 9951; Colo. Rev. Stat. § 12-6-401, -402, -403; Conn. Gen. Stat. § 14-164aa; Del. Code § 3918; Me. Rev. Stat. Ann. tit. 29-A §§ 1971, 1972, 1973; Mont. Code § 61-12-1001 et seq.; Nev. Rev. Stat. § 484D.485; N.H. Rev. Stat. § 357-G:1; N.J. Stat. § 39:10B-7 et seq.; N.Y. Vch. & Traf. Code § 416-b; N.D. Cent. Code § 51-07-28; Or. Rev. Stat. § 105.925 et seq.; Tex. Transp. Code § 547.615; Utah Code § 41-1a-1501 et seq.; Va. Code §§ 38.2-2212(C)(s), 38.2-2213.1, 46.2-1088.6, 46.2-1532.2; Wash. Rev. Code §46.35.010. 62 Va. Code Ann. § 38.2-2213.1 (West).

EPIC Letter to House Energy & Commerce   3   Self-Driving Cars: Road to Deployment
Subcommittee on Digital Commerce &   February 13, 2017
Consumer Protection

CCA

Competitive Carriers Association
Rural · Regional · Nationwide™

February 13, 2017

The Honorable Robert Latta   The Honorable Janice Schakowsky
Chairman   Ranking Member
Subcommittee on Digital Commerce   Subcommittee on Digital Commerce
       and Consumer Protection   and Consumer Protection
Committee on Energy and Commerce   Committee on Energy and Commerce
U.S. House of Representatives   U.S. House of Representatives
2125 Rayburn House Office Building   2125 Rayburn House Office Building
Washington, D.C. 20515   Washington, D.C. 20515

Dear Chairman Latta and Ranking Member Schakowsky:

Competitive Carriers Association (CCA)[1] respectfully submits this letter for the record regarding the hearing on "Self-driving Cars: Road to Deployment." As autonomous vehicles take to our roadways, Americans will benefit from new automotive innovations that will impact commerce, tourism, commuting, and safety. In fact, several automotive innovations available today are supported by mobile broadband networks. In addition to emerging vehicle technologies, mobile broadband networks are the technological key that help make self-driving cars possible. Applications that will enhance consumers' experience in self-driving vehicles and in-demand features will continue to run on mobile wireless networks.

Without strong, reliable, and ubiquitous mobile network infrastructure throughout the United States to support evolving technologies, autonomous vehicle capabilities will be limited. As Congress moves forward to support the rise of autonomous vehicles, it should consider policies to foster mobile broadband availability, including in rural areas, to support continued growth and innovation of autonomous vehicles and the applications that unleash their potential.

Competitive carriers serve some of the most rural parts of the country, in addition to the vast suburban areas that link urban and rural America. Gaps in service could prove detrimental to an autonomous vehicle presuming or relying on ubiquitous service to optimally perform outside or beyond a major metropolitan area. To provide necessary network coverage, carriers need mobile broadband infrastructure deployment policies and regulations that promote investment and buildout and streamline challenges and unnecessary red tape. This includes providing certainty regarding the siting process and timelines for application review as carriers seek to deploy or upgrade services. Unnecessary red tape, burdens, fees, or open-ended timeframes frustrate efforts to expand mobile

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[1] CCA is the nation's leading association for competitive wireless providers and stakeholders across the United States. CCA's membership includes nearly 100 competitive wireless providers ranging from small, rural carriers serving fewer than 5,000 customers to regional and national providers serving millions of customers. CCA also represents close to 200 associate members, including vendors and suppliers that provide products and services throughout the mobile communications ecosystem.

broadband. Removing barriers to deployment at federal, state, and local levels by adopting "dig once" and "deemed granted" policies, master applications, and the use of shot clocks will help competitive carriers meet the needs of unserved communities. Streamlining these processes is particularly important as carriers work to densify their networks or bring services to high cost areas. Additionally, carriers need certainty with regards to support from the Universal Service Fund (USF) to deploy and maintain mobile networks in high cost areas. Congress should support USF policies that preserve and expand mobile broadband in rural America.

Mobile networks connect roadways to support and enhance self-driving vehicles. Network quality and coverage is as important to ongoing autonomous vehicle innovation as the asphalt driverless cars will ride on. Congress and the Administration must include mobile broadband deployment in any infrastructure plan, ensure certainty of USF support to preserve and expand networks, and streamline the infrastructure deployment process to encourage expansion of mobile broadband services nationwide.

CCA thanks the Subcommittee for its leadership on this important issue, and appreciates the opportunity to assist your efforts on such a critical issue. We welcome any questions or comments you may have.

Sincerely,

Steven K. Berry
President & CEO

CC: Chairman Greg Walden
        Ranking Member Frank Pallone

ADVOCATES
FOR HIGHWAY
& AUTO SAFETY

February 13, 2017

The Honorable Robert Latta
Chairman
Committee on Energy and Commerce
Subcommittee on Digital Commerce and
Consumer Protection
2125 Rayburn House Office Building
Washington, D.C. 20515

The Honorable Jan Schakowsky
Ranking Member
Committee on Energy and Commerce
Subcommittee on Digital Commerce and
Consumer Protection
2125 Rayburn House Office Building
Washington, D.C. 20515

Dear Chairman Latta and Ranking Member Schakowsky:

As you prepare for tomorrow's hearing, "Self-Driving Cars: Road to Deployment," Advocates
for Highway and Auto Safety (Advocates) would like to offer our safety position for your
consideration. Advocates is a coalition of public health, safety, and consumer organizations,
insurers and insurance agents that promotes highway and auto safety through the adoption of
safety laws, policies and regulations. We respectfully request that this letter and the comments
Advocates submitted to the public docket in response to the National Highway Traffic Safety
Administration (NHTSA) "Federal Automated Vehicles Policy" Notice and Request for
Comments (81 Federal Register 65703, September 23, 2016, DOT Docket No. NHTSA-2016-
0090), which are attached, be included in the hearing record.

Advocates has always been a leader in supporting technological solutions to advance safety,
reduce crashes, save lives, mitigate injuries and contain crash costs. These efforts include
requirements for airbags, electronic stability control, anti-lock brakes, rearview cameras and
other important safety features as standard equipment on cars, trucks and motorcoaches. In fact,
NHTSA has estimated that since 1960, over 600,000 lives have been saved by motor vehicle
safety technologies.[1] Similarly, we believe autonomous vehicle (AV) technology will enhance
our ability to achieve meaningful and lasting reductions in the death and injury toll currently
inflicted on our streets and highways.

According to NHTSA, 35,092 people were killed on our nation's roads in 2015.[2] This 7.2-
percent increase is the largest percentage increase in nearly fifty years.[3] Early data for 2016,
unfortunately, appears to be even worse. Preliminary information for the first half of 2016
shows a further 8 percent rise in fatalities compared to the same time period in 2015.[4] Advocates
is hopeful that AVs have the potential to significantly reduce this carnage.

On the development and deployment of AVs, Advocates has both a short-term and long-term
view. If, as some experts predict, it may be 15-20 years before AVs comprise a major portion of
the vehicles on public roads, we should not stand by while more than 500,000 people are killed
and more than 36 million are injured in crashes during these intervening years. In the short term,

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[1] Lives Saved by Vehicle Safety Technologies and Associated Federal Motor Vehicle Safety Standards, 1960 to
2012, DOT HS 812 069 (NHTSA, 2015); See also, NHTSA AV Policy, *Executive Summary*, p. 5 endnote 1.
[2] National Center for Statistics and Analysis, *2015 motor vehicle crashes: Overview*, Report No. DOT HS 812 318,
National Highway Traffic Safety Administration (Aug. 2016).
[3] *Id.*
[4] National Center for Statistics and Analysis, *Early Estimate of Motor Vehicle Traffic Fatalities for the First Half
(Jan–Jun) of 2016*, Report No. DOT HS 812 332 (Oct. 2016).

we urge NHTSA to use its authority to require that available and effective crash avoidance technologies be required as standard equipment on all motor vehicles. These include automatic emergency braking and lane departure warning systems for trucks, buses and cars. In fact, in February of 2015, Advocates, along with other safety groups and families of victims and survivors of crashes, filed a Petition for Rulemaking with NHTSA requesting the agency issue a rule to require automatic braking systems to prevent frontal crashes involving large trucks. The agency granted the petition and Advocates is hopeful that NHTSA will commence rulemaking in 2017, particularly because of the urgency in addressing the unacceptable and dramatic increases in truck crash deaths these past five years.

