THE CLEAN FUTURE ACT: DECARBONIZATION OF THE TRANSPORTATION SECTOR

VIRTUAL HEARING

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SUBMITTED MATERIAL

[1] The legislation has been retained in committee files and is available at https://docs.house.gov/Committee/Calendar/ByEvent.aspx?EventID=112550.

[2] The report has been retained in committee files and is available at https://docs.house.gov/Committee/Calendar/ByEvent.aspx?EventID=112550.

THE CLEAN FUTURE ACT: DECARBONIZATION OF THE TRANSPORTATION SECTOR

WEDNESDAY, MAY 5, 2021

House of Representatives,
Subcommittee on Energy,
Committee on Energy and Commerce,
Washington, DC.

The subcommittee met, pursuant to call, at 11:31 a.m., via Cisco Webex online video conferencing, Hon. Jerry McNerney (vice chair of the subcommittee) presiding.

Members present: Representatives Rush, Peters, Doyle, McNerney, Tonko, Schrier, Butterfield, Matsui, Welch, Schrader, Kuster, Barragán, Blunt Rochester, O'Halleran, Pallone (ex officio), Upton (subcommittee ranking member), Burgess, Latta, McKinley, Griffith, Walberg, Duncan, Palmer, Lesko, Pence, Armstrong, and Rodgers (ex officio).

Also present: Representatives Clarke and Dingell.

Staff present: Jeffrey C. Carroll, Staff Director; Waverly Gordon, General Counsel; Tiffany Guarascio, Deputy Staff Director; Perry Hamilton, Clerk; Mackenzie Kuhl, Digital Assistant; Kaitlyn Peel, Digital Director; Lino Peña-Martinez, Policy Analyst; Tim Robinson, Chief Counsel; Chloe Rodriguez, Clerk; Kylea Rogers, Staff Assistant; Sarah Burke, Minority Deputy Staff Director; Nate Hodson, Minority Staff Director; Peter Kielty, Minority General Counsel; Mary Martin, Minority Chief Counsel, Energy and Environment; and Michael Taggart, Minority Policy Director.

Mr. McNerney. [In progress] panelists, and I want to welcome all the members of the committee.

I am in my district office, so it is a little bit of a challenge, technically, because I haven't done this before. So bear with me if I cause any delays.

This morning's hearing is on "The CLEAN Future Act: Driving Decarbonization of the Transportation Sector." So this is a very important issue that we all care about, and I want to go ahead and recognize myself for an opening statement.

The Subcommittee on Energy will now come to order.

Today the subcommittee is holding a hearing entitled "The CLEAN Future Act: Driving Decarbonization of the Transportation Sector." Due to the COVID–19 public health emergency, today's hearing is being held remotely. All Members and witnesses will be participating via video conferencing.

As a part of our hearing, microphones will be set on mute for the purposes of eliminating inadvertent background noise. Members and witnesses, you will need to unmute your microphone each time you wish to speak.

Documents for the record can be sent to Lino Peña-Martinez at the email provided to staff. All documents will be entered into the record at the conclusion of the hearing.

Again, I now recognize myself for 5 minutes for an opening statement. If you will, give me a minute to pull up the opening statement.

You know what? It is going to take me a minute to find that, so I am going to yield to the ranking member 5 minutes for an opening statement, and then I will follow up with my opening statement.

OPENING STATEMENT OF HON. FRED UPTON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MICHIGAN

Mr. UPTON. Well, thanks. Thanks, my friend, and I look forward—I understand Bobby is going to be a little bit late, but good to see you. And thanks to our witnesses, as well, for appearing before us virtually to discuss the role of EVs, electric vehicles.

You know, the CLEAN Future Act contains billions in subsidies and mandates in an attempt to push EVs on the American public, whether they are ready for them or not.

Now, I would note that I have always supported reasonable fuel efficiency standards, and I am excited about the prospect of EVs, that is for sure. And I know that our great domestic automakers in Michigan are hard at work to make cars that consumers are going to want to buy.

With that, I confess that I have concerns that the CLEAN Future Act puts the cart before the horse by mandating electric vehicles, because there is no consideration for American workers or car buyers, our growing reliance on China for critical materials and minerals to make those batteries, and certainly the strain that EVs will place on our grid. As members of this committee already know, every summer California—your State—faces rolling blackouts. And of course, just last winter, in March, Texas, Oklahoma, and Louisiana suffered prolonged power outages.

Today EVs account for less than 2 percent of the cars on the road. And we are simply not ready to charge EVs at scale, or potentially during emergencies. Instead, we need to let the market and consumer choice drive the adoption of EVs.

While this hearing is focused on EVs, we have got to realize that the CLEAN Future Act has sweeping impact across a thousand pages—a thousand pages. That is going to result in de facto bans in hydraulic fracturing, plastics manufacturing, and new pipelines. And as a result, the CLEAN Future Act is going to increase the cost of energy and make it practically impossible to build new industrial facilities.

The question is, how are we going to build these EVs here at home?

How are you going to replace all the plastic and hydrocarbon-based materials contained in these vehicles?

How are we going to import all the critical minerals from China, with their weak environmental and labor standards?

We simply can't have it both ways. House Republicans, we have introduced a number of bills as part of our Securing a Cleaner American Energy Agenda to protect American jobs, the environment.

We need first to look at regulatory reform to mine and process critical minerals at home so that we can secure that supply chain and reduce our reliance on China.

I would also note that I introduced H.R. 1599, Securing America's Critical Minerals Supply Act. It is an important step in that direction. We need to modernize the electric grid so that it can handle the charging, even in extreme weather conditions.

We have also got to make sure that we protect American jobs and consumer choice. The last thing we want to do is take away people's mobility and livelihoods by limiting the options of affordable and reliable vehicles.

We all know that the U.S. has become the world's leading producer of oil and gas. Thanks to free markets—sorry, that is my phone in the background—thanks to free markets, competition, and the American spirit of innovation. And thanks to more efficient engines, advancing materials in plastics, less carbon-intensive fuels, we are going to be making great strides to decarbonize our transportation sector and maintain that energy security.

The COVID pandemic has exposed many weaknesses in our supply chain for pharmaceuticals, medical supplies, and even food. I am afraid that the CLEAN Future Act is going to trade away the progress that we have made to become almost energy independent by increasing our reliance on China, which controls 80 to 90 percent of the critical minerals that go into the EV business.

I am also concerned that the real impact on American jobs and the needs of car buyers perhaps are being overlooked. I am pleased that two of our witnesses today, Dr. Foss and Mr. Siccardi, will help us explore those challenges. Rather than rushing new mandates with taxpayer subsidies, we need to take the time and do the work to enact durable, bipartisan policies.

I look forward to the testimony and continuing the discussion, and I yield back.

[The prepared statement of Mr. Upton follows:]

PREPARED STATEMENT OF HON. FRED UPTON

Thank you, Mr. Chairman. And thank you, to our witnesses, for appearing before us virtually to discuss the role of electric vehicles. The CLEAN Future Act contains billions of dollars in subsidies and mandates in an attempt to push electric vehicles on the American public, whether they are ready for them, or not.

I have always supported reasonable fuel efficiency standards, and I'm excited for the prospects of EVs. I know that our great domestic automakers in Michigan are hard at work to make cars that consumer are going to buy. But I have real concerns that the CLEAN Future Act puts the cart before the horse by mandating electric vehicles, because there is no consideration for American workers and car buyers, our growing reliance on China for critical minerals to make batteries, and the strain that electric vehicles will place on our grid.

As members of this committee already know, every summer California faces rolling blackouts, and just last winter Texas, Oklahoma, and Louisiana suffered prolonged power outages. Today, electric vehicles account for less than 2% of the cars on the road. We are simply not ready to charge electric vehicles at scale or potentially during emergencies. Instead, we should let the market and consumer choice drive the adoption of EVs.

While this hearing is focused on electric vehicles, we must also recognize that the CLEAN Future act has sweeping impacts across 1,000 pages—that will result in de facto bans on hydraulic fracturing, plastics manufacturing, and new pipelines. As a result, the CLEAN Future Act will increase the cost of energy and make it practically impossible to build new industrial facilities. The big question is how are we supposed to build these electric vehicles here at home? And how would you replace all the plastic and hydrocarbon based materials contained in these vehicles? Are we going to continue importing all the critical minerals from China, with their weak environmental and labor standards? We simply cannot have it both ways.

House Republicans have introduced several bills as part of our Securing Cleaner American Energy Agenda to protect American jobs and the environment. First, we need regulatory reform to mine and process critical minerals at home, so we can secure our supply chain and reduce our reliance upon China. Legislation that I introduced, H.R. 1599 Securing America's Critical Minerals Supply Act, is an important step in this direction. We need to modernize our electric grid so it can handle the charging—even in extreme weather conditions. We also need to make sure we protect American jobs and consumer choice. The last thing we want to do is take away people's mobility and livelihoods by limiting options of affordable and reliable vehicles.

The United States has become the world's leading producer of oil and gas, thanks to free markets, competition, and the American spirit of innovation. Thanks to more efficient engines, advanced materials and plastics, and less carbon intensive fuels, we are making great strides to decarbonize our transportation sector and maintain our energy security.

The COVID pandemic has already exposed many weaknesses in our supply chains for pharmaceuticals, medical supplies, and even food. I am afraid the CLEAN Future Act will trade away the progress we have made to become almost energy independent by increasing our reliance on China, which controls 80–90% of the critical minerals that go into EV batteries.

I am also concerned that the real impacts on American jobs and the needs of car buyers are being overlooked. I am pleased that two of our witnesses today—Dr. Michot Foss and Mr. Siccardi—will help us explore these challenges.

Rather than rushing new mandates and taxpayer subsidies, Congress must take the time and do the work to enact durable bipartisan policies. With that, I look forward to the testimony and continuing this discussion.

Thank you, I yield back.

Mr. MCNERNEY. I thank the ranking member for yielding back, and I see that the chairman has arrived. If he is ready, I will yield to him.

Mr. Rush, are you ready?

OPENING STATEMENT OF HON. BOBBY L. RUSH, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ILLINOIS

Mr. RUSH. I am. I thank my vice chairman and thank each and—all the Members. We had a very serious accident on my way in this morning, and traffic was at a—standing still for a long time.

The impacts of the auto industry on this Nation and the entire globe are sweeping. Since the late 1800s, the auto industry has become a major, worldwide industrial and economic force. In the U.S. alone, innovation within this industry revolutionized travel, improved transportation infrastructure, and radically changed both rural and urban landscapes across the Nation and, indeed, across the world.

A recent report from the University of California at Berkeley suggests that auto innovation in the U.S. is once again on the brink of a—that will unleash equally revolutionary outcome, if you could imagine that. According to the 2035 Report 2.0, with the right series of policies, it is, and I quote, "technically and economically feasible for all new car and truck sales to be electric by 2035."

The rapid electrification of light-, medium-, and heavy-duty vehicles to this degree would drive down consumer costs, create jobs, and save lives. More specifically, the electrification of all new trucks and cars by 2035, paired with a clean electric grid, would prevent 150,000 deaths. If that is not convincing enough, the study also showed that broad vehicle electrification will save U.S. consumers $2.7 trillion by 2050 and create over 2 million jobs by 2035.

The report also indicates that electric vehicles will be cheaper than gasoline-powered vehicles within the next 5 years. To achieve this reality, the current U.S. transportation sector, much like the other sectors of the U.S. economy, is in need of deep decarbonization. Absent any action, greenhouse gas pollution will result in harsh consequences for our communities, especially the most vulnerable among us.

For these reasons, Chairmen Pallone and I and Chairman Tonko, along with many of our Democratic committee colleagues, set forth the CLEAN Future Act to put the Nation on a path toward achieving net-zero greenhouse gas pollution no later than 2050.

I have also introduced the NO EXHAUST Act, which promotes the electrification of the transportation sector to improve air quality and electric vehicle infrastructure access, especially in rural, urban, low-income, and minority communities.

Sadly to say, our friends across the aisle have often expressed concern for how other industrialized nations are charging ahead in energy-related markets. They have also expressed concern for how domestic manufacturing has diminished, rural communities have been left out, and labor has been left out. These are indeed bipartisan issues. We are all concerned about these issues. Let me say emphatically we are all concerned, and share concern in terms of these issues.

A productive discussion of all of today's bills presents an opportunity to fine-tune legislative solutions that are geared towards tackling these challenges and the climate crisis head-on.

I want to thank all of the witnesses for your participating in today's hearing.

[The prepared statement of Mr. Rush follows:]

PREPARED STATEMENT OF HON. BOBBY L. RUSH

The impacts of the auto industry on this Nation and the entire globe are sweeping. Since the late 1800s, the auto industry has become a major worldwide industrial and economic force. In the U.S. alone, innovation within this industry revolutionized travel, improved transportation infrastructure, and radically change both rural and urban landscapes across the country. A recent report from the University of California, Berkeley suggests that auto innovation in the U.S. is once again on the brink of a shift that will unleash equally revolutionary outcomes.

According to the "2035 Report 2.0," with the right series of policies, it is [quote] "technically and economically feasible for all new car and truck sales to be electric by 2035." The rapid electrification of light-, medium-, and heavy-duty vehicles to this degree would drive down consumer costs, create jobs, and save lives. More specifically, the electrification of all new trucks and cars by 2035—paired with a clean electric grid—would prevent 150 thousand deaths. If that is not convincing enough, the study also shows that broad vehicle electrification will save U.S. consumers $2.7 trillion by 2050 and create over 2 million jobs by 2035. This report also indicates that electric vehicles will be cheaper than gasoline powered vehicles within the next 5 years.

To achieve this reality, the current U.S. transportation sector—much like the other sectors of the U.S. economy—is in need of deep decarbonization. Absent any action, greenhouse gas pollution will result in harsh consequences for our communities, especially for the most vulnerable among us. For these reasons, Chairmen Pallone, Tonko, and Rush, along with many of our Democratic committee colleagues, set forth the CLEAN Future Act to put the Nation on a path toward achieving net-zero greenhouse gas pollution by no later than 2050. Mr. Rush has also introduced the NO EXHAUST Act, which promotes the electrification of the transportation sector to improve air quality and electric vehicle infrastructure access—especially in rural, urban, low-income, and minority communities.

Our friends across the aisle have often express concern for how other industrialized nations are charging ahead in energy-related markets. They have also expressed concerns for how domestic manufacturing has diminished, rural communities have been left behind, and labor has been left out. These are bipartisan issues, and these are shared concerns. A productive discussion of all of today's bills presents an opportunity to fine-tune legislative solutions that are geared towards tackling these challenges and the climate crisis head-on. With this in mind, the subcommittee gathers for this important discussion to provide expert witnesses and members of this Committee with the opportunity refine vital proposals through regular order.

I thank all of the witnesses for their participation in today's hearing. And, with that, I yield to my friend and colleague, the gentleman from Michigan, Ranking Member Upton for 5 minutes.

Mr. RUSH. And, with that, I yield right now to the chairman of the full committee, Chairman Pallone, for 5 minutes for the purposes of an opening statement.

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

Mr. PALLONE. Thank you, Chairman Rush.

One of this committee's top priorities is taking action to address the climate crisis. In the last several months we have held numerous legislative hearings on the CLEAN Future Act, our comprehensive and ambitious legislation to combat the climate crisis and to achieve a 100 percent clean economy no later than 2050.

And today the Energy Subcommittee is focusing on decarbonizing the transportation sector through investments in electric vehicles and EV infrastructure. We will be discussing a suite of provisions in the CLEAN Future Act that support electric vehicle infrastructure and domestic manufacturing of EV-related technology, and the subcommittee will also review legislation from Chairman Rush, Representative Clarke, and Representative Dingell that are also included in the CLEAN Future Act, and I thank them for their leadership.

Electrifying the transportation sector is critical to meeting our climate goals. This is particularly important, since we will be simultaneously working to decarbonize the power sector, which will result in EVs becoming even cleaner in the future. And it is expected that nearly 7 million electric vehicles will be sold per year by 2025.

To ensure we are ready for this growing demand, we must invest in the necessary charging and manufacturing infrastructure, so that consumers are able to reliably power their cars. Now, President Biden's American Jobs Plan invests heavily in EVs and infrastructure, with a goal to build a network of 500,000 EV chargers by 2030. And the President's plan recognizes the important role of EVs in our economic recovery and growth, and in our fight against climate change. The legislation we are discussing today is part of this larger effort with the President.

At the same time, we must also guarantee that benefits of electric vehicles are available and accessible to all communities. Minority communities often have the most exposure to polluted air from gasoline- and diesel-powered vehicles. Electric vehicle access could help provide cleaner transportation options in these environmental justice communities.

Rural and underserved communities also stand to benefit from EV infrastructure deployment, as EV-charging infrastructure can help support local economies. And I am particularly excited to hear from Francis Energy today about its rollout of a statewide EV infrastructure network in Oklahoma.

Perhaps more—most importantly, as we see growing EV adoption in this country, we must make sure our transition prioritizes American workers. China and other countries are rapidly growing their EV markets, and therefore we must invest aggressively to ensure we don't lose the EV market to China.

It is imperative this investment occur here to grow an American EV manufacturing base that employs union workers at good wages with real benefits, and that is why the CLEAN Future Act provides funding for domestic manufacturing conversion grants to help create and expand domestic manufacturing of advanced vehicles and advanced vehicle components. It also modernizes and expands the Department of Energy's Advanced Technology Vehicles Manufacturing Program, or ATVM.

Now, I know that—I know Mr. Upton—I was listening to what he said, and he is right when he talks about foreign supply chains. He, you know, points out the role of critical minerals and the fact that many of these are produced now or mined in China and other countries. And so, as Democrats, Fred, I do want to say we believe we have to work together to find new, reliable, and responsible sources for these materials. And the CLEAN Future Act includes provisions that begin to address the extraction and processing and reuse of critical minerals. We can't be relying on China and our—and other, you know, enemies for these materials.

But I do want to say this. Look, I don't think—everyone has to understand that electric vehicles are the future. That is coming from the auto industry itself. And therefore, we need to do everything we can to ensure America needs that future by making the necessary investments now.

And again, I am not trying to pick on you, Fred, but I know, Fred, you talk about how, you know, we are spending money and, you know, government dollars to help this investment. But I just don't think it is possible to do if we just rely totally on the private sector and don't make those investments to spur this industry in order to compete with China and other countries that are making those investments.

And therefore, we need to, you know—with these bills we are investing in innovation, and helping give consumers the ability to choose between more than just gasoline or diesel. We have to ensure that our roads, our grid, and our workers are prepared for this important transition. When charging stations are as ubiquitous as gas stations, then consumers will have a choice, and we truly will be in a position to win the future, which is what we are trying to accomplish.

So thank you again, Mr. Chairman. It is an important hearing. And I yield back.

[The prepared statement of Mr. Pallone follows:]

PREPARED STATEMENT OF HON. FRANK PALLONE, JR.

One of this committee's top priorities is taking action to address the climate crisis. In the last several months, we have held numerous legislative hearings on the CLEAN Future Act, our comprehensive and ambitious legislation to combat the climate crisis and to achieve a 100 percent clean economy no later than 2050. Today, the Energy Subcommittee is focusing on decarbonizing the transportation sector through investments in electric vehicles and EV infrastructure.

We'll be discussing a suite of provisions in the CLEAN Future Act that support electric vehicle infrastructure and domestic manufacturing of EV-related technology. The subcommittee will also review legislation from Chairman Rush, Representative Clarke, and Representative Dingell that are also included in the CLEAN Future Act. I thank them for their leadership on these important provisions.

Electrifying the transportation sector is critical to meeting our climate goals. This is particularly important since we will be simultaneously working to decarbonize the power sector, which will result in EVs becoming even cleaner in the future. It is expected that nearly seven million electric vehicles will be sold per year by 2025. To ensure we are ready for this growing demand, we must invest in the necessary charging and manufacturing infrastructure so that consumers are able to reliably power their cars.

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At the same time, we must also guarantee the benefits of electric vehicles are available and accessible to all communities. Minority communities often have the most exposure to polluted air from gasoline and diesel-powered vehicles. Electric vehicle access can help provide cleaner transportation options in these communities.

Rural and underserved communities also stand to benefit from EV infrastructure development as EV charging infrastructure can help support local economies. I'm particularly excited to hear from Francis Energy today about its rollout of a statewide EV infrastructure network in Oklahoma.

Perhaps most importantly, as we see growing EV adoption in this country, we must make sure our transition prioritizes American workers. China and other countries are rapidly growing their EV markets and therefore we must invest aggressively to ensure we don't lose the EV market to China. It's imperative this investment occur here to grow an American EV manufacturing base that employs union workers, at good wages, with real benefits.

That's why the CLEAN Future Act provides funding for Domestic Manufacturing Conversion Grants to help create and expand domestic manufacturing of advanced vehicles and advanced vehicle components. It also modernizes and expands the Department of Energy's Advanced Technology Vehicles Manufacturing program, or ATVM.

Today, we will also discuss the role of critical minerals and foreign supply chains in the EV industry. My Republican colleagues are right to point out the problems with the labor practices and, in some cases, outright exploitation that occurs in the extraction of some of the critical minerals found in the batteries in electric vehicles. Democrats share these concerns and believe we should work together to find new, reliable, and responsible sources for these materials. The CLEAN Future Act includes provisions that begin to address the extraction, reprocessing, and reuse of critical minerals.

Make no mistake—electric vehicles are the future. That's coming from the auto industry itself. And therefore, we need to do everything we can to ensure America leads that future by making the necessary investments now. With these bills, we are investing in innovation and helping give consumers the ability to choose between more than just gasoline or diesel. We must ensure that our roads, our grid, and our workers are prepared for this important transition. When charging stations are as ubiquitous as gas stations, then consumers will have a choice, and we truly will be in a position to win the future.

Thank you, and I yield back.

Mr. RUSH. The Chair yields back. Now the Chair now recognizes the ranking member of the full committee, Mrs. Cathy McMorris Rodgers, for 5 minutes.

OPENING STATEMENT OF HON. CATHY McMORRIS RODGERS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF WASHINGTON

Mrs. RODGERS. Thank you, Mr. Chairman. Great to see everybody.

Yes, it is about winning the future. I would suggest it is EVs and AVs, right, electric vehicles and autonomous vehicles. That is our future. I know today we are focused on EVs, you know, but there's many exciting technologies under development that will help drive cleaner energy systems, protect our environment, expand economic opportunity, and benefit families and workers. That is the wonder and promise of the American free enterprise system and our culture of innovation, which is driven by consumer demand, not a government socialist agenda.

The fruits of free enterprise innovation can be seen in all the amazing advances over the decades in our transportation systems, like the cars and trucks that we drive. This includes constantly improving performance, efficiency, and safety. It also includes improving mobility, convenience, and comfort, all the benefits that people want and look for.

Think about the benefits of autonomous vehicle systems, which we have examined in this committee. AVs will mean more safety and more mobility, especially as these advances become more affordable to everyone, including seniors and people with disabilities.

Think about new power trains, including EV power trains, and the fuels which are building upon our existing energy infrastructure and providing more efficient, cleaner, high-performing vehicles.

Unfortunately, this free market innovation and its benefits are being jeopardized by the mandatory rush to green. This approach includes regulatory mandates to drive reduction of greenhouse gas emissions from our transportation systems by restricting people's options, regardless of technological capability or cost. The leading edge of this approach is happening at the State level, led by California, with its aggressive renewable electric mandates and vehicle standards.

Despite rapidly rising electric rates 7 times the national average and a struggling, unreliable electric grid, people having to buy generators just to keep the lights on, California's Governor was unconvinced the State policies were enough to meet climate goals. So last year he issued an order to restrict oil and gas production and to ban sales of gas-powered cars and light trucks by 2035. Add the Biden administration's plans to drive electrification on aggressive timelines nationwide, and costs on families and workers will increase. We have detailed this in recent hearings.

Today's hearing concerns legislation to expand electric vehicle infrastructure as part of the majority's climate agenda and its CLEAN Future Act. Taken together with the energy restrictions in the broader bill, the policies today should be scrutinized to understand, unfortunately, how it will hurt security, innovation, affordability, and reliability. All of these consequences will hurt especially the low- and middle-income families.

In hearings earlier this year we discussed risk from replacing existing energy infrastructure with systems reliant mostly on wind and solar, batteries, and completely electric transportation.

All of us should be asking: What are the security impacts of the United States trading its strategic advantage in fossil energy for more reliance on supply chains from China?

What will weather-dependent electricity systems mean for reliability and rates people pay, like the working families of eastern Washington?

What are the costly impacts on people who rely on gas-powered vehicles well into the future? What will happen to their cost?

Although the radical left doesn't like to recognize it, America has led with a sophisticated and competitive fuel system developed over nearly a century to serve our needs. What are the benefits of working to foster continued innovations in the system and building on its attributes, even as autonomous and electric vehicle innovations are deployed and developed?

As I have said before, we should build upon our energy systems, not dismantle them. We should stop attacking the source of American innovation and stop trying to pick winners and losers. We should recognize the essential role technological innovation and American free enterprise serves to address climate risk. Let's win the future. Let's do it the American way.

And with that, I yield back the balance of my time.

[The prepared statement of Mrs. Rodgers follows:]

PREPARED STATEMENT OF HON. CATHY MCMORRIS RODGERS

There are many exciting technologies under development that will help drive cleaner energy systems, protect our environment, expand economic opportunity and benefit families and workers.

That is the wonder—and the promise—of the American free enterprise system and our culture of innovation, which is driven by consumer demand, not a government socialist agenda. The fruits of free market innovation can be seen in all the amazing advances over the decades in our transportation systems, like in the cars and trucks we drive.

This includes constantly improving performance, efficiency, and safety. It also includes improving mobility, convenience, and comfort—all benefits people want and look for. Think about the benefits of autonomous vehicle systems, which we've examined in this committee.

AVs will mean more safety and more mobility, especially as these advances become more affordable to everyone, including seniors and people with disabilities. Think about new power trains—including EV powertrains—and the fuels, which are building upon our existing energy infrastructure and providing more efficient, cleaner, higher-performing vehicles.

Unfortunately, this free market innovation and its benefits are under assault by the compulsory "rush to green" schemes presented by the majority and the administration to address climate risks. These schemes include regulatory regimes to drive reduction of greenhouse gas emissions from our transportation systems by restricting people's options—regardless of technological capability or cost.

As usual, the leading edge of this assault is happening at the State level led by California, with its aggressive renewable electricity mandates and vehicle standards. Despite rapidly rising electricity rates, and a struggling, unreliable electric grid, California's governor was unconvinced the State's policies were enough to meet climate goals.

So last year he issued an order to restrict oil and gas production and to ban sales of gas-powered cars and light trucks by 2035. Add the Biden administration plans to drive electrification on aggressive timelines nationwide, and costs on families and workers will increase, as we've detailed in recent hearings.

Today's hearing concerns legislation to expand electric vehicle infrastructure as part of the majority's radical climate agenda in its CLEAN Future Act. Taken together with fossil energy restrictions in the broader bill, the polices today should be scrutinized to understand how it hurts security, innovation, affordability, and reliability. All these consequences will hurt low and middle income families the most.

In hearings earlier this year, we discussed risks from replacing existing energy infrastructure with systems reliant mostly on wind and solar, batteries, and completely electric transportation. All of us should be asking: What are the security impacts of the United States trading its strategic advantage in fossil energy for more reliance on supply chains from China?

What will weather dependent electricity systems mean for reliability and the rates people pay—like the working families of eastern Washington? What are the costly impacts on people who rely on gas-powered vehicles well into the future? What will happen to their costs?

Although the radical left does not like it, America is blessed with a sophisticated and competitive fuel system, developed over nearly a century to serve our needs. What are the benefits of working to foster continued innovations in this system and building on its attributes—even as electric vehicle innovations are developed and deployed?

As I've said before, we should build upon our energy systems, not dismantle them. We should stop attacking the source of American innovation, stop trying to pick winners and losers. We should recognize the essential role technological innovation and American free enterprise serves to address climate risks.

Mr. RUSH. I want to thank the ranking member. The ranking member yields back.

The Chair would like to remind Members that, pursuant to committee rules, all Members' written opening statement shall be made part of the record.

And now that concludes our opening testimony. I would like to, at this time, welcome our witnesses who are at this morning's hearing.

First of all, Mr. Amol Phadke, staff scientist and deputy department head for the International Energy Analysis Department in the Lawrence Berkeley National Lab.

Next, Mr. Joe Britton, executive director of the Zero Emissions Transportation Association.

Following Mr. Britton will be Mr. Josh Nassar, the legislative director of the International Union, United Automobile, Aerospace, and Agricultural Implement Workers of America, the UAW.

Next will be Mr. David Jankowsky, founder and president of Francis Energy.

Next, following Mr. Jankowsky, will be Dr. Michelle Mishot—Michot, rather—Foss, who is a Ph.D., a fellow in energy and minerals, Baker Institute for Public Policy at the Center for Energy Studies at Rice University.

And lastly, Mr. AJ Siccardi, president of the Metropolis Energy, Incorporated—Metroplex, rather—on behalf of the National Association of Convenience Stores, NACS; the National Association of Truck Stop Operators, NATSO; and the Society of Independent Gasoline Manufacturers of America, SIGMA.

I want to thank each and every one of the witnesses for joining us today, and we look forward to your testimony.

Dr. Phadke, you are now recognized for 5 minutes for the purposes of an opening statement.

STATEMENTS OF AMOL PHADKE, PH.D., STAFF SCIENTIST AND DEPUTY DEPARTMENT HEAD, INTERNATIONAL ENERGY ANALYSIS DEPARTMENT, LAWRENCE BERKELEY NATIONAL LABORATORY; JOSEPH BRITTON, EXECUTIVE DIRECTOR, ZERO EMISSIONS TRANSPORTATION ASSOCIATION; JOSH NASSAR, LEGISLATIVE DIRECTOR, INTERNATIONAL UNION, UNITED AUTOMOBILE, AEROSPACE, AND AGRICULTURAL IMPLEMENT WORKERS OF AMERICA (UAW); DAVID JANKOWSKY, FOUNDER AND PRESIDENT, FRANCIS ENERGY; MICHELLE MICHOT FOSS, PH.D., FELLOW IN ENERGY, MINERALS AND MATERIALS, CENTER FOR ENERGY STUDIES, BAKER INSTITUTE FOR PUBLIC POLICY, RICE UNIVERSITY; AND AJ SICCARDI, PRESIDENT, METROPLEX ENERGY, INC.

STATEMENT OF AMOL PHADKE, PH.D.

Dr. PHADKE. All right. Thank you. I am just going to pull up my desk for a second.

All right. Good morning, everybody. Chairman Pallone, Ranking Member McMorris Rodgers, Chairman Rush, Ranking Member Upton, and distinguished members of the committee, thank you for holding this important hearing and for inviting me to testify.

I am Dr. Amol Phadke, I am a staff scientist and deputy department head of the International Energy Analysis Department, Lawrence Berkeley National Lab. I am also affiliate and senior scientist at the Goldman School of Public Policy, University of California, Berkeley, and the lead author of the 2035 Power Report, which looks at the technical economic feasibility of reaching 90 percent clean power by 2035, where we find that such a grid is technically feasible and dependable and, in fact, the lower wholesale consumer cost. I am also the joint lead author with Dr. Nikit Abhyankar of the recently released 2035 Transport Report, which assessed rapid decarbonization of the U.S. transport sector via electrification.

What is really exciting is that my own research and the research of several other scientists show that limiting battery cost breakthroughs and battery technology have created new opportunities for accelerated decarbonization of the transport sector via electrification. Significant barriers remain, but the total consumer cost savings and societal benefits of accelerated vehicle electrification are just staggering.

In our report we analyze the economic, human health, environmental, and electric grid impacts of a future scenario in which all new sales of light-duty and heavy-duty vehicles are electric by 2030 and 2025, respectively. This timeline is consistent with what we need to do to avoid climate change and also in line with the recent private-sector and government targets.

Our key findings are: One, such a scenario is technically feasible. EVs can deliver the required performance, given recent dramatic improvements in battery technology.

Two, which is very important, it leads to massive savings to consumers, due to much lower running cost of EVs. The consumer saves $2.7 trillion in vehicle spending by 2050. This translates to approximately $1,000 in average household savings each year over the next 30 years.

Three, it avoids 150 premature deaths, due to dramatic decline in air pollution from transport. This one is particularly important for environmental justice.

Four, over 2 million new jobs are supported by 2035, because of significant increases in construction and manufacturing jobs to build the grid and charging infrastructure required to support this transformation. And more importantly—jobs, because the $1,000 that consumers save to spend on other things, which drives investments.

Five, investments in charging infrastructure are critical, but the investments are modest compared to the rapid benefits of electrification. However, several hurdles, including high upfront vehicle costs and inadequate charging infrastructure, remain.

A robust policy ecosystem is required to address these barriers, which potentially include five elements.

First, strong standards that require all new auto sales to be zero-emission, a technology neutral standard.

Second, targeted financial incentives that ramp down over time.

Third, equity-focused programs.

Fourth, and most importantly, investments in a ubiquitous charging network and a modern grid.

Five, the strong made-in-America policies.

You know, Europe and China are implementing several of these policies already. And in 2020, EV sales and public charge points in Europe and in China will more than double that of the U.S. So we have some catch-up to do, but it is eminently possible.

Last, but not the least, enhanced investment in R&D to establish U.S. leadership in clean technology and rapid decarbonization of the transport sector. Examples include extreme fast-changing, cobalt-free batteries, solid-state advanced manufacturing.

In short, recent dramatic technology improvements have created a massive opportunity for consumers, climate, economy, and jobs. And I think it is wise to take it.

I yield back, or I am done.

[The prepared statement of Dr. Phadke follows:]

THE CLEAN FUTURE ACT: DRIVING DECARBONIZATION OF THE TRANSPORTATION SECTOR

A Hearing of the Subcommittee on Energy

Committee on Energy and Commerce

United States House of Representatives

Testimony of Dr. Amol Phadke

Staff Scientist and Deputy Department Head, International Energy Analysis Department,
Lawrence Berkeley National Laboratory

May 5th, 2021

Introduction

Chairman Rush, Ranking Member Upton and distinguished members of the committee, thank you for holding this important hearing and for inviting me to testify.

I am Amol Phadke, and I am a Staff Scientist and Deputy Department Head in the International Energy Analysis Department at Lawrence Berkeley National Laboratory (Berkeley Lab). I am also an Affiliate and Senior Scientist at the Goldman School of Public Policy at the University of California (UC), Berkeley. My research is focused on electrification of heavy duty vehicles, grid scale storage, and deep decarbonization of the power and transport sectors. I have published over 30 peer reviewed journal articles and over 35 scientific reports. I have a Bachelor of Engineering degree from the Government College of Engineering, Pune, India, and a M.S. and Ph.D. from the Energy and Resources Group, from UC Berkeley. I am the lead author of the recently released 2035 Transport Report and 2035 Power Report by UC Berkeley which assess rapid electrification and deep decarbonization of the US transport and power sectors respectively.

My testimony represents my views only and does not necessarily represent the views of Berkeley Lab or of the Department of Energy.

My own research and the research of several other scientists shows that plummeting battery costs, breakthroughs in battery technology, and dramatic declines in clean energy costs have created new opportunities for an accelerated decarbonization of the transport sector via electrification. Significant barriers remain, but the total consumer cost savings and societal benefits of accelerated vehicle electrification are staggering. In this testimony, I will discuss the key findings of our related research.

I will specifically discuss the findings of our recent report: *2035 Report 2.0: Plummeting Costs And Dramatic Improvements In Batteries Can Accelerate Our Clean Transportation Future* ***(2035 Transport Report)***.[1]

Figure 1: Annual consumer savings in the DRIVE Clean scenario (cumulative savings of $2.7 trillion through 2050) and a delayed-electrification scenario (cumulative savings of $2.2 trillion through 2050).

[1] Phadke, A, N Abhyankar, J Kirsey, T McNair, U Paliwal et al., 2021. 2035 Report 2.0: Plummeting Costs and Dramatic Improvements in Batteries Can Accelerate Our Clean Transportation Future. University of California, Berkeley. Available at www.2035report.com. **[A Phadke and N Abhyankar are co-lead authors]**

We analyze the economic, human health, environmental, and electric grid impacts using a future scenario in which electric vehicles (EVs) constitute 100% of new U.S. light duty vehicle (LDV) sales by 2030 as well as 100% of medium-duty vehicle (MDV) and heavy-duty truck (HDT) sales by 2035. We find that such a scenario is technically feasible and leads to

- Saving consumers $2.7 trillion in vehicle spending (Figure 1). This translates to approximately $1,000 in average household savings each year, over the next 30 years
- 150,000 avoided premature deaths, and nearly $1.3 trillion in avoided health and environmental costs through 2050;
- Over 2 million new jobs in 2035, with opportunities to bolster job growth and global competitiveness through sound industrial policies to support manufacturing.

Several hurdles, including high upfront vehicle costs and inadequate charging infrastructure, rather than technical or economic feasibility, are the largest barriers to EV sales growth and accelerated decarbonization to align with global climate targets.

A robust policy ecosystem is required to address these barriers which potentially includes strong standards that require all new auto sales to be zero emission by 2035, targeted financial incentives that ramp down over time, equity focused programs, investments in a ubiquitous charging network and a modern grid, strong "Made in America" policies, and smart electric utility regulations. These are described in a Companion Policy Report to the 2035 Transport Report (see Baldwin et al. 2021).[2] Europe and China are implementing several of these policies already and in 2020, EV sales and public EV charge points in Europe and China were more than double of those in the US.

In addition, enhanced investments in RD&D are required to establish US leadership in clean technology and further enable rapid decarbonization of the transport sector. Next, I will elaborate on the findings of our recent research.

2035 Report 2.0: Plummeting Costs And Dramatic Improvements In Batteries Can Accelerate Our Clean Transportation Future

In our recent report, *2035 Report 2.0: Plummeting Costs And Dramatic Improvements In Batteries Can Accelerate Our Clean Transportation Future*, we analyze the economic, human health, environmental, and electric grid impacts of a future in which ground transportation is all-electric. Our main scenario, called the Drive Rapid Innovation in Vehicle Electrification (DRIVE Clean) scenario, represents a future in which EVs constitute 100% of new U.S. light duty vehicle (LDV) sales by 2030, as well as 100% of medium-duty vehicle (MDV) and heavy-duty truck (HDT) sales by 2035. The scenario also assumes that the grid reaches 90% clean electricity by 2035, and

[2] Baldwin, Sara, Amanda Myers, Michael O'Boyle, and David Wooley. 2021. Accelerating Clean, Electrified Transportation by 2035: Policy Priorities (A 2035 2.0 Companion Report). Energy Innovation and University of California, Berkeley.

substantial EV charging infrastructure is deployed. We then compare the DRIVE Clean scenario to a No New Policy scenario, in which EVs constitute 45% of new LDV sales, 38% of MDV sales, and 12% of HDT sales in 2035, and the clean electricity share reaches only 47% by 2035. By demonstrating that the ambitious DRIVE Clean goals are technically feasible and economically beneficial, we aim to inform broader discussions of the U.S. transportation transition. Following are key findings from our analysis.

1. **CONSUMER SAVINGS FROM EV OWNERSHIP START SOON AND GROW RAPIDLY**

Historically, EV sales have been hindered by two consumer cost disadvantages: the total cost of ownership (TCO) and upfront prices of EVs have both been high in relation to internal combustion engine (ICE) vehicles. Our results show, however, that electric heavy-duty trucks already hold a TCO advantage today, and light-duty EVs will overtake ICE vehicles in TCO terms within 5 years (Figure 1). In addition, light-duty EVs will reach upfront price parity with their ICE counterparts in the mid- to late-2020s, while electric HDTs will approach upfront price parity with diesel trucks in the mid- to late-2030s. However, the persistence of high upfront EV costs is a major barrier to achieving rapid decarbonization of the transportation sector. At a national level, the DRIVE Clean scenario yields cumulative economic savings of approximately $2.7 trillion through 2050 compared to the No New Policy scenario — an average household savings of approximately $1,000 per year over the next 30 years. The DRIVE Clean scenario's electrification of light duty EVs by 2030 is critical to the benefits realized, saving $460 billion more than a scenario in which 100% light-duty EV sales are achieved 5 years later.

Figure 1: TCO for EVs (bars) vs. ICE vehicles (lines), showing TCO parity achieved by 2023 for LDVs (left and center) and an existing TCO advantage for HDTs (right). Upfront costs include taxes. Maintenance costs of EVs include battery replacement cost.

2. ACCELERATING EV ADOPTION SAVES 150,000 LIVES AND AVOIDS $1.3 TRILLION IN HEALTH AND ENVIRONMENTAL DAMAGES THROUGH 2050

Gasoline- and diesel-powered vehicles harm human health and the environment via emissions of pollutants such as fine particulate matter, nitrogen oxides, and sulfur oxides, as well as greenhouse gas emissions that contribute to climate change. These emissions disproportionately impact low-income communities and communities of color, which are often located near major roads, transit centers, or freight hubs. Compared with the No New Policy scenario, the total transportation sector pollutant and carbon dioxide (CO2) emissions reductions in the DRIVE Clean scenario avoid approximately 150,000 premature deaths and equate to nearly $1.3 trillion in health and environmental savings through 2050 (Figure 2). The DRIVE Clean scenario slashes ground transportation sector CO2 emissions by 60% in 2035 and by 93% in 2050, relative to 2020 levels. Total transportation sector emissions fall by 48% in 2035 and by 75% in 2050, relative to 2020 levels (Figure 3).

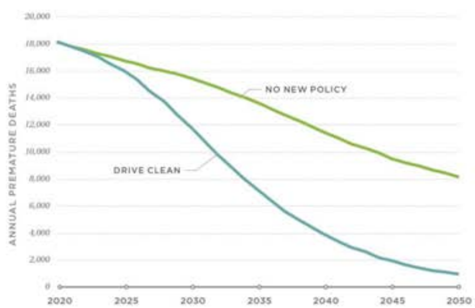

Figure 2: Annual premature deaths in the No New Policy and DRIVE Clean scenarios, 2020–2050. The DRIVE Clean scenario avoids 150,000 premature deaths due to air pollution through 2050.

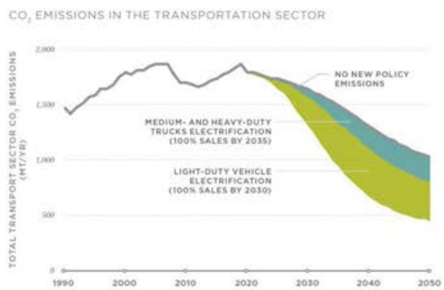

Figure 3: Transportation sector CO_2 emissions in the DRIVE Clean and No New Policy scenarios through 2050.

3. THE ELECTRIC VEHICLE TRANSITION SUPPORTS EMPLOYMENT OPPORTUNITIES ACROSS THE ECONOMY

The DRIVE Clean scenario supports consistent job gains in 2020-2035, peaking at over 2 million jobs in 2035 compared to the No New Policy scenario (Figure 4). Employment gradually ramps up in this timeframe as electric vehicle manufacturing expands and the electric grid adds new renewable energy and battery storage resources to support increased vehicle electrification. Consumer cost savings in the transition to electric vehicles similarly increases induced jobs in the economy. While electric vehicles require less maintenance and have fewer parts, the reduction in auto repair jobs is more than offset by gains in economy-wide induced jobs and increased power sector jobs.

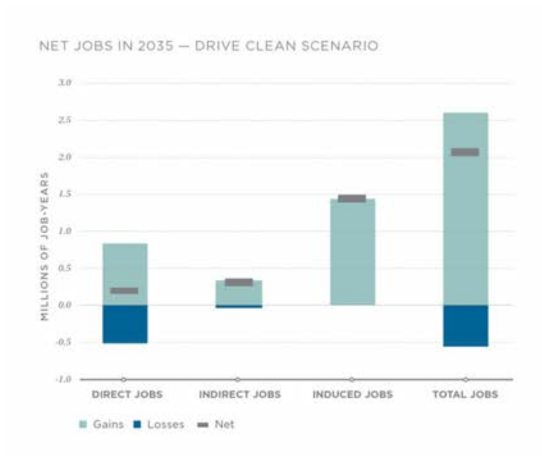

Figure 4: Net jobs in 2035, DRIVE Clean scenario compared to the No New Policy scenario.

4. EV PERFORMANCE AND AVAILABILITY CAN MEET THE NEEDS OF AMERICAN DRIVERS

American drivers have become accustomed to the vehicle performance and availability standards established by gasoline and diesel-powered vehicles for vehicle range (Figure 5), fueling time, diversity of vehicle models, and—for commercial vehicles— weight. EVs have been improving rapidly across all these dimensions, and our analysis suggests they will not present significant barriers to the accelerated EV deployment envisioned in the DRIVE Clean scenario.

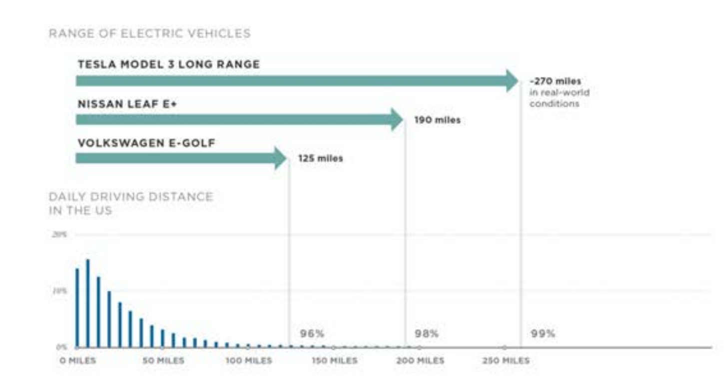

Figure 5: Nearly 96% of U.S. passenger vehicle trips are shorter than 125 miles suggesting many EV models can meet average daily passenger vehicle needs (image recreated from ICCT 2020).

REQUIRED CHARGING INFRASTRUCTURE CAN BE BUILT COST-EFFECTIVELY TO SERVE THE ENVISIONED EV FLEET

To enable the DRIVE Clean scenario, U.S. EV-charging infrastructure must provide drivers with at least as much convenience as provided by existing gasoline and diesel fueling stations. We find that the pace of the required infrastructure scale-up is challenging but achievable, and the costs are modest compared with the benefits of widespread EV deployment.

Each year over the next 30 years, the United States must install an average of approximately 270,000 public chargepoints for LDVs and 35,000 MDV/HDT chargepoints. The cumulative investment in public charging infrastructure ($6.5 billion per year) makes up a small portion of EV TCO in the DRIVE Clean scenario.

5. GLOBAL AND DOMESTIC SUPPLY CHAINS CAN SATISFY ACCELERATED EV AND BATTERY PRODUCTION, LED BY U.S. COMPANIES

With strong policy support, domestic and global EV manufacturing capacity can sufficiently scale to meet the DRIVE Clean goals. In addition, accelerated U.S. EV deployment will present opportunities for U.S. manufacturing leadership in an increasingly competitive global context. The DRIVE Clean scenario requires that annual U.S. electric LDV sales grow from 331,000

to over 15 million by 2030. Domestic manufacturing of these vehicles is beginning to ramp up, with significant investments from manufacturers such as Ford and General Motors. At the same time, more than 125 zero-emission MDVs and HDTs are in production or development in the United States. Similarly, the DRIVE Clean scenario will depend on at least 1,200 GWh

of battery capacity per year by 2035. While current global lithium-ion battery demand is about 300 GWh, global battery manufacturing capacity is expected to exceed 2,000 GWh by 2028. **Strong policies will be necessary to further develop domestic vehicle and battery manufacturing capacity, encourage raw material procurement and cost-competitive battery recycling, and help the U.S. compete globally.**

6. ELECTRIC GRID IMPACTS OF THE ENVISIONED EV FLEET ARE MANAGEABLE

Even with additional electric loads in the DRIVE Clean scenario, the 90% clean grid is dependable without coal plants or new natural gas plants by 2035. In addition, the resulting wholesale electricity cost is lower than today's costs. Under the DRIVE Clean scenario, all existing coal plants are retired by 2030, no new fossil fuel plants are built, and electricity demand growth from increased electrification averages about 2% per year, a growth rate slower than that achieved in 1975-2005 (Figure 6). To meet this demand, the United States must install on average 105 GW of new wind and solar and 30 GW of new battery storage each year—nearly four times the current deployment rate in the U.S., but lower than that achieved by China in

2020. Although new investments in the distribution system are necessary to support increased load from electric vehicles, the costs are modest. Because electricity sales are increasing due to electrification, the increased distribution costs are spread across more units of electricity, which results in lower costs to consumers on a per kWh basis.

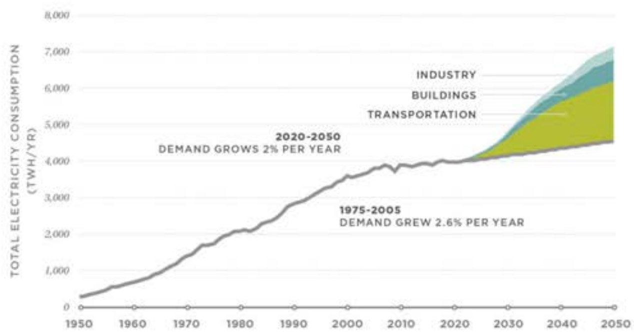

Figure 6: Average annual U.S. electricity demand growth, 2020–2050 (left) and average U.S. renewable energy capacity additions necessary to support the DRIVE Clean scenario, compared to renewable energy capacity additions in China in 2020 (right). The United States must add approximately 105 GW of new wind and solar each year through 2035.

CONCLUSION

Plummeting battery costs, breakthroughs in battery technology, and dramatic declines in clean energy costs have accelerated the timeline for cost-effective transportation decarbonization. Significant barriers remain, but the total consumer cost savings and societal benefits of accelerated vehicle electrification are staggering. Achieving the goal of the DRIVE Clean scenario puts the United States on a 1.5°C pathway for economy-wide decarbonization while yielding substantial human health and environmental benefits and saving consumers $2.7 trillion in vehicle spending—approximately $1,000 in average household savings each year—over the next 30 years. If light-duty vehicle electrification is delayed to 2035 in accordance with many currently proposed transportation electrification goals, we leave significant cost savings on the table. When it comes to electrifying transportation, sooner is definitely better. Europe and China appear to be significantly ahead of the US in terms EV sales and charging infrastructure deployment. For example, in 2020, EV sales and public EV charge points in Europe and China were more than double of those in the US (Figure 6).

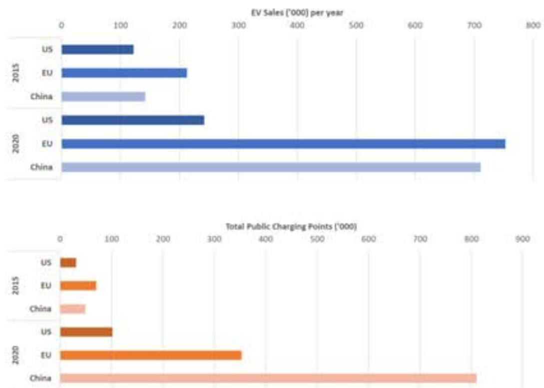

Figure 6: EV sales and pubic charging points in US, EU, and China

New policies and regulations will be needed to achieve the accelerated 100% electric vehicle sales goal. These are described in a Companion Policy Report to the 2035 Transport Report (see Baldwin et al. 2021) which I have summarized below.[3]

Strong national fuel economy and tailpipe emissions standards for all vehicle classes consistent with will pave the road for market transformation, spur technology innovation, reduce local pollution, and lock in consumer savings. Combined with state leadership in ZEV standards, strong national standards will protect consumers, improve public health, and ensure U.S. manufacturers remain globally competitive. America needs strong standards to reduce greenhouse gas emissions in line with a 1.5 degree Celsius global target. These are the highest priority policies in terms of emissions reductions.

Equity-focused policies and programs designed with input from communities most adversely impacted by transportation pollution — namely communities of color in historically redlined neighborhoods, and frontline and underserved communities — will ensure all people, regardless of race or other socio- economic demographics, benefit from cleaner, more efficient transportation solutions.

Targeted incentives that ramp down over time as the market matures will encourage early adoption and drive down costs to benefit all consumers. Means-based incentives will help ensure low- and moderate-income consumers and small businesses also benefit. Consumer education

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[3] Baldwin, Sara, Amanda Myers, Michael O'Boyle, and David Wooley. 2021. Accelerating Clean, Electrified Transportation by 2035: Policy Priorities (A 2035 2.0 Companion Report). Energy Innovation and University of California, Berkeley.

programs will increase awareness of expanding EV model availability and suitability. Incentive programs for EV infrastructure are also key to an all-electric future.

Investments in a ubiquitous charging network and a modern grid will address range anxiety and ensure reliability as the EV market grows. Meeting the mobility needs of families and businesses will boost consumer and business confidence in EVs for urban, rural, and long-distance trips.

Strong "Made in America" policies to encourage domestic manufacturing will help retool U.S. industry to manufacture batteries, EVs, energy storage, and other advanced technologies. An early focus on these policies will improve global competitiveness, sustain jobs, and support workers in the transition.

Smart electric utility regulations and local government leadership will reduce permitting and other soft costs and elicit full electrification transportation value for the benefit of EV owners, utility customers, and the grid. Efforts to streamline interconnection and integration of EVs in homes, businesses, and communities will pay dividends as demand grows.

In addition enhanced investments in RD&D are required to establish US leadership in clean technology and further enable rapid decarbonization of the transport sector.

Thank you for the opportunity to share my views with the Committee.

Mr. RUSH. I want to thank Dr. Phadke.

The Chair now recognizes Mr. Britton for 5 minutes for the purposes of an opening statement.

STATEMENT OF JOSEPH BRITTON

Mr. BRITTON. Thank you. Subcommittee Chairman Rush, Vice Chair McNerney, Ranking Member Upton, full committee Chairman Pallone, and Ranking Member McMorris Rodgers, and other members of the committee, thank you for the opportunity to speak about zero-emission transportation and the CLEAN Future Act today.

My name is Joe Britton. I am the executive director of the Zero Emission Transportation Association, a public-interest nonprofit representing 55 company interests who are all advocating for a 100 percent EV sales by 2030. Our membership spans the entire EV supply chain and includes critical materials, charging companies, utilities, vehicle manufacturers, and battery producers, and recyclers.

At the start of this year, ZETA launched a comprehensive Federal roadmap to achieve 100 percent EV sales by 2030. This EV agenda offers Federal policymakers a blueprint to create hundreds of thousands of domestic manufacturing jobs, protect public health, and secure American leadership in the automotive space. We are pleased to see key provisions of ZETA's platform captured in the CLEAN Future Act and the additional legislation included in today's hearing. My testimony will provide context on ZETA's recommendations and on how we can best invest to create an unbeatable U.S. automotive sector for decades to come.

We know the world is moving forward with transportation electrification, with or without us. So the United States has a choice and an opportunity to revive its industrial and automotive superiority.

Hundreds of thousands of Americans, many in rural communities, depend on the automotive industry for their livelihood. Electric vehicles present a critical pathway and opportunity for American leadership in manufacturing at a time when economic advancement in these areas is sorely needed. EVs will define the new automotive economy. That is because they create enormous value, without asking the consumer to sacrifice.

In fact, EVs are superior products that deliver a better driving experience, have zero tailpipe emissions, cost significantly less in terms of fuel, maintenance, and service costs.

The choices we face are stark. We can either cultivate an advanced vehicle sector or cede this economic opportunity to others. It is true that China holds a disproportionate share of the EV supply chain, particularly when it comes to battery processing, materials, and recycling. But this didn't happen accidentally. They have delivered support and funding for research and development that has allowed their economy to capture the market.

But that doesn't need to be the end of the story. We can drive American innovation through programs like the Advanced Technology Vehicle Manufacturing Program and seek to reshore the production of components, parts, and vehicles. Investing in the U.S. domestic supply chain will protect us from overreliance on foreign competitors and ensure that disruptions like those brought on by the coronavirus are not repeated.

In short, the United States cannot be on the sidelines while our foreign competitors continue to solidify their control over the manufacturing, processing, and commodities critical to our economic future.

The current policy landscape presents an opportunity to retake a leading position in the EV space. Congress can help by passing strong consumer incentives, investing in charging infrastructure, and instituting rigorous fuel economy standards, all while ensuring this transition is achieved in an equitable manner.

ZETA specifically recommends removing the 200,000-unit-per-manufacturer cap as part of the 30D tax credit and making those EV incentives point-of-sale refundable.

We must also provide rebates to the used-car market to ensure electrification is not only—out of reach but is available for those 70 percent of Americans that are not in the market for a brand-new car.

And we have urged the Federal Government set strong fuel economy standards. This will send a market signal that we are going to make this transition to EVs in the next 10 or 15 years, and not the next 40 or 50.

We have also called for a $30 billion investment to build out accessible charging infrastructure. Reliable charging that meets every community's needs is critical. We are pleased to see charging infrastructure prioritized in the American Jobs Plan.

Finally, each of ZETA's policy objectives are grounded in a recognition that historic infrastructure efforts have not made a pointed attempt to engage frontline communities and communities of color. With this in mind, we fully support Representative Clarke's Electric Vehicles for Underserved Communities Act, which directs DoE to support the deployment of EV charging in disadvantaged or underserved communities.

In tandem with the investments in the American Jobs Plan, these proposals present a critical opportunity for full transportation electrification.

ZETA's membership has come together, as a business group and a business voice to ensure that the United States can lead the global EV market while creating good-paying domestic jobs and cutting our emissions to improve public health and reduce our carbon footprint.

We can make this an American success story and outcompete anyone, but we have to do it now. Together, we can establish the best products, careers, and public health outcomes possible.

ZETA encourages the committee to adopt these policies, and I look forward to taking your questions and contributing to the discussion about how best to invest in a strong economic future. Thank you.

[The prepared statement of Mr. Britton follows:]

Statement of Joseph Britton

Executive Director of the Zero Emission Transportation Association

Before the Subcommittee on Energy
United States Senate Committee and Energy and Commerce
117th Congress

The CLEAN Future Act: Driving Decarbonization of the Transportation Sector
May 5, 2021

Introduction

Subcommittee Chairman Rush and Ranking Member Upton, Full Committee Chairman Pallone and Ranking Member McMorris Rodgers, and other members of the Energy and Commerce Committee, thank you for the opportunity to speak about zero emission transportation and the CLEAN Futures Act today. Electric Vehicles (EVs) present a critical pathway and opportunity for American leadership in manufacturing and the environment at a time when economic advancement in these sectors is sorely needed.

My name is Joe Britton, and I am the Executive Director of the Zero Emission Transportation Association, a public interest non-profit with over 50 member companies advocating for 100% electric vehicle sales by 2030. Our membership spans the entire EV supply chain and includes critical materials, charging companies, utilities, vehicle manufacturers, and battery recyclers.

The world is moving toward electric transportation, and the United States has an opportunity to revive its industrial automotive prowess while reducing air pollution and addressing dressing climate change. And while other solutions may require sacrifice on the part of the consumer, EVs are far superior products that deliver a better driving experience than gas-powered cars, have zero emissions and cost significantly less in terms of fuel, maintenance and service. EVs are irreversibly the defining product of the new automotive economy. The choices we face are stark – we either cultivate an advanced vehicle sector or cede this economic opportunity to others. We don't have to look far back to recall what happened when more efficient foreign imports consumed the market. The United States cannot be on the sidelines while countries like China continue to solidify their control over the commodities, processing and manufacturing critical to our economic future.

ZETA's membership has come together to ensure the United States has the capability to lead the global EV market – while creating well-paying domestic jobs spanning the entire supply chain and cutting our emissions to improve public health and reduce our carbon footprint. We can make this an American success story and outcompete anyone, but the time for half-measures is behind us. ZETA's policy platform lays out a roadmap that both Congress and the Biden administration can take to secure U.S. leadership in clean transportation. We must use public policy as a tool to galvanize our global competitiveness to match the scale of our foreign counterparts – like China – that have made significant strides in the last decade.[1] For example, we can help the U.S. become an EV leader by passing strong consumer incentives, investing in charging infrastructure, and instituting rigorous fuel economy standards that send a strong market signal that we are going to make this transition in the next 10-15 years, not the next 40-50. Together, we can establish the best products, supply chains and economic development the

[1] "Policy Platform." ZETA, https://www.zeta2030.org/policy-platform/. Accessed 28 Apr. 2021.

automotive world has ever seen. I look forward to taking your questions and contributing to the discussion about how best to invest for a stronger economic future.

Environmental Benefits of EVs

Transportation accounts for 28% of all U.S. greenhouse gas (GHG) emissions and is the largest source of emissions across all economic sectors.[2] With both population and driving rates on the rise, it is also the only sector that continues to increase its GHG emissions. Electrification of the transportation sector is a critical step to reversing this troubling trend.

An overwhelming amount of research has shown that EVs produce lower lifecycle GHG emissions than traditional Internal Combustion Engine Vehicles (ICEVs). A well-cited and regularly updated study from the Union of Concerned Scientists demonstrates that, on average, even in the region of the country using the most carbon intensive electricity, EVs perform better than the equivalent of a 50 mile-per-gallon (mpge) gas-powered car, and in the cleanest region of the grid, EVs perform at the equivalent of 122 mpge.[3] As the grid continues to move to clean power, these numbers will only continue to improve –whereas an ICEV is locked into the same inefficiency over its lifetime.[4]

Medium- and heavy-duty vehicles (MHDVs) play an outsized role in negative environmental implications from emissions. Although they represent 7% of vehicles on the road, they are responsible for 25% of GHG emissions, 50% of nitrous oxide (NOx) emissions, and 67% of particulate matter (PM) emissions.[5] NOx and PM emissions are linked with higher rates of asthma, birth defects, premature birth, and complications from COVID-19.[6] New research published last week shows that PM pollution, which is the largest environmental cause of human mortality, disproportionately affects communities of color in the U.S. It also found that gasoline vehicles were the largest source of PM emissions negatively impacting those communities.[7] Removing tailpipe emissions associated with these vehicles will not only have a marked benefit to the U.S. economy, but also an immediate and dramatic impact on public health and equity.

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2 US EPA, OAR. "Sources of Greenhouse Gas Emissions." US EPA, 29 Dec. 2015, https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.

3 https://blog.ucsusa.org/dave-reichmuth/are-electric-vehicles-really-better-for-the-climate-yes-heres-why

□ "Are Electric Vehicles Really Better for the Climate? Yes. Here's Why." Union of Concerned Scientists, 11 Feb. 2020, https://blog.ucsusa.org/dave-reichmuth/are-electric-vehicles-really-better-for-the-climate-yes-heres-why.

5 Ready for Work | Union of Concerned Scientists. https://www.ucsusa.org/resources/ready-work. Accessed 30 Apr. 2021.

□ Brown, Austin L., et al. Driving California's Transportation Emissions to Zero. Apr. 2021. escholarship.org, doi:10.7922/G2MC8X9X.

7 Tessum, Christopher W., et al. "PM2.5 Polluters Disproportionately and Systemically Affect People of Color in the United States." Science Advances, vol. 7, no. 18, Apr. 2021, p. eabf4491. advances.sciencemag.org, doi:10.1126/sciadv.abf4491.

The U.S. can position itself as an innovator and dramatically reduce emissions with full transportation electrification. Economic growth and emissions reductions do not need to be mutually exclusive; in fact, 41 states demonstrated that GDP and emissions can be negatively correlated when their emissions dropped to all-time lows and their GDP rose.[8] This resulted from a combination of regulatory policy and incentives for innovation in clean energy. As demonstrated by ZETA's 55 members in the industry, clean transportation is no different.

Domestic Manufacturing Opportunity

Securing our global competitiveness rests on our ability to create domestic manufacturing jobs. With U.S. auto sector employment down 30% as a result of the COVID-19 pandemic[9], American auto workers are in a precarious position that an investment in electric vehicle manufacturing can help alleviate. A report by the BlueGreen Alliance found that over 250,000 Americans are working to manufacture, sell, and repair electric and hybrid vehicles[10]; as the number of EVs sold globally and domestically grows, we can anticipate even greater job growth.

On the other hand, choosing to ignore the opportunities presented by EVs will result in devastating losses for communities dependent on the auto industry as foreign competitors move past us. A 2018 study found that in Ohio alone, failing to attract members of the EV industry will correlate with a 7,000-job loss[11]. By leaning into the opportunities presented by the EV sector and the U.S. companies leading this charge, the United States can protect the futures of our auto workers and reestablish our automaking dominance.

U.S. companies like Tesla, Rivian, Ford, GM, Lucid, Lordstown, and others manufacture EVs that outperform foreign competitors in terms of sales, quality, and performance. However, China's critical minerals stronghold has allowed it to gain outsized control of the EV market. With the right policy to shift supply chain control away from China and to North America, the United States can secure and prioritize sourcing critical minerals domestically.

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[8] Saha, Devashree, and Joel Jaeger. Ranking 41 US States Decoupling Emissions and GDP Growth. July 2020. www.wri.org, https://www.wri.org/insights/ranking-41-us-states-decoupling-emissions-and-gdp-growth.

□ See national employment in motor vehicles and parts manufacturing for May 2020. U.S. Bureau of Labor Statistics, "Automotive Industry: Employment, Earnings, and Hours," available at https://www.bls.gov/iag/tgs/iagauto.htm. The COVID-19 pandemic cost nearly 50,000 jobs in clean vehicles alone in March and April 2020, with greater losses expected to continue in coming months. See Philip Jordan, "Memorandum: Clean Energy Employment Initial Impacts from the COVID-19 Economic Crisis, April 2020" (Carlsbad, CA: BW Research Partnership, 2020), available at https://e2.org/wp-content/uploads/2020/05/Clean-Energy-Jobs-April-COVID-19-Memo-FINAL.pdf.

[10] National Association of State Energy Officials and Energy Futures Initiative, "2020 U.S. Energy & Employment Report" (Arlington, VA, and Washington: 2020), available at https://static1.squarespace.com/static/5a98cf80ec4eb7c5cd928c61/t/5e78b3c756e8367abbd47ab0/1584968660321/USEER+2020+0323.pdf.

[11] On the other hand, if Ohio embraces electrification, the auto industry could add an estimated 2,000 jobs. See Asa S. Hopkins and others, "A Path Forward For Energy & Transportation" (Powering Ohio, 2018), available at http://www.poweringohio.org/files/2018/11/Powering-Ohio-A-Path-Forward-FINAL.pdf.

Recent events like the blockage of the Suez Canal and the year-long, pandemic-related computer chip shortages demonstrate the fragility of the supply chain. Establishing a domestic supply of critical minerals and manufacturing capacity to prevent these issues from recurring must be a top priority. The U.S. has both the supplies and the capacity to expand, but this can only occur if domestic projects are a priority and Congress sets criteria for project review based on the Biden Administration's net-zero goals. China has taken a lead in the EV manufacturing supply chain largely because of its investment in research and development to source critical minerals and process them into battery-grade metals. China's dominance stems from heavy government support, not naturally-occurring deposits – most lithium is sourced from South America, and China is ranked sixth in the world. The United States, which is rich in these same critical minerals, has the potential to outperform China.

ZETA member companies produce, process, and recycle the minerals and components needed for EV batteries and components domestically. For this reason, ZETA has endorsed the American Jobs in Energy Manufacturing Act of 2021,[12] which provides a 30% tax credit to manufacturers that are retooling, expanding, or building new facilities making clean energy and transportation technologies.

With strong public policies encouraging responsible development like the American Jobs in Energy and Manufacturing Act, the U.S. can realize its geological advantage over China and can scale its processing and refining capacity. Examples of North American raw materials companies with the sources and capacity to bring domestic supply to the U.S. are outlined below.

- **Albemarle Corporation**'s lithium site in Silver Peak, Nevada has been in production since the 1960s. This site is the most productive lithium brine well field in the U.S. and produces lithium carbonate. Albemarle's domestic resources also include the 800-acre Kings Mountain, North Carolina lithium site, which is one of the richest spodumene ore deposits in the world and home to the company's global lithium technical center and piloting operations. Albemarle also operates lithium-containing brines in Arkansas.[13]
- **The Piedmont Lithium Project** is located within the world-class Carolina Tin-Spodumene Belt (TSB) and trends along the Hallman Beam and Kings Mountain mines. Sited approximately 25 miles west of Charlotte, North Carolina, the TSB is one of the largest lithium regions in the world and provided most of the western world's lithium from the 1950s through the 1980s.

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[12] Manchin, Joe. S.622 - 117th Congress (2021-2022): American Jobs in Energy Manufacturing Act of 2021. 9 Mar. 2021, https://www.congress.gov/bill/117th-congress/senate-bill/622.

[13] Albemarle Announces Expansion of Nevada Site to Increase Domestic Production of Lithium. Albemarle Corporation. https://investors.albemarle.com/news-releases/news-release-details/albemarle-announces-expansion-nevada-site-increase-domestic. Accessed 13 Apr. 2021.

- **Livent Lithium** has been a leader in lithium production and supply since the 1990s. Livent's largest manufacturing facility is located in Bessemer City, North Carolina and produces lithium hydroxide, butyllithium, and high purity lithium metal. Notably, their proprietary processing method results in 95% lithium purity.[14]
- **Lithium Americas Corporation**'s Thacker Pass Project is a pre-feasibility stage lithium project in Humboldt County, Nevada. The Project is situated at the southern end of the McDermitt Caldera, approximately 60 miles northwest of Winnemucca. In 2018, Lithium Americas completed a pre-feasibility study on a two-phase project with a production capacity designed to reach 60,000 tonnes of battery-grade lithium carbonate per annum and a 46-year mine life.[15] In January 2021, the Bureau of Land Management granted a Record of Decision to allow for construction to begin. Final feasibility engineering is progressing to support construction and will be completed this year. This is the first lithium asset permitted in the United States in over 50 years.
- **Ioneer** operates the Rhyolite Ridge Lithium-Boron Project. The Rhyolite Ridge is a large, shallow lithium-boron deposit located close to existing infrastructure in southern Nevada. The lithium and boron mineral resource is estimated at 146.5 million metric tonnes and includes an ore reserve of 60.0 million metric tonnes. This represents a 280% increase in reserves from the Pre-Feasibility Study. The company expects to process 63.8 million metric tonnes over the 26-year mine life at an average annual rate of 2.5 million metric tonnes per year.[16]
- **NOVONIX** is an advanced battery materials and technology company with synthetic graphite manufacturing operations based in Chattanooga, Tennessee. They are set to support 10,000 tonnes of synthetic graphite anode production by 2023 and have plans to expand capacity to 40,000 tonnes by 2025 and 150,000 tonnes by 2030. Graphite is the largest input material by volume into lithium-ion batteries. High purity graphite powder is used to make the anode of a lithium-ion battery and represents 10-15% of the cost of the battery cell. According to the USGS, approximately 1.1 million tons of graphite were produced in 2020, with 650,000 tons from China and zero tons from the United States.
- **Jervois Mining USA Limited**, a Nevada-registered corporation, is proposing to build what will be America's only primary cobalt production operation in the heart of the Idaho Cobalt Belt, which stretches 40 miles near the town of Salmon, Idaho. Jervois' production could represent 15-20 percent of U.S. annual consumption and will directly counter risks that China could use its dominant position in the cobalt supply chain to the detriment of the U.S. Cobalt is critical to the performance and stability of EV batteries and helps to mitigate thermal runaway, making it a difficult-to-replace component in the

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[14] "Pursuing Advanced Lithium Technologies | Livent's History & Growth." Livent, https://livent.com/company-overview/history-of-livent/. Accessed 14 Apr. 2021.
[15] "Lithium Americas." *Lithium Americas*. Accessed 13 Apr. 2021.
[16] "Overview." *Ioneer Ltd (INR)*, 1 Feb. 2018, https://www.ioneer.com/rhyolite-ridge/overview.

cathodes of these batteries. China also dominates the supply of refined cobalt products, controlling around 80% of global cobalt refining capacity.

- The **Copper Development Association** has led the way in ensuring our copper supply can be maximized for the benefit of EVs and auto manufacturers. While not given the same attention as a defined critical material, it is important to recognize the value of copper to EVs and EV infrastructure. The average EV battery pack uses 183 lbs. of copper, compared to internal combustion engines (48 lbs.) and hybrid EVs (88 lbs.). Additionally, copper is essential to charging stations: a charging port from 3.3 kW to 200 kW contains between two to 17 pounds of copper. As we seek to drive domestic supply chains, ZETA sees copper development as an important part of our security considerations.
- Battery recycling is a promising American innovation that can help free us from reliance on foreign supply chains. Recycling technology is already delivering on a promise to reclaim 95% of critical materials in a commercially competitive way.
    - **The American Battery Technology Company (ABTC)**, **Redwood Materials**, and **Li-Cycle** utilize cutting-edge recycling technologies to separate and process these minerals from used batteries and convert them to storage cells and new EV batteries. While over 69% of the world's lithium battery recycling occurs in China, ABTC is currently permitting and building a lithium-ion battery recycling facility in Fernley, Nevada. This facility would quadruple the current annual U.S. lithium carbonate equivalent (LCE) supply to 20,000 metric tonnes a year. By recovering critical materials and selling high-quality metals back into the battery market, ABTC and others in this sector are forging a path for sustainability and supply chain security.
    - **Enel** is embarking on Second Life, a partnership with Nissan Leaf. This initiative disassembles batteries at the end-of-life and repurposes them for large stationary storage systems. Rivian is designing their batteries for both first-life vehicle application and a post vehicle second life in energy storage. The Department of Energy (DOE) should engage in public-private partnerships to develop and deploy repurposed batteries, use sustainable materials in battery manufacturing (i.e. reclaimed/recycled rare earth metals), and standardize battery module design and build for easier disassembly, repair or recycling.

ZETA members also represent battery manufacturers, equipment manufacturers for EV supply equipment, charging companies, utilities, and vehicle manufacturers. Across their organizations, members can create millions of domestic jobs if the federal government commits to supporting EVs. U.S. battery manufacturers have the ability to secure North American supply chains – especially lithium operations – at the scale needed to achieve a zero-emissions transportation sector. This can occur only if we take swift action to make up ground that has been lost in recent years. With coordination, smart incentives, and appropriate policies, the U.S. can regain a competitive advantage in domestic battery manufacturing and EV production.

Global EV Market Trends

EVs are selling at exponential rates around the world today. In a report released by the International Energy Agency (IEA) last week, the global stock of EVs on the road grew to over 10 million in 2020, despite the economic slowdown that negatively affected the entire auto industry.[17]

In Europe and China, growth of the EV market is largely driven by consumer satisfaction and lower total cost of ownership. Europe had the largest annual growth and increased its EV registrations to 3.2 million, with 1.4 million in 2020 alone, even though the overall car market contracted 22%. In Norway, EVs represented 75% of new car sales, which puts Norway well on its way to the 100% EV sales goal they set for 2025. China followed, having added 1.2 million EV registrations in 2020 and brought their EV total to 4.5 million.

Bloomberg New Energy Finance projects that by 2030 there will be 116 million EVs on the road, driven by lower costs of batteries and ownership, more charging, and sales incentives to spread to new markets.[18] However, the U.S.'s role in this outcome will depend on smart policy at the federal level.

U.S. EV Market Trends and Consumer Choices

Although many of the EVs sold in other countries are made in the U.S. by manufacturers like Tesla and GM, a different story is unfolding in market trends for U.S. EV sales. The U.S. is not growing EV sales at a rate fast enough to meet climate targets or compete with Chinese and European automakers. Although EV registrations fell less than the overall market, the U.S. auto market declined 23% in 2020. Over the course of last year, consumers registered 295,000 new EVs, down from 327,000 in 2019. This was partly due to the elimination of the 30D-related federal tax credit for Tesla and GM. As demonstrated by these trends, the 30D manufacturer cap in the tax code only harms domestic manufacturers and consumers.[19] ZETA's proposed reforms to the 30D tax credit include removing the 200,000-per-unit manufacturer cap and converting the credit into a refundable incentive. ZETA has proudly endorsed the Electric CARS Act of 2021,

[17] "Trends and Developments in Electric Vehicle Markets – Global EV Outlook 2021 – Analysis." IEA, https://www.iea.org/reports/global-ev-outlook-2021/trends-and-developments-in-electric-vehicle-markets. Accessed 30 Apr. 2021.
[18] "BNEF EVO Report 2020 | BloombergNEF | Bloomberg Finance LP." BloombergNEF, https://about.bnef.com/electric-vehicle-outlook/. Accessed 30 Apr. 2021.
[19] "Trends and Developments in Electric Vehicle Markets – Global EV Outlook 2021 – Analysis." IEA, https://www.iea.org/reports/global-ev-outlook-2021/trends-and-developments-in-electric-vehicle-markets. Accessed 30 Apr. 2021.

introduced by Congressman Welch and Senator Jeff Merkley, which calls for the elimination of the cap for the next 10 years.[20]

EVs have a lower total cost of ownership compared to ICEVs due to their maintenance and fuel cost savings.[21] They also have high satisfaction ratings: studies and opinion polls show that people who have ridden in an EV are three times more likely to consider purchasing one as their next vehicle.[22] Research has also shown that as new technologies (like EVs) move out of the "early technology adopter" – who tend to be higher-income [23] – phase, consumer incentives targeting the broader population are critical.[24,25] Although people are reliant on these incentives to help lower upfront cost barriers today, EVs are expected to reach price parity with ICEVs as batteries and other components become cheaper. If trends continue, EVs will become more economical on price, fuel and maintenance than ICE vehicles. Bloomberg New Energy Finance projects cost parity with ICEVs before 2030, and forecasts that over 500 models will be available globally by 2022.[26]

The United States has the world's largest car market, and we must sell EVs domestically if we want to secure our leadership in this space. To do so, the federal government must reform and extend consumer incentives and invest in charging infrastructure.

Lack of public charging infrastructure and range anxiety are leading reasons for EV hesitancy among consumers. Studies demonstrate that the public is also often unaware of charging locations or how to access them. If we are to meet the goal of full electrification by 2030, the federal government must invest in constructing charging infrastructure.

Currently, about 80% of EV charging occurs at home. Though EVs can be plugged into a standard 120-volt outlet and charged to meet most consumer needs, polling indicates a lack of

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[20] Merkley, Jeff. S.395-117th Congress (2021-2022). "Electric CARS Act of 2021. Introduced February 23, 2021. https://www.congress.gov/bill/117th-congress/senate-bill/395?s=1&r=6

[21] Preston, Benjamin. "EVs Offer Big Savings Over Traditional Gas-Powered Cars." Consumer Reports, https://www.consumerreports.org/hybrids-evs/evs-offer-big-savings-over-traditional-gas-powered-cars/. Accessed 30 Apr. 2021.

[22] Voelcker, John. "J.D. Power Finds The Best Way To Sell EVs Is Getting Butts In Seats." Forbes Wheels, 25 Feb. 2021, https://www.forbes.com/wheels/news/j-d-power-electric-vehicle-consideration-study/.

[23] Muehlegger, Erich, and David Rapson. Understanding the Distributional Impacts of Vehicle Policy: Who Buys New and Used Electric Vehicles? Nov. 2019. escholarship.org, doi:10.7922/G21Z42N.

[24] "An In-Depth Examination of Electric Vehicle Incentives: Consumer Heterogeneity and Changing Response over Time." Transportation Research Part A: Policy and Practice, vol. 132, Feb. 2020, pp. 97–109. www.sciencedirect.com, doi:10.1016/j.tra.2019.11.004.

[25] Hardman, Scott. "Understanding the Impact of Recurring and Non-Financial Incentives on Plug-in Electric Vehicle Adoption – A Review." Transportation Research Part A: Policy and Practice, vol. 119, 2019, pp. 1–14.

[26] "BNEF EVO Report 2020 | BloombergNEF | Bloomberg Finance LP." BloombergNEF, https://about.bnef.com/electric-vehicle-outlook/. Accessed 30 Apr. 2021.

awareness about the necessary types of chargers. Homeowners requiring a longer-range overnight charge can install a Level 2 charger, which has the same electrical service as a dryer. Incentives and rebate programs can help reduce the cost for home charging and public charging alike.