Additionally, you will note in our comments to the docket that Advocates is urging NHTSA to require a functional safety process for new AV technologies which are rapidly entering the marketplace. The command and control software of these vehicles is not addressed by current Federal Motor Vehicle Safety Standards (FMVSS). Furthermore, it is expected that there will be efforts by industry to seek and obtain exemptions for AVs from some or all of the existing FMVSS. While we know there will be crashes, deaths and injuries during the transition between old and new cars, human error should not be replaced with computer error. Predictable problems and flaws that pose unreasonable risks to public safety before these vehicles are sold to the public and used on public roads should be eliminated and this can be achieved with a mandatory functional safety process.

Functional safety is a process by which a system is designed, developed and deployed to ensure that the system, as a whole, operates correctly and safely in response to inputs, errors, and failures. Functional safety is applied throughout the life-cycle of a system, from hazard analysis during design through auditing of performance after deployment. The user interface is an essential aspect of the development and deployment of AVs. In the functional safety approach, the human/machine interface (HMI) presents both a source for and means of addressing hazards stemming from the user. As some products currently on the road have demonstrated, poor HMI design can lead to dangerous and deadly situations. Only through ubiquitous adoption of a functional safety approach to the development and deployment of AVs can the safety and benefits of this technology be achieved.

The fatal crash in Florida last May of the Tesla Model S equipped with an Autopilot system is an example of what happens when manufacturers fail to carry out their due diligence before marketing an experimental system. NHTSA's guidelines (Federal Automated Vehicles Policy) would not have prevented the crash because they are voluntary and lack specific requirements for safety assurance and functional safety. However, AVs are being developed, tested and marketed now with no government oversight. Weak, unenforceable, voluntary guidelines will not ensure public safety.

Cybersecurity is an important aspect of AV development which must be addressed as part of functional safety. NHTSA should identify problem areas and require specific responses from manufacturers as to how those are being addressed. Problem areas could include subjects such as GPS signal loss or degradation, spoofing, and off-line and real time hacking of single vehicles or fleets of vehicles. As with all other AV performance aspects, the sharing of data in terms of cybersecurity will improve overall safety and ensure that all vehicles are afforded the same level of security. Data and information about known flaws or problems must be shared among manufacturers and with NHTSA and the public to ensure solutions to safety problems are readily identified and remedied. The potential risk of a single software error, or malevolent computer hack impacting hundreds or thousands of AVs, perhaps whole model runs, makes strong cybersecurity protections a crucial and essential element of AV design.

Additionally, the development and deployment of AVs as well as NHTSA's role in regulating this technology must be open and transparent. Therefore, all communications and responses between the agency and a manufacturer as it relates to any issues involving AVs must be made available for public review and scholarly research. All data generated from the testing and deployment of AVs, except for trade secrets and private individual information, must also be made public. Lack of transparency will severely undermine the public's confidence in this new technology and inhibit its widespread adoption, regardless of its benefits.

In fact, a recent national survey commissioned by Kelley Blue Book found that a large portion of the public is hesitant to accept AVs. Fifty-one percent of respondents replied that they prefer to have full control of their vehicle, even if it's not as safe for other drivers. Additionally, awareness of the higher levels of vehicle autonomy is limited, with 6 out of 10 people saying they know little or nothing about AVs. For half of the respondents, the perception of safety and personal comfort with autonomous technology diminished as the level of autonomy increased. In fact 80 percent believed that people should always have the option to drive themselves.[5]

Advocates urges the agency to issue appropriate safety standards for the AV technologies and we hope that the industries involved will support this position. There are important benefits to the auto and tech industries and public safety of having some basic rules of the road that everyone follows, drivers as well as manufacturers. If consumer confidence is shaken by a lack of transparency or malfunctioning technology that leads to crashes, deaths and injuries, it will set back our efforts to advance these lifesaving technologies.

Fifty years ago, Congress passed the National Traffic and Motor Vehicle Safety Act of 1966 in response to concerns about the death and injury toll on our highways.[6] The law required the federal government to establish the FMVSS to protect the public against "unreasonable risk of accidents occurring as a result of the design, construction or performance of motor vehicles."[7] While cars have changed dramatically and will continue to do so in the future, the underlying premise of this prescient law has not.

Thank you for your consideration of this letter and our viewpoint. We are glad to provide any additional information you may need and continue to be available and willing to be a resource for your Subcommittee.

Sincerely,

Jacqueline S. Gillan

Jacqueline S. Gillan
President

Catherine Chase

Catherine Chase
Vice President of Governmental Affairs

cc: Members of the Subcommittee on Digital Commerce and Consumer Protection

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[5] 2016 Kelley Blue Book Future Autonomous Vehicle Driver Study, www.kbb.com
[6] Pub. L. 89-563 (Sept. 9, 1966).
[7] Title 49, U.S.C. Sec. 30102.

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Written Testimony of

Robbie Diamond

Founder and CEO, Securing America's Future Energy (SAFE)

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and

Dr. Amitai Y. Bin-Nun

Director, Autonomous Vehicle Initiative, Securing America's Future Energy (SAFE)

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House Committee on
Energy and Commerce

Subcommittee on Digital Commerce and Consumer Protection

February 14, 2017

Self-Driving Cars: Road to Deployment

Dear Chairman Latta, Ranking Member Schakowsky, and distinguished members of the Committee:

Thank you for offering us the opportunity to submit this written statement on this critical topic. My name is Robbie Diamond and I am the founder and CEO of Securing America's Future Energy (SAFE). For over a decade, SAFE has worked to strengthen America's national and economic security by reducing our oil dependence in the transportation sector to lessen our nation's resulting exposure to the destructive impacts of oil price volatility. In 2006, SAFE formed the Energy Security Leadership Council (ESLC), a nonpartisan group of business and former military leaders in support of long-term policy to reduce U.S. oil dependence. The ESLC is co-chaired by Frederick W. Smith, Chairman, President and CEO of FedEx, and General James T. Conway, 34th Commandant of the U.S. Marine Corps (Ret.).

SAFE's mission is to end the United States' extreme reliance on oil as a matter of national and economic security. This strategic commodity is bought and sold on an unfree global market under the influence of the Organization of the Petroleum Exporting Countries (OPEC), its member nations and other national oil companies (NOCs), which control over 90 percent of the globe's proven crude reserves. The cartel's activity over the last two years alone demonstrates its ability to manipulate the market to meet the political aims of its most powerful members, often to the detriment of American interests.

Oil powers more than 92% of the United States' massive transportation sector. Solving the challenge of oil dependence will require the sum of America's ingenuity on both the supply and demand side of the equation. Since our founding, we have advocated for policies that would leverage a combination of market forces and American innovation to address our oil dependence, including but not limited to expanding domestic energy production. Today, we address a prominent emerging technological innovation, autonomous vehicles (AVs). It is broadly recognized that AVs offer an opportunity to revolutionize transportation, reduce the 35,000 annual fatalities on our roads, offer improved access to mobility for underserved populations, and promote economic growth. Perhaps less recognized is the potential for AVs to drive adoption of advanced fuel vehicles such as electric vehicles, fuel cell vehicles, and others, to end oil's monopoly over the transportation sector. With this statement, we offer our perspective on the link between AVs and national security, and how Congress can aid industry by clearing obstacles to the deployment of AVs, thereby expediting the economic, social, safety and security benefits they portend.

This hearing is timely. AVs have grown over the last several years from a futuristic concept studied in university laboratories to a source of massive private sector investment and public interest. This fact motivated SAFE's own work, and included in this submission are the findings of our Commission on AV Testing and Safety, led by Major General Mark Rosenker, former chairman of the National Transportation Safety Board, Admiral Dennis Blair, Paul Brubaker, Robert Lange, and Cuneyt Oge.

We look forward to 2017 as a key transitional year when AV technology continues to mature and become more accessible to members of the public. At this critical juncture, it is essential to continually update our public officials on this rapidly developing technology, identify key policy issues that can impact its deployment trajectory, and find opportunities for Congress to effectively reduce regulatory barriers that could impede AVs and their resultant benefits.
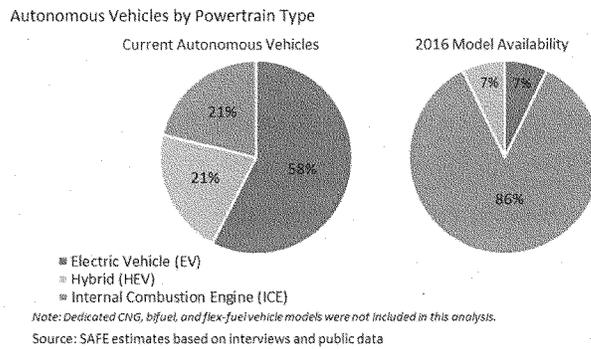
Energy Security and the Autonomous Vehicle Opportunity

Because the United States has essentially no control over oil price volatility nor the foreign actors that create or manipulate its fluctuations, the United States' best approach to ending our oil dependence rests

with the widespread adoption of vehicles that can use alternative fuels, providing U.S. consumers and businesses fuel choices beyond oil. Yet, plug-in electric and other alternative fuel vehicles have thus far achieved only a small share of total vehicle sales.

SAFE believes that autonomous vehicles will likely accelerate and drive the adoption of EVs. Importantly, we believe this transition will occur as a result of consumer choice and does not require government mandates or market interference. This belief is rooted in observing current industry developments, as well as our own modeling that demonstrates that AVs are likely to be advanced fuel vehicles, particularly electric or hybrid. Already, AVs being built and tested today disproportionately use electric or hybrid powertrains. This trend is particularly compelling when compared to the current sales penetration of electric vehicles—about 1% (or 3% if hybrid vehicles are included). As shown below, 58% of autonomous vehicle platforms are built over an electric powertrain, while a further 21% utilize a hybrid powertrain. By comparison, in the larger vehicles market, only 14% of domestically available 2016 models were either electric or hybrid.[1]

There are several explanations for the disproportionate representation of electric and hybrid vehicles in the AV testing space. One contributing explanation held by vehicle engineering experts is that a "symbiotic link" exists between AVs and vehicle electrification. This is partly because it is somewhat easier today to build an AV on top of a more modern, electrified vehicle system.

Autonomous Vehicles by Powertrain Type

Current Autonomous Vehicles — 58%, 21%, 21%
2016 Model Availability — 86%, 7%, 7%

- Electric Vehicle (EV)
- Hybrid (HEV)
- Internal Combustion Engine (ICE)

Note: Dedicated CNG, bifuel, and flex-fuel vehicle models were not included in this analysis.
Source: SAFE estimates based on interviews and public data

Our engagement with OEMs, technology companies, stakeholders and outside experts lead us to believe that this trend will continue. Many within industry anticipate that future vehicles will predominantly operate on advanced fuels due to overarching technological, economic, and regulatory trends. These trends are magnified by AVs, which are likely to benefit from and spur the further growth of a significant shared, on-demand business model for transportation.

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[1] Specifically, we conducted market research on AV models, either retrofitted or novel platforms, for which public information exists. For example, Uber Technologies has modified two vehicles as part of their AV fleet—a Ford Fusion hybrid, and gas-powered (ICE) Volvo XC90. To make as fair a comparison as possible, we compared this figure to the breakdown of electric, hybrid, or ICE models sold domestically in the 2016 model year. Although this number was 14%, the fleet penetration of electric and hybrid vehicles is considerably lower than that—around 3%, making the preponderance of autonomous advanced fuel vehicles even more noteworthy.

The current transportation system is extraordinarily inefficient. On average, only 4 percent of household vehicles are in use at any given time, and peak utilization is about 11 percent. Moreover, the vast majority of vehicle trips take place with just one or two passengers onboard and with several empty seats. Autonomous vehicles can address these inefficiencies by making a growing transportation mode—shared on-demand mobility—even more common and affordable. SAFE modeling shows that while most households will continue to own vehicles, shared on-demand AVs will rival—and eventually surpass—private vehicles as a mode of transportation.

SAFE modeling further demonstrates that the lower operating costs of EVs will prove a compelling proposition to owners of shared AV fleets, and that nearly all shared, on-demand AVs will be electric vehicles. As fleet operators seek lower marginal costs, they will gravitate toward cost-saving options such as cheaper, predictable electricity prices over volatile gasoline prices. Moreover, increased vehicle utilization rates of shared fleets maximize the importance of operating costs over the lifetime of the vehicle, while centralized fleet management and recharging hubs obviate concerns over the proliferation of charging stations.

New Vehicle Sales by Fuel Type
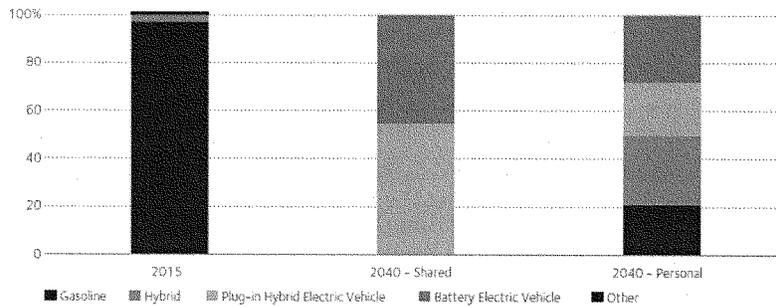
Note: Analysis does not assume existence of policies supporting AFVs and does not account for positive impact of duty cycle matching ("right-sizing").

Source: SAFE analysis

For these reasons, we, along with many other close observers, believe that the uptake of AVs will go hand-in-hand with the rise of advanced fuel vehicles. We further believe that AV adoption will be rapid, as they offer significant new value propositions to consumers.

Today's EVs do not, on their own, offer consumers a considerably different value proposition compared to an internal combustion engine (ICE) in getting from "point A" to "point B." The leap from a "standard" vehicle to an autonomous one is more analogous to the jump from traditional cell phones to today's ubiquitous smartphones—a transition which happened rapidly. Once proven safe, consumers are likely to quickly adopt this technology that promises more time with no driving, more freedom, more productivity, less congestion, no parking, and no refueling. As such, rather than needing encouragement through government action, we expect consumer choice to drive rapid adoption of AVs, which will naturally lead to energy security benefits through fuel diversification, in addition to the technology's myriad social benefits.

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Policy Recommendations

Autonomous vehicles technology is largely here, and industry is preparing for deployment in the next few years. The potential impacts of AV technology are transformative and of enormous public interest. However, the technology's novelty creates a dynamic where the existing regulatory framework around the automotive industry is not fully in sync with what is needed to facilitate the deployment of AV as they become technologically ready. AVs are a technology which interfaces with federal, state, and local laws, many of which were designed when self-driving vehicles were not a remote possibility nor prospect.

SAFE has identified key principles that we hope will help inform any congressional action in this arena.

Over the next several years, AV technology is expected to evolve rapidly and will need policy support to enable experimentation with different potential business models, technology platforms, and roles in the transportation system. Congress has an important role in providing the "runway" this technology needs by offering AV developers flexibility and protections. This support may take the form of exemptions from current federal regulations that did not anticipate AVs.

Additionally, we recommend that Congress authorize pilot deployments of AVs in American communities. Industry is already deploying technology in parts of the country and we encourage this to continue. However, government can assist, encourage and expand the value of deployments by working with industry to target social good "use-cases" and by facilitating collaboration among stakeholders. Without such communities, we risk a scenario in which individual companies test their technologies in isolation and are ill prepared to "share the road" with competitors.

Locations should be selected through a competitive bidding process and enable the testing of AV technology in a variety of contexts and use-cases (e.g. commercial vehicles, utility for the disabilities and elderly communities, services for rural communities, and synergies with public transportation systems in urban areas). To successfully work with leading technology providers, Congress should consider putting in place an alternative liability framework for these deployments, as it has successfully done several times for other industries.