Federal Leadership

The Biden-Harris Administration has signaled that President Biden will require full electrification of the federal fleet vehicles, an action that ZETA supports. The federal fleet consists of over 600,000 vehicles, and mass procurement would be cost effective for the government, including for the U.S. Postal Service's (USPS) fleet of over 200,000 mail delivery vehicles.

This transition will require an accelerated deployment of EV charging infrastructure. The Biden Administration should consider including plans for all federal capital projects to incorporate public EV charging wherever possible.

The federal government can also demonstrate leadership by requiring that federal employees have the option to rent an electric vehicle. Such a position would move commercial rental vehicle companies to procure a range of electric models. Because rental vehicles are a main source of used cars in the market, this move would expand the availability of used EVs.

ZETA is disappointed with the USPS decision to award the contract for its next delivery fleet to a diesel-powered drivetrain concept. However, the Biden administration and Congress have options to ensure the electrification of the fleet. The Postal Vehicle Modernization Act[27] would require 70% fleet electrification in order for the USPS to receive $6 billion in funding from Congress.

EV Equity and Environmental Justice

ZETA's policy objectives are grounded in a recognition that historic infrastructure efforts, even within the environmental policy sphere, have not made a pointed effort to engage with frontline communities and communities of color. This is particularly important to correct for, considering that these same groups disproportionately suffer from mobile-source pollution and public health impacts. A recent study by the Union of Concerned Scientists found that Asian American, Black, and Latino American residents in the Northeast and Mid-Atlantic region of the U.S. breathe an average of 66 percent more air pollution from cars and trucks.[28] ZETA urges that relevant policy

[27] Huffman, Jared. H.R.7969 - 116th Congress (2019-2020): Postal Vehicle Modernization Act. 7 Aug. 2020, https://www.congress.gov/bill/116th-congress/house-bill/7969.

[28] Inequitable Exposure to Air Pollution from Vehicles | Union of Concerned Scientists. https://www.ucsusa.org/resources/inequitable-exposure-air-pollution-vehicles.

be designed with a focus on equity, inclusion, and justice. The federal government must keep communities of color (particularly Black and Latinx) and low-income communities at the forefront of its infrastructure planning.

Higher income earners tend to lead new technology adoption. However, EV prices have decreased, more models have become available, and studies show that moderate- and low-income earners are entering the market. As referenced in previous sections, this is a critical time to provide consumer incentives that will encourage EV adoption among middle-income consumers.

Consistent with ZETA's policy platform, consumer incentives should extend and expand the current 30D tax credit so that members of all income brackets can realize the value of the credit upfront. Used vehicles should also be eligible for purchase incentives, as over 70% of vehicle sales[29] in the U.S. are used vehicles, and a majority of low- and middle-income earners purchased used vehicles. Point-of-sale purchase incentives for used EVs should be prioritized.

Similarly, current charging access is not equitably distributed. Most EV drivers charge at home in their garage, but a large percentage of low-income earners do not have access to a charger or off-street parking. Representative Clarke's Electric Vehicles for Underserved Communities Act helps address this issue by directing DOE to support deployment of EV charging infrastructure in disadvantaged or underserved communities. On a similar note, the federal government must invest in charging infrastructure for neighborhoods that lack off-street parking and update building codes to drive multi-unit residential charging infrastructure installation. These investments should include grants and incentives for cities and states. Representative Tonko has laid out these policy objectives in the Electric Vehicle Infrastructure Rebate Act of 2021 by establishing a rebate program to promote the purchase and installation of publicly accessible electric vehicle supply equipment. Both Representative Clarke and Representative Tonko's bills will help further the long road to EV equity and ZETA fully supports them becoming law.

The federal government should also prioritize electrification of public transportation, freight vehicles, and ports to reduce the harmful effects of diesel pollution in historically redlined and disadvantaged areas. Electric buses and urban delivery vehicles are already available, including models from ZETA members Proterra, Workhorse, and Arrival. Representative Panetta's Green Bus Tax Credit Act[30] and Senator Padilla's Clean Commute for Kids Act[31] will help reduce negative health consequences for children who can ride on electric school buses. Within Rep.

[29] The US Used Car Market and Digital Disruption | McKinsey. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/used-cars-new-platforms-accelerating-sales-in-a-digitally-disrupted-market#.
[30] Panetta, Jimmy. All Info - H.R.5163 - 116th Congress (2019-2020): Green Bus Tax Credit Act of 2019. 19 Nov. 2019, https://www.congress.gov/bill/116th-congress/house-bill/5163/all-info.
[31] Cardenas, Tony. H.R.2906 - 116th Congress (2019-2020): Clean Commute for Kids Act of 2019. 9 Jan. 2020, https://www.congress.gov/bill/116th-congress/house-bill/2906.

Panetta's legislation, a 10% manufacturer's credit up to $100,000 for electric buses will go a long way in transitioning these critical fleets of buses.

Conclusion

We have a once-in-a-lifetime opportunity to dramatically shift the automotive landscape to the benefit of both the American worker and domestically produced zero emission vehicles. Progress with the right federal policies is paramount, but that is only the beginning. In the next few years, tens of millions of Americans and fleet operators will be introduced to the idea of going electric for their next automotive purchase. EVs present an opportunity to raise awareness about fuel and service savings for consumers, dramatic American competitiveness and job creation potential, and a choice to protect public and environmental health by removing harmful tailpipe emissions from communities.

ZETA is encouraged by the transportation electrification commitments recently outlined in President Biden's American Jobs Plan. The significant investment in EV charging infrastructure, federal fleet electrification goals, strong consumer incentives, and domestic supply chain emphasis are all commensurate with ZETA's mission to enact policies that will accelerate the United States' adoption of electric vehicles while creating hundreds of thousands of jobs. We look forward to continuing to work with Congress and the Administration to ensure that these proposals are adopted.

Mr. RUSH. The Chair now recognizes Mr. Josh Nassar for 5 minutes for the purposes of an opening statement.

STATEMENT OF JOSH NASSAR

Mr. NASSAR. Thank you, Chairman Rush and members of the committee. I really appreciate the opportunity to testify here today on behalf of the million members and retirees of the United Auto Workers, our president, Rory L. Gamble, and the executive board.

I want to start off by just saying that there is no organization that the fate—our fate, our members' and retirees' fate, is directly tied to the success of the motor vehicle automobile industry in the United States. So this is an issue that we are deeply engaged in.

I think, first of all, you know, from our standpoint, often it is set up as a choice between either we can have strong environmental standards or we can have, you know, good jobs. We think both are absolutely necessary here. And when talking about what I mean by good jobs, we think that, absolutely, we support the idea of there being massive Federal investments to create the infrastructure for EV manufacturing and deployment, but there has to be conditions. Employers have to be held accountable for how they treat their workers, and it has to be part of the equation.

The other thing is that we believe strongly that taxpayer money should be used to support U.S. jobs and U.S. manufacturing. We don't think it should be for imported vehicles. It should be for domestically built vehicles.

We also strongly believe that, you know, we have to beef up our supply chains. The current shortage of auto-grade wafers for semiconductors is having a devastating impact on our members and on parts of the economy throughout the country. And it really shows kind of the fallacy of overly relying on foreign supply chains. So this is an opportunity to bring those supply chains here, start them here in the first place. We are at kind of a key moment.

The other thing is we just need to make sure that, you know, those new jobs that are created are good jobs. And right now, I can't say with any assurance that they will be. We have seen, you know, joint ventures and other arrangements from some of the startups and stuff, and where, just with an unproven record of working conditions and wages. So we are really at a kind of a—at the cusp here.

If Congress does not get involved, if Congress does not make big investments here, we are afraid we are just going to fall further and further behind China and Europe and other places with a strong auto presence. So we do think those investments are necessary public investments. But again, we think there needs to be conditions attached to those investments.

The other thing is that if we don't make those investments, we are really worried that investments made by the companies will not be successful. So we need that infrastructure, and we need to boost EV sales in order to support the EV manufacturing.

But to be clear, EVs aren't, you know, a silver bullet here. When we are talking about reducing emissions, which we believe, you know, we all have a role to do, we also need to focus on what could be done to make existing ICE-powered vehicles more efficient, as well. So I am pleased to see that there are provisions in the CLEAN Future Act that do just that.

Also, when talking about, you know, workers, and having, you know, wages increase, we really need workers to have a voice on the job, and commend the House for passing the PRO Act. And now it is really important, we think, for the Senate to follow suit, because if workers have a voice on the job, then we are going to see higher wages and better working conditions.

So we are looking at all this in a holistic way. And, you know, from our point of view, the future is really on the line here. But we need to be smart in how we proceed here. We need to do it based on, you know, where—partly where consumers are at, partly where we could incentivize. So if we do this in kind of a deliberate and careful way with strategic supply chains in mind, we could very well be in a much better position than we are right now when it comes to EV production and sales.

As has been noted, less than 2 percent of the vehicles on the roads right now are electric vehicles.

So I just want to conclude by saying that we don't really see this as a choice between creating good jobs or protecting the environment. We must do both. And in fact, we won't succeed in either endeavor if we don't do both, which I am happy to get into later in questions and answers.

So really, I just appreciate the opportunity to testify here today, and I really look forward to answering the questions and further engagement here, as we continue down this very important effort. Thanks so much.

[The prepared statement of Mr. Nassar follows:]

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INTERNATIONAL UNION, UNITED AUTOMOBILE, AEROSPACE & AGRICULTURAL IMPLEMENT WORKERS OF AMERICA – UAW

RORY L. GAMBLE, *PRESIDENT* RAY CURRY, *SECRETARY-TREASURER*
VICE-PRESIDENTS: TERRY DITTES • CINDY ESTRADA • GERALD KARIEM

May 5, 2021

The CLEAN Future Act: Driving Decarbonization of the Transportation Sector
House Committee on Energy and Commerce Subcommittee on Energy
Submitted by Josh Nassar
UAW Legislative Director
1757 N Street NW, Washington, D.C. 20036

Chairman Rush, Ranking Member Upton, and members of the Subcommittee, on behalf of the one million active and retired members of the International Union, United Automobile, Aerospace, and Agricultural Implement Workers of America (UAW), UAW President Rory L. Gamble, and the UAW International Executive Board (IEB), I want to thank you for the opportunity to share our perspective on reducing carbon emissions in the transportation sector and on the CLEAN Future Act. It is my honor to appear before you today.

Global Challenges

We currently face several global crises that have a direct impact on the topics before us today. The World Health Organization (WHO) announced that the number of global COVID-19 cases reported in recent weeks eclipses the first six months of the pandemic. Over the past year, more than 17% of the U.S. population has been infected by COVID-19 (32 million cases), and over 583,000 Americans have died. The global coronavirus pandemic is by no means over and will take many years until we fully appreciate the profound impact it has had on our country and the world.

COVID-19 has already demonstrated how past strategic decisions can come back to haunt us today. Regarding the motor vehicle sector, lack of resilience in our global supply chains has painfully demonstrated that the slightest disruption can have significant impacts on working people and the economy. Our members have been severely impacted by the pandemic-driven shortage of automotive-grade semiconductors. Production at numerous U.S. plants have been idled and tens of thousands of workers have been laid off, with ripple effects across the automotive value chain.

The current shortage is relevant to the discussion of electric vehicles (EVs) and autonomous vehicles (AVs). EVs and AVs are heavily reliant on semiconductors. It is estimated that an EV autonomous vehicle will have over a thousand dollars' worth of semiconductors. This increase in semiconductor usage comes at a time when U.S. semiconductor manufacturing has been in decline. The total number of U.S. fabrication plants have decreased from 123 in 2007 to 95,[1] while the industry employs 100,000 fewer production workers than it did at the turn of the century.[2] Currently, U.S. manufacturers account for only 13% of the global semiconductor supply. This is because the U.S. is no longer attracting new fabs. In 2011, of 27 high-volume fabs built worldwide, only one was in the U.S.; 18 were in China and 4 in Taiwan. In 2018, 20 new fab projects were announced in China, with total investment exceeding $10 billion.[3] Clearly, we need to bolster domestic production of automotive-quality semiconductors and we commend the Biden Administration for making these domestic investments a priority in the American Jobs Plan. We urge Congress to fully fund the Administration's initiative and ensure a sufficient portion of the production is dedicated to the motor vehicle sector to support U.S. made vehicles.

Climate Change is Here

A large body of scientific research predicted for decades that climate change would increase the number and strength of extreme weather and climate events such as heat waves and droughts. Unfortunately, these predictions regarding climate change are proving correct, and we all have a responsibility to take action to mitigate its impacts. We need cleaner and more efficient vehicles on the road and jobs building these cleaner vehicles should pay family and community-sustaining wages and provide benefits that workers can count on to care for themselves and their loved ones.

U.S. manufacturing workers face serious headwinds, including weak labor laws that fail to protect workers' rights to join a union, bad trade deals that put interests of investors before workers, and misguided tax incentives that allow corporations to pay fewer U.S. taxes on profits earned overseas than those earned within our borders and some to pay no corporate taxes at all. Over the past fifteen years, U.S. automotive production workers' wages have fallen significantly. When adjusting for inflation, average hourly earnings for production workers in auto assembly have declined by 21%, while wages in the auto parts sector have declined by 19%.[4] The status quo is unacceptable. The transition to EVs could either further exacerbate these problems or protect and create good-paying union jobs. Federal and state policies will play a significant role in determining which path we take.

Labor law reform is desperately needed. In fact, the National Labor Relations Act (NLRA) has not been strengthened since becoming law over 85 years ago. Our laws must ensure workers are able to collectively bargain for better wages, safer worker conditions and a dignified retirement. We urge the Senate to pass the *Protecting the Right to Organize (PRO) Act.* The PRO ACT could help raise job standards in the motor vehicle industry. We applaud the House for passing the *PRO Act* in the 117th and 116th Congresses on a bipartisan basis. If signed into law, the PRO Act will protect a worker's right to join a union by strengthening penalties against corporations that violate

[1] MForesight, "Manufacturing Prosperity: A Bold Strategy for National Wealth and Security", June 2018: http://mforesight.org/download/7817/

[2] BLS, Quarterly Census of Employment and Wages (QCEW) for NAICS 334413, http://www.bls.gov/cew/.

[3] MForesight, "Manufacturing Prosperity: A Bold Strategy for National Wealth and Security", June 2018: http://mforesight.org/download/7817/

[4] Bureau of Labor Statistics. "Average hourly earnings of production and supervisory employees." Series CEU3133610008 & CEU3133630008, Data from January 2006-January 2021. Adjusted using BLS CPI Inflation Calculator.

workers' rights, provide for mediation and arbitration of first contracts, eliminate right to work laws, prohibit captive audience meetings, and support workers' right to strike. Passing the PRO Act will go a long way in strengthening outdated labor laws and rebuilding our nation's middle class.

Comprehensive Manufacturing Policy

The UAW supports a coordinated industrial policy centered on maintaining and growing high-quality jobs in U.S. manufacturing while combating climate change and advancing equity. As we work toward the future of clean transportation, it will be critical to ensure this transition benefits American workers, enhances U.S. competitiveness, and promotes economic security. Unless comprehensive policies are adopted which focus on raising standards for U.S. workers and boosting domestic manufacturing, we will continue to fall behind in production of EVs and middle class, and union jobs in auto sector will be eroded even further.

As the Committee deliberates on legislation aimed at improving the environment and ensuring that jobs of the future are good jobs, it is incumbent to incorporate provisions related to shoring up domestic supply chains and strengthening Buy America provisions. Consumer and deployment incentives must support domestic assembly and high domestic content requirements. Lawmakers should include U.S. domestic content requirements for key vehicle components, like those considered super-core components in the USMCA, focusing on domestic EV batteries, plug-in hybrid engines, hybrid transmissions, and electric motors. Companies that fail to meet labor standards and U.S. final assembly requirements will still be able to sell their automobiles, they just should not get taxpayer assistance.

In his first 100 days, President Biden has made it clear that his Administration will do all it can to support buying American products, made here by American workers by signing the Executive Order to Strengthen Buy America provisions. President Biden also has a plan to build out and re-shore critical supply chains, including medical equipment, semiconductors, energy and grid resilience technologies, key electronics and related technologies, telecommunications infrastructure, and key raw materials. These initiatives have the potential to create new jobs and protect U.S. supply chains against national security threats. We urge you to work with the Administration to strengthen domestic supply chains and support U.S. made products.

Future of the EV Industry

The global market is moving towards ever more efficient vehicles, including hybrids and electric vehicles. Global electric car registrations increased by 41% in 2020, despite the pandemic-related worldwide downturn in car sales in which global car sales dropped 6%.[5] It has been projected that by 2040, over 50% of new car sales globally will be electric.[6] If the U.S. fails to make public investments and adopt smart public policies to encourage and attract investment in the growing electric vehicle market, companies will locate production and supply facilities in countries that are making these investments. The greener vehicles of the future are going to be made

[5] International Energy Agency, "Global EV Outlook 2021." https://www.iea.org/reports/global-ev-outlook-2021

[6] BloombergNEF, "Electric Vehicle Outlook 2020." https://about.bnef.com/electric-vehicle-outlook/

somewhere and other countries are preparing for these innovative technologies. We could see the U.S. auto industry fall behind on advanced technology, hurting the American economy and American workers.

Years of inaction have put the U.S. far behind other nations in public and private investments needed to make the U.S. a competitive player in vehicle electrification. China has invested more than $60 billion to support EV manufacturing. Chinese firms, either owned or supported by the Chinese government, currently produce 60% of passenger EVs sold around the globe and produce almost 70% of battery cells.[7] China also controls some 80% of the supply of rare earth minerals—which are essential for aerospace, defense, and EV production—and may impose export controls on these vital materials.[8] The European Union (EU) has established the European Battery Alliance to promote production of batteries and key components within EU.[9] South Korea is home to LG Chem, the world's largest producer of lithium-ion batteries for electric vehicles, with a 24.6% market share. The company has plans to triple its battery production.[10]

The transition to EVs is not going to happen overnight. EV sales have grown steadily over the past decade, but they still represent a fraction of vehicle sales. EVs and PHEVs combined represent just 2% of U.S. auto sales in 2020.[11] And EVs face several hurdles to mass-adoption. EVs are more expensive to produce, making them less profitable and dependent on consumer incentives. In most parts of the country, EV charging infrastructure is woefully inadequate, and the electrical grid is unprepared. And consumers shopping for an EV, face barriers in battery range and charging speed, as well as a limited selection of models and segments.

The industry is preparing for EVs to be a much larger part of the market going forward, both in the U.S. and abroad. Major automakers around the world, including the Detroit 3, have each announced several billion in EV investments and ambitious new product plans and target dates. As automakers improve technology, decrease battery costs, and produce at scale, EVs will become more competitive with ICEs. And in the coming years, automakers plan to launch EVs in the segments that are most popular with American consumers: CUVs, SUVs, and pickups.

UAW members must lead this transition and are in fact already building the vehicles of the future. Our members currently make advanced technology vehicles that include battery electric (Chevy Bolt), plug-in hybrids (Jeep Wrangler PHEV, Ford Escape PHEV), and autonomous vehicles (Cruise AV). UAW employers have also announced plans to make EVs and PHEVs at UAW plants in a range of segments, including CUVs, SUVs, pickups, and delivery vans. This year will also see production

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[7] New York Times, "The Auto Industry Bets its Future on Batteries," Feb. 16, 2021. Available online: https://www.nytimes.com/2021/02/16/business/energy-environment/electric-carbatteries-investment.html?action=click&module=Top%20Stories&pgtype=Homepage

[8] Financial Times, China targets rare earth export curbs to hobble US defense industry, Feb. 16, 2021. Available online: https://arstechnica.com/tech-policy/2021/02/china-targets-rare-earthexport-curbs-to-hobble-us-defense-industry/

[9] European Battery Alliance, "EBA 250," accessed Jan. 15, 2020. Available online: https://www.eba250.com/about-eba250/

[10] Reuters, "LG Chem to triple its EV battery production capacity," October 21, 2020. Available online: https://www.autoblog.com/2020/10/21/lg-chem-to-triple-ev-battery-production/

[11] Wards Intelligence, ""U.S. Light Vehicle Sales, December 2020 - Updated" https://wardsintelligence.informa.com/WI965360/US-Light-Vehicle-Sales-December-2020--UPDATED

launches by several start-ups. If new entrants are hostile to unions and provide subpar wages & benefits, it will further erode job quality in the industry.

The CLEAN Future Act (H.R. 1512)

The CLEAN Future Act is a comprehensive clean energy bill covering a range of sectors, including transportation. H.R. 1512 wisely includes supply-side manufacturing programs, such as funding the Domestic Manufacturing Conversion Grant program, strengthening the Advanced Technology Vehicle Manufacturing (ATVM) loan program, and creating the Clean Energy Manufacturing Grant program. It also includes funding to transition the school bus fleet to Zero Emission Vehicles (ZEVs), and money for EV charging infrastructure.

We support transparency and accountability provisions, such as the requirement found the in the Clean School Bus Program (Sec. 423) that requires manufacturers disclose three years of labor, employment, civil rights, health & safety violations, outline plans for compliance, and describe actions to ensure compliance from their direct suppliers. We recommend enhancing this requirement and ensuring that labor standards are applied to all government spending intended to promote green technologies and bolster EV adoption.

Where applicable we recommend adding provisions to reward domestic production and linking labor standards to public funds used to subsidize the industry.

Conclusion

We do not have to choose between protecting our environment and economic prosperity. This is a false choice that hinders our ability to tackle real dangers and build a better future. In fact, to effectively combat climate change and strengthen our middle class, we must do both. To lead the future, electric vehicles and other green technologies must create good U.S. jobs where workers have a voice on the job.

The shift to more EVs will be a costly endeavor for the industry. Even with billions in planned investments, auto companies are relying on public subsidies and other policies to promote sales, transform production capacity, and speed up profitability for EVs. Strategic government support is a crucial tool for strengthening American innovation and manufacturing capacity. But if the public is going to foot the bill, the public should get economic benefits in return, in the form of domestic investments and quality jobs. To make EVs work for American workers, we need policies that promote domestic manufacturing and quality union jobs.

We stand ready to work with you and all other stakeholders on developing standards that are good for working people and our environment. Thank you for considering our views. I look forward to answering your questions.

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Mr. RUSH. Well, I thank the witness.

The Chair now recognizes Mr. David Jankowsky for 5 minutes for the purposes of an opening statement.

STATEMENT OF DAVID JANKOWSKY

Mr. JANKOWSKY. Well, thank you so much, Chairman Pallone, Ranking Member McMorris Rodgers, Subcommittee Chairman Rush, Subcommittee Ranking Member Upton, and other Members on the committee today. My name is David Jankowsky. I am the founder and president of Francis Energy, and I am just so grateful to be in front of you and testifying here today.

Francis Energy is an Oklahoma-based owner and operator of direct current fast chargers. In very simple terms, these are simply chargers that can power cars very rapidly. In fact, some of these chargers can power cars in 7 to 12 minutes. Francis Energy and other companies built the first comprehensive fast-charging network in the country, with over 350 direct-current fast chargers spread across 110 sites, strategically placed every 50 miles across the State of Oklahoma. And this was accomplished through a public-private partnership with the State.

The CLEAN Future Act is exactly the kind of public-private partnership, in the form of rebates and grants, that will enable the private sector to build out modern infrastructure that is both comprehensive and equitable across all communities—urban, rural, underserved, disadvantaged, Tribal, and all other communities across America. This bill helps make that possible.

In fact, roughly 75 percent of Francis Energy's charging stations in Oklahoma are in such communities. We built these stations because we know your constituents will be purchasing electric vehicles in the very near future. We say that with confidence because of the massive investment auto manufacturers and other stakeholders have committed to the electrification of transportation, as Mr. Britton so eloquently described in his opening statement.

In the short term, because of this investment, electric vehicles will be at price parity with combustion engine vehicles and, importantly, with comparable range in the very near term. At that point, we see the acceleration of EV adoption in every community across America.

The Oklahoma example proves that modern infrastructure does not have to be a partisan issue. In fact, lawmakers and other stakeholders in Oklahoma understood that placing fast chargers in these communities would have massive, massive economic development impact. We support the CLEAN Future Act and the rebate and grant provisions because it is this robust legislation that will enable private companies like ourselves and other charge point operators and other stakeholders—it will take a village to create this network across America.

But we know that this legislation will enable the private sector to place charges every 50 miles across the U.S., leaving no community behind. Francis Energy is committed to that mission.

I am just very grateful, again, to be in front of you today and very much look forward to the question-and-answer session.

[The prepared statement of Mr. Jankowsky follows:]

Testimony of David Jankowsky, Founder and President, Francis Energy

Subcommittee on Energy of the Committee on Energy and Commerce hearing entitled, "The CLEAN Future Act: Driving Decarbonization of the Transportation Sector."

May 5, 2021

Chairman Rush, Ranking Member Upton, and members of the subcommittee. My name is David Jankowsky and I am the Founder and President of Francis Energy. I appreciate the opportunity to testify before you today.

Francis Energy is an Oklahoma-based owner and operator of over 350 public-access direct-current fast chargers (DCFC), across 119 distinct locations, under its ownership and management.[1] In the next five years, Francis plans to build comprehensive statewide networks every 50 miles across the heartland. Our core mission is to eliminate range anxiety, which is an electric vehicle (EV) driver's fear of being unable to recharge when away from home. According to numerous studies, range anxiety is a leading impediment to the adoption of EVs. Placing DCFC every 50 miles - across urban, rural, underserved, tribal, and disadvantaged communities - solves range anxiety.

Our company and others stand ready to implement the Biden administration's laudable goal of deploying 500,000 electric vehicle chargers throughout America. To accomplish this, the federal government must provide appropriate incentives to attract private capital in order to facilitate the build out of publicly accessible DCFC. The total project cost of an individual DCFC unit can easily exceed $100,000. In fact, DCFC with the highest power output can cost $400,000, or more. Without sufficient public support, the private sector will deploy projects only where EV adoption rates justify the investment. The result would mirror the rural broadband disparity, leaving countless Americans without meaningful access to modern infrastructure.

The comprehensive EV charging network built in Oklahoma is a useful case study in how effective policy can ensure equitable access to DCFC. In response to Oklahoma's alternative fuel infrastructure tax credit,[2] Francis Energy and other companies developed the first statewide network of DCFC in the country, and did so in less than two years. Importantly, this network, with chargers located roughly every 50 miles across Oklahoma, was designed to include every community. In order for America's transportation sector to fully electrify, federal policy must be

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[1] *What's Missing in the Electric-Vehicle Revolution: Enough Places to Plug In*, WSJ.COM, https://www.wsj.com/articles/whats-missing-in-the-electric-vehicle-revolution-enough-places-to-plug-in-except-tesla-11614380406 (last visited February 28, 2021)

[2] 68 O.S. § 2357.22 (2014) *superseded 2020*

tailored to incentivize private capital to build chargers in communities which would otherwise be overlooked. Absent such federal policy, EV deserts will inevitably result.

The Oklahoma EV network exists because of the bipartisan efforts of state legislators. Lawmakers from both parties collectively realized that only a public-private partnership would properly incentivize the private sector to construct alternative fuel infrastructure. They also understood that embracing modern infrastructure will attract modern businesses, generating investment in rural and underserved communities.

The majority of Francis Energy's chargers are located in just such communities. The duration of charging sessions varies. Given that DCFC charging sessions can last 30-60 minutes, EV drivers will require access to amenities while they wait.[3] Drivers will thus visit local businesses, spend money, and contribute to the local economy. EV drivers who wish to charge quickly can do so. Travel stops, rest stops, gas stations, and convenience stores will serve that segment by providing high-powered DCFC systems which can fully charge an EV in 7 to 12 minutes.

Automakers have made it abundantly clear that EVs will be in these communities soon. GM recently announced its goal to manufacture only zero-emissions vehicles by 2035. Soon after that, Ford's President and CEO Jim Farley echoed the industry shift when he announced a $29 billion investment, stating, "The transformation of Ford is happening and so is our leadership of the EV revolution." Ford's "E-150" is expected next year. And a number of startup automakers, such as Rivian and Lordstown, will begin selling trucks and SUVs this year.

As we witness this exponential shift, away from internal combustion engines (ICE) and toward EV options for consumers, the scale of production will result in a decrease in their price. Estimates vary, but it is widely agreed that EVs will hit price parity with ICE vehicles in the near future, rapidly accelerating EV adoption. Consumers benefiting from the reduced ownership costs of EVs will also accelerate adoption. EV drivers will save between $1,000-$1,500 annually due to avoided maintenance and significantly lower fueling costs.[4]

It is clear that we are on the cusp of a major transformation in the transportation sector. Francis Energy seeks to replicate its success in Oklahoma across the country, with a near-term focus on the mid-continent region. H.R. 1512, "The Climate Leadership and Environmental Action for our Nation's Future Act" is the kind of bold legislative action that will have a far-reaching and

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[3] Charging times can vary due to many factors, such as the power of the charging station, the state of charge of the vehicle's battery, ambient temperature, among others.

[4] *EVs Offer Big Savings Over Traditional Gas-Powered Cars*, CONSUMERREPORTS.ORG https://tinyurl.com/hsaxy6ha (last visited April 1, 2021).

lasting impact on the electrification of transportation in the United States. Specifically, the rebate and grant provisions in H.R. 1512 will incentivize private capital to build out EV infrastructure across the country without leaving any community behind.

Francis Energy respectfully offers the following suggestions to further increase EV adoption rates:

- Section 432(b)(4)(A)(iv): increase the $100,000 cap for "covered expenses." The current cap will not provide sufficient incentive for private capital to install higher-powered DCFC systems, which are an essential component of public EV infrastructure.

- Section 432(b)(7): raise the 40% cap on appropriations for "networked direct current fast charging equipment" because networked DCFC are significantly more expensive than both non-networked DCFC and Level 2 chargers. Networked DCFC are the most widely utilized component of public EV charging infrastructure and should be prioritized.

- Section 440B(e): include private entities under the EV Charging Equity Program eligibility criteria.

Mr. RUSH. Well, I thank the witness.

The Chair now recognizes Dr. Michelle Michot Foss for 5 minutes for the purposes of an opening statement.

STATEMENT OF MICHELLE MICHOT FOSS, PH.D.

Dr. FOSS. Thank you, Chairman. And I would like to thank all of the members of the committee for asking me to join the hearing today, and I would like to commend all of the members of the committee for demonstrating a really good handle on all of the risks and challenges that are embedded in the subject that we are discussing today: how to how to change transportation, how to introduce new technologies, and other things. I feel like you all have a very good handle on all of the enormous aspects that have to be dealt with on this.

When it comes to electric vehicles, the main part of the vehicle, of course, is the battery. This is what everybody is focused on. And battery costs, risks associated with those costs, and affordability are contingent on regional differences in manufacturing—huge regional differences in manufacturing. I can't emphasize that enough. And that includes both supply chains and labor. And I think everybody understands that the cheaper EVs are made in the locations where both of those things are way less expensive than they are in our country or in Europe.

Enormous cones of uncertainty exist. In part, what policy can do is help to narrow those cones. But it has to be sensible, and it has to be targeted the right way.

Batteries and battery electric vehicles are materials-intense. I don't need to restate everything that is coming into the public domain on that front. It is well known now. The thing that I find ironic is that so many people who want to promote electric vehicles in their States are also opposed to mining and minerals processing in their States, and that raises a distinct question: If you are concerned about sustainability of what we are trying to do because of mining and minerals processing abroad, then you—and you are also concerned about it in your own State, those two things don't equate. So I think the committee has to kind of deal with some of the contradictions and intentions and some of the things that I think that people are focused on.

Commodity prices are already rising sharply. We are full of news about that right now. It is something that I have been concerned about for some time. Rapidly rising commodities prices, because of a mix of factors including policy mandates and other things, will contribute to inflation and higher interest rates. And that will undermine everything that you are trying to accomplish, in terms of positive goods.

Electricity is a distinctly difficult commodity. I am all for fast recharging, there are very exciting developments on that front. But we have a lot of work to do on electric power systems. And I think that people have an understanding of that. Who should pay for recharging? How much should recharging cost? Those are things that are enormous puzzles with no real solutions to.

Half of a vehicle comes from other materials, hydrocarbons-based plastics. That is how we have made combustion engine vehicles more efficient already. That is how battery efficient—battery electric vehicles are going to remain—are going to move—become higher performing, going forward. Anything and everything that affects the ability to extract oil and gas, extract hydrocarbons, provide the materials from those that are needed, are going to affect the affordability and availability of battery electric vehicles. I can't say that strongly enough.

Finally, on China, we have already had a lot on the table about China. So much of what people think they understand about battery cost structures, battery electric vehicle cost structures, is distorted by the Chinese role in all of this. With more than 80 percent, or roughly 80 percent of control—of battery-making capacity, and a dominant position in electric vehicle manufacturing platforms, we simply cannot look at those cost structures and assume that we can do the same thing. We have got a lot of a learning curve that we have to absorb in our market.

It is certainly true that the automakers are focused on this and trying to find the best ways of escalating. But to reach the level of sales growth that people would like to achieve is a pretty massive effort. And I am not sure that going toe to toe with China, frankly, on all of this really makes sense. I have plenty of content in my formal testimony related to Chinese dominance of supply chains, Chinese dominance of trade flows.

I want to go back to what Mrs. McMorris pointed out about free markets. It is not hard to operate in a free—or it is not easy, I should say, always to operate in a free market. But communism is much worse. And I think that, when we look at China, we have to be skeptical about a lot of the confidence around what they are doing, given what we know about communist regimes.

Thank you very much for the time, and I wish the committee best of luck.

[The prepared statement of Dr. Foss follows:]

RICE UNIVERSITY'S
BAKER INSTITUTE
FOR PUBLIC POLICY

Testimony

Minerals & Materials Supply Chains – Considerations for Decarbonizing Transportation

Michelle Michot Foss, Ph.D.
Fellow in Energy, Minerals & Materials
Rice University's Baker Institute for Public Policy, Center for Energy Studies

Before the:
U.S. House of Representatives
Committee on Energy & Commerce
Subcommittee on Energy
Hearing on "The CLEAN Future Act: Driving Decarbonization of the Transportation Sector"
May 5, 2021

Summary – Presented Testimony

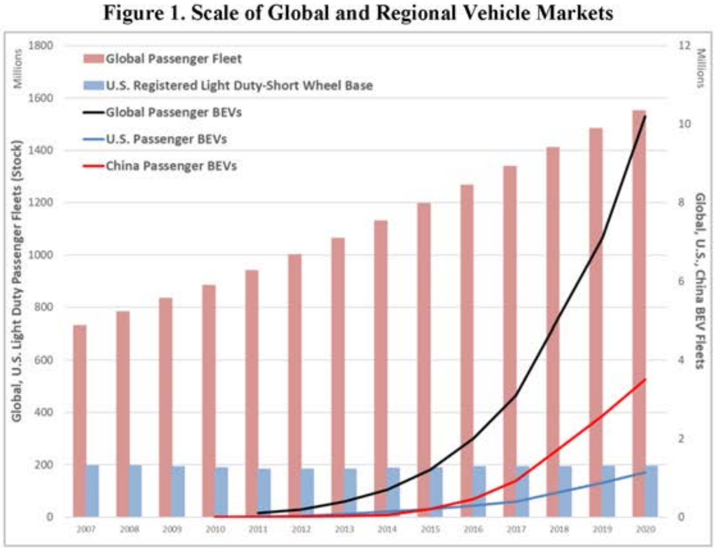
- Policy and decision makers should take an approach that is not part of conventional thinking.
  - **Materials** – all materials, regardless of source – are the first building blocks. Materials science is dynamic. The nature of innovation is serendipitous and economic and financial risks are substantial. Both are vulnerable to underlying business conditions and tax policies.
  - **Systems** require extraordinary attention and support, be they for basic infrastructure or to push sophistication into essential functions like electric power grids. A country that cannot attain public acceptance of legacy components, fuels and technologies is unlikely to be one where public acceptance of new technologies and their intrusions can easily be achieved.
  - **Data** is in a fragile state. BEVs increasingly interact with energy, telecommunications and other systems, infrastructure and data streams. Data is intellectual property (IP), with inherent value and assorted strategies for monetization. Everything from automation in transport to road maintenance and environmental controls has the potential for solutions embedded in data. A world full of BEVs is one in which data extends well beyond terabytes, creating new demands for storage with attendant energy and sustainability considerations.
- Battery costs, risks and affordability.
  - Are contingent upon regional distribution of manufacturing platforms, associated supply chains and logistics, workforce capacity and labor costs and the assortment of contextual factors that are responsible for comparative advantages, or not, across nations and localities.
  - Large "cones of uncertainty" exist.
  - Policy makers should focus on core economic policies that support competitiveness and resilience.
  - Batteries and BEVs are materials intense. Mining and minerals processing already are a focus for ESG imperatives. Recycling can help but is a work in progress. BEV manufacturing and recycling must become "symbiotic". A worry is that environmental regulations that affect businesses engaged with hazardous materials could throttle vital new processes and approaches. A further concern is that BEVs, batteries and other components of alternative energy will add to waste volumes much more rapidly than we can build capacity for handling end of life.
  - Commodity prices already are rising sharply. A "rush to materials" for alternative energy aspirations will threaten economic and national security, could trigger inflation or even hyperinflation, create new sources of geopolitical risks and uncertainties, undermine fragile states, lead to expansion of unsustainable industries and a host of other consequences. Expectations for minerals price increases are now baked into every trading position as well as into nearly every minerals expansion or new venture. They are not, however, baked into forecasts of battery costs.
  - Electricity prices are at least as unreliable as other commodities. Many government policies to support BEVs in other countries entail measures to soften the cost of recharging. U.S. residential costs have climbed persistently even while the key marginal fuel for power generation – natural gas – has been historically low. When it comes to expanding recharging, a distinct consumer issue is whether non-BEV owning or using customers will pay an oversize share of costs.
- Hydrocarbons and petrochemicals are vital raw materials.
  - Our Texas freezageddon provided an illustration of how plastics costs can soar with constraints.

  - Global oil and gas operations are leveraged by sale of petroleum and natural gas fuels, keeping costs of materials affordable.
  - Plastics are crucial for BEVs – more than half of vehicle content but only 10% of weight.
  - Advanced polymers are essential for advanced vehicles and batteries.
  - Advanced plastics recycling is underway and would benefit from more strategic thinking about supply chains and circular economics.
  - Bioplastics are under development for automotive use but availability and affordability of BEVs – any vehicle type for that matter – will continue to hinge on hydrocarbons-based materials sourced from U.S. and global oil and gas operations.
- Executive Order 14017, America's Supply Chains, should include hydrocarbons as critical minerals; add end of life management and associated logistics. Interactions are pervasive – diverse industry participants share concerns. Supply chain preparedness and resilience would benefit from the building blocks of materials first, systems and data.
- Finally, to China's role.
  - China dominates production of many critical and basic minerals and now also dominates trade flows, with some expanding as much as ten times 2001-2019.
  - China's coal dominated electric power capacity is key to its battery manufacturing.
  - China also dominates trade in LIB products.
  - China's strength in LIB manufacturing and supply chains is well documented by DOE CEMAC.
  - A "rush to materials" to counter China's influence and secure alternative energy supply chains would exacerbate global tensions on many fronts.

Full Testimony – Background: Pushing on Strings

A search has been underway for levers to accelerate an assortment of technologies that, in many views, could be used to address myriad energy, environmental, economic and hard security concerns. Battery electric vehicles (BEVs) have been iconic in this regard, as salves for everything from urban air quality to sensitivities around supply and pricing of petroleum fuels. Growth rates in BEV production, sales and fleets are enticing. However they remain a very small portion of the overall global stock of passenger vehicles (Figure 1), a luxury good in most countries and locales. Poorer countries that aspire to electric transport must first build more robust and reliable electric power systems – electricity must be available in some form and BEVs are demanding. Wealthier countries face a vast assortment of challenges to accelerating expansion of BEV fleets and displacing traditional internal combustion engine (ICE) vehicle designs.

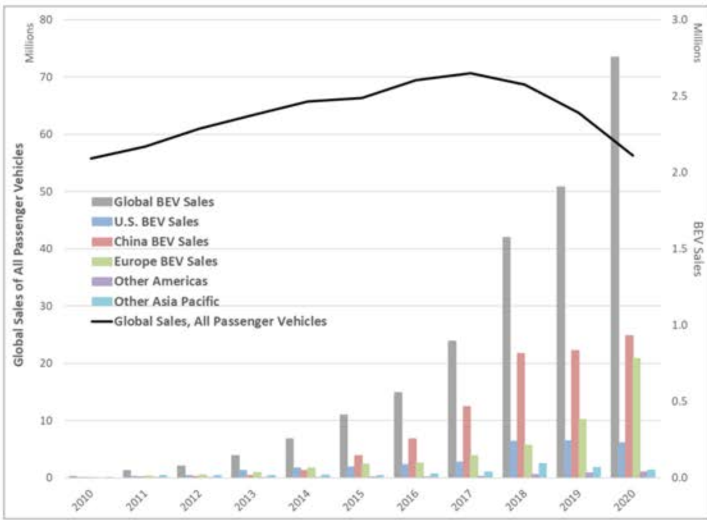
Figure 1. Scale of Global and Regional Vehicle Markets



Sources: Various including International Energy Agency's (IEA's) 2021 Global BEVs Outlook, https://www.iea.org/reports/global-ev-outlook-2021; U.S. Department of Transportation's Bureau of Transportation Statistics, https://www.bts.gov/; and other sources as compiled by Statista (accessed via Rice University).

Some of these challenges are battery manufacturing and associated supply chains; costs of raw materials (including many that are not usually considered in analysis), labor and other inputs; access to and costs of recharging along with all of the associated complexities; other variables such as consumer behavior and competing alternatives; and many more. Depending upon information sources and how one looks at these things and the implications for vehicle production and sales (**Error! Not a valid bookmark self-reference.**), transitioning the U.S. and global fleets could take a mere 150 years, or much longer.

Figure 2. Only "XXX" Years to Go



Sources: Various including IEA's 2021 Global BEVs Outlook, https://www.iea.org/reports/global-ev-outlook-2021; U.S. Department of Transportation's Bureau of Transportation Statistics, https://www.bts.gov/; and other sources as compiled by Statista (accessed via Rice University).

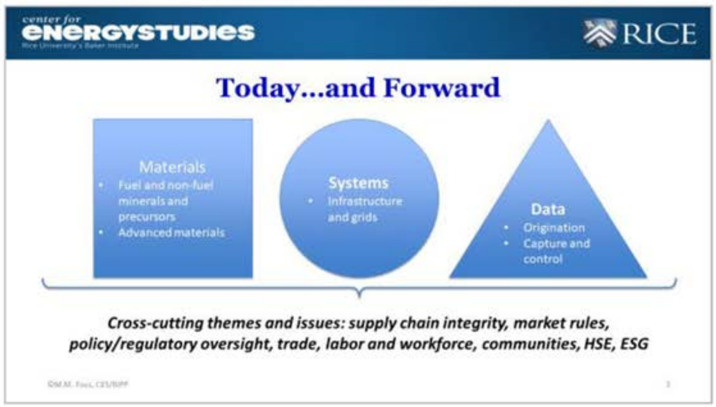
Devilish Details

I suggest that policy and decision makers take an approach that is not part of conventional thinking. **Materials** – all materials, regardless of source – are the first building block. Materials are in a dynamic state as bench science dips into ever more adventurous endeavors, down to the atomic scale and to include "smart materials" that can be used to achieve extraordinary performance in applications. Achieving better understanding realistic time frames to "proof of concept" is vital. The nature of innovation is serendipitous and – of great consequence in light of pandemic recovery – economic and financial risks are substantial. Both are vulnerable to underlying business conditions and tax policies. **Systems** require extraordinary attention and support, be they for basic infrastructure or to push sophistication into essential functions like electric power grids. **A country that cannot attain public acceptance of legacy components, fuels and technologies is unlikely to be one where public acceptance of new technologies and their intrusions can easily be achieved.** This is true no matter the lip service to "leap frogging".[1] **Data** is in a fragile state. Legacy technologies already are lagging in data security. By their very nature, existing BEV models and, even more, new designs under development raise the bar on "hardening". This is especially true as BEVs increasingly interact with energy, telecommunications and other systems, infrastructure and data streams. Data is intellectual property (IP), with inherent value and assorted strategies for monetization. Everything from

[1] Many political leaders of U.S. states desire to promote BEVs but also want bans on mining and minerals processing in their states. See https://www.americanexperiment.org/looming-nickel-shortage-threatens-to-slam-the-brakes-on-governor-walzs-electric-vehicle-mandates/ and https://www.reuters.com/article/us-usa-mining-polymet-mining/minnesota-court-orders-fresh-review-of-polymet-mine-permits-idUSKBN2CF2KK.

automation in transport to road maintenance and environmental controls has the potential for solutions embedded in harvesting, managing, controlling, protecting and ultimately effective utilization of data. A world full of BEVs is one in which data extends well beyond terabytes, creating new demands for storage and the attendant energy and sustainability considerations.

Figure 3. Building Blocks for Policy and Decision Makers



Against that backdrop, I focus on four aspects for the hearing today.

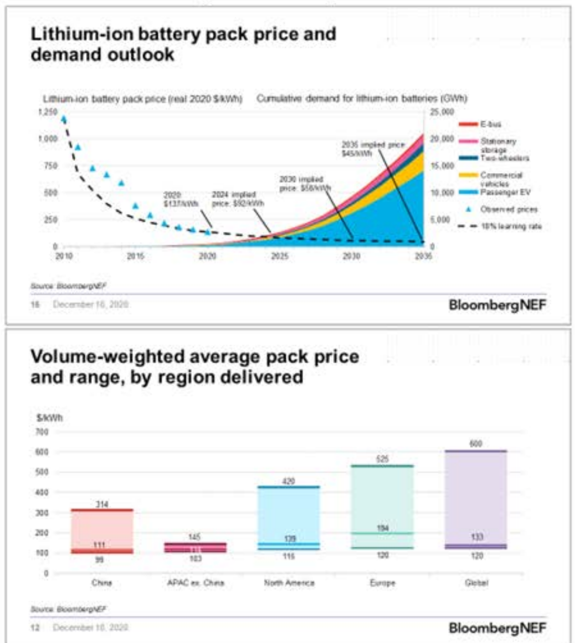
- Battery costs, risks and affordability.
- Hydrocarbons and petrochemicals, vital raw materials.
- Executive Order 14017.
- China's role.

Battery Costs, Risks and Affordability

The widespread view is, and has been, that BEVs make sense because battery costs have declined and will continue to do so. In the most assertive views, batteries for BEVs not only can reach the magical $100 per kilowatthour (KWh) "stretch" goal but could even come close to zero! That is the implicit conclusion from the top panel of Figure 4 below. Most automotive original equipment manufacturers (OEMs) and their vendors will say, at least privately, that such a vision is critical, vital, to making BEVs affordable. Anything less is usually considered a deal breaker. Batteries are one-third to one-half of the cost of a BEV, depending upon design and model and so not an inconsequential feature. A great deal more goes into making affordable cars, of course, than the collection of battery metals that are capturing high profile attention. Driving down battery costs has become the mantra for achieving sufficient headroom to accommodate costs of other inputs and all of those associated risks and uncertainties.

Many of these are inherent in the regional distribution of manufacturing platforms, associated supply chains and logistics, workforce capacity and labor costs and the assortment of contextual factors that are responsible for comparative advantages, or not, across nations and localities. The bottom panel of Figure 4 provide a quick snapshot of variations in battery cost, which can be extensive in both scope and in the "cone of uncertainty" around the full set of factors. The higher the cost of manufacturing locations, the greater the pressure to seek interventions, including through policy and/or regulatory actions. Would a better approach be to tear apart cost structures, assess competitiveness and build more resilient platforms? Time, attention and scarce resources devoted to overhauling and simplifying tax codes, addressing labor markets and productivity along with workforce education and training, reviewing laws and rules for IP, devising creative strategies for de-risking and funding research and development (R&D), implementing sensible market rules for energy and other goods and services – these and more would build for overall economic growth and performance.

Figure 4. Battery Costs



Sources: BNEF analysis accessed via license and used with permission.

Materials Intensity

No matter the analysis or source, BEVs, and all other alternative energy technology, is materials intense. Almost daily, new research and evidence attests to the materials demands of the technologies that we hope will carry us into a sustainable future. In the past week, insights from the IEA are added to the mix. As noted (Figure 5):

> *"According to the International Energy Agency's 2020 Global BEV Outlook, the material demand for batteries in BEVs sold in 2019 was estimated at about 19 kilotons for cobalt, 17 kt for lithium, 22 kt for manganese and 65 kt for nickel.*
>
> *Under a projected scenario that incorporates existing government policies — where demand for BEV batteries increases from 170 gigawatt-hours today to 1.5 terawatt-hours by 2030 — demand for cobalt would expand to about 180 kt per year in 2030, lithium to around 185 kt/year, manganese to 177 kt/year and Class I nickel to 925 kt/year.*

If projected demand is in line with the goals of the Paris climate agreement and includes a target where BEVs make up 30% of global sales, material demand would more than double."[2]

Figure 5. The EV Sustainability Conundrum

https://www.eenews.net/climatewire/stories/1063731395/print

In previous testimony[3], I focused on some of the mining minerals processing environment, social, governance (ESG) concerns and imperatives. The widespread view is that recycling can address much of the tension around battery raw materials. In our surveying thus far, recyclers face their own, not insignificant hurdles for locating, certifying, building logistics for and achieving financial success of the new capacity that so many envision. The chicken-egg dilemma surrounding volumes of feedstock for recovery are such that one OEM representative commented that manufacturing and recycling simply must become "symbiotic". A great worry is environmental regulations that affect businesses engaged with hazardous materials, impacting development of vital new processes and approaches before they can even be pilot tested or, much less, commercialized. Considerable R&D is underway on recycling – which is highly contingent on battery chemistries – along with thinking about how to best to build this essential function of materials and manufacturing supply chains. A distinct possibility, considering the very rapid escalation of electronic waste (e-waste)[4] is that **BEVs, batteries and other components of alternative energy schemes will add to waste volumes much more rapidly than we can build capacity for handling end of life.**

Commodity Markets and Prices

Many views are that increases in costs of materials can be accommodated in battery manufacturing and affordability. **Absolutely no research or outlooks accommodate the sheer extent of a worldwide policy push to vastly accelerate, in short time frames, BEVs, batteries,**

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[2] Excerpted from https://www.eenews.net/climatewire/2021/04/30/stories/1063731395 (accessed via subscription).

[3] See my testimony, https://energycommerce.house.gov/committee-activity/hearings/hearing-on-building-a-100-percent-clean-economy-opportunities-for-an-0.

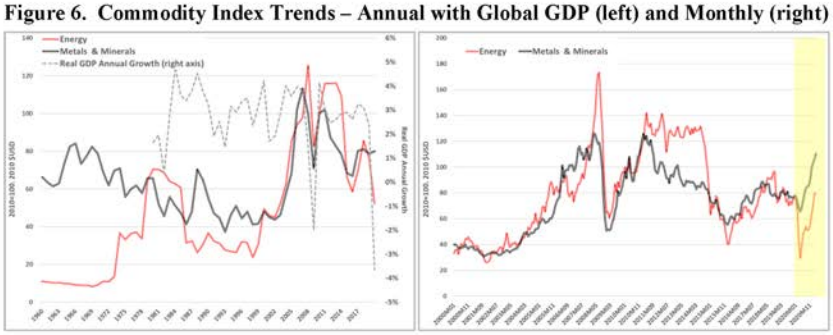
[4] See http://ewastemonitor.info/.

wind and solar, power grids and any number of other technologies and devices. While researchers and analysts typically construct scenarios that capture forward pathways that are not "business as usual", "BAU" is generally the underlying assumption for the extractives industry and processing businesses. To a large extent, this is because lack of data and, worse, lack of transparency around closely held, proprietary businesses and operations, including battery manufacturing. However, history has demonstrated that more often than not, these businesses and industries – a great number of which are controlled and/or owned by sovereign governments – are anything but BAU. **A "rush to materials" for alternative energy aspirations will threaten economic and national security, could trigger inflation or even hyperinflation, create new sources of geopolitical risks and uncertainties, undermine fragile states, lead to expansion of unsustainable industries and a host of other consequences.**

I raised all of these possibilities in previous testimony.[5] I pointed to the history of the battery minerals of interest as typical "cartel commodities", those which are often subject to attempts by producing governments to control exports, control ownership and/or exert changes to fiscal terms (taxes, royalties and other methods for capturing economic rents). Even where fiscal regimes should be reviewed and where producing governments have not had the best deals, righting the ship can destabilize mining properties and industries. Since my testimony in September 2020, countries from Indonesia to Zambia have taken or are contemplating taking actions that will have negative consequences for materials supplies. Even sophisticated countries like Chile are looking to extract more from their established mining industries to close pandemic economic gaps. Broad awareness of these threats does exist, but is largely confined to the extractives industry community. As well, change is slow. Programs that target ESG for sustainable mining and minerals processing have a very long way to go.

We already have evidence of price pressures on commodities that will affect the gamut of industrial and consumer products (Figure 6). Recent reporting notes the broad impact of latent demand on energy, minerals and agriculture, across the board, and also recognizes the impact of expectations regarding the "rush to materials" as governments promote alternative energy policies and strategies. **These expectations are now baked into every trading position as well as into nearly every minerals expansion or new venture. They are not, however, baked into forecasts of battery costs.**

Figure 6. Commodity Index Trends – Annual with Global GDP (left) and Monthly (right)



Source: Commodity price charts compiled by M. Michot Foss using IMF World Economic Outlook data for GDP and World Bank Pink Sheet for commodities.

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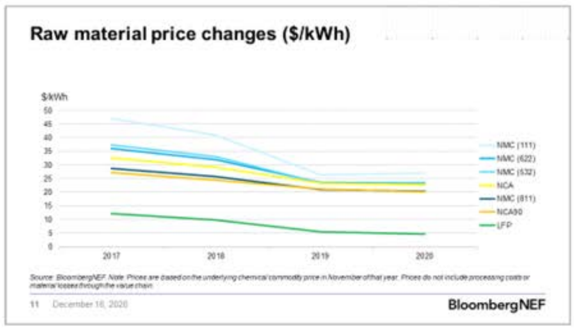
[5] See footnote 3.

When compared to a typical projection of battery materials cost patterns (Figure 7) the fragility of assertions and assumptions regarding future trajectories should come into full debate.

Figure 7. Historical Price Changes for Battery Raw Materials



BNEF analysis on raw materials price changes accessed via license and used with permission.

Electricity Prices

Another argument put forward to promote BEVs is "cheapness" of electric power for recharging. Below is typical treatment, profiling a widely quoted study.[6]

> *"As of 2020 in the United States, the total cost of ownership of electric cars is less than comparable ICE cars, due to the lower cost of fueling and maintenance, more than making up for the higher initial cost…. Several national and local governments have established BEV incentives to reduce the purchase price of electric cars and other plug-ins…. According to a study done in 2018, examining only fuel costs, the average fueling cost of an electric vehicle in the United States is $485 per year, as opposed to an ICE cars' $1,117 per year. Estimated gasoline costs varied from $993 in Alabama to $1,509 in Hawaii. Electric costs varied from $372 in Washington to $1,106 in Hawaii."*

Electricity prices are at least as unreliable as other commodities. Many government policies to support BEVs in other countries entail at least some measures to soften the cost of recharging. In countries where EVs of various types have grown fastest, administered electricity pricing is often in the mix. The latter bears numerous implications for investment in electric power systems.

For several years, a puzzle for U.S. electric power has been why residential costs have climbed persistently even while the key marginal fuel for power generation – natural gas – has been historically low (Figure 8). A number of analysts – including the U.S. Energy Information Administration (EIA) – have suggested that rising costs are linked to pursuit of wind and solar. Although these generation sources are pegged as inexpensive, pricing of dispatched electricity is an artifact of federal subsidy support. Production tax credits (PTCs) for wind make up the difference between low prices in the wholesale market and realized price project developers need for "bankability". Investment tax credits (ITCs) for solar help to buy down the cost of grid-based installations. These intermittent generation sources consume system services to integrate them with grids, enabling grids to function with reliability (hopefully).

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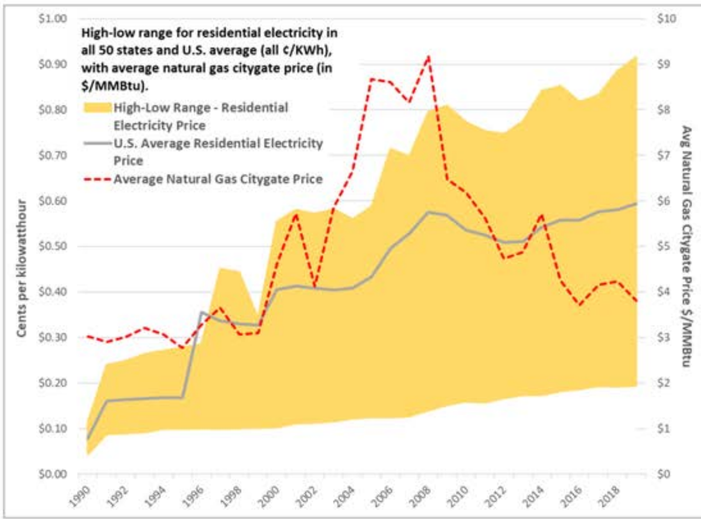
[6] See https://www.wikiwand.com/en/Electric_car#/Economics, https://www.energysage.com/electric-vehicles/advantages-of-evs/do-electric-cars-save-money/, or any number of links and sources.

Figure 8. U.S. Residential Electric Power Prices



Source: compiled by M. Michot Foss using U.S. Energy Information Administration data. High cost states are: RI, MA, CT, NY, NH, CA, ME, HI, NJ, MI, MD, DE, PA, (DC), IL.

Wind and solar resources are often thought of as "free" but, in fact, considerable expense is entailed in capturing and utilizing them. Beyond wind turbines and solar photovoltaics (PV) the cost of backup – usually natural gas generation – and/or alternative storage – usually grid-scale stationary batteries – are rarely, if ever, included in price quotes to customers. Yet all of these costs for system integration, backup, storage and so on are incurred and must be paid with allocation always, eventually to the customer. Residential customers in locations that are still operated by regulated utilities or where market restructuring has not been deep or where states/municipalities are promoting alternative energy are most likely to be affected. All customers, but residential users in particular, are subject to transfer of costs through their "wires" charges. Much of the thinking about BEV recharging incorporates assumptions of cost transfer to electric power customers in order to amortize the enormous costs of expanding capacity. "Free" BEV recharging is anything but. A distinct consumer issue is whether non-BEV owning or using customers will pay an oversize share of such endeavors.[7]

[7] Several sources and links for electric power research are in the appendix. Much of what I describe centers on the growing debate surrounding use of "levelized cost of electricity" (LCOE) as an appropriate measure. For previous related work under my direction, see https://www.beg.utexas.edu/files/cee/legacy/2016/CEE_Snapshot-Retail_Electricity_Price_Mar16.pdf, https://www.beg.utexas.edu/files/cee/legacy/2017/CEE_Research_Note-What_Future_for_Electricity_Markets-Mar17.pdf, https://www.beg.utexas.edu/files/energyecon/CEE_Research_Note_Competitiveness_Generation_Apr18.pdf and https://store.beg.utexas.edu/special-books/3777-us0007-net-social-cost-of-electricity.html.

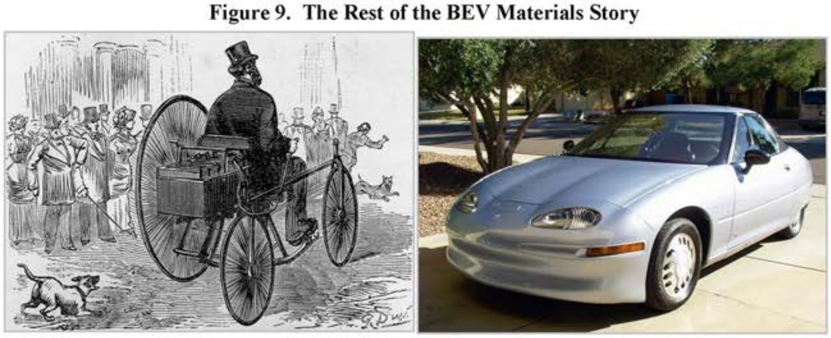
Cost of Hydrocarbons for Plastics (and Fuels)

A sidebar to our February deep freeze in Texas has been disruption to petrochemicals output and broad impacts on plastics supply chains.[8] The soaring cost of petrochemicals is a good analogy for what could happen to the other, larger portion of BEV materials requirements. **Any, all policy actions and mandates against oil and gas production and processing will be felt not only in cost of fuels – the intended effect – but also in the cost of critical materials – a widely unintended and never considered effect.**

Hydrocarbons and Petrochemicals

It is doubtful that a modern BEV customer would ever be content to motor around on an implement that was simply a collection of metals. (The same holds true for cyclists and their gear.) The rest of the story (Figure 9) is that modern vehicles have long owed a good portion of their substantial improvement in performance and fuel economy to "light weighting" as auto makers substituted plastics for heavier metal components. Expectations are that BEVs and other transportation technologies of the future will hinge on continued ability to incorporate light weight, durable, strong, safe composites throughout vehicle designs. This means that policy and decision makers simply must attend to hydrocarbons supplies and hydrocarbons based materials for the foreseeable future, perhaps forever.

Figure 9. The Rest of the BEV Materials Story



Left: Gustave Trouvé's personal electric vehicle (1881), world's first full-scale electric car to be publicly presented. Right: The General Motors BEV1, one of the cars introduced due to a California Air Resources Board (CARB) mandate, had a range of 260 km (160 miles) with NiMH batteries in 1999. https://www.wikiwand.com/en/Electric_car

IEA estimates that petrochemicals account for about 14% of global oil demand and 8% of global natural gas consumption.[9] This means that the enormous cost for drilling, producing and shipping feedstock is born largely by the revenues derived from sales of refined petroleum and natural gas fuels. ***In other words, the vast global uses and benefits of petroleum and natural gas for energy leverages the cost and affordability of materials derived from petrochemicals.*** This reality is largely, if not totally, ignored in the race to electrify transport. Automakers and customers will benefit most from less expensive oil and gas for materials. ***But the lower cost of petroleum and natural gas fuels competes head on with desires to shift away from these vital***

[8] See https://www.wsj.com/articles/one-week-texas-freeze-seen-triggering-monthslong-plastics-shortage-11615973401 (subscription required).

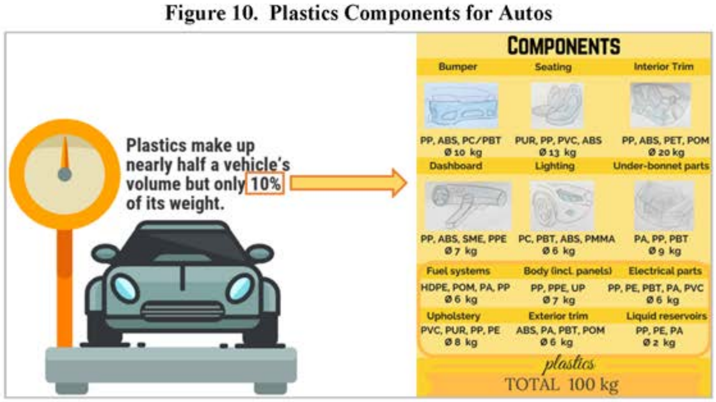
[9] See https://www.iea.org/reports/the-future-of-petrochemicals.

resources. Likewise, the many solutions proposed that target fossil fuel consumption will only serve to increase the cost of materials that are essential for substitutes, be they wind turbine blades or BEVs. Bans and moratoria on drilling, carbon taxes, opposition to oil and gas infrastructure and other options have the ultimate aim of making hydrocarbons scarce and expensive (note that "expensive" translates to "higher price" which has the contrary effect of luring investors). All of these considerations makes a "materials first" approach to policy making more than sensible.

When it comes to the specifics of plastics for autos, one analysts notes that:

> *"The overall plastic weight per car will not change significantly with BEV's. However, there will be a slight increase in weight in total. There are currently 10 000 parts made out of plastic in an average car and these use ca. 39 different polymers. Out of the 39, 6 are used the most, i.e. polypropylene, polyurethane, polyamides, polyethylenes, acryle-butadien-sytrenes, and polyvinylchloride."*[10]

Figure 10. Plastics Components for Autos



Source: *https://www.innovativeautomation.com/the-history-importance-and-use-of-plastics-in-automobiles/* *and* *https://www.findoutaboutplastics.com/2019/04/high-performance-polymers-in.html*

Moreover:

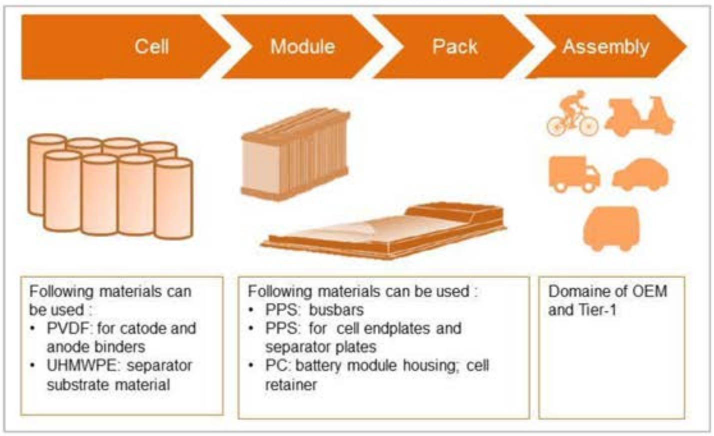
> *Also in electrification, light weighting together with fuel economy will continue to be a megatrend. The rule of thumb says that for every 10% of weight reduction, fuel economy improves by ca. 6-8%. This additionally drives the consumption of plastics in automotive.*
>
> *Today, in hybrid and full BEV's, material selection tends to be much more differentiated, since applications need to fulfill specific requirements. The one-fits-all approach is no longer working in a similar sense. Standards from other industries such as electronics influence now material selection in automotive. As a result, a "wedding" between e.g. consumer electronics and automotive standards may take place.*

High performance materials, akin to and, in fact, drawn from state of the art polymers for electronics will be integrated for controls, thermal management, safety, dielectric properties and

[10] See https://www.innovativeautomation.com/the-history-importance-and-use-of-plastics-in-automobiles/.

myriad other applications. Battery cells and packs incorporate and will incorporate polymers, adhesives, coating and more. Vehicles of the future will reflect the focus on materials and advances in materials – there is no choice. Figure 11 summarizes the potential plastic materials for cells, module, and pack.

Figure 11. Battery Plastics



Source: *https://www.findoutaboutplastics.com/2019/04/high-performance-polymers-in.html.*

"Plastics" invokes any number of images, mental or otherwise, regarding waste. The chemicals industry is pursuing a number of options for waste reduction, substitutes and other solutions. Recycling is advancing rapidly but, as with battery recycling, nascent technologies and processes need to be cultivated.[11] Can some auto plastics components be derived from bio sources? Plenty of thinking and research are underway regarding development of bioplastics for automotive uses. Bioplastics are estimated to account for about 1% of total global plastics production (roughly 368 million tonnes).[12] While much of that output is targeted for consumer goods and packaging of all sorts, autos are increasingly a target for application. **Until that nut is cracked, availability and affordability of BEVs – any vehicle type for that matter – will continue to hinge on hydrocarbons-based materials sourced from U.S. and global oil and gas operations.**

EO 14017 – America's Supply Chains

The executive order on supply chains has the side benefit of educating many on the challenges ahead, especially when it comes to how best to source materials at home. A number of issues exist, relative to points in my testimony.

- EO 14017 focuses on minerals, with emphasis on those deemed "critical". The vital, ongoing operations of the domestic oil and gas industry are ignored. Indeed, other executive orders

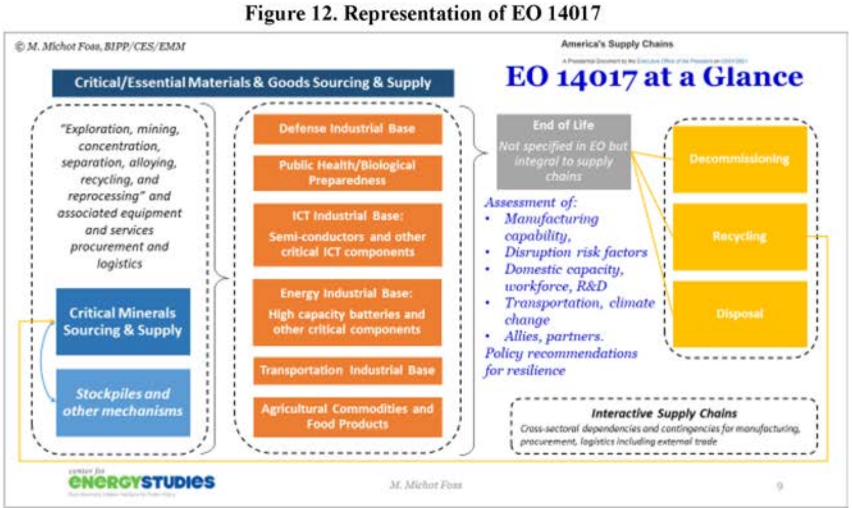
[11] My colleague Dr. Rachel Meidl points out that much of the issue on plastics waste is poor conceptualization of the need, https://blog.bakerinstitute.org/2021/04/19/smart-policy-and-innovative-technologies-like-advanced-recycling-will-deliver-on-climate-and-sustainability-goals/.

[12] See https://docs.european-bioplastics.org/conference/Report_Bioplastics_Market_Data_2020_short_version.pdf.

serve to threaten oil and gas resource development and supply, thus my view that **hydrocarbons should be designated as critical minerals**.

- **End of life** and the complicated supply chains associated with decommissioning, recycling and disposal are excluded.
- When it comes to interactions, we are exploring semiconductor industry priorities. Industry participants **share concerns about raw materials supplies that extend beyond their own needs** because of how these impact their key customer groups – such as auto manufacturers.
- Overall, **supply chain preparedness and resilience**, including both defense and non-defense needs, would benefit from the building block approach of materials first, systems and data.

Figure 12. Representation of EO 14017



Source: compiled by M. Michot Foss based on EO 14017.

All China All the Time

Since my previous testimony[13], a number of organizations and resources have emerged with a focus on China's role. Our own research demonstrates the following.

- Lithium ion battery (LIB) minerals are, for now, a relatively small part of the global nonfuel minerals pie. Figure 13 illustrates state of knowledge on minerals output using the main lithium nickel, manganese, cobalt chemistry (NMC).
- An image of our world map of minerals production is captured in Figure 14. I add phosphates for the lithium iron phosphate, LFP battery that is in use by, and promoted by, BYD, a prominent Chinese producer. LFP offers safety advantages over other LIB designs and longer life cycle. Drawbacks are low energy density and conductivity. Some makers add carbon for improvements. Given the influence of Chinese capacity and progress around the LFP chemistry, it bears watching, as do other advanced battery designs such as solid state.
- Our data and mapping continue to reinforce China's impressive build out of energy infrastructure but also that battery making is only as "clean" as supporting power systems.

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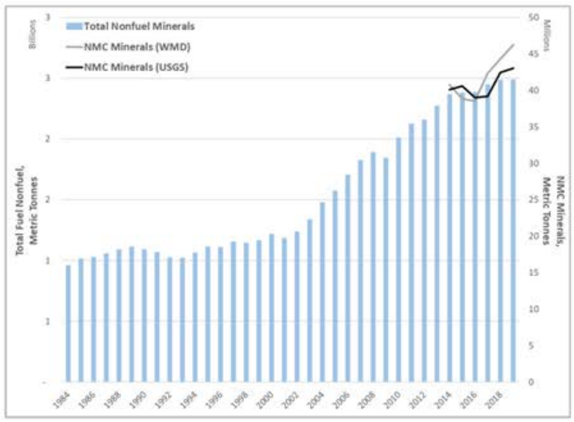
[13] See previous footnote 2.

To our thinking, **China's EVB capacity is highly advantaged by the enormous installed base of coal-fired electric power generation** (EVB sites are proximal to these facilities).

Figure 13. Worldwide Production of Nonfuel and NMC Minerals



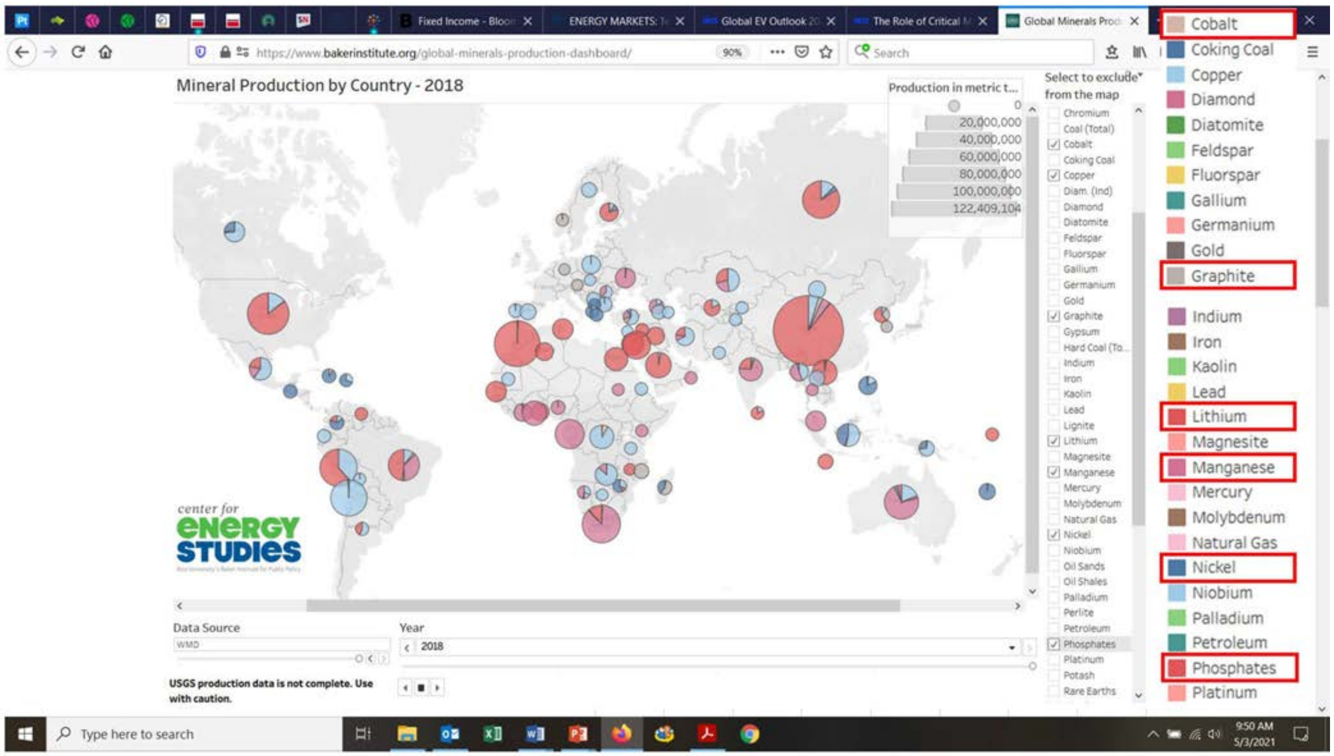
Source: CES dataset based on U.S. Geological Survey (USGS) and World Mining Data (World Mining Congress), https://www.world-mining-data.info/?World_Mining_Data.

Table 1. China's Energy System

		BEV Battery Factories	Nuclear Power Plants	Coal Power Plants
Units by Status	**Total**	**248**	**175**	**3,096**
	Operating	217	49	2,753
	Under construction	22	17	180
	Permitted			85
	Announced	9	58	78
Capacity	2020 Installed Capacity (GW)		51	1,080
Capacity by Status	**Total (GWh/GW)**	**1,083 GWh**	**106 GW**	**1,215 GW**
	Operating	559	48	1,033
	Under construction	325	16	92
	Permitted			43
	Announced	89	43	47
By Age	Average age for operating units (yrs)	9	9	14
	Map captured (*CEC, 2020)		93%	96%

Source: https://www.bakerinstitute.org/chinas-energy-infrastructure/ for map, methodology, sources and updates.
**Note – CEC is China Electric Council.*

Figure 14. Worldwide Production of NMC Battery Minerals, Copper and Phosphates



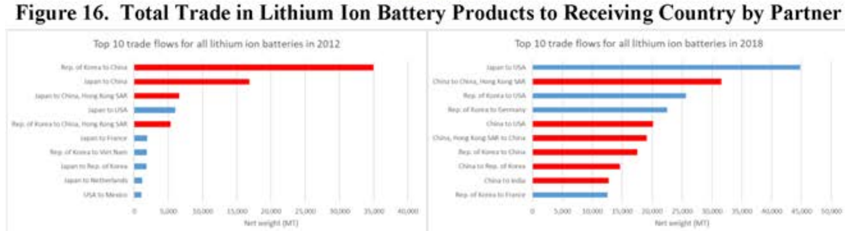
From: CES Energy, Minerals & Materials program, https://www.bakerinstitute.org/global-minerals-production-dashboard/.

- China's command of LIB and BEV raw materials supply chains is the bottom line. China's outbound investment has enlarged global supply, a good outcome in general. **Chinese participation abroad as well as escalation of domestic production are the main factors prodding rapid growth in nonfuel minerals supply since 2000** (previous Figure 13). China's investment style and associated implications bear more detailed analysis, which we and others are undertaking.
- The rapid evolution of minerals trade routes to China is astounding, by any measure. Figure 15 shows, in three panels, the first prominent flow, Australia to China (mainly copper, manganese and lithium). **By 2019, China dominates all minerals trade flows. In addition, even more notable and astounding, is that trade volumes for these minerals ballooned up to ten times between 2001 and 2019.**
- A similar story holds for trade in LIBs (Figure 16). Volumes include all LIB products, for consumer goods as well as EVBs. **Even where other countries manufacture components, trade flows revert back to China for finishing and shipment to importing markets.**

Figure 15. Total Minerals Trade to Receiving Country by Partner (metric tonnes)

Source: extracted from background data for CES visualizations, https://www.bakerinstitute.org/global-minerals-trade-dashboard/.

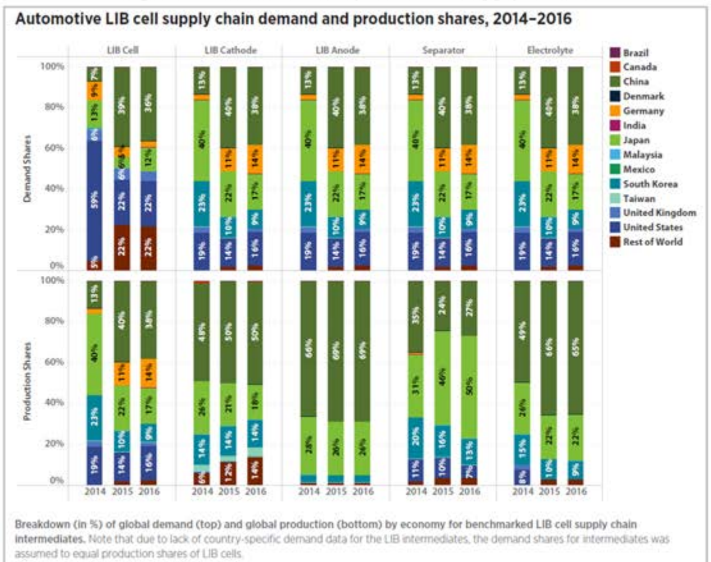
Figure 16. Total Trade in Lithium Ion Battery Products to Receiving Country by Partner



Sources: UN COMTRADE data as compiled by E. Hung, depicted by M. Michot Foss, CES (forthcoming).