To begin moving towards a more stable and sustainable regulatory framework for AVs, Congress should establish an interagency task force on AVs that integrates the necessary perspectives. Lastly, as a baseline and target, we believe that AVs should be allowed on U.S. roads once they are as safe as the average human driver, and Congress can support the R&D necessary to create metrics to verify compliance with that standard.

Commission on AV Testing and Safety

To support the transition to AVs, SAFE has maintained an active policy research agenda. For example, our Energy Security Leadership Council published a *National Strategy for Energy Security* that detailed the role of AVs in advancing energy security and identified the policies necessary to advance those goals. In January, SAFE published a white paper entitled *Self-Driving Cars: The Impact on People with Disabilities* which estimated that individuals with disabilities would see 2 million new job opportunities because of enhanced mobility through AVs, and that better access to medical care would save $19 billion in annual health care expenditures, mostly through public entitlement savings. A number of additional research efforts are underway. The goal of our work is to shine a spotlight on the benefits that AVs will

bring, and ensure that the broad benefits of the technology are strongly considered in any policy discussion.

In particular consonance with the theme of today's hearing "Self-Driving Cars: The Road to Deployment," we would like to present the findings of our sponsored Commission on Autonomous Vehicle Testing and Safety. We formed the Commission to identify key risks to the deployment of AVs and the steps industry can take to mitigate those risks. As noted, the Commission is chaired by Major General Mark Rosenker, former chairman of the National Transportation Safety Board. Other members were Admiral Dennis Blair, Paul Brubaker, Robert Lange, and Cuneyt Oge.

The Commission identified two critical threats to the deployment of autonomous vehicles—public acceptance and regulatory risk—and offered industry-focused solutions to help mitigate each.

Public Acceptance: It is expected that once a certain technological threshold is met, autonomous vehicles will be safer than human drivers. However, it is impossible to eliminate all accidents entirely. As we have already seen with crashes involving autonomous and semi-autonomous vehicles, individual incidents can overtake even the most compelling statistics on safety and reliability, especially when there is loss of life. The Commission expressed concerned whether public support for AVs—which public opinion polls show is currently mixed—can survive the inevitable negative attention that will stem from early accidents as the technology continues to improve.

Regulatory Risk: Regulation of emerging technology is always challenging, but autonomous vehicles face two exceptional obstacles. The first is that vehicles are regulated by a complex network of national, state, and local laws. The second is that AVs function based on highly sophisticated computer algorithms, or software. These technologies stress current regulatory frameworks, which are designed to test and approve more limited safety technologies such as seatbelts, airbags, or basic collision warning systems. The broad deployment of AVs will depend on finding new approaches to the verification and certification of safety.

To address these risks, the Commission offered a series of recommendations aimed specifically at defining a leadership role for industry. A subset of the Commission's recommendations include:

- Creating an industry-wide policy statement defining the minimum acceptable safety standard for AVs. A reasonable standard would be to allow AVs on the road once they are as safe as the average human driver.
- Incorporation of redundant safety measures in the vehicle, including DSRC-based V2X communications
- Companies should create a staged, safety milestone plan for AVs, including public disclosure of achieved milestones.
- The formation of a technical data consortium to accelerate AV learning and safety through shared, anonymized information.
- Research and development to support the formulation of objective, practical, quantitative metrics for measuring AV safety, which are necessary to ascertain whether AVs meet safety goals.

Because of the relevance and stature of the Commission's work, we include their entire report as a part of this statement.

Thank you for the opportunity to submit this statement for the record. We look forward to continuing to work with the Committee as it engages in the critical work of ensuring the proper future role of AVs in protecting and aiding the American consumer.

ONE HUNDRED FIFTEENTH CONGRESS

Congress of the United States
House of Representatives
COMMITTEE ON ENERGY AND COMMERCE

2125 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515–6115

Majority (202) 225–2927
Minority (202) 225–3641

March 6, 2017

Mr. Mike Abelson
Vice President of Global Strategy
General Motors
25 Massachusetts Avenue, N.W.
Washington, DC 20001

Dear Mr. Abelson,

Thank you for appearing before the Subcommittee on Digital Commerce and Consumer Protection hearing entitled "Self-Driving Cars: Road to Deployment."

Pursuant to the Rules of the Committee on Energy and Commerce, the hearing record remains open for ten business days to permit Members to submit additional questions for the record, which are attached. The format of your responses to these questions should be as follows: (1) the name of the Member whose question you are addressing, (2) the complete text of the question you are addressing in bold, and (3) your answer to that question in plain text.

To facilitate the printing of the hearing record, please respond to these questions by the close of business on Monday March 20, 2017. Your responses should be mailed to Giulia Giannangeli, Legislative Clerk, Committee on Energy and Commerce, 2125 Rayburn House Office Building, Washington, DC 20515 and e-mailed in Word format to **Giulia.Giannangeli@mail.house.gov.**

Thank you again for your time and effort preparing and delivering testimony before the Subcommittee.

Sincerely,

Robert E. Latta
Chairman
Subcommittee on Digital Commerce
and Consumer Protection

cc: Jan Schakowsky, Ranking Member, Subcommittee on Digital Commerce and Consumer Protection
Attachment

GM

House Energy and Commerce Subcommittee on Digital Commerce and Consumer Protection Hearing; "Self-Driving Cars: Road to Deployment"
General Motors Response to Questions for the Record

The Honorable Jan Schakowsky

1. **We heard at the hearing that a number of companies have already made automatic emergency braking (AEB) standard on all new vehicles. I know a voluntary commitment was made for model year 2022, but is GM working to speed up the role out? How soon will we see AEB on 100% of GM cars?**

GM supported the industry AEB agreement reached in early 2016 and intends to make AEB standard on nearly all models by September, 2022. In the meantime, GM has continued to make AEB widely available. For example, about half of our 2017 Model U.S. vehicles already offer AEB, including:

- Chevrolet Bolt EV, Volt, Malibu, Impala, Tahoe, and Suburban
- Buick Envision, Regal, and Lacrosse
- Cadillac – all models
- GMC – Acadia and Yukon

For 2018 Model Year, the recently unveiled all-new Chevrolet Equinox and Traverse, and the GMC Terrain also will offer AEB. By 2021 Model Year, AEB will be offered on about 90% of our models.

2. **What assurances will GM provide before putting AVs on the roads that they are protected from cybersecurity attacks?**

GM has devoted substantial resources to cybersecurity and we will continue to do so. We are taking a multi-layered approach to in-vehicle cybersecurity and are designing vehicle systems so they can be updated with enhanced security measures as potential threats evolve.

We were the first auto manufacturer to create an integrated and dedicated global organization focused on minimizing the risks of unauthorized access to vehicles and customer data. Through GM's established policy of cybersecurity by design, our Chief Product Cybersecurity Officer has the responsibility for the end-to-end cybersecurity of our vehicles and reports on a regular basis to our CEO and Board of Directors. We have collaborated with experts in the defense and aerospace industries, government organizations, academia and industry consortiums on the development of best practices and key lessons.

GM also applauded the release of NHTSA's Cybersecurity Best Practices in October of last year. GM continues to work with NHTSA in achieving our mutual goals of advancing automotive cybersecurity through the implementation of best practices.

We also fully support the Auto Information Sharing and Analysis Center (Auto ISAC), which identifies trends and common cyber threats and supports the industry's ongoing efforts to safeguard vehicle electronic systems and networks. The Auto ISAC's membership represents 99% of cars on the road in North America and has recently opened membership to commercial vehicles. Many major auto suppliers, including major telecommunications providers, have joined the Auto ISAC. GM's Chief Product Cybersecurity Officer is the Vice Chairman of the Auto ISAC Executive Committee.

3. **There is a lot of interest in expanding NHTSA's authority to grant exemptions from FMVSSs. Does GM support public notice and comment period when automakers request an exemption or should NHTSA be allowed to make these determinations without public input? If GM does not support notice and comment, why?**

GM supports the concept of providing the Department of Transportation with authority to grant specific exemptions to FMVSS for self-driving vehicles. As you may know, NHTSA's current exemption process requires a notice to be published in the Federal Register for public comment. Once there is an entire exemption proposal for self-driving vehicles to review, GM will provide a perspective on any particular aspect such as a public notice and comment period.

4. **It has been widely reported that autonomous commercial motor vehicles could precede autonomous cars in widespread distribution. Will GM be selling AV trucks? If yes, when will this begin? What assurances will GM provide to the motoring public that AV trucks are safe?**

GM does not currently manufacture commercial motor vehicles and has no immediate plans to manufacture self-driving commercial motor vehicles.

5. **There has been a lot of discussion about the importance of data sharing among the companies, with NHTSA, and with the public. I understand the sensitivity around sharing certain company data, and I know that no company wants proprietary information revealed to its competitors.**

    a. **Assuming confidential business information is adequately protected and that only relevant safety information is shared, does GM agree that more data sharing would help improve self-driving cars and lead to quicker deployment? Does GM agree that the public needs more information to know self-driving cars are safe?**

Under the proper circumstances and conditions, we believe data sharing can help to advance autonomous vehicle technology. We also agree that it is important to educate the public on the safety attributes for autonomous vehicles. This is one reason why GM supports controlled ride sharing projects where the public can experience autonomous vehicle technology in a safe and

structured environment. This real world experience and the data that it generates can help to move the technology forward.

> **b. Please list the types of information that GM is willing to share and types of information GM is not willing to share? And detail with whom GM is prepared to share that information, such as other companies, NHTSA, or the public.**

At this juncture, third party data sharing (and related specifics) would take place on a case-by-case basis as we continue to study business and consumer privacy implications. Autonomous vehicles generate a tremendous amount of highly complex data, much of which is either confidential or not helpful to advance the technology. We will continue to work collaboratively on these matters with industry and NHTSA as this technology evolves.

> **6. Some have expressed concern that testing through miles of driving may not adequately represent all real driving conditions, e.g., that such testing is occurring on open highways and not necessarily in city conditions. Please list how many miles GM autonomous vehicles have been tested and under what conditions such testing has occurred.**

GM is testing a fleet of over 50 vehicles in San Francisco, California; Scottsdale, Arizona; and in the metro Detroit area. Our test fleet is accumulating significant miles under many different real world conditions every day. GM also publicly discloses miles tested and corresponding disengagements on California roadways. *See* GM/Cruise's DMV Autonomous Vehicle Disengagement Report available at
https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/disengagement_report_2016

> **7. There has been discussion of level 4 AVs being rolled out as ridesharing fleets before being sold to individuals. How does GM plan to educate ridesharing passengers on what to do should a problem occur with those vehicles?**

GM will develop appropriate plans to provide information to its ridesharing passengers before the public is allowed access to its self-driving vehicles.

> **8. Some automakers have committed to accepting liability for accidents involving self-driving vehicles. Is GM considering this model and if so, would GM accept that liability for level 4 vehicles and above?**

The laws and principles of liability related to automotive products generally are well developed and applicable to new products as well as old ones.

The Honorable Tony Cardenas

> **1. California has been a pioneer and leader in technology for many years. More recently, Southern California and Los Angeles have been home to rapid growth in an exciting technology industry. Of course, as policymakers, part of our jobs is to make sure that our laws don't fall too far behind. It's definitely easier said than**

done. Given that, I am encouraged by the conversation, and hope that we can continue to explore this in a bipartisan way, with the collaboration of industry.

    a. **We know concerns have been raised with a situation in which 50 states develop 50 different ways of addressing autonomous vehicles. When exploring the development of a federal standard, what within the California standards developed over the past few years has worked well? How has California being at the forefront contributed to AV development?**

GM and Cruise Automation have been testing in California since mid-2016. The testing application and reporting requirements have allowed companies that are testing in California the flexibility to innovate and to gain experience in real world situations. This has contributed to AV development. We are also encouraged by the California Department of Motor Vehicles' proposed regulations released on March 10, 2017 and will be providing comments to those proposals. The proposed regulations provide a path for driverless testing and deployment, which is an important step to realizing the technology's tremendous safety potential.

    2. **As technologies evolve, our workforce also evolves. I've heard some really interesting ideas from companies about how they're thinking about addressing this issue when it come to our workers.**

        a. **Has GM studied the possible effects of mass deployment of autonomous vehicles on transportation jobs? If so, are there any initiatives that are being developed to ensure our workforce doesn't get left behind?**

Potential loss of employment is something that will have to be studied as this technology progresses. Job creation is an important issue for GM. This is evidenced by our recent announcement of $1 billion of manufacturing investment in the U.S. We are also looking for ways to promote STEM education in the United States, which is critical to our business. We see job growth opportunities in AVs as well. In fact, at GM we have observed that demand for talent in automation exceeds the supply. This includes automation focused jobs that need to be filled today, and also jobs that will be created in the future.

GREG WALDEN, OREGON
CHAIRMAN

FRANK PALLONE, JR., NEW JERSEY
RANKING MEMBER

ONE HUNDRED FIFTEENTH CONGRESS

Congress of the United States
House of Representatives
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Majority (202) 225–2927
Minority (202) 225–3641

March 6, 2017

Mr. Anders Karrberg
Vice President of Government Affairs
Volvo Car Group
2900 K Street, N.W.; Suite 401
Washington, DC 20007

Dear Mr. Karrberg,

Thank you for appearing before the Subcommittee on Digital Commerce and Consumer Protection hearing entitled "Self-Driving Cars: Road to Deployment."

Pursuant to the Rules of the Committee on Energy and Commerce, the hearing record remains open for ten business days to permit Members to submit additional questions for the record, which are attached. The format of your responses to these questions should be as follows: (1) the name of the Member whose question you are addressing, (2) the complete text of the question you are addressing in bold, and (3) your answer to that question in plain text.

To facilitate the printing of the hearing record, please respond to these questions by the close of business on Monday March 20, 2017. Your responses should be mailed to Giulia Giannangeli, Legislative Clerk, Committee on Energy and Commerce, 2125 Rayburn House Office Building, Washington, DC 20515 and e-mailed in Word format to **Giulia.Giannangeli@mail.house.gov.**

Thank you again for your time and effort preparing and delivering testimony before the Subcommittee.

Sincerely,

Robert E. Latta
Chairman
Subcommittee on Digital Commerce
and Consumer Protection

cc: Jan Schakowsky, Ranking Member, Subcommittee on Digital Commerce and Consumer Protection
Attachment

Attachment 1—Additional Questions for the Record

The Honorable Brett Guthrie

1. I understand that a handful of states have enacted laws regulating the testing and deployment of self-driving cars. Many other states, and some cities, have signaled an intent to legislate in this area as well. How have state laws had an impact on the current testing and deployment of self-driving cars?

2. If states continue to legislate in this area, what impact do think it will have on the investment and development of self-driving cars here in America?

The Honorable Jan Schakowsky

1. You stated that Volvo offers an optional motion sensor in its cars that can sense if an animal or child moves, but cannot sense heartbeats. Can you elaborate on this technology's effectiveness at preventing child heat deaths, and is there anything Volvo is working on to ensure a sleeping child is not left behind in a hot car?

2. I think the best way to keep defective vehicles off our roads is to prevent the sale of used cars under recall until the recall is repaired. Has Volvo committed to not selling used vehicles as "safe," "repaired for safety," passed a "rigorous inspection," and/or qualified to be sold as "certified" pre-owned cars when they have open recalls?

3. There is a lot of interest in expanding NHTSA's authority to grant exemptions from FMVSSs. Does Volvo support public notice and a comment period when automakers request an exemption or should NHTSA be allowed to make these determinations without public input? If Volvo does not support notice and comment, why?

4. It has been widely reported that autonomous commercial motor vehicles could precede autonomous cars in widespread distribution. Will Volvo be selling AV trucks? If yes, when will those sales begin? What assurances will Volvo provide to the motoring public that AV trucks are safe?