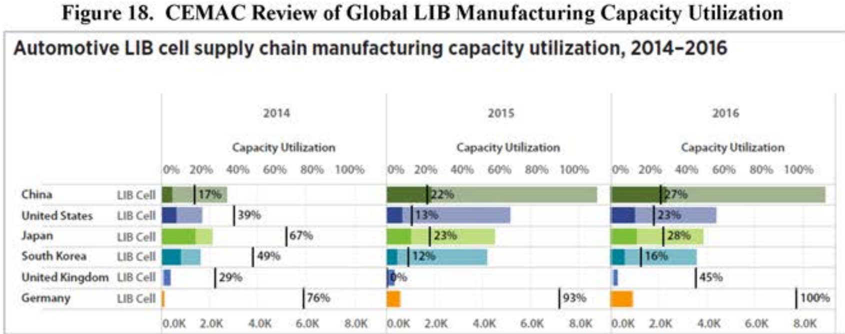
Beyond our own work and documentation, good signals on China's position come from the periodic benchmarking of components such as wind, solar and batteries undertaken by DOE's CEMAC (Clean Energy Manufacturing Analysis Center). Figure 17and Figure 18 vividly illustrate the strengthening of Chinese competence and influence on LIB supply chains and manufacturing. The effect of large slugs of Chinese capacity have negatively affected other plants and countries. Slack capacity in various locations might help with production output if supply chains can be secured. A more pronounced impact is the flurry of announcements for new plants outside of China as competitors seek to balance the playing field. The test for new facilities will be supply chain sourcing, including domestic content where that is an imperative. Although not popular in today's energy narrative, new facilities in countries like Germany and France will benefit from zero emissions nuclear power.

Figure 17. CEMAC Analysis of LIB Supply Chains



Source: https://www.nrel.gov/docs/fy21osti/78037.pdf.

Figure 18. CEMAC Review of Global LIB Manufacturing Capacity Utilization



Source: https://www.nrel.gov/docs/fy21osti/78037.pdf.

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Appendix

Supporting research and publications of interest from the Baker Institute's Center for Energy Studies

Michelle Michot Foss, Ph.D., Fellow in Energy, Minerals & Materials

- Testimony before the U.S. House Energy & Commerce Committee-Subcomitte on Environment & Climate Change, "Building a 100% Clean Economy
- Upcoming Testimony before the U.S. House Energy & Commerce Committee-Subcomitte on Energy, "The CLEAN Future Act: Driving Decarbonization of the Transportation Sector" (May 5)
- Minerals and Materials for Energy: We Need to Change Thinking – Recommendations for the New Administration
- Chinese Firms Position for an Energy Transition Copper Supercycle
- The "criticality" of minerals for energy transitions. Hydrocarbons? Yes, hydrocarbons.
- Framing Energy & Minerals for Future Pathways, with Michael S. Moats and Kwame Awuah-Offei, Missouri S&T – G20 Policy Brief
- Energy in Transition – Presentation to World Federation of Science-Erice 2019
- Battery Materials Value Chains – Verma, et.al., BEG/CEE The University of Texas at Austin

Rachel A. Meidl, Lp.D., CHMM, Fellow in Energy & Environment

- Waste Management and the Energy Transition –Recommendations for the New Administration
- Measuring the True Cost of Sustainability: A Case Study in a Green Energy Approach
- Recommendations for Realizing the Full Potential of Nanotechnology as the Energy Sector Transitions - Recommendations for the New Administration and Full Report
- Smart policy and innovative technologies, like advanced recycling, will deliver on climate and sustainability goals
- Banning Carbon Nanotubes Would Be Scientifically Unjustified and Damaging to Innovation
- Policy Considerations for Energy Infrastructure Resilience
- Hurricane Risk Assessment of Petroleum Infrastructure
- The Future of Plastics Sustainability: Advanced Recycling – Recommendations for the New Administration
- A G20 Circular Carbon Economy: Policies and Practices to Foster Circularity in Plastics – G20 Policy Brief

Gabriel Collins, JD

- Dua, et.al., "A Cost-Effective Pathway to a Low-Emissions Transportation Future," Policy Brief 2, September 2020, G20 Policy Brief
- "Ford vs. Tesla: What Does a Transformational Automobile Scale-up Look Like?," Issue Brief no. 02.14.20
- "Want an Electric Pickup to Tow Like a Ford F-250? You'll Need a Battery That Weighs As Much As An F-150 Raptor" – Presentation

- "The BEV Conundrum: High Power Density and Low Energy Density" - Presentation
- "Low-Speed Electric Vehicles: An Underappreciated Threat to Gasoline Demand in China and Global Oil Prices?," Issue brief no. 05.15.19
- Hold the Line Through 2035: A Strategy to Offset China's Revisionist Actions and Sustain a Rules-based Order in the Asia-Pacific – with Andrew S. Erikson

Specific Contributions on Electric Power

- Michelle Michot Foss CEE/BEG legacy, The University of Texas at Austin – papers, presentations on electric power, 2005-2018 including the guides to electric power in Texas and Mexico, competitiveness of renewables
- Julie A. Cohn, Ph.D., Nonresident Scholar, Center for Energy Studies, Olivera Jankovska, M.Sc., Nonresident Fellow, Center for Energy Studies and Kenneth B. Medlock III, Ph.D., James A. Baker, III, and Susan G. Baker Fellow in Energy and Resource Economics, and Senior Director, Center for Energy Studies https://www.bakerinstitute.org/research/grids-renewables/ recommendations for the new Administration
- Peter Hartley, Ph.D., George A. Peterkin Professor of Economics, Rice University; Baker Institute Rice Faculty Scholar, Center for Energy Studies, Jim Krane, Ph.D., Wallace S. Wilson Fellow for Energy Studies, Center for Energy Studies, Michael Maher, Ph.D., Senior Program Advisor, Center for Energy Studies and Kenneth B. Medlock III, Ph.D., https://blog.bakerinstitute.org/2021/04/09/lets-mess-with-texas-power-market-and-make-it-stronger/
- Mark Finley, Fellow in Energy and Global Oil, http://blog.bakerinstitute.org/2021/02/25/for-energy-security-power-is-the-new-oil/
- Olivera Jankovska and Julie Cohn, https://www.bakerinstitute.org/research/texas-crez-lines-how-stakeholders-shape-major-energy-infrastructure-projects/
- Peter Hartley, Kenneth B. Medlock III and Olivera Jankovska, https://www.bakerinstitute.org/research/electricity-reform-and-retail-pricing-texas/
- Ted Temzelides, Baker Institute Rice Faculty Scholar, George and Cynthia Mitchell Professor in Sustainable Development and Lee E. Ohanian, Does Subsidizing Renewables Work? https://www.bakerinstitute.org/research/my-kingdom-renewable-energy-source/.
- Forthcoming research by Robert Idel, Levelized Full System Costs of Electricity, The Energy Journal.

Mr. RUSH. I want to thank Ms. Foss for your testimony.

The Chair now recognizes Mr. Siccardi for 5 minutes for the purpose of an opening statement.

STATEMENT OF AJ SICCARDI

Mr. SICCARDI. Chairman Rush, Ranking Member Upton, and members of the subcommittee, thank you for the opportunity to testify today. My name is AJ Siccardi, and I am the president of Metroplex Energy, based in Atlanta, Georgia.

Metroplex is a subsidiary of RaceTrac, one of the largest independent convenience chains in the United States. I am testifying today on behalf of NACS, NATSO, and SIGMA, which represent more than 90 percent of retail motor fuels in the U.S.

The retail liquid fuels industry is indispensable to decarbonizing the transportation sector, both through the sale of cleaner liquid fuels as well as through EV chargers. We want to partner with Congress to help achieve environmental goals in a market-oriented and affordable manner.

Fuel retailers represent the consumer. We don't care what types of fuel our customers choose to buy from us. We simply identify the most reliable, lowest-cost fuels that people want to buy, and deliver those fuels throughout the country. We compete with one another on price, speed, quality of our facilities, and service. This is a good dynamic for consumers. If you want there to be more publicly available charging stations, you should make investing in charging stations more attractive for private companies.

Today it is not an attractive option. There is range anxiety because existing charging infrastructure is not convenient to consumers. More EV charging stations at existing retail fuel locations is the most effective way to eliminate range anxiety.

Our stores are already convenient locations. We offer the services and amenities that drivers want, such as food, beverages, restroom, and security. There is no range anxiety for liquid fuels today. That is not because of government incentives. It is because businesses like mine had a clear, unambiguous profit incentive to sell fuel to consumers.

The profit incentive does not exist today with regard to EV chargers. There are several impediments standing in the way. Most of these impediments involve an electricity market that was not designed for and is not compatible with the retail fuel market. For example, some States prohibit fuel retailers from selling electricity to EV users. We appreciate the legislation seeks to address this. A lot more must be done.

It remains a threat that regulated utilities will use their status as monopolies to gain a competitive edge over private, unregulated businesses.

Additionally, many States allow utilities to charge all of their customers higher electric bills to underwrite the utilities' investments in charging stations. Private companies like RaceTrac cannot access a pool of risk-free capital. Allowing utilities to do so only makes sense if the money will go towards enhancing regeneration and capacity. Our concern only arises when utilities are also able to use ratepayer funds to own and operate the charging stations themselves.

It is unnecessarily regressive to force the lowest-income Americans to pay higher electricity bills to subsidize EV driving fuel and costs. It is also counterproductive because it will take away fuel retailers' desire to invest, because we can't compete with businesses that are guaranteed a return. This will result in fewer public charging stations available for consumers.

On top of all this, regulated utilities under current rules can force EV charging station owners to pay for electricity more than it costs the utility to power their own chargers. The large demand charges authorized under outdated regulations make it impossible for private fuel retailers to compete on price.

When our competition at retail is the same company that sells us power, that is not an attractive investment opportunity. In fact, no successful business buys goods and service at retail prices and sells at retail prices. Successful business models provide a spread between wholesale and retail. Otherwise, consumer prices will have to rise to create a margin for retail. Or retailers simply won't enter the market, because there is no viable business model. No amount of grant money or tax incentives will change that fundamental economic reality.

To be clear, that is why there is range anxiety today. The EV charging proposals the committee is considering, unfortunately, would not fix these problems. This makes rebate opportunities unattractive for private companies. It would be far more attractive if the legislation stipulated that businesses putting capital at risk to own and operate EV charging stations are prioritized over applicants seeking to double dip. By "double dip" I mean access both Federal rebates and funds to own and operate EV charging stations.

Fuel retailers are the representative for the consumer. When you make the EV charging investment more attractive for us, you will make the transition more comfortable and attractive to the public.

Thank you for the opportunity to testify today. I am happy to answer any questions you might have.

[The prepared statement of Mr. Siccardi follows:]

TESTIMONY OF AJ SICCARDI
PRESIDENT, METROPLEX ENERGY, INC.

ON BEHALF THE NATIONAL ASSOCIATION OF CONVENIENCE STORES, THE NATIONAL ASSOCIATION OF TRUCKSTOP OPERATORS, AND THE SOCIETY OF INDEPENDENT GASOLINE MARKETERS OF AMERICA

BEFORE THE

HOUSE COMMITTEE ON ENERGY AND COMMERCE
SUBCCOMMITEE ON ENERGY

MAY 5, 2021

HEARING ON “THE CLEAN FUTURE ACT: DRIVING DECARBONIZATION OF THE TRANSPORTATION SECTOR”

I. Summary of Testimony

The retail fuel industry is an indispensable asset to lowering the carbon footprint of transportation fuel in the United States. Fuel retailers should be viewed as surrogates for the consumer in that we identify the most reliable, lowest cost transportation energy available, and deliver that energy to every community in the country. In so doing, we compete with one another on price, speed, and quality of facilities and service.

To be effective, policies designed to encourage private sector investment in alternative fuel infrastructure, including but not limited to electric vehicle ("EV") charging stations, must be predicated upon unambiguous policy signals that such alternatives create attractive economic propositions for our industry and for our customers.

This can be done. Not even two decades ago Congress passed the Renewable Fuel Standard ("RFS"). Although the RFS is far from perfect, it created market incentives for fuel retailers to invest in new fuel dispensers and storage infrastructure to accommodate higher amounts of biofuel. Many fuel marketing companies, including RaceTrac Petroleum, Inc. ("RaceTrac"), have invested in the physical and intellectual capital necessary to participate in agriculture and commodities markets. Fuel retailers did this in order to efficiently incorporate those products into our fuel supply in a manner that improved fuels' greenhouse gas ("GHG") footprint while also enabling us to sell the alternative fuel to customers for less money at retail than purely petroleum-based fuels. This has caused more customers to gravitate toward those cleaner burning fuels.

Our industry is eager to work with you to find market-driven ways to address concerns about carbon. To do that, federal policy should incentivize and leverage private investment in bringing to market other alternatives. Equally importantly, federal policies should not undercut the incentives for retailers to invest in alternatives such as EV charging. There has to be a viable pathway to profitability for any alternative to gain any meaningful market share.

For any solution to work, it must promote competitive market dynamics and work with consumers' existing behavior and the business infrastructure we have. If policy does that and ensures a functioning private market – then private dollars will make sure infrastructure is there to meet consumers' needs. If that is not done, it is likely that any public dollars spent will be stranded and wasted in ways that do not serve an appreciable number of consumers and cost far more than any benefit they produce.

At the moment, there are several impediments that make it challenging for fuel retailers to locate a pathway to profitability with respect to EV charging. Most of these impediments involve an electricity market structure that was not designed for – and is not surprisingly incompatible with – the retail fuel market.

Foremost among these headwinds is the threat of regulated utilities making use of their status as monopolies to gain a competitive edge over private businesses. Throughout the country today, for example, regulated utilities are seeking to convince public utility commissions that they should be able to charge all of their ratepayers – regardless of income – a higher dollar figure on their monthly electric bill in order to underwrite the utilities' investment in EV charging stations. Private companies like RaceTrac do not have access to such a pool of risk-free capital. What's more, many regulated utilities want to bill EV charging station owners more money for electricity than their own cost to power their utility-owned chargers. If these efforts persist, fuel retailers will not consider EV charging stations to be an attractive investment. No amount of grant money or tax incentives will change that fundamental reality.

The flip side of this is that if policymakers signal that there must be a productive partnership between utilities and fuel retailers, with each sector incentivized to concentrate on its core competencies, progress can be made faster and at a lower cost. For utilities, the focus should be on modernizing the power grid to provide reliable, clean power and meet dramatic increases in demand that will come with enhanced EV penetration. At the same time, the market dynamics that govern the retail fuel industry today should be replicated to accommodate EVs. This will ensure that customers have multiple fueling options that are competing for their business.

Legislation before the Committee includes grant and rebate programs for the installation of EV chargers. As currently constructed, however, these legislative proposals risk encouraging utilities to “double dip” by accessing ratepayer funds to own and operate EV charging stations and also receive a rebate for such installation. This possibility would waste federal funds and block private sector investments from companies such as RaceTrac. It sends the wrong policy signal to the market.

Simple, modest guardrails around how any money should be spent would make these policies far more effective and would leverage rather than waste federal dollars. The legislation should stipulate that businesses that are putting capital at risk in order to own and operate EV charging stations are prioritized over other applicants. This, in conjunction with other tax credits and incentives, can move us toward a viable business model, rather than exacerbating the various challenges that already exist.

Meaningful guardrails can be crafted in a way that would impose no limitations on utilities’ ability to use ratepayer funds and access federal funds for any infrastructure development up to and until the point of owning and operating the chargers. They would also allow utilities to compete with the private sector with no disadvantage if they are putting their own capital at risk and not increasing all of their customers’ electricity bills to pay for EV chargers.

We simply believe the policy should prioritize recipients that are putting capital at risk. If there is no competing rebate application where private capital is being placed at risk, utilities could then access federal funding (even if they are already using ratepayer funds). But, replacing the highly familiar, price competitive fuel market in place today with the opaque pricing of electricity will reduce efficiency, raise costs, and impose large regressive costs on lower income Americans. That is not an attractive solution.

Changes must also be made to electricity pricing. Retailers with EV chargers today are forced to pay retail prices for electricity with very high demand charges. There is no business case for buying at retail prices and selling at retail prices. Regulated utilities that own and operate their own charging stations, on the other hand, are not subject to demand charges and thus have an insurmountable competitive advantage over anyone else in that market.

For the private market to work, there must be a pathway to retailers buying electricity at wholesale prices (like the internal transfer cost that utilities have to deliver electricity) without punitive demand charges. That would make the economics work not only for retailers but, more importantly, for consumers.

The bottom line is that any changes to the transportation energy mix must make it work for American consumers – which means those changes must work for our industry. Fuel retailers already have the real estate that customers visit when they refuel. We offer the services and amenities that consumers have come to expect alongside the refueling network (such as foodservice facilities, restrooms, security, and the like). Until consumers see alternatives like electricity at the outlets where they currently refuel, they will not adopt those alternatives in large numbers.

Fuel retailers are surrogates for the consumer. If you ensure there are competitive market dynamics governing refueling – including alternatives like electricity – you will make the transition more affordable and attractive for the public. We are eager to work with you to ensure policy accounts for that reality.

II. Introduction

Chairman Rush, Ranking Member Upton, and members of the Subcommittee, thank you for the opportunity to testify today. My name is AJ Siccardi and I am the President of Metroplex Energy, Inc. ("Metroplex"). Metroplex is an Atlanta-based wholesale fuel company that secures bulk fuel to supply rack sales and delivery of gasoline, diesel, and biofuel products by pipeline, rail, truck, barge, and vessel and is a wholly-owned subsidiary of RaceTrac.

The marketing and retail companies that currently provide transportation energy across the United States, including RaceTrac, are well positioned to play an important role in the development of infrastructure to offer American motorists not only traditional liquid motor fuels but also a range of alternatives, including electricity to power their vehicles, so long as the policy framework and incentive regime established facilitates a competitive and level playing field. In fact, it is nearly impossible to effectively decarbonize the transportation sector without working with our industry to offer a range of alternatives to our nation's drivers.

III. Background

A. About RaceTrac

As I mentioned, Metroplex is a wholly owned subsidiary of RaceTrac, which purchases bulk and rack fuel to supply its two operating divisions: RaceTrac and RaceWay stores.[1] Metroplex transports all of its fuel products by rail, pipeline, truck and barge across 13 states.[2]

Almost all RaceTrac stores and 111 RaceWay stores are open 24 hours per day, 7 days a week; and 93 RaceWay stores are typically open from 5am to 11pm. Our continuous and extended hours ensure that consumers are always able to access our stores to refuel when they need.

Every day, RaceTrac operates under its mission to "make people's lives simpler and more enjoyable"—and for that reason, the company has been named a top workplace across many of the states in which it operates, and has been recognized on the Forbes list of largest private companies every year since 1998.

Since 2015, RaceTrac has built an average of 40 new stores annually, investing about $225 million each year across our footprint. We plan to invest another $300 million to build 31 new stores in 2021, which will lead to expanded employment opportunities as each of our stores employs approximately 20-22 people. The company has also invested over $33 million in alternative fuels infrastructure. Because of those investments, we are able to sell alternative fuels, including E15, E85, and B20 biodiesel to customers that want to buy those products and are a market leader in our sales of higher biofuel blends.

B. About the Associations

I am testifying today on behalf the National Association of Convenience Stores ("NACS"), the National Association of Truck Stop Operators ("NATSO") and the Society of Independent Gasoline Marketers of America ("SIGMA")(collectively, "the Associations").[3] Together, the Associations represent approximately 90 percent of retail sales of motor fuel in the United States. The fuel wholesaling, fuel retailing and convenience industry employed about 2.34 million workers and generated more than $548.2 billion in total sales in 2020, representing more than 3 percent of U.S. gross domestic product. Of those sales, approximately $292.6 billion came from fuel sales alone.

The Associations' members process more than 160 million transactions every single day. That means about half of the U.S. population visits one of our stores on a daily basis. In fact,

[1] RaceTrac operates 549 RaceTrac-branded retail fuel and convenience stores across seven southern states: Alabama, Florida, Georgia, Louisiana, Mississippi, Tennessee, and Texas; and owns more than 200 franchise-operated RaceWay-branded stores across 11 states: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia. RaceTrac employs nearly 10,000 individuals across its divisions and subsidiaries.

[2] Alabama, Arkansas, Florida, Georgia, Louisiana, Maryland, Mississippi, North Carolina, Pennsylvania, South Carolina, Tennessee, Texas, and Virginia.

[3] NACS is an international trade association representing the convenience store industry with more than 2,200 retail and 1,600 supplier companies as members, the majority of whom are based in the United States. NATSO currently represents more than 4,000 travel plazas and truck stops nationwide, comprised of both national chains and small, independent locations. SIGMA represents a diverse membership of approximately 260 independent chain retailers and marketers of motor fuel.

ninety-three percent of Americans live within 10 minutes of one of our locations. The average time a customer spends in one of our stores is about three and one-half minutes and the Associations' members compete to ensure the customer's needs are met as efficiently as possible – saving them time and money.

The Associations' members' sole objective is to sell legal products, in a lawful way, to customers who want to buy them. While agnostic as to what types of fuel they sell to satisfy consumer demand, the Associations' members do have a bias: they believe it is best for the American consumer and America's industrial position in the world marketplace to have reasonably low and stable energy prices.

C. The Associations' Environmental Transportation Policy Principles

The Associations believe the most expeditious and economical way to achieve environmental advancements in transportation energy technology is through market-oriented, consumer-focused policies that encourage our industry to offer more alternatives. With the right alignment of policy incentives, the private sector is best equipped to facilitate a faster, more widespread, and cost-effective transition to alternatives – including electricity – in the coming years.

Policies attempting to improve the environmental characteristics of transportation energy in the United States should adhere to the following principles:

(1) Science should be the foundation for transportation climate policies – Any effort to improve transportation energy's emissions characteristics requires an accurate accounting of the lifecycle carbon intensity associated with particular fuels and technologies. This analysis should include everything from acquisition of natural resources, engine and battery manufacturing, tailpipe emissions, and vehicle end-of-life consequences. It should also be regularly updated so that policy is nimble enough to adjust to efforts to innovate and improve the environmental characteristics of different alternatives. Additionally, every sector of the economy should assume a burden of reducing carbon emissions.

(2) Establish performance goals without mandating specific technologies to allow for the benefits of innovation and technology development – Sound policy must recognize that the state of technology can change rapidly, and tie incentives to technologies' lifecycle environmental attributes rather than the underlying technology itself. No one solution will decarbonize transportation energy and policies should incentivize multiple technologies. What policymakers think is the best solution today may be surpassed by subsequent ingenuity and innovation. Sound policy should not stifle innovation by mandating specific fuel solutions. Instead, policy should set performance goals and let the market – guided by consumers – innovate to find the best way to meet those goals.

(3) Develop competitive market incentives to ensure a level playing field and provide long-term consumer benefits – As described in more detail below, fuel retailers today are best positioned to provide alternative sources of transportation energy – including EV charging stations – because we are fuel agnostic and have a keen understanding of consumer preferences and tendencies. Fuel retailers have strategically located themselves where

refueling demand is greatest and they compete with one another on price, speed, and quality of service. Moreover, fuel retailers offer the security and amenities that consumers demand regardless of the type of fuel their vehicle consumes. Fuel retailers have made investments in renewable fuels and existing alternative fuel incentives allow retailers to offer lower carbon fuels to consumers at a price at which they are willing to purchase them.

(4) Harness existing infrastructure to help commercialize new technology, maximize diverse investments, and achieve near-term and long-term emission reduction goals – It is far less expensive to leverage existing infrastructure than create entirely new supply chains and infrastructure. To the extent environmental objectives can be achieved by harnessing existing infrastructure, especially retail fuel outlets, customers will more seamlessly gravitate to new types of fuels and vehicles. American companies have spent more than sixty years building out a refueling infrastructure system that optimizes logistics and maximizes customer benefits. Deployment of new technology that complements this infrastructure will (all else being equal) be less expensive and thus more likely to generate consumer loyalty.

(5) Set consistent, uniform national policy so that (i) the market has certainty to help it invest, and (ii) state policies do not create inconsistent or counterproductive measures – Federal policy should be designed to lower the cost of alternative fuels to make those sources of transportation energy more competitive with petroleum-based fuels. This is the only way to ensure that consumers will gravitate toward low carbon technologies. Although some state incentive programs adopt this approach, others have vacillated between different approaches in a way that does not allow private market participants to plan long-term investments in alternatives. These inconsistent policies are ultimately self-defeating and should be avoided.

(6) Ensure fair treatment so that all households are not forced to subsidize alternative energy users – Fundamental tenets of fairness dictate that users of transportation energy pay for that energy and related infrastructure. It is patently unfair and inequitable for policymakers to force most households to subsidize the refueling costs for EV drivers. When utilities rate-base their EV infrastructure investments, however, it raises the monthly utility bills for all of a particular rate class, even though the benefits are confined to a small group of users. Vehicle owners should pay the costs of powering their own vehicles in order to create a market system that will keep energy prices down and avoid regressive charges. Moreover, it is imperative that highway infrastructure funding comes from all highway users, and not just those that rely on a particular technology.

By observing these principles, environmental transportation policies can create new jobs, accelerate the deployment of advanced alternative fuel infrastructure and vehicles, benefit consumers through a competitive and robust marketplace and drive massive economic investment and improvements in air quality—objectives fuel retailers and lawmakers share.

IV. Fuel Retailers Understand Consumer Behavior and Respond to Consumer Demand

A. Overview of the Retail Fuels Marketplace

The retail fuels market is the most transparent, competitive commodities market in the United States. Retailers post fuel prices on large exterior signs that consumers use to shop for the best prices. Many consumers drive out of their way to save a few cents per gallon. Our members operate on tiny margins—generally measured in cents per gallon of fuel sold.

Fuel retailers are agnostic to the type of fuel sold to satisfy consumer demand and have demonstrated they are prepared to invest in any transportation energy technology that their customers desire. Over the last thirty years, our industry has adapted to meet consumer demand with increased biofuel blends and other alternative fuels, as well as healthy and made-to-order food and beverage offerings. Fuel retailers provide the security and amenities desired by the motoring public more than any other type of location. These dynamics can be harnessed to facilitate the transition to a growing market for alternative transportation energy sources.

The competitive nature of the retail fuels market compels retailers to pass through cost savings to consumers in order to maintain and increase their market share. It is in retailers' interests to increase the amount of energy they sell to consumers. This is not only because those sales drive profit opportunity in and of themselves, but also because such sales drive in-store traffic, which is another source of profit for the retailer.

B. Fuel Retailers Are the Solution to Range Anxiety

To have any chance to be successful, the refueling experience for alternative fuels should be as similar as possible to today's refueling experience. Fuel retailers are best positioned to provide alternative sources of transportation energy because they have a keen understanding of consumer preferences and tendencies. This fact is essential when it comes to adoption of EVs or other alternative fuel vehicles. The transition to EVs will require what was previously a quick stop to become a 30-minute consumer experience. Currently, it takes the driver of a passenger vehicle approximately two to three minutes to complete a fueling experience. It takes the driver of an EV, on the other hand, 20 to 40 minutes to recharge at a Direct Current ("DC") Fast Charger (depending upon the vehicle and the capacity of the charger available). Fuel retailers will be forced to compete on the service and amenities they offer their customers during this refueling experience to maintain their share of the market. This is a positive market dynamic for consumers.

Observers of vehicle trends and consumer behavior agree that one of the major factors deterring consumers from transitioning to EVs is concern about where they will (and will not) be able "refuel" those vehicles. This "range anxiety" is such a strong sentiment that consumers often decidedly underestimate the availability of EV charging infrastructure that already exists today.[4]

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[4] There are currently 102,621 public charging outlets available at 42,078 public stations across the United States, of which 17,861 charging outlets at 5,040 public stations are DC Fast Chargers. *See* Alternative Fueling Station Locator *available at* https://afdc.energy.gov/fuels/electricity_locations.html.

Availability of EV charging stations at our locations is the most effective way to solve range anxiety. Consumers freely drive their gas- and diesel-powered vehicles to every part of country today without concerns about whether they will be able to refuel whenever they need to do that along the way. Offering EV charging at fuel retailing locations would mean drivers would not need to change their habits if they choose not to—they can refuel on the go at the same convenient locations they do today. The availability of EV charging on large price signs at fuel retailers' locations as they drive down the streets in their communities and traverse America's highways will effectively relieve EV range anxiety.

Consumers frequently use their vehicles for travel—including visits to family and friends and vacations. And, the majority of consumers are not in a position to purchase or rent a separate vehicle solely for these types of trips. If EV charging is not available in the neighborhoods they want to visit as well as along Interstate locations, many Americans simply will not purchase an EV.

Placing chargers only in individual garages in private homes, apartment buildings, and parking lots cannot combat the notion of "range anxiety" the way fuel retailers offering that service would. If EVs are to be adopted at the rate policymakers desire and by broader demographics than those that currently can afford an EV, the charging model must include the full range of options available in the refueling experience that exists today. The majority of renters across the nation do not have garages nor do many homeowners. And, those that have garages often do not have space in their garage for the number of vehicles their family drives nor do they have the electrical capacity in their garage to support a charger or multiple chargers. This is also true for workplaces; many employees will not have the option, for a variety of reasons, to charge at work. Consumers must have viable charging options available outside of their home or workplace.

Refueling stations are strategically located throughout the country where refueling demand is greatest, competing with one another on price, speed, and quality of service. In fact, our industry currently has about 150,000 fueling stations across the country in local communities of all kinds, including in every single congressional district. Furthermore, these locations include accessible restrooms and parking lots, food and beverage options, vehicle service and repair centers, and even showers and other amenities for professional drivers. Consumers demand all of this, regardless of the type of fuel their vehicle consumes, and fuel retailers respond accordingly.

C. EV Charging Needs Price Competition

As described above, our industry provides about 150,000 locations across the country for drivers to currently refuel. This refueling capacity drives aggressive price competition which, in turn, keeps prices as low as possible for consumers. Consumers know how much a gallon of gas costs at a location – either due to a big price sign on the street or some type of fuel price comparison resource – before they decide to refuel. This forces retailers to shave every penny they can off of the price of a gallon of fuel to compete for market share. When adjusted for inflation, the three years with the lowest average gas prices in the United States since 1978 are 2020, 2018, and 2019, in that order.[5] That is not an anomaly. Fuel prices stay as low as possible and generally trend

[5] *See* https://www.usinflationcalculator.com/gasoline-prices-adjusted-for-inflation/.

slightly downward over time when adjusted for inflation due to price competition. If electricity is to be the transportation fuel of the future, EV drivers should get the benefits of that remarkable price competition.

The overarching structure of wholesale and retail electricity markets are not designed for – and is thus incompatible with – the retail fuel market. Many states are exacerbating this problem by allowing utilities to pass through the costs of EV charging stations to all of their customers on their monthly utility bill, rather than having EV drivers pay for the costs of refueling their own vehicles. And, there are no wholesale purchasing options or pricing structures for retailers to provide electricity as a fuel. If that practice were to continue and become the prevalent model, this country will risk replacing one of the most price-transparent and price-competitive consumer markets in the world (retail fuel pricing) with one of the least price-transparent and price-competitive markets in the United States (utility electricity pricing).

V. Federal Policies Should Incentivize Private Investment

Competitive markets with a level playing field for investments must be the focus for any alternative fuel to be successful. Existing alternative fuel incentives – such as biofuel blending and alternative fuel infrastructure tax credits – have allowed retailers to offer less expensive, lower carbon fuels to their customers, while also supporting investments in renewable fuel production. Regardless of how one may feel about ethanol and biodiesel, the incentives Congress established for those fuels have successfully displaced a large volume of petroleum-based fuel by these renewable fuels since 2005.

In just the past decade, there has been extraordinary growth in consumption of biofuels such as ethanol and biodiesel, as well as other low carbon fuels such as renewable natural gas, compressed natural gas, renewable diesel, and biobutanol. These are all liquid fuels that are mostly compatible with existing infrastructure that was originally developed for hydrocarbons. With all of these fuels, fuel retailers have responded to policy signals by allocating capital toward bringing the fuels to market. Retailers then sell the fuels to consumers for less money than the fuels that were being displaced. This has created enormous environmental benefits in a relatively short period of time.

Federal policy should be designed to lower the cost of alternatives to make those sources of transportation energy more competitive with petroleum-based fuels. This is the only way to ensure that consumers will gravitate toward low carbon technologies. Although some state incentive programs adopt this approach, others have vacillated between different approaches in a way that does not allow private market participants to plan long-term investments in alternatives. Such inconsistent policies are ultimately self-defeating, and that approach should be avoided. Federal policy instead should incentivize and leverage private investment in bringing alternative fuels to market. By the same token, federal policies should not undercut incentives for retailers to invest in alternative fuels. Policymakers can leverage existing infrastructure to achieve meaningful environmental benefits while also incentivizing fuel retailers to invest in new technology if policymakers adopt a market-oriented and consumer-focused perspective.

VI. Different but Interdependent Roles of Utilities and Fuel Retailers

In an effort to decarbonize the transportation sector, the Biden Administration has committed to adding 500,000 EV charging stations over the next decade. A nationwide network of fast charging stations is achievable, but there must be a policy framework to harness the core competencies of the utility and retail fuel sectors. The most efficient, cost-effective path to achieving this goal is a partnership between utilities and fuel retailers, with support from federal policymakers.

In order to develop policies that facilitate productive work from utilities and fuel retailers, there are fundamentally two buckets of activities that need to be pursued. Federal policies should encourage utilities and retailers to focus activities where each is most effective and productive. At the same time, policies that may appear to be quick and easy solutions often undermine either utilities' incentives to modernize the power grid, or retailers' incentive to invest in charging infrastructure.[6]

A. Role of Utilities

The power grid undoubtedly needs to be modernized. As EV charging stations are installed, generation, transmission, and distribution networks will need to be expanded to meet the dramatic increases in electricity demand. Before drivers are willing to transition to EVs, they must be assured that they will be able to refuel as reliably as they do today.

The utility sector is best suited to perform the generation development and power grid modernization work that will be needed. Funding those necessary electricity infrastructure investments through rate increases makes sense – and will be needed for the increasing future demands our electricity grid will face (from all sectors, such as industrial processes and heating homes, as well as transportation energy). Policymakers should encourage and incentivize utilities to focus on these investments.

B. Role of Fuel Retailers

The market dynamics that govern the retail fuel industry today should be replicated to accommodate EVs. Customers should have multiple charging options that are competing for their business on price, speed, and quality of service—the same market dynamics that govern the retail fuel industry today. Fuel retailers are best positioned to own and operate EV charging stations and provide transportation energy to consumers at competitive prices in convenient locations.

C. Avoiding Negative Incentives and Outcomes

One of the biggest impediments currently to fuel retailers investing in EV charging infrastructure is the practice of utilities charging all of their electricity customers more in order to pay for their investments in EV charging stations. Where this occurs, utilities are able to compete

[6] It is important to distinguish between the charging port and/or charger itself and aspects of the underlying electrical infrastructure that should only be operated by a utility company, including the interconnection, switching station, and/or grid connections behind the charger.

with private sector groups without risking a single dollar of their own. This tilts the cost for EV charging infrastructure in favor of utilities such that the private market cannot compete, placing existing and new market participants at a competitive disadvantage which they cannot overcome. That the private market is reluctant to risk capital investing in EV charging infrastructure is entirely predictable when it knows it cannot make a return on that investment due to the threat of unfair competition from regulated utilities.

As described above, many states allow utilities to charge all of their customers, regardless of the type of vehicle they drive (or if they drive at all), for the utility's investments in EV charging stations via their customers' monthly electric utility bills. There is no public policy rationale for pursuing this approach with respect to refueling, as it will only decrease transparency and competition, increase costs, and stifle innovation.

This is not true for fixed locations like homes and commercial properties that need electricity. In these instances, it might not make sense to have multiple electricity lines and robust price competition. Funding necessary electricity infrastructure investments to carry the electricity to fixed locations through rate increases therefore makes sense and should be done for the increasing future demands our electricity grid will face.

EVs move from place to place rather than remaining in one spot. Policy should enable the motoring public to access every benefit that our competitive market system has to offer. If that customer interface is funded through consumer utility bills, consumers will collectively pay far more than they should for the chargers and electricity to fuel EVs.

That cost burden will hit hardest on those least able to afford it. Individuals who struggle to pay their monthly bills should not be required to underwrite investments that the private sector is willing and better equipped to make. EV drivers – who today have above-average incomes and drive cars that cost much more than average – can and should pay the costs of charging their vehicles. As EVs become more common in less affluent communities, it will be especially important that drivers know that they will pay the smallest amount possible due to retail price competition.

Furthermore, some states classify businesses that sell electricity for the purpose of charging EVs as utilities, effectively prohibiting such sales from anyone other than utilities. Federal policy preempting these state regulations should be established, allowing non-utilities such as fuel retailers to resell electricity for refueling commercially.

Finally, federal policy should maintain the ban on commercialized Interstate rest areas, including disallowing EV charging within federal Interstate rights of way. This will ensure that off-highway businesses are not discouraged from investing in EV charging. Our industry has supported the ban on commercial activity and electric charging should be treated no differently from any other commercial service. If EV charging is opened up at Interstate rest areas, it will undercut private sector investments in that infrastructure at Interstate exits. That will mean fewer, not more, EV chargers.

D. Electricity Market Challenges

In addition to the challenges fuel retailers face investing in EV charging infrastructure, there are challenges with the electricity market that must be addressed before a robust EV charging marketplace is viable. Utilities do not simply charge their commercial customers a fixed price for electricity that is used. Instead, commercial consumers are charged a rate for the energy itself, billed as kilowatt-hours (kWh), and then an additional rate to provide reserve capacity when needed, known as a demand charge, billed as kilowatts (kW).

Demand charges are based on the largest amount of power that a business needs at a particular time during the entire month. They are there to compensate the utility for having enough power in reserve to meet spikes in demand. Private businesses that have short, but high spikes in their power needs will be hit hard by this pricing structure. Utilities' demand charges make it very challenging for private companies to offer electricity to EV drivers at a price that is competitive with gasoline or diesel.

DC Fast Chargers require a large amount of power in a short time frame to recharge vehicles quickly. A DC Fast Charger pulls 150% more power than a RaceTrac store and fueling operation combined does at its peak moment in a month.[7] Accordingly, when businesses offer EV charging, these large demand costs restrict profitability and increase the cost for drivers of EVs to "refuel." DC Fast Chargers are capable of filling a vehicle up half way in about 20 minutes and 80 percent of the way in about 35 minutes. For a customer, a charge can cost anywhere from $10 to $30 depending how much charge is required to refuel the battery. For a typical business, adding a single DC Fast Charger can increase its monthly bill by about $1,600. The demand portion of this bill is $1,500 and the energy portion of this bill is $100.

But, it is very difficult for businesses to have consumers fully pay the demand charge. The business would have to precisely know ahead of time how many people would use its chargers over the course of an entire month in order to do that. If it turned out to make the wrong assumptions, consumers could be dramatically undercharged or overcharged – leading to difficult consumer protection questions or business losses, respectively. No matter the incentive for charging infrastructure, the ongoing costs for electricity, particularly demand charges which cannot effectively be passed through to consumers, make profitability near impossible to achieve for private businesses without changes.

Fuel retailers getting hit with demand charges also cannot compete with a utility that has substantially lower cost for energy and power. Utilities have excess capacity and much lower energy costs that allow them to offer EV charging with little impact to their bottom line. What's more, demand charges are compounded so a fuel retailer will be saddled with higher demand charges for every additional charger available to their customers. That will make it more difficult for retailers to deploy DC Fast Chargers and give consumers the benefit of competitive pricing. The utility demand pricing model could not be further from the current retail fuel model, where

[7] This is assuming a RaceTrac's peak demand is 100 kW and the DC Fast Charger is a 150 kW charger. While a DC Fast Charger can be anywhere from 50 kW to 350+ kW, a 150 kW is comparable to what Tesla's Supercharger network and Electrify America charger network has in place today.

increased consumption and volume results in efficiencies and lower costs for consumers. The utility model, then, will not work for EV charging on a large scale.

The challenges with electricity pricing as it exists today threaten to stunt the growth of the EV market. Congress could address this problem by ensuring businesses offering EV charging only pay the costs that utilities pay for the electricity, without demand charges. Such a wholesale rate would allow businesses to offer charging, compete, and develop the competitive market for EV charging. Demand charges are the greatest barrier to entry to mass adoption of DC Fast chargers by private business, even greater than the large capital costs to install DC fast chargers.

VII. Legislative Proposals Before the Committee

As the Committee considers various legislative proposals to reduce carbon in the transportation sector, lawmakers should harness American ingenuity and innovation and leverage the private sector to the greatest extent possible. With respect to the refueling marketplace, we do not need to reinvent the wheel to transition to new fuels and technology. There is a refueling infrastructure in place that can adapt and attract consumers so long as the regulatory regime governing it allows businesses to justify investment in those new fuels and technologies. Policies should take into consideration the market dynamics that govern the liquid fuel marketplace and replicate those as much as possible to achieve greater adoption of alternative fuels and technologies.

In some states, arcane laws require any entity selling electricity to be regulated as a utility. While this made sense when electricity was only used to power residential and commercial locations, the logic does not extend to the provision of electricity as fuel. The Associations applaud the language included in Chairman Rush's NO EXHAUST legislation that encourages states to consider allowing the resale of electricity for the purposes of refueling. The Committee, however, could go one step further and preempt those arcane state laws so RaceTrac and other fuel retailers can resell electricity just as we sell motor fuel today.

Various proposals before the Committee, including the CLEAN Future Act and the NO EXHAUST Act, incorporate the Electric Vehicle Infrastructure Rebate Act. First and foremost, if the market dynamics exist that fuel retailers can provide electricity as a fuel and make money off of that sale, federal financial incentives will be unnecessary. Fuel retailers do not need federal incentives to install gasoline and diesel fueling equipment today because market forces justify the investment. That said, to the extent the Committee is committed to making such federal investments, the Associations' members have significant concerns that the program as structured will disincentivize businesses from taking advantage of the rebates. As written, the rebate program is silent on the ability of utilities to access ratepayer funds to build out EV charging stations and also receive a rebate for such stations. The allowance of such double-dipping compounds the unlevel playing field on which we find ourselves. The Committee should include simple guardrails on any funding program to ensure that federal dollars going to the installation and operation of EV chargers prioritize businesses putting capital at risk. Doing so will leverage federal dollars and result in a competitive and convenient refueling experience for the consumer.

Similarly, the CLEAN Future Act includes provisions from the Electric Vehicles for Underserved Communities Act that aims to deploy EV charging infrastructure in low-income communities and communities of color. Without these guardrails on federal funding, however, federal dollars are available to utilities that are also accessing ratepayer funds to build EV charging infrastructure. Again, low-income communities and communities of color should not be required to underwrite EV charging investments that the private sector is willing and better equipped to make, especially in legislation that is trying to protect these vulnerable populations.

Finally, there are inherent challenges in shifting our transportation fuel from the liquid marketplace of today, where retailers have the ability to price shop among a variety of suppliers, to a market with one power provider operating in a regulated environment. Without injecting competitive forces throughout the fuel supply chain, fuel retailers will be limited in their ability to lower the prices to the consumer. Congress can help alleviate that challenge by ensuring that utilities sell power to EV charging retailers at their own internal transfer price. Demand charges, which set our rates exorbitantly high during peak demand times, are another impediment to make the EV business case for retailers. Again, demand charges do not make sense for refueling on the go. A driver should not be penalized for needing to refuel at certain times of the day and fuel retailers should not be penalized for providing the fuel this Committee wants sold. Addressing the cost-prohibitive demand charge model will be beneficial to building the business case for investment by our industry.

The Committee should consider policy mechanisms to address these concerns, including:

- Ensure federal funding does not block private sector investment by compounding the problem of utilities charging all their customers more for chargers and not putting capital at risk.

- End the electricity pricing problem of demand charges that make the business case unattractive for retailers to sell electricity.

- Prioritize credit regimes and/or tax incentives that make alternative energy less expensive for the end user, thereby providing a stable economic case for upstream investment. Tax credits and other incentives targeting the underlying economics of different fuels are a far more efficient, effective way to incentivize behavior than grant and rebate programs.

- Permitting all EV charging station owners to generate a profit by selling electricity to EV owners without being subject to regulation as a utility. This allowance is essential if fuel retailers are to have any incentive to invest in EV charging technology.

- Adopting uniform retail pricing measurements (e.g., dollars per kilowatt-hour) and requirements for consumer-friendly price disclosures.

VIII. Conclusion

Race Trac and the Associations believe decarbonization efforts should incentivize private sector investments in the desired behavior – offering alternatives that reduce carbon output. To be effective, any alternative – including electricity – should be offered in an open, competitive market that gives American consumers the fullest economic benefits of robust price competition. This has worked well for consumers for nearly one hundred years with liquid fuels because the market had a business case to invest to meet consumer needs. It can work for alternative energy sources in the future if we follow those lessons.

Our industry is eager to work with the Committee to help it achieve this objective and place critical guardrails on any programs the Committee may pursue to decarbonize the transportation sector.

Thank you for the opportunity to testify, I am happy to answer any questions you may have.

Mr. RUSH. The Chair wants to thank all the witnesses for their opening statements. And indeed, we have concluded all the opening statements. We will now move to Member questions.

Each Member will have 5 minutes to ask questions of our witnesses. I will start by recognizing myself for 5 minutes.

Mr. Jankowsky, in your testimony you describe the work of your company, which I find fascinating. Francis Energy created a comprehensive electric vehicle charging network through the largely rural State of Oklahoma, and also within urban, low-income, Tribal, and other underserved communities. My bill, the NO EXHAUST Act, has provisions aimed at enhancing the Federal Government's role to address exactly this type—why is it that—why is investment important to the deployment of electric vehicles, and how will it specifically impact underserved and disadvantaged communities?

Mr. JANKOWSKY. Well, thank you so much, Chairman Rush, for the question. So why is Federal investment important into the EV infrastructure space?

And really, we feel it is important because of the chicken-or-the-egg problem, right? Economists call it a market coordination problem. Simply, without infrastructure, no one is going to buy cars. And if cars are available and the market is demanding it but that infrastructure is not there, then, quite simply, no one is going to buy EVs.

It is going to take a whole host of public funding. The Federal Government has a significant role to play in that public-private partnership. And really, that is the only way this network across the U.S. will get created. It is a function of private capital, Federal investment, and also, importantly, State investment. Those three kind of, you know, prongs to that stool, they are all critical. They are all critical.

Now, how do—how does EV infrastructure get into underserved and disadvantaged communities? The upfront capital cost to build these stations, particularly when we talk about 7-to-12-minute charging systems, they can cost upwards of $400,000 for the first dispenser. The way that the EV market is going simply to be developed, in terms of what charge point operators would charge electric vehicle consumers, the absolute baseline is that EV consumers will be paying much, much less in fuel costs to power that car and also avoided maintenance. In order for, you know, these communities to be able to access, you need to solve this market coordination failure, and that is exactly what the CLEAN Future Act does.

Mr. RUSH. Thank you so much.

Mr. Nassar, the NO EXHAUST Act and the CLEAN Future Act both include strong labor standards that are attached to several grant programs. These programs invest in electric vehicle legislation and infrastructure in the U.S., and require that grant recipients pay workers not less than the prevailing wage.

Can you describe why provisions to—labor standards are essential to Federal infrastructure deployment efforts, especially as we work to decarbonize our economy?

Mr. NASSAR. Sure. Thank you for the question. Basically, if we don't have kind of employer responsibility standards and kind of, you know—keeping track not just of the wages and working conditions, but also, you know, are they offering full-time jobs, are a lot of the workers, you know, temporary workers, for example, keeping track and kind of an accountability on all that, is a key way to ensure that the jobs that are being created are, in fact, good jobs.

And I want to point out that, while we support Davis-Bacon provisions, they don't apply for the manufacturing of the vehicles themselves. So we think that these labor provisions are important, and would support those provisions for sure. Thanks.

Mr. RUSH. Well, that concludes my time for questioning. Now the Chair now recognizes my friend from Michigan, the ranking member, Mr. Upton, for 5 minutes.

Mr. UPTON. Thank you, Mr. Chairman. It is a pleasure to see you, and know that you are just across the lake here, as I am in Michigan and you are in Illinois.

Mr. Siccardi, let's talk a little bit about the business case to support EVs and the charging stations. Can we actually do this? Is it possible to do without a heavy taxpayer subsidy?

Mr. SICCARDI. Thank you for the opportunity, Representative Upton.

That is probably the biggest thing that our members are struggling with today, is finding a business case for EV chargers or our fast-speed chargers. Our goal would be to make EV fast chargers as ubiquitous as the 150,000 fueling locations that we have across the country today for liquid fuels. But in order to do so, we need a business model that actually makes sense.

Unfortunately, there's a number of things that create challenges to that business model. The first and foremost is utilities rate basing. So being able to charge all ratepayers the cost of installing a charging station, that might seem like a great short-term idea in that it gets chargers out there quickly. But, unfortunately, it takes away the profit incentive for retailers to choose to deploy private capital to do the same thing.

As important is most States have very expensive charges for demand charges. Demand charges make the cost to power—for a retailer to provide the load required for a high-speed charge cost-prohibitive, really, for us to have much of a margin. So it becomes very, very difficult for a retailer to not only deploy the capital required to get a return, but then, on an ongoing basis, be able to generate any margin on the transaction.

So what we would encourage the committee to do is focus on making the business model make sense, remove the impediments, give us the opportunity to compete. We will compete with all manner of businesses, whether it is other fuel retailers, or chargers, or whatever happens to come to the marketplace. But we need a profit incentive to do so. That profit incentive can be done with relatively well-intentioned and smart legislation to allow the utilities to focus on the areas that they should be focused on, which is providing power and grid resiliency and allowing retailers of all stripes to compete on price and to offer the consumer the amenities they need.

Mr. UPTON. Thank you. I would note that there is—I was in a conference call, a Zoom call earlier today with some folks in Michigan, and they talked about an energy storage incentive that [audio malfunction] suspect that that would be a good thing, as it would be able to store that battery energy, or that energy stored, and then be able to release it in off-peak times. That may be something that actually has pretty strong bipartisan support that might move forward.

Mr. Jankowsky, I was pretty—obviously, with what you are doing—and I sense that Mr. Mullin, Markwayne Mullin, will be asking you some questions. But how much does it cost to actually build—you talk about a facility every 50 miles. Well, I look at my district, six counties, it is—there is no gerrymandering here, it is a cube. Every 50 miles would be about maybe 4, 3 or 4 charging stations in my district, serving 750,000 people. That would be some pretty long lines there, longer than what we had in the energy crisis in the 1970s, when you wanted to fill up your car on an even or odd day.

But what is the cost per station that you have invested in Oklahoma?

Mr. JANKOWSKY. So, Congressman Upton, thank you so much for the question. So Oklahoma—and these are just hard numbers—Oklahoma, with 355 superchargers, cost all-in—and we are talking all-in project costs, so, as defined in the legislation, "eligible costs"—about 30 to 40 million dollars.

Now, it is a difficult question to answer, simply because the charging stations themselves have very different power outputs for different applications and therefore,cost very differently and widely across those direct-current fast chargers.

Mr. UPTON. But you are going to want that. So, again, I didn't see your testimony until, literally, this morning, but you are going to want—I mean, someone driving an EV car, driving, I don't know, here or someplace else, Mackinac Island or Debbie's district on the other side of the State, you don't want to stop, and you are not going to want to take more than 7 or 10 minutes to charge it, unless you have a spare battery in the trunk.

So, I mean, it is remarkable technology that you are ready to go, but what—you are going to want that type of thing, and so you—what you are saying is that—I know my time—40 million, to—30 to 40 million dollars——

Mr. RUSH. The ranking member, your time has expired.

Mr. JANKOWSKY. So——

Mr. RUSH. The witness will be allowed to answer your question.

Mr. JANKOWSKY. You know, Congressman Upton, you know, I am very happy to meet with you and your staff after this. But our infrastructure in Oklahoma, effectively, 50 percent of them are in rural communities that are more slower fast-charging systems. So these are systems that can charge in 60 to 90 minutes. And we put those in rural communities, in underserved communities, because they serve as a beacon. So drivers on the highways will have to come into town and be captive. And there are some environmental—or, sorry, some economic development impacts for having a single charger in a rural or underserved community.

But equally important, what one charger does is it now gives permission to your constituents to buy electric vehicles when they become available in your communities. And it is really a function of investment going into light-duty trucks, which, in our part of the world, is a car that a lot of people like, SUVs. And simply, the cost of batteries have come down so much that we are certain that your constituents and constituents in rural and underserved and disadvantaged communities will be able to afford these cars. But you need that public infrastructure to give them permission to buy them. Thank you.

Mr. RUSH. The Chair now recognizes the chairman of the full committee, Mr. Pallone, for 5 minutes for the purposes of questioning the witnesses.

Mr. PALLONE. Thank you, Chairman Rush. I wanted to start with Mr. Nassar.

Can you discuss some of the policies we should pursue in order to make sure that U.S. workers benefit from this growing domestic industry and ensure we don't lose out to other countries, if you would, Mr. Nassar?

Mr. NASSAR. Sure. Thank you for the question, Mr. Chairman.

I think—well, for starters, we should make sure that Federal money used is used to support vehicles that are built in the United States. I think that is going to be important. We have to anchor the jobs here, and by anchoring the jobs here, it is not just going to be the final assembly, it is going to be throughout the supply chain. We could have more of those jobs being good, U.S. jobs.

We also, you know, as I said, I mean, other changes in law are needed, such as strengthening the National Labor Relations Act by passing the PRO Act.

But as far as conditions within, you know, the money that is given, first of all, we think it should be looked at broadly. So we shouldn't just look at tax credits. We should look at grant, loan programs too. And what it should be is that, as part of, you know, being able to access those funds, an employer should be held accountable for what—you know, what kind of wages, what kind of retirement, you know, benefits do they have. Are the workers full time, or are they permatemps?

What we see in a lot of manufacturing is the companies that will have the same person come back day after day, year after year, and technically they are called a temp, because their paycheck is from a third party, but they are not a temp worker whatsoever. So we—you know, there really has to be way more accountability and transparency for the companies receiving the aid. I think that is a really key part of it.

Mr. PALLONE. Thank you. And let me go to Mr. Phadke.

Your testimony includes some of the grid considerations related to EV infrastructure. And last week FERC held a conference on electrification of the U.S. economy, including vehicles. Can you talk about the grid planning and upgrades that are necessary to support increased EV demand, if you will?

Dr. PHADKE. Thanks for the question. And I would say that there are three aspects of grid planning that need to accommodate EV demand.

First is generation. Essentially, you will need—U.S. will need additional generation to support the additional electricity demand generated by the EVs. And we find that, in order to electrify—all sales to be electric, the additional supply that the U.S. power system needs to support is about 2 to 3 percent per year. And this kind of supply growth has already been achieved in the past. And why this number is relatively modest, the answer is EVs are 3 to

5 times more efficient than combustion engine cars. So when you move all that demand from oil to electricity, yes, there is demand growth, but the demand growth is modest. But it needs to be taken into account, because what—the last thing we want is an unreliable grid. That is first.

Second, similar investments in transmission and distribution infrastructure are required to kind of anticipate what electricity demand will occur, and do those investments proactively.

That is why it is so important—perspective to do two things.

First, we have to have some kind of indication of goals of what is the kind of transformation we are looking at in the transportation sector. So, for example, by what date we should be expecting oil sales to be zero emission/electric. That will give the utilities the certainty to make some investments in transmission generation and distribution infrastructure.

And secondly, there are opportunities for research and development and smart policies on the grid which actually use the existing grid more efficiently to support EVs. That links to the issue of kind of off-peak rates and being smart about the—so you are incentivizing EVs to charge when the power system is not constrained and loaded.

What it will, in fact, do is that, if EVs are charging during, say, nighttime or off-peak time, you are using the existing infrastructure to send more electrons. That will, in fact, lower rates for all consumers, if such smart grid policies are implemented.

Mr. PALLONE. All right, thanks so much.

Thank you, Mr. Chairman.

Mr. RUSH. That concludes the Chairman's questioning. He yields back the balance of his time.

Now Mrs. McMorris Rodgers is not present with us right now, so the Chair recognizes Dr. Burgess for 5 minutes for the questioning of the witnesses.

Mr. BURGESS. Well, thank you, Chairman Rush, and I certainly hope people are watching this hearing. I think it is perhaps one of the most critical hearings that people might have on their radar screens right now, because it is certainly indicative of what the narrow House Democratic majority is trying to do with that narrow majority and, of course, the Senate being divided even Steven and things going through on reconciliation.

So these policies that we are talking about today are all at risk of becoming law. And I say that with all due respect and affection for my friends on the other side of the dais. But, clearly, what we are talking about is taking the country in the wrong direction.

Look, this committee has a rich history of making decisions for the benefit of the country, decisions that, in fact, benefit other jurisdictions, other committees' jurisdictions. Think of what we did on allowing—or lifting the ban on the sale of exports of crude oil in December of 2015 and how much more flexibility we gave to the Department of State and the Department of Defense by providing the pathway for America to become energy independent.

And today, as quickly as we can, the Democrats are trying to undo that energy independence and literally give it away. And I hope people are paying attention and understand what is at stake here and what is being given away.

And the sad thing is bipartisan policies do exist. You know, in the last Congress I introduced the EV MAP Act with Mr. O'Halleran. We strove to provide better information to the developers of electric vehicle charging infrastructure to help people make more educated investments. But the bills we are considering today waste taxpayer money, they reduce competition, they harm consumers, and they harm our country.

So, Dr. Foss, let me ask you—and of course—it is always great to have someone from Rice University come and testify to one of our subcommittees because it raises the overall educational stature of our exercise, from merely partisan to truly informed. But can I just ask you, where do the electric vehicle batteries come from?

Dr. FOSS. I am sorry. Can you restate the question, please? I couldn't hear it.

Mr. BURGESS. Where do our batteries for these electric vehicles—where do they come from?

Dr. FOSS. Well, they all come from outside of the United States, for the most part, right now, and they will——

Mr. BURGESS. So let me stop you there for a second. So, if my premise is energy independence was good for America, we are basically dialing that back. Is that not correct? We would not be energy independent if we are dependent upon other countries for the source of this battery technology.

Dr. FOSS. You are correct, if what we also do is ban the fuels that have made us independent, which we also need for materials. And that is the conundrum.

Mr. BURGESS. Yes, and thank you for pointing that out. Since my time is limited, I do have some additional questions for you, Dr. Foss. I am going to be submitting those for the record. But I do need to ask Mr. Siccardi, because I am a frequent visitor of RaceTrac.

You all provide a significant service for constituents of the—in the North Texas area. But you have kind of said it already, but is this CLEAN Future Act—is it a level playing field for the competitors in the fuel market?

Mr. SICCARDI. Yes, we believe that good policy should focus on outcomes and drive the outcomes that we are trying to achieve here. And, fundamentally, as I mentioned earlier, there is not a business case today for retailers, given the constraints and the cost of capital, to install charging stations across the country and replicate the existing infrastructure that we have for liquid fuels.

That is not to say that there isn't things we can do. We can. We can work collectively to continue to lower the carbon intensity of existing fuels, as well as continue to expand the EV charging stations. And our hope——

Mr. BURGESS. Which you have done. And I certainly appreciate the efforts that you have put forward on that.

But, look, one of the things you brought out in your testimony, if this becomes law, we are going to have a very regressive system, where people at the lower end of the income scale are paying for the charging stations for people at the upper end of the income scale, who are able to afford these fancy electric vehicles. Is that not correct?

Mr. SICCARDI. Our focus would be to allow private capital to come into the market so that private capital can make the investments necessary to build out the infrastructure necessary. Private capital will do that, just as we have done with liquid fuels, as long as there is a business case that is viable.

Rate basing, as I mentioned, while it might seem attractive because it is an opportunity to build out chargers quickly, it creates very perverse incentives, because it not only leads to additional charges for those that don't have EVs, but, on top of that, it crowds out private capital. Because who wants to compete with a guaranteed rate of return?

Mr. BURGESS. Well, thank you. Thank you both for your important contribution today, and I will have additional questions for all of the witnesses for the record.

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

Mr. RUSH. The gentleman yields back. The Chair now recognizes Mr. Peters for 5 minutes.

[Pause.]

Mr. RUSH. Mr. Peters?

[No response.]

Mr. RUSH. The Chair now recognizes Mr. Doyle for 5 minutes.

Mr. Doyle, you are now recognized.

Mr. DOYLE. Mr. Chairman, thank you very much, and thanks to the witnesses for being here today.

The switch to zero-emission vehicles is coming. Our own car makers have announced as much. And China and Europe are making investments in the supply chains and manufacturing capability already. So we need to invest in the whole supply chain and in ensuring that the future of EVs are made in America, where we can create thousands of good-paying jobs, and ensure that our companies are the world's leaders in clean car technology.

Let me ask Dr. Phadke.

You know, my colleagues on the other side of the aisle love to talk about how all green technology is made abroad. So, instead of ceding the future of battery manufacturing to China and Europe, shouldn't we be the ones investing now to lead the way?

Can you speak to the jobs, environmental and national security impacts of investing in on-shoring our battery and EV supply chain?

Dr. PHADKE. Thanks for the question. I would say I would agree that—because of the massive benefits that EVs offer to consumers, this transition is going to happen. Now the question is whether we take advantage of it or not.

So what is interesting about batteries, batteries are quite heavy and more difficult to transport. So suppliers tend to locate manufacturing close to where the demand is. So if there are specific policies, from financial incentives or requirements for EVs, suppliers will have an incentive to locate manufacturing in the U.S., especially when combined with incentives of strong make-in-America policies.

The second most important thing I would say is that the battery costs are also driven by the cost of manufacturing, and U.S., at times, has a significant advancement, because of advanced manufacturing capabilities in the U.S. So continued investments in R&D

and advanced manufacturing and U.S. advanced manufacturing capabilities can be used as an advantage to really locate the supply chain close to where the demand is.

And lastly, I would just give an example of Europe. Europe also has high labor costs. It is not like China. And they are able to successfully locate significant battery manufacturing in Europe, with a concerted effort on supply-and-demand push-and-pull policies.

Mr. DOYLE. Thank you. Let me ask you another question. I appreciate that answer.

There is another zero-emission transportation option, and that is hydrogen-powered fuel cell vehicles. I am just curious, what are your thoughts on the future of hydrogen transportation?

Dr. PHADKE. I would quickly say that, essentially, the policy has to be technology neutral. Technology has always surprised us. So currently it appears that battery technology has moved much quicker, and it provides a competitive or highly cost-saving option to—with continued investment in hydrogen, especially for heavy-duty vehicles or ships, aviation, trains, it could become a very competitive option. So one has to keep all options open, and keep technology policy neutral and investment R&D.

Mr. DOYLE. Thank you.

Mr. Britton, would a large government investment through grants or loans in the upstream and midstream sectors, battery materials processing, and battery materials manufacturing incentivize private investment in further upstream or downstream processes?

What would be the overall impact of that kind of government investment?

Mr. BRITTON. Well, it would be huge. And Congressman Burgess asked where do these batteries come from, so I wanted to take a moment to, in some ways, correct the record.

We have mega-factories either in operation or in development in Nevada, Texas, Michigan, Ohio, Tennessee, Georgia, New York. So this is totally possible. We have the opportunity here to drive domestic manufacturing, create hundreds of thousands of jobs.

And if you think about every State, they have got an economic development office who is trying to provide incentives to locate that manufacturing in their State. We have the opportunity to do that, as a country. If we send the right signal that we are open for business, that we are willing to innovate, it will accrue dividends across the entire supply chain, from upstream to components, to parts, to batteries.

Mr. DOYLE. Thank you.

Mr. Chairman, I see my time is expiring, and I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes Mr. Latta for 5 minutes.

Mr. LATTA. Well, thanks, Mr. Chairman, for today's hearing, and thanks to our witnesses for appearing before us. I really appreciate your testimony.

Dr. Foss, I believe you and I would agree that, in order that the electric grid could be able to provide enough electric power to charge the tens of millions of additional electric vehicles that would be on the road, as envisioned by the legislation before us, continued access to reliable sources of energy will be essential.

Isn't it true that we will still need natural gas, oil, clean coal, and nuclear power to generate the amount of electricity needed to charge this new EV fleet?

Dr. FOSS. Yes, I think you are correct.

First of all, I disagree. I think that the demand on electricity, with the kinds of scenarios people talk about for scaling up electric vehicles, it is bigger than what people are estimating or forecasting. And the reason is an electric vehicle is both a consumer of huge amounts of data and also a producer of huge amounts of data.

Along with the idea of electrification, actually, for all transport, what we are trying to do is use data from mobility to accomplish a host of other things, to be able to anticipate road maintenance, to be able to look at traffic patterns, whatever it is. And data is energy intensive. That is all there is to it.

And so one of the things that we have to think about is, as we move in these directions, what is the overall demand for energy, the overall demand for electricity? And I think we are going to need all of our generation sources.

I also want to point out and add to the record that a lot of the large-scale battery manufacturing that is being located in various places, including in Europe, are in places that have robust nuclear energy competence. And that is a very attractive energy source for the high-energy intensity of battery manufacturing.

Mr. LATTA. You know, as you talk about battery manufacturing, let me just follow up on some of your testimony. And maybe you would like to just go into it some more.

According to the IEA's 2020 Global BEV outlook material, the demand for batteries and BEVs starting in 2019 was estimated at 19 kilotons for cobalt, 17 kt for lithium, 22 kt for manganese, and 65 kt for nickel. But then you go into your projection scenario. For when it increases you are going from 170 gigawatt hours today to 1.5 kilowatt hours by 2030. Demand for cobalt would expand about 180 kt per year in 2030, lithium to about 185 kt, manganese 177 kt, class-one nickel to 925 kt a year. Where is that going to come from?

Dr. FOSS. Most of it will come from abroad, from the countries that are resource rich, many of them that are traditional suppliers already. Some of it will have to come from new projects that we can't imagine yet, including marine minerals, other locations.

There are a great number of ideas out there. The question is how well the public will tolerate that kind of activity.

Mr. LATTA. Well, and again, do you think the—in the climate that we are in today, that we will be able to mine for that in the United States for all these different minerals?

Dr. FOSS. Well, I want to go back to a comment that was made by either one of the Members or one of the other panelists. One of the things that I have advocated for in previous testimonies and in other places is that we need to revisit our commitment to mining and minerals processing in the United States, regulatory reform, streamlining.

It is hard to look at the timelines that people are interested in, also knowing the timelines that it takes for projects. Fifteen, 16 years to be able to begin to even start to realize production from a facility, a new facility? That is just not going to work in the discussions that we are having.

Mr. LATTA. Thank you.

Mr. Siccardi, I come from a very large area manufacturing district here, in Ohio. Would you say that moving away from renewable fuels toward an EV-only future would hurt these producers on the—and the agricultural community?

Mr. SICCARDI. Yes, we would encourage smart policy to be focused, as Dr. Phadke said, on technology-neutral solutions. Technology solutions should be focused on outcomes, and doing so should preserve a way for fuels to compete, whether they are renewables or hydrocarbons or EVs.

Mr. LATTA. Well, thank you very much, Mr. Chairman. My time has expired, and I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes the fine gentleman from the State, the excellent State of California, Mr. McNerney, for 5 minutes.

Thank you again, Mr. McNerney, for your assistance this morning. You are recognized for 5 minutes.

Mr. MCNERNEY. Well, I thank the chairman, and I thank the witnesses. I think your testimony is all very, very informative and useful.

Dr. Phadke, what opportunities exist to pair EV charging infrastructure with distributed resources, including energy storage, but with times of high renewable generation?

Dr. PHADKE. I think there are—thanks for the question. I think there are incredible opportunities to bear this, especially because, essentially, demand charges are levied by utilities when they are really constrained in meeting the supply. So if you have storage located on site, then, even if consumers are coming and charging during the peak hours for convenience, the stores, or whoever has the distributed storage, can potentially mitigate and avoid those demand charges. So it is an incredible opportunity.

Also it improves grid resilience overall, because you have that kind of on-site storage, which can improve grid resilience.

Mr. MCNERNEY. Thank you. Well, in your testimony you note that, although new investments in the distribution systems are necessary to support increased loads from EVs, the costs were modest. Could you please elaborate on this and what it means for consumers?

Dr. PHADKE. So, essentially, distribution investments required to—for upgrades are about—nationwide, in our scenario—are about 8 to 10 billion dollars a year. Distribution utilities, on average, invest $30 billion a year already per year.

And why I am saying that the—why we find that the consumer costs will not go up? Essentially, if you are able to sell more electrons, then those investment dollars are distributed over many electrons. And that is the reason why they would be able to keep the rates at the same level or lower, because, essentially, you are selling—you are investing, but you are also selling more power.

Mr. MCNERNEY. Thank you.

Mr. Britton, can you please expand on your—on the consumer interest in EVs?

What are some of the trends you are seeing in EV adoption?

Mr. BRITTON. Well, I think the thing that is important to think about is the savings for fuel, and service, and maintenance. So, on average, most consumers save around $1,100 a year. That is a real driver.

The other thing that we are seeing in this space is dramatic increases in range. Many of the new vehicles—and there's going to be dozens coming on the market in the years ahead—are going to have 300 or 400 miles of range, which will be a huge breakthrough.

But also, if you think about the battery pack, most folks think that $100 per kilowatt is the price parity with the internal combustion engine vehicle. We expect in the next couple of years to get down to $60 per kilowatt for that battery pack. So that will provide not only savings on the fuel and maintenance, but eventually price reduction and competitiveness on the upfront cost that will be able to drive adoption and show that they are not only cheaper for fuel and maintenance, but even the upfront costs. You are going to be getting a superior product and a better driving experience for the same amount of money, with savings on the fuel and maintenance side.

Mr. MCNERNEY. That sounds great. Mr. Britton, my congressional district includes parts of the San Joaquin Valley, where air pollution has been a significant problem, having some of the poorest air quality in the country. What would the potential impact of EVs and EV charging stations do to areas like San Joaquin—the San Joaquin Valley?

Mr. BRITTON. Well, I think that is, in some ways, the missing part of this equation when we talk about the public interest. You know, we talk about consumer choice, but once those emissions leave the tailpipe, the public doesn't have a choice. The impacts on public health are dramatic.

If you look at the medium- and heavy-duty vehicles, they represent about 7 percent of vehicles on the road, but they represent over 30 percent of the carbon emissions, and well over 50 percent of the toxic pollution that has dramatic public health impacts. And so, if we are able to reduce those emissions from—on the light-duty side, it is estimated that that is $8,600 in saved public health costs per light-duty vehicle that is on the road—we are going to be delivering not only consumer benefits on fuel and maintenance and service, but dramatic public health benefits.

And again, we can do this in a way where we are addressing climate change and creating huge economic development opportunities and reshoring domestic manufacturing in the country.

Mr. MCNERNEY. Well, do you think we can catch up and surpass China in the supply chain? And if so, what would it take to do that?

Mr. BRITTON. Well, I think, you know, some of the things that are being talked about are investment tax credits for the full lifecycle of the battery. So that is upstream. It is manufacturing, but it is also the recycling. That is absolutely key.

But if you think about what we really need to accomplish in this space, it is leaning in. You know, America doesn't shy away from the competition. And we can outcompete China in absolute terms. We actually have greater lithium deposits than China does. It is a matter of really investing wisely to drive that domestic production in a responsible way.

Mr. MCNERNEY. Well, thank you.

Mr. Chairman, I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes the Member extraordinare from the great State of West Virginia, my friend, Mr. David McKinley.

Mr. MCKINLEY. You are always too kind.

Let me begin by saying, look, I support EVs and renewable energy, but not on this particular timeline that we are talking about, politically driven timeline. But I would rather on a free-market approach. And certainly not until researchers have developed an alternative mineral composition for our batteries.

Now, look, no one on this panel can tell us the impact on the global temperature changes that a 100 percent renewable grid in America and a 100 percent EV mandate is going to have. But what we do know that—are the devastating environmental and human rights consequences by pursuing this objective in this time frame.

Look, in recent years my Democrat colleagues have called Republicans "climate change deniers." But I could tell you, Mr. Chairman, maybe it is time they look in the mirror and ask themselves why are they denying these devastating environmental and human right abuses in order to obtain the critical minerals needed for batteries?

Is it because they don't want it to occur in their backyard?

Look, this road to get 100 percent EVs and renewables is littered with environmental damage and human rights abuses. For example, just—the UN just came out with a report last year that talked—that warned us about these. They talked about the critical minerals being mined in the cobalt by an estimated 40,000 children. And I have shown these pictures before. But here are some of the pictures of some of these children that are impacted with it. Here is another with the children being impacted.

And lithium. To produce just one ton of lithium, you need to use 500,000 gallons of water, which consumes more than 65 percent of all the water available in Chile. And this will only make 20 batteries out of a ton. So—and there are similar problems in harvesting graphite and manganese and the like.

So—and excavating. According to Mark Mills at the Manhattan Institute, to make one battery you have to excavate 250 tons of dirt, just to get the minerals necessary to make just one battery. Now, do the math, Mr. Chairman.

As we transition to only 20 million vehicles by, let's say, 2050, that will require 5 billion tons of dirt that will have to be excavated. That is an amount that will fill the vast Chesapeake Bay, just in one year. And we are talking about years going on in the future. So isn't it time to be honest with the American people about the raw materials needed to make these batteries, where they come from, and the consequences of extracting these raw materials?

This is nothing more—just exporting American guilt, and turning a blind eye to the devastating impact we are doing to these emerging—the environment of these emerging nations.

So, Dr. Foss, can you just tell me a little—am I wrong in assessing these consequences with this government?

Should we be considering alternatives, like we have mentioned before about hydrogen fuel cells and carbon capture, that we can continue to use fossil fuels into the future as part of our mix?

Where am I wrong on that?

Dr. FOSS. First of all, to be fair, anything that we do requires minerals and materials. We need platinum group metals or noble metals of other sorts for hydrogen-based fuel cells. We need metals for our legacy energy businesses, our carbon-based businesses, oil, gas, coal, whatever.

The problem is the metals intensity and the vehicle designs. And I think you can go to just about any other source. You could look at something simple like copper, and you can see the amount of metals intensity in the electric vehicle designs versus the traditional combustion engine designs. So I think we have to be honest about all of that.

When it comes to all of the excellent points that you are making about responsibility, accountability, governments, I think that people are aware of all of these issues. But this is one of the things that will take so much time. It is very, very difficult to get countries on the same page with regard to best practices in extractive industries, things that make sense with regard to responsible operation.

I think the mining industry, overall, is actually a very responsible industry, has good practices, but the rules and the government oversight, the protections for labor and environment in other countries are not the same. And the issue is the cost structure of minerals that are available and the timelines that everyone is talking about versus where they are located, and the governance structures in those countries. And I think that is what you are trying to get to here.

Mr. MCKINLEY. Thank you. And I just want to reinforce for everyone, you ought to read this United Nations report, because it really does document very clearly some of the problems that we are foisting on other nations, instead of doing it ourselves.

So, Mr. Chairman, I thank you, and I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes the brilliant chair of the environmental subcommittee, the gentleman from New York, Mr. Tonko, for 5 minutes.

Mr. TONKO. Thank you, Mr. Chair. Thank you to our witnesses.

My hometown is a relatively small, working-class city. But just last month they cut the ribbon on 25 new, publicly accessible charging stations located in our city parks. We don't have many EV drivers there yet, but this is an investment with an eye toward adoption trends, and it will help people develop a comfort level with future EV ownership.

So I want to thank Mr. Jankowsky, because it takes vision to build out this infrastructure in remote and rural communities. And I think it is clear we are going to need public charging in every community across the country, and sooner than people think.

So, Mr. Britton, you make an important point that, today, 80 percent of charging occurs at homes. How might that number change, as more people adopt EVs, some of whom won't have a garage or a dedicated off-street parking space?

Mr. BRITTON. Well, we anticipate that 70 or 80 percent of charging will occur at home, as we move towards 100 percent EV sales. But the important point is how do you close that gap?

And really, what that looks like is municipal parking, on-street parking, multi-unit, and then retail and workplace settings. And that will provide, I think, the comfort and the ecosystem where people can plan for their charging needs, whether it is something that they are going to, you know, be doing at home, in supplement of work, whether that is going to the grocery store, or other settings that, you know, really reflect, I think, a more convenient charging and refueling approach, where they will go about their daily lives, and they will have a full charge. Most Americans will wake up with a full charge, but closing that gap is really important.

And I think, you know, your local community leaders are trying to think through that. They are trying to make capital decisions for the next 25 or 50 years, and electrification is going to be part of that picture. And I think that is why your leadership on these issues to deploy the rebates, certainly for those subnational governments, is key.

Mr. TONKO. Do you believe charging at workplaces and multifamily homes can fill some of this gap, and provide charging access for people that may not have a dedicated parking spot?

Mr. BRITTON. Absolutely, and I think that is why—you know, and Mr. Siccardi has noted with the current gas station model—there is a 30C tax credit that is available for folks to, you know, receive a 30 percent investment tax credit for deploying charging. I think your rebates that are available to those that may not have a tax liability are especially important to close that gap.

But absolutely, when you think about it, it is going to be on-street parking, it will be municipal, it will be workplace, it will be retail. That is the way we are going to close that gap. Again, 70 or 80 percent will be at home. But getting to where you are meeting every community's needs is closing that gap with those other use cases.

Mr. TONKO. And do you believe level-two chargers, which may take a few hours to complete a charge rather than a few minutes, would be sufficient at most homes and workplaces?

Mr. BRITTON. So most homes will likely be level one, which is your current, you know, 110-volt service, or level two, which is the same service that your dryer operates on. That will be the vast majority of your at-home.

When you think about the other settings, 90 percent—our estimation is that 90 percent of the public charging will be level two. So it will be a—you know, you will get 25, 30 miles of range while you are at the grocery store, while you are at church, while you are at work. Ten percent of that public charging will likely need to be direct current fast-charging along transportation corridors, where there is a need to—you know, to refuel in, you know, 10 to 30 minutes. But level two is a really important part of this puzzle, and, you know, it will be the vast majority of what public charging looks like and will require.

Mr. TONKO. All right, thank you.

I absolutely support building out charging corridors to address people's concerns with long distance and interstate travel. But is it fair to say that most people will continue to do most of their driving similarly to how it is done today? That would be, like, commuting to work, taking their children to school, running their errands.

Mr. BRITTON. Yes, most of the—most range that you would think for a normal consumer is—the average is about 30 miles a day. So most consumers will have 10 times as much range in a given day than they would otherwise use.

And again, that is why you supplement it for those instances where they are traveling across country, they are traveling to see family. But again, that is likely to be about 10 percent of the use cases and where we should deploy resources to meet those needs.

Mr. TONKO. And how might investments that build out infrastructure to support this around-town driving at people's workplaces and grocery stores complement investments along our highways and travel corridors?

Mr. BRITTON. Well, again, that is why I think, you know, the combination of the 30C tax credit, which is that 30 percent ITC, along with the rebates you have proposed, is a perfect mix to have a flexible deployment to meet each of those use cases in need.

So if it is a city that is the site host and they don't necessarily have a tax liability, you know, and may not be eligible for 30C, your rebate that they can go and access is a key part of deploying the charging to meet their community's needs.

Mr. TONKO. Thank you very much.

Mr. Chair, I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes the gentleman from Virginia, Mr. Griffith, for 5 minutes.

Mr. GRIFFITH. Thank you very much, Mr. Chairman.

Mr. Siccardi, according to the independent U.S. Energy Administration, EIA, miles driven in electric vehicles pale in comparison of those covered in internal combustion engines, meaning folks don't drive EVs as much.

We also know the majority of consumers who currently own electronic vehicles make over $100,000 a year and own multiple vehicles.

In a list from Car and Driver magazine, with every new EV model for sale in 2021, the prices of certain vehicles might not seem so bad to some, but once you look at the range available per charge, that value diminishes. The average annual income in my district in 2018 was $41,250. Spending $41,190 on a 2021 model from this list would get you a range of 250 miles.

Now, we just heard from the previous witness that most people are just going to be driving to and from work about 30 miles a day. But that is not true in rural districts like mine. People are driving sometimes, you know, 50, 60 miles just to go to their regular workplace.

Having States—and I would say, along with that, having States consider basing cost of electric vehicles on the ratepayers across the board, whether you have an EV or not, is burdensome to my constituents.

Do you agree with the numbers that I have gone over, Mr. Siccardi?

Mr. SICCARDI. I would agree that rate basing or charging stations across the market is regressive to consumers that don't have the EV charging stations.

And we also don't believe it is the right policy. The right policy is to put incentives in place to allow private capital to come into the marketplace.

We also do respectfully disagree with others that view that consumers are going to want to change their refueling experience that they have done over the last 60 years and go to places that, in some cases, are desolate, don't have security, and certainly don't offer the amenities that are offered at the stores that our retailers offer.

Our new stores, typically, are 5,000 to 6,000 square feet, have lots of amenities, including great lighting, fresh food, seating, free Wi-Fi. It is tailored for someone who wants to stay with us, to shop with us, as well as fuel. To do that in a parking lot is a very, very different experience. And to me, I just think it will be very difficult to get consumer adoption and to address the range anxiety you shared, if people don't have a similar fueling experience that is ubiquitous to what they do today.

Yes, I think it is a real problem for rural America, because there likely won't be options.

Mr. GRIFFITH. Yes, and the problem is that we have—and I am going to go back to the electricity, but I am going to come back to your point just now—I mean, we just had in the Roanoke Times, which is probably the largest newspaper in my district, we had an article last week indicating that there might be as much as a $22 per month rate increase. And, you know, and all of a sudden Twitter blows up and says, just what we needed, you know, more expenses. And if we start adding the electric vehicle cost on top of that, particularly for areas that may not be served, I think we are going to be in real trouble.

I will tell you that there is a lot of areas that won't be served. And I have heard them, you know, talk about Oklahoma and 50—you know, one every 50 miles. I wonder if that is as the crow flies. Because in my district—which is mountainous, it is not Oklahoma—you would have a hard time placing the stations where they were actually convenient to folks to do the electricity. And it is rural. It is sparsely populated. You know, I am hearing about we are going to do it in multifamily homes and we are going to be doing it, you know, in all these different places. Well, if you are driving that distance, you are not going to have that opportunity.

And let me say this, and I know that maybe my world is a little bit different, but my district is roughly the size of the State of New Jersey, maybe a little bit bigger. And so last week I drove from my hometown of Salem to an event in Pennington Gap, 198 miles. My wife was out of town. I had to get home. I didn't have time to wait 40 minutes, as the new technology says they can do, or the 60 to 90 minutes somebody on—one of the other witnesses on the panel said. I had to get home to make sure that my kids—they are now teenagers, so they weren't in desperate need, but they needed to have somebody in the house with them that night. I didn't have time to sit on the side of the road 40 minutes, 60 minutes, 90 minutes, refueling. That is why there is this hesitancy on ranges.

And look, my district is still waiting for the promise of broadband that was given to them by the Federal Government 20 years ago. We haven't gotten that everywhere yet. We are hopeful that it will be in the next 2 or 3 years. And now you are coming along with a new promise? We hear about these promises all the time, and they rarely develop the way the Federal Government says they are going to. And the last place you get them is someplace like my great city of—or town of Pennington Gap, very rural, very out there, and the last to receive what the Federal Government promises it is going to give to all citizens.

Do you hear those complaints in your—for RaceTrac?

Mr. SICCARDI. We serve rural, urban, and suburban communities. We have stores all throughout all communities, as do our retailers. In fact——

Mr. GRIFFITH. Do you recognize this is going to be a problem? Yes or no, because my time is up.

Mr. RUSH. The gentleman's time has expired.

Mr. GRIFFITH. I yield back, Mr. Chairman.

Mr. RUSH. The Chair now recognizes Dr. Schrier for 5 minutes. Dr. Schrier?

Ms. SCHRIER. Thank you, Mr. Chairman, and thank you all for being here today for this very spirited discussion about these important issues.

Now, as we continue to expand electric vehicle infrastructure, it is also important that we support demand for the EV charging with vehicle exchange programs for older, more polluting vehicles and provide secondary market credits to make electric vehicles more accessible for everyone.

We have to remember that two-thirds of Americans are not in the market for a new car, and we have to help drive down emissions everywhere, especially in areas of disproportionate impact and public health concerns. So when we are talking about cars, this bill incentivizes the purchase of new EVs. For those in the market for a used car, there's also incentives to make it a used EV. And for some, it is just moving from an older, very polluting vehicle to a newer, more efficient, used gas vehicle, because every one of those helps reduce overall greenhouse gas emissions.

So I want to focus on disadvantaged communities just for a moment, because electrification for some areas may really refer more to transit or school buses or, especially, medium- and heavy-duty vehicles. So, Mr. Britton, you stated that medium- and heavy-duty vehicles play an outsized role in negative environmental implications for emissions. Although they represent 7 percent of the vehicles on the road, they are responsible for 25 percent of the greenhouse gas emissions, 50 percent of the nitrous oxide emissions, and 67 percent of particulate matter emissions, which has a profound impact on health, particularly for these communities who are most exposed to trucks and pollution and ports.

So I was wondering, Mr. Britton, can you talk about incentivizing the transition to electric vehicle medium and heavy vehicles, and the impact for these disadvantaged communities, as compared to simply replacing passenger vehicles?

Mr. BRITTON. Well, yes. The medium- and heavy-duty space is a huge opportunity, and it is one where many of these vehicles are really hard-wired for the use cases that you might want, given charging and battery and range.

So if you think about, for example, the Postal Service, the average route for the Postal Service is 20 miles, and they sit and they idle while they deliver mail for a majority of that route. And so you can provide a zero-emission transportation option and not be emitting those pollutants in every community in the country. So there is huge decarbonization but also pollution reduction opportunities there.

The other thing that I think is worth remarking on is that it may not feel like an emergency for your community, but it certainly is an emergency for some communities. And if you look at the mid-Atlantic region, where there was a recent study, Black and Brown communities breathe in 66 percent more transportation-based emissions.

And so we can think about these things as consumer choice, and I happen to believe that, on the light-duty side in particular, the products need to sell themselves. But there is also the public health element, where people don't have a choice. And so how we contribute to that and how we address it is really, really important, from an equity standpoint.

Ms. SCHRIER. I agree, and we are already seeing this with FedEx. We have got investments in this bill for the Postal Service and for buses, because nobody likes to get stuck behind them. And there's more of these vehicles in those communities.

I want to pivot a little bit, Mr. Jankowsky, to talk about rural America. I appreciate range anxiety. We are a family that took a 1,000-mile road trip, including the Sierra Nevada Mountains, in an electric vehicle. And so I have felt that anxiety.

Mr. JANKOWSKY. Wow.

Ms. SCHRIER. I know that those 50-mile-separated chargers, just in answer to some of the other comments I have heard, they are probably not for people who are living in rural America. They are charging at home. They are for people who are traveling rural America. So I just wanted to clarify that.

Can you talk about your vision for electric vehicles in rural America, and even maybe, you know, some thoughts about not just personal vehicles but trucks or farm equipment?

Mr. JANKOWSKY. Excellent. So thank you so much for the question.

So in rural communities you need charging stations, simply because people travel away from their homes. Sure, in the typical day, maybe they are only traveling 30 miles. But I can certainly tell you, in the midcontinent of the U.S., people travel a lot further, and they leave home and they go further distances. So you have to have this charging infrastructure in those rural communities.

But the other thing I would like to point out is those fast chargers, those 7-to-12-minute chargers in rural areas, are not just for crosscommuting traffic. There are for the local community. And if you consider, you know, that a home charging station—so a level two home charging station that could take about 6 to 8 hours to charge, I think today, where we stand, could cost between 1,500 to

2,000 dollars, and it is not like there is a lot of R&D going into that hardware, where those costs are going to come down so significantly that everyone can afford them. That is why we think it is not only for crosscommuter traffic, it is also for the community.

Ms. SCHRIER. That is a great point. Thank you for those comments, and I yield back none of my time. Thanks.

Mr. RUSH. The gentlelady yields back. The Chair now recognizes the gentleman from South Carolina, Mr. Duncan.

Mr. DUNCAN. Thank you, Mr. Chairman. I want to thank everyone for being here.

As discussed today, the CLEAN Future Act aims to massively build out electricity transmission to transform the economy towards complete electrification. I am not anti-EV, but I am opposed to Federal mandates requiring electric vehicles. I also have concerns about the rush to green in the U.S. transportation sector, and the implications that this will have for the grid, energy rates, and reliability. I also believe there is a huge disconnect between those who live in metropolitan areas and those areas in rural America. I was interested to hear a brief glimpse of these issues from Congresswoman Schrier just now.

I will point out that I have been told each charging station has a cost of around $70,000. That is not counting the build-out infrastructure needed to get electricity to many of those areas. From an environmental justice perspective, I do find it ironic that the reality of the Democrats' EV plan may result in the cost of charging stations being passed along to utility customers, many of those in low-income communities. Any tax credits are regressive and burden working-class Americans and many who don't own or have intention to purchase electric vehicles. According to the Congressional Research Service, about 78 percent of the credits claimed are by filers with an adjusted gross income of more than $100,000.

Putting aside the climate motives behind the electric vehicle push, the policy, on its face, is a transfer-of-wealth scheme, harming folks like my constituents. If you live in rural South Carolina and you do not own an EV, you are de facto subsidizing some wealthy person's purchase of one.

Furthermore, most of my constituents don't want EVs. According to the Auto Alliance, almost 50 percent of my constituents that own a vehicle drive either SUVs, pickup trucks, or minivans. Many of the jobs and lifestyles my constituents have require them to drive pickup trucks and bigger vehicles. I know auto companies are investing in larger electric vehicles, but the reality is the technology is just not there.

So, Mr. Siccardi, it is clear the bureaucrats here in Washington and the Biden administration are pushing a one-size-fits-all approach to EV policy. They want an irreversible path to EVs and do not care about a lack of consumer demand. Do you think policies like the CLEAN Future Act totally ignore market realities and consumer demand?

What is the right approach, Mr. Siccardi?

Mr. SICCARDI. We believe the right approach is focusing on outcomes. In this case, if the outcome desired is to reduce carbon intensity and reduce emissions, there are ways to do that in a way that is market neutral and technology neutral that will bring fuels to market, that will continue to reduce the carbon intensity of fuels.

As I mentioned earlier, we believe that this can happen and has happened. It has happened in the liquid fuel space. With the renewable fuel standard that was passed by this Congress almost a decade ago, we have brought down the carbon intensity of liquid fuels. There are still more—a lot more—work to be done there, and I think these are absolutely a part of the future.

But I think the key is we have the opportunity to allow technology to compete because, ultimately, it has to be consumer-focused. The consumer wins when all technologies are competing, and they have many options for the lowest possible price. And that is what we think is important, is focusing on outcomes, and allow the consumer to have a choice, allow the consumer to have a lot of competition at the lowest possible prices.

Mr. DUNCAN. And, you know, look, I talk to a lot of my petroleum marketing companies, and many of them do agree with you, that EVs are a part of the future. In fact, they would like to have charging stations because, as that consumer is sitting there for 15, 20, 30 minutes charging an EV, they are probably going in the convenience store and purchasing a lot of the items in that store, where the margin is much higher than the gasoline sold by those petroleum workers at the pump.

I want to shift gears. Dr. Foss, you state in your testimony data is in a fragile state. Could you walk through some of the data and intellectual property concerns related to EVs that you have identified?

Dr. FOSS. Sure. Just quickly, in a nutshell, it is everything from the design of batteries, the chemistries, powertrains, manufacturing processes, the design and intellectual property associated with a lot of the electric power system equipment, design and intellectual property associated with advanced mineral processing. It is a pretty big list. Would you like me to continue? I think I have given you enough of a flavor.

Mr. DUNCAN. You have done great, and I appreciate that.

I am about out of time, so, Mr. Chairman, I yield back the 8 seconds I have got. Thanks.

Mr. RUSH. The Chair thanks the gentleman. The Chair now recognizes the gentleman from the other Carolina, Mr. Butterfield of North Carolina, for 5 minutes.

Mr. BUTTERFIELD. Thank you very much, Mr. Chairman, and good afternoon to you, and good morning to those of you who might be on the West Coast.

Yes, I want to make sure that you keep Mr. Duncan and I separated. He is certainly South Carolina, Greenville County, and I am upstate in North Carolina, what we call Wilson County.

But thank you for this very important hearing today. We are talking about the future. That is exactly what we are talking about. And thank you to our witnesses for your testimony. Your testimonies have been very, very helpful. Let me go back to Mr. Britton.

And you have been on the hot seat today, Mr. Britton, and let me just continue with you. I listened very carefully a few moments ago to your testimony. And I appreciate you talking about equity.

Equity must be part of our approach to electric vehicles. And Dr. Schrier and Jeff Duncan have both touched on some of my concerns about rural America.

Rural America is absolutely important. I am rural America. Jeff is rural America. Dr. Schrier is rural America. We all represent rural America. I am concerned that, when it comes to electric vehicle charging, rural communities may again be left behind. What do you see as the barriers that need to be overcome right now?

And do you see utilities, particularly rural electric co-ops, playing a significant role?

Mr. BRITTON. Yes, I do. I think we have got so much build-out to be done that we need everybody to be playing a role. So that's your site hosts, your municipalities, your third-party charging companies, and your utilities.

And one of the things that has been noted, I think, is—important to remark on—is we have heard folks suggest that this is going to be a huge runaway and, from an equity standpoint, may hurt people because of the increased cost. In your State of North Carolina, Duke put forward a $76 million charging infrastructure build-out plan for the regulators. That would have extrapolated to ratepayers—been a 15-cents-per-month addition to their bill. What was approved was a $26 million charging plan, so about 6 cents per month per customer. So the dividends here are enormous. The costs are very small.

And one of the things that has also been found in—on the other coast, with PG&E, is that, by shaving the peaks and the valleys and using those fixed costs for generation, you can actually have downward pressure on rates. And so PG&E has found that there is a $350 million dividend by better managing their grid through vehicles that has accrued to their customers.

And so, when you think about the utilities, they have a service, obligation, and responsibility that I think will be of particular use and value to rural Americans, as they seek to, you know, meet the use cases that those customers require.

Mr. BUTTERFIELD. Thank you——

Mr. SICCARDI. Congressman Butterfield, if I may, I have——

Mr. BUTTERFIELD. Yes.

Mr. SICCARDI [continuing]. Something I would like to add.

Mr. BUTTERFIELD. You certainly can, yes.

Mr. SICCARDI. Thank you. What I would add is I think it misses the point, just looking at the cost. The cost ranges State by State, depending on the size of investment utilities are trying to make.

More important, or as important, is the fact that it creates barriers to entry for private capital. Who wants to invest with someone who has a guaranteed return on their investment? That model made sense for building out electricity infrastructure across the U.S. It doesn't make sense for charging when you have retailers today ready and willing to invest and add capabilities, just like we have done at 150,000 locations across the United States.

Mr. BUTTERFIELD. Thank you. I have got a minute and a half left. Let me jump over to Mr. Jankowsky. Thank you so very much, sir, for your testimony.

You highlight your experience in managing over 350 rapid-charging stations for EVs across 119 distinct locations. As North Carolina, my State, continues to add fast-charging electric vehicle stations throughout our State, with one added to the City of Halifax in my district 3 weeks ago, I think our State can benefit from the lessons you have learned in deploying electric vehicle chargers to rural and underserved communities. Could you elaborate, please, in the minute that we have left, on specific grid upgrades and considerations that should be considered?

Mr. JANKOWSKY. So thank you so much, Representative Butterfield. So in rural areas, I think we all agree, as EV adoption rates increase in those areas, the grid is also going to have to be increased, because it is an ecosystem.

Now, in the meantime, while that grid is getting built out to meet EV adoption demand, we think batteries have a very important role to play in grid stabilization. The ability to be able to feed back power during peak power times, which is particularly hurtful for rural electric cooperatives and municipality utilities, this is going to help stabilize the grid while that investment is being made into that infrastructure.

Mr. BUTTERFIELD. Thank you.

Thank you, Mr. Chairman. I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes the ranking member, who returned.

Mrs. McMorris Rodgers, you are recognized for 5 minutes.

Mrs. RODGERS. Thank you, Mr. Chairman. And thank you to all the witnesses for joining us today. I think it is really important that we are looking at what is the real-person impact on some of these policies that we seem to be rushing through this committee and through the House right now, the real-person impact of—on electricity generation in America, and what it is going to cost ratepayers with these type of mandates that are coming down and, really, the impact that it is going to have on reliability, keeping our lights on, on affordability. It seems like there is a rush for action right now that is—that includes a stifling of our current energy and all of its economic, technological benefits in exchange for this idea that is being promoted.

So—and it is also jeopardizing American energy independence at the very time that we are celebrating America being energy independent. The first time in decades that this has been achieved, and it has been a long-time goal.

When Dr. Michot testified last fall, we discussed how the drive for more wind and solar, and the impact that it would have on supply chains, and what it means for the environmental impacts, both here and abroad. And I don't think anybody really questions that we are playing into China's strategic interest with these policies, even to the point of ignoring human rights abuses.

Dr. Michelle Foss, you talk in your written testimony about a worldwide rush to materials for alternative energy that will threaten economic and national security. Would you just explain a little bit more what you mean by this, including what actions you see other nations taking in response to that—to this demand?

Dr. FOSS. So the first part of the question is the reality, in terms of the distribution of current supply. The bulk of it is not in our country, or even in China. In fact, China is, as was pointed out earlier, not necessarily rich in lithium, but they control lithium deposits and lithium supplies and processing at other places. So that is the first issue.

I will add that China's participation in all of this has helped to expand the global supply picture, which is one good thing.

Because all of our requirements are outside of our respective countries, that puts us in the position, as I said earlier, of trying to encourage everyone else to do a good job with their minerals sectors, with their extractive and processing businesses. And it is a work in progress, is the best that I can say. Resource-dependent countries that are heavily dependent on commodities for their treasuries, for revenue, are always subject to cycles and commodity prices that also include inflation and inflationary pressures.

And we have gone through this so many times. We have seen countries in Latin America and Africa and other parts of the world continuously try to get ahead in economic development and then get set back as they have to deal with various commodity cycles.

There is a lot of concern right now that we are moving in a direction of a supercycle. I don't know how to think about that yet, but I think some of the concerns have credence. And I think the consequences of that would be damaging, not only for the commodity-based economies but also for the receiving countries, like ours. So it is a very complex problem that requires a lot of thought.

This is not to say that people are not doing the thinking. Everyone is trying to think about how to improve conditions, operating and otherwise, in all of the countries that we depend on for sourcing. But it is a very complex endeavor. It takes a long time. Not everybody is in agreement how to do it.

Mrs. RODGERS. Would you just speak to what you believe the impact will be, the real-life impact on higher costs, whether it is for electric vehicles or other products?

Dr. FOSS. There is no way that we would not get higher costs across the board for all consumer products, including what we are talking about today, vehicles and everything related to vehicles. They are materials price sensitive.

And we have been through a period of time in which materials costs have been lower. So it is very comforting or easy to think that somehow that will remain that way. But, as I said in the beginning, and in my remarks, we already are seeing pressure on commodity prices. Those get transferred very, very quickly into goods. We have already seen effects from higher copper prices and consumer products. We have seen effects from our freeze in Texas, which caused plastics prices to skyrocket, and that is getting transferred across everything that we need and use, including larger appliances, like vehicles.

Mrs. RODGERS. Yes, well, thanks again. Thank you, everyone.

Bottom line, we need to make sure that we are keeping affordability and reliability at the forefront as we continue to explore this clean energy future.

And with that, I yield back. Thank you, Mr. Chairman.

[Pause.]

Mr. RUSH. The Chair now recognizes the gentlelady from California, Ms. Matsui, for 5 minutes.

Ms. Matsui, you are recognized.

Ms. MATSUI. Thank you very much, Mr. Chairman, and thank you very much for having this really very important hearing. And I want to thank the witnesses for being here today.

I want to talk a little bit about tailpipe emissions standards, because, if we look at the future of our country, we need to realize that we need to transform, in essence, to really look to the future, and transition to EVs with dramatically reduced transportation emissions that are harmful to communities nationwide, exacerbate the devastating effects of the climate crisis.

So to lower transportation emissions, I fought to codify Obama-era tailpipe emission and fuel economy standards through my——

Mr. RUSH. Will the gentlelady yield? Will——

Ms. MATSUI. Yes.

Mr. RUSH. We can't hear you that well, Doris. Can you move closer?

Ms. MATSUI. OK.

Mr. RUSH. Yes, that is better.

Ms. MATSUI. OK, great, good. So I recently led a letter, with 70 of my colleagues, asking the Biden administration to, at minimum, reinstate these important measures.

Mr. Britton, does your organization support the strong implementation of the Obama-era standards for the light-duty sector that are necessary to reduce emissions and expedite EV adoption?

Mr. BRITTON. Yes, we do, and we thank you for leading the letter.

We have called for strong fuel economy standards for a couple of reasons. One is consumers are not demanding less-efficient vehicles. Every year consumers are rewarding the manufacturers that are providing more fuel-efficient vehicles. And so it helps us keep pace. And we don't have to look far back to know what happens when we get caught from behind. So, if we look back to 2007, more fuel-efficient foreign imports ate our lunch, and it led to a $34 billion auto bailout.

And so other countries are racing ahead, and that is the right market signal to send to suggest to both manufacturers but also our foreign competitors that we are taking this seriously and we are going to make this transition in the next 10 or 15 years and not the next 40 or 50.

Ms. MATSUI. OK, thank you very much.

Clean transportation is crucial, as we know, to reduce harmful emissions, which disproportionately affect communities of color and low-wealth populations. And that is why I have long been a leader of initiatives such as the Diesel Emissions Reductions Act, as we call DERA, to retrofit legacy diesel engines. And I led a letter to the Appropriations Committee to increase this funding.

Mr. Britton and Dr. Phadke, in both your testimonies you highlighted the negative impacts of medium- and heavy-duty vehicle emissions. Can you expand on how increased funding for DERA and other provisions in the CLEAN Future Act can help electrify medium- and heavy-duty vehicles and ensure the transportation transition is equitable?

Mr. Britton?

Mr. BRITTON. Thank you. Well, I think it is also important for California how the stakes are—the transportation sector emits more carbon emissions than any other sector in our economy. Right now, countrywide, that is about 28 percent. In California, I believe it is well over 40 percent. So the Diesel Emissions Reduction Act, in concert with the congestion mitigation and air quality programs, all drive really important emissions reductions in those frontline communities and have a huge impact on public health.

And again, I think it is important to note where, if you don't feel like it is an emergency for your community, that doesn't mean that it is not an emergency for other communities. And the public health impacts are dramatic.

Ms. MATSUI. OK. Dr. Phadke, do you have any comments on that?

Dr. PHADKE. Yes, I would say that it is a very important issue. And what is actually exciting is that battery technology has moved fast enough so that even medium- and heavy-duty trucks can be electrified cost-effectively, meaning that our recent work shows that electrifying a long-haul truck will save the long-haul truck operator $200,000 over its lifetime.

And I want to explain why really quickly. Long-haul trucks drive five times as cars. They are driving 100,000 miles a year. So, if your savings are based on total mile, because they are much lower to operate, then your savings are higher. So I would say that, from equity, and from an environmental perspective, but from economic perspective, this is apportionment is just massive. So anything that pushes that forward is of great value.

And our assessments have—last 3 years.

Ms. MATSUI. OK, thank you. The Biden administration's plan includes $15 billion to help build and support a national charging network of half a million stations by 2030. Accessibility for communities of color as well as rural and underserved populations are a top priority as we expand EV charging.

Mr. Jankowsky, what additional efforts should Congress prioritize to ensure that underserved communities can become a part of the transition to EVs?

Mr. JANKOWSKY. So thank you, Congresswoman Matsui. I see that I am already out of time, but I will——

Ms. MATSUI. I am sorry, yes.

Mr. JANKOWSKY. No, no, no, I will give a brief answer. So what the Federal Government can do for these communities?

You know, private companies like ourselves are naturally doing this because we see the utility. However, there could be, as an example, some sort of set-aside for these types of communities, just as an example, to encourage other companies like ourselves to actually leverage those funds and place them in communities where, currently, utilization is very low.

So private enterprise is certainly not going to go into those communities and tell those communities "start buying EVs" in a massive way. We think that is a coordination problem, and that is why we are there today.

Ms. MATSUI. Sure. Well, thank you very much.

And thank you very much, Mr. Chairman, for your patience.

Mr. RUSH. The gentlelady yields back. The Chair now recognizes the gentlelady from Arizona, Mrs. Lesko, for 5 minutes.

Mrs. LESKO. Well, thank you, Mr. Chairman, and thank you to all of the people that are our witnesses today, I appreciate the time. My first question is for Mr. Jankowsky with Francis Energy.

I believe you said that you built 355 electric vehicle charging stations in Oklahoma, and that the rural charging stations take 50 to 70 minutes to charge the vehicles. Is that accurate?

Mr. JANKOWSKY. So, Congresswoman Lesko, thank you for the opportunity to kind of clarify.

So there's basically three gradations of superchargers. There is the 60-to-90-minute charger, and those have applications that we discussed.

There is also the 20 to 40-minute charger. And that, to us, is kind of the bread and butter for retail settings, because it typically matches kind of the behavioral patterns of people going into grocery stores, or going to shop, or eating in cafes.

And then you have the 7-to-12-minute chargers. So in the State of Oklahoma, we have four of these systems that are currently at convenience facilities, convenience stores, on highways through Oklahoma. Those are all in rural areas. So the build-out in the rural communities is going to be a mix of those grades of chargers, just depending on the application, and depending on the site.

Mrs. LESKO. And thank you, Mr. Jankowsky. So, just to confirm, you—right now you have—4 of the 355 charging stations are the fast ones, 7 to 9 minutes. And how many are these 20-to-40-minute ones?

Mr. JANKOWSKY. So, of our portfolio, I would say, you know, 49 percent are the 50 kWs. So those are the slower-charging systems, the 60 to 90 minutes that have great applications in certain settings, of course.

The—another 49 percent is the 20-to-40-minute charger. Those, to us, are kind of the bread and butter for public usage, not for cross-country commuting traffic, but for local communities, a 20-to-40-minute charge.

And then, of course, 2 percent, roughly, are those superchargers, the 400 kW chargers. And the reason for that is they are very expensive, and a consumer on the highway at a Francis Energy station getting a 7-to-12 or 9-minute charge is going to pay anywhere between $18 to $22 for the full range, 300-plus-mile range, to fill up their battery.

That is kind of the market in our part of the world. Obviously, it is going to be very different, because it is very dependent on electricity rates, which is very local.

Mrs. LESKO. And how much would a full charge that costs 18 to 22 dollars to fill up, how far would that car go?

Mr. JANKOWSKY. So, Congresswoman, that is very much dependent not on the charging stations, which can deliver all the power that any car is going to need in America, it is dependent on the battery in the car and the onboard software that controls it.

So, as an example, you know, a Nissan Leaf today is going to take longer to charge, simply because of the battery chemistry. There is a smaller battery in that Nissan Leaf. Whereas, a larger vehicle with a larger battery will be able to take that charge in 7 to 9 minutes——

Mrs. LESKO. So——

Mr. JANKOWSKY [continuing]. And go 300-plus-mile ranges.

Mrs. LESKO. OK, thank you. And I am going to go to Dr. Foss.

Dr. Foss, do you think it makes sense for us to shift so fast to electrification of the transportation sector and the goal of reducing emissions when existing electric vehicle battery production in China is powered significantly by coal-fired electric power generation?

Dr. FOSS. Congresswoman Lesko, I think that, for many, many years, the bulk of battery making in many places is going to be powered by coal use. That is the structure in most of the countries outside of ours. Even in ours, in some places where battery manufacturing is either located now or contemplating it being located, it will use whatever is available on the grid. And good baseload power—I mentioned nuclear earlier, coal, other sources, natural gas—will be what feeds battery manufacturing.

What we are doing is shifting emissions around. I appreciate fully the desire to do things that reduce pollution in urban airsheds and other places. I think what you have to do is weigh that against all of the consequences that are being created elsewhere in the supply chain and value chains.

Mrs. LESKO. Thank you.

And Mr. Chair, I yield back.

Mr. RUSH. The gentlelady yields back. The Chair now recognizes Mr. Welch for 5 minutes.

Mr. WELCH. Thank you very much, Mr. Chairman. This has been a very good hearing, including many of the concerns that have been raised by——

Mr. RUSH. Could you——

Mr. WELCH. I am from rural Vermont.

Mr. RUSH. Would the gentleman suspend?

Peter, will you move closer to your mike?

We lost you now.

[Pause.]

Mr. WELCH. Thank you.

Mr. RUSH. All right.

Mr. WELCH. I was saying that I wanted to thank my Republican colleagues and also Mr. Butterfield for bringing up concerns that rural America has. These are significant in Vermont, as well.

But raising the concerns doesn't—it doesn't answer the challenge that we have and also the market reality. I mean, concerns about the range anxiety, concerns about access to critical minerals, concerns about folks who are driving SUVs and pickup trucks—and there's an awful lot of those in Vermont, we love them—it does not answer the reality that the market is moving. VW is doing electric, GM is going all electric, and Ford is going all electric. And we are in a competition with China to see who is going to be on top in the electric market and also create a new future.

So raising those concerns is not a reason to stop or pause, it is a reason to answer. So I will start by asking, Mr. Britton, would you agree that it is important for the U.S. to significantly improve its collection, recycling, and reuse of critical minerals?

Mr. BRITTON. Absolutely, and I think most people would be shocked at how much of these minerals we can actually acquire from a battery.

So we have got members like LifeCycle, Redwood Materials, an American battery technology company, and they are able to get, on average, about 95 percent of the critical materials out of a battery. In some ways, their biggest challenge is there is not many EVs coming out of their lifecycle. A lot of EVs go into a second use, where the battery is used for stationary, utility-scale storage. And so they are left with——

Mr. WELCH. Well, that is great. You have made my point, so I want to come back to a few other questions.

I am introducing legislation that would incentivize public, on-street, publicly available EC charging. Mr. Siccardi, could you—I know you want to have some help with the private infrastructure, but do you have any problems with access so the customers you have can get it at home in their apartments, apartments that would be built with building codes so that the charging will be available?

Mr. SICCARDI. No, we——

Mr. WELCH. So that is OK, but what you want to do is get some help so that you can provide this option for your customers, the fuel choice that they prefer, correct?

Mr. SICCARDI. What I would say is we want consumers to have a choice to shop wherever they want to shop, or power wherever they want to power.

Mr. WELCH. We get that, and we have got these local stores all over Vermont, and people love them. And it is a place where they get fuel and—I hate to say it—pick up a doughnut or two.

The question that I have for—here—what is the best method by which the public, who—the driving public—can get access to the EV charging station? Doesn't it absolutely require, Mr. Britton, that there would be some public investment in this?

Mr. BRITTON. Absolutely. And I think that is—you know, David has mentioned this already. There are some areas where there is a really strong commercial case now. But the importance is the sequence. So you want to outsequence the vehicle to address range anxiety, but you don't want idle capital. So the sequencing is important, and getting into those areas that are underserved, whether that is rural or other low-income areas, are critical.

Mr. WELCH. So how do we get into those underserved areas and have a policy where, from the very beginning, that is what we are doing?

Mr. BRITTON. Well, the two main levers are the 30C tax credit, which provides an incentive. The other is the rebates. And I think you and Congressman Tonko have put forward ideas on how to do that, and I think they are complementary policies that will allow for flexibility to meet each community's needs.

Mr. WELCH. And Mr. Nassar, do you have any views on this, with respect to how this is going to affect job access and wages for the people you represent?

Mr. NASSAR. I am sorry, are you talking about the charging stations and how they are set up? Is that what you are talking about?

Mr. WELCH. And also, you know, comment on the—the problems that folks have raised are problems.

Mr. NASSAR. Sure.

Mr. WELCH. But it is not as though raising the problem is we don't try to solve the things, we do solve them. So maybe you could comment on that.

Mr. NASSAR. Sure. I mean, I think, first of all, you know, as has been stated many times, you know, it is a global market. EVs are an increasing share. The real question is the speed in which it happens, and where those jobs are going to be.

And I would just say that, you know, one way to ease working people's minds is to have, you know, not only just policy here, but also a tax policy, others that hold companies accountable. We are seeing companies, you know, make—get taxpayer assistance and then turning around and making big investments overseas in electric vehicles.

So one of these things is we really need that production here. We need to become good jobs. That is the way that you reduce anxiety with our members. They need to see good jobs——

Mr. WELCH. Thank you, Mr. Nassar, thank you. My time is up, so I want to yield back and not overstay my welcome.

Mr. RUSH. The gentleman yields back. The Chair now recognizes the gentleman from Indiana, Mr. Pence, for 5 minutes.

Mr. PENCE. Thank you, Chairman Rush and Ranking Member Upton, for holding this hearing today, and all the witnesses for your participation.

Representing the crossroads of America, I support innovation in the transportation industry. At home, companies throughout Indiana's 6th district are leading the way in developing low-emission engines, EV batteries, and alternative fuels like hydrogen. But the future of our transportation industry should not be a one-size-fits-all decision made by Washington.

We should seek a diverse slate of technologies and delivery options competing with one another to reduce the financial pressures on our consumers. Lightweight fuels like hydrogen can generate enough power to haul heavier loads and should be a major part of the conversation. Renewable diesel that lowers agricultural emissions is fully compatible with existing diesel assets and has a place at the table, too.

Electric vehicles make sense for cities and densely populated areas, where commutes are predictable and charging stations may be more economical. However, instead of bolstering innovation in transportation fuels, this bill imposes unrealistic deadlines to establish electric vehicle as an only solution. The provisions of the CLEAN Future Act are moving ahead of our ability to get the products to consumers, as my peers have mentioned repeatedly.

It will take more than a decade to construct the high-voltage transmission lines needed to meet transportation demand peaks. Coal is achieving this in my district right now.

On the generation side, the out-of-touch clean electricity standards timeline set in this bill will only drive up costs for consumers. In Indiana, efforts to implement wind and solar have already started to increase electricity prices for ratepayers. In a mere 2½ years from today, the retail power sector will need to start overhauling assets to meet compliance. Meanwhile, it can take up to 5 years to fully implement carbon capture equipment that is still not ready for commercialization.

I agree with my colleagues that EVs will play a critical role in our future transportation sector, and there are appropriate opportunities to incentivize manufacturing here in the U.S., which could bring back jobs lost to China and other countries. But the CLEAN Future Act severely limits hydrocarbons and plastic production necessary for car manufacturers without a realistic alternative by harming the very petroleum industry that has millions of jobs.

This bill makes no meaningful regulatory reforms to protect the supply and economic case for mining minerals and rare earths here in the U.S. All the while, provisions of this bill will put all ratepayers, not just EV owners, on the hook to foot the bill for charging infrastructure, unfairly costing my rural areas early in the process.

Mr. Siccardi, you mentioned in your testimony that there is a missed opportunity for the committee to create incentives for private investment. Particularly, you mentioned the fairness in electrical pricing. I, too, am concerned that this Act may put your industry at a competitive disadvantage. As you know, I spent many years in your industry. You and I remember when retailers were protected against predatory pricing by retail refiners.

My question: How would you propose fairness in wholesale electric pricing to private retailers be managed to prevent the destruction of your constituents and all of the convenience of your industry?

Mr. SICCARDI. Thank you for the opportunity to speak on that. We think this is really an opportunity for the committee to consider.

The power markets were structured almost 100 years ago. And, as the world is changing and new technologies are coming about, we have to look at new regulations. The current regulations put very large demand charges on when you pull a large amount of grid—load from the grid. And those demand charges make the business case for EVs untenable for high-speed charging applications.

That is why we would hope that the committee would seek to figure out a way to address that, to offer a wholesale pricing for people that are offering EV charging services, or to ensure that utilities charge no worse than their transfer price or their avoided costs. There's a number of ways to solve this.

And I want to be clear here. This isn't at the expense of utilities. There is a role for utilities here. All of us have to participate in trying to move this technology forward. The role for utilities is adding redundancy and resiliency to the grid, adding the load necessary to be able to support the high-speed chargers. It is the role for retailers, whether it is retailers that are fueling locations or other retailers, to offer the services to consumers in the places where they want to go.

Mr. PENCE. Thank you, Mr. Chair.

Mr. RUSH. The gentleman yields back. The Chair now recognizes Mr. Schrader of Oregon for 5 minutes.

Mr. SCHRADER. Thank you very much, Mr. Chairman, I appreciate the opportunity to participate in this hearing. It is very interesting. It is going to be very critical for the future of our country. I guess my first question is for Mr. Nassar.

You know, everyone talks about—well, a lot of people talk about all the new jobs that are going to be created by the green revolution and the opportunity for electric vehicles and what have you. And I think that is true. I am looking forward to that. But I am concerned about the current jobs, make sure those folks that—in this great country that work in the oil, gas, and coal parts of our geography have opportunity, too, and even more particularly for UAW workers.

I mean, I guess my question is what—are the skills transferable between what your men and women do on combustion engines to the electrical vehicle sector?

Are there provisions in place to make sure there is an opportunity for those folks to get trained to transition over to working on electric vehicles?

Mr. NASSAR. I could speak most to the—well, thank you for your question, first of all, to the—to our—you know, to where we have a union workforce collectively bargained, because there are, you know, apprenticeship and training programs which enable people to have that transfer of skill. The problem isn't lack of workers who can do the job when it comes to EVs and such.

But I want to talk to your point about, yes, we got to make sure these jobs are good jobs. And right now what we are seeing is we are seeing a lot of folks, frankly, in the industry, new OEMs, who are resisting giving workers a voice, even though often they have it in their home country.

So real wages in auto have dropped 20 percent over the past 15 years. If we don't start creating good jobs in auto through this transition, I think there is going to be actually a backlash on this, which would actually reduce the ability to achieve the environmental goals too. So, yes, we better get this right. I hope that helps answer the question.

Mr. SCHRADER. No, that is great. Yes, we need to have some labor standards in here to make sure we are not downwardly mobilizing American families. So thank you.

Mr. Siccardi, I think your line of concern is very legitimate. I guess the question would be, why are we even subsidizing public stations?

Why not just—we have got gas stations, truck stops all over the country. Why are we not targeting them with whatever public assistance we get to set up these EV charging stations?

Mr. SICCARDI. I think the best way to do that would be to provide the profit incentives for retailers to make that investment. We are prepared. We have made that investment over the course of the last 60 years. We can continue to make those investments. We have the right real estate, the amenities, the things consumers want.

The problem is we have some true problems with the business cases. Representative Pence just mentioned the fact that we buy power from a utility at a retail price and then try and turn around and sell a retail price to consumers. It doesn't work. The structure of the electricity market, as it was structured 100 years ago, doesn't work with demand charges. The nature of power for charging is you have to have a lot of load to put in a battery in a short period of time.

As we do more [audio malfunction] and it makes it impossible to recover that from the consumer.

Mr. SCHRADER. So some sort of incentive or direction to our utilities to, you know, to help incentivize that opportunity for EV stations so that they could—I would assume some sort of discounted rate so that you can mark it up at least a little bit and make it worth your while.

Mr. SICCARDI. There's lots of ways to do it, but bottom line is a mechanism for us to be able to have a wholesale rate for power so that we can offer consumers a retail price and be able to still offer low prices to consumers but have some ability to compete. If we can do that and address some of the other obstacles we mentioned, like making sure we don't do rate basing and provide a competitive market, then I feel confident capital will come into the marketplace and will provide the charging stations necessary.

We believe it is important to have the level three fast chargers. It—we don't believe the market is going to work with just level one and level twos. We do believe people will charge at home. But for people to have ultimate comfort in driving across the country, or wherever they want to, they have got to know that they can stop at a place that they can charge quickly, and that it has the amenities that they need.

Mr. SCHRADER. Well, and Mr. Jankowsky, real quick, I am mostly concerned about rural America. I mean, I think there is a—can be a business case to be made that these stations could go easily in urban areas. But, you know, for the long haul, an urban guy—or rural guys, you know, the farmers and ranchers, how are they going to be able to access EV stations where they live?

Mr. JANKOWSKY. Well, we are going to have to put charging stations into farming and rural communities. And the reason why the incentives are so important is because private capital simply is not going to put in charging stations in those rural communities, at least in the first couple of years, because there is simply no one charging on those systems.

I mean, our system in Oklahoma today achieves maybe 1 percent utilization, just a very fancy name for how often it is being used. Our forecast is 5 to 10 percent in 5 years. So there are companies like ours that are prognosticating that cars will be in these communities. But that is not where chargers are going in today. And that is why, quite frankly, the CLEAN Future Act provides that incentive for us and other charge point operators to go into those communities.

Mr. SCHRADER. Very good, and I apologize for going over my time, Mr. Chairman.

Thank you all very, very much.

Mr. RUSH. The gentleman yields back. The Chair now recognizes the gentleman from North Dakota, Mr. Armstrong, for 5 minutes.

Mr. ARMSTRONG. Thank you, Mr. Chairman. And thank you, Congressman Schrader, for raising some of those issues, as well. You know, we heard earlier sequencing is important, and I agree with that. And listening to Mr. Siccardi's testimony about this, I think, is also important.

But I have also heard some of my colleagues talk about rural areas getting left out. I will be here right now and I will just say

I am comfortable with North Dakota getting left out of the first portion of this, because I do think sequencing is important, and we are rushing towards these things and we keep acknowledging what the challenges are, but we just gloss over what it is going to take to solve those challenges.

And I think a perfect example is exactly what we are talking about, is who is going to play in this space. We are investing billions and billions of infrastructure, but we are spending very little time about—talking about who is going to play in the space, whether it is a utility, a municipality, private equity, gas stations, all of this. There are structural ways in which electricity is delivered to communities that has to be addressed before we move into this portion of that.

And I mean, that is before we get into heavy trucks, a Volvo. A Volvo truck for a medium-weight load is about 800—8,000 pounds more than a diesel truck. That means you have two options. It either carries one-seventh less weight, which means more deliveries, higher prices, or you have to raise road rates, and in places like mine, which means more roads are going to get beat up, they are going to be dealt with—dealing with that.

How about 90 minutes to charge a truck? Does that—I mean, what does that do to hours of service? What does that do to cost of delivery? These are all real things that exist, and we have to talk about them. Because I agree, to some degree or another, electric vehicles are coming.

And that is before we talk about, if we are going to expand the grid on resiliency and reliability, which we have had numerous other hearings on, how do you deal with people plugging in their car at night when the sun isn't shining and the wind isn't blowing? These are real, consequential things.

And I appreciate what my friend Congressman McKinley talks about, outsourcing our guilt, and where we currently get our rare earth metals. Because one of the things—we do have them here, we have lithium deposits here.

And we talk about the streamlining permitting and development like we are just going to snap our fingers and do that. But that is ignoring 50 years of permitting history, whether it is at the Federal, local, State level, and the regulatory fights. That is before you get into sue-and-settle litigation with activists that will file a lawsuit if you are potentially going to harm an earthworm.

So, I mean, we have to—this—as we move forward—and listen, these things are going to move forward. We have to be better at addressing some of these.

So, Dr. Michot Foss, your testimony, you discuss recommendations for overall economic growth and performance, including statutory and regulatory changes. Are there opportunities to pursue these changes while utilizing existing energy infrastructure?

Dr. FOSS. Absolutely. If you have a more reasonable view of the world and you think about how long it will take to deal with—to actually construct solutions for a lot of the things that we have been pointing to today, I think that you could rely on investment coming from existing legacy energy businesses as they move forward with all of the strategies that they have got to continue to ensure that traditional fuels are clean and widely available and affordable.

I mean, a more reasonable approach would allow all of those things to take place. Sound tax policy, making sure that, you know, you, our representatives on the Hill, are not moving us in directions that—in which the Federal Government is becoming too intrusive, especially on State and local initiatives. I mean, those are all things that, taken together, I think, could improve on the picture hugely.

Mr. ARMSTRONG. You also discussed workforce training and development, something even Energy Secretary Granholm touched on in March when she stated having coal workers employed in the mining of critical materials is a natural shift. Wouldn't easing permitting and existing mine transition also support your recommendation of workforce education and retraining?

Dr. FOSS. So I think if you are—you were breaking up a little bit. So what you are raising a question about is how to streamline permitting and certification of new facilities, which, by the way, includes recycling.

One of the things that gets taken very lightly is the certification process that you have to go through to participate in recycling, because you are dealing with hazardous materials, all—under all of our existing laws. So you need the appropriate education and skills competency. You need people who understand how mining and minerals processing work. We have done a good job of kind of depleting that part of our labor force.

I made a comment to one of Mr. McKinley's staff yesterday that, when I look at this—I am a Colorado School of Mines alumni. When I look at the state of mining, engineering, metallurgy, other essential disciplines today, the coal industry historically has done a huge amount to contribute to that, because it is a big part of the extractives businesses. We have done a good job of actually impacting all of the programs that now we need, by actually putting the coal industry under pressure. Those are just realities that we have to deal with.

Mr. ARMSTRONG. I appreciate that, and our coal guys are pretty good at making a money—or making a living digging stuff——

Mr. RUSH. The gentleman's time has——

Mr. ARMSTRONG. I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes the gentlelady from New Hampshire, Ms. Kuster, for 5 minutes.

Ms. KUSTER. Thank you very much, Chairman Rush, for organizing this important hearing, and for your commitment to ensuring that all Americans, regardless of their ZIP Code, have access to electric vehicles.

The transportation sector is the number-one source of carbon pollution in the United States. And as we decarbonize our electric grid, transitioning to electric vehicles will help our country reduce carbon pollution. In order to support electric vehicles, we need to build out a robust network of charging stations around the country. But these charging stations can't be isolated to urban areas or along major highways. We need to ensure that electric vehicles chargers are built in rural communities too.

Sadly, two rural counties in my district, Coos and Cheshire, don't have a single fast-charging station. Rural communities need robust charging infrastructure that—so that people who live there can experience the benefits of electric vehicles, like lower maintenance and fuel costs, and so that visitors, including our guests from Canada, can feel confident traveling to and spending their money in rural communities.

The CLEAN Future Act and the bills before the committee today are a historic step. They will help address some of the financial barriers to expanding electric vehicle charging infrastructure in rural communities, and I commend my colleagues for their important work.

One of the major barriers to deploying electric vehicle infrastructure in rural communities are fees called demand charges electric companies place on businesses with electric vehicle fast-charging stations. In New Hampshire this means that small businesses or towns can't afford to operate these fast-charging stations. These fees are particularly burdensome in rural communities. One charging station in Derry, New Hampshire, was forced to close because demand charges made it simply unaffordable to operate.

Mr. Jankowsky, in your view, are these fees known as demand charges a barrier to deploying fast-charging stations, especially in rural communities?

Mr. JANKOWSKY. Thank you so much, Congresswoman, for the question. I think you have just identified probably the number-two major barrier to EV infrastructure deployment. The first is, obviously, the upfront capital costs. You are talking now about the ongoing operating costs of these chargers. And, yes, high-demand chargers, particularly in rural areas, where many of our chargers are, is a major impediment to EV adoption.

Now, how do we handle it? So, in the rural communities, with the rural electric co-ops and municipalities that are providing electricity, we are building relationships with all of these utilities in rural communities, and most of these rural electric co-ops are not subject to State utility commissions, necessarily, at least not extensively. So we are able to go to the co-ops on a one-on-one basis and say, "We want to bring significant infrastructure to your service territory, but your demand charges are going to impede that." So it almost becomes a bilateral discussion simply to say, "If you, Mr. or Mrs. Rural Electric Co-op, can reduce your demand charges or give us a significant holiday, right, for the first 5 years, that would be extraordinarily helpful to us."

Now, in return, we could certainly absorb higher kilowatt hour rates for EV charging stations, and that is simply because of the dynamics of electricity going through, and the price of that electricity. You can—a charging station operator that is operating direct current fast chargers can absorb that. What you cannot absorb are the exorbitant demand charges because, in the rural areas, consider there is only one or two people with charging stations today. The second they plug in, you get hit with what could be, in some of our areas, $2,000 per month that is basically set on a rolling average for 12 months. There is no——

Ms. KUSTER. I am sorry to interrupt you——

Mr. JANKOWSKY [continuing]. Way anybody can make money——

Ms. KUSTER. I want to make sure we get to all our witnesses.

Mr. Siccardi, in your view, are these fees known as demand charges a barrier to deploying fast-charging stations in rural communities?

Mr. SICCARDI. Absolutely. And I would expand to say it is not just in rural communities, it is across the country. It is urban, suburban, rural. It is a part of the utility pricing model. And it has to be addressed to create the profit incentive for any retailer to want to invest in high-speed charging stations.

It is good that we are able to do one-off things with co-ops from time to time, but that is not a scalable model. If we want to see charging stations——

Ms. KUSTER. Thank you, I apologize. My time is up.

But I do want to yield back by saying that, Mr. Chairman, the majority and minority witnesses are in agreement here. And if you will indulge me, I seek unanimous consent to enter a white paper by the Great Plains Institute, and another article by Dr. Phadke. And I will make sure that those get to the committee.

And with that, I yield back. I apologize for cutting you off.

Mr. RUSH. The gentlelady yields back. The Chair now recognizes the gentleman from Alabama, Mr. Palmer, for 5 minutes.

Mr. PALMER. Mr. Chairman [audio malfunction].

Mr. RUSH. Mr. Palmer, can you come closer to your mike, or—it is hard to hear you.

Mr. PALMER. OK. I said can you allow the next Democrat member to ask their questions? I am having some connection problems. Can you hear me?

Mr. RUSH. Yes, OK, all right. Well, we will come back to you.

Mr. Walberg of Michigan, you are recognized for 5 minutes.

[No response.]

Mr. RUSH. All right. Mr. Bucshon of Indiana, you are recognized for 5 minutes.

[No response.]

Mr. RUSH. All right. We will go back to Mr. Palmer.

Are you prepared, Mr. Palmer, now?

Mr. PALMER. No, sir, I am not. Let me—I am trying to get——

Mr. RUSH. OK, we will go back to the Democrat side. Ms. Barragán, you are recognized for 5 minutes.

Ms. BARRAGÁN. Well, thank you, Chair Rush, for holding this important hearing on how we reduce and eventually eliminate emissions from the transportation sector. This is critical for our climate and for bringing cleaner air to my district. The transportation sector is the largest source of greenhouse gas emissions and a major source of ozone emissions and particulate matter.

My district in Los Angeles County is not in compliance with the EPA air quality standards for ozone emissions and particulate matter, which leads to higher rates of cancer and respiratory illnesses. This also made us more vulnerable to COVID–19 and COVID–19 deaths. A priority of our electric vehicle policies has to be expanding access to communities of color and low-income residents who are most impacted by air pollution.

Mr. Britton, we need to think creatively on how electric vehicles access can work for people who often struggle to afford a car. One example in my district is at Rancho San Pedro, a 478-unit public housing complex that has recently launched a community car-share program named Rancho San Pedro Electric Car Share. This project brings the benefits of electric vehicle access and mobility to residents who previously had neither. Should our policies for encouraging electric vehicle adoption be thinking outside the box about how to be inclusive and whether that always involves ownership of a car?

Mr. BRITTON. Absolutely, and I want to thank you for providing leadership in this space, especially on port electrification. I think that is another area where there's a lot of dividends, certainly for areas with disproportionate public health impacts from emissions. But certainly, we should be thinking about flexible ways to deploy electrification, whether that is on the light-duty side or on the medium- and heavy-duty and, you know, potentially, forklifts and drayage trucks, the things that are, you know, an everyday part of life in the port landscape, as well. So I think we absolutely need to be flexible. It needs to be leasing. It needs to be used cars. It needs to be ride share.

We can actually achieve the emissions reductions necessary if we are smart and we think about all the various use cases that provide an opportunity for us to deliver a better experience to drivers and address the public health impacts that we know in your district are particularly acute.

Ms. BARRAGÁN. Thank you for that.

Dr. Phadke, it would be helpful to get a sense of scale for how big our investment plans need to go to eliminate emissions from the transportation sector. The American Jobs Plan includes $15 billion for a national charging network and a total of 174 billion over 8 years when you include electric vehicle incentives and grants. Is this enough public investment to decarbonize our transportation sector, or should we go bigger?

Dr. PHADKE. I would suggest that that is about the scale that appears to be reasonable. Just in comparison, the annual utility-sector revenues are about $400 billion. And if you look at auto-sector revenues, they are about $800 billion. So, yes, these numbers look large, but in comparison of the saving estimates that we have, they are pretty modest.

I would say that these incentives need to be matched by clear goals of electrification on zero-emission vehicles. That, in fact, in addition, could go a long way in terms of providing the investment certainty to automakers and utilities to make those investments. So establishing a clear goal of when we should be reaching all vehicle sales to be zero emission, a technology-neutral goal, will also be critical and complementary to these investments. And that is the way to go bigger, I think.

Ms. BARRAGÁN. Well, thank you. I just want to highlight a piece of legislation called the THRIVE Act, which I am coleading with my colleagues, Representatives Dingell and Clarke, which would be a good investment and a large investment in electric vehicles and charging over the next 10 years.

Mr. Britton, electric truck adoption in the goods movement system is an important part of reducing emissions in the transportation sector. Many trucks bringing cargo from ports are bringing the cargo to rail yards or warehouses well within the range of battery. Do you agree that investing in purchasing electric drayage trucks at ports could help to accelerate the adoption of heavy-duty electric trucks?

Mr. BRITTON. Yes, and there's two important points here. One is that we have really sophisticated buyers in the medium- and heavy-duty space, so they can, you know, see through and have a line of sight on the net present value savings that are to be accrued. The other thing that I think is really exciting about that use case is you think about induction charging, the kind of charging that, while in operation and use, can also be charging the vehicle to have continuous and unlimited charge for those use cases. So there is a lot of innovation to be had in that space.

Ms. BARRAGÁN. Well, thank you for that. And my bill, the Climate Smart Ports Act, which is in the CLEAN Future Act, includes grant funding for replacing diesel drayage trucks with zero-emissions vehicles. It is as much a transportation bill as it is a ports bill.

And with that, Mr. Chairman, I yield back.

Mr. RUSH. The gentlelady yields back.

Mr. Palmer, are you prepared to question the witnesses?

Mr. PALMER. Can you hear me now, Mr. Chairman?

Mr. RUSH. You want to try——

Mr. PALMER. Can you hear me?

Mr. RUSH. Yes.

Mr. PALMER. Mr. Chair, you can hear me now? Thank you. Yes, sir, I will be happy to——

Mr. RUSH. You are breaking up——

Mr. PALMER. Thank you for your indulgence.

OK, Mr. Siccardi, we have heard a lot about justice and environmental justice in this committee. Section 435 of the CLEAN Future Act would require [audio malfunction] consider allowing utility companies to recover from ratepayers any type of operating expenditure or other costs with the electric utility relating to operating expenditure—programs or investments associated with integration of electric vehicles—the grid. In layman's terms, the electric companies can build whatever they want related to electric vehicles, and everyone with electricity service has to pay for that.

Would you consider that——

Mr. RUSH. Mr. Palmer, you seem to be—we can't hear you well. You try to correct your technical difficulty, and we will—I promise you, we will get back to you. But please try to—we can't hear you at all.

All right, the Chair now recognizes Mr. O'Halleran for 5 minutes.

Mr. O'HALLERAN. Thank you, Mr. Chairman, I appreciate the time—and ranking member.

I want to start off with a little bit of discussion about—earlier on it was mentioned, "the American way." And my definition is—that relates to this issue—is we need to be innovative, protect our market share, to be able to be competitive in the entire environment that is out there, not go and say somebody else can take care of it and we will follow. We don't follow. We are America.

We have to identify that we need to plan for the future. This is what this is doing. And the competition side of it is—that is what we are made of, as a country. We grew up being competitive and not taking second place.

Research, we are doing the research now. We are moving forward with it. It would be terrible if we even thought of not addressing this in a meaningful, strategic way.

And then, obviously, recognize our competition, and stay ahead of them all the time. So thank you for that right now.

I am pleased to—that this committee is working on legislation to expand the use of electric vehicles across the country. I hope this is an area where we can have some bipartisan agreement on both sides of the aisle.

Mr. RUSH. Can you please——

Mr. O'HALLERAN. Arizona is ready to be a leading player in this industry, with local manufacturing plants ready to roll out parts for EVs. We have two EV factories, manufacturers in the State already, with a third on its way in Arizona. The industry is opening up new, good-paying jobs for Arizonans, and will across America.

However, we must ensure that changes to the transportation sector do not leave our rural areas out. I am proud that the CLEAN Future Act includes a provision I have championed to provide grants to determine where charging stations will need to be. We want to see these charging stations built, but we need to know where to put them first. These grants would be available to communities and private entities. The data collected from this program will be available to the public. As we encourage the build-out of electric vehicles, charging stations, we need to be careful in setting up the right incentives for market competition.

We also need to make sure our electric grid can handle the increased demand that comes from more EVs and have it much more reliable than it is today.

Mr. Jankowsky, can you tell us what successes you have seen in getting private capital to build chargers in rural communities?

Mr. JANKOWSKY. Thank you so much, Congressman, for the question. So, you know, Oklahoma and the network in Oklahoma was built, really, through a public-private partnership with the State of Oklahoma, and it was through various funding mechanisms. One was a State tax credit. Also, Volkswagen funds that were available for DCFC in our communities.

The success, though, is not necessarily here yet, because there are not many EVs in our rural communities. However, we do have a number of success stories, and just one very quickly.

In a community called Okmulgee in Oklahoma, we put in several fast chargers. And we started noticing utilization on those chargers going up rapidly. In fact, it was probably our best charger in our entire network. And the reason for that is some very enterprising entrepreneur decided to create a ride-share program using electric vehicles, and he uses our charging stations for his business. As a result, his operating costs to run his business have come down so significantly, because fuel is a major component of these ride-share costs. With electricity, the cost of that business has gone down so significantly that he has added more cars and more employees.

We think that is going to happen everywhere, not just ride share, but we are going to see economies of scale and new businesses across the entire value chain created because you have that public infrastructure now, and you have now given permission to people in those communities to buy cars.

Mr. O'HALLERAN. Thank you very much.

And Mr. Chairman, I have a couple of other questions, but I will yield with this final statement. We owe it to the American people to make sure we do not fall behind in manufacturing of this product, in development of these products. And we also need to understand completely that we have lost the solar market and the wind generation market. We cannot lose this market. And I yield.

Mr. RUSH. The gentleman yields back.

Mr. Palmer, I am going to ask you once again, are you ready for questioning the witnesses?

Mr. PALMER. I am going to try one more time, Mr. Chairman.

Mr. RUSH. All right.

Mr. PALMER. Can you hear me?

Mr. RUSH. We hear you now.

Mr. PALMER. Can you hear me?

Mr. RUSH. Yes, quite well.

Mr. PALMER. OK. First of all, I want to thank you. It is ridiculous that we continue to have these virtual hearings when most of us, if not all of us, have been vaccinated. With that said, I will go back to my questions.

Mr. Siccardi, what I was trying to ask earlier was we heard a lot about justice and environmental justice and climate justice. Section 435 of the CLEAN Future Act would require the States to consider allowing utility companies to recover from ratepayers any capital operating expenditure or other costs of the electric utility relating to load management programs or investments associated with the integration of electric vehicle supply equipment into the grid.

In layman's terms, the electric companies can build whatever cost they want to into the—related to the electric vehicles, and everyone in the electricity service has to pay the bill. Is that just? Would it be just to the single mom that only takes a public bus has to pay for electric vehicle charging stations if she has electricity in her home? Would that be just?

Mr. SICCARDI. We think it is a problem. We don't think utilities should be able to rate-base for charging equipment. As I said a few times, it will not only pass the cost onto consumers that don't have EVs, but on top of that it will crowd out private capital.

Mr. PALMER. Well, it is also interesting to note that the AARP agrees with you on that. Some minority groups agree with that. You know, I keep trying to bring up the fact that they keep talking about climate justice and environmental justice, but there is also a problem with energy poverty, energy justice, economic justice. And they don't seem to be concerned about that, that energy cost is the most inflationary component of our economy. And it is going to have an enormous negative impact on low-income families, their ability to heat and cool their homes.

I raised the example of Pembroke Township in Illinois, town of 2,100 people, 80 percent of them are African-American. They don't have natural gas. Yet my Democratic colleagues all are opposed to natural gas. They don't want it. Yet the Reverend Jesse Jackson is working to get a natural gas pipeline in the Pembroke Township so that those people can stop having to heat their homes with propane or, in a lot of cases, with wood-burning stoves.

Would you agree that the Reverend Jackson is doing the right thing to try to address energy injustice and economic injustice by getting a natural gas pipeline into that community?

Mr. SICCARDI. Well, I would say one of the things our industry is focused on for—since its inception was trying to get the lowest-cost energy to consumers. And I think consumers deserve that. It helps our economy. That is our focus. The last 3 years have been the lowest inflation-adjusted gasoline prices in our history. So I think consumers should have options for all sorts of fuel types to get them the lowest cost of energy.

Mr. PALMER. So what—if I understand what you are saying, it is you don't want a low-income family to pull up to your gas pump and have to make a decision on how much gas they can put in their tank because they are deciding between being able to get to and from whatever job they have and putting food on their table or helping pay for their kid's school. Is it—you want to keep these prices low, because you understand how it impacts individuals up and down the income scale, is that right?

Mr. SICCARDI. America wins when we have low energy prices for all consumers. And yes, that is our——

Mr. PALMER. Yes, I am not against electric vehicles. I want my colleagues on the committee to understand that.

But this bill, like many of the other green initiatives, they take choice away from Americans and they pick winners and losers. And we have seen it with the Keystone XL pipeline. We have seen what has happened to union pipe workers versus the green activists. And I just don't think we need to have politics involved in the decision making, and we certainly shouldn't be subsidizing millionaires' ability to buy Teslas at the expense of lower-income people who are driving used vehicles and not being able to pay their own household bills, living in homes that are colder than they need to be, especially people who are susceptible to respiratory diseases and cardiovascular.

I just think that we are, once again, going down the wrong track with this. And again, I am not against electric vehicles. I just—I am for fairness, I am for justice, particularly for people who are often overlooked when it comes to justice.

And I yield back.

[Pause.]

Ms. BLUNT ROCHESTER. Mr. Chairman?

Mr. Chairman, you are on mute.

Mr. PALMER. Mr. Chairman, I yield back.

You are still on mute, Mr. Chairman.

Mr. RUSH. I am unmuted now, and I guess these technical difficulties are contagious.

I just wanted to just remind the gentleman that we have had hearings on energy justice, and also just to remind the Member I am very familiar with Pembroke, Illinois, and I don't think that your viewpoints of Pembroke are consistent with what is really happening in Pembroke, Illinois.

With that said, I—now the Chair recognizes the gentlelady from the great State of Delaware.

Ms. Blunt Rochester, you are recognized for 5 minutes.

Ms. BLUNT ROCHESTER. Thank you so much, Mr. Chairman, and thank you for calling this important hearing, and to all of the witnesses for your testimonies today.

In Delaware we see the impacts of climate change every day. As the State with the lowest mean elevation in the country, and as the State that is urban, suburban, and rural, and coastal, we see the impacts through saltwater intrusion in our farmlands and wells, to the flooding in our neighborhood, such as Southbridge, Wilmington, and on our beautiful beaches. We can overcome these impacts and tackle the climate crisis, but we need to act now, and the transportation sector can play a key role.

The transportation sector accounts for almost a third of greenhouse gas emissions. And by reducing transportation emissions and shifting to zero- and low-carbon fuels, we can take an important step in our fight against climate change, and we can do it in ways that create good-paying union jobs and protect our environmental justice communities.

And at this point I just want to also clarify something that has been said a few times during the hearing from some of my colleagues across the aisle, just to clarify that we are not insisting that we mandate that new car sales in the U.S. are EVs. The CLEAN Future Act does not include a mandate for EVs. We do include programs and policies that provide grants and support to build out the infrastructure needed for EVs. Additionally, we include policies that support domestic manufacturing of EVs. We see growing interest in these cars, and we are—and vehicles—and we are trying to ensure that drivers have reliable charging options.

So my first question is for Mr. Britton. Countries across the globe are taking steps to modernize and electrify their transportation sector. And in many of those countries, their governments are working closely with the private sector to build infrastructure to support new technologies. Earlier this year I reintroduced the Open Back Better Act, which leverages public funding to draw a private investment for energy efficiency and resiliency—retrofits in public facilities.

How can we take a similar approach in the EV space and use public-private partnerships to build out EV charging stations and support infrastructure—and the supporting infrastructure?

Mr. BRITTON. Well, thank you for the question. I think it is important to note that other economies are racing ahead. And one of the things that we really risk is not only falling behind but getting caught from behind. And it is something that we have experienced in the automotive sector before.

So the opportunities here are multifaceted. We can do something that is great for the consumer. We can do something that addresses climate change. We can invest in domestic manufacturing. We can reduce emissions that harm public health. This is, literally, a win for everybody across the spectrum. We can also do more for rural communities that want economic development with critical materials. So everybody should be invested in getting ahead of this.

And I think that is where the public-private partnerships really exist. We have folks in what we represent as 55 separate companies, they are eager to invest. They are eager to work with local communities, with site hosts, with economic development offices across the country to get this right and make it a win for everybody.

Ms. BLUNT ROCHESTER. Excellent. And just to follow up on that, how can these public-private partnerships support good-paying union jobs for all Americans?

Mr. BRITTON. Well, I think that is one of the exciting parts about this, is these are—this is a stark contrast. We either invest here and we create these jobs here in America, or we are ceding that economic opportunity elsewhere.

And when you think about the entire supply chain, certainly in the upper Midwest we have a long history of providing the parts, components, and critical materials that go into not only your traditional vehicles but even now those advanced batteries. And so these are all jobs that we can be securing for our economy, or ones that we will be ceding forever. And I think Congressman O'Halleran mentioned it with some other sectors. This is a once-in-a-lifetime chance, and we either do it or we are turning our back on this opportunity forever.

Ms. BLUNT ROCHESTER. And just to help us in Congress understand the prioritization for EV infrastructure funding, can you talk about what existing programs within the Department of Transportation or the Department of Energy we should prioritize?

Mr. BRITTON. So some of the—I think, certainly for the public-private partnerships, the loan program office at the Department of Energy is key. You think about the Vehicles Technology Office, the Advanced Technology Vehicle Manufacturing Program. You have got the Congestion Mitigation and Air Quality Program along with the Diesel Emissions Reduction Act. These are all opportunities for us to identify either gaps or problems in our economy and to drive resources and drive investment in R&D to solve them.

Ms. BLUNT ROCHESTER. And my time is running out, so I will ask for a followup for the record, but transit agencies with bus fleets are at various stages of transitioning to zero-emission vehicles. What can Congress do to further enable those agencies as they modernize their facilities and fleets? If we could do that for the record, I would appreciate it.

And, Mr. Chairman, I know I am out of town, so I—out of time, so I yield back. Thank you so much.

Mr. RUSH. Thank you very much. The gentlelady yields back. The Chair now recognizes Ms. Castor of Florida.

VOICE. She isn't here yet.

Mr. RUSH. Oh, she—no? Ms. Castor, is she—I don't see her on the screen.

All right, now we have two—I only see one of them on the screen right now, and it is the gentlelady from the great State of Michigan, someone who has really embedded herself in this particular issue, very knowledgeable about this issue, none other than the gentlelady Ms. Debbie Dingell from Michigan.

You are recognized as a waive-on. We want to thank you for your—and you are now recognized for 5 minutes.

Mrs. DINGELL. Thank you, Chairman Rush, for holding today's hearing, because it is so important to talk about decarbonizing the transportation sector. The CLEAN Future Act will help us accomplish this goal to meet the climate crisis head-on and at the same time support American jobs.

The world is going electric, and the United States has had the opportunity to lead the way. As the automotive industry makes this shift, there are going to be risks and there are going to be opportunities. So we have got to make sure we get the policies right to not only compete and remain the global leader for the next era, which I am very dedicated to, but to also ensure that we don't leave the finest workforce in the world behind: the American worker.

I am pleased that the CLEAN Future Act includes two bills I have authored: the USA Electrify Forward Act, and the ATVM Future Act. Together, these bills will expand the ATVM program to include medium- and heavy-duty vehicles and modernize the ATVM to help develop supply chain manufacturing in the United States with American workers. And the legislation will update domestic manufacturing conversion grant programs to include plug-in electric vehicles and components.

I would like to first start with the UAW. Mr. Nassar, I would like to focus on EV production, the current state of EV production in the United States, in our workforce. From your testimony, you make the case that the United States is falling behind in the production of electric vehicles. First, can you please elaborate more on the specific impediments auto workers are facing referenced in your written testimony?

Mr. NASSAR. Sure, and thank you for the question. You know, I would, first of all, just want to point out that we do have members that are making, you know, battery electric vehicles, plug-ins, and this sort, and we need to just make sure that we are creating a whole lot more of those good jobs. But I just want to say that, just because it is a new job and a battery job or from a startup, we cannot say with confidence that those are good jobs. We—that is yet to be seen.

When you are talking about what our membership and manufacturing workers are dealing with—and we are still in the middle of this pandemic, first of all, you know, blue-collar folks have had to take it really hard in there, they don't have the luxury of working at home like we do.

Then you look at the situation where, you know, we have this massive, you know, supply chain problem with semiconductors, which just points to the fact that we really have neglected our supply chains for a long time, not to mention we have tax policies that are, you know, costing us jobs and are perverse.

We have a lot that needs to be done. We also need to train more folks——

Mrs. DINGELL. Now——

Mr. NASSAR [continuing]. To come into manufacturing.

So I would just say this. At the end of the day, what we need to do is we have to make sure that we are attaching government funding to labor standards and making sure the work is in the U.S. If we do not, the trends are going to continue in the wrong direction, and there is no assurance that the auto jobs of the future are going to be the good jobs that we are accustomed to. There is no assurance of that, whatsoever. So I hope that helps with the question.

Mrs. DINGELL. So what happens if Congress doesn't invest in the EV infrastructure?

Mr. NASSAR. Quite simply, what is going to happen is, first of all, you are going to have an EV market that is continually dominated by the very wealthy. You are not going to have cars becoming cheaper and more affordable, and you are not going to have the adoption rates, and then you are going to have less manufacturing of it here. Most vehicles made, you know—or sold, rather, close to where they are made. We are going to lose supply chains. A lot of bad trends are just going to continue and become, actually, much, much worse, especially over time as more of the fleet becomes EVs and fewer percentage becomes the traditional engine.

So this is the chance to act. If we don't act, we are going to—I am convinced that we will be regretting it for many, many, many decades.

Mrs. DINGELL. I have got 1 minute left, and I was going to ask both you and Mr. Britton, so I will ask Mr. Britton this, but I am going to do more questions for the record.

Mr. Britton, could you speak to the importance for your members of expanding programs and modernizing the ATVM to enable component manufacturers to participate in the program?

Mr. BRITTON. Yes, ATVM has been part of the progenitor story for many companies in the advanced vehicle space, and it is very important. Certainly your upgrades to the program to expand it to medium- and heavy-duty, where there is more innovation to be had, and companies like Proterra that I think are very interested in the program, so I think it is really, really important.

The one thing I would also add is, if there is any doubt about the economic potential here, I think folks need to go back and look to 2 weeks ago, where the GM LG Chem advanced battery plant was announced in Tennessee. The Republican Tennessee Governor called it the single greatest investment in economic development in the State's history. So I think there is a consensus here that we have to take this seriously, but the rewards are not elusive. We can see the material progress on economic development and job creation and something that we can really achieve, and I think your leadership is driving that through programs like ATVM.

Mrs. DINGELL. So I have more questions that I would like to submit for the record, Mr. Chairman.

I would also like to request unanimous consent to submit two documents into the record. The first is a recent background report by the BlueGreen Alliance, United Steelworkers, UAW, and the AFL–CIO that reviews factors likely to drive U.S. job gains and job losses related to the electrification of the U.S. and global vehicle fleet, and the second is a recent joint letter by the Alliance for Automotive Innovation, MEMA, and UAW to President Biden that highlights the need for a comprehensive national vision and strategy for electrification and the policies that will help us get there.

[Pause.]

Mrs. DINGELL. Mr. Chairman?

Mr. RUSH. The Chair will entertain your UC request at the conclusion of the Members' questioning.

And the Chair now recognizes the other waive-on to the subcommittee, Ms. Clarke of New York, for 5 minutes.

Ms. CLARKE. Thank you, Mr. Chairman, Chairman Rush, and Ranking Member Upton, for convening this important hearing on the future of our transportation sector. And let me also thank our witnesses for your testimony today.

I am very optimistic about the opportunities we have before us to fully electrify our Nation's transportation sector. Our colleague Mr. Butterfield remarked earlier during his statement and line of questioning that this is about our future. I would like to add that our future is now.

Right now, transportation is not only our Nation's largest contributor to the climate crisis in communities like mine in the district in Brooklyn, it is also a major source of air pollution that contributes to the disproportionate health outcomes we see around asthma, heart disease, and even premature death, which the COVID–19 pandemic has now exacerbated.

VOICE. No——

Ms. CLARKE. The transition—OK, let's mute, everyone.

The transition to electric vehicles presents us with the opportunity to tackle these disparities head on by decreasing air pollution in the communities that have been suffering for decades, and most profoundly.

But while I am optimistic, I am also cautious. History has shown us very clearly that, unless we act with intentionality and purpose, the communities who have most to gain from a clean transportation sector will also be the last to receive the least amount of benefit. And that is exactly why I have introduced H.R. 1221, the Electric Vehicles for Underserved Communities Act, which I am happy to see under consideration in this legislative hearing.

On day one, my legislation would direct the Department of Energy to commence a nationwide assessment of the EV charging infrastructure in underserved communities in both urban and rural areas. This assessment would specifically gather data about the quantity and location of publicly accessible level-two charging stations and DC fast-charging stations. So for light-duty and medium-duty electric vehicles.

It would also identify current barriers and opportunities to greater and more equitably put out charging deployment.

Mr. Britton, how would this major study help companies and communities target their charging build-out and clean transportation services towards the areas that need it the most?

Mr. BRITTON. Thank you, Congresswoman Clarke, and we are proud endorsers of the legislation, and thank you for your leadership on it.

One of the important things about sequencing charging infrastructure build-out is that it paves the way for adoption of the vehicles. And obviously, adoption of the vehicles leads to emissions reductions and public health gains.

And so the most important thing I think we can do—it is kind of a twofold step—one is that your bill is shining a light on not only the need, but also the impediments and how we can knock down those barriers, but two are the incentives, whether those be tax credits or rebates, in order for us to actually deploy the infrastructure and make this a reality.

Ms. CLARKE. Mr. Jankowsky, the same question to you: What do you see as the benefits to underserved communities of this nationwide assessment?

Mr. JANKOWSKY. Oh, Congresswoman Clarke, thank you again. We are very much with Mr. Britton and support 1221. We think a competitive grant process is going to entice private capital to come into underserved communities, whether it is rural or urban communities, and build out this infrastructure.

Ms. CLARKE. Thank you very much, and so my legislation would also establish an EV charging equity program at the Department of Energy to invest $960 million in Federal grants over the next 10 years to help deploy over 200,000 EV stations.

So, Mr. Britton, how would this Federal support expand investment and deployment of not only EV charging infrastructure but also the services many ride-share and last-mile transportation companies are striving to provide?

Mr. BRITTON. Well, I think what your leadership has, I think, shown is that it is important to engage the community. So we can't tell a community what the best way for them to electrify their transportation sector is. Every community is different. And I think what you noted is important, is that for some folks it might be a light-duty vehicle. For others, it might be transit and school buses, and those last-mile medium and heavy-duty delivery trucks. And so providing the infrastructure paves the way to make emissions reduction and the public health gains and our ability to address climate change possible.

And so, without those sort of markers and market signals to the private sector to go in and to leverage those resources, I agree that we will be missing an opportunity to drive benefits in every community.

Ms. CLARKE. Very well. Mr. Chairman, thank you for allowing me to waive on, and I yield back.

Don't forget to unmute, Mr. Chairman.

Mrs. DINGELL. Mr. Chairman, you need to unmute.

Ms. CLARKE. We hear you now.

Mr. RUSH. All right. That concludes the witness questions.

Mrs. DINGELL. Mr. Chairman?

Mr. RUSH. And I especially want to thank all the Members, and all—particularly, all the witnesses for their participation in today's hearing. This has been a very, very informative, worthwhile hearing, and we thank you for your patience and for your contribution to this hearing.

I must remind Members that, pursuant to committee rules, they have 10 business days to submit additional questions for the record to be answered by the witnesses who have appeared with us today. And I ask each of our illustrious witnesses to respond promptly to any such questions that you may receive.

Before we adjourn, though, I request unanimous consent for entering the following documents, testimony, or other information into the record. And I am trying—I am going to ask the ranking member—I think who is driving an EV right now on the committee hearing.

Mr. Ranking Member, is there any objection on the Republican side to inserting these into the record en bloc?

Mr. UPTON. No, Mr. Chairman, I have got no reservations. I would note I am not driving an EV, I am driving a Jeep, getting 30 miles to the gallon, so I am doing pretty well.

But thank you for the hearing, and I appreciate the witnesses' attention, too.

And it is a six-speed stick.

Mr. RUSH. OK, so the question is, is there any objection to entering—we have 22 documents. Can we enter these into the record, without objection?

Mr. UPTON. No objection.

Mr. RUSH. Thank you. Now, before we adjourn, I think Mrs. Dingell had an additional remark.

Mrs. DINGELL. I am just making sure what I had wanted to introduce into the record before could be introduced, Mr. Chairman.

Mr. RUSH. Right. All right. Well, now 22 documents, including the documents of Mrs. Dingell and others who have brought forth documents today. And without any objection, these are entered into the record, and they are a part of the record.

Now, at this time, the subcommittee stands adjourned, and the subcommittee is adjourned.

[Whereupon, at 3:11 p.m., the subcommittee was adjourned.]

[Material submitted for inclusion in the record follows:]

WHITE PAPER

Analytical White Paper: Overcoming Barriers to Expanding Fast Charging Infrastructure in the Midcontinent Region

Analysis conducted by the Great Plains Institute for the Midcontinent Transportation Electrification Collaborative

JULY 2019

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About the Great Plains Institute (GPI)

GPI is a nonpartisan, nonprofit organization transforming the energy system to benefit the economy and environment. GPI works on solutions that strengthen communities and provide greater economic opportunity through creation of higher-paying jobs, expansion of the nation's industrial base, and greater domestic energy independence while eliminating carbon emissions.

About the Midcontinent Transportation Electrification Collaborative (MTEC)

MTEC is composed of representatives from automakers, state government, electric utilities and cooperatives, charging companies, and environmental organizations. MTEC coordinates regionally in the Midcontinent region to increase electric vehicle (EV) use, decarbonize the transportation sector, improve air quality, improve electric system efficiency, provide a great customer experience, and build infrastructure to support EV travel throughout the Midcontinent region. The group aims to inform decision-makers' thinking around policies and initiatives to speed the electrification of transportation in the region. The group carries out collective research, develops white papers and policy recommendations, and hosts public workshops for policymakers and stakeholders in the Midcontinent region. MTEC is co-convened by the Midcontinent Power Sector Collaborative and the Charge Up Midwest coalition. GPI convenes the Midcontinent Power Sector Collaborative and MTEC and is a member of the Charge Up Midwest coalition.

MTEC published a white paper entitled, "Electric Utility Roles in the Electric Vehicle (EV) Market: Consensus Principles for Utility EV Program Design," in April 2018 and "A Road Map to Decarbonization in the Midcontinent: Transportation Electrification," in January 2019.

Authors

This report is by Dane McFarlane, Matt Prorok, Brendan Jordan, and Tam Kemabonta.

Acknowledgments

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Contents

Executive Summary

Increased adoption of electric vehicles (EVs) has the potential to significantly and positively impact the electric utility sector and its customers. EVs offer utilities load growth opportunities without necessarily increasing coincidental load peaks. They can also help minimize new investments in generation and distribution infrastructure and actively match load with expanding renewable generation. Studies have shown that for EV owners with access to home charging configurations, most EV charging will occur at home which presents opportunities for load management over longer charging periods.[1] Outside of the home, public charging remains a crucial enabling factor for significant adoption of EVs. In particular, strategically located direct current fast charging (DCFC) will enable longer trips, higher mileage-per-day usage, and charging by people without access to home or workplace charging.