5. There has been a lot of discussion about the importance of data sharing among the companies, with NHTSA, and with the public. I understand the sensitivity around sharing certain company data, and I know that no company wants proprietary information revealed to its competitors.

    a. Assuming confidential business information is adequately protected and that only relevant safety information is shared, does Volvo agree that more data sharing would help improve self-driving cars and lead to quicker deployment? Does Volvo agree that the public needs more information to know self-driving car are safe?
    b. Please list types of information that Volvo is willing to share and types of information Volvo would not be willing to share? And detail with whom Volvo is

prepared to share that information, such as other companies, NHTSA, or the public.

6. Some have expressed concern that testing through miles of driving may not adequately represent all real driving conditions, e.g., that such testing is occurring on open highways and not necessarily in city conditions. Please list how many miles Volvo autonomous vehicles have been tested and under what conditions such testing has occurred.

7. There has been discussion of level 4 AVs being rolled out as ridesharing fleets before being sold to individuals. How does Volvo plan to educate ridesharing passengers on what to do should a problem occur with those vehicles?

The Honorable Tony Cardenas

1. California has been a pioneer and leader in technology for many years. More recently, Southern California and Los Angeles have been home to rapid growth in an exciting technology industry. Of course, as policymakers, part of our jobs is to make sure that our laws don't fall too far behind. It's definitely easier said than done. Given that, I am encouraged by the conversation, and hope that we can continue to explore this in a bipartisan way, with the collaboration of industry.

   a. We know you're concerned with a situation in which 50 states develop 50 different ways of addressing autonomous vehicles. When exploring the development of a federal standard, what within the California standards developed over the past few years has worked well? How has California being at the forefront contributed to AV development?

2. As technologies evolve, our workforce also evolves. I've heard some really interesting ideas from companies about how they're thinking about addressing this issue when it comes to our workers.

   a. Has Volvo studied the possible effects of mass deployment of autonomous vehicles on transportation jobs? If so, are there any initiatives that are being developed to ensure our workforce doesn't get left behind?

Attachment 2—Member Requests for the Record

During the hearing, Members asked you to provide additional information for the record, and you indicated that you would provide that information. For your convenience, descriptions of the requested information are provided below.

The Honorable Jan Schakowsky

1. Even though we are sometime away from fully self-driving cars on the road, manufacturers have developed some very helpful self-driving technologies right now. From blind spot detection to rear seat notification. I want to focus on those discrete technologies. Last year, 39 children died from heatstrokes in cars. These are tragic accidents. Last year, Reps. Tim Ryan, Peter King, and I introduced HOT CARS, a bill to equip new vehicles with rear seat notification to warn drivers that a passenger may be left behind. What is GM doing to prevent child heat deaths?

    a. Are your companies working on technologies to prevent child deaths?

2. The best way to prevent defective vehicles off our roads is to prevent the use of cars that have been recalled. GM has committed to not selling used vehicles as certified pre-owned when they have recalls?

GREG WALDEN, OREGON
CHAIRMAN

FRANK PALLONE, JR., NEW JERSEY
RANKING MEMBER

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March 6, 2017

Dr. Nidhi Kalra
Senior Information Scientist
Rand Corporation
1776 Main Street
Santa Monica, CA 90407

Dear Dr. Kalra,

Thank you for appearing before the Subcommittee on Digital Commerce and Consumer Protection hearing entitled "Self-Driving Cars: Road to Deployment."

Pursuant to the Rules of the Committee on Energy and Commerce, the hearing record remains open for ten business days to permit Members to submit additional questions for the record, which are attached. The format of your responses to these questions should be as follows: (1) the name of the Member whose question you are addressing, (2) the complete text of the question you are addressing in bold, and (3) your answer to that question in plain text.

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Sincerely,

Robert E. Latta
Chairman
Subcommittee on Digital Commerce
and Consumer Protection

cc: Jan Schakowsky, Ranking Member, Subcommittee on Digital Commerce and Consumer Protection
Attachment

Additional Questions for the Record

The Honorable Tony Cardenas

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   a. We have heard concerns with a situation in which 50 states develop 50 different ways of addressing autonomous vehicles. When exploring the development of a federal standard, what within the California standards developed over the past few years has worked well? How has California being at the forefront contributed to AV development?

2. As technologies evolve, our workforce also evolves. I've heard some really interesting ideas from companies about how they're thinking about addressing this issue when it comes to our workers.

   a. Has RAND studied the possible effects of mass deployment of autonomous vehicles on transportation jobs? If so, are there any initiatives that are being developed to ensure our workforce doesn't get left behind?

GREG WALDEN, OREGON
CHAIRMAN

FRANK PALLONE, JR., NEW JERSEY
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March 6, 2017

Mr. Gill Pratt
CEO
Toyota Research Institute
325 7th Street, N.W.; Suite 1000
Washington, DC 20004

Dear Mr. Pratt,

Thank you for appearing before the Subcommittee on Digital Commerce and Consumer Protection hearing entitled "Self-Driving Cars: Road to Deployment."

Pursuant to the Rules of the Committee on Energy and Commerce, the hearing record remains open for ten business days to permit Members to submit additional questions for the record, which are attached. The format of your responses to these questions should be as follows: (1) the name of the Member whose question you are addressing, (2) the complete text of the question you are addressing in bold, and (3) your answer to that question in plain text.

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Sincerely,

Robert E. Latta
Chairman
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TOYOTA

TOYOTA MOTOR NORTH AMERICA, INC.

WASHINGTON OFFICE

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March 20, 2017

The Honorable Robert E. Latta
Chairman
Subcommittee on Digital Commerce and Consumer Protection
2125 Rayburn House Office Building
Washington, DC 20515-6115

Dear Chairman Latta:

I am writing in response to your letter dated March 6, 2017, regarding Gill Pratt's testimony before the Subcommittee on Digital Commerce and Consumer Protection at the hearing entitled "Self-Driving Cars: Road to Deployment." Please find responses to the additional questions enclosed for the hearing record. In responding to these questions, Toyota has used its best efforts to be as accurate and responsive as possible based on our understanding of the terms used in the questions and the limited time available to respond as requested. The representations herein are based on reasonably available information and current information and belief.

The Honorable Jan Schakowsky

1. **You stated that the Toyota Research Institute is working on systems that could detect a heartbeat and changes in skin temperature in the occupants of a car. Do you have a timeline for when this technology will be available? Is Toyota is [sic] working on any other technologies to prevent child heat deaths?**

   Toyota has not conducted research to directly address the "hot car" issue. Toyota is conducting general research on driver monitoring systems. Currently, there is no timetable for introduction of this technology, as it is still in its research phase. As this future technology is being developed and as it becomes reliable, it is possible that it could be adapted for other occupant monitoring uses.

2. **In your testimony, you stated that automatic emergency braking (AEB) will be standard in almost every Toyota model sold this year. How soon will Toyota get to 100 percent?**

By the end of the 2017 calendar year, consistent with the Commitment to Advancing Automatic Emergency Braking Technology, Toyota will have automatic emergency braking on approximately 95% of Toyota and Lexus vehicles sold in the United States. There are only 2 models for which the technology will not be available in the foreseeable future. Currently, there are technological issues related to vehicles with a very low stance (e.g., sports cars). In such cases, current technology is unable to ensure accurate detection of obstacles in the path of the vehicle. In the future, when the technology evolves to ensure accurate detection, Toyota will develop a plan to install the technology on such vehicles. Further, there is a model that is nearing the end of its life cycle, and thus, there are no plans to update this vehicle at this time.

3. **I think the best way to keep defective vehicles off our roads is to prevent the sale of used cars under recall until the recall is repaired. Has Toyota committed to not selling used vehicles as "safe," "repaired for safety," passed a "rigorous inspection," and/or qualified to be sold as "certified" pre-owned cars when they have open recalls?**

Toyota Certified Used Vehicles (TCUV) policy and L/Certified policy for Lexus models prohibits the certification of any vehicle with an outstanding recall. In addition, Toyota is looking into measures to reinforce the importance of the policy with dealers.