Numerous studies demonstrate the importance of public DCFC in enabling higher rates of EV adoption.[2,3,4,5,6] However, a study by the National Renewable Energy Laboratory (NREL) found that the Midcontinent region, and the US in general, has far less public charging infrastructure than what is required to achieve greater levels of EV adoption.[7] The region currently has 425 DCFC plugs at charging stations and NREL's analysis indicates that 4,020 plugs will by needed by 2030. This suggests a gap of 3,595 dedicated DCFC plugs at public charging stations. At $60,000-$100,000 per plug, this would require an investment between $215-$360 million over the next 11 years. In addition to capital and construction costs, the NREL analysis found that operating costs, including the costs of electric demand, present a huge barrier to the economic feasibility of DCFC stations.

This white paper is intended to study a specific barrier to providing adequate DCFC services in the Midcontinent region and nationwide: electric utility demand charges. For most utilities, the demand charge is based on the demand (kW) measured for a billing month that is required to supply the maximum 15 minute-average amount of energy used by the customer in a billing month.

In terms of high wattage (50 kilowatts and above) electrical equipment, DCFC is a unique use-case characterized today by relatively high-power capacity and low-energy utilization. This means that the operating cost incurred through capacity or demand charges often can far exceed the cost for energy usage. As the analysis in this white paper demonstrates, this situation can lead to operating costs that far exceed the revenue these chargers can receive from customer payments. Importantly, it is clear from the results of GPI's analysis that demand charges are a primary factor in DCFC station economics, representing the majority of costs in most scenarios studied here.

GPI investigated the economics of operating a DCFC station along a specific highway corridor along Interstate 94 from Minnesota to Michigan, passing through the service territories of many electric utilities. The analysis presented here demonstrates that there is a high degree of variability from one utility service territory to the next. In some service territories, it is possible to economically operate a DCFC station today with the current rate tariffs, even with low utilization. In some territories, because of tariff structures designed for conventional commercial and industrial equipment, it may never make economic sense, even with very high utilization. As the market demands higher capacity DCFC, moving from 50 kilowatt (kW) to 150 kW and higher to enable faster charging, the economic challenges presented by utility demand charges are further exacerbated.

Addressing this issue is complicated. Demand charges exist for a reason and are based on a "cost-of-service" philosophy, which asserts that electricity system users should pay for any costs they impose on the system. Every utility has a different system and customer base and will approach this challenge in different ways. At the same time, analysis suggests both that DCFC is a critical element in enabling EV adoption and that managed Level 2 charging at home and the workplace offers significant benefits to the electric system. There is clearly a balance to be struck between possible costs imposed by DCFC in certain settings, and considerable benefits from the increased EV adoption it can enable.

This white paper highlights the main considerations in designing a demand charge tariff structure that is suitable for encouraging DCFC investment, highlights approaches taken by some utilities, and presents information for utilities and regulators to consider as they are seeking their own solutions to this problem.

1 "Plugged In: How Americans Charge Their Electric Vehicles," Idaho National Laboratory, 2015, https://avt.inl.gov/sites/default/files/pdf/arra/ARRAPEVnInfrastructureFinalReportLqltySept2015.pdf (accessed November 2018).

2 Li, Shanjun; Tong, Lang; Xing, Jianwie; Zhou, Yiyi, "The Market for Electric Vehicles: Indirect Network Effects and Policy Design," *Journal of the Association of Environmental and Resource Economists* 4, no. 1 (March 2017).

3 Vergis, Sydney; Chen, Belinda, "Understanding Variations in U.S. Plug-In Electric Vehicle Markets," Institute of Transportation Studies, University of California – Davis, Research Report UCD-ITS-RR-14-25, November 2014.

4 Tietge, Uwe; Mock, Peter; Lutsey, Nic; Campestrini, Alex, "Comparison of Leading Electric Vehicle Policy and Deployment in Europe," International Council on Clean Transportation, May 2016.

5 Bakker, Sjoerd; Trip, Jan Jacob, "Policy options to support the adoption of electric vehicles in the urban environment," *Transportation Research Part D* 25 (December 2013):18-23.

6 Searle, Stephanie; Pavlenko, Nikita; Lutsey, Nic, "Leading Edge of Electric Vehicle Market Development in the United States: An Analysis of California Cities," International Council on Clean Transportation, September 2015.

7 Wood, Eric; Rames, Clement; Muratori, Matteo; Raghavan, Sesha; Melaina, Marc. "National Plug-In Electric Vehicle Infrastructure Analysis," National Renewable Energy Laboratory, September 2017.

Summary of Analytical Methodology

Many analyses demonstrate the potential benefits for utilities and utility customers from home and workplace EV charging. According to a previous MTEC white paper:

> "Electric vehicles offer the potential for benefits to the electric system, for electricity consumers, and for utilities themselves. Increased revenue from growth in transportation electrification can supply necessary investments to enable the transition to a modern system, while turning the conventional wisdom about stagnant load growth on its head. Electric vehicles can add a significant additional load without an equivalent increase in peak demand, thus improving the utilization of existing infrastructure and avoiding the need for significant new investment…EV charging at night can increase load while only minimally increasing the daily peak of the system, thereby avoiding the need for new infrastructure investment."[8]

Even though most charging load is likely to be home or workplace Level 2 charging that is suitable for managed charging, DCFC will be a critical enabler of increased EV adoption and must be supported even if managed charging is not possible or desirable in every setting.

This paper analyzes the readily available information on costs for the installation of a DCFC station, explains the typical business model of a DCFC investor/owner, and suggests rationale and opportunities for utilities to modify their rate structure to ensure DCFCs are viable business ventures. GPI staff conducted analysis for MTEC to evaluate the economics of operating DCFC today in the Midcontinent region. The analysis focused on potential DCFC infrastructure operated along the I-94 corridor from Minnesota to Michigan. Researchers gathered assumptions about the following:

- capital and operating costs for DCFC
- typical utilization rates and revenues
- actual utility rates that would be paid by DCFC operators in utility service territories across the region

Information was collected on 57 rate schedules for commercial and small industrial customers across 30 utilities. A total of 165 charging scenarios were created through a combination of three variables:

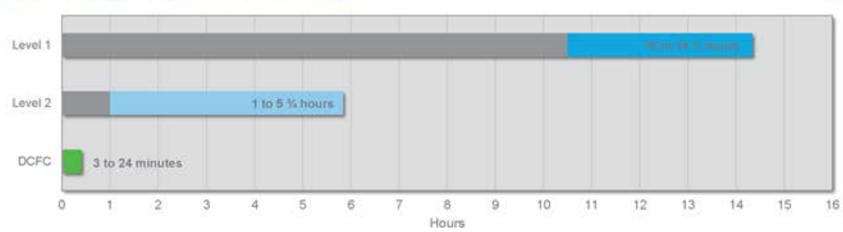
- demand level (wattage)
- utilization (charges per day)
- energy use (kWh) per charging session

Demand levels reflect typical combinations of one to three DCFC plugs: 50kW, 100kW, 150kW, 350kW, and 450 kW. Utilization was varied from 0.5 to 10 charges per day. Using utility rate information and assumptions about capital and operating costs, revenues from users, and utilization rates, an annual cash flow analysis was performed. Sensitivity analyses were run on key variables.

Results for annual cash flow in over five thousand economic scenarios and configurations (165 charging scenarios across each utility rate schedule) were calculated according to costs from volumetric, demand, customer, and facilities charges for each of the utility rates for which data was collected. The results demonstrate generally difficult economics for DCFC station operation at currently expected utilization rates and with current demand charge tariffs.

8 Great Plains Institute and Midcontinent Transportation Electrification Collaborative, "Electric Utility Roles in the Electric Vehicle (EV) Market: Consensus Principles for Utility EV Program Design," April 2018. https://www.betterenergy.org/wp-content/uploads/2018/04/MTEC_White_Paper_April_2018-1-1.pdf. (accessed November 2018)

Figure 1. Charging time required for 80 miles of range



Primary Findings

This analysis found that demand charges are one of the most significant cost factors in DCFC operation. Most utilities in the region base their demand charge on the demand (kW) measured for a billing month that is required to supply the maximum 15 minute-average amount of energy used by the customer in a billing month. As seen in figure 6 later in this paper, DCFC economics are challenging at higher power levels such as 350 kW and 450 kW, where nearly all stations that break even or generate profit are those operating in utility territories where there is no demand charge. Demand charges represented the majority of costs in most scenarios studied by this analysis. As a result, the demand charges present in utility rate schedules are a key determining component of a DCFC station's ability to break even or generate profit.

With lower-capacity DCFC (50kW), profitability is linked with utilization rate and is highly variable based on demand charge tariffs. DCFC stations of 50 kW would not operate profitably in any of the utility service territories at 1 charge per day but would be profitable in all of them at 10 charges per day. Because we expect charger utilization to be low in early years, and higher in the future, you can argue that for 50kW DCFC, higher utilization eventually solves the market failure for DCFC. This may or may not be sufficient to result in third-party investment in 50 kW DCFC. The fact that 50 kW DCFC is not profitable in every utility service territory and at all levels of utilization will make it difficult to build a truly comprehensive DCFC network and make a more fragmented network more likely.

Demand charges are more of a barrier for higher-capacity DCFC, which many industry experts expect will be needed in the future to allow for faster charging rates. For 150 kW, 350 kW, and 450 kW DCFC, a minority of utility demand charge tariffs allowed for profitable operation, even at utilization levels as high as 10 charges per day.

Our analysis makes clear that demand charges are a barrier to the widespread availability of DCFC. It also makes clear that this is not simply a chicken and egg problem that will be solved when there are more EVs and higher levels of utilization at the chargers; demand charges are higher still for higher-capacity DCFC and challenge the economics of operating these chargers even at higher levels of utilization.

Figure 2: The Minnesota to Michigan corridor segment of the I-94 highway that was the focus of the data analysis discussed in the analysis section of this white paper

Literature Review

The literature presents a strong argument that the availability of adequate public charging is a pre-requisite for increased EV adoption and a lack of adequate charging can halt further advances. Although studies demonstrate that a high percentage of charging occurs at home during the night or during the day at work when workplace charging is available, there will still be a need for public charging for certain types of driving and the preferences and needs of certain drivers. This might include those without access to home or workplace charging, people who are able to charge in a garage but occasionally take a longer road trip and must charge along the way, and fleet operators who drive too many miles in a day to rely only on Level 2 charging.

A study by Idaho National Laboratory evaluated the charging habits of people driving 8,300 EVs over three years and found that typical EV drivers charged at home 84-87 percent of the time.[9] Drivers with access to charging at their workplace (a small percentage of the overall sample) charged at work between 32-39 percent of the time. Although most EV drivers charged mostly at home, only a small percentage of EV drivers (5-13 percent) charged solely at home. This implies that public charging is infrequently used but its availability is still desired by most EV drivers. In particular, it appears that DCFC is critical for enabling trips further from home or work, as the study found that DCFC stations were used much more frequently than typical public Level 2 stations. The most highly utilized DCFC stations tended to be located close to interstate highway exits, suggesting that they are being used to enable longer-distance travel. Anecdotal evidence from charging station operators suggests increased utilization of DCFC by ride-hailing (e.g. Lyft, Uber) drivers converting to EVs and needing DCFC to extend a working shift. DCFC can also be part of the solution for offering charging to multi-unit dwellers.

Many analyses demonstrate the potential benefits for utilities and utility customers from home and workplace EV charging and generally focus on Level 2 charging. According to a previous MTEC white paper:

> "Electric vehicles offer the potential for benefits to the electric system, for electricity consumers, and for utilities themselves. Increased revenue from growth in transportation electrification can supply necessary investments to enable the transition to a modern system, while turning the conventional wisdom about stagnant load growth on its head. Electric vehicles can add a significant additional load without an equivalent increase in peak demand, thus improving the utilization of existing infrastructure and avoiding the need for significant new investment… EV charging at night can increase load while only minimally increasing the daily peak of the system, thereby avoiding the need for new infrastructure investment." [10]

That paper also discusses the importance of "designing technological or behavioral programs to enable optimal EV charging." It further reviews multiple studies demonstrating benefits for utility customers from increased EV adoption, with enhanced benefits from managing EV charging load through technological or behavioral programs. The majority of EV charging load today occurs in home or workplace settings and is either Level 1 or 2. Home and workplace Level 2 lends itself well to managed charging through behavioral or technological programs due to the likelihood that cars will park in those settings for longer than their required charging time. Managed charging options, whether they are time-of-use rates or chargers with load control capabilities, are generally low cost to implement. Not all charging settings are conducive to managed charging. DCFC, in particular, lends itself less well to the managed charging paradigm, especially when prioritizing a positive customer experience. DCFC customers are more likely to require an immediate charge and less likely to tolerate delays or curtailments. Managed charging strategies may be possible with certain uses of DCFC such as night-time charging of transit buses and school buses. Some utilities, like Pacific Gas and Electric, are trying to strike a balance by creating DCFC rate structures that have some differentiation based on time-of-day. A variety of managed and unmanaged charging strategies will be necessary to serve all users of DCFC.

A range of studies attempts to establish a causal relationship between DCFC availability and EV adoption. Searle et al. conductec regression analysis on a range of variables and found that total EV sales share was positively correlated with EV model availability, public charging availability per capita, and median household income and found that the correlation was statistically significant.[11] Other studies (Bakker et al. 2013[12]; Tietge et al. 2016[13]; Lutsey et

9 Idaho National Laboratory, "Plugged In: How Americans Charge Their Electric Vehicles," 2015, https://avt.inl.gov/sites/default/files/pdf/arra/ARRAPEVnInfrastructureFinalReportLqltySept2015.pdf

10 Great Plains Institute and Midcontinent Transportation Electrification Collaborative, "Electric Utility Roles in the Electric Vehicle (EV) Market: Consensus Principles for Utility EV Program Design," April 2018, https://www.betterenergy.org/wp-content/uploads/2018/04/MTEC_White_Paper_April_2018-1-1.pdf (accessed November 2018)

11 Searle, Stephanie; Pavlenko, Nikita; Lutsey, Nic, "Leading Edge of Electric Vehicle Market Development in the United States: An Analysis of California Cities," International Council on Clean Transportation, September 2015.

12 Bakker, Sjoerd; Trip, Jan Jacob, "Policy options to support the adoption of electric vehicles in the urban environment," *Transportation Research Part D* 25: 18-23 (December 2013).

13 Tietge, Uwe; Mock, Peter; Lutsey, Nic; Campestrini, Alex, "Comparison of Leading Electric Vehicle Policy and Deployment in Europe," International Council on Clean Transportation, May 2016.

al. 2016[14]; Vergis and Chen, 2014[15]; Li et al., 2017[16]) have similarly found that although home charging is more heavily utilized, EV adoption and public charging infrastructure are still linked. Searle et al. postulate that infrequent convenience charging "is still important, as it can increase the functional range, and, even when seldom used, increase electric vehicle driver confidence to use the full existing range. Another interpretation is that the charging network increases general awareness, understanding, or comfort about the visibility of the electric vehicles among prospective new buyers."

NREL offers the most comprehensive attempt to quantify the "charging gap" around the country.[17] NREL analyzed the level of charging needed to support higher levels of EV adoption—modeling linear growth from today's level of EVs on the road to 15 million light-duty EVs by 2030, translating to 2 percent of light-duty vehicle sales. This includes a mixture of plug-in hybrid and full battery EVs with various ranges. The study assumed that 88 percent of charging occurred at home. Results indicated that 27,500 DCFC plugs (at 8,500 stations) will be needed, including 19,000 in cities, 4,000 in towns, 2,000 in rural areas, and 2,500 along interstate corridors. For Level 2 charging, 601,000 plugs will be needed, including 451,000 in cities, 99,000 in towns, and 51,000 in rural areas. According to NREL, there were 3,383 DCFC plugs nationwide and 36,339 Level 2 plugs as of the publishing date. This understates the infrastructure gap for the Midcontinent region because the vast majority of US public charging infrastructure is on the coasts. Tesla's proprietary chargers are not included in these numbers because they can only be used by Tesla vehicles.

The NREL analysis goes into great detail on considerations for DCFC corridor planning, including mapping traffic volumes and trips to designated corridors, evaluating the distance to substations to ensure adequate electricity infrastructure to support DCFC, land availability for new DCFC, and other considerations. NREL's state-by-state results are included in table 1. Comparing these numbers to current levels clearly show the gaps in the Midcontinent region. In the region, there are currently 425 public DCFC plugs and NREL's analysis indicates that 4,020 will be needed by 2030. That is a gap of 3,595. A rough estimate of $60,000-$100,000 per plug suggests an overall investment need of $215-360 million over the next 11 years.

14 Lutsey, Nic; Slowik, Peter; Jin, Lingzhi, "Sustaining Electric Vehicle Market Growth in U.S. Cities," International Council on Clean Transportation, October 2016.

15 Vergis, Sydney; Chen, Belinda, "Understanding Variations in U.S. Plug-In Electric Vehicle Markets," Institute of Transportation Studies, University of California – Davis, Research Report UCD-ITS-RR-14-25, November 2014.

16 Li, Shanjun; Tong, Lang; Xing, Jianwie; Zhou, Yiyi, "The Market for Electric Vehicles: Indirect Network Effects and Policy Design." *Journal of the Association of Environmental and Resource Economists* 4, no. 1 (March 2017).

17 Wood, Eric; Rames, Clement; Muratori, Matteo; Raghavan, Sesha; Melaina, Marc, "National Plug-In Electric Vehicle Infrastructure Analysis," National Renewable Energy Laboratory, September 2017.

Table 1. Plug-in Electric Vehicles (PEVs) and Charging Plugs by State: NREL 2030 Projections

State	Total PEVs today[18]	Total PEVs projected, 2030	% PEV projected, 2030	Workplace L2 plugs, 2030	Public L2 plugs, 2030	Public DCFC plugs, 2030	Public L2, today	Public DCFC, today[19]
AR	889	68,000	33%	2,300	1,800	140	52	10
IA	2,111	99,000	30%	3,500	2,500	170	164	2
IL	17,336	555000	51%	16,600	8,700	880	816	71
IN	4,638	210000	37%	6,700	4,700	410	270	30
KS	1,992	98000	39%	2,900	2,000	160	664	20
LA	1,304	70,000	44%	2,000	1,600	170	84	7
MI	16,444	258,000	20%	9,700	6,700	290	749	39
MN	6,902	228,000	43%	6,600	4,500	370	440	53
MO	5,052	201,000	43%	5,900	4,100	370	1410	58
MS	542	46,000	44%	1,400	1,100	130	30	7
ND	226	13,000	26%	500	400	20	20	0
NE	1,459	53,000	37%	1700	1100	100	119	2
OH	10,604	393000	38%	11,900	8,000	690	490	95
SD	335	21,000	28%	800	600	40	11	0
WI	6,967	243,000	36%	7,800	5,500	450	227	31

18 Atlas Public Policy, "EV Hub," July 2017, https://atlaspolicy.com/rand/ev-hub/ (accessed November 2018)

19 Atlas Public Policy, July 2017.

DCFC Economics: GPI's Analysis

To investigate the impact of utility demand charge tariffs on the economics of DCFC, the analysis focused on a specific corridor—the M2M (Moorhead, MN, to Port Huron, MI) corridor along Interstate 94. This corridor was designated as an alternative fuel corridor by the Federal Highway Administration. Through a US Department of Energy grant administered by the Clean Cities Coalition, a collaborative group is currently working to plan and build DCFC along this corridor. This analysis has already been used by project partners in conversations with utilities about potential projects in their service territories.

Cities and towns of interest along the M2M part of the I-94 corridor were considered, with a focus on identifying towns roughly 50-70 miles apart. These cities include Fergus Falls, Saint Cloud, and Alexandria in Minnesota; Hudson, Eau Claire, Tomah, and Wisconsin Dells in Wisconsin; and Kalamazoo and Ann Arbor in Michigan. Major cities like Minneapolis, Saint Paul, Milwaukee, Chicago, and Detroit were not considered as these cities already have multiple DCFC stations available for EV charging (figure 3). For this study, we only looked at DCFC stations that are compatible with all EVs and thus excluded Tesla superchargers that are only compatible with Tesla automobiles.

A 10-mile buffer around each of the cities being considered was used to identify utilities with service territories along the I-94 corridor. The electric rate schedules of these utilities were then compiled, as discussed further below.

Figure 3: Cities of interest with 10-mile buffers

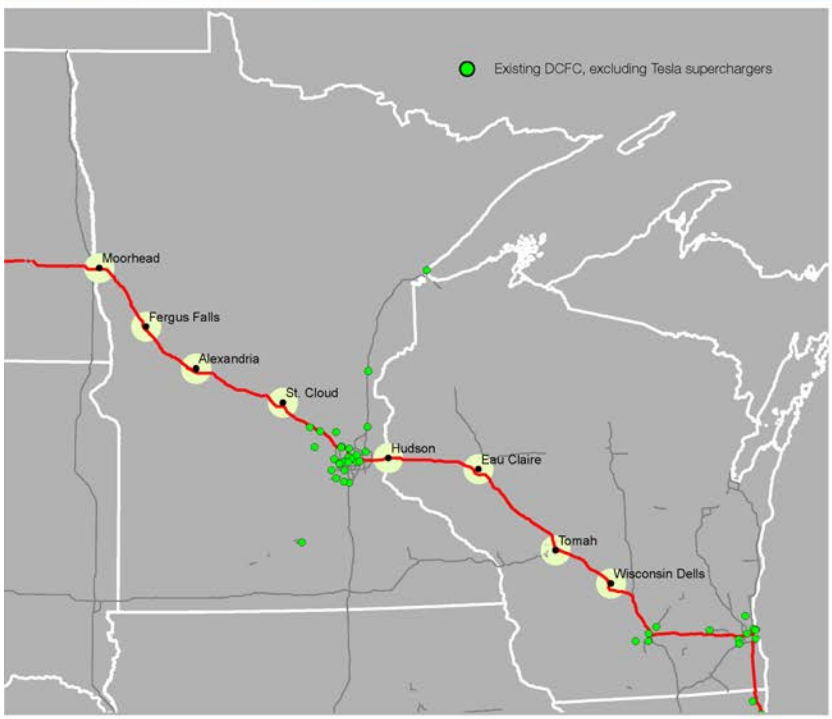
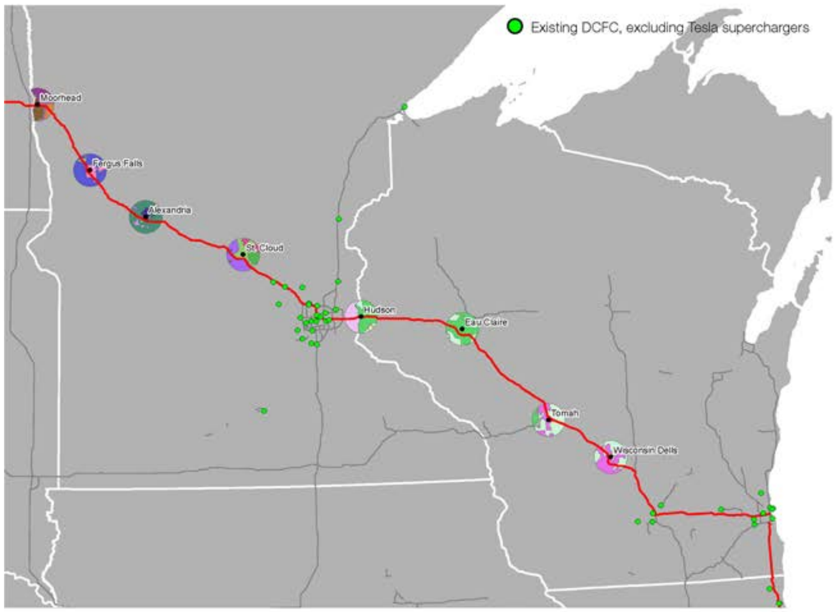


Figure 4: Cities of interest and utility territories within a 10-mile buffer



Data collection

Information was collected for 57 electric service rate schedules for commercial and small industrial customers across 30 utilities along the M2M corridor. Rates were classified by applicable demand levels representing various levels of DCFC capacity currently on the market or expected to be in the near future: 50kW, 100 kW, 150kW, 350kW, and 450kW or above. It is assumed that high-capacity charger levels are an adequate representation of co-located chargers. For example, a level of 150kW could represent either a single charger or three co-located 50kW charges.

For each applicable rate schedule, the following information was collected:

- minimum and/or maximum demand level—kW
- customer/facilities charge—$
- energy charge (summer, winter, shoulder as applicable)—$/kWh
- demand charge (summer, winter, shoulder as applicable)—$/kW
- periodicity of each rate component (i.e., monthly, annual, etc)

While most utilities base their demand charge on the demand (kW) measured for a billing month that is required to supply the maximum 15 minute-average amount of energy used by the customer in a billing month, some, but not all, utility rates vary across the seasons of the year. A rate may include a summer season, winter season, shoulder season, or combination of the three. This information was captured and compiled into a database.

Charging Scenarios

A total of 165 charging scenarios were created, varying three variables: demand level (kW), utilization (charges per day), and energy use (kWh) per charging session. Demand levels reflect typical combinations of one to three DCFC plugs: 50kW, 100kW, 150kW, 350kW, and 450 kW. Utilization was varied from 0.5 to 10 charges per day. This time-agnostic approach enables this study to examine both near-term and long-term economic viability of DCFCs as utilization rates are currently low but expected to increase as EV penetration increases throughout the region. Energy usages of 12, 14, and 16 kWh per charging session were also modeled.

Modeling Assumptions

In addition to the variables used to define the scenarios used in this study, other operating assumptions were needed to perform an annual cash flow analysis. The non-electrical costs associated with operating a DCFC in the Midcontinent region were held constant across all modeling scenarios to isolate the effects of variation in utility rate design on DCFC economic viability. These assumptions are:

- annual scheduled maintenance: $2,200/year
- insurance: $300/year
- cellular fees: $150/year
- networking fees: $300/year
- capital cost: $1000/kW of installed DCFC capacity

Note that capital cost was varied in a sensitivity case to explore the impact on project viability of policy options to lower or eliminate the capital cost born by project developers. To amortize capital costs, we assumed a 10-year period and a 3 percent annual interest rate.[20]

The model also includes income assumptions that are separate from the electrical cost assumptions to reflect the fact that many states do not allow the sale of electricity by non-utilities and require that DCFC developers instead sell "charging time." These income assumptions include:

- connection fee: $3/charging session
- per-minute charging time fee: $0.20/minute of charging

In reality, the operator of a charging station will charge rates depending on their own business model. These example rates are meant to represent a generalized Midwestern charging station and are not meant to reflect any particular charging operator. An average connection length of 17 minutes was assumed for all examined scenarios. These values were also held constant across all scenarios modeled to isolate the effects of variance in utility rate design on DCFC economic viability.

These economic modeling assumptions represent a generalized or average business model for a typical charging station operator, but costs and rates charged to customers do vary. GPI has built an interactive web tool that allows any user to set their own rates and view model results in real time. Please contact the study authors if you are interested in using this tool.

Model Calculations

An annual cash flow was calculated that included annual electrical costs and revenue driven by assumed charging behavior, and non-electrical costs associated with operating and maintaining the charger. Equation 1 below describes the summation used to calculate annual cash flow, where *CF* is the annual cash flow, *I* is annual income, *EC* are the various electrical costs, *CC* is the amortized annual capital cost, and *OOC* is the annual operating costs not included in the electrical costs.

Eq 1. $$CF = I - EC - CC - OOC$$

Eq 2. $$I = [(cpd * f) + (cpd * mf * t)] * 365$$

Equation 2 describes the annual income of the DCFC where *cpd* is the number of charges per day at the modeled DCFC, *f* is the connection fee, *mf* is the per-minute charging fee, and *t* is the charging time. These revenue components are multiplied by 365 to determine annual income.

Eq 3. $$EC = (cpd * epc * vr) * d + [(dl * dr) + fc + cc] * m$$

Equation 3 describes the annual electrical costs of operating the DCFC where *epc* is the energy use per charging session (in kWh), *vr* is the volumetric rate ($/kWh), *dl* is the demand level of the DCFC (in kW), *dr* is the demand charge rate ($/kW), *fc* is the annual facilities charge, and *cc* is the annual customer charge. Volumetric charge costs are incurred daily (*d*) while demand charge costs are incurred monthly (*m*). Note that the appropriate volumetric and demand rates are applied in the model within this summation for summer, winter, and shoulder periods for each utility. The periods are then summed to calculate annual costs.

Eq 4. $$CC = (dl * C * s) * \left[i + \left(\frac{i}{1+i^{(n-1)}}\right)\right]$$

Equation 4 describes the amortized annual capital cost incurred by the project developer, where *C* is the assumed all-in capital cost of a DCFC per kW of installed capacity, *s* is the share of the capital cost the project developer is responsible for,[21] *i* is the assumed interest rate, and *n* is the assumed amortization period. Note that *s* is held constant at a value of 1 except in the sensitivity cases.

Eq 5. $$OOC = sm + I + cf + nf$$

Equation 5 describes the annual operating costs for the DCFC where *sm* is the annual scheduled maintenance cost, *I* is the annual insurance cost, *cf* is the annual cellular fee, and *nf* is the annual networking fee.

20 Johnson, Charlie. Walker, Jonathan, "Peak Car Ownership: The Market Opportunity of Electric Automated Mobility Services," 2017, https://www.rmi.org/wp-content/uploads/2017/03/Mobility_PeakCarOwnership_Report2017.pdf (accessed November 2018)

21 This parameter allows the model to explore policy options for capital cost sharing between multiple engaged entities.

Results

Results for annual cash flow in over five thousand scenarios and configurations (165 charging scenarios, across many utility rate schedules) were calculated according to costs from volumetric, demand, customer, and facilities charges for each of the utility rates for which data was collected. The results demonstrate generally difficult economics for DCFC station operation at current utilization rates. Cash flow to the station operator positively increases with greater utilization levels, as usage increases from one charge per day to 5 or 10 charges per day. Costs, however, are highly sensitive to charging level (50 kW, 150 kW, 350 kW, and 450 kW) and the resulting demand charge from the utility. Increased charging levels provide significantly faster charging times while delivering the same amount of energy. Most utility rate schedules considered in this study incurred both demand charges (per peak kW) and energy charges (per monthly kWh) at power levels of 50 kW and above.

Figure 5 demonstrates the impact of utilization rates at 50 kW DCFC stations operating throughout the study area. Each circle represents a unique utility rate schedule, where the size of the circle represents the cost incurred through customer and facility charges, which are placed along the axis according to their energy charge (vertical axis) and demand charge (horizontal axis). Green circles represent a DCFC station that can break even or profit under their particular utility rates at each chart's power level (kW) and utilization rate (charges per day). Red circles represent stations where costs exceed revenues and thus operate at a loss.

As seen in figure 5, low-utilization rates present challenging economics for DCFC operators. As utilization increases, more stations begin to break even or make a profit. At 5 charges per day, about half of the utility rate schedules in this study provide favorable economics for DCFC operators at the 50 kW demand level. Those utilities which have higher than average demand charges (above $6 / kW) still present challenging economics until higher utilization rates. At charging levels of 50 kW, DCFC stations at all utilities in this study would break even or profit at 10 charges per day.

Figure 5. Break even performance of 50 kW DCFC stations under each utility rate schedule with increasing utilization (charges per day). Red circles are stations where incurred annual costs are greater than revenues. Green circles are stations that break even or profit.

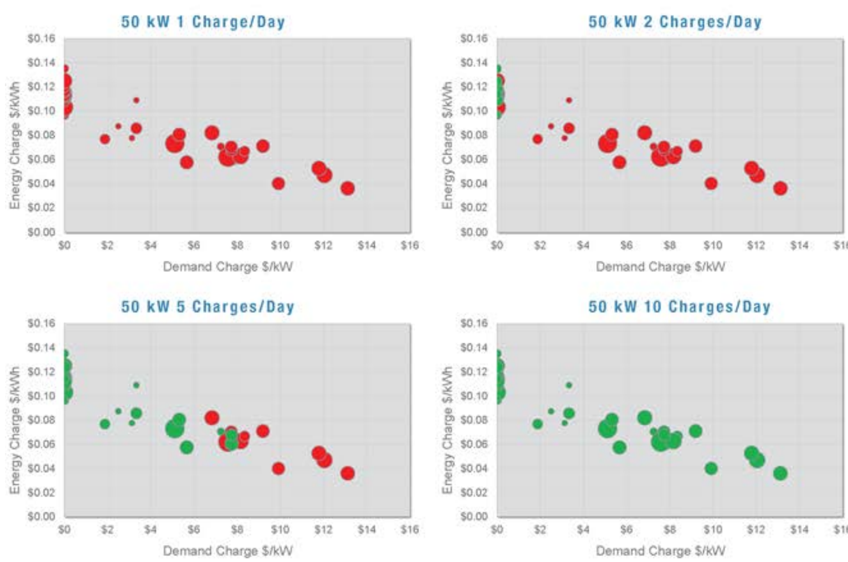
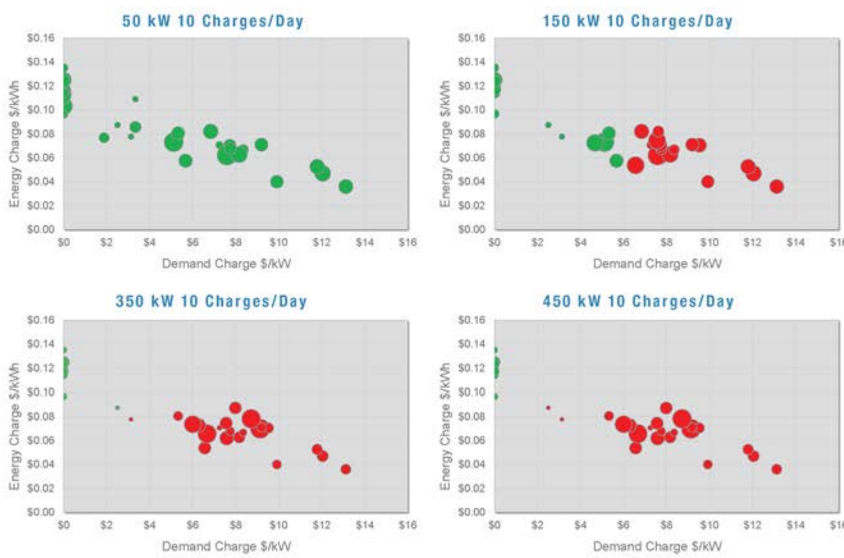


Figure 6 compares the performance of varying charging levels at higher utilization rates. The 50 kW DCFC stations break even or achieve profit at 10 charges per day under all utility rate schedules considered by this study. Higher power levels (faster charging) present more difficult economics under the current rate design paradigm. Upgrading from 50 kW to 150 kW results in DCFC stations no longer breaking even in more than half of utility rate schedules. The number of utility rates that offer favorable economics continues to decline at 350 kW and 450 kW. This is a result of demand charges, which are determined by the peak demand seen at the facility for each month, typically measured across a single 15-minute interval. A single charger operating at its full capacity of 50 kW will incur a corresponding demand charge (between $2 and $14 per kW) for 50 kW each month.

This analysis found that demand charges are one of the most significant cost factors in DCFC operation. As seen in figure 6, DCFC economics are challenging at higher power levels such as 350 kW and 450 kW, where nearly all stations that break even or profit are those operating in utility territories where there is no demand charge.

To determine the relative impact of each cost component, the volumetric energy costs, demand charge costs, and fixed costs were calculated for up to 10 charges per day at each power level.

Figure 6. Break even performance of DCFC stations under each utility rate schedule at 10 charges per day with increasing charging levels (50 kW, 150 kW, 350 kW, and 450 kW). Red circles are stations where incurred annual costs are greater than revenues. Green circles are stations that break even or profit.



Figures 7 and 8 present the resulting cost components. In each case of charging level, demand charges remain constant across all utilization levels while volumetric charges grow with increased utilization. Assuming that charging station operation would not exceed the total power capacity of the charger, a 50 kW charger would not incur demand charges (per kW) that exceed the 50 kW demand level. Growing utilization does increase the amount of energy that is delivered to customers, however, and thus the volumetric energy charge (per kWh) also increases.

A 150 kW or 350 kW DCFC station may deliver the same amount of energy over a time period as a 50 kW DCFC station. Thus, volumetric energy charges are not correlated with charging power levels and remain flat as charging level increases to 150 kW, 350 kW, 450 kW, and so on. Demand charges, however, are intrinsically correlated with charging power levels, resulting in significantly increased demand charges with upgraded power levels. A comparison of the annual electrical costs charts in Figures 7 and 8 shows that while volumetric energy charges can be seen increasing with utilization rates, the increased demand charges are of much higher magnitude as the power level is increased.

The share of costs charts in figures 7 and 8 also report the share of fixed costs, which include the non-electrical costs of running a DCFC station (such as payment system software and communications). For lower-power levels such as 50 kW, fixed costs do represent a significant portion of overall costs. As utilization increases, however, costs incurred by volumetric energy charges outpace fixed costs. Additionally, as power levels increase to 150 kW, 350 kW, and 450 kW, the costs incurred by demand charges represent by far the largest share of the total cost.

Figure 7. DCFC station costs by charges per day: 50 kW and 150 kW chargers

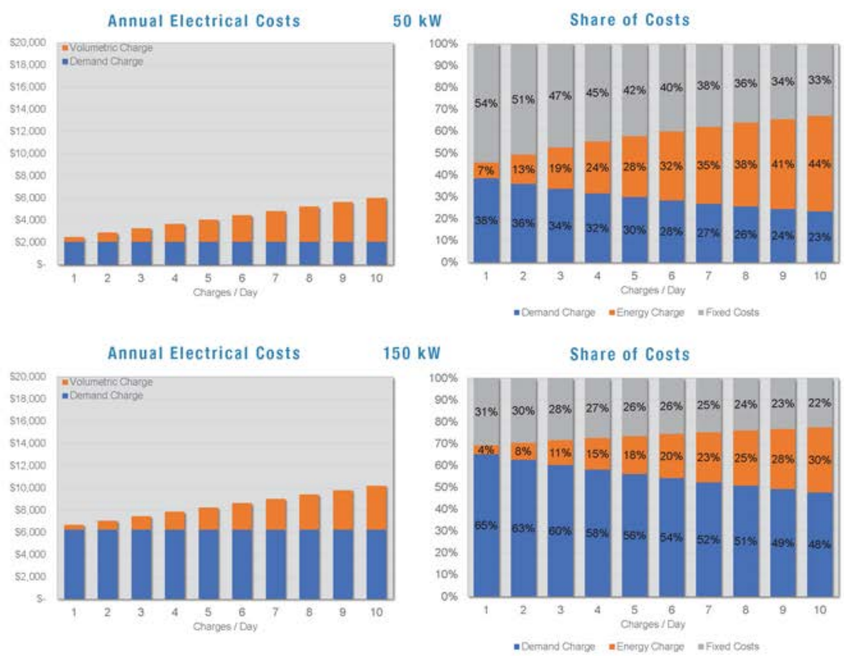


Figure 8. DCFC Station costs by charges per day: 350 kW and 450 kW chargers

Figure 9. Demand charge share of DCFC station costs across kW power levels

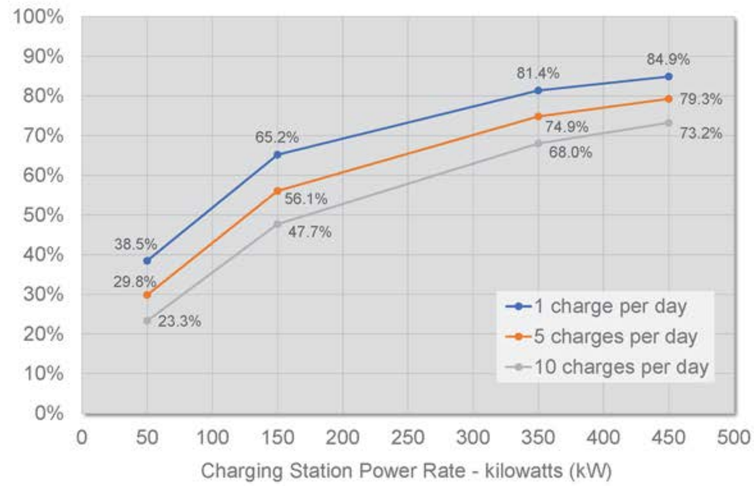


Figure 9 demonstrates the impact of both increased utilization and increased charging rate power levels on the demand charge share of DCFC station costs. In all power levels, increased utilization will decrease the share of demand charge costs as the amount of energy supplied by the DCFC increases. At 50 kW, increasing utilization by a factor of 10 from one charge per day to 10 charges per day will decrease the demand charge share by about 15 percent from 38.5 percent of total costs to 23.3 percent. At 450 kW, the share is reduced by only about 12 percent, from 84.9 percent to 73.2 percent. Meanwhile, upgrading charging power levels from 50 kW to 450 kW (by a factor of 9) results in significantly greater growth in demand charge share of total costs. At a low utilization rate of 1 charge per day, the demand charge share increases by 46 percent from 38.5 percent at 50 kW to 84.9 percent at 450 kW. At higher utilization rates, a similar increase of about 50 percent is seen, with the demand charge share of total costs of 23.3 percent at 50 kW growing to 73.2 percent at 450 kW.

It is clear from these results that demand charges are a primary factor in DCFC station economics, representing the majority of costs in most scenarios studied by this analysis. As a result, the demand charges present in utility rate schedules are a key determining component of a DCFC station's ability to break even or generate profit. Figure 6 above demonstrates that the only DCFC stations able to break even at higher charging rate power levels are those that are subject to utility rates with reduced or no demand charges.

Figure 10 illustrates the break-even threshold of DCFC stations at utilization rates between 2 and 10 charges per day. The horizontal axis reports feasible demand charges along the breakeven threshold lines, while the vertical axis reports feasible energy charges. At each utilization rate, a DCFC station would be expected to break even at energy and demand charges anywhere along that line. The average of energy and demand charges rate (about \$0.07 / kWh and \$6.6 / kW) studied in this analysis along the M2M corridor is shown as a red dot. According to the placement of the average rate schedule, a 150 kW DCFC station operating in the M2M Corridor region would need a utilization rate between 7 and 8 charges per day to economically break even.

Figure 10: Break-even thresholds by utilization rate at 150 kW

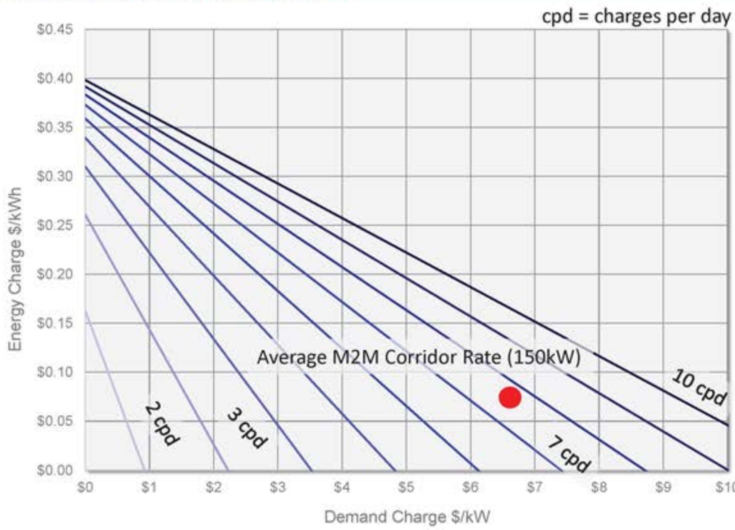


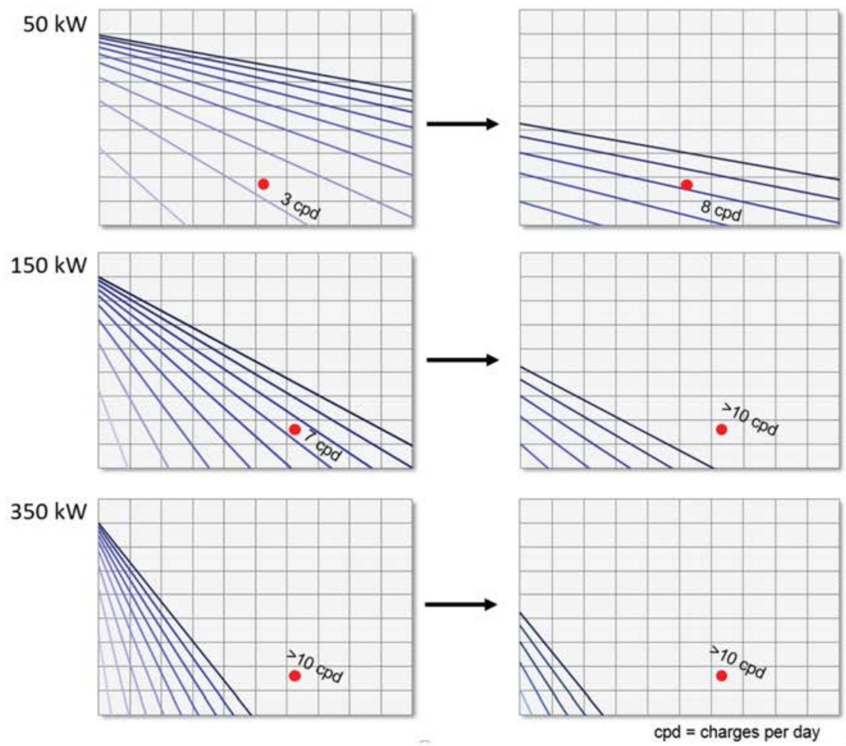
Table 2: Charges per day needed to break even with and without capital costs

Charger Level	Break Even Charges Per Day	
	Including Capital Cost	Excluding Capital Cost
50 kW	7	4
100 kW	14	7
150 kW	18	9
350 kW	40	19
450 kW	51	24

Based on modeled average rates

The capital costs of DCFC construction and installation are a significant expense. Depending on the business plan and mode of operation for a particular DCFC, capital and operation costs are often covered by two separate entities. DCFC stations considered in discussions that occurred as a part this analysis were often paid for by grants or sponsorships, or were covered by the site host while operated by an EV charging station service provider. Thus, the operational costs discussed by this paper generally do not include financed or amortized capital costs. Figure 10 illustrates the impact of including amortized capital costs in the break even considerations for 50 kW, 150 kW, and 350 kW DCFC stations, with the average M2M corridor rate schedule shown as a red circle The overall impact of including capital costs in annual finances is an increase in the utilization rates required to break even. At power levels above 150 kW, utilization rates greater than 10 charges per day are required for positive financial performance.

Figure 11: Impact of capital cost on DCFC station break even threshold



Case Studies

This section discusses specific approaches to demand charges by different utilities that try to strike a balance between protecting the electricity system and utility customers from highly variable load, while also creating economic conditions that allow DCFC to operate and capture the benefits that result from increased EV adoption enabled by DCFC availability.

Case Study: Xcel Energy's "Rule of 100"

As noted above, DC fast chargers may often result in high peak demand (kW) due to their power level while not actually using very large amounts of energy (kWh). Under standard rates posted by most of the utilities in this study, this can result in high demand charges that make the economics of operating a DCFC station difficult until utilization levels increase. As this situation may arise at facilities in other industries or sectors, some utilities have established procedures for balancing high demand charges when usage is relatively low. The study authors spoke to Xcel Energy to hear their perspective of the need and usefulness of such demand charge adjustments.

In some areas of its service territory, including Minnesota, Xcel Energy has established a "demand limiter" provision that limits the billable kW quantity used to calculate demand charges. This provision applies when a customer has a relatively high level of peak kW demand compared to their total kWh energy usage. It functions to effectively cap monthly customer bills to an average price per kWh.

$$\frac{\textit{demand limiter}}{\textit{average price}} = energy\,charge + \frac{demand\,charge}{100\,hours}$$

The demand limiter provision produces a maximum average price that is simply the total of the energy charge and the demand charge divided by 100 hours. For example, with an energy rate of 5 cents per kWh and a demand rate of $10 per kW, the maximum average price is the total of 5 cents per kWh energy rate and 10 cents per kWh from the demand rate (based on $10 per kW divided by 100 hours), which is 15 cents per kWh.

$$\overset{\text{Volumetric Charge}}{\frac{\$.05}{kWh}} + \left(\overset{\text{Demand Charge}}{\frac{\$10}{kW}} \times \overset{\text{Demand Limiter}}{\frac{1}{100\,hours}}\right) = \frac{\$.05}{kWh} + \frac{\$.10}{kWh} = \overset{\text{Effective Energy Rate}}{\frac{\$0.15}{kWh}}$$

Example rates, not meant to convey actual utility rates

Prior to the demand limiter provision, a specific fixed maximum price per kWh was used. Because this required a manual reset for each change in energy or demand rates, the demand limiter provision was developed to automate the process and eliminate the need for a separate maximum price rate component. In addition to administrative simplicity, the provision also provides a directly recognizable revenue impact by its effect on historical billed demand quantities.

The relative level of peak demand and energy use is measured as "hours use" (which is the measure used in the demand limiter provision for 100 hours use) and is calculated by kWh divided by kW. Load factor is another more common measure of the relationship between kWh energy and kW demand, which is derived from the hours use measurement. For example, 100 hours use out of a total 730 hours for a month is approximately a 14 percent load factor.

Xcel's demand limiter provision provides a reasonable and practical cap on the average price per kWh, which can otherwise be excessive when customer usage at a very low load factor is applied to a demand-billed rate schedule. There is a widely recognized cost basis for the limiter provision. At the charging session lengths and utilization levels studied in the analysis for this white paper, DCFC stations load factors reached a maximum of 11.5 percent while having relatively high peak demands. As customer load factors progressively decline from an average level across the customer base, the probability of a customer peak demand occurring during a system peak times drops at a faster rate than the load factor. This relationship is known as the "Bary Curve" in the electric utility industry. This cost basis applies to generation and transmission system costs, but not to distribution system costs.

Case Study: Pacific Gas & Electric Commercial EV Rate Proposal

Pacific Gas and Electric (PG&E) is working on new commercial EV rate plans to support EV adoption. These rates propose to use a monthly subscription model while **eliminating demand charges**. PG&E is tentatively planning two commercial EVs (CEVs): CEV-Small for charging installations up to 100 kW; and CEV-Large for charging installations over 100 kW.

PG&E Commercial EV Rate Plans

CEV Small	CEV Large
Up to 100 kW	Over 100 kW
Smaller workplaces & multi-family dwellings	Fleets, large commercial spaces, fast charging
	Options for secondary and primary voltage service
Lower Cost $ / 10 kW	Higher Cost $ / 50 kW

The CEV rate includes a consistent monthly subscription charge based on the customer's chosen power (kW) level and an energy usage charge based on time-of-day pricing. Charging is actually cheapest mid-day, when renewable energy generation is at its highest on PG&E's system. Customers do pay an overage fee if their power level exceeds their subscribed level.

Replacing demand charges with a consistent monthly subscription fee can greatly alleviate many of the concerns and uncertainty with demand charges. Based on PG&E's modeling, the CEV rates provide EV charging at significantly cheaper costs than the equivalent gas or diesel prices, as well as their current commercial and industrial rates.

Note: the PG&E rates proposed here are preliminary and subject to California Public Utilities Commission review.

Discussion

According to a review of the existing literature, availability of DCFC is critical to enabling increased EV adoption. Even though the majority of charging by EV drivers is home and workplace charging, publicly accessible DCFC infrastructure is necessary for enabling adoption and necessary to allow for longer trips.

Level 2 charging at home and work offers the greatest opportunity for managed charging to offer grid benefits, for example by avoiding on-peak charging, increasing off-peak charging, and integrating off-peak generation of renewables. The benefits of managed Level 2 charging for the electric grid may not be as large without the existence of DCFC to remove a significant barrier to increased adoption.

By studying actual utility rate structures for a variety of utilities across the I-94 corridor from Minnesota to Michigan, we were able to model the likely economics of operating DCFC based on realistic assumptions about capital and non-energy operating costs and usage. We learned the following:

- Relatively low usage in the near-term translates to relatively low revenue from users.
- Demand charges are a high percentage of the overall cost of operating DCFC, as compared to energy costs and non-energy operating costs. This is exacerbated with higher-power and faster DCFC equipment.
- With lower capacity DCFC (50kW), profitability is linked with utilization rate and is highly variable based on demand charge tariffs. A 50 kW DCFC operates profitably in none of the utility service territories at 1 charge per day and all of them at 10 charges per day. Because charger utilization is expected to be low in early years and higher in the future, higher utilization could eventually solve the market failure for DCFC at 50 kW. This may or may not be sufficient to result in third-party investment. The lack of profitability of 50 kW in every utility service territory and at low to medium levels of utilization will make it difficult to build a truly comprehensive DCFC network and make a more fragmented network more likely.
- The barrier to economic feasibility presented by demand charges is greater for higher capacity DCFC, which many industry experts expect will be needed in the future to allow for faster charging rates. For 150 kW, 350 kW, and 450 kW DCFC equipment, a minority of utility demand charge tariffs allowed for profitable operation, even at utilization levels as high as 10 charges per day.
- There is a high degree of variability among utilities in terms of their demand charge tariffs. Some utilities have more "DCFC-friendly" tariffs that result in DCFC systems operating profitably across a wider range of operating conditions (see this paper's case studies from Xcel Energy and PG&E). Many utilities have demand charge tariffs that make it difficult for DCFC to operate under many or most utilization levels.
- It is expected that DCFC systems will have low-utilization rates near term, and for utilization to increase over time as EV adoption increases (which will be enabled in part by increasing access to DCFC and network effects of building more chargers). Our analysis suggests that the conditions that are likely to facilitate increased DCFC availability in the region are a combination of reducing DCFC capital costs, which could come through state or utility cost-share in combination with private investment, and adjusting demand charge tariffs.

Demand charges exist for a reason and all utilities will have a different approach to this challenge based on their individual system and customer base. This analysis is not intended to create a "one-size-fits-all" approach, but to give utilities and regulators informational tools tc address this problem in the way that works best for their system and customers.

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Reforming electricity rates to enable economically competitive electric trucking

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Abstract

The imperative to decarbonize long-haul, heavy-duty trucking for mitigating both global climate change as well as air pollution is clear. Given recent developments in battery and ultra-fast charging technology, some of the prominent barriers to electrification of trucking are dissolving rapidly. Here we shed light on a significant yet less-understood barrier, which is the general approach to retail electricity pricing. We show that this is a near term pathway to \$0.06/kWh charging costs that will make electric trucking substantially cheaper than diesel. This pathway includes (i) reforming demand charges to reflect true, time-varying system costs; (ii) avoiding charging during a few specific periods (<45 h in a year) when prices are high; and (iii) achieving charging infrastructure utilization of 33% or greater. However, without reforming demand charges and low utilization of charging infrastructure, charging costs more than quadruple (to \$0.28/kWh). We also illustrate that a substantial share of current trucking miles within select large regions of the United States can be reliably electrified without constraining electricity generation capacity as it exists today. Using historical hourly electricity price and load data for last 10 years and future projections in Texas and California, we show that electricity demand is at least 10% lower than yearly peak demand for at least 15 h on any given day. In sum, with electricity rates that closely reflect actual power system costs of serving off-peak trucking load, we show that electric trucks can provide overwhelming cost savings over diesel trucks. For reference, at diesel prices of \$3.16/gal and charging costs of \$0.06/kWh (inclusive of amortized charging station infrastructure costs), an electric truck's fuel cost savings are \$251 000 (NPV), providing net savings of \$61 000 (18% of lifetime diesel fuel cost) over the truck's lifetime at battery price of \$170/kWh, or up to \$148 000 (44% of lifetime diesel fuel cost) at a battery price of \$100/kWh (figure 1).

1. Introduction

The imperative of decarbonizing long-distance, heavy-duty trucking to mitigate global climate change and reduce air pollution is clear. For instance, medium- and heavy-duty trucking—almost entirely diesel-based—contributes 23% of U.S. transportation-sector greenhouse gas (GHG) emissions (US EPA 2015); heavy-duty trucking is expected to contribute a third of transportation NO_x emissions by 2025 (US EPA 2018). In developing countries, this sector has an even larger impact—for example, of India's transportation emissions, heavy-duty trucking contributes 41% of the CO_2 and 55% of the NO_x (Guttikunda and Mohan 2014). However, technological constraints and economic conditions have generally suggested that electrifying this sector is challenging.

The emerging reality is different. Two recent developments suggest that two widely understood barriers to electrification of long-distance trucking have diminished substantially. One is the reduced cost of battery storage. By the end of 2017, lithium-ion battery costs had fallen more than 80%—to \$176 per kilowatt-hour (kWh)—relative to their cost in 2010 (Goldie-Scot 2019). Costs are expected to continue falling; a cost of \$100/kWh is expected by 2026 according to BNEF

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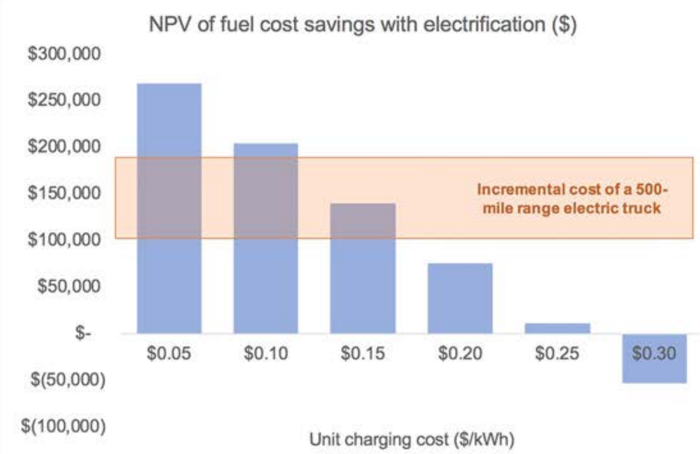

Figure 1. Electric truck fuel cost savings versus unit charging costs. At charging costs of \$0.06/kWh (inclusive of amortized infrastructure costs), an electric truck's fuel cost savings are \$251 000 (NPV), providing net savings of \$61 000 (18% of lifetime diesel fuel cost) over the truck's lifetime at battery price of \$170/kWh, or up to \$148 000 (44% of lifetime diesel fuel cost) at a battery price of \$100/kWh. Notes: Fuel cost savings are based on \$3.16/gal diesel, 5.9 mi gal^{-1} diesel fuel efficiency, and 2.1 kWh mi^{-1} electric fuel efficiency. Incremental cost is based on the cost of a 1000 kWh battery costing between \$170/kWh (top of range) or \$100/kWh (bottom of range).

(Curry 2017), and by 2020 according to Tesla (Holland 2018). The other development is the dramatically lower cost of electricity generation due in part to solar and wind technologies that are now at parity with or cheaper than coal generation on a levelized cost basis. While declining natural gas prices have played a larger role than renewables in depressing wholesale energy prices (Wiser *et al* 2017), high penetrations of renewables are expected to drive substantial drops in wholesale prices in the future (Seel *et al* 2018). These changes—coupled with the fact that several large automakers are developing multiple long-range electric truck models, and ultra-fast charging technologies are being commercialized—suggests that truck electrification is not unrealistic in the near to medium term.

However, the presumed need for electric trucks to charge via direct-current fast charging (DCFC) would likely incur significant electricity demand charges, which could make electric trucks uneconomical. Electric utilities commonly employ demand charges, which charge customers on a \$/kW basis for their maximum instantaneous consumption in a given period. The justification for demand charges is that the utility must maintain adequate generation, transmission, and/or distribution capacity to serve the customer at all times (Wood *et al* 2016). Yet non-peak-coincident demand charges are levied regardless of whether an individual customer's peak coincidences with system peak and imposes additional costs on the grid. As stated by economist Severin Borenstein, 'the single highest consumption hour of the billing period is not the only, and may not even be the primary, determinant of the customer's overall contribution to the need for generation, transmission, and distribution capacity.' Instead, 'time-varying price schedules…can easily be designed to more effectively capture the time-varying costs that a customer imposes on the system' (Borenstein 2016).

Given this context, the focus of this paper is twofold. First, we illustrate that it is feasible for trucks to avoid charging during peak demand hours, when the power system is truly constrained. For example, using historical hourly electricity price and load data for the last 10 years and future projections in Texas and California, we show that the demand is at least 10% lower than the yearly peak demand for at least 15 h on any given day. Further, we show that a substantial share of total annual trucking miles within select US regions can be electrified using the current grid configuration with little or no impact on grid generation capacity, and thereby little impact on generation cost to current electricity consumers. We demonstrate this through a detailed analysis of available system capacity during each hourly interval from 2010–2018 for Texas and California independent system operator (ISO) regions, as well as under alternative future scenarios with substantial renewable electricity generation.

Second, we estimate the achievable cost of electric truck charging to illustrate the importance of appropriate electricity prices to making electric trucks economically

Table 1. Unit charging cost model. Capital costs and $/MW costs levelized over 20 year lifetime and baseline 33% capacity utilization (with sensitivity of 10% utilization) using 7% cost of capital[a].

Cost component	Estimation method for customer in ERCOT	Estimation method for customer in SCE territory within CAISO	Estimation method for direct-access customer in CAISO
	Modeled as the unit charging cost for a retail customer able to access wholesale energy prices in ERCOT territory. Realistic under current regulation.	Modeled as the unit charging cost for a retail customer on SCE's real-time pricing program. Realistic under current regulation.	Modeled as the unit charging cost for a retail customer able to access wholesale energy prices in CAISO territory, but (1) paying the same T&D charges as in ERCOT, and (2) not paying for resource adequacy. Not realistic under current regulation; modeled to understand the impact of not paying for capacity expansion if charging exclusively off-peak.
Electricity Generation	Modeled as the price a retail electric provider would pay to pass through the real-time price to a retail customer: $27/MWh[b]	Modeled as the price a large customer connected at the transmission level would pay on SCE's 2017 real-time price tariff: $38/MWh[c]	Illustratively modeled as the price an energy service provider would pay to pass through the real-time price to a direct-access customer, not including resource adequacy payments: $34/MWh[d]
T&D	Modeled as the T&D charges paid by a transmission-connected customer in Oncor service territory, charging only at non-critical-peak times: $2/MWh[e]	Modeled as the price of a large customer connected at the transmission level on SCE's 2018 real-time price tariff: $49/MWh[f]	Illustratively modeled as the T&D charges paid by a transmission-connected customer subject to critical peak pricing, charging only at non-critical-peak times: $2/MWh[g]
Infrastructure			
Electrical equipment	Modeled as the average of best-case electric vehicle supply equipment (EVSE) costs, taken to be (1) the balance of system (BOS) costs of grid-tied storage, and (2) industry-projected EVSE costs: $18/MWh[h]		
Grid connection cost	Modeled as the average U.S. grid connection cost for utility-scale solar photovoltaic (PV) projects: $5/MWh[i]		
O&M cost	Modeled as the cost of (1) inverter maintenance for a PV plant, (2) preventive maintenance and inspection, averaged for both an existing electric bus charging station and the electrical/wiring inspection costs of a PV plant, and (3) estimated structural maintenance: $5/MWh[j]		
Installation cost	Modeled as the installation costs associated with grid-tied storage plus land costs in California and Texas: $8/MWh[k]		

[a] Based on recent California IOU rates of return (CPUC 2018).

[b] Number modeled based on ERCOT energy prices from 2011–2018 (ERCOT 2018), ERCOT day-ahead market clearing prices for capacity (ERCOT 2019), SCID monthly fee from CAISO (California ISO 2018), conversations with ERCOT staff, and industry interviews.

[c] Number modeled based on SCE 2017 rate schedule TOU-8-RTP (Southern California Edison 2017), using 2017 Los Angeles temperature data.

[d] Number modeled based on CAISO real-time prices from 2012–2018 (LCG Consulting 2018), California RPS standards (CPUC, n.d.), REC prices (Pinko and Weinrub 2013), and CAISO fees (California ISO 2018).

[e] Number modeled based on Oncor retail delivery tariff (Oncor 2017).

[f] Number modeled based on T&D charges in SCE 2017 rate schedule TOU-8-RTP (Southern California Edison 2017).

[g] Number modeled based on Oncor retail delivery tariff (Oncor 2017).

[h] Number modeled based on utility-scale solar+storage BOS costs (Fu *et al* 2018), inverter lifetime (Enbar *et al* 2015), and industry interviews.

[i] Number modeled based on US utility-scale solar grid connection costs (IRENA 2016).

[j] Number modeled based on wiring/electrical inspection costs for PV plants (Enbar *et al* 2015), inverter O&M costs (Enbar *et al* 2015), PMI costs from Foothill Transit, and industry interviews.

[k] Number modeled based on the average price of existing truck stops in California and Texas (Interstate Frontage 2018) and grid-connected storage cost of installation labor and equipment, EPC overhead, and interconnection (Fu *et al* 2018).

competitive. Specifically, we show why it is essential to align a retail consumer's electricity prices with wholesale energy market prices and with their true contribution to buildout of system-wide generation capacity. We do this by modeling scenarios with access to dynamic energy and T&D pricing (in ERCOT and CAISO) and scenarios without (in Southern California Edison territory) (see table 1). We argue that, if trucks can avoid charging when the system is truly constrained, they should realize much lower electricity costs because they are not incurring the cost of building additional generation capacity. We do not consider prices on environmental externalities in this analysis. We also show how pricing is negatively interrelated with low average utilization of charging infrastructure.

2. Methods and data

We investigate the cost of DCFC and the feasibility of off-peak charging under different regulatory regimes.

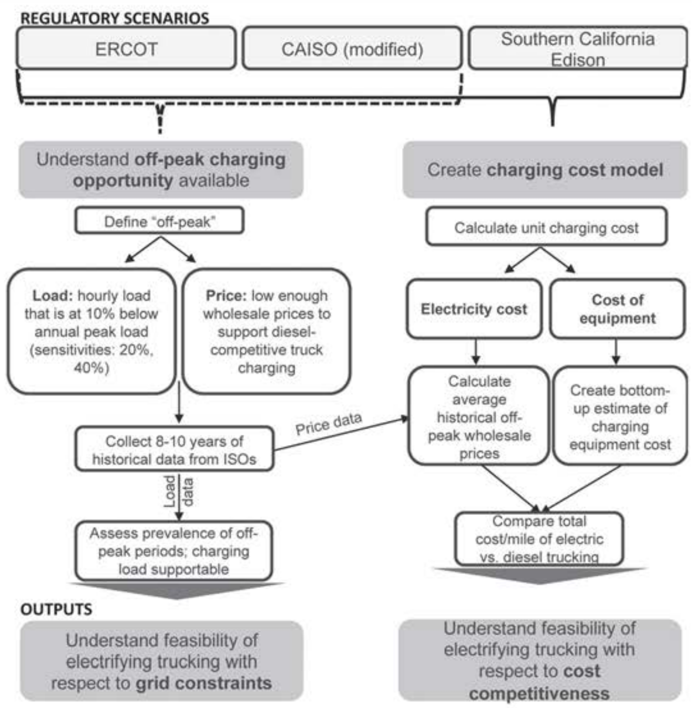

Figure 2. Methodology flow chart. Here we outline our basic methodological approach in order that it can be more easily replicated for regions other than ERCOT and CAISO.

We compare (1) an Electricity Reliability Council of Texas (ERCOT) direct-access customer, and (2) a full-service customer within the Southern California Edison (SCE) utility territory. We also envision (3) an illustrative CAISO direct-access customer with modified delivery charges (table 1). We chose Texas because ERCOT is among the most liberalized US electricity markets (Stoft 2002): it is the only US ISO with both an energy-only wholesale market and full retail competition. We selected California because it is a leader in clean energy technology and policy, has vertically integrated utilities, and its policies will likely encourage the adoption of electric trucks. By comparing two different states and two different regulatory regimes (i.e. regulated utilities versus direct-access customers), we highlight how differences in electricity policy and regulation affect the economics of truck charging. See figure 2 for a schematic depiction of our approach.

First, we explain our analysis of historical price and load data to determine the opportunities for off-peak charging (section 2.1). Separately, we present our basic economic model for the cost of electrified trucking. This model consists of calculating the unit charging cost (section 2.2) and integrating it with the incremental cost of truck electrification (section 2.3) to obtain an overall cost per mile for truck electrification.

2.1. Off-peak price and demand analysis

We analyze data on demand and wholesale energy prices in ERCOT and CAISO to understand the prevalence of off-peak periods that would support truck charging. Various definitions exist for the term 'off-peak'; in this paper, we use it to indicate hours with low demand relative to yearly peak demand (i.e., hourly demand at least 10% below yearly peak demand), and hours with low enough wholesale energy prices to support competitive truck charging.

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In terms of demand, this use of the term off-peak aligns with the concept of critical peaks—that is, analyzing off-peak periods relative to truly extreme system conditions rather than daily peaks that may not reflect true system constraint.

We analyze historical demand and price data. Determining if adequate off-peak demand windows exist is the most fundamental question regarding tariff design, to see if truck charging can avoid incurring new generation capacity buildout on the electricity system. Separately, determining if off-peak price periods consistently exist is important for determining if low energy prices are available even on hot days with extreme price spikes.

We also analyze hourly demand and price projections for the year 2030 for both ISOs. The projection we analyze was built on a scenario of each ISO achieving 40% variable renewable energy (VRE) penetration with balanced amounts of wind and solar (Seel *et al* 2018). In this paper, we do not attempt to predict how the electricity system will evolve in response to higher EV penetrations; we instead use historical and forecasted scenarios as baselines to see where additional EV load could fit in.

We only analyze price and demand in wholesale markets and not within SCE territory because (1) on the demand side, we want to examine the capacity of the larger system, and not artificially constrain our understanding of available capacity, and (2) on the pricing side, SCE's fixed hourly real-time price offering is determined annually and does not necessarily reflect actual grid conditions.

2.2. Charging cost model

Unit charging cost is principally a function of the levelized cost of charging equipment and the cost of electricity:

$$\begin{aligned} \textit{Unit charging cost} = \ & \textit{Levelized cost of equipment} \\ & + \textit{Cost of electricity}. \end{aligned} \tag{1}$$

The levelized cost of equipment is the minimum price per unit of energy delivered (kWh) that a charging service provider should charge consumers to break even on the investment in charging equipment and grid interconnection. The levelized cost is a function of (1) the useful service life of the charging equipment, and (2) the utilization rate in terms of average kWh/day delivered to consumers. Utilization rate is defined as the fraction of time trucks spend charging per day (i.e. a 33% utilization rate means a station is fully utilized for 8 h out of 24). A higher utilization rate implies a lower levelized cost per kWh for the equipment. In this paper, we assume that utilization rate is constant throughout the project lifetime.

The cost of electricity is a function of the cost of generation (i.e. energy production) and the cost of transmission and distribution (T&D). Both generation and T&D have fixed and variable cost components.

$$\begin{aligned} \textit{Cost of electricity} = \ & \textit{Cost of generation} \\ & + \textit{Cost of T\&D}. \end{aligned} \tag{2}$$

Generation costs consist of the variable cost of producing a unit of electricity and the fixed cost of having adequate generating capacity on hand. The recovery of these costs varies significantly by territory. In ERCOT, both the fixed and variable costs of generation are intended to be recovered in the energy-only market. In CAISO, the energy market covers variable generation costs, but separate capacity contracting (for resource adequacy) covers fixed capacity costs. In SCE's territory, customers pay different tariffs that cover generation costs; large customers can access a 'real-time' volumetric energy price that varies between fixed levels hourly depending on the time of day and the temperature.

Recovery of T&D costs also differs from one market to another. Typically, a portion of T&D costs is recovered through energy prices, and a portion is recovered through demand charges. In ERCOT, T&D costs are largely recovered through a critical-peak pricing scheme in which customers pay for their peak use during four 15 min critical-peak demand periods per year. Eighty percent of a customer's use during these windows determines their demand charges for each other month of the year; this is called the '80% ratchet.' In CAISO, both direct-access customers in SCE's territory and full-service SCE customers pay a non-coincident monthly peak demand charge and a per-kWh charge (called an 'energy charge') for T&D.

To analyze unit charging cost, we model a transmission-connected 9.4 MW DCFC station that can simultaneously charge five trucks to a 75% state of charge in 30 min. The size of the truck battery pack—1000 kWh—is estimated based on a 500 mile range semi with a fuel efficiency of 2 kWh mi^{-1}, which current market trends suggest is a reasonable efficiency[4]; however, the modeled per-kWh charging costs would be the same for smaller trucks. We model a baseline station utilization rate of 33%[5] with a sensitivity of 10%. Truck charging is scheduled during the hours of the day with lowest-cost electricity. The model is based on long-range combination trucks charging at public truck stops; grid-connection and land cost values reflect this scenario.

Table 1 summarizes the methods and data used to estimate each of these unit charging cost components.

[4] Tesla gives 2 kWh mi^{-1} as the upper bound for the efficiency of the Tesla Semi (Tesla 2019). Burns & McDonnell, in an analysis of the electricity infrastructure of the Port of Oakland, cite manufacturers of Class 8 trucks as claiming less than 2 kWh mi^{-1} (Burns & McDonnell Engineering Company, Inc., 2019); California ARB also supports a roughly 2 kWh mi^{-1} estimation based on dynamometer testing and in-use data (California ARB 2019).

[5] Upper bound based on utilization rate of 30%–40% assumed for fueling stations in scenario of 100% conversion of long-haul freight trucking to natural gas (Tong *et al* 2019).

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Table 2. Inputs to per-mile fuel cost estimation.

	Inputs: electric		Inputs: diesel
Fuel efficiency	0.48 mi $kW^{-1} h^{-1}$ (California ARB 2019)	Fuel efficiency	5.87 mi gal^{-1} (California ARB 2019)
Battery capital costs	\$100/kWh (Curry 2017) and \$170/kWh (Goldie-Scot 2019)	Diesel price	\$3.16/gal (national), \$2.81/gal (TX), \$4.20/gal (CA)
Battery cycles	2000/lifetime (Miles 2018)	Miles/lifetime	1 000 000 (California ARB 2014)
Battery depth of discharge	75% (Miles 2018)		
Miles/year	68 000 (Alternative Fuels Data Center, n.d.)		

It should be noted that diesel price, truck mileage, grid connection cost, and other variables each have a high degree of variability and uncertainty, although point estimates are used in representative calculations.

2.3. Per-mile cost of electric trucking

After calculating unit charging cost, we compare the total cost per mile of electric and diesel trucking. We assume that the incremental cost of an electric truck relative to a diesel truck is simply the cost of the battery (minus the cost of the diesel engine and transmission, plus the difference in costs of diesel and electric drivetrains), and we treat the battery as an asset that depreciates at a constant level per mile[6]. This is consistent with Sripad *et al*, who use a detailed model of total cost of ownership to show that battery replacement costs and electricity price are the top two critical determinants of the payback to electrification (Sripad and Viswanathan 2019). Our model explicitly accounts for both of those factors and complements the analyzes of Sripad *et al.* We ignore maintenance costs, although this only makes our estimate more conservative, because electric vehicles are expected to realize lower maintenance costs relative to internal combustion engine vehicles (Sripad and Viswanathan 2019).

Diesel fuel cost is a function of diesel price and the fuel efficiency of diesel trucks. Electric fuel cost is a function of the unit charging cost, the fuel efficiency of electric trucks, and the per-mile battery depreciation cost. We compare diesel and electric fuel costs as follows:

$$\begin{aligned} &\textit{Fuel cos t per mile(Diesel)} \\ &= \textit{Diesel fuel price/Fuel efficiency diesel}, \end{aligned} \tag{3}$$

$$\begin{aligned} &\textit{Fuel cost per mile (Electric)} \\ &= \textit{Unit charging cost/Fuel efficiency EV} \\ &+ \textit{Battery depreciation cost}. \end{aligned} \tag{4}$$

Under our approach, a lower fuel cost per mile automatically translates into a lower total lifecycle cost of ownership per mile, because the total cost of all other truck components is assumed to be identical and thus accounted for. In other words, a lower fuel cost per mile for electric trucks implies a negative incremental cost on a lifecycle cost-of-ownership basis.

We incorporate three assumptions on diesel price into our modeling: a national average price of \$3.16/gal (EIA 2019), a Texas price of \$2.81/gal, and a California price of \$4.20/gal (AAA 2019). (Both Texas and California prices are current as of June 2019 and do not attempt to project state-specific diesel prices into the future.) We analyze incremental cost of electrification using both a state-specific and a national average diesel price in order to capture savings that are possible for both intrastate and interstate trucking. This paper primarily relies on the national average price to facilitate comparison between different electrification scenarios.

Table 2 outlines the basic inputs underlying our fuel cost per mile estimates, with the exception of unit charging cost, which varies based on the scenario used in our analysis.

3. Results

Our analysis of historical and projected demand and price data suggests that the current CAISO and ERCOT electricity systems have abundant non-critical-peak opportunities for trucks to charge in terms of both price and demand. Most hours of the year offer opportunities for trucks to charge without contributing to peak demand and, thus, to the need for additional generation capacity. Since 2010, the vast majority of hours in ERCOT (98% of hours) and CAISO (99% of hours) have provided a greater than 10% margin between hourly load and annual peak; in fact, fully 91% of hours in ERCOT and 96% of hours in CAISO have had a greater than 20% margin (figures 3 and 4).

While maintaining a 10% margin between hourly load and annual peak, 724 000 truck-charges/day, at 750 kWh/charge (or 272 million truck-miles/day) could be delivered on average in ERCOT, and 489 000 truck-charges/day (or 183 million truck-miles/day) could be delivered on average in CAISO. An average of 23 h/day in ERCOT, and 24 h/day in CAISO, offer opportunities for truck charging while maintaining a 10% margin.

[6] This treatment of batteries differs from the analysis in (Sripad and Viswanathan 2019), which included battery replacement costs rather than treating batteries as assets that depreciate per mile. We find the battery-as-an-asset approach to be particularly appropriate from a fleet owner perspective.

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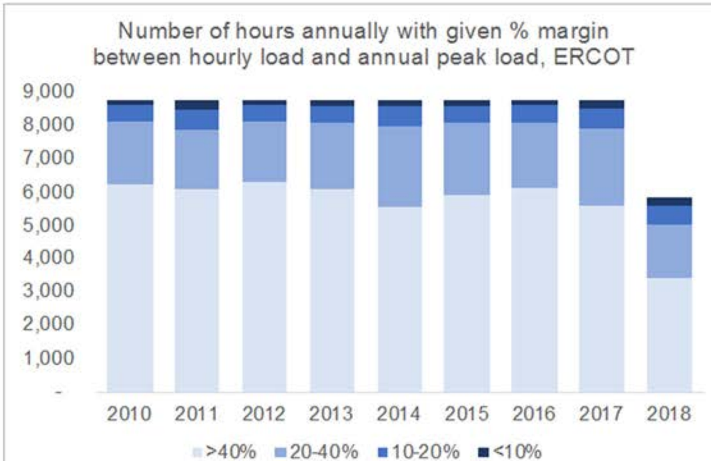

Figure 3. Number of hours annually with given percentage margin between hourly load and annual peak load, ERCOT, 2010–2018. Total hours in 2018 are less than 8760 because of partial-year data.

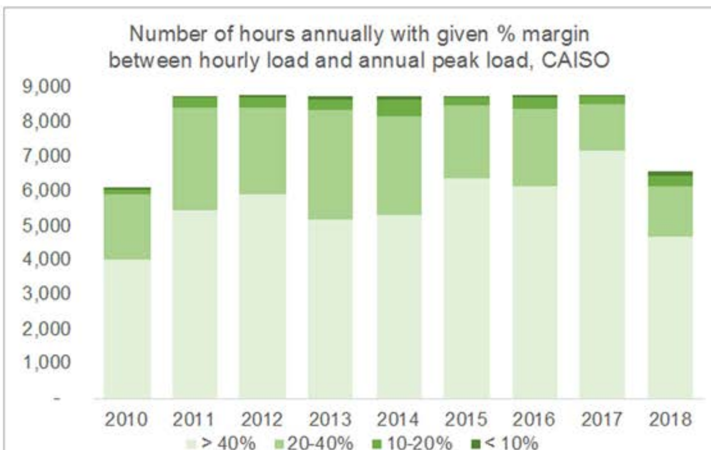

Figure 4. Number of hours annually with given percentage margin between hourly load and annual peak load, CAISO, 2010–2018. Total hours in 2010 and 2018 are less than 8760 because of partial-year data.