4. **What assurances will Toyota provide before putting AVs on the roads that they are protected from cybersecurity attacks?**

Cybersecurity remains a priority for the auto industry, including Toyota, and considerable time and effort is currently focused on minimizing potential hazards caused by cybersecurity attacks. We are incorporating measures into vehicles for this purpose. In addition to our own efforts, a little more than a year ago, the auto industry formed an Automotive Information Sharing and Analysis Center, Auto-ISAC where companies can share cybersecurity threat and vulnerability information. The Auto-ISAC is also currently engaged in a robust effort to develop cybersecurity best practices for the industry.

5. **There is a lot of interest in expanding NHTSA's authority to grant exemptions from FMVSSs. Does Toyota support public notice and a comment period when automakers request an exemption or should NHTSA be allowed to make these determinations without public input? If Toyota does not support notice and comment, why?**

Toyota believes the process currently in 49 CFR Part 555 is adequate. This process provides for an exemption following a public comment period, which allows the industry and other stakeholders to consider the potential impacts of such an exemption.

6. **It has been widely reported that autonomous commercial motor vehicles could precede autonomous cars in widespread distribution. Will Toyota be selling AV trucks? If yes, when will this begin? What assurances will Toyota provide to the motoring public that AV trucks are safe?**

There is a possibility that vehicle sensors and systems for automated driving may be shared with commercial trucks, but we do not currently have any plans to sell automated commercial trucks.

7. **There has been a lot of discussion about the importance of data sharing among the companies, with NHTSA, and with the public. I understand the sensitivity around sharing certain company data, and I know that no company wants proprietary information revealed to its competitors.**

   a. **Assuming confidential business information is adequately protected and that only relevant safety information is shared, does Toyota agree that more data sharing would help improve self-driving cars and lead to quicker deployment? Does Toyota agree that the public needs more information to know self-driving cars are safe?**

   Toyota agrees that, if properly implemented, data sharing during testing could help to improve self-driving cars and lead to quicker deployment. Toyota supports the various goals of data sharing, including sharing with the government to improve understanding of highly autonomous vehicle technology, sharing with the government or public for evaluation of the safety of a particular system, and sharing among developers to help improve the performance of systems. We note that a significant amount of work needs to be done to ensure that such sharing does not unintentionally delay innovation or worsen safety. For example, the sharing of miles-tested and disengagement statistics – without more - may create a perverse incentive for developers to only test "easy" miles, potentially impairing the quality of research and lowering safety outcomes. In addition, appropriate means must be considered to preserve a company's confidential and propriety intellectual property. Toyota looks forward to working with stakeholders to determine how to share relevant data in the most practical and effective manner.

   b. **Please list the types of information that Toyota is willing to share and types of information Toyota is not willing to share? And detail with whom Toyota is prepared to share that information, such as other companies, NHTSA, or the public.**

   As noted above, Toyota supports the goals of data sharing and looks forward to working with relevant stakeholders to develop an approach that improves safety outcomes while protecting companies' proprietary innovations. Because the types of data that should be shared depend on the goal of data sharing, it is not possible for us at this time to list out the specific types of information that should be shared and with whom. We recognize that some of these decisions may be specific to the level or function of the automated driving system being developed and may not be amenable to a one-size-fits-all data sharing solution. In addition, there are important details that need to be worked out by the industry, including identifying what data should be shared to maximize comparability across different systems, ensuring that the source of the data is anonymized, deciding where the data will be compiled, and determining who should have access to the data and for what purposes.

8. **Some have expressed concern that testing through miles of driving may not adequately represent all real driving conditions, e.g., that such testing is occurring on open highways and**

not necessarily in city conditions. Please list how many miles Toyota autonomous vehicles have been tested and under what conditions such testing has occurred.

Toyota is testing its autonomous vehicle technologies on closed courses and on some public roads in Japan and the U.S. Test vehicles supporting the development of the Chauffeur system are currently being tested on closed courses in Massachusetts, California, and Michigan. We are also testing on public roads in Michigan. A trained safety driver is always present in the driver's seat and able to intervene during this testing. For proprietary reasons, we prefer not to disclose publicly how many miles and under what conditions our autonomous test vehicles have been tested.

We believe that developing a truly reliable autonomous vehicle technology will require extensive testing. The complexities involved in the development, testing, and deployment of autonomous vehicle technology requires a significant amount of public road testing. This testing would not only address the thousands of traffic scenarios that human drivers would encounter on a regular basis, but also would identify as many "edge cases" or "corner cases" as possible. Millions of test-drive miles are necessary, but probably not sufficient, to achieve the reliability that we need for autonomous vehicle technology, particularly if those test-driven miles are through "easy" or predictable routes. The truth is that all testing miles are not created equal, and developers should be focused on testing scenarios while driving is challenging or even exceedingly difficult. Computer simulation can accelerate and expand the range of testing of these systems, and should – with adequate evidence of validity – be an acceptable equivalent to real-world testing to achieve the billions of test-driven miles that will likely be needed to accomplish this.

9. **There has been discussion of level 4 AVs being rolled out as ridesharing fleets before being sold to individuals. How does Toyota plan to educate ridesharing passengers on what to do should a problem occur with those vehicles?**

We agree that it would be important for Level 4 ridesharing customers to be educated about how to handle a problem with the vehicle should one occur. The customer training or education that would be most effective for those who ride in Level 4 ridesharing fleet vehicles is an important area of discussion.

Toyota is still exploring the full range of potential business models for this technology. Educating our customers on the safe use of our products is, as always, a part of the development and marketing process.

10. **Some automakers have committed to accepting liability for accidents involving self-driving vehicles. Is Toyota considering this model and if so, would Toyota accept liability for level 4 vehicles and above?**

To the extent that a crash is the result solely of a defect in the product itself, Toyota believes that strict liability would apply under current law. However, there are factors that may contribute to a

crash having nothing to do with the vehicle itself, so generalizing about potential liability is not appropriate.

The Honorable Tony Cardenas

1. California has been a pioneer and leader in technology for many years. More recently, Southern California and Los Angeles have been home to rapid growth in an exciting technology industry. Of course, as policymakers, part of our jobs is to make sure that our laws don't fall too far behind. It's definitely easier said than done. Given that, I am encouraged by the conversation, and hope that we can continue to explore this in a bipartisan way, with the collaboration of industry.

    a. We know you're concerned with a situation in which 50 states develop 50 different ways of addressing autonomous vehicles. When exploring the development of a federal standard, what within the California standards developed over the past few years has worked well? How has California being at the forefront contributed to AV development?

    We believe that California's pioneer spirit contributed to the current proliferation of research and development of automated driving systems. We understand that many of the laws and regulations put forward by states, including California, are well-intended and actions are being taken to assure public safety while keeping doors open to innovation. We appreciate California being transparent and receptive to industry input as the state updates its testing regulations and finalizes its deployment regulations. This process has opened up an important dialogue among Federal and State governments and developers. This has allowed us to work towards a solution that can work for all stakeholders and, most importantly, assures public safety. We agree that the public should be kept safe and have reasonable assurance that developers are testing responsibly, but firmly believe that a single, national framework is the best way to do this.

2. As technologies evolve, our workforce also evolves. I've heard some really interesting ideas from companies about how they're thinking about addressing this issue when it comes to our workers.

    a. Has Toyota studied the possible effects of mass deployment of autonomous vehicles on transportation jobs? If so, are there any initiatives that are being developed to ensure our workforce doesn't get left behind?

    The potential for autonomous vehicle technology to result in job displacement, particularly for those who make a living driving, is something that needs to be studied. All of the stakeholders need to have a better understanding about the extent of the potential impact, what can be done to address those impacts in a meaningful and effective manner, and whether automation may create new economic and employment opportunities. It is likely going to be a number of years before the technology is deployed in a way that could potentially displace drivers, so there is an opportunity to address some of these challenges before any displacement occurs.

At the same time, we should recognize that there is not a one-size-fits-all approach to autonomous vehicle technology. For example, we are working on two types of autonomy – Chauffeur and Guardian. Under Guardian, there is still a driver and the system is designed to provide driver assist. The deployment of these types of technologies would not lead to any job displacement, but is designed to help increase the safety of our roads and the safety of those who are employed as drivers.

If you have any questions, or need additional information, please let me know.

Sincerely,

Stephen Ciccone
Group Vice President
Government Affairs
Toyota Motor North America, Inc.

ONE HUNDRED FIFTEENTH CONGRESS

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March 6, 2017

Mr. Joseph Okpaku
Vice President of Public Policy
Lyft
185 Berry Street
San Francisco, CA 94107

Dear Mr. Okpaku,

Thank you for appearing before the Subcommittee on Digital Commerce and Consumer Protection hearing entitled "Self-Driving Cars: Road to Deployment."

Pursuant to the Rules of the Committee on Energy and Commerce, the hearing record remains open for ten business days to permit Members to submit additional questions for the record, which are attached. The format of your responses to these questions should be as follows: (1) the name of the Member whose question you are addressing, (2) the complete text of the question you are addressing in bold, and (3) your answer to that question in plain text.

To facilitate the printing of the hearing record, please respond to these questions by the close of business on Monday March 20, 2017. Your responses should be mailed to Giulia Giannangeli, Legislative Clerk, Committee on Energy and Commerce, 2125 Rayburn House Office Building, Washington, DC 20515 and e-mailed in Word format to **Giulia.Giannangeli@mail.house.gov.**
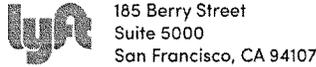
Thank you again for your time and effort preparing and delivering testimony before the Subcommittee.

Sincerely,

Robert E. Latta
Chairman
Subcommittee on Digital Commerce
and Consumer Protection

cc: Jan Schakowsky, Ranking Member, Subcommittee on Digital Commerce and Consumer Protection
Attachment

QUESTIONS FOR THE RECORD

JOSEPH OKPAKU VICE PRESIDENT, GOVERNMENT RELATIONS, LYFT, INC.

COMMITTEE ON ENERGY AND COMMERCE – SUBCOMMITTE ON DIGITAL COMMERCE AND CONSUMER PROTECTION

MARCH 20, 2017

The Honorable Brett Guthrie:

Q-1: What does Lyft see as the appropriate role for the federal government and the states in the testing and deployment of self-driving cars?

First and foremost, Lyft believes that the most important role that both Federal and State governments can play with respect to the development of self-driving cars is to advocate for the benefits of the technology. Having Federal and State lawmakers communicate to the public the safety, accessibility, and transportation efficiency benefits of self-driving cars will be key towards ensuring that the public accepts and adopts this technology.

In terms of individual roles as it relates to testing and deployment of self-driving cars, Lyft believes that States should retain their traditional responsibilities for vehicle licensing and registration, traffic laws and enforcement, and motor vehicle insurance and liability regimes. Moreover, Lyft does not believe that States need to take affirmative legislative or regulatory action to advance the testing and deployment of self-driving cars. It is our view, however, that if a State does choose to take affirmative legislative or regulatory action with respect to self-driving cars, such action should be premised on creating a pro-competitive and technology-neutral playing field and addressing secondary impediments in current law to the safe testing or deployment of such vehicles.

As for the federal government, Lyft would urge Congress to examine two potential avenues for action. The first is revising NHTSA's exemption authority to allow for a greater number of self-driving cars to be allowed on the road for testing and deployment purposes. The second is directing NHTSA to begin a rulemaking to update current FMVSS standards to accommodate the development, deployment, and introduction into commerce of self-driving cars at commercial scale.

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Q-2: How do you see the testing and deployment of self-driving cars occurring among the public over the next 10 to 20 years? Do you think it will be through privately owned vehicles?

Lyft believe that the transition to a self-driving future will not occur primarily through individually owned cars. Rather, it will be both more practical and appealing to rely on self-driving cars when they are part of Lyft's networked fleet. The cost of owning a self-driving car will be prohibitively expensive to all but the most wealthy individuals. That is why Lyft's commitment to testing and deploying self-driving cars through our platform is rooted in the belief that the tremendous safety benefits of self-driving cars should be affordable and available to all segments of the public, regardless of income, geography, or disability.

The Honorable Tony Cardenas

California has been a pioneer and leader in technology for many years. More recently, Southern California and Los Angeles have been home to rapid growth in an exciting technology industry. Of course, as policymakers, part of our jobs is to make sure that our laws don't fall too far behind. It is definitely easier said than done. Given that, I am encouraged by the conversation, and hope that we can continue to explore this in a bipartisan way, with the collaboration of industry.

Q-1: We know you're concerned with a situation in which 50 states develop 50 different ways of addressing autonomous vehicles. When exploring the development of a federal standard, what within the California standards developed over the past few years has worked well? How has California being at the forefront contributed to AV development?

Lyft is very concerned about the developing patchwork of inconsistent and conflicting state laws. We believe that this worrisome development will ultimately hamper efforts to bring the lifesaving benefits of self-driving technology to market. It is our hope that as discussions about the federal role in testing and deployment of self-driving cars continue within Congress that Members will recognize the critical need to establish a uniform framework that recognizes the preeminent role of the federal government to set safety and performance standards for self-driving vehicles, and in ensuring that such vehicles can swiftly and seamlessly be introduced into interstate commerce.

Lyft is very appreciative of the leading role that our home State of California has played in raising and debating issues around this rapidly developing industry. California has been at the forefront of advancing not only consumer awareness of the technology, but also in unraveling the many complex and unique issues that self-driving technology brings with it. It is not easy to be the first, and while we may not always agree with the approach the State has taken with respect to every issue, we do very much appreciate the openness and earnestness with which the State of California, and the DMV in particular, has brought to the discussion.

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As technologies evolve, our workforce also evolves. I've heard some really interesting ideas from companies about how they're thinking about addressing this issue when it comes to our workers.

Q-2: Has Lyft studied the possible effects of mass deployment of autonomous vehicles on transportation jobs? If so, are there any initiatives that are being developed to ensure our workforce doesn't get left behind?

Lyft is a company that prides itself on community of drivers. They are our most vital asset, our best ambassadors, and the key to the success and growth of the Lyft platform. There is a misconception that the introduction of self-driving cars will mean human drivers are no longer needed. We believe that in the next five or more years following the introduction of self-driving cars onto our platform, the need for human drivers will actually increase, not decrease. While this seems counterintuitive, it is our expectation that rides in self-driving cars will be less expensive than any options today and will lead to more people using Lyft for their transportation needs. As people rely on Lyft for more of their transportation, they are more likely to live car-free. And as more people trade their keys for Lyft, the overall market will grow dramatically. When self-driving cars can only solve a portion of those trips, more Lyft drivers will be needed to provide service to the growing market of former car owners.

Over the longer term, in the next decade and beyond, Lyft will always see a role for our drivers. That being said, as automation begins to normalize in transportation and other industries, Lyft wants to be a part of the larger discussion that will inevitably and necessarily occur about how to address issues regarding the economic impact, positive and negative, that automation will bring. We look forward to discussing those issues with you, other Members of Congress, the public, and other stakeholders.

The Honorable Jan Schakowsky

Q-1: There has been discussion of level 4 AVs being rolled out as ridesharing fleets before being sold to individuals. How does Lyft plan to educate ridesharing passengers on what to do should a problem occur with those vehicles?

The security and safety of our passengers is and will always be of primary concern to Lyft, regardless of what type of vehicle a ride on our platform takes place in. With respect to self-driving cars with level 4 or above capability, Lyft believes that ridesharing platforms such as ours will play a critical role in educating consumers, not only about self-driving cars generally, but also about what may be occurring once a passenger is in a self-driving car that is associated with our platform. Moreover, through our technology platform, we have a unique ability to connect with millions of passengers via their smartphones in a way that other industry models cannot.

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In light of the inherent advantages to reach and educate consumers that the Lyft platform provides, Lyft believes that platforms such as ours may supplement, or even supplant in some instances, the responsibilities of the human machine interface embedded in self driving cars as such interface relates to informing consumers about what is happening with the vehicle. This would be accomplished by allowing consumers to use our app to send and receive communications over our platform regarding the status of the vehicle or its occupants while in the vehicle. Furthermore, all current safety features available to a passenger, including access to 24/7 Trust and Safety associate and the ability to share their destination and real time GPS based progress of their ride with loved ones or others, would continue to be available.