At worst (i.e. on a single day in the 9 years of data analyzed), to maintain a 10% margin between hourly load and annual peak, 15 h are available for charging. Only 239 000 truck-charges (89 million truck-miles) would be available in ERCOT, and 177 000 truck-charges (67 million truck-miles) would be available in CAISO.

During at least 8 h of every day in ERCOT and CAISO over the past 7–8 years, wholesale energy prices have been low enough to support diesel-competitive

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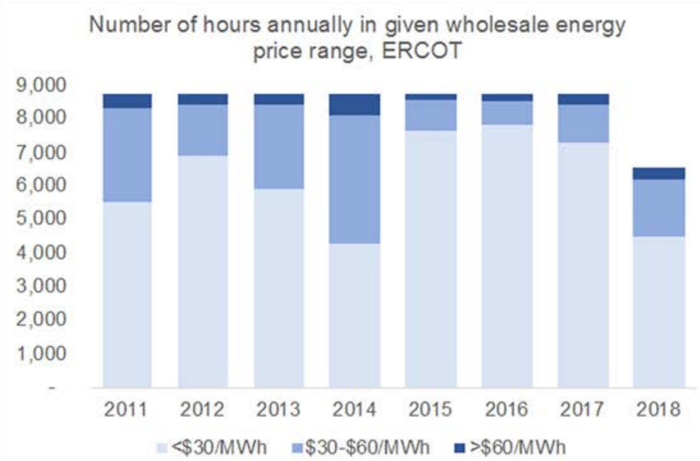

Figure 5. ERCOT historical energy prices, 2011–2018. Total hours in 2018 are less than 8760 because of partial-year data.

Figure 6. CAISO historical energy prices, 2012–2018. Total hours in 2012 and 2018 are less than 8760 because of partial-year data.

truck charging (figures 5 and 6)—and 8 low-price hours could enable 33% utilization of charging infrastructure. (The energy price required to support diesel-competitive charging varies slightly by ISO, but ranges from ~\$65/MWh at high battery prices to ~\$127/MWh at low battery prices).

In this period, 53% of hours in CAISO and 74% of hours in ERCOT have had average prices of \$30/MWh or less, while 95% of hours in CAISO and 96% of hours in ERCOT have had average prices of \$60/MWh or less. On average, the 8 cheapest hours in ERCOT from 2011–2018 had a price of \$20/MWh. In CAISO, the 8 cheapest hours

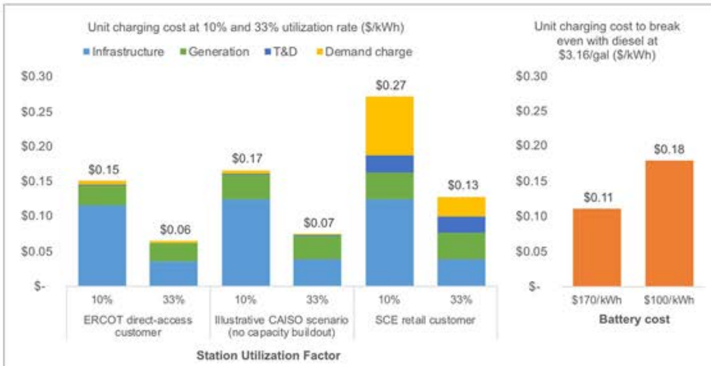

Figure 7. Estimated unit truck charging costs across customer scenarios and utilization factors (left), and unit charging cost needed to break even with diesel trucking (right).

Table 3. Historical and projected (2030) hourly load patterns in ERCOT and CAISO.

	Historical		Projected	
	ERCOT (2011–2018)	CAISO (2012–2018)	ERCOT (2030)	CAISO (2030)
% of hours with >10% margin between hourly load and annual peak load	98%	99%	98%	99%
% of hours with >20% margin between hourly load and annual peak load	91%	96%	91%	93%
Average number of 750 kWh truck-charges available per day	724 000	489 000	839 000	503 000
Number of 750 kWh truck-charges available on the most constrained day	239 000	177 000	231 000	175 000

Table 4. Historical and projected (2030) wholesale energy price patterns in ERCOT and CAISO

	Historical		Projected	
	ERCOT (2011–2018)	CAISO (2012–2018)	ERCOT (2030)	CAISO (2030)
% of hours ⩽$30/MWh	74%	53%	87%	16%
% of hours ⩽$60/MWh	96%	95%	98%	90%
Average price of 8 cheapest hours ($/MWh)	$20	$27	$16	$31
Average price of 8 cheapest hours on the most expensive day ($/MWh)	$58	$78	$30	$56

from 2012 to 2018 had an average real-time price of $27/MWh. Even on the most expensive days, low-cost truck charging opportunities exist: in ERCOT, the most expensive day had 8 h averaging $58/MWh. In CAISO, the most expensive day had 8 h averaging $78/MWh. Electric trucking is still competitive with diesel at these prices.

These demand and price trends hold in a projection to the year 2030 under high wind and solar penetration. In CAISO demand projections, 99% of hours maintain a greater than 10% margin between hourly load and annual maximum load, although only 93% maintain a greater than 20% margin, down slightly compared with historical data (table 3). The average amount of charging available at a 10% margin increases modestly, to 503 000 truck-charges/day (3% greater than historical), and the amount of charging available on the most constrained day decreases slightly (by 3%). In ERCOT demand projections, 98% of hours maintain a greater than 10% margin, and 91% maintain a greater than 20% margin (same as historical). However, the average truck-charges/day available at a 10% margin increase to 839 000 (16% greater than historical).

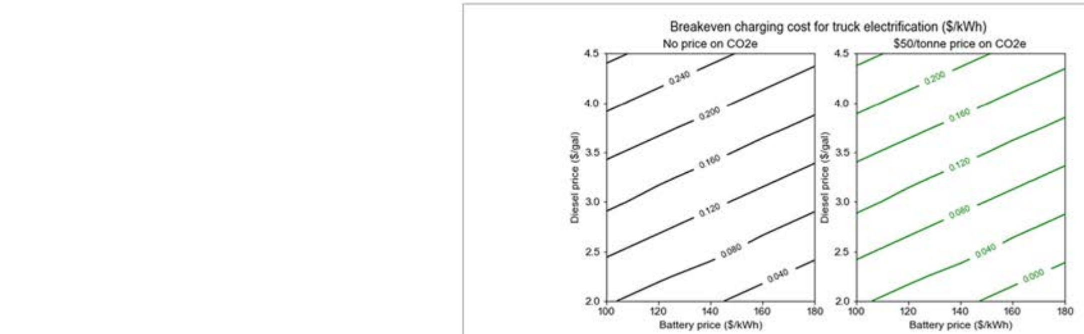

Figure 8. Breakeven charging cost ($/kWh) for truck electrification at varying diesel prices, battery costs, and carbon prices.

Table 5. Net savings with electrification, as dollar figure and as percentage of lifetime diesel fuel costs.

	Scenario	ERCOT		CAISO		SCE	
	Charging cost ($/kWh)	$0.06		$0.07		$0.13	
	Diesel price ($/gal)	$2.81	$3.16	$4.20	$3.16	$4.20	$3.16
Battery price ($/kWh)	$100	$111 000 38%	$148 000 44%	$246 000 56%	$137 000 41%	$175 000 40%	$65 000 20%
	$170	$24 000 8%	$61 000 18%	$159 000 36%	$49 000 15%	$88 000 20%	($22 000) −7%

In ERCOT price projections, 87% of hourly prices are projected at $30/MWh or less, and 98% at $60/MWh or less; even the most expensive day demonstrates an average price of only $30/MWh over the 8 cheapest hours (table 4). Projected prices are higher in CAISO than in ERCOT, with only 16% of hours at $30/MWh or less. However, 90% of hours are at $60/MWh or less, and the average price over the 8 cheapest hours of the most expensive day is only $56/MWh.

It should be noted that these figures address average prices. Price spikes are highly dependent on hourly variations in electricity demand and supply and thus are difficult to predict into the future. Similarly, in our analysis of forecasted demand, we only analyze average patterns rather than hourly extremes.

Given the opportunity for trucks to charge off-peak and at low-cost hours, we estimate that truck charging can be delivered at a lowest unit charging cost of about $0.06/kWh (figure 7, left). At this cost, electric trucking demonstrates substantial cost savings over diesel (figure 7, right). Including infrastructure costs and assuming 33% station utilization, $0.06/kWh charging is achievable in ERCOT, $0.07/kWh is achievable in the illustrative no-capacity-buildout CAISO scenario, and $0.13/kWh is achievable in SCE territory. However, at 10% station utilization, charging costs rise to $0.15/kWh in ERCOT, $0.17/kWh in the CAISO scenario, and $0.28/kWh in SCE territory.

The economics of truck charging vary significantly based on demand-charge design and charging station utilization. With a peak-coincident demand-charge design, truck charging can still be competitive with diesel at low utilization, assuming trucks charge off-peak. This competitiveness could in turn increase the utilization of truck charging stations and further reduce costs by spreading charging station costs over more kWh sold.

The breakeven point for and net savings from electrification vary depending on assumed battery cost and diesel price (see figure 8). (While this work largely avoids any pricing on environmental externalities, we have included a scenario with a $50/tonne tax on carbon emissions in figure 8 as well). Where diesel prices are lower and battery costs higher, breakeven charging cost is lower. However, almost all scenarios demonstrate net savings over diesel trucking (see table 5)—in ERCOT, the maximum benefit from electrification of a truck amounts to 44% savings ($148 000) over the truck's lifetime diesel costs; in the illustrative CAISO scenario, the maximum benefit is 56% savings ($246 000). The only scenario in which truck electrification leads to net financial losses is in SCE

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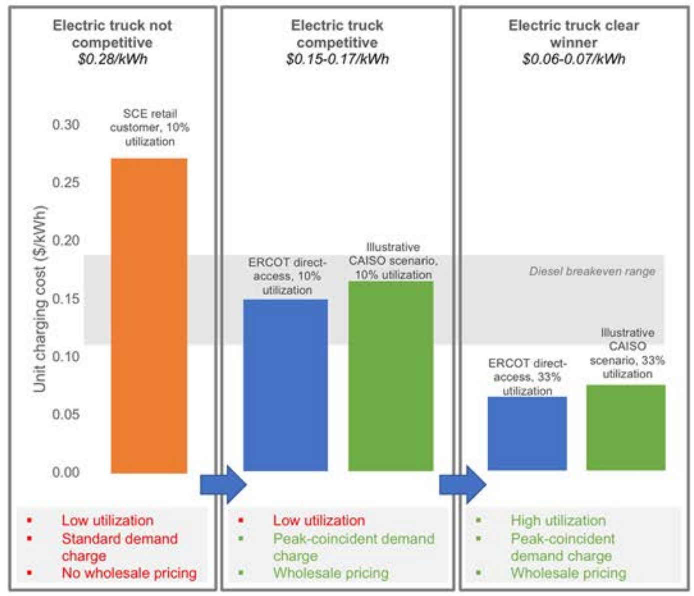

Figure 9. Pathway from conditions that result in non-competitive electric trucks (low utilization, standard non-peak-coincident demand charges, and no wholesale pricing) to conditions that result in increasingly competitive electric trucks (peak-coincident demand charges, wholesale pricing, and—eventually—high utilization). Diesel breakeven figures reflect battery costs between \$170/kWh and \$100/kWh, and \$3.16/gal diesel costs.

territory, which has the highest charging costs, when diesel prices are low and battery prices are high.

4. Discussion

Our modeling identifies a near-term pathway to charging costs that would make the lifetime cost of electric trucks substantially lower than the lifetime cost of diesel trucks, even before accounting for additional benefits of electrification from mitigating environmental externalities. In the illustrative pathway depicted in figure 9, the left panel shows conditions resulting in non-competitive electric truck economics, corresponding to our highest-cost scenario: standard non-peak-coincident demand charges (which account for about a third of the unit charging cost), retail electricity prices, and 10% charging infrastructure utilization. In the center panel are conditions resulting in competitive truck economics, still featuring 10% utilization but now assuming policies that improve electric truck economics: a critical-peak demand charge (based on demand coincident with the year's highest-demand hours) and access to wholesale electricity prices. If such policies successfully promote electric truck deployment, charging station utilization would rise as depicted in the right panel (33% utilization), in which case electric trucks become clear economic winners over diesel trucks. (If high utilization could be achieved independent of demand-charge reform and wholesale price access, the economics of truck charging would still improve, but the pathway described should provide a smoother path to favorable economics). Achieving this pathway might establish a positive feedback loop, with lower charging costs driving increasingly higher electric truck deployment and station utilization, which would reduce costs further. Low-cost financing appropriate to the long lifetimes of truck charging infrastructure would also help reduce costs.

Revising or replacing demand charges in electricity rate structures is particularly crucial to electric truck economics, particularly in the early stages of electrification when station utilization is low. For example, off-peak charging in ERCOT avoids critical-peak demand charges and makes electric trucking competitive even at low station utilization, whereas non-coincident demand charges in SCE drive electric trucking to be non-competitive with diesel, comprising 31% of the charging cost stack[7]. Today, California's IOUs have some of the country's highest demand charges. ERCOT comes closest to tariffs reflecting true system costs with its energy-only market and low fixed T&D charges. However, its '80% ratchet' essentially extends demand charges through the rest of the year at an 80% level.

Instead of non-coincident demand charges, time-varying rates reflecting the time-varying system costs that customers incur—higher on-peak and lower off-peak—are a more economically efficient approach to cost recovery. As the Regulatory Assistance Project states, 'Rate design should make the choices the customer makes to minimize their own bill consistent with the choices they would make to minimize system costs' (Linvill 2018). Aligning incentives to shift trucking off-peak will be increasingly important as high levels of renewable energy depress wholesale prices further, especially during the day. Texas, California, and other states that want to level the playing field for electric trucking should reevaluate their use of demand charges.

Some utilities, especially those in California, are responding to vehicle electrification by developing EV-specific electricity tariffs. For example, PG&E has created a subscription rate plan with a basic TOU structure; SDG&E is working with 'dynamic adders,' which are similar to critical peak pricing; and SCE is granting a five-year demand charge holiday for EV charging (Pyper 2018). However, SCE will be phasing demand charges back in over the course of five years, and the demand charge on SCE's large-customer EV tariff is still over 90% as high as the demand charge for other large customers, with no time-varying component. In fact, unit charging cost as modeled using SCE's EV tariff is marginally higher than the cost using SCE's generic large customer tariff. Although it is encouraging to see utilities addressing EV rate design, further work is needed to design cost-reflective tariffs.

With beneficial electricity rate structures in place, electric trucks would still need to charge at off-peak times to realize the full economic benefits of electrification. Fortunately, off-peak charging periods are abundant. We demonstrate that a minimum of 89 (24) million miles of charge can be delivered daily in ERCOT, and 67 (35) million in CAISO, such that maximum demand remains below 10% (20%) of each ISO's annual peak. For reference, in 2017 Texas's highway system saw 43 million miles/day of combination truck travel and California's saw 24, suggesting that even when the electricity grid is most constrained, Texas's and California's heavy-duty truck charging needs could be met (Federal Highway Administration 2017). Furthermore, there are more than enough low-priced hours to enable high levels of station utilization: on average, fewer than 45 h/year in both ERCOT and CAISO have charging costs greater than $4/gallon diesel equivalent. Even on the most expensive days, there are several hours in which energy prices are significantly lower than peak prices. In addition, trucks could lock in prices on day-ahead electricity markets to mitigate fuel price uncertainty.

In conclusion, our analysis shows that institutional innovations, such as electricity tariff reform, are needed to exploit the economic advantages of electric trucking that have emerged from advances in battery and fast-charging technologies. Although we explore the potential in CAISO and ERCOT, utilities and grid operators nationwide are experiencing similar trends that could support trucking electrification, including low wholesale electricity prices and stronger diurnal electricity price profiles—both driven in part by increasing renewable energy penetrations (Seel *et al* 2018). This analysis can be replicated for other regions using this methodology, depicted in figure 2. Valuable future research might include estimating the achievable utilization of charging stations based on the rate of trucking electrification, station siting practices, and vehicular autonomy. In addition, expanding on our hourly demand and price analysis by examining load-zone-specific data instead of ISO-wide averages would provide a better picture of inter-zonal variability in grid conditions. Finally, in this paper we focus on reforming electricity rates to account for the fact that trucking can be electrified without incurring new generation build; an important area for future research is to assess the extent to which truck electrification would or would not incur new build on either the transmission or the distribution system.

[7] For a low-utilization, transmission-connected SCE customer, demand charges account for about $0.10/kWh of unit charging cost, whereas the cost per kWh of transmission for IOUs from 1960 to 2014 is only $0.0047/kWh.

Acknowledgments

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Data availability statement

The data that support the findings of this study are openly available.

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ALLIANCE FOR AUTOMOTIVE INNOVATION · UAW · MEMA

March 29, 2021

President Joseph R. Biden, Jr.
The White House
1600 Pennsylvania Avenue
Washington, DC 20500

Dear President Biden:

We write today on behalf of a diverse group of motor vehicle manufacturers, suppliers, and hundreds of thousands of United Auto Workers members and retirees, who are committed to working toward a net-zero carbon transportation future that includes a shift to electric-drive vehicles. This shared vision has brought the auto industry in the United States to a transformative moment, one that will shape a cleaner future and redefine motor vehicle transportation for generations to come.

For the U.S. to be a leader in this transformation, we must work collaboratively to develop a comprehensive national vision and strategy. This is not just about the future of the auto industry in the U.S., it is about the nation's global competitiveness, economic security, and the transition of the U.S. workforce. Nations that lead the development and adoption of innovative technologies will also shape supply chains and job creation, define global standards and, potentially, reshape the international marketplace. However, neither the current trajectory of consumer adoption of EVs, nor existing levels of federal support for supply- and demand-side policies, is sufficient to meet our goal of a net-zero carbon transportation future.

We stand ready to work with your Administration to define the bold, comprehensive vision and innovation that will place the U.S. at the forefront of creating a cleaner future for motor vehicle transportation. This transformation is greater than any one policy, branch or level of government, or industry sector. It will require a sustained holistic approach with a broad range of legislative and regulatory policies rooted in economic, social, environmental, and cultural realities. Such an approach will complement and amplify significant private sector resources that will accelerate a net-zero carbon transportation future. If we work without a comprehensive plan, our nation will fall short of this goal.

Automakers and suppliers will invest $250 billion in electrification by 2023, including Plug-in Hybrid Vehicles (PHEV), Battery Electric Vehicles (BEV) and Fuel Cell Electric Vehicles (FCEV) (collectively, "EVs"). IHS Markit predicts there will be 130 EV models available in the U.S. by 2026. Even with the collective efforts of the public and private sectors, of the 278 million light-duty vehicles currently registered in the U.S., only 1.5 million are EVs. And despite growing consumer interest and more than 50 EV models available, EVs only made up about two percent or roughly 300,000 of the 14.5 million new vehicle sales last year. This is why we need a comprehensive plan that takes the present market realities into consideration, as well as the on-going investment and innovation in internal combustion engine (ICE) technologies.

This bold, comprehensive strategy is required to establish the U.S. as a leader in the next generation of clean transportation innovation. Efforts that incentivize wider-scale EV adoption, build out the necessary infrastructure, and facilitate consumer awareness are essential components to EV market expansion. As we work toward the future of clean transportation, it will be critical to ensure this transition benefits all communities, supports American workers, and enhances U.S. competitiveness and economic security.

We look forward to working with your Administration and other public and private stakeholders to craft and implement a comprehensive plan that includes both the supply- and demand-side policies necessary to realize the transition to a cleaner future. We believe that a comprehensive approach must focus on three key areas: Consumers; Infrastructure; and Innovation, Manufacturing and Supply Chain. The following reflects areas where we have general alignment.

Consumers – Affordability and Awareness

The auto sector has made significant progress driving down battery and fuel cell costs. Even still, further research and development investments will be needed to realize "cost, utility, and convenience parity" between EVs and their internal combustion counterparts. EVs currently cost significantly more to produce than equivalent gasoline cars or trucks. This divide grows when considering "convenience and utility parity," which requires larger batteries to support longer EV ranges commensurate with consumer expectations and needs. Larger, more capable vehicles (e.g., pickup trucks and SUVs) used by individuals and businesses for a variety of purposes may require even higher-capacity batteries. To bridge these divides, we offer the following policy recommendations:

- Address the cost premium and directly support sales of EVs by expanding and extending the 30D Federal Tax Credit for PHEVs and BEVs and enacting a long-term extension of the 30B Fuel Cell Motor Vehicle Tax Credit to help equalize the upfront cost to consumers.
- Prioritize additional R&D investment (federal and private) to reduce costs and improve performance of batteries, fuel cells, and hydrogen fuel generation.
- Direct the Secretary of Energy and Secretary of Transportation to develop and fund programs to expand consumer awareness and adoption of EVs and to highlight infrastructure availability.
- Set ambitious federal fleet requirements to adopt EVs, which helps to increase consumer awareness by putting more vehicles on the road and provides more consumers, such as federal employees, with EV driving experience.

Charging and Refueling Infrastructure

While reducing costs and increasing consumer awareness, we must also strive for greater "convenience parity" that ensures access to abundant electric charging and hydrogen fueling infrastructure. Publicly available charging infrastructure not only eases perceived concerns about "range anxiety," but also substantially increases consumer awareness of the technology.

Currently, the majority of EV charging takes place at home, and that is likely to continue into the future. Charging at home can be inexpensive, convenient, and reliable. Extending these benefits to all EV owners will require new and targeted efforts. Installing charging is a fairly straightforward prospect for those who own their own homes and have dedicated off-street parking in a garage or driveway, but policymakers will need to carefully consider the tens of millions of Americans who rent or live in multi-unit dwellings (MUDs). While public DC fast charging stations or other public chargers could meet some needs, the convenience of refueling at home is a key advantage of EVs, and it would be unreasonable and unequitable to expect renters and MUD residents to pay more and spend time away from home each week to charge publicly. Numerous studies show that the cost to retrofit a home or business with EV charging equipment is several times more expensive than installing it during new construction, so designing EV-ready building codes must be part of the answer. Supporting charger installation at apartment complexes or renter-occupied housing that already exists will be necessary, too. Public policies will need to account for this and find ways to support installation of charging options that serve all drivers.

All stakeholders must work together on public policy efforts, such as federal tax incentives, grants, rebates and other mechanisms to spur significant refueling infrastructure development in three key areas: homes, workplaces, and highway and other public locations—especially since currently there are only approximately 100,000 public charging outlets nationwide, and only about 18,000 of these are DC fast chargers capable of rapid fill-ups. The following are policy recommendations to expand charging and refueling infrastructure that can also help to increase consumer awareness and prepare for expanded EV sales:

- Extend the duration of and expand the 30C Federal Tax Credit for alternative fuel vehicle refueling property (including multiple charge points at a single location), which supports electric vehicle supply equipment (EVSE), hydrogen fueling infrastructure, and residential EV charging. The 30C Federal Tax Credit should also be expanded to include medium- and heavy-duty alternative fuel vehicle refueling property.
- Establish a grant program to build public charging and hydrogen refueling infrastructure along the Federal Highway System by expanding alternative fuel corridors. Additionally, grant programs could also serve a similar purpose along secondary roads and within metropolitan areas.
- Establish a grant program allowing states to update State Energy Transportation Plans, including plans to deploy charging equipment and promote the modernization of the electric grid to accommodate charging equipment.
- Expand Congestion Mitigation and Air Quality Grants (CMAQ) to allow funds to be used for installation of charging and hydrogen refueling infrastructure.
- Commit substantial resources, such as a federal rebate program for charger installation or hydrogen refueling infrastructure at workplaces, MUDs, and in underserved and disadvantaged communities.
- Develop a Federal Clean Fuels Policy that further supports reductions in transportation carbon emissions and provides revenue that can be reinvested into charging infrastructure.
- Direct the Secretary of Energy to establish or update model building codes for integrating charging or battery storage equipment into residential and commercial buildings, as well as public parking spaces – including future retrofits to existing facilities.
- Establish a grant program to assist local governments, universities, non-profits, research institutions, independent system operators, public utilities commissions, and utilities in identifying optimal locations to install charging stations and ensure grid resiliency, and in researching and developing technologies to convert existing natural gas pipelines and power plants to support hydrogen.
- Direct the Secretary of Energy to make loan guarantees for EVSE and hydrogen refueling infrastructure.
- Include EV charger installation as eligible for home efficiency retrofit funds or otherwise consider establishing dedicated retrofit programs to wire older structures for Level 2 charging.

Innovation, Manufacturing, and Supply Chain

While the demand-side solutions outlined above can help address near-term challenges, they will contribute to sustained U.S. leadership in automotive innovation only if they are aligned with supply-side realities. Vital aspects of the EV supply chain require the manufacturing of batteries (critical minerals extraction, processing, battery cell production, end of life recycling) and fuel cell stacks. In 2019, Chinese chemical companies accounted for roughly 80 percent of the world's total output of advanced battery raw materials. In fact, the supply side represents one of the best opportunities to develop long-term and sustainable U.S. leadership through manufacturing investments. From the outset, we believe it is necessary to preserve the full and immediate deductibility of R&D expenses, which is slated on January 1, 2022 to erode to five-year deductibility. In addition, we offer the following specific policy recommendations to encourage and incentivize investment by manufacturers and suppliers:

- Expand the 48C Advanced Energy Manufacturing Tax Credit to allow vehicle and equipment manufacturers to retool, expand, or build new facilities for the manufacture, or recycling, of advanced light-, medium-, and heavy-duty electric and fuel cell vehicles, batteries, fuel cells, components, and related infrastructure in the U.S.
- Expand investment in the Domestic Manufacturing Conversion Grant Program and appropriate funds to accelerate the domestic manufacture of batteries, power electronics, electric motors, and other technologies in zero emission vehicles.
- Promote national security and economic security enhancements through the development of U.S.-based supplies of critical minerals (extraction, processing, recycling), battery and fuel cell manufacturing, and other critical components, including semiconductors.
- Expand R&D incentives that maintain and enhance American automobile manufacturers' and suppliers' leadership in the development and production of new innovations that will make the zero-emission future a reality.
- Expand, modernize, and fund the Advanced Technology Vehicles Manufacturing Incentive grant and loan program at the Department of Energy.
- Expand and target workforce training and development programs that will upskill the existing workforce and train new workers to support both our evolving workforce needs and future technology innovations.
- Complement the various tax credits that support renewable energy production by creating a new investment tax credit to support hydrogen production and storage.
- Establish Clean Energy Manufacturing Grant Programs to provide grants for manufacturers, including vehicle manufacturers and equipment and component suppliers, to reequip, expand, and establish facilities for the manufacturing of clean energy technologies and components.

While the approach we have outlined is robust, it should not preclude other important efforts by states and localities that support increased adoption of zero emission transportation via demand- and supply- side solutions. These include corresponding purchase/lease incentives, charging options, low carbon fuel standards, regional market-based carbon reduction efforts, fleet purchases, and use of high-occupancy vehicle lanes for travel.

It will take collaboration and a sustained commitment to realize the U.S.'s political, economic, environmental, and competitive interests in a net-zero emission transportation future. Many of the proposals outlined in this letter align with provisions introduced by members in both chambers and your Administration. From the infrastructure investments reflected in your commitment to 500,000 charging stations nationwide, as well as investments in charging and refueling infrastructure included in the

CLEAN Future Act, LIFT America Act, and other legislation from both this Congress and last, to the supply chain and manufacturing support also included in those same proposals as well as the American Jobs in Energy Manufacturing Act and the GREEN Act, it is clear policymakers understand the broad range of investments necessary to realize this transformation.

On supply chain efforts alone, the proposals outlined above contemplate anywhere from a $4 billion to over $12 billion investment in the 48C tax credit, $12 billion to $25 billion for domestic manufacturing conversion grants, and a ten-year reauthorization of the Advanced Technology Vehicle Manufacturing incentive program. These are steps in the right direction, and if enacted, would not be an insignificant commitment of federal resources. Our organizations and members have been supportive of some of these foundational proposals. However, in order to drive real change, solidify U.S. leadership in clean energy innovation, and support a transition of the automotive workforce, we need to think big because individual policy proposals or investments alone will not result in a successful transition to a net-zero transportation future.

To that end, we are working with our members, key stakeholders, and other experts to identify the appropriate size and scale for these programs to most effectively support the shift to an electric-drive future for consumers, the environment, the economy, and the millions of workers depending on the auto industry for their livelihoods. We look forward to continuing that conversation with your Administration and elected officials in Congress. We must seize this moment and work collaboratively to develop a coherent, national approach to support the transition to an electric-drive future. The coming years will be pivotal to building a strong foundation to support increased adoption and use of electric vehicles above the two percent of new vehicle purchases in 2020.

The road leads to an increasingly electrified future. Let's drive there together.

Sincerely,

John Bozzella
President and CEO
Alliance for Automotive Innovation

Rory Gamble
President
United Autoworkers International Union

Bill Long
President & CEO
Motor & Equipment Manufacturers Association

CC: Speaker Nancy Pelosi
Senate Majority Leader Chuck Schumer
Senate Republican Leader Mitch McConnell
House Republican Leader Kevin McCarthy

About our organizations:

The Alliance for Automotive Innovation (Auto Innovators) is the singular, authoritative and respected voice of the automotive industry, representing nearly 99 percent of cars and light-duty trucks sold in the United States. Our members include vehicle manufacturers, original equipment suppliers, technology and automotive-related mobility companies and trade associations. The Alliance for Automotive Innovation is headquartered in Washington, DC, with offices in Detroit, MI and Sacramento, CA.

Since 1904, **the Motor & Equipment Manufacturers Association** has been the voice of the automotive and commercial vehicle supplier industry — the largest employer of manufacturing jobs in the United States, employing more than 900,000 Americans nationwide. Across the entire range of new vehicle innovation — from autonomous to net-zero carbon technologies — vehicle suppliers are leading the way. Our member companies conceive, design and manufacture the original equipment systems and technologies that make up two-thirds of the value in every vehicle. Member companies also supply the aftermarket with the parts that keep millions of vehicles on the road, fueling international commerce and society's need for transportation. And all of our members' work is done with a focus on public safety and the environment.

The United Autoworkers International Union represents over 400,000 active members and 575,000 retirees. UAW members assemble vehicles, make vehicle parts, assemble heavy trucks and agriculture implement products. In addition, UAW members work as casino dealers, higher education workers, government workers, aerospace workers, food and beverage production and many other fields. The UAW is active in advocating for its members, working families, communities and has a long history of civil rights and human rights support.

Backgrounder: EVs Are Coming. Will They Be Made in the USA?

The global auto industry is at a crossroads. New technologies, new market entrants, and an industry committed to decarbonization means that change is accelerating. Over the next decades, the industry will make a historic shift away from internal combustion engines towards electric vehicles (EVs). Consider these projections:

- By 2025, industry analysts predict sales of all-electric vehicles (known as battery electric vehicles) are likely to reach 7 percent of all U.S. auto sales and 21 percent by 2030.[1]
- By 2035, General Motors has set a goal to sell only EVs and other zero-emission vehicles.[2]
- By 2040, Bloomberg New Energy Finance predicts electric vehicles will be a majority of new worldwide passenger car sales, reaching a 58 percent global market share.[3]

WILL EVS BE MADE IN THE USA?

The transformation of the global auto industry presents both opportunities and threats for America's manufacturing workers and communities. Projections about future adoption of EVs depend on a range of factors including but not limited to cost, development of charging infrastructure, model availability, and customer adoption. Public policies regarding energy, climate, trade, labor, and manufacturing will also play a significant role.

There is little doubt, however, that the auto industry of the future will look quite different than it does today. This means an opportunity to create a high-road, high-value, far more equitable strategy that avoids past mistakes and redresses past harms. Previous short-sighted private investment decisions and public policy choices led to **an overreliance on outsourcing and offshoring, a proliferation of imported vehicles and critical components, a decline in the living and working standards of U.S. auto and manufacturing workers, and lost access to family-supporting careers for the most impacted communities**

To provide perspective for affected workers, policy makers, and community leaders, **The Economic Policy Institute** is undertaking a detailed study of the jobs impact associated with the shift from conventional to electric vehicles, forthcoming in the spring of 2021.

This backgrounder, from the **BlueGreen Alliance, UAW, United Steelworkers,** and the **AFL-CIO Industrial Union Council**, reviews the factors likely to drive U.S. job gains and job losses related to electrification of the U.S. and global vehicle fleet. We also examine the key role the auto sector plays in the U.S. economy and preview policy options that can make electrification a winning strategy for U.S. workers, industries, and the communities that need it most. Our focus is on sustaining, creating, and improving access to good-paying, secure jobs with safe working conditions.

WHAT WILL DRIVE THE FUTURE OF U.S. AUTO JOBS?

Potential EV Job Gains

Rapid growth of EVs will create jobs producing key components such as batteries, electric motors, electronics, regenerative braking systems, and semiconductors.[4] Producing the materials, components, and technology that go into vehicles makes up more than half of jobs in auto manufacturing. There is intense global competition for this high-value manufacturing work, and potential benefits for U.S. workers and communities will be lost if EVs and key components are imported, or shifted to low-wage, insecure jobs.

Maintaining and adding U.S. vehicle assembly capacity will be a central factor in the location of supply chain jobs. To reduce shipping costs and improve logistics and engineering integration, auto manufacturers often purchase or produce key auto components from locations near final assembly plants. Without major assembly facilities, it is difficult to build and maintain the advanced supplier networks necessary for globally competitive advanced manufacturing technology. To capture more domestic supply-chain jobs, the United States must reduce the market share of complete vehicle imports, which stood at 48% in 2017, and address persistent offshoring of key materials.[5]

Widespread adoption of EVs will create new demand for electricity generation and transmission, and EV charging stations, yielding opportunities for skilled electricians, power line installers, construction workers, and the manufacturing workers who will produce the equipment for EV infrastructure.

Potential EV job losses

Battery-powered propulsion systems in electric vehicles have fewer parts than in traditional ICE vehicles. In an electric vehicle, complex internal combustion engines and transmissions are replaced with batteries and motors that have fewer parts, meaning fewer labor hours per car to produce components and assemble them.[6]

Engines are often built here. Battery cells are not—yet. Manufacture of internal combustion engines and key components currently supports tens of thousands of high-skill U.S. union jobs in the United States.[7] These workers will be at risk without a proactive strategy that treats advanced vehicle technology as a key strategic building block of the U.S. manufacturing economy, emphasizing domestic production of critical propulsion and other technology to maintain and grow U.S. jobs.

If the U.S. does not become a major location for assembly of electric vehicles, many more jobs are at risk: As noted above, auto assembly typically anchors the production of component parts—and for EVs, this production is rapidly being established outside the US. If assembly plants are also relocated, the U.S. will lose not only jobs in those facilities, and in EV batteries and cells, but also in other supplier industries: steel and aluminum, glass, tires, seats, and many others.

U.S. AUTO JOBS DEPEND ON U.S. LEADERSHIP

The auto industry drives the U.S. manufacturing economy. Over 900,000 workers are directly employed by U.S. auto manufacturers and parts suppliers,[8] and one job in an auto assembly plant creates an additional 7.4 jobs from upstream and downstream economic activity.[9] The auto sector is also a major driver of spending on research and development, patents and technological innovation.[10]

American auto workers, steel workers, aluminum workers, rubber workers, and others know all too well what happens when the U.S. market, industry, and policy falls behind the rest of the world. For many years U.S. trade and currency policies failed to match what other countries were doing to support core industries, often sacrificing domestic production of key technologies and materials.

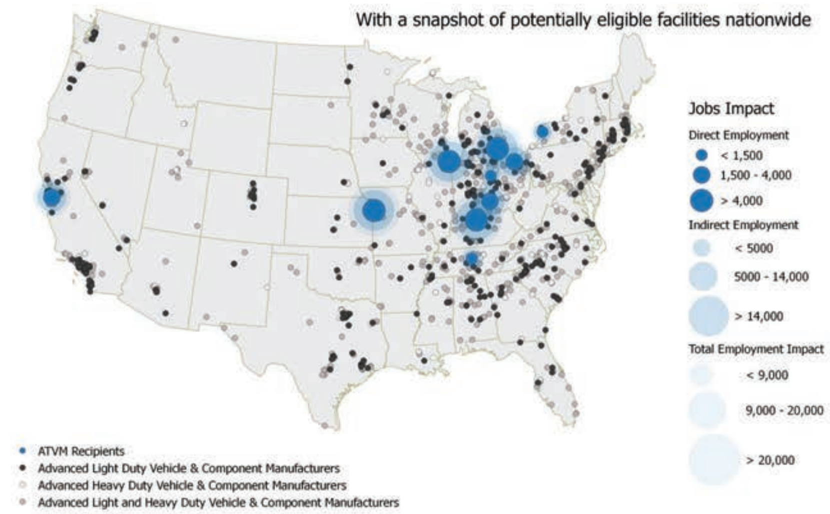
Meanwhile, at several critical junctures—in the 80's, and again in the early 2000's—U.S.-based automakers lost market share, and autoworkers lost jobs when the domestic industry failed to innovate to meet global trends particularly in improved fuel economy.

By contrast, however, industry-wide fuel economy and vehicle greenhouse gas standards adopted by **the U.S. Environmental Protection Administration (EPA)** and **National Highway Traffic Safety Administration (NHTSA)** in 2010 and 2012 positioned the industry to compete with imports, even in the face of volatile oil prices. The standards, which delivered significant benefits to consumers, were complemented by policy to aid retooling U.S. manufacturers. The resulting race for cleaner, more fuel-efficient engines and vehicles spurred enhanced investment in advanced technological innovation and production in the U.S., aiding a recovery in U.S. auto jobs from the 2008-2009 recession.[11]

While the dynamic of potential job gains and losses are different for electrification of vehicles than for fuel economy improvements, the future of the industry still depends on building vehicles here in the U.S. that lead globally in technological and environmental performance.

FIGURE 1: MANUFACTURING LOANS, GRANTS AND TAX INCENTIVES SHOW CLEAR BENEFIT

Example: Employment Impacts of Advanced Vehicle Technology Manufacturing (ATVM) Loans



Source: BlueGreen Alliance, Advance Technology Vehicles Manufacturing Loans: Employment Impacts, 2016

■ ADDRESSING THE LONG-TERM DECLINE IN THE QUALITY OF U.S. AUTO JOBS

Technological progress on its own does not guarantee quality job opportunities for the workers or communities who help create it. Unwise tax, trade and labor policies have hollowed out U.S. manufacturing, encouraging the outsourcing and offshoring of jobs and leaving remaining workers with less compensation and deteriorating working conditions. As the Center for American Progress reports, "many of the new auto manufacturing jobs created in the past decade have been non-union or temporary positions, which come with lower wages and benefits, fewer job protections, and little opportunity for growth."[12]

Unfortunately, this includes EVs. Initial indications are that major automakers are not pursuing a high-road, family-wage strategy for new jobs in EV assembly and core components, and are instead resorting to offshoring, outsourcing, and the use of low-wage, non-union labor for even the most advanced manufacturing operations.[13]

Shortsighted public policy, tolerating low-wage jobs in high value-added manufacturing industries, is costly to taxpayers. Half of all temporary workers in manufacturing receive some form of public assistance, because low wages and inadequate non-cash compensation (such as sub-standard health insurance) are not sufficient to support themselves and their families.[14]

The decline of family-wage U.S. manufacturing jobs is not an accident or the result of impersonal "market" forces. Government and industry leaders made deliberate choices which cost U.S. workers their livelihoods. As the auto industry goes through a major transformation, we can make different choices this time around.

WHERE WE STAND NOW: THE U.S. LAGS FAR BEHIND GLOBAL COMPETITORS

The Biden administration has pledged to reinvigorate American manufacturing and re-establish the U.S. as a leader in action on climate change. The U.S. has already re-joined the Paris Agreement, but four years of inaction have put the U.S. far behind other nations in public and private investments needed to make the U.S. a competitive player in vehicle electrification (see Figure 2).

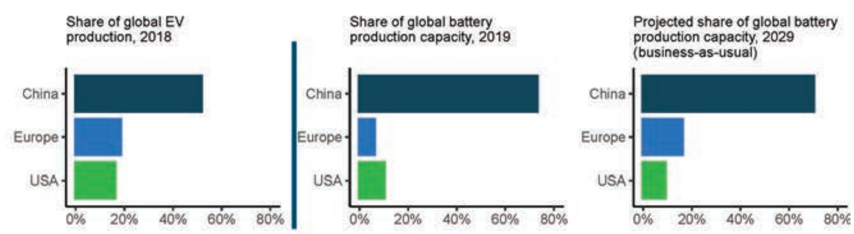
- **China** has invested more than $60 billion to support EV manufacturing. Chinese firms, either owned or supported by the Chinese government, currently produce 60 percent of passenger EVs sold around the globe and produce almost 70 percent of battery cells.[15] China also controls some 80 percent of the supply of rare earth minerals—which are essential for aerospace, defense, and EV production—and may impose export controls on these vital materials.[16]

- **The European Union (EU)** has established the European Battery Alliance to promote production of batteries and key components within EU countries[17] and recently approved $3.5 billion to support battery research and production.[18]

- **South Korea** is home to LG Chem, the world's largest producer of lithium-ion batteries for electric vehicles, with a 24.6% market share. The company has plans to triple its battery production and is currently considering where to locate that capacity.[19]

If the U.S. fails to make public investments and adopt smart public policies to encourage and attract investment in the growing electric vehicle market, companies will locate production and supply facilities in countries that *are* making these investments.

FIGURE 2: COMPARISON OF GLOBAL EV AND BATTERY PRODUCTION CAPACITY



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POLICY PRIORITIES: A HIGH-ROAD STRATEGY FOR WORKERS, COMPANIES, AND COMMUNITIES

In the coming months and years, global auto manufacturers will make decisions about where to locate hundreds of billions of dollars of investment in production of EVs, batteries, battery materials, and other components of the EV supply chain. Now is the time for U.S. policy makers to implement and build on the major plans laid out by the Biden-Harris administration, to ensure U.S. workers, companies, and communities will see gains from these emerging and advanced technologies.

Urgent steps include:

- **Ensure a coordinated industrial policy** centered on maintaining and growing high-quality union jobs in U.S. manufacturing while combating climate change and advancing equity. This must feature equally robust manufacturing, procurement, trade, tax, and energy policies working together to promote clean energy and U.S. industrial production—with a specific focus on advanced vehicle technology manufacturing.

- **Return to smart vehicle standards:** A decade of strong fuel economy and clean vehicle standards, jointly developed with labor, community, environmental, and industry groups at the table, drove both innovation and job creation while reducing greenhouse gas emissions. The rollback of these successful standards in 2020 put manufacturing jobs directly at risk. One of President Biden's first executive orders directs the EPA to consider "suspending, revising, or rescinding" this rollback. Now a new generation of standards should put the U.S. back in a leadership role as a market for advanced vehicle deployment and production.
- **Invest to retool American manufacturing** to safeguard and create jobs building EVs and key components. This includes:
  - **Expand the funding and scope** of existing advanced vehicle manufacturing loans, grants, and tax incentives. This will support reshoring, expansion, retooling of domestic manufacturing across EVs, key components, and the related supply chain.
  - **Focus on manufacturing conversion of plants at risk of closure** and to bring new manufacturing into existing plants, directly tracking the status of plants producing components that are exclusive to ICEs.
  - **Target investments to rebuild manufacturing communities,** strengthen supplier networks, and improve job quality, equity, and environmental outcomes throughout the supply chain; and to ensure impacted, low-income and communities of color see both environmental and economic benefits and real pathways into family-supporting manufacturing careers.
  - **Tax credits, loans and other public subsidies must be contingent** on acceptance of high-road employment strategies, including fair compensation, upholding civil rights and health and safety protections, and freedom of association.
- **Make strategic investments and coordinate to fill gaps in essential supply chains, including** semiconductors and battery cells, as well as environmentally and socially responsible production, reclamation, and recycling of critical EV materials—such as lithium and cobalt.
- **Enforce and strengthen policies to leverage the U.S. advantage in basic research.** The United States is still a leader in the research that drives clean-energy breakthrough. We should enhance this leadership through programs such as the proposed Biden "Earthshots", and do more to ensure we produce the technology we invent. Our top competitors have very active programs to develop or acquire new technology for home country manufacturing advantage, while the United States does not enforce even the weak provisions it has on the books.
- **Take a new approach to trade agreements, and trade enforcement** focused on protecting workers, consumers, and the environment instead of protecting the right of corporations to shift jobs and resources to low-cost, low-regulatory environments. This means trade rules and enforcement that improve worker and environmental standards and building out charging stations. The federal government can set high-quality environmental, labor, and safety standards for manufacturing, operations, and maintenance as a benchmark for similar transitions by state and local governments and private industry. Throughout the manufacturing supply chain and stem offshoring and the leakage of jobs—and pollution—overseas.
- **Boost incentives** especially for low-and-moderate income households, for purchase of domestically manufactured EVs and charging stations, and for low and moderate income households and make major investments to **rapidly and equitably increase availability of electric vehicle charging** to further expand the domestic market.
- **Electrify publicly owned vehicle fleets at all levels of government.** The U.S. government owns or leases more than 640,000 vehicles, allowing efficiencies of scale when transitioning to electric vehicles and building out charging stations. The federal government can set high-quality environmental, labor and safety standards for manufacturing, operations and maintenance as a benchmark for similar transitions by state and local governments and private industry.

A PROACTIVE STRATEGY TO MAINTAIN AND EXPAND U.S. JOBS AND CRITICAL SECTORS

A focused effort to win a significant share of the growing vehicle electrification market will be essential to maintain and create jobs for U.S. workers and preserve a strong U.S. manufacturing base. A pro-active strategy to sustain core manufacturing industries is also essential to U.S. national security, and to maintaining U.S. leadership in research and development, innovation and new technologies.

The Biden-Harris administration has already taken important steps to prioritize well-paying jobs across the clean economy and commit to a new generation of energy, manufacturing and infrastructure investments that deliver clear economic and environmental benefits particularly in the most impacted communities and ensure equity and diverse workforce.

Taking action now to promote leadership in the next generation of vehicles, manufacturing, high-road, high-wage U.S. jobs will be a critical to meeting these goals.

Aggressive, coordinated action is needed to increase and sustain investment, production, jobs, and equitable outcomes in a critical U.S. manufacturing sector, and in manufacturing communities across America.

With the right policy choices, that avoid and address the mistakes of the past, these goals are achievable and will deliver the results working people across the nation need on jobs, equity, and climate change.

For further information, please contact:

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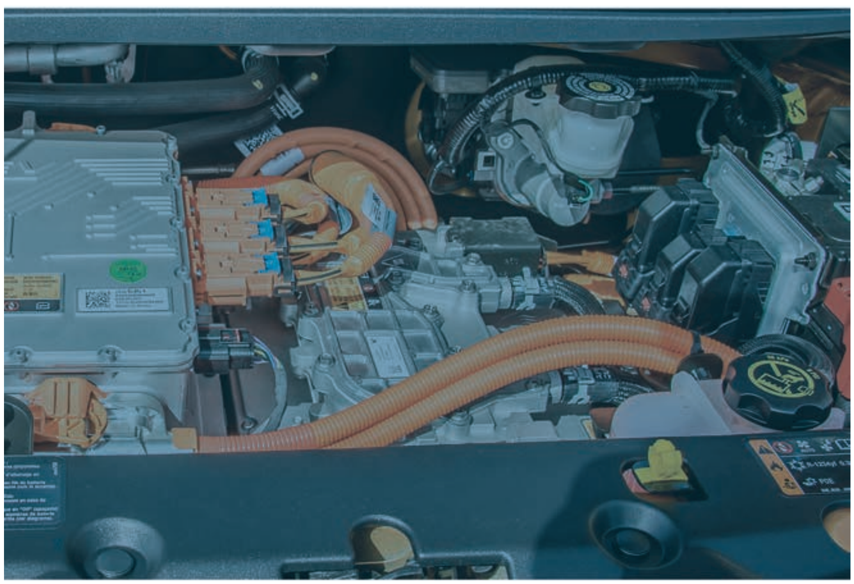
Brad Markell, AFL-CIO Industrial Union Council, bmarkell@aflcio.org



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ABOUT

The **AFL-CIO Industrial Union Council (IUC)** brings together manufacturing unions to develop strategies and promote policies to revitalize the U.S. manufacturing industries. The IUC takes a leadership role in issues related to the global economy, Chinese currency manipulation, clean energy, and development of green jobs.

The **BlueGreen Alliance** unites labor unions and environmental organizations to solve today's environmental challenges in ways that create and maintain quality jobs and build a clean, thriving, and equitable economy.

The **International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)** is one of the largest and most diverse unions in North America, with members in virtually every sector of the economy.

The **United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union (USW)** represents 850,000 workers in metals, mining, pulp and paper, rubber, chemicals, glass, auto supply and the energy-producing industries, along with a growing number of workers in health care, public sector, higher education, tech and service occupations.

STATEMENT OF
GENEVIEVE CULLEN,
PRESIDENT,
ELECTRIC DRIVE TRANSPORTATION ASSOCIATION
SUBMITTED TO THE
SUBCOMMITTEE ON ENERGY
HOUSE ENERGY AND COMMERCE COMMITTEE
MAY 5, 2021

The Electric Drive Transportation Association (EDTA) is the cross-industry trade association promoting the advancement of electric drive technology and electrified transportation. EDTA's members represent the entire value chain of electric drive, including vehicle manufacturers, battery and component manufacturers, utilities, charging infrastructure developers and others. Collectively, we are committed to realizing the economic, national security and environmental benefits of displacing oil with electricity in battery and fuel cell-powered vehicles.

EDTA believes that achieving net-zero emissions transportation requires a comprehensive effort, across multiple sectors of the economy, to electrify transportation with plug-in and fuel cell vehicles and infrastructure. EDTA's members represent the largest source of employment in the electric transportation supply chain, and they are poised for major expansion of those opportunities. With U.S. leadership, the transition to e-mobility will ensure our economic future while driving innovation that reduces emissions, creates jobs and boosts opportunity throughout the economy.

To secure our leadership, the U.S. needs to catalyze growth with significant, long-term investments in market expansion, accelerate technology development, and rapidly expand deployment of the e-mobility ecosystem. As detailed in our EV Leadership Plan, which accompanies this statement, action is required in five key areas: scaling the passenger vehicle market, accelerating commercial fleet adoption, expanding charging infrastructure, building a 21st century power grid and advancing next-generation technology through research and development. The legislation before the Energy Subcommittee today addresses many of these critical areas.

As the bills under consideration attest, a comprehensive approach is essential to the success of our shared effort to build the 21st century's transportation sector. EDTA commends the Committee and the Chairman for advancing policies to provide resources for vehicles, infrastructure, planning and manufacturing and we thank you for the opportunity to share our views on these critical proposals.

<u>HR 1512, The CLEAN Future Act</u>

The provisions of Title 4-Transportation include important programs to accelerate deployment of infrastructure, modernize building codes, ensure equitable access to charging and refueling, expand federal investment in electric drive alternatives in the medium- and heavy-duty fleet, update the ATVM program and Sec 131 of the *Energy Independence and Security Act*.

Specifically, in Subpart D Part 1, we support the creation of rebates for deployment of electric drive infrastructure for plug-in and fuel cell vehicles, as contained in HR 1512 and HR 2852. We appreciated the opportunity to provide input to Mr. Tonko to ensure that the program supports investment in the diverse charging and refueling options that are needed in Level 2, DCFC and hydrogen applications. The additional flexibility to revisit the apportionment of the funds will allow for the program to evolve with this emerging ecosystem. We look forward to continuing to work with the Committee as you refine these provisions to maximize the effectiveness of the program in building out electric drive infrastructure.

EDTA supports updating building codes as essential to efficient growth of electric drive infrastructure, particularly in multi-unit dwellings and funding for integrating electric vehicle infrastructure into state planning through State Energy Conservation Plans.

We also support amending Sec. 131 of the *Energy Independence and Security Act* to recognize advances in electric drive technologies, including medium- and heavy-duty electrification and the need for investment in recycling and secondary uses of batteries.

HR 1512 provides needed and beneficial updates to federal fleet purchasing requirements. The bill's graduated increases in the *Energy Policy Act's* alternative fuel requirements provide a powerful roadmap for increased electrification in federal fleets. The revisions recognize the diversity of use cases in the federal fleet and maximize electric drive choices to serve fleet needs in the light-, medium- and heavy-duty segments.

Subtitle D Part 2 requires the Secretary of Energy to pursue measures ensuring access and equity in electric transportation. As the Committee is aware, disadvantaged and front-line communities bear a disproportionate burden of pollution and its health and economic detriments. Comprehensive electrification legislation can address these disparities. EDTA supports the effort in HR 1512 and HR 1221, the *Electric Vehicles for Underserved Communities Act*, to assess needs and opportunities and to provide resources for technical assistance and project grants that will increase access to electric transportation and the benefits it provides to individuals and communities.

The grants provided in Subtitle D Part 3, to support mapping current and future Electric Vehicle Supply Equipment (EVSE) needs, are important to help accelerate the scaling electric transportation with informed investment. A comprehensive and consistently updated public database will help to ensure that the Department of Energy and the industry can make effective investments to meet current electric transportation infrastructure needs and plan for future ones.

EDTA supports investment in advanced manufacturing to create resilient supply chains, employment and U.S. leadership in the global market. As provided in Subtitle E and in HR 2308, the *ATVM Future Act*, updating the *Energy Policy Act* with explicit inclusion of "plug-in" technology and acceleration of domestic manufacturing of batteries and other technologies will focus resources on U.S. leadership in the global EV technology race. In addition, the expansion and updating of the ATVM program will enable this resource to be more effectively deployed to build U.S. manufacturing and employment and grow supply chain resilience.

<u>HR 2852, the *NO EXHAUST Act*</u>

EDTA applauds the leadership of Mr. Rush in the development of HR 2852, the NO EXHAUST Act, which was developed last year and serves as the basis of many of the electric drive provisions in the CLEAN Future Act. We are supportive of the bill's comprehensive investment in the electric drive transition, as described above.

<u>HR 1221, the *Electric Vehicles for Underserved Communities Act of 2021*</u>

As noted above, disadvantaged and front-line communities bear a disproportionate burden of pollution and its health and economic detriments. Representative Clarke's bill addresses the need to address these disparities and we support the effort in HR 1512, and in HR 1221, The Electric Vehicles for Underserved Communities Act, to provide resources for assessment, technical assistance and project grants for projects that advance access to electric transportation and the benefits that it provides, to individuals, communities and the nation.

<u>HR 2308, the *ATVM Future Act*</u>

As noted above, EDTA supports investment in advanced manufacturing to create resilient supply chains, employment and U.S. leadership in the global market. Subtitle E of HR 1512 and HR 2308, as introduced by Representative Dingell, will update the Energy Policy Act and accelerate domestic manufacturing of batteries and electric drive supply chain technologies. In addition, the expansion and updating of the ATVM program will enable this resource to be more effectively deployed to build U.S. manufacturing and employment, recognize the importance of medium- and heavy-duty vehicles, grow supply chain resilience and contribute to securing U.S. leadership in the global electric drive technology race. We appreciate Representative Dingell's leadership in ensuring not only that the future of transportation is electric, but also that the U.S. leads this transition in a way that benefits our economy and workers.

<u>Conclusion</u>

As the legislation under consideration recognizes, electric transportation is essential in addressing the climate crisis, advancing environmental justice and reducing health inequities. Building out an electric transportation sector will also grow employment and competitiveness. U.S. leadership in transportation electrification is vital to the creation of millions of good-paying American jobs and to our role in the global marketplace.

Simply, electrifying transportation is the choice to design a cleaner, smarter, fairer and more prosperous future. That does not, however, mean it will be simple to accomplish. We applaud the leadership of the Energy and Commerce Committee and appreciate the opportunity to work with you to ensure the success of this urgent and comprehensive effort.

EDTA
Electric Drive Transportation Association

EV Leadership: A 5-Year Policy Plan

The Electric Drive Transportation Association (EDTA), the collective voice of the entire EV value chain, believes that:

- Achieving net-zero emissions transportation for all Americans is a critically important goal that requires a comprehensive effort across multiple sectors of the economy to electrify transportation.
- U.S. leadership in this effort to electrify transportation will secure our economic future while driving innovation that reduces emissions, creates jobs and boosts investment opportunities in our communities and across all segments of the economy.
- To secure our leadership, the U.S. should implement an aggressive five-year plan that catalyzes growth with significant, long-term investments in market expansion and accelerates technology development and deployment for cross-sector adoption of e-mobility.

The federal policies detailed in this document can catalyze innovation and investment that will grow markets and supply chains, speed U.S. innovation and empower consumers with mobility choices.

Scale the passenger vehicle market	Accelerate commercial fleet adoption	Expand infrastructure to support local, regional and interstate charging and refueling options	Build a 21st century power grid to deliver an electrified transportation sector	Advance next-generation technology and the supply chain through research, development and deployment

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SCALE THE PASSENGER VEHICLE MARKET

To accelerate the growth of the still-emerging market, federal policy should promote investment in electric transportation throughout the supply chain with consistent, long-term incentives for electric drive vehicles and infrastructure to enable the widest market participation by consumers and manufacturers.

EDTA recommends the following to achieve scale in the passenger vehicle market:

- Update the federal Sec. 30(D) plug-in electric drive vehicle credit with an increased cap on eligible vehicles and ensure that the credit continues to give consumers maximum vehicle choice and promotes investments by diverse industry entrants.
- Extend the Sec. 30(B) consumer credit for fuel cell vehicles for a period comparable to plug-in vehicles.
- Provide a long-term extension of the Sec. 30(C) credit for alternative fuel infrastructure, increasing the current cap to promote investment in advanced infrastructure options and ensuring accessibility and flexibility of payment methods at eligible facilities.
- Maintain regulatory incentives for electric vehicles in fuel economy and greenhouse gas standards to promote investment in advanced technologies that can provide the highest efficiency and emissions reductions benefits.
- Continue zero-emission treatment for battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs).
- Maintain compliance multipliers for these vehicles in any revision to the regulatory framework.
- Recognize the benefits of EVs and efficiency in any updated infrastructure funding mechanisms, including the Highway Trust Fund. Support a comprehensive update of the Highway Trust Fund that advances investment in 21st century infrastructure and does not penalize efficiency.
- Update federal authority to recognize technology advances and support access to High-Occupancy Vehicle lanes for electric drive vehicles. Public-private partnerships should maintain HOT/HOV treatment for advanced technology vehicles.

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ACCELERATE COMMERCIAL FLEET ADOPTION

Fleets provide an immediate opportunity to move markets and reduce emissions in the transportation sector. Electrifying the federal fleet with electric drive light-, medium- and heavy-duty vehicles will save energy and operating expenses while growing American competitiveness in the global energy technology race. Support for state, local, utility and private fleet investment in electric drive vehicles and infrastructure will reinforce community and business efforts to improve air quality and services. Fleets will also be the proving ground for innovative mobility models, including car sharing and automated vehicles.

EDTA recommends the following to accelerate commercial fleet adoption:

- Expand the fuel diversity of the commercial fleet with restored incentives for medium- and heavy-duty electric drive vehicles; ensure incentives recognize next-generation costs and technologies for alternative fuel trucks and buses, including medium- and heavy-duty hybrid, plug-in and fuel cell vehicles.
- Provide resources for state rebate funds for purchases of both electric drive trucks and charging/refueling infrastructure at fleet depots in federal transportation programs.
- Expand Department of Transportation programs that support electric transit, including full funding for the Federal Transit Administration's Public Transportation Innovation program, which advances innovative public transportation projects through research, development, demonstration and deployment, and evaluation of technologies of national significance to public transportation.
- Grow the U.S. manufacturing base by reinvigorating the Advanced Technology Vehicles Manufacturing (ATVM) program with expanded eligibility for medium- and heavy-duty vehicle and component manufacturing facilities.
- Provide funds to manufacturing grant programs established in 42 USC 16062, and IRC Section 48C for advanced energy projects, to light-, medium- and heavy-duty vehicle manufacturers, and component manufacturers to encourage domestic production of electric drive vehicles and infrastructure.
- Update federal and state fleet requirements and expand incentives for fleet turnover.
- Expand the Department of Transportation's Low/No Emissions funding to accelerate electrification of transit; expand programs to accelerate new technology adoption in all medium- and heavy-duty vehicle fleets.
- Expand EPA's Diesel Emissions Reduction Act (DERA) program of grants, loans, and rebates for replacing and retrofitting diesel vehicles, to advance electric drive technology options in medium- and heavy-duty markets.
- Provide increased funding for the Clean School Buses Program, which will yield real-time public health benefits for children and communities while stimulating jobs and investment through the electric medium- and heavy-duty supply chain. Limits on grant amounts should be raised to accommodate the higher initial costs of the advanced technologies.
- Establish and expand fleet manager education and training initiatives; support education and assistance for installation of workplace infrastructure by private employers.

EDTA
Electric Drive Transportation Association

EXPAND INFRASTRUCTURE TO SUPPORT LOCAL, REGIONAL AND INTERSTATE CHARGING AND REFUELING OPTIONS

Rapid expansion of the electric drive fleet must be matched by expansion of infrastructure. We support the Administration's call for a comprehensive federal effort to accelerate build out of electric charging and hydrogen refueling options to meet the diverse needs of an evolving U.S. vehicle fleet. At the same time, we need to invest in efforts that speed installation of electric drive infrastructure that serves homes, workplaces and communities.

EDTA recommends the following to expand charging and refueling infrastructure:

- Establish a national infrastructure bank, or otherwise enable the financing of public-private partnerships through existing federal loan programs, such as Transportation Infrastructure Finance and Innovation Act (TIFIA), to support expansion of electric vehicle infrastructure, including DC fast charging and hydrogen refueling networks in diverse areas, including those that support seaports, inland ports and freight movement.
- Work with states and infrastructure stakeholder groups to advance alternative fuel corridor nominations and expand corridors overall.
- Provide a grant funding mechanism under the Department of Transportation's Alternative Fuel Corridors program to accelerate the installation of electric drive infrastructure along designated corridors and designated alternatives.
- Establish a rebate program to promote the purchase and installation of publicly accessible electric drive infrastructure in parking facilities, workplaces and multi-unit dwellings. Individuals, State, Local, Tribal, or Territorial governments, private entities and metropolitan planning organizations should be eligible for rebates.
- Reauthorize and increase funding for the Department of Energy's Clean Cities program.
- Expand funding and eligible program activities for the Congestion Mitigation and Air Quality Improvement (CMAQ) program.
- Provide federal support for local, state, and regional infrastructure planning collaborations.
- Allow greater access to federal lands, such as national parks, for charging and refueling infrastructure.

EDTA
Electric Drive Transportation Association

BUILD A 21ST CENTURY POWER GRID TO DELIVER AN ELECTRIFIED TRANSPORTATION SECTOR

An electrified transportation sector will also provide benefits to the power sector if we plan for the emerging opportunities to manage load and demand. Policies to make the energy grid stronger, smarter, cleaner, and more secure will enhance customer experience, while maximizing system benefits and supporting expansion of electric transportation.

EDTA recommends the following to modernize the grid and build out an integrated electric drive ecosystem:

- Increase collaboration among stakeholders, including electric utilities, labor, hydrogen producers and distributors, vehicle manufacturers, charging infrastructure providers and communities, and infrastructure site hosts to expand charging and hydrogen fueling infrastructure at the state and local levels.
- Advance policies to accelerate investment in electric drive and hydrogen infrastructure to support light-, medium- and heavy-duty vehicles.
- Fund grid research to optimize the connection between electric transportation and the power sector, including cyber and physical security, demand response and energy storage capabilities, vehicle-to-grid integration, secondary-use of batteries and hydrogen storage demonstrations with private partners.
- Promote a robust infrastructure market for vehicle manufacturers, electric utilities, equipment & service providers; support industries that ensure a consistent user experience, customer choice, and innovation.
- Secure EPA action on pending applications to the RFS's biogas-to-electricity pathway and issuance of electricity Renewable Identification Number (eRIN) credits associated with those applications.
- Work with the EPA's ENERGY STAR program to identify effective timing and scope of action on energy efficiency standards for electric vehicle supply equipment.
- Coordinate with building codes and LEED stakeholders to expand recognition of the benefits of electric drive infrastructure and promote its installation in new and existing buildings.
- Advance connection standardization and work with private standard setting organizations, such as the Society of Automotive Engineers (SAE), Institute of Electrical and Electronics Engineers (IEEE) and National Electrical Manufacturers Association (NEMA), to facilitate increased standardization, while preserving rights of innovation and competition in infrastructure development.

EDTA
Electric Drive Transportation Association

ADVANCE NEXT-GENERATION TECHNOLOGY AND THE SUPPLY CHAIN THROUGH RESEARCH, DEVELOPMENT AND DEPLOYMENT (RD&D)

U.S. leadership in electric transportation begins with innovation. The transition to e-mobility will include battery and fuel cell vehicle electrification, automation, and connectivity technologies – as well as the interconnected ecosystems of transportation, power and communications. Federal policy can promote and reward innovation with a long-term vision for e-mobility, accompanied by increased agency research funding, expanded demonstration and deployment initiatives to speed technology advances and public-private partnerships to bolster U.S. capacity to develop, build and deploy EV technologies.

EDTA recommends the following to speed innovation through the supply chain:

- Fund robust Department of Energy, Department of Defense and other agency research and development of battery, fuel cell and hybrid technologies.
- Increase emphasis on multi-level demonstration and deployment of light-, medium-, heavy-duty, and non-road vehicles, and secondary-use batteries.
- Expand ARPA-E and other public-private partnerships to develop pre-commercial breakthroughs and grow the U.S. lead in the global advanced transportation technology race.
- Support investment in advanced manufacturing facilities through Department of Energy Loan Programs.
- Use the federal government's purchase power to deploy fleets and develop microgrids that advance markets, community resilience and expand expertise in e-mobility.

With a comprehensive vision and an aggressive plan of action for e-mobility, the United States can secure leadership in the global race for electric drive technologies that are essential to achieving net-zero emissions.

The Electric Drive Transportation Association, whose members represent the entire value chain of the electric drive industry, looks forward to working with the new Administration and Congress to seize the opportunity to lead the world in e-mobility.

Working together, we can realize the essential economic, environmental and employment benefits that electrifying transportation will provide.

EDTA
Electric Drive Transportation Association

ABOUT
EDTA

Mission

The Electric Drive Transportation Association (EDTA) is the trade association promoting battery, hybrid, plug-in hybrid and fuel cell electric drive technologies and infrastructure. EDTA conducts public policy advocacy, education, industry networking, and conferences. EDTA's membership includes vehicle and component manufacturers, utilities, infrastructure providers and electric transportation stakeholders.

For more information about EDTA and our members, visit **ElectricDrive.org**. For information about owning and operating an electric vehicle, please visit **GoElectricDrive.org**.

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ampLe

To: The Honorable Bobby L. Rush
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From: Dr. Levi Tillemann (VP for Policy and International, Ample, Inc.);
John Paul Schnapper-Casteras, Schnapper-Casteras PLLC;
Matt McGovern, CleanTech Law Partners.

cc: Khaled Hassounah, CEO Ample, Inc.;
John DeSouza, President Ample, Inc.

Date: May 2, 2021

Re: Equity, Technology Neutrality and The CLEAN Future Act

Ensuring Equity and Technology Neutrality of The CLEAN Future Act

Dear Chairman Rush, Ranking Member Upton, and members of the House Committee on Energy and Commerce, Subcommittee on Energy,

Ample, Inc. strongly supports the efforts of the Energy and Commerce Committee to promote a transition to a clean, equitable, electrified mobility system and we appreciate this opportunity to provide comments to Committee members and staff in advance of the scheduled hearing on "The CLEAN Future Act: Driving Decarbonization of the Transportation Sector."

Ample, Inc. is a San Francisco-based company that is in the process of deploying battery swap-based energy delivery infrastructure for electric vehicles. It is Ample's intention to install, operate and maintain a significant network of battery swap stations within the State of California, throughout the

United States and internationally. Well-designed battery swapping is an important solution to many of the functional and equity-centered challenges surrounding EV charging and ownership today. This is because battery swapping can be a highly cost-effective means of transitioning drivers without access to overnight EV charging to electric vehicles.

Currently, Ample supports a fleet of high-mileage Uber drivers in the Bay Area. All of these drivers have transitioned to Ample's zero emission EV platform from internal combustion engine vehicles. Without Ample's quick refueling, these drivers would not be able to rely on electric cars, and because they drive for a living (all day, every day) they would be a high-intensity source of GHG gases and criteria emissions. Drivers currently utilizing the Ample's platform come from low-income communities that have not been prioritized by many EV-incentives to date and their shift toward electrification translates directly into improved environmental, noise, and air quality outcomes in these communities.

While EV charging will undoubtedly be part of the solution for refueling electric cars, the challenging economics and slow speed at which electric vehicles charge and infrastructure can be deployed means that battery swapping should also be viewed as a primary mode of public EV refueling. This shift is already under way in more developed EV markets like China, which has roughly 16X as many DC fast chargers as the United States. Chinese companies have announced capacity for battery swap stations capable of servicing 40+ million vehicles by 2025. In light of this burgeoning technology trend, Ample urges the Committee to strive to adopt technology-neutral language with regard to electric vehicle supply equipment (EVSE) and EV infrastructure wherever possible. Within this letter, Ample wishes to highlight some elegant examples of technology-neutral language from Representative Tonko's Electric Vehicle Infrastructure Rebate Act of 2021 (introduced April 30, 2021), urge broader use of such technology neutral language, underline the benefits of incentivizing energy storage and load-balancing devices linked to both EV charging and battery swapping infrastructure, and offer some suggestions for how to further improve economics and equity outcomes related to EV charging policy.

Electric Vehicle Infrastructure Rebate Act of 2021 and the definition of electric vehicle supply equipment

The current definition of Electric Vehicle Supply Equipment (EVSE) found in the CLEAN Future Act, the NO EXHAUST Act, and the Electric Vehicles for Underserved Communities Act of 2021 is:

> (1) ELECTRIC VEHICLE SUPPLY EQUIPMENT.— The term "electric vehicle supply equipment" means any conductors, including ungrounded, grounded, and equipment grounding conductors, electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatuses installed specifically for the purpose of delivering energy to an electric vehicle.[i]

(Emphasis added). This definition could inadvertently exclude EV battery swapping stations and other innovative alternatives to EV charging because it requires the delivery of energy directly to a vehicle. However, there are real systemic benefits to systems like Ample's which deliver energy to batteries that are separate from the vehicle, and can thus recharge while a vehicle is not present, store renewable energy, reinforce the grid and provide other grid services that will strengthen America's electricity transmission capabilities.

Ample requests that this Subcommittee and the Energy and Commerce Committee as a whole, use the definition of EVSE from the Electric Vehicle Infrastructure Act of 2021. This bill defines EVSE as

> "any conductors, including ungrounded, grounded, and equipment grounding conductors, electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, electrical equipment, or apparatuses installed <u>specifically for the purpose of delivering energy to an electric vehicle or to a battery intended to be used in an electric vehicle</u>."

(Emphasis added). This definition is more technology-neutral because it would encompass battery swapping and other alternatives to existing EV charging technology.

There are a number other provisions of the Electric Vehicle Infrastructure Rebate Act of 2021 that Ample strongly supports and would prefer to see adopted in Chairman Rush's NO EXHAUST Act and other EV infrastructure legislation under consideration by the Energy and Commerce Committee. For instance:

SECTION 2(c) DEFINITIONS

(3) ELECTRIC VEHICLE SUPPLY EQUIPMENT. -- Based on our interpretation, this definition is wide enough to cover battery swap infrastructure, charging, and alternative means of delivering fuel to electric vehicles.

SECTION 2(b)(2) -- ELIGIBLE EQUIPMENT AND LOCATIONS

(D) LOCATION REQUIREMENT. -- Based on our interpretation, the *"workplace"* provision encompasses infrastructure required to fuel fleet vehicles. This is important, as fleet vehicles have utilization factors that are three times higher than privately owned vehicles. They will be a critical lever for addressing climate change and many low-income workers drive for fleets. For the elimination of any doubt, however, we suggest that the bills expressly include fleet vehicles and shared vehicles, e.g., whether driving in their operating territory, pausing in between rides but still engaging in work, or participating in other distributive work or alternative work arrangements, within the definition of "workplace."

SECTION 2(c)(1) -- COVERED EXPENSES

(E) *The cost of an on-site energy storage system that supports electrical load balancing or otherwise improves the performonce of such electric vehicle supply equipment.* Based on our interpretation, this provision covers onsite storage broadly enough to support EV chargers with onsite backup as well as battery swap stations. We appreciate the thoughtfulness, fairness and technology neutrality of this approach.

SECTION 2(b) -- REBATE PROGRAM REQUIREMENTS

(9) NETWORKED DIRECT CURRENT FAST CHARGING. -- We strongly support efforts to endow the Secretary of Energy with a degree of administrative flexibility with regard to these programs. We would, however, encourage the Committee to include clear metrics and guidelines (e.g. cost, performance, and GHG reductions) by which the Secretary of Energy is required to make such an evaluation.

Potential areas for improvement in the Electric Vehicle Infrastructure Rebate Act of 2021

We appreciate the work done by the staff of the House Energy and Commerce Committee to ensure that the Electric Vehicle Infrastructure Rebate Act of 2021 is technology neutral and responsive to changes in America's evolving EV industry. And while Ample is broadly supportive of the current version of the bill as it is designed to support the growth of America's EV market and adapt to emerging market trends and realities, we also see a few areas where the current version of the bill could potentially be strengthened.

SECTION 2(c) Definitions.

There are systemic benefits to low power systems that can gradually store energy but quickly refuel a vehicle. In general, we would encourage the Committee to substitute language focused on the speed of energy delivery to a vehicle, rather than the power rating. For instance:

> *(6) NETWORKED DIRECT CURRENT FAST CHARGING EQUIPMENT.—The term "networked direct current fast charging equipment" means electric vehicle supply equipment that is* capable of refueling a 50 kilowatt hour electric vehicle battery pack to at least 80% capacity in less than an hour *and is enabled to connect to a network to facilitate data collection and access.*

This would include all stations operating at 50kw or above while also incentivizing low-power (e.g. 20kw) battery swapping that utilizes lower power levels but can quickly recharge an EV. If the Committee adopts such language, it may also wish to include a minimum power threshold (e.g. 20kw). However, to maximize system flexibility and resilience, and support energy storage and arbitrage we recommend that threshold be no higher than 30kw.

SECTION 2(b) REBATE PROGRAM REQUIREMENTS. --

(9) NETWORKED DIRECT CURRENT FAST CHARGING. –

In order to ensure that promising technologies are not arbitrarily excluded from EV infrastructure programs, we recommend an explicit prohibition on excluding emerging technologies and business models on the basis of low levels of market penetration. Performance metrics could address any concerns regarding utilization.

SECTION 2(b)(6) DISBURSEMENT OF REBATE

We recommend including a provision allowing the Department of Energy to issue regulations to claw back funding for any equipment that is not functional at least 90% of the time. We also recommend 50% of the credit be dispensed in the form of performance-based incentives (e.g. utilization).

Additional potential areas for improvement in the NO EXHAUST Act of 2021

TITLE I—ELECTRIC VEHICLE INFRASTRUCTURE

Sec. 102(b)(6) MULTI-PORT CHARGERS.— We recommend substituting performance-based incentives (e.g., electricity dispensed) in place of the incentive for additional chargers.

Sec. 105(a)(22)(A) Electric vehicle charging programs. In general.— We recommend omitting proposals for states to reexamine the rate-basing EVSE infrastructure. Rate-basing infrastructure without corresponding utilization requirements (i.e., performance-based metrics) could result in perverse incentives for the industry to overbuild costly EV chargers that are not adequately utilized.

TITLE III—PROMOTING DOMESTIC ADVANCED VEHICLE MANUFACTURING

Sec. 711(c)(1) Cost Share and Guarantee of Operation— We see the requirement that facilities continue to manufacture goods for at least 10 years after completion of construction to be both onerous, imprecise, subject to gaming and potentially misaligned with the dynamic nature of the modern EV economy.

Conclusion

Overall we are strongly supportive of the new definition of EVSE and the other updated language in the Electric Vehicle Infrastructure Rebate Act of 2021. We would urge the Energy and Commerce Committee to adopt these thoughtful and technology neutral definitions more broadly in forthcoming EV infrastructure-related bills. In general, Ample supports performance-based metrics and robust reporting requirements for EV charging infrastructure that is built with taxpayer dollars. We also support provisions that allow for regulatory flexibility for executive agencies to take advantage of improved technologies and evolving market conditions. Ample looks forward to supporting the Committee as it continues to develop this and other EV charging infrastructure legislation.

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[i] *See generally* H.R. 1512, CLEAN Future Act, Title IV, Subtitle D, Section 431(1), pp. 398-99; H.R. 2852, NO EXHAUST Act of 2021, Title I, Section 101(1), p. 2; H.R. 1221, Electric Vehicles for Underserved Communities Act of 2021, Section 6(1), p. 14.

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Re: Support for "New Opportunities to Expand Healthy Air Using Sustainable Transportation Act of 2021"

Dear Chairman Rush and Ranking Member Upton:

This letter is being submitted by the National Association of State Energy Officials (NASEO) in support of the "New Opportunities to Expand Healthy Air Using Sustainable Transportation Act of 2021" ("NO EXHAUST Act") (H.R. 2852). We ask that this letter be made part of the hearing record for the Subcommittee hearing on this bill, set for May 5, 2021. NASEO represents the 56 governor-designated State Energy Office members across the United States, Washington, D.C. and the U.S. Territories. One of the key policy and program areas that NASEO members have been working on with their private and public sector partners is the deployment of electric vehicles (EVs) and associated infrastructure, as well as a variety of important clean energy policies.

NASEO enthusiastically supports H.R. 2852, and we commend the Chairman for introducing the bill. The NO EXHAUST Act would spur domestic manufacturing of EVs and facilitate the build-out of a nationwide network of EV charging stations at multifamily, workplace and publicly-accessible locations, enabling seamless EV travel from coast-to-coast. Important provisions of H.R. 2852 include programs to support domestic advanced vehicles manufacturing, an EV Supply Equipment Rebate Program, an EV Charging Equity Program to support sustainable transportation in disadvantaged and underserved communities, and aggressive federal fleet vehicle procurement targets (promising 100 percent zero-emission vehicle adoption in light-duty federal fleets by 2050).

The NO EXHAUST Act also would reauthorize appropriations for the State Energy Program (SEP), and has a separate authorization for appropriations to encourage states to create State Energy Transportation Plans to guide their investment and support state and federal energy and workforce goals. This is a critical element of the legislation: whether leading or engaging their sister Departments of Environment to support the build-out of EV charging infrastructure under the Volkswagen Settlement, working at the regional level to promote interstate EV travel, or promoting policies and implementing programs to ensure the electric distribution networks are modernized for greater integration of EVs, the State Energy Offices have demonstrated their invaluable role in advancing the market for clean vehicles.

The inherent strength of this legislative approach is in its comprehensive nature, and State Energy Offices are a clear partner to advance the goals of the NO EXHAUST Act. The nation can ill-afford to address EV infrastructure and EV promotion in stovepipes. We must holistically develop a network of EV charging stations and support light-duty, medium-duty and heavy-duty vehicle electrification, in conjunction with the expansion of electricity transmission and distribution networks, and recognize the correlation to locations of generating sources, especially as the sources of generation, energy storage and renewables advance. We also must take in to account the need for cybersecurity and physical security, including the need to adapt to natural disasters and climate (e.g., charging stations on evacuation routes). State Energy Offices have over a decade of experience developing EV policies and administering EV infrastructure programs, and we recognize the importance of considering equity, workforce and electric system implications of widespread EV investment. The NO EXHAUST Act wisely includes provisions to allow for electric system upgrades at EV charging locations, and supports renewable generation and storage installations at EV charging sites. With almost every major automobile manufacturer offering EV models – and most setting ambitious goals for phasing-out gasoline-powered vehicles – a robust reliable network of EV chargers will be needed. It is also critical that DOE move forward to adopt an EV building energy code, especially since the International Code Council rejected this effort.

We are encouraged by this legislation and we believe that it will lay the groundwork for a nationwide sustainable transportation network. If enacted, this legislation accompanied by needed federal appropriations should reinvigorate American manufacturing, create well-paying, sustainable jobs, decrease emissions in some of our most vulnerable communities, and help build a backbone of EV chargers across the country that drivers will use for years to come.

NASEO has previously expressed support for key elements of the CLEAN Future Act (H.R. 1512), which is also the subject of this hearing. We also support the legislation recently introduced by Representative Tonko on electric vehicles (H.R. 2948), and we are working with Senator Stabenow and others on EV legislation, which will also advance the nation's future. The State Energy Offices are prepared to work with the Committee and the Administration to implement a plan to install EV chargers. Federal funding for this purpose could easily flow through the State Energy Program, as a known and operational mechanism for quick delivery of services. We also encourage Congress to incentivize publicly available on-street charging.

Thank you for the opportunity to express our views.

Respectfully Submitted,

David Terry
Executive Director

cc: The Honorable Frank Pallone
The Honorable Cathy McMorris Rodgers
State Energy Officials
Jeff Genzer, NASEO Counsel

AMERICAN PUBLIC GAS ASSOCIATION

May 5, 2021

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Re: May 5, 2021 Energy Subcommittee Hearing on "The Clean Future Act: Driving Decarbonization of the Transportation Sector"

Dear Chairman Rush and Ranking Member Upton:

The American Public Gas Association (APGA) writes regarding the Energy Subcommittee's May 5, 2021 hearing on "The Clean Future Act: Driving Decarbonization of the Transportation Sector."

APGA is the trade association for approximately 1,000 communities across the U.S. that own and operate their retail natural gas distribution entities. They include municipal gas distribution systems, public utility districts, county districts, and other public agencies, all locally accountable to the citizens they serve. Public gas systems focus on providing safe, reliable, and affordable energy to their customers and support their communities by delivering fuel to be used for cooking, clothes drying, and space and water heating, as well as for various commercial and industrial applications. Our members also supply gas to natural gas vehicle (NGV) fueling stations, and many also maintain and manage fueling stations or operations of their own.

APGA has been a strong supporter of the growth and development of the NGV industry, which is why we are eager to contribute to the Subcommittee's discussion of the important topic of decarbonization of the transportation sector. NGVs are already some of the cleanest vehicles on the road with significantly lower greenhouse gas (GHG) emissions than those using gasoline or diesel engines. Despite this, the ongoing conversation regarding transportation and climate change centers on electrification. We appreciate the opportunity to share more information with the Subcommittee about NGVs' potential to help accomplish the Administration's ambitious climate goals.

The Subcommittee is right to draw attention to the importance of low and no-emission vehicles in America's pursuit of a clean energy future. Electric vehicles, however, are not the only available technology. The Department of Energy estimates that natural gas engines can lower emission levels of

GHGs as much as 11 percent when compared to traditional gasoline combustion engines.[1] While NGVs are already cleaner and achieve lower GHG emission levels than traditional vehicles, they also have the immediate potential to become even more environmentally friendly with additional support for the development of renewable natural gas (RNG). RNG, which is produced by capturing gas created by various waste sources, is chemically identical to fossil natural gas and can be blended with fossil natural gas or, in some cases, used exclusively in a system.[2] Blending even small amounts of RNG with fossil natural gas can produce significant emissions reductions,[3] and RNG currently accounts for more than 53 percent of all natural gas motor fuel.[4] Because RNG is created by recycling biomethane collected from agricultural waste, landfills, and wastewater treatment plants into a usable product, it has the potential to yield a carbon-negative lifecycle emissions result.[5] Continuing to promote and invest in the development and use of this fuel will only further advance the already existing environmental benefits of NGVs.

The environmental benefits of RNG have led to growing interest from the transportation sector in increasing the use of RNG to lower GHG emissions. The United Parcel Service (UPS), for example, is making significant investments in RNG and compressed natural gas (CNG) transportation initiatives. They recently announced plans to purchase more than 6,000 natural gas-powered trucks between 2020 and 2022, a commitment representing a $450 million investment in the company's alternative fuel program to reduce emissions.[6] Amazon, as part of its commitment to become carbon neutral by 2040, also recently signed a five-year contract to purchase RNG for its fleet.[7]

It is especially noteworthy that, when fueled by RNG, the newest NGVs are the only fully commercially available option to achieve ultra-low or near-zero emission levels of nitrogen oxides (NOx).[8] They also produce a much lower amount of particulate matter than other engines, supporting the Administration's goals of decreasing emissions in areas disproportionately impacted by urban air pollution. Cummins Westport, for example, already produces natural gas engines that are 90% cleaner than what the current EPA standard requires.[9] The company's 8.9-liter ISL G NZ engine is certified to meet the California Air Resource Board (CARB) standard – the most rigorous emission standard for NOx.

This already-existing natural gas engine technology can fill an important gap by providing an opportunity to reduce emissions in difficult to electrify applications like long-haul and regional trucking, transit buses, refuse trucks, and high horsepower off-road equipment. Heavy-duty vehicles and equipment are

[1] "Natural Gas Vehicle Emissions," Alternative Fuel Data Center, U.S. Department of Energy, https://afdc.energy.gov/vehicles/natural_gas_emissions.html, accessed May 4, 2021

[2] *Id.*

[3] *Id.*

[4] "Decarbonize Transportation with Renewable Natural Gas," NGVAmerica, https://static1.squarespace.com/static/53a09c47e4b050b5ad5bf4f5/t/6079e813a7999069b32ece17/1618602009958/NGV+RNG+Decarbonize+2020+final.pdf, accessed May 4, 2021.

[5] *Id.*

[6] "UPS adding 6,000 NGVs," Shale Directories, https://www.shaledirectories.com/blog/ups-adding-6000-ngvs/ accessed May 4, 2021.

[7] "Amazon Inks RNG Agreement, Considers Possible Stake in Clean Energy Fuels," Natural Gas Intel, https://www.naturalgasintel.com/amazon-inks-rng-agreement-considers-possible-stake-in-clean-energy-fuels/ accessed May 4, 2021.

[8] NGVAmerica, *supra* note 4.

[9] "Next Generation Heavy-Duty Natural Gas Engines Fueled by Renewable Natural Gas," NGV America, https://cdn.ngvgamechanger.com/pdfs/game-changer-graphic-onesheet.pdf, accessed May 4, 2021.

major sources of emissions, and while reliable electric alternatives are not yet available, natural gas options are. Replacing one diesel-burning, heavy-duty truck with a new ultra low-NOx, natural gas heavy-duty truck has the same emissions reduction impact as removing 119 traditional combustion engine passenger vehicles from the road.[10] If policymakers are serious about achieving the ambitious emissions reduction goals laid out by the Administration, it would be foolish to ignore the opportunity to capitalize on existing natural gas technology to reduce emissions in these areas, simply because it does not fit with the current narrative of electrification as the "end all be all" climate solution.

Finally, APGA would like to urge the Committee to consider the full lifecycle of vehicles and their energy source when considering the path forward. While we acknowledge that battery powered electric vehicles (BEVs) have the advantage of zero-tailpipe emissions, producing lithium-ion batteries is an energy intensive process. In fact, manufacturing an electric vehicle can produce anywhere from 15 to 68 percent more GHG emissions than a conventional vehicle, depending on the size and range.[11] This should be taken into account when evaluating the environmental benefits of BEVs versus other alternatives, like NGVs. It is also important to note that battery disposal is another looming environmental issue associated with BEVs. The current lack of available recycling methods when electric vehicle batteries reach the end of their useful life is an additional environmental cost that should be factored into the Committee's consideration of how to move towards a cleaner transportation future.

APGA supports the Committee's work to reduce emissions and move towards a cleaner transportation sector, and we are grateful for the opportunity to contribute to the conversation on this important topic. However, the Committee should promote a level playing field for all clean vehicle fuels. The pursuit of electrification as the sole solution ignores the contributions natural gas has already made to lowering emissions and abandons its potential in achieving environmental goals. If policymakers provide support for the adoption of NGV technology and the increased use of RNG, public natural gas utilities will continue to deliver emissions reductions and environmental benefits well into the future. For these reasons, APGA hopes the Committee will pursue an "all of the above" approach to reducing emissions in the transportation sector. Thank you again for the opportunity to submit this input. APGA stands ready to work together in this effort.

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Washington, DC 20002
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[10] "Which Road to Take," NGV America, https://ngvamerica.org/wp-content/uploads/2020/10/NGVAmerica-Which-Road-TX-vs-CA-Investments.pdf, accessed May 4, 2021.
[11] Cleaner Cars from Cradle to Grave, Union of Concerned Scientists, https://www.ucsusa.org/resources/cleaner-cars-cradle-grave, accessed May 4, 2021.

Statement for the Record

On behalf of the:
American Public Power Association
Edison Electric Institute
National Rural Electric Cooperative Association

Hearing Before the
House Subcommittee on Energy of the Committee on Energy and Commerce

"The Clean Future Act: Driving Decarbonization of the Transportation Sector"

May 5, 2021

Introduction

This statement is submitted on behalf of the American Public Power Association, the Edison Electric Institute and the National Rural Electric Cooperative Association. Together, we represent the nation's investor-owned electric companies, public power utilities and electric cooperatives.

Our members provide safe, reliable, and affordable energy to more than 300 million Americans. The electric power industry supports more than 7 million American jobs and contributes $880 billion annually to U.S. gross domestic product, about 5 percent of the total. Each year, our industry invests more than $110 billion to make the energy grid stronger, smarter, cleaner, more dynamic, and more secure. These investments enable us to integrate more clean energy and new technologies into our electric systems, including electric vehicles (EVs), to benefit customers.

Federal Investment in Electric Vehicle Charging Infrastructure and Supply Equipment Is Needed

We write in support of federal investment in EV charging infrastructure, which includes everything from installing the supply equipment (charging station) to performing any energy grid upgrades or modifications that may be needed. To help incorporate increased EV penetration on U.S. roads, it is important that we invest in and deploy more charging infrastructure. Building this infrastructure will require public-private partnerships, and our members are critical to that effort, in part because they employ a highly skilled workforce that builds and maintains the electric grid. A collaboration between the federal government and our sector will help to create additional jobs and will help spur economic growth.

Our members already are partnering with their customers to overcome barriers to deploy charging infrastructure. Some of our members own and operate EV charging stations in a variety of locations and for all types of customers, which is particularly beneficial to consumers who prefer not to procure and maintain charging infrastructure and seek a turnkey solution. Some of our members install the "make-ready" infrastructure that connects to the charging station, leaving it to the customer to own and maintain the charging station. And other members offer rebate programs to offset the costs to install charging infrastructure or partner with third parties to provide charging services. Regardless of the approach, each of these solutions is critical to building charging infrastructure that helps to spur the EV market and benefit communities.

Our members continue to work with local stakeholders and are best-positioned to understand and to maximize the value of different technologies and systems that can help optimize the operation of the grid, integrate EVs, and recover more quickly from natural disasters. This is particularly true in regions where private investment in EV charging stations historically has been lacking.

Any federal policy for EV infrastructure must maintain flexibility for states and localities to determine the most effective public-private partnership structure that meets their needs. We do not support efforts to restrict federal program flexibilities and limit stakeholder participation.

Federal Investment Can Complement and Leverage Public-Private Partnerships

Federal investment in charging infrastructure can leverage and amplify the progress that the nation's investor-owned electric companies, public power utilities, and electric cooperatives are already making in deploying charging infrastructure. The federal government is a key partner in the development of a nationwide EV charging network and technical and financial assistance can help accelerate EV deployment by filling in gaps or providing cost-share to complement the efforts already underway. **We**

support legislation that would include financial assistance for EV supply equipment, including grid upgrades and modifications, as part of a larger effort to support EV infrastructure.

In addition, electric transportation options are extending beyond light-duty vehicles, with many fleet operators looking to diversify their medium- and heavy-duty vehicle mix to include zero-emission options. Fleet charging may have disproportional impacts and reliability could be impacted if not managed properly and in coordination with utilities. Our members will be crucial partners in the building and maintaining of infrastructure – including charging depots – needed for an increasingly clean medium- and heavy-duty fleet market. We support federal efforts to help address upfront costs for the deployment of these vehicles and necessary infrastructure as it nears commercial viability.

While our members are investing in electric vehicle infrastructure, additional information regarding when and where public charging stations will be needed, particularly in areas that have not yet seen significant saturation or rural areas that may serve to connect communities. Mapping this demand, based on data, such as regional commute and travel patterns, can improve upon the investment decisions our members are making in charging infrastructure. **We support legislation that would provide technical and financial assistance to help entities, including electric utilities, map the demand for EV charging.**

Conclusion
Thank you for your consideration of these proposals. We look forward to working with you and to our continued partnership in advancing electric vehicle infrastructure.

Organizations

The American Public Power Association
The American Public Power Association is the voice of not-for-profit, community-owned utilities that power 2,000 towns and cities nationwide. We represent public power before the federal government to protect the interests of the more than 49 million people that public power utilities serve, and the 93,000 people they employ. Our association advocates and advises on electricity policy, technology, trends, training, and operations. Our members strengthen their communities by providing superior service, engaging citizens, and instilling pride in community-owned power.

Edison Electric Institute
The Edison Electric Institute (EEI) is the association that represents all U.S. investor-owned electric companies. Our members provide electricity for 220 million Americans, and operate in all 50 states and the District of Columbia. As a whole, the electric power industry supports more than 7 million jobs in communities across the United States. In addition to our U.S. members, EEI has more than 65 international electric companies as International Members, and hundreds of industry suppliers and related organizations as Associate Members.

National Rural Electric Cooperative Association
The National Rural Electric Cooperative Association (NRECA) represents more than 900 electric cooperatives. America's electric cooperatives are energy providers and engines of economic development for more than 20 million American homes, businesses, farms and schools across 48 states. Electric cooperatives play a vital role in transforming local communities.

CLEAN Future Act Puts Ratepayers On The Hook For EV Infrastructure

AEA americanenergyalliance.org/2021/03/clean-future-act-puts-ratepayers-on-the-hook-for-ev-infrastructure

March 18, 2021

In early March, the House Energy and Commerce Committee Chairman Frank Pallone, Jr. (D-NJ), Environment and Climate Change Subcommittee Chairman Paul Tonko (D-NY) and Energy Subcommittee Chairman Bobby L. Rush (D-IL) introduced the Climate Leadership and Environmental Action for our Nation's (CLEAN) Future Act. The bill aims to achieve net zero greenhouse gas emissions by 2050, with an interim target of reducing greenhouse gas emissions by 50 percent from 2005 levels no later than 2030.

Taken as a whole, the bill would impose overbearing regulations on the production of our most reliable energy sources, which would raise costs on energy consumers and destroy jobs in the energy industry. Here, I want to focus on one particular section of the bill that aims at encouraging the deployment of electric vehicle charging stations in the name of environmental justice. Here is the summary language for the relevant section of the CLEAN Future Act:

> "Sec. 435. STATE CONSIDERATION OF ELECTRIC VEHICLE CHARGING.
>
> Amends PURPA section 111(d) to require states consider authorizing measures encouraging deployment of electric vehicle charging stations; allowing utilities to recover from ratepayers' investments that further deployment of electric vehicle charging networks; and excluding from regulation as electric utilities entities selling electricity to the public solely through electric vehicle chargers."

Under rate-of-return regulation, utilities are allowed to recover their cost to do business and earn a guaranteed return on invested capital. Under this system, there is little incentive for the utility to reduce operating costs. As long as the rate-of-return is above the cost of debt, the rate base can be inflated by spending more capital than is necessary. If passed, the CLEAN Future Act would allow utilities to rate base the construction of electric vehicle charging stations, meaning that the cost of these charging stations will be passed on to utility customers as a whole.

As we have noted elsewhere, EVs are already heavily subsidized and those subsidies are costly, unnecessary, and unfair. Electric vehicles are mainly subsidized through tax credits, which are the result of the Energy Improvement and Extension Act of 2008 (H.R. 6049) and The American Recovery and Reinvestment Act of 2009 (ARRA). These provide federal income tax credits for new qualified electric vehicles of up to $7,500.

According to a report by the Congressional Research Service, the majority of people who claim the electric vehicle tax credit earn a much higher income than the national average. As the report notes:

> "In 2016, 57,066 individual taxpayers claimed $375 million in plug-in EV tax credits. EV tax credits are disproportionately claimed by higher-income taxpayers. Most of the tax credits (78%) are claimed by filers with adjusted gross income (AGI) of $100,000 or more, and those filers receive an even higher proportion (83%) of the amount of credits claimed. About 7% of credits claimed, and 8% of the total amount of credits, were on returns where the taxpayer's AGI exceeded $1 million."

That same report found, based on estimates provided by the Joint Committee on Taxation, that under current law tax expenditure (forgone revenue) for the plug-in EV tax credit would be $7.5 billion between 2018 and 2022.

In other words, American taxpayers are already spending billions of dollars to subsidize electric vehicles that are mostly being purchased by high-income earners. On top of that, this new bill would ensure that the costs of building out EV infrastructure will be paid by utility ratepayers in the form of higher electricity prices. This follows a familiar pattern where policies that are enacted in the name of 'environmental justice' disproportionately benefit wealthier individuals while the costs are passed on to everyone else.

Changes in Non-Ferrous Production: United States vs. China 1996 to 2020

Michael Moats

Thomas J. O'Keefe Institute

Missouri University of Science and Technology

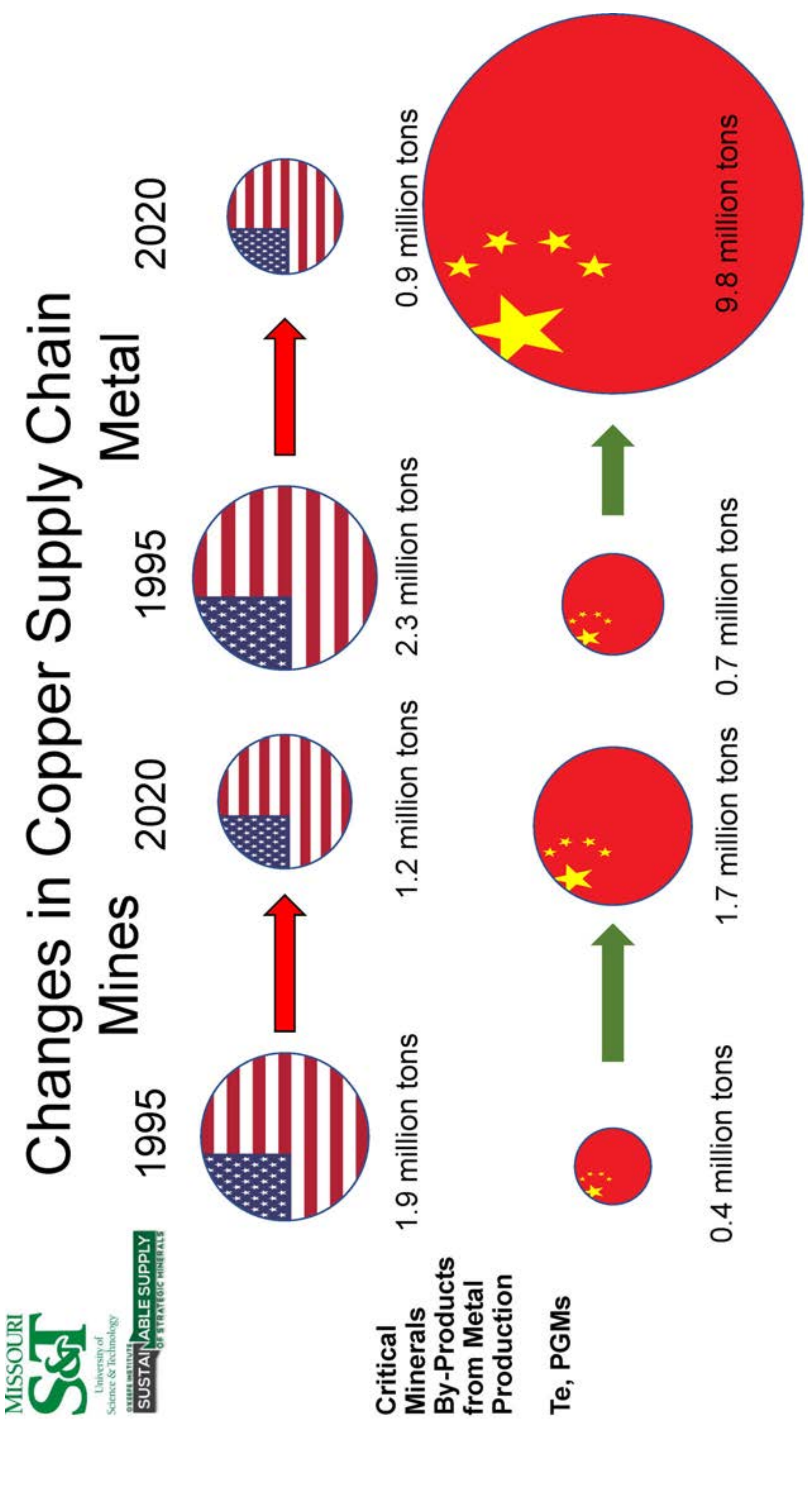
United States – Copper Mining, Smelting and Refining

- 1995
  - 40 mines produce copper
    - 1.9 million tons production
  - 7 primary smelters
  - 4 secondary smelters
  - 7 electrolytic refineries
  - 15 electrowinning facilities
    - 2.3 million tons refined copper
- 2020
  - 25 mines produce copper
    - 1.2 million tons production
  - 3 primary smelters
  - 0 secondary smelters
  - 3 electrolytic refineries
  - 14 electrowinning facilities
    - 0.9 million tons refined copper

China – Copper Mining, Smelting and Refining

- 1995
  - 0.4 million tons mine production
  - 0.7 million tons refined copper
- 2020
  - 1.7 million tons mine production
  - 9.8 million tons refined copper

All information from USGS National Minerals Information Center's Mineral Commodity Summaries or Yearbook
All tons are metric tons


MISSOURI S&T
University of Science & Technology
SUSTAINABLE SUPPLY OF STRATEGIC MINERALS
Changes in Copper Supply Chain
Mines
Metal
1995
2020
1995
2020
1.9 million tons
1.2 million tons
2.3 million tons
0.9 million tons
0.4 million tons
1.7 million tons
0.7 million tons
9.8 million tons
Critical Minerals By-Products from Metal Production
Te, PGMs

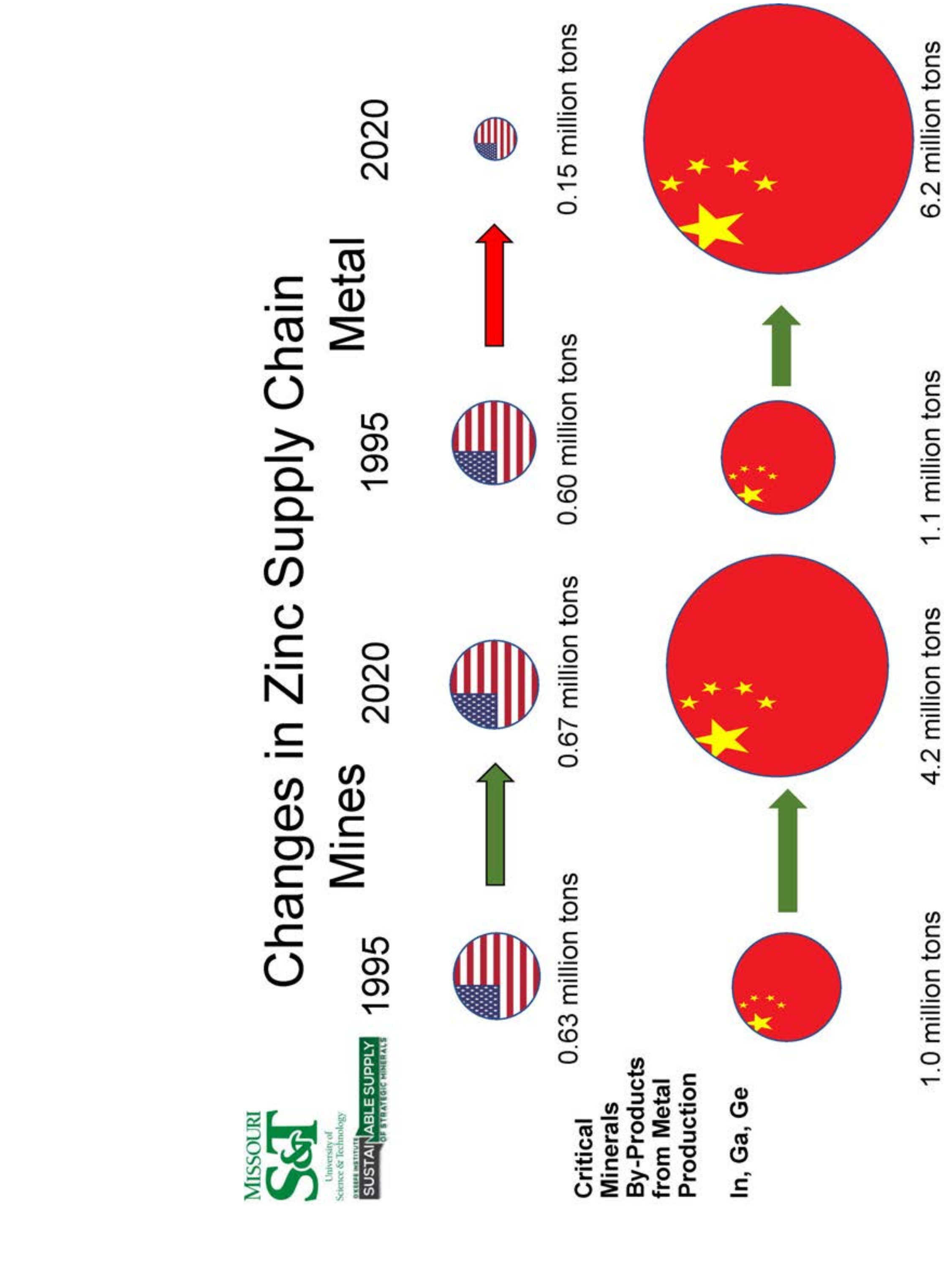
United States – Zinc Mining, Smelting and Refining

- 1995
  - 25 mines produce zinc
    - 0.63 million tons production
  - 3 primary smelters
  - 7 secondary smelters
    - 0.60 million tons refined zinc (total)
- 2020
  - 14 mines produce zinc
    - 0.67 million tons production
  - 1 primary smelters
  - 2 secondary smelters
    - 0.15 million tons refined zinc (total)

China – Zinc Mining, Smelting and Refining

- 1995
  - 1.0 million tons mine production
  - 1.1 million tons refined zinc
- 2020
  - 4.2 million tons mine production
  - 6.2 million tons refined zinc (2019, ILZSG)

Most information from USGS National Minerals Information Center's Mineral Commodity Summaries or Yearbook
All tons are metric tons


Missouri S&T
University of Science & Technology
O'Keefe Institute
SUSTAINABLE SUPPLY OF STRATEGIC MINERALS
Changes in Zinc Supply Chain
Mines
1995
2020
Metal
1995
2020
0.63 million tons
0.67 million tons
0.60 million tons
0.15 million tons
Critical Minerals By-Products from Metal Production
In, Ga, Ge
1.0 million tons
4.2 million tons
1.1 million tons
6.2 million tons

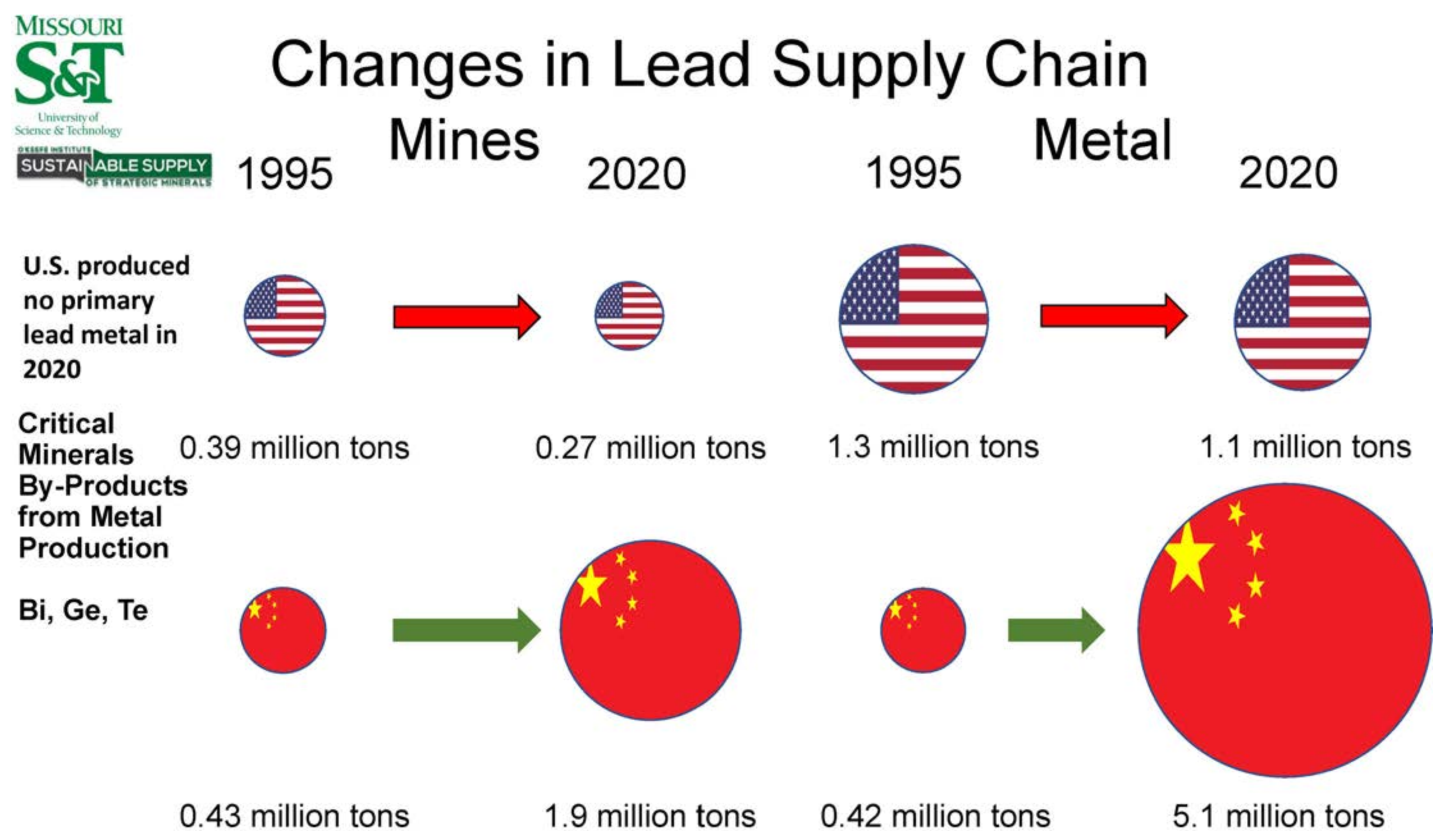
United States – Lead Mining, Smelting and Refining

- 1995
  - 11 mines produce lead
    - 0.39 million tons production
  - 3 primary smelters
    - 0.37 million tons refined lead
  - 18 secondary refineries
    - 0.9 million tons refined lead
- 2020
  - 10 mines produce lead
    - 0.29 million tons production
  - 0 primary smelters
  - 12 secondary refineries
    - 1.1 million tons refined lead

China – Lead Mining, Smelting and Refining

- 1995
  - 0.43 million tons mine production
  - 0.42 million tons refined lead
- 2020
  - 1.9 million tons mine production
  - 5.1 million tons refined lead (2019, ILZSG)

Most information from USGS National Minerals Information Center's Mineral Commodity Summaries or Yearbook; All tons are metric tons


MISSOURI S&T
University of Science & Technology
SUSTAINABLE SUPPLY OF STRATEGIC MINERALS
Changes in Lead Supply Chain
Mines
Metal
1995
2020
1995
2020
U.S. produced no primary lead metal in 2020
Critical Minerals By-Products from Metal Production
Bi, Ge, Te
0.39 million tons
0.27 million tons
1.3 million tons
1.1 million tons
0.43 million tons
1.9 million tons
0.42 million tons
5.1 million tons

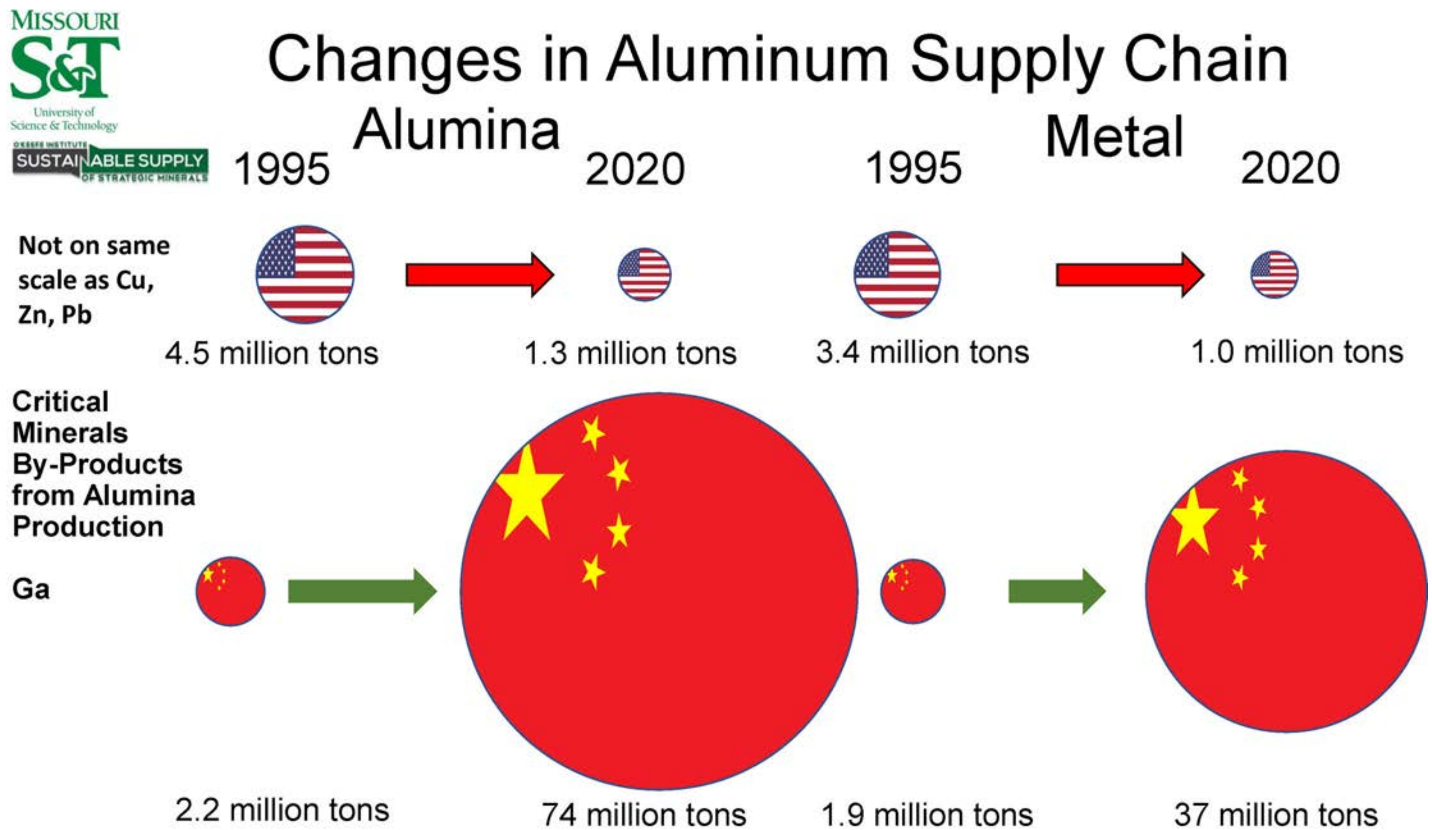
United States – Alumina and Aluminum Production

- 1995
  - 5 alumina production facilities
    - 4.5 million tons alumina
  - 22 primary smelters
    - 3.4 million tons aluminum
- 2020
  - 2 alumina production facilities
    - 1.3 million tons alumina
  - 7 primary smelters
    - 1.0 million tons aluminum

China – Alumina and Aluminum Production

- 1995
  - 2.2 million tons alumina
  - 1.9 million tons aluminum
- 2020
  - 74 million tons alumina
  - 37 million tons aluminum

Most information from USGS National Minerals Information Center’s Mineral Commodity Summaries or Yearbook
All tons are metric tons



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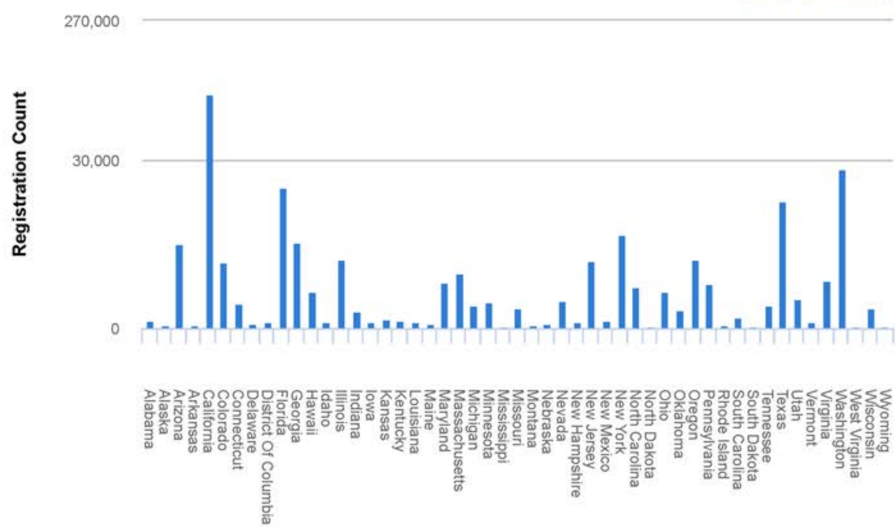
University of Science & Technology
SUSTAINABLE SUPPLY OF STRATEGIC MINERALS
Changes in Aluminum Supply Chain
Alumina
Metal
1995
2020
1995
2020
Not on same scale as Cu, Zn, Pb
4.5 million tons
1.3 million tons
3.4 million tons
1.0 million tons
Critical Minerals By-Products from Alumina Production
Ga
2.2 million tons
74 million tons
1.9 million tons
37 million tons

Back to Maps & Data (/data)

Electric Vehicle Registrations by State

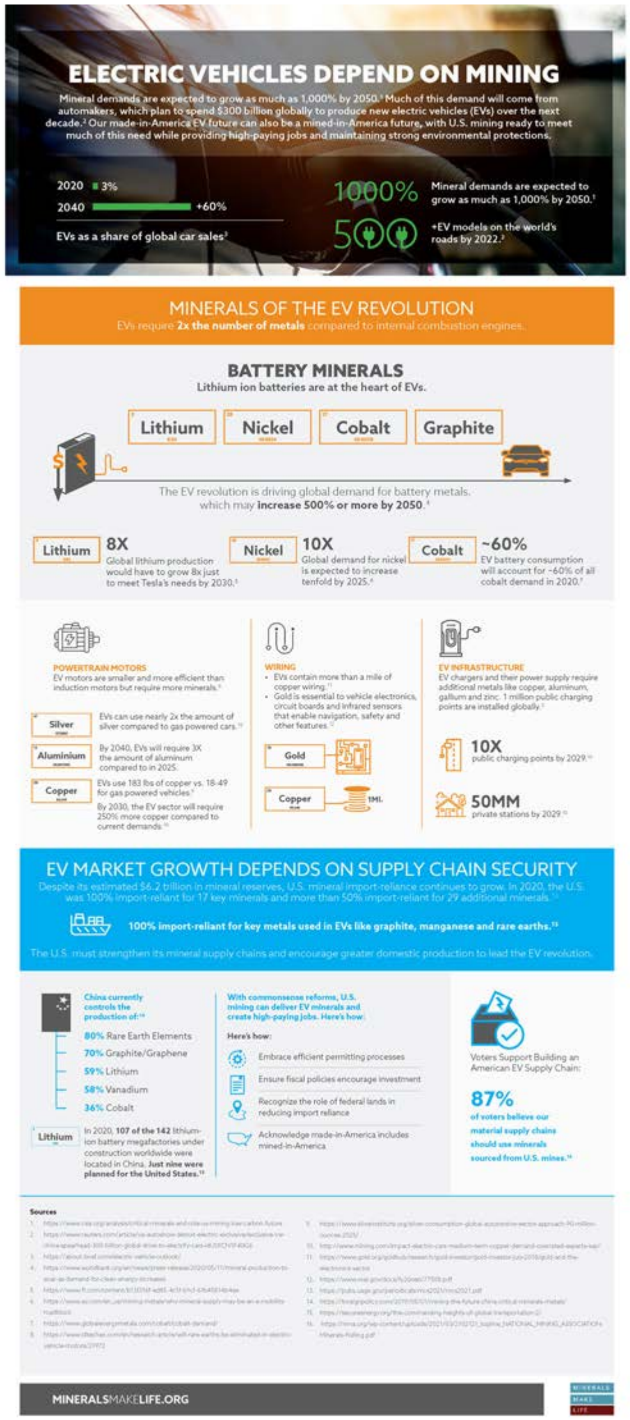
Print Download



Source: National Renewable Energy Laboratory (NREL). Data derived from IHS Markit light-duty vehicle registrations in 2018
Notes: California had approximately 256,800 electric vehicle registrations in 2018. The scale of the axis changes at 30,000 to make it easier to see the other states.

This chart shows the vehicle registration counts of all-electric vehicles (EVs) by state as of December 31, 2018. California has the greatest population of EVs and accounts for approximately 47% of the overall population. Washington state has the second highest population, followed by Florida. These numbers loosely reflect the EV purchase incentives in given states (see Electric Vehicle Laws and Incentives by State (https://afdc.energy.gov/data/10373)) and state population.

To view more details, notes, and acronyms, please download the Excel spreadsheet.


ELECTRIC VEHICLES DEPEND ON MINING
Mineral demands are expected to grow as much as 1,000% by 2050.[1] Much of this demand will come from automakers, which plan to spend $300 billion globally to produce new electric vehicles (EVs) over the next decade.[2] Our made-in-America EV future can also be a mined-in-America future, with U.S. mining ready to meet much of this need while providing high-paying jobs and maintaining strong environmental protections.
2020 3%
2040 +60%
EVs as a share of global car sales[3]
1000%
Mineral demands are expected to grow as much as 1,000% by 2050.[1]
500
+EV models on the world's roads by 2022.[2]
MINERALS OF THE EV REVOLUTION
EVs require 2x the number of metals compared to internal combustion engines.
BATTERY MINERALS
Lithium ion batteries are at the heart of EVs.
Lithium
Nickel
Cobalt
Graphite
The EV revolution is driving global demand for battery metals, which may increase 500% or more by 2050.[4]
Lithium
8X
Global lithium production would have to grow 8x just to meet Tesla's needs by 2030.[5]
Nickel
10X
Global demand for nickel is expected to increase tenfold by 2025.[6]
Cobalt
~60%
EV battery consumption will account for ~60% of all cobalt demand in 2020.[7]
POWERTRAIN MOTORS
EV motors are smaller and more efficient than induction motors but require more minerals.[8]
Silver
EVs can use nearly 2x the amount of silver compared to gas powered cars.[9]
Aluminium
By 2040, EVs will require 3X the amount of aluminum compared to in 2025.
Copper
EVs use 183 lbs of copper vs. 18-49 for gas powered vehicles.[3]
By 2030, the EV sector will require 250% more copper compared to current demands.[10]
WIRING
EVs contain more than a mile of copper wiring.[11]
Gold is essential to vehicle electronics, circuit boards and infrared sensors that enable navigation, safety and other features.[12]
Gold
Copper
1MI.
EV INFRASTRUCTURE
EV chargers and their power supply require additional metals like copper, aluminum, gallium and zinc. 1 million public charging points are installed globally.[3]
10X
public charging points by 2029.[10]
50MM
private stations by 2029.[10]
EV MARKET GROWTH DEPENDS ON SUPPLY CHAIN SECURITY
Despite its estimated $6.2 trillion in mineral reserves, U.S. mineral import-reliance continues to grow. In 2020, the U.S. was 100% import-reliant for 17 key minerals and more than 50% import-reliant for 29 additional minerals.[13]
100% import-reliant for key metals used in EVs like graphite, manganese and rare earths.[13]
The U.S. must strengthen its mineral supply chains and encourage greater domestic production to lead the EV revolution.
China currently controls the production of:[14]
80% Rare Earth Elements
70% Graphite/Graphene
59% Lithium
58% Vanadium
36% Cobalt
Lithium
In 2020, 107 of the 142 lithium-ion battery megafactories under construction worldwide were located in China. Just nine were planned for the United States.[15]
With commonsense reforms, U.S. mining can deliver EV minerals and create high-paying jobs. Here's how:
Here's how:
Embrace efficient permitting processes
Ensure fiscal policies encourage investment
Recognize the role of federal lands in reducing import reliance
Acknowledge made-in-America includes mined-in-America
Voters Support Building an American EV Supply Chain:
87%
of voters believe our material supply chains should use minerals sourced from U.S. mines.[16]
Sources
MINERALSMAKELIFE.ORG

Contents Full report ↓

The Role of Critical Minerals in Clean Energy Transitions

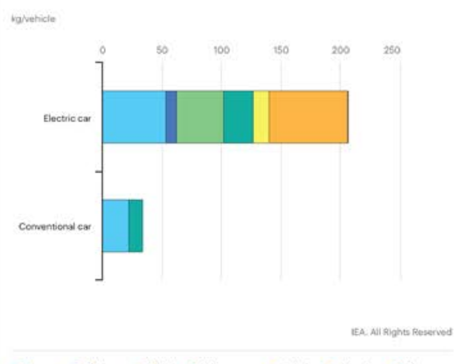
Report extract
Executive summary

In the transition to clean energy, critical minerals bring new challenges to energy security

An energy system powered by clean energy technologies differs profoundly from one fuelled by traditional hydrocarbon resources. Solar photovoltaic (PV) plants, wind farms and electric vehicles (EVs) generally require more minerals to build than their fossil fuel-based counterparts. A typical electric car requires six times the mineral inputs of a conventional car and an onshore wind plant requires nine times more mineral resources than a gas-fired plant. Since 2010 the average amount of minerals needed for a new unit of power generation capacity has increased by 50% as the share of renewables in new investment has risen.

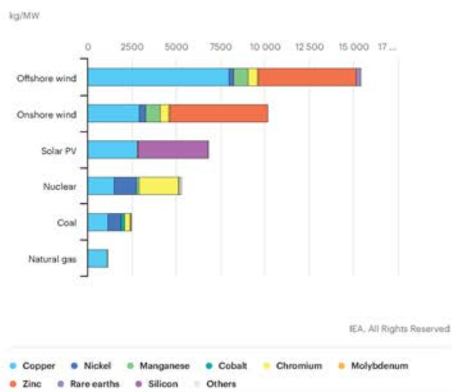
Minerals used in electric cars compared to conventional cars

Open



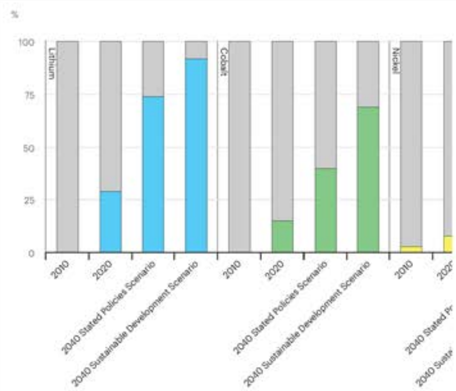
Contents Full report

Minerals used in clean energy technologies compared to other power generation sources Open



The types of mineral resources used vary by technology. Lithium, nickel, cobalt, manganese and graphite are crucial to battery performance, longevity and energy density. Rare earth elements are essential for permanent magnets that are vital for wind turbines and EV motors. Electricity networks need a huge amount of copper and aluminium, with copper being a cornerstone for all electricity-related technologies.

The shift to a clean energy system is set to drive a huge increase in the requirements for these minerals, meaning that the energy sector is emerging as a major force in mineral markets. Until the mid-2010s, for most minerals, the energy sector represented a small part of total demand. However, as energy transitions gather pace, clean energy technologies are becoming the fastest-growing segment of demand. In a scenario that meets the Paris Agreement goals (as in the IEA Sustainable Development Scenario [SDS]), their share of total demand rises significantly over the next two decades to over 40% for copper and rare earth elements, 60-70% for nickel and cobalt, and almost 90% for lithium. EVs and battery storage have already displaced consumer electronics to become the largest consumer of lithium and are set to take over from stainless steel as the largest end user of nickel by 2040.



As countries accelerate their efforts to reduce emissions, they also need to make sure that energy systems remain resilient and secure. Today's international energy security mechanisms are designed to provide insurance against the risks of disruptions or price spikes in hydrocarbons supply, oil in particular. Minerals offer a different and distinct set of challenges, but their rising importance in a decarbonising energy system requires energy policy makers to expand their horizons and consider potential new vulnerabilities. Concerns about price volatility and security of supply do not disappear in an electrified, renewables-rich energy system.

to stay ahead of the curve on all aspects of energy security in a fast-evolving energy world.

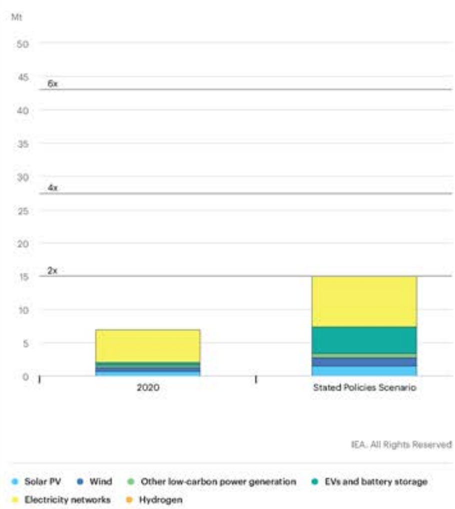
The rapid deployment of clean energy technologies as part of energy transitions implies a significant increase in demand for minerals

Our bottom-up assessment of energy policies in place or announced suggests that the world is currently on track for a doubling of overall mineral requirements for clean energy technologies by 2040 (in the IEA Stated Policies Scenario, STEPS).

However, a concerted effort to reach the goals of the Paris Agreement (climate stabilisation at "well below 2°C global temperature rise", as in the SDS) would mean a quadrupling of mineral requirements for clean energy technologies by 2040. An even faster transition, to hit net-zero *globally* by 2050, would require six times more mineral inputs in 2040 than today.

Total mineral demand for clean energy technologies by scenario, 2020-2040

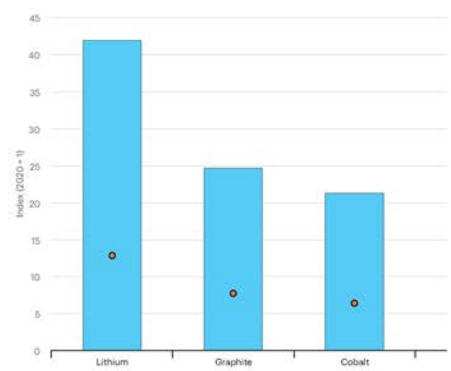
Open



Which sectors do these increases come from? In climate-driven scenarios, mineral demand for use in EVs and battery storage is a major force, growing at least thirty times to 2040. Lithium sees the fastest growth, with demand growing by over 40 times in the SDS by 2040, followed by graphite, cobalt and nickel (around 20-25 times). The expansion of electricity networks means that copper demand for grid lines more than doubles over the same period.

The rise of low-carbon power generation to meet climate goals also means a tripling of mineral demand from this sector by 2040. Wind takes the lead, bolstered by material-intensive offshore wind. Solar PV follows closely, due to the sheer volume of capacity that is added. Hydropower, biomass and nuclear make only minor contributions given their comparatively low mineral requirements. In other sectors, the rapid growth of hydrogen as an energy carrier underpins major growth in demand for nickel and zirconium for electrolysers, and for platinum-group metals for fuel cells.

Growth in demand for selected minerals from clean energy technologies by scenario, 2040 relative to 2020 Open



Demand trajectories are subject to large technology and policy uncertainties. We analysed 11 alternative cases to understand the impacts. For example, cobalt demand could be anything from 6 to 30 times higher than today's levels depending on assumptions about the evolution of battery chemistry and climate policies. Likewise rare earth elements may see three to seven times higher demand in 2040 than today, depending on the choice of wind turbines and the strength of policy support. The largest source of demand variance comes from uncertainty around the stringency of climate policies. The big question for suppliers is whether the world is really heading for a scenario consistent with the Paris Agreement. Policy makers have a crucial role in narrowing this uncertainty by making clear their ambitions, and turning targets into actions. This will be vital to reduce investment risks and ensure adequate flow of capital to new projects.

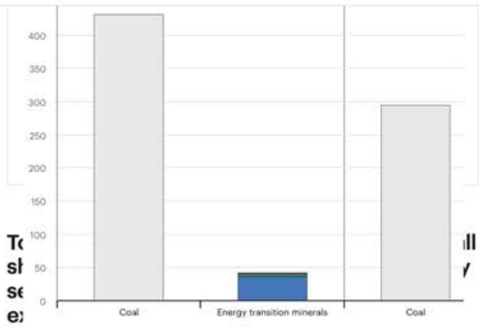
Changing fortunes: Coal vs energy transition minerals

Clean energy transitions offer opportunities and challenges for companies that produce minerals. Coal is currently the largest source of revenue for mining companies by a wide margin. Today's revenues from coal production are ten times larger than those from energy transition minerals.

However, accelerating clean energy transitions are set to change this picture. There is a rapid reversal of fortunes in a climate-driven scenario, as the combined revenues from energy transition minerals overtake those from coal well before 2040.

Revenue from production of coal and selected energy transition minerals in the Sustainable Development Scenario, 2020-2040 Open

USD billion (2019)



The prospect of a rapid rise in demand for critical minerals – in most cases well above anything seen previously – poses huge questions about the availability and reliability of supply. In the past, strains on the supply-demand balance for different minerals have promoted additional investment as well as measures to moderate or substitute demand, but these responses have come with time lags and have been accompanied by considerable price volatility. Similar episodes in the future could delay clean energy transitions and push up their cost. Given the urgency of reducing emissions, this is a possibility that the world can ill afford.

Raw materials are a significant element in the cost structure of many technologies required in energy transitions. In the case of lithium-ion batteries, technology learning and economies of scale have pushed down overall costs by 90% over the past decade. However, this also means that raw material costs now loom larger, accounting for some 50-70% of total battery costs, up from 40-50% five years ago. Higher mineral prices could therefore have a significant effect: a doubling of lithium or nickel prices would induce a 6% increase in battery costs. If both lithium and nickel prices were to double at the same time, this would offset all the anticipated unit cost reductions associated with a doubling of battery production capacity. In the case of electricity networks, copper and aluminium currently represent around 20% of total grid investment costs; higher prices as a result of tight supply could have a major impact on the level of grid investment.

Our analysis of the near-term outlook for supply presents a mixed picture. Some minerals such as lithium raw material and cobalt are expected to be in surplus in the near term, while lithium chemical, battery-grade nickel and key rare earth elements (e.g. neodymium, dysprosium) might face tight supply in the years ahead. However, looking further ahead in a scenario consistent with climate goals, expected supply from existing mines and projects under construction is estimated to meet only half of projected lithium and cobalt requirements and 80% of copper needs by 2030.

ready to support accelerated energy transitions. While there are a host of projects at varying stages of development, there are many vulnerabilities that may increase the possibility of market tightness and greater price volatility:

- **High geographical concentration of production:** Production of many energy transition minerals is more concentrated than that of oil or natural gas. For lithium, cobalt and rare earth elements, the world's top three producing nations control well over three-quarters of global output. In some cases, a single country is responsible for around half of worldwide production. The Democratic Republic of the Congo (DRC) and People's Republic of China (China) were responsible for some 70% and 60% of global production of cobalt and rare earth elements respectively in 2019. The level of concentration is even higher for processing operations, where China has a strong presence across the board. China's share of refining is around 35% for nickel, 50-70% for lithium and cobalt, and nearly 90% for rare earth elements. Chinese companies have also made substantial investment in overseas assets in Australia, Chile, the DRC and Indonesia. High levels of concentration, compounded by complex supply chains, increase the risks that could arise from physical disruption, trade restrictions or other developments in major producing countries.
- **Long project development lead times:** Our analysis suggests that it has taken 16.5 years on average to move mining projects from discovery to first production. These long lead times raise questions about the ability of supply to ramp up output if demand were to pick up rapidly. If companies wait for deficits to emerge before committing to new projects, this could lead to a prolonged period of market tightness and price volatility.
- **Declining resource quality:** Concerns about resources relate to quality rather than quantity. In recent years ore quality has continued to fall across a range of commodities. For example, the average copper ore grade in Chile declined by 30% over the past 15 years. Extracting metal content from lower-grade ores requires more energy, exerting upward pressure on production costs, greenhouse gas emissions and waste volumes.
- **Growing scrutiny of environmental and social performance:** Production and processing of mineral resources gives rise to a variety of environmental and social issues that, if poorly managed, can harm local communities and disrupt supply. Consumers and investors are increasingly calling for companies to source minerals that are sustainably and responsibly produced. Without efforts to improve environmental and social performance, it may be challenging for consumers to exclude poor-performing minerals as there may not be sufficient quantities of high-performing minerals to meet demand.
- **Higher exposure to climate risks:** Mining assets are exposed to growing climate risks. Copper and lithium are particularly vulnerable to water stress given their high water requirements. Over 50% of today's lithium and copper production is concentrated in areas with high water stress levels. Several major producing regions such as Australia, China, and

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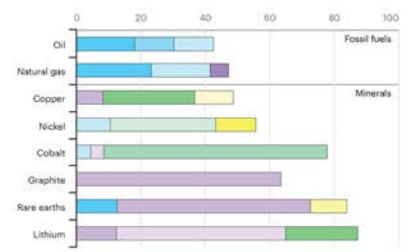
These risks to the reliability, affordability and sustainability of mineral supply are manageable, but they are real. How policy makers and companies respond will determine whether critical minerals are a vital enabler for clean energy transitions, or a bottleneck in the process.

Share of top three producing countries in extraction of selected minerals and fossil fuels, 2019 Open



United States · Saudi Arabia · Russia · Iran · China · Australia · Chile · DRC · Indonesia · Philippines · Myanmar · Peru

Share of top three producing countries in total processing of selected minerals and fossil fuels, 2019 Open

%

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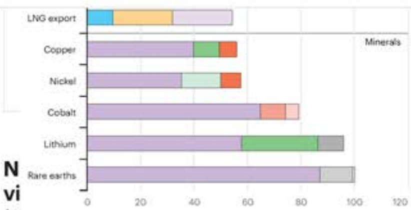


N ... /ill be vi ... 're

As ... g prominence in the energy security debate, a realm where oil has traditionally occupied a central role.

There are significant differences between oil security and mineral security, notably in the impacts that any disruption may have. In the event of an oil supply crisis, all consumers driving gasoline cars or diesel trucks are affected by higher prices. By contrast, a shortage or spike in the price of a mineral affects only the supply of *new* EVs or solar plants. Consumers driving existing EVs or using solar-powered electricity are not affected. In addition, the combustion of oil means that new supply is essential to the continuous operation of oil-using assets. However, minerals are a component of infrastructure, with the potential to be recovered and recycled.

Nonetheless, experience from oil markets may offer some valuable lessons for an approach to mineral security, in particular to underscore that supply-side measures need to be accompanied by wide-ranging efforts encompassing demand, technology, supply chain resilience and sustainability.

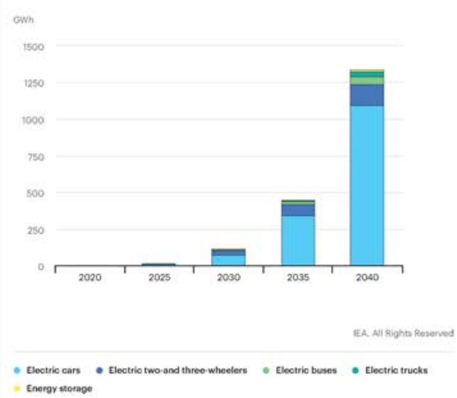
Rapid, orderly energy transitions require strong growth in investment in mineral supply to keep up with the rapid pace of demand growth. Policy makers can take a variety of actions to encourage new supply projects: the most important is to provide clear and strong signals about energy transitions. If companies do not have confidence in countries' climate policies, they are likely to make investment decisions based on much more conservative expectations. Given the long lead times for new project development, this could create a bottleneck when deployment of clean energy technologies starts to grow rapidly. Diversification of supply is also crucial; resource-owning governments can support new project development by reinforcing national geological surveys, streamlining permitting procedures to shorten lead times, providing financing support to de-risk projects, and raising public awareness of the contribution that such projects play to the transformation of the energy sector.

Reducing material intensity and encouraging material substitution via technology innovation can also play major roles in alleviating strains on supply, while also reducing costs. For example, 40-50% reductions in the use of silver and silicon in solar cells over the past decade have enabled a spectacular rise in solar PV deployment. Innovation in production technologies can also unlock sizeable new supplies. Emerging technologies, supply volumes.

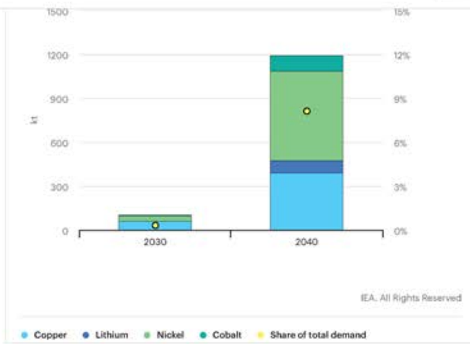
A strong focus on recycling, supply chain resilience and sustainability will be essential

Recycling relieves the pressure on primary supply. For bulk metals, recycling practices are well established, but this is not yet the case for many energy transition metals such as lithium and rare earth elements. Emerging waste streams from clean energy technologies (e.g. batteries, wind turbines) can change this picture. The amount of spent EV batteries reaching the end of their first life is expected to surge after 2030, at a moment of continued rapid growth in mineral demand. Recycling would not eliminate the need for continued investment in new supply to meet climate goals, but we estimate that, by 2040, recycled quantities of copper, lithium, nickel and cobalt from spent batteries could reduce combined primary supply requirements for these minerals by around 10%. The security benefits of recycling can be far greater for regions with wider deployment of clean energy technologies due to greater economies of scale.

Amount of spent lithium-ion batteries from electric vehicles and storage in the Sustainable Development Scenario, 2020-2040 Open



Contribution of recycling and reuse of batteries to reducing primary supply requirement for selected minerals in the Sustainable Open



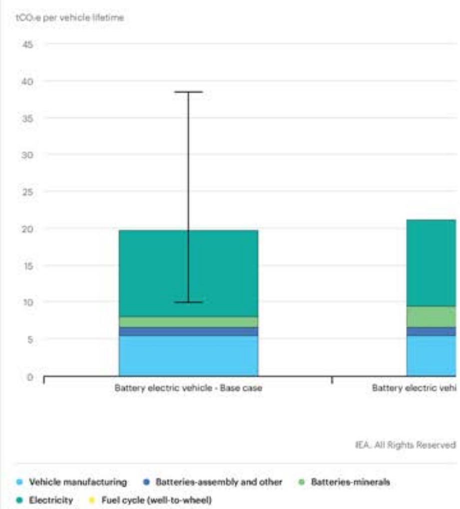
Regular market assessments and periodic stress-tests, coupled with emergency response exercises (as with the IEA's existing emergency response programmes), can help policy makers identify points of potential weakness, evaluate potential impacts and devise necessary actions. Strategic stockpiling can in some cases also help countries weather short-term supply disruptions. Such programmes need to be carefully designed, based on a detailed review of potential vulnerabilities. Some energy transition minerals with smaller markets have low pricing transparency and liquidity, making it difficult to manage price risks and affecting investment decisions. Establishing reliable price benchmarks will be a crucial step towards enhancing transparency and supporting market development.

Tackling the environmental and social impacts of mineral developments will be essential, including the emissions associated with mining and processing, risks arising from inadequate waste and water management, and impacts from inadequate worker safety, human rights abuses (such as child labour) and corruption. Ensuring that mineral wealth brings real gains to local communities is a broad and multi-faceted challenge, particularly in countries where artisanal and small-scale mines are common. Supply chain due diligence, with effective regulatory enforcement, can be a critical tool to identify, assess and mitigate risks, increasing traceability and transparency.

Stronger actions are required to counter the upward pressure on emissions from mineral production, but the climate advantages of clean energy technologies remain clear

emissions of EVs are around half those of internal combustion engine cars on average, with the potential for a further 25% reduction with low-carbon electricity. While energy transition minerals have relatively high emission intensities, a large variation in the emissions footprint of players suggests that there are ways to minimise these emissions through fuel switching, low-carbon electricity and efficiency improvements. Integrating environmental concerns in the early stages of project planning can help ensure sustainable practices throughout the project life cycle.

Comparative life-cycle greenhouse gas emissions of a mid-size BEV and ICE vehicle by scenario Open



IEA's six key recommendations for a new, comprehensive approach to mineral security

1. Ensure adequate investment in diversified sources of new supply. Strong signals from policy makers about the speed of energy transitions and the growth trajectories of key clean energy technologies are critical to bring forward timely investment in new supply. Governments can play a major role

2. Promote technology innovation at all points along the value chain. Stepping up R&D efforts for technology innovation on both the demand and production sides can enable more efficient use of materials, allow material substitution and unlock sizeable new supplies, thereby bringing substantial environmental and security benefits.

3. Scale up recycling. Policies can play a pivotal role in preparing for rapid growth of waste volumes by incentivising recycling for products reaching the end of their operating lives, supporting efficient collection and sorting activities and funding R&D into new recycling technologies.

4. Enhance supply chain resilience and market transparency. Policy makers need to explore a range of measures to improve the resilience of supply chains for different minerals, develop response capabilities to potential supply disruptions and enhance market transparency. Measures can include regular market assessments and stress-tests, as well as strategic stockpiles in some instances.

5. Mainstream higher environmental, social and governance standards. Efforts to incentivise higher environmental and social performance can increase sustainably and responsibly produced volumes and lower the cost of sourcing them. If players with strong environmental and social performance are rewarded in the marketplace, it can lead to greater diversification among supply.

6. Strengthen international collaboration between producers and consumers. An overarching international framework for dialogue and policy co-ordination among producers and consumers can play a vital role, an area where the IEA's energy security framework could usefully be leveraged. Such an initiative could include actions to (i) provide reliable and transparent data; (ii) conduct regular assessments of potential vulnerabilities across supply chains and potential collective responses; (iii) promote knowledge transfer and capacity building to spread sustainable and responsible development practices; and (iv) strengthen environmental and social performance standards to ensure a level playing field.

American Chemistry Council

April 14, 2021

The Honorable Jennifer M. Granholm
Secretary
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585

Re: Notice of Request for Information (RFI) on Risks in the High-Capacity Batteries, Including Electric Vehicle Batteries Supply Chain; 86 FR 16343; DE-FOA-0002502

Dear Secretary Granholm:

The American Chemistry Council (ACC) represents a diverse set of companies engaged in the business of chemistry, an innovative, $565 billion enterprise. We work to solve some of the biggest challenges facing our nation and our world. Our mission is to deliver value to our members through advocacy, using best-in-class member engagement, political advocacy, communications, and scientific research. We are committed to fostering progress in our economy, environment, and society.

The business of chemistry:

- Drives innovations that enable a more sustainable future.
- Provides 544,000 skilled good paying jobs—plus over 3.9 million related jobs—that support families and communities.
- Enhances safety through our diverse set of products and investments in R&D.

Every year, the chemistry industry invests tens of millions of dollars to support product and worker safety. In addition to research initiatives, ACC programs focus on anticipating and preventing accidents, as well as educating the public about how to use our products safely. Chemistry makes it possible to satisfy a growing world population. Among other things, oe4ur products protect our food supply, deliver drinking water, ensure safe living conditions, and provide access to efficient and affordable energy sources and lifesaving medical treatments in communities around the globe. To enable these ongoing innovations, we advocate for public policies that support the creation of groundbreaking products to improve lives, protect our environment and enhance the economic vitality of communities.

The chemical industry – and innovations in chemistry – are critical to achieving efficient and effective climate change solutions. Many low-carbon solutions rely on innovations in chemistry – from high capacity batteries (HCBs) to high-performance building insulation and windows to lightweight plastic packaging and auto parts that reduce energy needs, and carbon emissions, in shipping and transportation. As a significant manufacturing sector, we are continuously improving the energy efficiency and intensity of our own operations. The chemical industry is developing transformational technologies that cut emissions, improve energy efficiency and enable a socially, environmentally and economically sustainable future. We are also committed to safe transport of hazardous materials, including HCBs, as evidenced by the important work of ACC's CHEMTREC division, which our comments detail below.

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Free and Open Trade Strengthens Supply Chain Resiliency

Over the past four years, our industry has witnessed firsthand how trade policy uncertainty and the levying of high and broad tariffs on our imports and exports has disrupted the chemical value chain and the industries that rely on the business of chemistry. As a general matter, ACC advocates for the elimination and reduction of tariff and non-tariff barriers wherever possible. Reducing trade barriers is a better way to support production in the U.S. as opposed to the wielding of blunt trade instruments, which only increase uncertainty and costs and weaken competitiveness. We are also mindful that enabling greater U.S. production may require additional incentives from the U.S. and state governments. These incentives should be constructed in a way that does not distort trade and investment. As we have learned, when the United States implements trade actions such as tariffs, U.S. trading partners respond in kind, often retaliating against competitive U.S. exports, including chemicals.

We encourage the Administration to focus on what makes the U.S. chemical industry competitive. Factors of competitiveness include:

- Abundant sources of natural gas and natural gas liquids, the primary feedstocks and energy sources for manufacturing chemicals in the United States;
- Low cost imported intermediate inputs into manufacturing of chemicals;
- High skilled labor, including through immigration;
- Rule of law, including unbiased court systems that reliably and predictably enforce contractual commitments;
- Strong protection of intellectual property rights, including trade secrets;
- World class ecosystem for industry-university-government collaborative research & development and innovation; and
- High standard protections for human health, safety, and the environment.

By enhancing our competitiveness in the above areas, U.S. chemical manufacturers will be in a stronger position to produce more in the United States. Demand for the products of chemistry will increase in the U.S. over time but even more so in the rest of the world. In that regard, it is critical that the U.S. strategy on supply chain resilience prioritize opening new markets. Commercially meaningful new market access allows our companies to take advantage of economies of scale, thereby manufacturing more important chemistries at home in the United States and exporting more of those chemistries to the world. Enhancing our competitiveness will beget more competitiveness in the long run – and therefore greater supply chain resiliency.

And where U.S. trading partners are not playing by the rules and tilting the playing field in the favor of their domestic companies manufacturing HCBs and HCB materials, we urge the Administration to enforce U.S. trade agreements and U.S. trade remedies laws. Furthermore, we encourage the Administration to seek higher standards for environmental protection globally, so that chemical products, processes, and jobs do not move out of the United States into jurisdictions with weaker environmental protections.

Chemistry is Core to High Capacity Batteries (HCBs)

HCBs are crucial to modern life as they are used in everything from vehicles to mobile phones to cameras to pacemakers. Today the predominant HCB is the lithium-ion battery, which is a liquid-state battery. In the future, solid-state batteries may gain greater market share. Solid-state batteries that use innovative electrolytes promise greater energy density, conductivity, power, safety, and performance potential relative to lithium-ion batteries – at lower weight and cost.

The products of chemistry also help support other battery technologies. For example, bromine-based storage technologies are another electro-chemical energy storage solution, providing a range of options to successfully manage energy from renewable sources, minimizing energy loss, reducing overall energy use and cost and safeguarding security of supply. Typical bromine-based flow batteries include zinc-bromine ($ZnBr_2$) and more recently hydrogen bromide (HBr). Other variants in flow battery technology using bromine are also under development. Bromine-based storage technologies are typically used in stationary storage applications for grid, facility or back-up/stand-by storage.

HCBs have the potential to power innovation in areas like the auto industry, energy generation and storage, and military applications. And they are critical to the future of U.S. energy security. But before any of these products can be produced, the constituent materials and chemistry must be shepherded through the process from design, to large scale production, to commercialization, and to mass marketing. U.S. chemical manufacturers play an important role in multiple stages of the battery supply chain:

- extraction of raw materials;
- concentration and purification of those materials;
- conversion of material into derivatives;
- manufacturing of derivatives into battery components; and
- recycling used battery materials to return them to high purities and grades for use in new batteries.

In this light, it is important to define the key components of HCBs that involve chemistry and the materials containing chemicals (see Table 1 below).

Table 1: Components of Lithium-Ion Batteries and Constituent Materials

Components	Materials
Cathode	Primary materials include lithium carbonate and lithium hydroxide. Cathode materials include lithium-metal oxides (i.e., lithium cobalt oxide, lithium manganese oxide, lithium iron phosphate, lithium nickel cobalt manganese oxide and lithium nickel cobalt aluminum oxide). In addition to these primary materials, minor additives (often called dopants or coatings) are critical to enhancing the performance of batteries.
Anode	Primarily natural and synthetic graphite (in the form of meso-carbon micro bead), but lithium titanate is also used. New materials include cobalt oxide, copper oxide and lithium metal alloys, as well as silicon-based systems.
Electrolyte	Include lithium salts (including lithium hexafluorophosphate, lithium hexafluoroarsenate monohydrate, lithium perchlorate, lithium tetrafluoroborate and lithium trifluoromethanesulfonate (lithium triflate) in an organic solvent (including ethylene carbonate, dimethyl carbonate, and diethyl carbonate, ethyl methyl carbonate, propylene carbonate, diethyloxyethane, dioxolane, γ-butyrolactone, and tetrahydrofuran), and other electrolyte salts
Separator and separator coatings	Aramid film, polyethylene, polypropylene, polyethylene terephthalate, fluoropolymers

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Absorbent for electrolyte and electrode separator	PVDF copolymer film, which is used as a binder to bind lithium compounds and graphite to their respective electrodes; fluoropolymers
Battery Pack Insulation	Polyphenylene sulfide film and polyetherimide film; silicones.
Packaging	Polycarbonate, polypropylene, and polyamides

Flame Retardants

Flame retardants are a critical safety component because electronics have a variety of potential ignition sources generated by the essential components of the product, including circuit boards, batteries, wiring, fans, connectors, and even plugs. One of the most important benefits of flame retardants in product design is they can stop small ignition events from turning into larger fires. Electronic products are unique because they have a potential ignition source generated by the essential components of the product, including batteries. Batteries can overheat, and circuit boards and other device components carry electric currents; therefore, many electronic products present a higher risk of flammability than some non-electronic products. Flame retardants help to reduce the risk of fire and are essential for ensuring manufacturers meet fire safety standards.

Plastics and Polymer Composites

Plastics and polymer composites offer an unparalleled combination of properties that are essential to the mobility solutions of the future and modern innovations that benefit people's health and well-being, conserve natural resources, and reduce the impact on the environment. Plastics and polymer composites have the flexibility to enable batteries to be integrated safely and seamlessly into vehicles without adding extra weight. Polymer materials are lightweight, corrosion-resistant, and thermally conductive - enabling battery pack assemblies and battery pack protection during impact events – while at the same time, helping increase battery range on a single charge, extend battery life, and offset the significant added weight that comes along with electric and hybrid vehicle designs.

Global Demand for HCBs - and their Constituent Materials - is Poised to Skyrocket

The electrification of the transportation sector and integration of renewable energy sources into the electricity system is causing global demand for batteries to skyrocket. For example, 300 to 500 million electric vehicles are projected to be on the road around the world by 2040, driving HCB demand to grow an estimated 15-fold by 2028, as compared to 2016 levels[1]. In response, China, Japan, South Korea, and European countries are taking massive strides to meet material and technology needs by investing in the battery supply chain. Above all others, China has a commanding lead over the market with over 100 battery megafactories built or planned, ownership of more critical mineral reserves than any other country, and a stranglehold on the world's mineral processing industry.[2] Conversely, the U.S. has plans for only 9 battery megafactories, and is projected to control less than 10% of the global battery supply chain by the end of the decade.[3]

[1] Securing America's Future Energy, "The Commanding Heights of Global Transportation." 2020. Institute for Defense Analyses, "Lithium-Ion Battery Industrial Base in the U.S. and Abroad." 2019.
[2] SAFE, "The Commanding Heights of Global Transportation." 2020.
[3] Benchmark Minerals Intelligence, "Benchmark Summit 2020." 2020.

Increased HCB Manufacturing in the U.S. Would Offer New Supply Opportunities for U.S. Chemical Manufacturers

Many of the above materials are used by multiple downstream sectors and subsectors, including by companies manufacturing HCBs. If U.S. and global HCB manufacturers decided to build new HCB plants in the United States, demand for these chemistries could increase significantly, meaning that production and supply of HCB materials will also have to increase in order to meet demand by HCB manufacturers and other downstream sectors and subsectors that also rely on these materials. Furthermore, demand for HCBs across the world is estimated to increase exponentially as businesses and consumers move towards electrification. Specialty chemicals are an important part of the HCB supply chain and efforts by the U.S. Government to increase domestic HCB production should account for follow-on impacts to other industry sectors and the entire supply chain for each affected chemistry.

U.S. Tariffs Limit the Supply of Important Inputs for the Manufacturing of Chemistries Relevant to HCBs

A straightforward way to incentivize U.S. production of chemicals relevant to HCBs is to provide relief from tariffs. ACC encourages the Department of Commerce to work with the Office of the U.S. Trade Representative to identify the relevant intermediate inputs exposed to most-favored-nation customs duties and additional tariffs under Section 301 of the Trade Act of 1974. Quick Congressional renewal of the Miscellaneous Tariff Bill may provide temporary suspension or reduction of the MFN duties imposed on imports of intermediate inputs. Furthermore, if they are also subject to additional tariffs under Section 301, USTR may be in a position to exclude these intermediate inputs from the China Section 301 tariffs. Avoiding the payment of MFN duties and additional tariffs of up to 25 percent under Section 301 will help U.S. chemical manufacturers respond quickly to increased demand, instead of paying tariffs on inputs.

Incentives May be Necessary to Increase U.S. Production of Chemical Inputs for HCB Manufacturing

Clearly, the United States is facing myriad national security, economic, and environmental challenges at home and abroad. HCBs will play a critical role in meeting those challenges. To ensure that U.S. chemical manufacturers are in a stronger position to meet the increased demand for HCBs in the United States and globally, we encourage the Administration to consider appropriate incentives for producing the necessary minerals, materials, and technologies in the United States. The right mix of incentives will strengthen the business case for producing the constituent materials for HCBs in North America. A strong North American supply chain for HCBs will therefore strengthen the U.S. defense industrial base, grow high-value, high skilled jobs, address important environmental objectives (e.g., reducing greenhouse gas emissions), bolster U.S. technology and innovation leadership, and provide support for U.S. trading partners and allies.

Although the need for massive investment in production of battery materials is clear given the growing demand, the business case for where to produce chemistries relevant to HCBs is dependent upon many factors. The U.S. government and state governments could help solidify that business case by considering additional ways beyond tariff relief for incentivizing chemical manufacturers to increase production or build new facilities in the Uuited States. Because the significant investments in building manufacturing capabilities takes years of planning and development, these incentives must be in place promptly in order to drive decisions for future production.

Such incentives could include:

- Tax credits and abatements;
- Expedited permitting for plant construction or upgrading;
- Timely review and approval of new chemistries under TSCA;
- Programs to educate the workforce in response to industry needs;
- Facilitation of high skilled immigration;
- Access to worker training/retraining programs;
- Public-private partnerships for research and development of new materials and technologies; and
- Potential cost-shared grants to support domestic capital investments for key upstream materials, including chemical inputs, as well as infrastructure; and
- Relief/insurance for domestic supply chain disruptions, e.g., hurricanes, wildfires, and winter storms.

Supply security may also be supported by cooperation and support under the U.S.-Mexico-Canada Agreement (USMCA). Materials supplied by USMCA partners would be expected to flow more freely without restrictions and security risks.

Building Domestic Capacity for Recycling of HCBs Is Also Important to the U.S. Economy

Recycling and recovery of minerals contained in batteries, such as lithium, cobalt and nickel, is developing and will play a critical role in the security of supply for these materials, and will also contribute to a circular economy that is more sustainable for electrification. Historically, recycling of lithium and lithium-ion batteries has been limited due to dispersion in end-use devices and the high cost of collection, recovery, separation, and re-purification. Given the projected increase in electric vehicles, however, battery recycling rates should increase in part due to vehicle battery recycling systems already in place for lead-acid batteries.

But the Administration should not take recycling for granted. It is critical that the Administration view the battery supply chain holistically and incorporate a circular economy approach into its analysis and any recommendations. Greater recycling will alleviate the need for extraction of lithium and other materials, lessening environmental impacts. U.S. chemical manufacturers are using and developing advanced chemical processes to recover materials in batteries and concentrate and purify used battery materials, include lithium, to high battery grade standards. Ensuring that HCB recycling can stand up, become commercially viable, and grow should also be an essential goal for the Administration.

U.S. Regulation Also Impacts Chemicals Relevant to HCBs

As the Department of Energy reviews risks to the HCB supply chain, it would be important for it to explore with U.S. government agencies ongoing regulatory initiatives and actions relevant to the chemistries described below. In order for HCBs to meet the ever increasing performance demands, new chemistries must be advanced that decrease charging times, increase output and thus increase battery range, extend battery life and maintain safety (see detailed description below). These new chemistry technologies must be able to be brought to market quickly in order to compete globally. U.S. government agencies such as EPA, which has authority under TSCA to review the risk of new chemicals in commerce, must therefore be prepared to review new chemistry, assess risks, and approve them in a timely manner.

Many critical components of batteries (and certain substances used to make them) are manufactured outside the United States. Both the import of those components and development of a domestic supply chain by those seeking to manufacture in the U.S. are facing significant regulatory barriers under TSCA. For example, although some new cathode materials have chemistries similar to those already approved by EPA, they are nonetheless assessed *ab initio* as novel chemistry by staff reviewers afforded little opportunity to build up relevant expertise or leverage prior agency reviews. In addition, an industry willingness to accept EPA consent orders imposing conservative worker safety/risk management measures, in the hopes of accelerating agency approval of domestic manufacture, have had no apparent impact on the speed of regulatory review. This can result in unexplained regulatory approval delays of 2-3 years in some cases. The lack of a domestic battery materials supply chain could be an obstacle as battery demand increases, and its development is hindered by these regulatory challenges.

Fluorinated Chemistries

Fluoropolymers enable advanced energy storage and conversion technologies and are key components of lithium ion batteries. They offer unique performance benefits over other energy storage materials due to their innate resistance to high operating temperatures, chemical corrosion, and abrasion. They enable battery systems that are more efficient, consistent, and durable. Fluoropolymers are also essential chemical technology for flow batteries, which allow utilities and building and home owners to store energy for use at more optimal times, and play critical roles in renewable energy production and overall grid management. Standard appliance batteries (dry cells) and lithium battery cells use short-chain (c6) fluorosurfactants as a corrosion inhibitor at the electrodes.

An additional key point that could significantly and negatively affect the domestic battery supply chain is an overlybroad definition of per- and polyfluoroalkyl substances (PFAS). Certain overly broad definitions of PFAS will capture fluoropolymers themselves – products that are essential to the manufacture of lithium ion batteries. Indeed, lithium-ion batteries cannot be manufactured without fluoropolymers. In other words, unnecessary and inadvertent restrictions on fluoropolymers that would result from of an overly broad PFAS definition would have a catastrophic impact on the domestic EV battery business.

TSCA approvals for imports and domestic manufacturing

Modern Cathode Active Materials (CAM) consist of lithiated mixed metal oxides, commonly referred to NCM (Ni, Co, Mn-based) and NCA (Ni, Co, Al-based), *cf.* Table 1. There are also other material classes under development, namely Co-free variants. While these base materials have been investigated in the last decades, modern material developments target optimization of those materials for specific purposes, e.g., automotive application in electric vehicles. Typical optimization parameters include energy density, safety and long term stability during cycling (charging/discharging of the battery). There are complex material strategies, all of which build upon partial replacement of a few atoms in the crystal lattice by other elements, a process called doping, e.g., replacement of Mn by Al in NCM. Furthermore, CAM particles made of NCM or NCA can be treated with a coating of another material after calcination, e.g. resulting in an aluminum oxide layer surrounding the NCM core particle. Most, if not all, future CAM contain both, doping and coating, often using more than one additional element, to stabilize the material in the application.

It is important to note that the intrinsic material properties as well as the hazardous characteristics of NCM or NCA remain unchanged by these modifications. It is foreseeable that a variety of new combinations will be developed with short time-to-market requirements. This fundamental principle of doping and coating also applies to other basic cathode active materials like the Co-free materials mentioned above. Based on the arguments laid out in the EPA guidance document regarding formulated and statutory mixtures ("Products Containing Two or More Substances, Formulated and Statutory

Mixtures on the TSCA Inventory"), doped CAM may be regarded as statutory mixtures without the need for new PMN notifications.

CHEMTREC

CHEMTREC was established in 1971 by members of the American Chemistry Council as a 24/7 emergency response information center. Located in Falls Church, Virginia, CHEMTREC's mission is to provide accurate chemical information to emergency and hazmat incident responders quickly to mitigate the impact of transportation related hazmat and chemical emergencies. Since then, CHEMTREC has emerged as the premier "Level 1" Emergency Response Information Provider (ERIP).

As a public service, CHEMTREC operates under a Memorandum of Understanding with the U.S. Department of Transportation (DOT) to provide emergency response information for all incidents involving a hazardous material or dangerous good to all emergency responders - no matter who has responsibility for the hazardous material or dangerous good.

Lithium batteries are regulated as a hazardous material under the U.S. Department of Transportation's (DOT's) Hazardous Materials Regulations (HMR; 49 C.F.R., Parts 171-180). CHEMTREC supports the safe transportation of lithium batteries throughout the global supply chain by offering a host of tools to help comply with the current regulatory requirements. Specifically, CHEMTREC offers the following tools to help mitigate risk and increase safety confidence within the supply chain:

- Training: CHEMTREC recognizes the need for proper education before handling, packing, shipping, or transporting lithium batteries. CHEMTREC provides training that meets the U.S. DOT training requirements (49CFR§172, Subpart H) which covers excepted and fully regulated batteries.
- Test Summary Management: To help ensure safety, DOT's Pipeline and Hazardous Material Safety Administration (PHMSA) requires lithium battery and cell manufacturers to comply "to appropriate UN design tests to ensure they are classified correctly for transport, and to develop records of successful test completion, called a test report" (49CFR Parts 171-185). This rule has an implementation date of January 1, 2022. In response, CHEMTREC offers CRITERION®, a document management system for lithium battery test summaries. This program allows CHEMTREC to accelerate the flow of information between stakeholders allowing them to easily acquire, build, manage, and distribute thousands of battery and product test summaries in one simple solution.
- Emergency Response Information: CHEMTREC provides lithium battery shippers a method to comply with the U.S. DOT requirements (49CFR§172.604), providing a 24-hour emergency contact on all hazardous material shipping documents. With the CHEMTREC emergency contact number the industry has access to toxicology and medical specialist, language interpretation services, and a chemical industry professional to help through the emergency response process in the event of an incident involving a battery. Providing this additional layer of support to anyone within the supply chain helps limit potentially negative encounters with a battery product.

Conclusion

U.S. chemical manufacturers, our customers, and workers have benefited from global supply chains and also recognize that risks arise and must be mitigated. We welcome the Biden Administration's focus on risks to the HCB supply chain, of which the business of chemistry is a vital part. In the Department of Energy's review, we encourage a holistic examination of risks that includes trade policy and regulation.

Robust interagency and stakeholder consultation will be key to arriving at effective recommendations that are fit for purpose and support free and open trade and investment. ACC is ready to serve as a source of information and experience regarding the role of the business of chemistry in enabling production of HCBs in the United States.

Sincerely,

Ed Brzytwa

Director for International Trade
American Chemistry Council

NMA
THE AMERICAN RESOURCE

RYAN JACKSON
Senior Vice President,
Government and Political Affairs

April 28, 2021

The Honorable Lloyd Austin
Secretary
U.S. Department of Defense
1000 Defense Pentagon
Washington, D.C. 20301-1000

Re: Notice of Request for Comments on Executive Order "America's Supply Chains;" 86 FR 19230; Agency/Docket ID: DoD-2021-OS-0022; Document No. 2021-07539

Dear Secretary Austin:

The National Mining Association (NMA) welcomes the opportunity to respond to the U.S. Department of Defense's (DOD) request for comments regarding implementation of Executive Order 14017, "America's Supply Chains" (E.O.). NMA appreciates the administration's efforts to engage closely with the private sector as it identifies policy recommendations and priorities.

The NMA is U.S. mining's advocate in Washington, D.C. and beyond. Our mission is to build support for public policies that will help this nation fully and responsibly utilize its mineral resources. Headquartered in Washington, D.C., NMA has a membership of more than 300 corporations and organizations involved in various aspects of mining. We provide a forum for these diverse industry segments to be informed, heard, and represented.

The NMA strongly supports the President's E.O. and the DOD's evaluation of supply chains for strategic materials and critical minerals. NMA is especially supportive that the E.O. calls on the DOD to update the work and build on Executive Order 13953 – *Addressing the Threat to the Domestic Supply Chain from Reliance on Critical Minerals from Foreign Adversaries and Supporting the Domestic Mining and Processing Industries.*[1]

The DOD's efforts to implement the E.O. dovetail seamlessly with its duties pursuant to the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 (NDAA for FY21), which contained key sections to strengthen supply chains for strategic and critical minerals and metals required for national security. Specifically, section 848 of the law requires the DOD to first attempt to acquire strategic and critical materials from U.S. sources before seeking foreign sources. It also establishes a series

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[1] 85 FR 62539, found at https://www.federalregister.gov/documents/2020/10/05/2020-22064/addressing-the-threat-to-the-domestic-supply-chain-from-reliance-on-critical-minerals-from-foreign

of policies designed to eliminate U.S. dependence on potentially vulnerable sources of strategic and critical materials. Section 849 directs DOD to review high priority goods and services, including strategic and critical materials, to develop actions that strengthen sourcing. Section 850 builds upon the recommendations of a 2018 DOD report, titled "Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States"[2] requiring the Under Secretary of Defense for Acquisition and Sustainment to submit to the Secretary of Defense additional recommendations regarding executive actions, programmatic changes, regulatory changes, and legislative proposals related to U.S. industrial policies. Finally, Section 851 requires the DOD to report by the end of June 2021 updated information regarding amounts and types of strategic and critical materials needed for national security, vulnerabilities in their supply chains, and further directs the DOD to consider the development of alternative domestic supply chains to provide for a secure supply of strategic and critical minerals and metals.[3]

The NMA is pleased to see DOD taking actions on both the E.O. and the NDAA for FY21 provisions along with continued bipartisan attention on Capitol Hill to protect mineral supply chains. NMA strongly supports the recent bipartisan letter to you concerning implementation of the provisions in the NDAA for FY 21[4] and the new bipartisan House Armed Services Task Force established to examine supply chain vulnerabilities chaired by Reps. Slotkin (D-Mich.) and Gallagher (R-Wisc.).[5]

In these comments, the NMA provides a unique perspective on policies to allow the U.S. to guard against supply chain disruptions. NMA's comments principally focus on element xiii of DOD's request: "policy recommendations or suggested executive, legislative, regulatory action to foster more resilient supply chains for strategic and critical materials while promoting stewardship of affected communities and the environment."

Minerals are Essential to National Security and Defense

As an initial matter, the importance of metal and minerals provided by the domestic mining industry clearly are essential to DOD since these materials serve as the front end of the supply chain for all defense applications. Without the raw materials necessary to equip our servicemen-and-women to do their jobs, the U.S. cannot hope to maintain the commitment made to these dedicated individuals. The serious question remains, however, about where those materials will be sourced if we fail to pursue proactive policies that promote domestic mining of metals and minerals.

History has shown that innovation and adaptability is essential for sustaining a strong national defense, but the importance of a secure supply of metals and minerals should

[2] See, https://media.defense.gov/2018/Oct/05/2002048904/-1/-1/1/ASSESSING-AND-STRENGTHENING-THE-MANUFACTURING-AND%20DEFENSE-INDUSTRIAL-BASE-AND-SUPPLY-CHAIN-RESILIENCY.PDF

[3] H.R. 6395, the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Public Law No.116-283, found at https://www.congress.gov/bill/116th-congress/house-bill/6395

[4] U.S. Senate bipartisan letter dated April 20, 2021 enclosed with these comments.

[5] See, https://armedservices.house.gov/2021/3/house-armed-services-committee-stands-up-acquisition-task-force

not be overlooked. These building blocks are essential components of our increasingly high-tech defense systems such as the M1A1/2 Abrams battle tank or the Stryker family of vehicles, the radar and guidance systems that enhance the capabilities of the F-35 JSF or the infrared surveillance of missile defense early warning systems. We must ensure that our military has secure and reliable access to the domestic raw materials needed for these systems.

The need for metals and minerals for national security span beyond the oft-discussed rare earth elements. Metals such as copper, lead and nickel, platinum and silver, titanium and molybdenum – all are used in military equipment, weapon systems and other defense technologies. In fact, in a report prepared for Congress over a decade ago, DOD reported it uses on the order of three quarters of a million short tons of standard materials outlined in that report per year.[6]

Permitting and Supply Chain Security

In recent decades, the U.S. has been slow to develop and adopt policies that ensure secure access to the minerals and metals required to support manufacturing as a whole, and the defense industrial base is no exception. At the same time, countries around the world have increasingly recognized the connection between minerals, economic growth, and national security and have developed strategies to ensure timely access to the minerals that allow them to compete globally. Balanced policy incentivizes and increased permitting efficiencies would drastically help remove obstacles to new mining activities to support the availability of the metals and minerals needed for the defense industrial base.

With one of the longest permitting processes in the world for mining projects – taking on average seven to 10 years or more – the outdated and inefficient U.S. permitting process is one of the principal barriers to the domestic mining sector's ability to perform to its full potential and creates a competitive disadvantage in attracting investment for mineral development. Two decades ago, the U.S. attracted 20% of the world's mining investment. However, according to an S&P report, today that investment has been cut more than in half attracting only seven percent of the world's investment.[7] U.S. exploration investments have gradually increased in the last few years but remain low compared to historic trends. These lengthy permitting delays also compromise the commercial viability of mining projects by increasing costs, reducing the net present value of investments, and jeopardizing financing. On average, a domestic mining project can lose a third of its value as it waits for numerous permits needed to begin

[6] Reconfiguration of the National Defense Stockpile Report to Congress, April 2009, prepared pursuant to H.R. 1815, the National Defense Authorization Act for Fiscal Year 2006, H.R. Rep. No. 109-89, page 476, the House report to accompany H.R. 5122, the National Defense Authorization Act for Fiscal Year 2007, H.R. Rep. No. 109-452, page 444, and the Senate Report to accompany the Department of Defense Appropriations Bill, 2008, S. Rep. No. 110-155, page 189, concerning the National Defense Stockpile recommending a Strategic Materials Security Program.

[7] See, 2017 World Mining Exploration Trend, https://www.spglobal.com/marketintelligence/en/news-insights/research/report-worldwide-mining-exploration-trends-2017

production. The longer the wait, the greater the chance the mine will no longer be worth the investment.[8]

To attract investment dollars for mining projects, the U.S. needs to provide more certainty in permitting time frames similar to other major mining countries such as Canada and Australia where required permits can generally be obtained in two to three years. Importantly, Canada and Australia are known for their rigorous environmental safeguards, including environmental reviews similar to those required by the U.S. National Environmental Policy Act. These countries illustrate that permitting efficiencies can be achieved without sacrificing environmental protection.

Delays are not a new problem, but they are getting worse. Authorities ranging from the National Academy of Sciences to the Department of Energy to DOD to international mining firms have identified permitting delays as among the most significant risks and impediments to mining projects in the U.S.[9] More recently, the U.S. Government Accountability Office linked the need to streamline the mine permitting process to mitigating supply risks.[10]

Solutions:

- Promote balanced policy incentivizes and increased permitting efficiencies to support supply chain resiliency and remove obstacles to new domestic mining activities; and

- Provide certainty in permitting time frames similar to other major mining countries by setting and adhering to timelines for completion of the permitting process and working under a lead agency to ensure progress tracking and increased accountability.

Land Access

Access to federal lands is another significant barrier to new production or increases in current production of the metals and minerals. Twelve western states are the source of much of our nation's mineral endowment. Federal lands comprise almost 40 percent of the land area in those states, which is predominantly managed by the Department of the Interior's (DOI) Bureau of Land Management (BLM) and the U.S. Department of Agriculture's (USDA) Forest Service. Mining is not appropriate everywhere, however, half of that land is either off-limits or under restrictions for mineral development.

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[8] Permitting, Economic Value, and Mining in the United States, SNL Metals and Mining, 2015, found at https://nma.org/wp-content/uploads/2016/09/SNL_Permitting_Delay_Report-Online.pdf

[9] *See,* National Resources Council, Hardrock Mining on Federal Lands, National Academy Press (1999); U.S. Department of Energy, Critical Materials Strategy (Dec. 2010); U.S. Geological Survey USGS, the Principal Rare Earth Elements Deposits of the United States—A Summary of Domestic Deposits and a Global Perspective, 2010; Behre Dolbear, Where Not to Invest (2015).

[10] GAO Report 16-699, Advanced Technologies: Strengthened Federal Approach Need to Help Identify and Mitigate Supply Risks for Critical Raw Materials, Dec. 2016, found at https://www.gao.gov/assets/gao-16-699.pdf

Unknown amounts of resources on adjacent state and private lands are also off-limits because of federal land restrictions.

With that in mind, NMA has some concerns regarding the ambiguous goals set in the Biden administration's Executive Order 13990[11] to protect at least 30 percent of our lands and waters by 2030 (30x30 initiative). In particular, NMA has questions regarding the implementation of the 30x30 initiative given the fact that BLM and Forest Service are guided by a statutory-based multiple use mandate, and as such, the lands they manage must remain open to activities that support our nation's economic recovery and national security.

Specifically, the Federal Land Policy and Management Act (FLPMA) directs BLM to manage the federal lands under the principles of multiple use and sustained yield. Similarly, Congress has consistently and clearly specified in the National Forest Management Act and other statutes that the Forest Service's stewardship over the national forests must also be guided by the principles of multiple use and sustained yield. Addressing our supply chain insecurity and reliance on foreign sources of minerals will require access to federal lands. Given the vast amount of federal lands already closed to mining operations, caution should be exercised in placing additional lands off limits. NMA urges DOD to keep the importance of access to federal lands in mind as it formulates recommendations to address risks to the supply chain needs of the defense industrial base.

Solutions:

- Recognize that addressing our supply chain insecurity and reliance on foreign sources of minerals will require access to federal lands and that caution should be exercised when legislative and administrative efforts to block access to mining occur;
- Support U.S. Geological Survey mapping initiatives and geologically surveying of regions of the country that have high quality mineral and energy resources that remain unmapped at a useable scale; and
- Support existing multiple-use and sustained yield principles that govern Federal Land Management Agency's land management policies to support our nation's economic recovery and national security while also protecting federal lands of environmental and historic value.

<u>Mining Law</u>

U.S. mining is one of the most heavily regulated industries in the world. For decades, the industry has been forced to defend itself against legislative proposals to drastically alter the Mining Law. The legislation generally has been punitive, containing gross

[11] 86 FR 7037, found at https://www.federalregister.gov/documents/2021/01/25/2021-01765/protecting-public-health-and-the-environment-and-restoring-science-to-tackle-the-climate-crisis

retrospective royalties, taxes on the movement of materials, duplicative environmental standards, and greater restrictions on land access. Essentially, these bills would have the result of making hardrock mining uneconomic in the U.S. These efforts embrace false assumptions regarding how modern mining is regulated and the economic benefits it provides. As examples, last Congress' H.R. 2579 and S. 1386 contain duplicative environmental provisions that ignore the more than three dozen comprehensive federal and state environmental, ecological, and reclamation laws and regulations applicable to the industry that have been continually amended to keep pace with modern mining practices.

Among the most punitive measures that would significantly impair the viability of domestic mining include:

- Conversion of the Mining Law's locatable claim system to a leasing system similar to the system for oil, gas, and coal under the Mineral Leasing Act (MLA); and

- Excessive gross royalties on new and existing mining operations.

Making currently locatable minerals leasable under the MLA will negatively impact the domestic mining industry and ignores the fact that minerals have a geology and geochemistry that are totally different from that of fossil fuels. The discovery potential for locatable minerals and metals remains vast. More exploration is required to find commercial developable deposits than for oil, gas, and coal.

Furthermore, minerals and metals require significant processing prior to having a marketable product. Oil and gas are much more readily marketable after being produced. For example, crude oil is sold in local and international markets, and the price of the product that comes out of the ground is generally readily ascertainable at the well. Gas is also often sold at the well head, in some cases without any processing. Upon initial extraction, many locatable metals and minerals have no real economic value – considerable upfront investment and ongoing operating expense must be incurred to turn them into marketable products. By introducing great uncertainty regarding the lands ultimately available for exploration and development, a leasing system will only serve to increase the U.S.' reliance on foreign sources of metals and minerals.

The oft-proposed royalty assessed on gross income also increases the economic risk of a given mining investment and acts as a disincentive to investment. As commodity prices decrease, the rate of return required to justify a mining investment increases more dramatically under a gross royalty than under a net royalty. Because the other costs of the mining operation are relatively fixed, the gross royalty takes a bigger bite out of the shrinking income pie as prices decrease. This can have a dramatic impact on whether existing mines stay open or new mines are built. A gross royalty can exacerbate industry downturns by causing a greater reduction in the cash flows of mining companies when profits are already low.

Additionally, a gross royalty raises the "cutoff point" between recoverable ore and waste and may shorten the life of a mine by causing what otherwise would be valuable minerals below the cutoff point to be lost. These lost reserves generally can never be recovered. Once a mine is closed and reclaimed, the stranded reserves are usually uneconomic to recover on their own in the future. When mines shut down prematurely, in addition to lost mineral reserves, jobs are lost, federal state and local tax revenues are lost, and business is lost by suppliers of other goods and services that support the mines. DOD should encourage the administration to oppose these types of punitive Mining Law measures that would adversely impact all domestic mining.

Solutions:

- Oppose punitive Mining Law measures that adversely impact all domestic mining and increase U.S. reliance on foreign sources of metals and minerals;
- Support policies to increase permitting efficiencies and access to mineralized public lands; and
- Promote renewed investment in the domestic mining industry to support strong supply chains, job creation, as well as economic and national security priorities.

Mining, Refining, Processing, and Smelting

Finally, another, equally important part of the minerals supply chain conversation is the processing, refining, and smelting of metals and minerals into functioning components for early and mid-stream manufactured goods. NMA supports a series of DOD's new technology investment agreements with rare earth element producers *and* processors.[12]

Unfortunately, not only does China control mineral production within its own borders along with controlling interests in mineral development across the globe, it also has significant control the refining and processing sectors. The U.S. and other countries send mined material to China for refinement and processing. This is an untenable supply chain security risk for U.S. economic and national security interests.

[12] See most recent announcements:
Feb. 1, 2021 - https://www.defense.gov/Newsroom/Releases/Release/Article/2488672/dod-announces-rare-earth-element-award-to-strengthen-domestic-industrial-base/,
Dec. 9, 2020 - https://www.moderncasting.com/column/2020/12/09/dod-awards-13-million-rare-earths-funding-us-projects,
Nov. 17, 2020 - https://www.defense.gov/Newsroom/Releases/Release/Article/2418542/dod-announces-rare-earth-element-awards-to-strengthen-domestic-industrial-base/,
July 21, 2020 - https://www.reuters.com/article/us-usa-rareearths/pentagon-resumes-rare-earths-funding-program-after-review-idUSKCN24M2Z4,
April 22, 2020 - https://www.prnewswire.com/news-releases/mp-materials-north-americas-only-rare-earths-producer-awarded-contract-from-dod-to-accelerate-us-production-of-critical-materials-to-support-national-defense-301045761.html.

Further, as China refines and processes host minerals from all over the globe, they are able to capture additional value from other metals and minerals extracted through these processes, many of which are critical minerals and rare earth elements, giving China additional leverage over commodity markets and a geopolitical advantage.

In a recent analysis conducted for NMA, researchers at the Thomas J. O'Keefe Institute at the Missouri University of Science and Technology compiled updated production and processing information for three principally used materials.

For example, aluminum is the first material on the DOI's list of thirty-five critical minerals.[13] Since 1995, U.S. alumina production has fallen by 75%, U.S. smelters have closed from 22 to now seven, and the U.S. produces 1 million tons of aluminum. By contrast, China now produces 74 million tons of alumina and 37 million tons of aluminum.

When the U.S., and other countries, send domestically mined minerals to China for refinement and processing, that does not simply apply to critical minerals and rare earth elements. For example, in 1995, the U.S. produced nearly 2 million tons of copper and refined 2.3 million tons in 18 smelters and refineries. Those smelters and refineries are now down to 6. In, 2020, the U.S. produced 1.2 million tons of copper and refined less than 1 million. In 1995, China produced less than half a million tons of copper and refined 0.7 million tons. Today, China produces 2 million tons of copper and refines nearly 10 million tons. Today, U.S. zinc smelters have been cut by two thirds from 10 primary and secondary smelters to three. The U.S. produces half a million tons of zinc and refines 100,000 tons. China produces 4.2 million tons of zinc and refines 6.2 million tons.

The numbers show that the U.S. has most ceded control of mineral production and processing capacity largely because of regulatory policies that did not account for long-term supply chain vulnerabilities that have become pervasive in our economy.

Solutions:

- Focus on reshoring, nearshoring, and developing domestic supply chains by supporting domestic mining and the production of raw minerals and materials, core competencies, and industrial processes – including refining, processing, and smelting;

- Through and all of government approach promote renewed investment not only in production but refining, processing, and smelting in the U.S. as a first priority to finding new production and processing for strategic and critical materials elsewhere in the world.

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[13] *See*, 83 FR 23295, found at https://www.federalregister.gov/documents/2018/05/18/2018-10667/final-list-of-critical-minerals-2018

A Note on Criticality

E.O. 14017 defines "critical minerals" by reference to E.O. 13953, which in turn refers to the definition contained in E.O. 13817, A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals. E.O. 13817 relies on the U.S. Geological Survey (USGS) to create and maintain a list of minerals that are "critical." The list was finalized in 2018 and designed to be updated periodically.

These comments are not intended to diminish the importance of the minerals that are included on the USGS list. However, there are many minerals that are of vital importance to our economic and national security that are absent from the list. For example, copper, silver, gold, lead, zinc, phosphate and other minerals are indispensable to our infrastructure and are essential components of consumer products, military and defense equipment, numerous manufacturing sectors, medical applications and other uses. The availability of minerals – especially minerals with widespread uses in infrastructure, manufacturing, and consumer products – is an issue of national importance because shortages of these minerals would create serious economic disruptions that would have a ripple effect throughout our economy.

If we do not treat these minerals on par with the minerals included on the USGS list, we create bifurcated minerals policies that will harm our economy, deprive Americans of the jobs that would result from domestic mining and mineral processing, and make us even more vulnerable to supply disruptions and price manipulations. Without a doubt, some of the minerals excluded from the list are major economic drivers. According to USGS, the principal contributors to the total value of metal mine production in 2020 were gold (38%), copper (27%), iron ore (15%), and zinc (6%).[14]

In addition, the list to some degree overlooks the reality that many metals and minerals are not only critical to manufacturing, in their own right, but they serve as hosts or gateways to other metals critical to innovation. Many high-tech metals are not the targets of primary mining projects, but rather by-products recovered from the mining of other metals and minerals. Copper, for example, serves as the gateway to molybdenum, rhenium, selenium, and tellurium. Zinc is a gateway metal to indium and geranium. These specialty metals and minerals are often byproducts of refining other metals and minerals and are essential for super-alloys, electrical components, advanced weapon systems, to mention just a few applications important to national defense.

Importantly, even USGS acknowledges the drawbacks of criticality methodologies in forecasting future supply and demand. Mineral criticality is not static, but changes over time and the "analysis represents a snapshot in time that should be reviewed and updated periodically using the most recently available data in order to accurately capture rapidly evolving technological developments and the consequent material demands."[15] Similarly, the National Academy of Sciences (NAS), "Minerals, Critical

[14] USGS, *Mineral Commodity Summaries 2021*

[15] 83 FR 7065, found at https://www.federalregister.gov/documents/2018/02/16/2018-03219/draft-list-of-critical-minerals

Minerals, and the U.S. Economy," highlighted the difficulty of determining which materials are actually critical for U.S. economic and national security reporting, "the 'dynamism' of mineral importance through time means that mineral criticality at a given moment is a snapshot, rather than an enduring constant."[16]

Creating and utilizing a complex methodology to determine "criticality" does not provide the needed flexibility for the U.S. to respond quickly to supply constraints. A complicating factor in predicting the criticality of minerals in the future is unanticipated geopolitical developments. World events can redefine criticality in an amazingly short period of time. The growing number of minerals required for emerging technologies also highlights the difficulty of evaluating which minerals may be critical in the future. Many of these technologies rely on combinations of a variety of different minerals—not simply single commodities. As new applications are discovered, markets for mineral commodities will expand considerably along with demand. Finding a methodology nimble enough to accommodate rapidly changing technologies and world events is nearly impossible.

Electric vehicle batteries provide a useful example of how changing technologies can drive demands for different minerals. According to the International Energy Agency, for the next decade, the Li-ion battery is likely to dominate the electric vehicle market. Subsequently, however, a number of potential technologies might be able to push the boundaries beyond the performance limits imposed by Li-ion battery technology. These include the lithium-metal solid state battery, lithium-sulphur, sodium-ion or even lithium-air.[17] As these technologies advance, minerals not previously defined as critical may now be critical. However, given the delays in permitting new U.S. mining projects, we may again be reliant on foreign sources.

Conclusion

During a U.S. Senate hearing on U.S. mineral production last year, Joe Bryan, (at the time with the Atlantic Council) and now Special Assistant to the Secretary of Defense and Senior Advisor for Climate testified,

> "Other witnesses will detail the U.S. competitive position in the race for supply chain investment. Suffice it for me to say, the United States is getting lapped. And while China is the dominant player, we are quickly losing ground to our European allies as well. This is a problem. Our supply chain weakness has obvious economic implications. But it also creates risk for our military and, more broadly, U.S. national security."[18]

[16] NAS report, p.68.

[17] International Energy Agency, "Global EV Outlook 2020: Technology Report." June 2020, found at https://www.iea.org/reports/global-ev-outlook-2020

[18] Testimony of Joe Bryan, Senior Fellow at Atlantic Council Global Energy Center before the U.S. Senate Energy and Natural Resources Committee, June 24, 2020, found at https://www.energy.senate.gov/hearings/2020/6/full-committee-hearing-on-the-impact-of-covid-19-on-mineral-supply-chains

However, the U.S. can change these self-imposed dynamics. We must take action to credibly address the pitfalls, duplication and inefficiencies of our existing permitting and processing systems. There is no question from multiple sources that the production of minerals will need to increase by orders of magnitude to meet the growing demand in new technologies. This applies to the defense industrial base. It is not a question of if minerals will be mined and processed to meet the ever-increasing demand. It is simply a question of where they will be mined and processed.

NMA stands ready to assist DOD's efforts on strategic and critical material supply chain security as we continue to provide the front end of the supply chain for America's economic recovery.

Should you have any questions, please reach out to me at rjackson@nma.org, Katie Sweeney at ksweeney@nma.org, or Justin Prosser at jprosser@nma.org. NMA appreciates the opportunity to comment on this important issue.

Sincerely,

Ryan Jackson

Enclosure

United States Senate
WASHINGTON, DC 20510

April 20, 2021

The Honorable Lloyd J. Austin III
U.S. Secretary of Defense
Department of Defense
1000 Defense Pentagon
Washington, D.C. 20301-1000

Dear Secretary Austin,

The William M. (Mac) Thornberry National Defense Authorization Act (NDAA) for Fiscal Year 2021 contained many provisions addressing the importance of sourcing and supply chains for strategic and critical minerals and materials necessary to Departmental programs and national security.

Section 848 notably directs the Department of Defense (DOD) to acquire strategic and critical materials from sources within the U.S. first and to eliminate our nation's reliance on rare earth materials from China by the year 2035. Section 849 requires the DOD to review high priority goods for the purpose of developing plans to address reliable sourcing. Section 850 builds on the DOD's work to strengthen the manufacturing and defense industrial base's supply chain resiliency. Finally, Section 851 requires the DOD to update critical material information, required by the NDAA for Fiscal Year 2006, for the U.S. Geological Survey and the DOD to coordinate with relevant grant-receiving academic institutions to evaluate domestic processing, manufacturing capacity, and supply chain vulnerabilities.

President Biden's Executive Order (EO) issued February 24, 2021, concerning America's Supply Chains, directs an all-of-government approach consistent with the sourcing and supply chain directives in the NDAA for Fiscal Year 2021. We appreciate President Biden's concerns about threats to the availability of critical and essential goods, products, and services.

We believe that it is also important that the EO specifically calls on the DOD to update the work conducted pursuant to Executive Order 13953. This broad focus is also consistent with Congressional directives in the Consolidated Appropriations Act for FY21. The year-long supply chain risk assessments required in the President Biden's EO are essential to identifying risks and to ensure resilient supply chains. We look forward to new policy recommendations from the work of the EO which may include new investments and development, among other key recommendations.

We are writing to request that the DOD include an evaluation of the advantages to real-time delivery within the domestic supply chain of critical and strategic minerals and metals in addition to the requirements of the National Defense Stockpile (NDS) to best serve our nation's strategic readiness posture. We are also writing to inquire how the new year-long evaluation directed in the EO can be supported and complemented by the supply chain evaluation required under Section 851 of the NDAA for FY 2021.

We thank you for your attention to our nation's supply chains and their importance to national security. We look forward to your response and continuing to work with you on these important matters.

Sincerely,

Jim Inhofe
United States Senator

Rick Scott
United States Senator

Dan Sullivan
United States Senator

Kevin Cramer
United States Senator

Marsha Blackburn
United States Senator

Jacky Rosen
United States Senator

nature energy

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Understanding discontinuance among California's electric vehicle owners

Scott Hardman ✉ and Gil Tal

For the market share of plug-in electric vehicles (PEVs) to continue to grow and reach 100% of new vehicle sales, adopters of the technology, who initially buy PEVs, will need to continue choosing them in subsequent purchases. Although much research has focused on the reasons for, and barriers to, initial PEV purchase, less has been devoted to the reasons for discontinuance—abandoning a new technology after first purchasing it. Here, on the basis of results from five questionnaire surveys, we find that PEV discontinuance in California occurs at a rate of 20% for plug-in hybrid electric vehicle owners and 18% for battery electric vehicle owners. We show that discontinuance is related to dissatisfaction with the convenience of charging, having other vehicles in the household that are less efficient, not having level 2 (240-volt) charging at home, having fewer household vehicles and not being male.

For any new product to achieve a 100% market share, owners must make initial purchases, continue to purchase the technology and not revert back to purchasing the incumbent product whenever they replace their initial purchase or buy additional products. Plug-in electric vehicles (PEVs), which include battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), have a growing market share in many nations. In California, the region of analysis in this study, PEVs reached 10% market share in 2019, whereas in Norway, the country with the largest PEV market share, the vehicles reached over 50% market share in 2019. California, Norway and several other nations have goals of reaching 100% of new vehicles sales being electric by 2025 (Norway), 2030 (Denmark, Ireland, India, UK), 2035 (California) and 2040 (France)[1]. These goals will be more difficult to achieve if PEV owners are discontinuing PEV ownership.

Most published research on PEV market penetration and consumer choice focuses on initial adoption and characteristics of early buyers. Discontinuance occurs when a BEV or PHEV owner no longer owns any PEV and now owns an internal combustion engine vehicle or hybrid electric vehicle. To our knowledge, there are no published reports on PEV discontinuance—that is, when an adopter no longer owns or uses the technology that they originally adopted[2]. IHS Markit has published data on electric vehicle loyalty, showing that 55% of households who owned a new PEV purchased another PEV in the last three months of 2018[3]. This does not reveal anything about discontinuance as those that did not purchase a PEV may or may not own their original PEV.

Although the literature does not include studies on PEV discontinuance, insights on who is buying PEVs, the barriers to adoption and purchase motivations are still useful for this study. The factors related to PEV adoption or non-adoption could be related to the decision to continue or discontinue PEV ownership. We therefore use insights from the literature to inform our study. Early studies used stated preference methods with surveys of general population to identify PEV adopters[4–13]. These studies typically found that those most likely to purchase a PEV tended to be male and have a high household income, a high level of education and multiple vehicles in the household. More recent research gathered data from consumers who had purchased a PEV. Studies in Sweden, Norway, the United States and Canada are consistent in finding that PEV owners are mostly male, middle aged with mid-to-high household income and high education[14–18]. Several studies[7,18–23] identified a relationship between pro-environmental attitudes and positive perceptions of PEVs. Having pro-technology attitudes is also related to PEV adoption or adoption intent[19,23], as is having preferences for vehicles with higher efficiencies[24].

Reasons for PEV purchase include environmental motivations[25–31] and low running and ownership costs—especially related to refuelling, but also to maintenance[7,25,31,32]. The high performance and rapid acceleration of PEVs can be a purchase motivator[30,33]. Reasons for adoption also include wanting to be the first to adopt a new technology or novelty seeking[26,30,31], which is related to having pro-technology attitudes. PEV buyers are also encouraged to buy the vehicles through direct incentives such as grants, rebates and tax credits[34], and indirect incentives such as free or discounted parking, access to bus or carpool lanes and toll fee waivers[35].

Studies on barriers to PEV adoption find some combination of purchase price, driving range, model availability and lack of infrastructure is the most substantial barrier to adoption[5,29,36–42]. Some suggest limited driving range is the largest barrier[5,40], whereas others suggest is it purchase price[37,39] or the availability of charging[43].

The aim of this study is to understand why PEV owners in California are discontinuing PEV ownership. We use results from five questionnaire surveys to achieve this, conducted between 2015 and 2019. The first four surveys are cohort surveys of PEV owners; in the final survey respondents are recruited from the first four surveys. We construct logistic regression models to assess the correlation of various factors with the decision to discontinue ownership of a BEV or PHEV (see Methods). In this study we find that discontinuance occurs at a rate of 18.1% for BEV owners and 20.1% for PHEV owners. Discontinuance is correlated with having fewer vehicles in the household and dissatisfaction with the convenience of charging for both BEV and PHEV owners. BEV discontinuance is correlated with owning other household vehicles with lower energy efficiencies and not having level-2 charging at home. PHEV discontinuance is also correlated with not being male, not living in a detached house, being dissatisfied with the purchase price of the PHEV but being satisfied with running costs, shorter commute distances and undertaking more long-distance trips.

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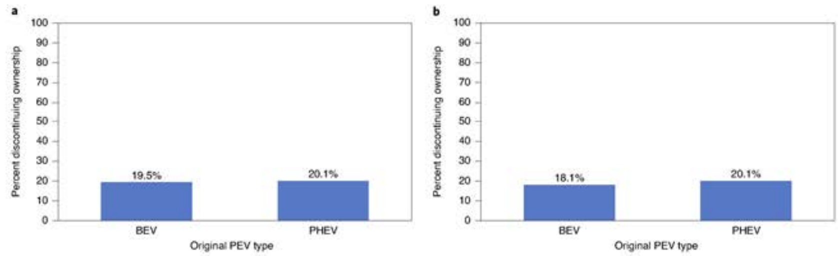

Fig. 1 | Percent of PHEV and BEV owners who discontinued ownership. a,b, Percentages are given for the sample (**a**) and the weighted percent (**b**). See Supplementary Table 1 for weights of PHEV and BEV owners in the sample ($n = 1{,}727$).

Discontinuance among California electric vehicle owners

Figure 1 shows the percent of PHEV and BEV owners who discontinued PEV ownership in the survey sample and the weighted percent (see Supplementary Table 1 for weights); PHEV discontinuance is slightly higher than BEV discontinuance. Figure 2 shows discontinuance among common PEV makes in the sample. The highest rate of discontinuance is among those who adopted a Fiat PEV, whereas the lowest is among those who adopted a Tesla PEV.

Supplementary Table 3 shows the number of people in the household, number of vehicles in the household, age, gender, household income, highest level of education, home type and home ownership for those that discontinued or continued PEV adoption. We also include data for California PEV buyers who purchased a vehicle between 2011–2020 for comparison. Supplementary Table 4 shows t-test comparisons for continuous variables and Supplementary Table 5 shows X^2 tests for nominal variables. Of the eight socio-demographic variables tested, seven are significantly different: households that discontinued PEV ownership have fewer people in the household ($P < 0.001$), fewer vehicles in the household ($P < 0.001$), are younger ($P = 0.0156$), have lower household incomes ($P < 0.001$), fewer are male ($P = 0.0024$), more of them rent rather than own their home ($P < 0.001$) and more live in a house that is not a single-family home/detached house ($P < 0.001$). Supplementary Table 6 shows t-test results for respondents's travel behaviour. Two significant differences exist: those who discontinued PEV ownership have lower annual vehicle miles travelled ($P = 0.0354$) and shorter one-way commute distances ($P < 0.001$).

Survey respondents were asked to rate how satisfied they were with their previous PEV for ten vehicle attributes. Figure 3 shows the distribution of responses for those who continued PEV ownership (top row) and those who discontinued PEV ownership (bottom row) for the five attributes that have significantly different distributions (Supplementary Fig. 1 includes a graph with all ten attributes). Table 1 shows X^2 test results for these distributions for all ten attributes. Respondents are mostly satisfied with their PEVs; the electric driving range is the only attribute where more respondents are dissatisfied than satisfied. The distributions are significantly different for safety ($P = 0.0345$), refuelling/recharging costs ($P = 0.0177$), reliability ($P = 0.0241$), electric driving range ($P = 0.0246$) and convenience of charging ($P < 0.001$). For all of these attributes, those who discontinued PEV ownership are less satisfied than those that continued ownership. The most significant difference is with satisfaction with charging convenience. The distribution for those that continued ownership is towards more satisfied than for those that discontinued PEV ownership.

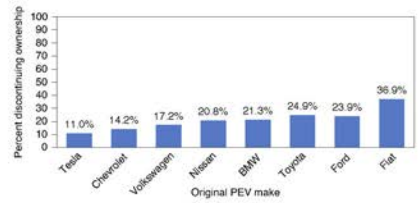

Fig. 2 | Percent of PEV owners who discontinued ownership by make of original PEV owned. We exclude less common vehicles within the sample for this graph. See Supplementary Table 2 for a table of all vehicles in the sample, and the percentage of each that discontinued PEV ownership ($n = 1{,}727$).

Figure 4 shows access to charging for those who continue versus discontinue PEV ownership. Having no charging access at home is more common among respondents who discontinue rather than continue PEV ownership (28.4% versus 13.5%, Fig. 4). These charging variables are measured during the early phase of adopters PEV ownership using results from survey 1, not their access to charging when we surveyed them a second time. Of those who continued ownership, 49.8% have access to level-2 (240 V) charging at home, compared with only 29% of those who discontinued PEV ownership. There are no significant differences in access to workplace charging for households that continued or discontinued ownership. Of those that continued PEV ownership, 58.4% report no public charging, compared with 62.7% of those that discontinued ownership. More households that continued PEV ownership report using only level-2 charging, although fewer report using level 2 in combination with direct current (DC) fast charging. X^2 tests (Table 2) comparing these distributions show that workplace charging access and public charging use are not significantly different. The distributions for access to home charging are significantly different: fewer households that no longer own a PEV have home charging, and of those that do, fewer have level-2 charging.

Factors related to discontinuance

Table 3 shows the results for the BEV and PHEV binary logistic regression models (see Methods for details). The table shows odds ratios for each variable. A value higher than one indicates higher

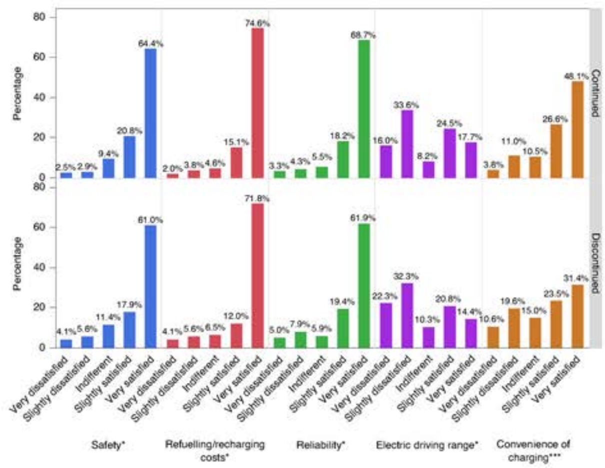

Fig. 3 | Satisfaction with previous PEV. The figure shows satisfaction with previous PEV for those who continued PEV ownership and those who discontinued PEV ownership for five attributes that have significantly different distributions. The figure represents answers to the question "Thinking about your {make and model of previous PEV}, how satisfied were you with the vehicle for each of the below?" (n = 1,672). Significance stars indicate whether distributions are significantly different (* = <0.05, ** = <0.01, *** = <0.001) using the X^2 test (see Table 1).

Table 1 | X^2 test results for satisfaction with previous PEV for those who continued PEV ownership and those who discontinued PEV ownership

	n	DF	Pearson X^2	P-value
Safety	1,672	4	10.378	0.0345*
Comfort	1,672	4	4.96	0.2914
Refuelling/recharging costs	1,672	4	11.954	0.0177*
Performance	1,672	4	5.461	0.2432
Environmental impacts	1,672	4	9.104	0.0586
Vehicle purchase price (including rebates, discounts and so on)	1,672	4	6.857	0.1436
Reliability	1,672	4	11.228	0.0241*
Electric driving range	1,672	4	11.181	0.0246*
Convenience of charging	1,672	4	63.701	<0.001***
Driving assistance features	1,672	4	4.477	0.3452

Results compare distributions in satisfaction on a Likert scale from very dissatisfied, slightly dissatisfied, indifferent, slightly satisfied, to very satisfied, for those who continued PEV ownership and those who discontinued PEV ownership (* = <0.05, ** = <0.01, *** = <0.001). DF, degrees of freedom.

odds of discontinuing BEV or PHEV ownership, whereas a value less than one indicates lower odds of discontinuing BEV ownership for a one-unit increase in the given independent variable.

In the BEV model, the number of vehicles in the household has an odds ratio of 0.563, that is, for a one-unit increase in the number of vehicles in the household there are 43.7% lower odds of discontinuing BEV ownership. This could be explained by households being less willing to own a BEV when they have fewer vehicles due to reduced flexibility from a limited range BEV compared with a conventional vehicle.

For a one-point increase in satisfaction with the convenience of charging a BEV, there are 19.5% lower odds of discontinuing BEV adoption. Those that no longer own a BEV have less favourable attitudes towards the convenience of charging compared with those that continued ownership.

For a one-unit increase in the MPG of the second vehicle in the household there are 2.6% lower odds of discontinuing BEV ownership. This could indicate that those who discontinue BEV ownership are less interested in energy efficient vehicles in general or have preferences for larger vehicles.

For access to level-2 charging from home compared to level-1, there are 52.8% lower odds of discontinuing ownership. Having level-1 charging over no charging does not have any significant relationship with discontinuance. This shows the importance of having higher speed level-2 charging at home over low speed level-1 charging. Of the two, level-2 charging gives drivers faster charging times and maximizes the amount of travel they can do in a BEV. Furthermore, the installation of a level-2 charger at home is an investment that will not be used if BEV ownership were discontinued. Access to charging at work or the use of public chargers has no relationship with discontinuance.

In the PHEV model the dummy variable for gender (1 = male, 0 = other) has an odds ratio of less than one, showing the odds of discontinuing PHEV adoption is 54.2% lower for males. For a one-unit increase in the dummy variable for home type (1 = detached house, 0 = other) there are 60.4% lower odds of

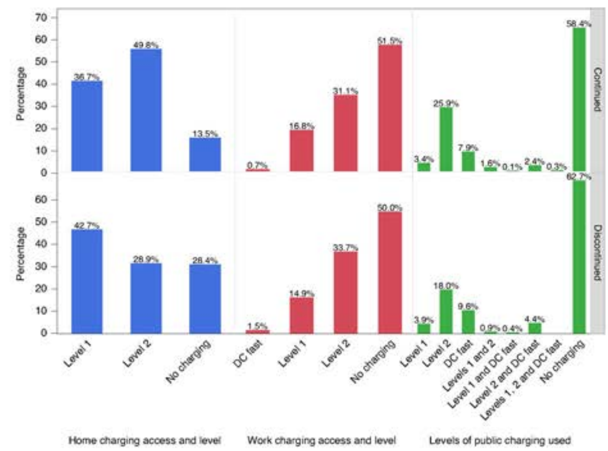

Fig. 4 | Usage of different charging types. The figure shows access to charging at home (blue) and work (red), including charging level and whether respondents report having used public charging, and the levels of charging they report using (green) for those who continued and discontinued PEV ownership.

discontinuing PHEV adoption. For one-unit increase in number of vehicles in the household there are 41.2% lower odds of discontinuing PEV ownership.

Similar to the BEV model, with a one-unit increase in the variable that measures satisfaction with the convenience of charging there are 24.3% lower odds of discontinuing PHEV adoption. For a one-point increase in satisfaction with vehicle purchase price there are 0.815 odds of discontinuing PHEV ownership. Those that discontinued owning a PHEV may be dissatisfied with the price they paid for their PHEV. Satisfaction with refuelling/recharging costs is positively correlated, showing 54.5% higher odds of discontinuing PHEV adoption for a one-unit increase in satisfaction. This is counterintuitive but is explained by those that continued PEV ownership moving from a less efficient PHEV that they were unsatisfied with to a more efficient PEV. For those that continued PHEV ownership the mean fuel economy of their original PEV is 68 MPGe, while the mean fuel economy of their newest PEV is 78 MPGe (miles per gallon equivalent). Although those that discontinued PHEV adoption were satisfied with this attribute, this was not influential enough for them to continue PHEV ownership.

Commute distance has an odds ratio of 0.978, indicating for a one-mile increase in commute distance there are 2.2% lower odds of discontinuing PHEV ownership. Households that continue PEV ownership may be doing so due to longer commutes, which can give them a greater financial benefit of owning a PHEV in comparison to an conventional gasoline vehicle. For a one-unit increase in the number of 200-mile trips taken in the past twelve months there are 2.6% higher odds of discontinuing PHEV ownership. This could be a result of buyers perceiving PHEVs to be less suited to long-distance travel, perhaps as the electric range of a PHEV is only useable in the first 10–40 miles on a long-distance trip.

No variables related to charging access (at home, work or in public) are significant in the PHEV model, although perceptions around convenience of charging are. This could be a result of drivers being able to use PHEVs regardless of whether they charge them or not.

Table 2 | X^2 test results for charging

	N	DF	Pearson X^2	*P*-value
Home charging access and level	1,795	2	69.774	<0.001***
Work charging access and level	1,049	4	1.784	0.586
Levels of public charging used	1,270	7	11.732	0.109

Results compare distributions in access to charging at home and work, including charging level, and whether respondents report having used public charging, and the levels of charging they report using for those who continued PEV ownership and those who discontinued PEV ownership. (* = <0.05, ** = <0.01, *** = <0.001).

The results of the BEV and PHEV models differ in a few areas. Only two variables are significant in both. Discontinuance of PHEVs and BEVs is correlated with having fewer vehicles in the household and dissatisfaction with the convenience of charging. BEV discontinuance is also correlated with owning household vehicles with lower efficiencies and not having level-2 charging at home. PHEV discontinuance is correlated with not being male, not living in a detached house, being dissatisfied with the purchase price of the PHEV, being satisfied with running costs, shorter commute distances and undertaking more long-distance trips.

Conclusion

It should not be assumed that once a consumer purchases a PEV they will continue owning one. In California, 18.1% of BEV and 20.1% of PHEV owners who purchased their PEV between

Table 3 | Binary logistic regression model results for BEV and PHEV discontinuance

	BEV model			PHEV model		
Term	**Odds ratio**	**Std error**	**Prob. > X^2**	**Odds ratio**	**Std error**	**Prob. > X^2**
Intercept			0.1101			0.5941
Age	1.0124	0.0101	0.2148	0.9934	0.0117	0.5713
Gender	0.6840	0.1583	0.1009	0.4585	0.1398	0.0105**
Education	0.8867	0.1365	0.4347	0.9193	0.1738	0.6564
Lease (1 lease, 0 other)	0.7769	0.2629	0.4557	1.5882	0.5195	0.1573
Number of people in the household	0.9552	0.1033	0.6721	0.9918	0.1325	0.9507
Number of vehicles in the household	0.5635	0.0834	<0.001***	0.5884	0.1112	0.0050***
Home type (detached 1, other 0)	0.8372	0.2378	0.5316	0.3959	0.1434	0.0105**
Miles per gallon of second vehicle in household	0.9737	0.0076	0.0007*	0.9914	0.0059	0.1447
Year of PEV purchase	1.1451	0.0958	0.1053	0.9479	0.0974	0.6030
Electric driving range	0.9976	0.0022	0.2745	0.9966	0.0061	0.5761
Satisfaction with vehicle attributes:						
Safety	0.9148	0.1188	0.4930	1.0184	0.1716	0.9137
Vehicle purchase price (including rebates, discounts and so on)	0.9273	0.0984	0.4767	0.8150	0.0997	0.0945*
Reliability	0.9221	0.1075	0.4864	0.8245	0.1282	0.2144
Convenience of charging	0.8053	0.0754	0.0208**	0.7569	0.0879	0.0165**
Refuelling/recharging costs	0.9282	0.1215	0.5694	1.5446	0.3139	0.0324**
Commute distance	0.9882	0.0080	0.1461	0.9783	0.0097	0.0271**
Long-distance trips	0.9952	0.0140	0.7302	1.0263	0.0138	0.0535*
Home charging categories:						
Level 2/level 1	0.4718	0.0752	0.0014**	0.6419	0.1163	0.1474
No charging/level 1	0.7595	0.1283	0.4423	1.0479	0.2259	0.9035
No charging/level 2	1.6098	0.2719	0.1991	1.6326	0.3519	0.2608
Work charging dummy (1 = L1, L2, DC, 0 = none)	0.9696	0.2122	0.8880	1.1127	0.3147	0.7059
Public charging dummy (1 = L1, L2, DC, 0 = none)	0.9276	0.2072	0.7364	0.5739	0.1983	0.1080
Log likelihood	311.076			201.054		
R-squared (U)	0.132			0.1334		
Observations (or sum of weights)	759			489		

Binary logistic regression model where the dependant variable is 1 = discontinued PEV ownership, 0 = continued PEV ownership (* = <0.1, ** = <0.05, *** = <0.01).

2012 and 2018 discontinued PEV ownership. This discontinuance occurred between the years 2015 and 2019. Without data from other sources to compare with, it is not clear whether this is a high or low rate of discontinuance. What is clear is that this could slow PEV market growth and make reaching 100% PEV sales more difficult.

Even after initially overcoming the barrier of the different refuelling style, some BEV and PHEV owners decided not to continue with PEV ownership for the same reasons many do not purchase one in the first place. The fact that discontinuance is not correlated with vehicle range but is correlated with access to charging and the convenience of charging intuitively makes sense. The way in which a PEV is charged has not changed, whereas vehicle range has been increasing since PHEVs and BEVs were introduced. PEV owners have the option to purchase longer-range vehicles, whereas they cannot yet purchase a vehicle that is charged differently (for example, though inductive charging).

Both PHEV and BEV discontinuance is negatively correlated with number of household vehicles. Those that continued ownership have on average more vehicles in their household than average California households, whereas those that discontinued ownership have a similar number of vehicles on average. This may mean households with fewer vehicles struggle to incorporate PEVs into their household fleet, something which could be problematic as the PEV market moves towards mainstream consumers.

The reasons why women are more likely to discontinue ownership of PEVs is not clear; similarly, the reason why so few PEV owners are women remains unclear[44]. More research is needed on this topic to understand how to encourage women to adopt and continue to own PEVs.

Finally, discontinuance of PEV adoption is occurring concurrently with more PEV owners reporting they would not purchase their PEV without incentives year on year[45] and with buyers's socio-demographics changing each year, with more moderate income buyers adopting a PEV[46]. This will mean that the introduction of BEVs and PHEVs will face more challenges over time, will not get easier as some hope and will still require policy support.

Initial purchase of a PEV by a consumer does not ensure that they will continue ownership. Most existing research investigates how to increase rates of first-time PEV adoption through incentives, infrastructure and other policies. We hope to encourage more research into understanding how to ensure PEV owners become permanent adopters and do not abandon a PEV for vehicles that are less energy efficient.

Methods

Overview. Using results from five questionnaire surveys, this study investigated rates of discontinuance and factors correlated with discontinuance. We investigated discontinuance among those who had made a subsequent purchase decision regarding their original PEV. These households now own a newer vehicle or chose to purchase their original PEV at the end of the lease period. We excluded those who have not made any decisions on the ownership of their original PEV as these households may or may not be planning to continue with PEV ownership. Leaving these out of the analysis was important, as we do not know whether their attitudes, satisfaction with their vehicle or any other factors are representative of someone who is planning to abandon or continue PEV ownership. If a BEV adopter purchased a PHEV after owning a BEV initially (or vice versa) this qualifies as continuing PEV ownership. Respondents originally purchased their PEVs in the years 2012–2018 and the decision to continue or discontinue PEV ownership occurred between 2015–2019.

Questionnaire surveys. The five questionnaire surveys conducted between 2015 and 2019 included four cohort surveys and a final survey where respondents were recruited from the first four surveys. The initial questionnaire surveys were conducted in 2015, 2016, 2017 and 2018. These surveys recruited households in California that purchased a PEV between 2012 and 2018. The California Air Resources Board helped in recruitment by sending survey invites to households that applied for a California Clean Vehicle Rebate. The final fifth survey was conducted in December 2019. Households that indicated willingness to participate in future studies at the end of the first survey were sent an email inviting them to take the final survey.

The sample is potentially biased. First, the initial recruitment using rebate recipients omits PEV owners who did not apply for a rebate due to being unaware of it or because they are ineligible. Second, the resurvey asked respondents of the initial surveys to participate in additional data collection. This could bias the sample towards households that are interested in sharing their experiences with electric vehicles. This sample bias could mean we over sampled those who continued PEV ownership, and under sampled those who discontinued ownership. The latter may be less inclined to take a survey on a technology they no longer own. This could mean the results on the number of PEV owners who discontinued ownership are not representative of the entire California market. Nevertheless, the results highlight the issue and reveal what factors are correlated with discontinuance.

The first four surveys were mostly concerned with understanding PEV adopters in California[46], their charging behaviour[47] and the impact of incentives on the decision to purchase a PEV[45]. The surveys contained the following sections:

- Household information including number of vehicles in the household, number of people in the household, age and gender of household members, household income, home type (for example, single-family home or multi-unit dwelling), home ownership.
- Information on household vehicles including make, model, year of purchase and odometer readings.
- Electric vehicle charging behaviour, including location of charging (for example, home, work or public charging).
- Travel behaviour questions, including home and work locations, which are used to determine commute distance and information on long-distance trips.
- The importance of incentives in the decision to purchase a PEV, including the US federal tax credit, California clean vehicle rebate, high occupancy vehicle lane access and other local incentives (for example, from utilities).

The final survey contained the same sections as previous surveys but added the following sections that were designed to help understand subsequent purchase behaviour of PEV owners. These included:

- Questions on satisfaction with vehicle attributes for their previously owned PEV in the following areas: safety, comfort, refuelling/recharging costs, performance, environmental impacts, vehicle purchase price (including rebates, discounts and so on), reliability, electric driving range, convenience of charging and driving assistance features.

The final survey was sent to 14,128 households that had previously participated in one of the four original surveys. Of these, 4,925 started the survey, and 4,167 completed it. Households that have not made an ownership decision on their original PEV are not included in the study. This leaves 1,842 respondents who have made a decision regarding their original PEV and therefore a decision to continue or discontinue PEV ownership. Discontinuance in this sample is 20.6% (356 households), whereas 79.4% (1,371 households) continue to own a PEV. Of those that continued with PEV ownership, 245 purchased their PEV at the end of the lease period and 1,213 now own a different PEV. The 384 households that discontinued PEV ownership own no plug-in vehicles in their household and own only conventionally fuelled vehicles.

Statistical analysis. To explore descriptive data, we compared responses to questions based on whether respondents continued or discontinued PEV ownership using X^2 for discrete data and t-tests for continuous data. Pearson's X^2 compares the distributions of frequencies in categorical data, it tests a null hypothesis of there being no difference in the distributions. We used a two-sample student's t-test to compare continuous data. The t-test is used to test the null hypothesis of there being no difference in the means of the two populations (those that continued and discontinued PEV ownership). We used a 5% (<0.05) level to reject the null hypothesis for both X^2 and student's t-test. We used binary logistic regression to model factors related to discontinuance. We used this to draw our conclusions, rather than X^2 and student's t-tests, as it allowed us to control for additional explanatory variables rather than investigating them in isolation.

As the decision to continue or discontinue PEV ownership is a binary outcome we used a binary logit model to investigate which variables are correlated with discontinuance and use odds ratios to measure the effect of these variables on discontinuance. We do not seek to predict discontinuance in the entire population of California PEV owners, rather we seek understand why discontinuance has occurred using responses to the questionnaire survey. We estimated two models to understand discontinuance: one for BEVs only and one for PHEVs only. We estimated separate models for BEVs and PHEVs because the vehicles are different in key areas, most notably their driving range and refuelling/recharging requirements. This allows us to see if reasons for discontinuance of a BEV or a PHEV diverge.

The models included socio-demographic variables that are commonly correlated with PEV adoption or adoption intention[illegible]. We originally intended to include lifestyle variables in the model, as studies show attitudes and lifestyles (for example, pro-technology attitudes), not just socio-demographic variables, are correlated with interest in PEVs. However, as these questions were recorded post decision to continue or discontinue PEV ownership it is plausible that this variable could be endogenous; for example, deciding to continue with PEV ownership could lead to respondents indicating they have more positive attitudes to technology. For charging we included respondents's access to charging at home, including the level they have access to as a categorical variable (no charging, levels 1 or 2). For workplace charging we included a dummy variable for whether they have access to any charging at work (level 1, level 2, DCFC). For public charging we included a dummy variable for whether respondents have used level 1, level 2 or DCFC charging. We included variables on how satisfied consumers were with their PEV across various attributes. Vehicle attributes are common barriers to adoption (for example, range)[illegible]. The year of PEV adoption is included as past studies have identified differences in PEV buyers's response to incentives and differences in their socio-demographic profile by year of PEV purchase[illegible]. Early buyers of PEVs are more likely to be innovators compared with later buyers, which may have a relationship with interest in continuing PEV adoption. The models contained the following variables:

- Socio-demographic variables: age of survey taker, gender (1 male, 0 other) of survey taker, highest level of education of survey taker, vehicle ownership (1 lease, 0 other), number of people in the household, home type (1 detached, 0 other).
- Charging variables: a categorical variable for whether respondents had charging at home (no charging, level 1, level 2), whether respondents have charging at work (1 yes, 0 no), whether respondents use public level 1, level 2 or DCFC (1 yes, 0 no), recorded during the early phase of their PEV ownership. This variable is taken from responses to the first survey respondents took, in which PEV owners had owned their vehicle for a median of 10 months and mean of 13 months (compared with 36 and 41 months in the second survey that they took).
- Travel variables: commute distance, number of trips over 200 miles in the past 12 months.
- Household vehicle variables: efficiency of the second vehicle in the household (in Environmental Protection Agency (EPA) MPG), BEV (or PHEV) EPA electric driving range, number of vehicles in the household.
- Respondent satisfaction with the following attributes of their PEV: safety, vehicle purchase price, reliability, convenience of charging, refuelling/recharging costs and electric driving range.
- Year that the PEV was purchased.

We originally ran two models for PHEVs and two for BEVs. The separate models included a measure of EV driving range and a measure of respondents' satisfaction with EV driving range. Separate models were used as these variables were closely related. In these models neither EV range nor satisfaction with EV range were correlated with discontinuance. We therefore only present the models with EV range in the paper. We had hypothesised that a change in home type or access to charging at home could be a reason for discontinuance. We found that of those that discontinued ownership 82% experienced no change in their home type, 13% moved from an apartment or condo to a house, and 5% moved from a house to an apartment or condo. Of those who changed house type more moved to a home type associated with having charging at home, than those who moved to a house type associated with less charging access. We also asked respondents whether they discontinued ownership due to a change in charging access at home. Only 2% of those who discontinued ownership indicated this. For these reasons we use home type and access to charging at home in the models.

We checked for multicollinearity using the variance inflation factor, we excluded variables with a variance inflation factor of greater than three; note this is lower than in linear models since logistic regression results are more sensitive to multicollinearity. We exclude the following: annual vehicle miles travelled, as it is correlated with commute distance; five of the ten vehicle-satisfaction measures (satisfaction with comfort, performance, environmental impacts and driving assistance features are excluded); and home ownership, as it is correlated with home type. We exclude satisfaction with electric driving range and use a measure of actual driving range in the models (using EPA ranges) to account for potential endogeneity issues. Finally, to detect observations that may have a large influence on the model and identify outliers we checked deviance residuals and studentized residual. This resulted in removing five observations from the PHEV model and three from the BEV model.

Ethics and consent. The University of California, Davis Institutional Review Board (IRB) Administration granted approval of this study. The study followed all relevant ethical regulations in the study of human subjects for social research. All participants consented to participating in the questionnaire survey.

Reporting Summary. Further information on research design is available in the Nature Research Reporting Summary linked to this article.

Data availability
The questionnaire survey data used in this study can be obtained from The Dryad Digital Repository: https://doi.org/10.25338/B8WS6R. More information on the data, the variables included, and a description of each variable are available in DRYAD.

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Author contributions

S.H. and G.T. were responsible for study design and conception, performed data collection, drafted and revised the manuscript, and approved the final version of the manuscript. S.H. performed the analysis.

Competing interests

The authors declare no competing interests.

Additional information

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Last updated by author(s): 2021.03.09

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☐	☒	The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement
☐	☒	A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒	The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☐	☒	A description of all covariates tested
☒	☐	A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒	A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☐	☒	For null hypothesis testing, the test statistic (e.g. F, t, r) with confidence intervals, effect sizes, degrees of freedom and P value noted *Give P values as exact values whenever suitable.*
☒	☐	For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☒	☐	For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
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Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	Data collection was via Lime Survey
Data analysis	JMP Pro 15

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research guidelines for submitting code & software for further information.

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Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	The data in this study is questionnaire survey data. The data comes from five questionnaire surveys conducted between 2015 and 2019. The first four are cohort surveys and a final survey where respondents are recruited form the first four surveys. The final survey was sent to 14,128 household who had previously participated in one of the four original surveys. Of these, 4925 started the survey, and 4167 completed it. This study uses data from 1727 respondents who have made a purchase decision regarding their original electric vehicle.
Research sample	Plug-in electric vehicle buyers in California recruited from the California Clean Vehicle Rebate Project for the cohort surveys. Respondents for this study are recruited from cohort survey respondents who indicated they are willing to participate in future studies and provided an email address. The sample is weighted to be representative of the electric vehicle market in California. This sample was chosen since California is the largest PEV market in the US.
Sampling strategy	The sample was a convenience sample using a database of electric vehicle buyers we had previously surveyed (in the 4 cohort surveys). The aim of sampling was to achieve a margin or error of less than 5% at a 95% confidence level. Given 695,582 electric vehicle buyers in California our sample gives us close to a 2% margin of error at a 95% confidence level.
Data collection	Lime Survey online questionnaire survey
Timing	1st cohort survey April-June 2015, 2nd cohort survey June-September 2016, 3rd cohort survey May-September 2017, 4th cohort survey July-November 2018. Final resurvey of respondents in all cohorts: November and December 2019
Data exclusions	Households who still own their original PEV are not included in the study since their attitudes, preferences, demographics, etc. may or may not be representative of a household who will continue or discontinue electric vehicle ownership. This is explicitly mentioned in the manuscript. This leaves 1842 responses for our study.
Non-participation	No survey respondents declined to participate in the survey post participation. The survey response rate was 29.5%.
Randomization	n/a

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study	
☒	☐	Antibodies
☒	☐	Eukaryotic cell lines
☒	☐	Palaeontology and archaeology
☒	☐	Animals and other organisms
☐	☒	Human research participants
☒	☐	Clinical data
☒	☐	Dual use research of concern

Methods

n/a	Involved in the study	
☒	☐	ChIP-seq
☒	☐	Flow cytometry
☒	☐	MRI-based neuroimaging

Human research participants

Policy information about studies involving human research participants

Population characteristics	See above
Recruitment	Cohort survey respondents were recruited from the California Air Resources Board database of Clean Vehicle Rebate Project participants, they were contacted via email address. Resurvey respondents were contacted by UC Davis using email addresses reported in their originla survey response.

Ethics oversight	UC Davis IRB Administration (study was given exempt status)

Note that full information on the approval of the study protocol must also be provided in the manuscript.

May 5, 2021

The Honorable Bobby L. Rush
Chairman
House Committee on Energy & Commerce
Subcommittee on Energy
2125 Rayburn House Office Building
Washington, DC 20515

The Honorable Fred Upton
Ranking Member
House Committee on Energy & Commerce
Subcommittee on Energy
2125 Rayburn House Office Building
Washington, DC 20515

Dear Chairman Rush and Ranking Member Upton:

On behalf of Hyundai, we welcome the opportunity to submit a letter for the record on the Subcommittee on Energy's hearing on the "The CLEAN Future Act: Driving Decarbonization of the Transportation Sector". The transportation industry is undergoing a massive shift towards electric vehicles and Hyundai like other automakers in the industry is actively developing electric vehicle technology including battery and fuel cell technology to meet the needs of our diverse set of consumers.

While investments in battery electric charging infrastructure have clear value in helping achieving the greenhouse gas (GHG) reduction targets, they will not get us there alone. Hydrogen fuel cell electric vehicles (FCEV) are undoubtedly another significant and necessary option to reduce GHG emissions. All technologies that reduce GHG emissions have a role to play which is why Hyundai has invested billions of dollars in both battery and fuel cell electric technologies. While there has been much focus on battery electric vehicles, Hyundai believes that vehicle electrification policies must be technology neutral and equally promote both battery and fuel cell technologies and corresponding infrastructure to achieve the greatest GHG emission reductions possible.

With the proper hydrogen refueling network, the transition to a fuel cell electric vehicle from a gasoline powered vehicle is rather seamless. The advantages of fuel cell electric vehicles include: long range – The Hyundai Nexo FCEV gets in excess of 360 miles of range on a full tank of hydrogen; cold weather does not impact vehicle performance; and fast refueling time of 3-5 minutes. Additionally, fuel cell technology is also scalable and well suited for medium and heavy-duty applications; foregoing concerns about battery weight, charge times, cold weather performance and long routes are just a few reasons why fuel cell technology is needed in these medium and heavy-duty settings. Without investments in hydrogen refueling infrastructure, those applications where consumer needs cannot be adequately met by battery electric technology will likely remain powered by diesel and other non-zero emission powertrains.

As the subcommittee evaluates the types of publicly accessible electric vehicle supply equipment (EVSE) for rebate programs under the DoE, we ask the committee support parity for hydrogen refueling infrastructure with that of charging infrastructure. Establishing parity should take into account the number of vehicles that can be serviced by different types of EVSE among other considerations. By doing so, Congress will show they are serious about reducing GHG emissions by promoting all technologies that lessen the burden on our environment while meeting customer expectations.

Thank you for your commitment to growing the electric vehicle market and the corresponding infrastructure. We look forward to serving as a resource to you as we transition to electrified vehicles.

Sincerely,

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Importing Our Energy Future

MINERALS MINING, IMPORT DEPENDENCE AND U.S. ENERGY TRANSITION

From copper to nickel, sil□er to lithium, a wide range of minerals are absolutely essential to produce the building blocks of our energy future, and demand is growing. The World Bank Group estimates minerals production demands could increase by nearly 500 percent or more by 2050. The Center for Strategic and International Studies □CSIS□has cited a 1,000 percent □ump.

The success of various green energy proposals – from the transition to an increasing amount of solar and wind energy to electric vehicle production and the infrastructure required to support it – depends on the U.S. taking action to strengthen our domestic mining industry to secure critical energy supply chains.

A wide variety of cross-cutting minerals are used across a range of advanced energy technologies, below are select e□amples of some of the minerals on which our energy future depends. The question for policyma□ers is why are we importing so many of these minerals, when we could be mining them here at home, creating □obs and upholding the strictest environmental standards in the world.

Electric Vehicles □EVs□. EVs, and the transportation infrastructure required to power them, require an array of minerals including the following:

Copper. Known for its electrical conductivity and high fle□ibility, copper, for which the U.S. is currently 37% import reliant, is an essential component in most energy technologies.

Gold. Used in circuit boards for EVs, the U.S. is currently 50% import reliant for gold.

Sil□er. The U.S. is currently 80% import reliant for silver, whose conductivity and corrosion resistance ma□es it ideal for use in electrical connections.

□ickel. The U.S. is more than 50% import reliant for nic□el, which is widely used in electric vehicle batteries.

Solar Panels. Many of the 35 mineral commodities listed as critical by the Department of the Interior play an important role in solar panels. These minerals include:

Indium. The U.S. is currently 100% import reliant for indium, which is used in solar cells and is typically found in □inc, iron, lead and copper ores.

Tellurium. The U.S. is currently □5% import reliant for this mineral, which is used in solar cells and can be e□tracted as a byproduct of copper smelting.

Wind Turbines. Each massive wind turbine requires vast amounts of mined materials, including:

Aluminum. The U.S. is □□% import reliant for aluminum, which is utili□ed in most parts of a wind turbine.

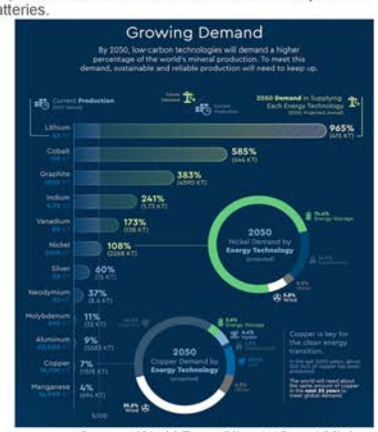
□inc. The U.S. is 83% import reliant for □inc, which is □ey in preventing corrosion.

Batteries. The importance of batteries to our energy future cannot be overemphasi□ed. From EVs to bac□up electricity, batteries - and the minerals that ma□e them - are the cornerstone of our energy future.

Lithium. The U.S. is currently more than 50% import reliant for lithium, which is used widely in batteries.

Cobalt. The U.S. is currently 7□% import dependent for this rechargeable battery essential.

Graphite. The U.S. is currently 100% import reliant for graphite, which serves as an electrode in many lithium batteries.



Source: World Ban□Climate Smart Mining

2020 New Light-Duty Vehicle Registrations By Vehicle Type, Segment, & Powertrain

ALLIANCE FOR AUTOMOTIVE INNOVATION
Transforming Personal Mobility

State	Vehicle Type		Light Truck Segments				Powertrain				
	Cars	Light Trucks	CUVs	SUVs	Pickups	Vans/Minivans	Hybrid	PHEV	BEV	FCEV	ZEV
AL	25.43%	74.57%	34.82%	10.71%	25.61%	3.42%	2.02%	0.10%	0.43%	0.00%	0.53%
AK	10.54%	89.46%	37.74%	10.39%	36.81%	4.53%	3.10%	0.12%	0.60%	0.00%	0.72%
AZ	25.50%	74.50%	35.06%	8.30%	22.45%	8.68%	3.47%	0.32%	1.91%	0.00%	2.23%
AR	19.59%	80.41%	34.40%	10.92%	32.16%	2.93%	1.91%	0.09%	0.28%	0.00%	0.37%
CA	37.29%	62.71%	36.87%	7.34%	15.08%	3.41%	7.41%	1.80%	6.09%	0.06%	7.95%
CO	16.13%	83.87%	43.13%	12.66%	23.49%	4.58%	4.08%	0.75%	3.02%	0.00%	3.77%
CT	24.97%	75.03%	49.52%	10.15%	11.97%	3.39%	4.13%	0.66%	1.70%	0.00%	2.36%
DE	23.71%	76.29%	44.11%	10.18%	17.70%	4.30%	4.42%	0.48%	1.34%	0.00%	1.82%
DC	33.18%	66.82%	45.55%	8.65%	7.94%	4.68%	9.48%	2.13%	3.82%	0.00%	5.95%
FL	31.43%	68.57%	41.65%	8.13%	14.95%	3.84%	2.78%	0.20%	1.57%	0.00%	1.78%
GA	28.48%	71.52%	35.60%	9.65%	21.26%	5.01%	2.62%	0.21%	1.07%	0.00%	1.28%
HI	28.59%	71.41%	34.55%	11.16%	20.53%	5.17%	2.97%	0.83%	4.26%	0.01%	5.11%
ID	13.42%	86.58%	37.58%	10.03%	35.54%	3.43%	4.48%	0.24%	0.81%	0.00%	1.06%
IL	23.54%	76.46%	47.47%	8.92%	14.21%	5.86%	4.48%	0.26%	1.36%	0.00%	1.62%
IN	19.71%	80.29%	42.87%	8.90%	22.04%	6.48%	3.39%	0.19%	0.76%	0.00%	0.95%
IA	13.54%	86.46%	41.17%	9.58%	30.84%	4.86%	3.38%	0.16%	0.46%	0.00%	0.62%
KS	19.09%	80.91%	38.15%	10.33%	27.22%	5.20%	3.49%	0.21%	0.85%	0.00%	1.06%
KY	20.82%	79.18%	40.25%	9.61%	25.04%	4.28%	3.18%	0.15%	0.54%	0.00%	0.69%
LA	23.81%	76.19%	32.34%	11.42%	29.24%	3.19%	1.58%	0.07%	0.26%	0.00%	0.33%
ME	14.17%	85.83%	43.37%	8.84%	29.74%	3.88%	3.85%	0.89%	0.84%	0.00%	1.74%
MD	28.73%	71.27%	41.50%	8.30%	14.44%	7.03%	5.04%	0.64%	2.00%	0.00%	2.63%
MA	22.71%	77.29%	48.49%	9.98%	14.82%	4.00%	4.88%	0.90%	2.06%	0.00%	2.96%
MI	11.45%	88.55%	49.74%	11.40%	24.46%	2.95%	2.48%	0.13%	0.62%	0.00%	0.75%
MN	13.70%	86.30%	46.84%	9.09%	25.82%	4.55%	3.80%	0.34%	1.21%	0.00%	1.55%
MS	26.74%	73.26%	31.65%	10.55%	28.02%	3.04%	1.80%	0.06%	0.23%	0.00%	0.29%
MO	19.26%	80.74%	34.97%	9.26%	28.01%	8.49%	3.59%	0.19%	0.68%	0.00%	0.87%
MT	10.34%	89.66%	31.85%	13.60%	40.00%	4.21%	3.51%	0.20%	0.57%	0.00%	0.76%
NE	14.92%	85.08%	40.92%	10.37%	29.88%	3.92%	3.01%	0.18%	0.58%	0.00%	0.77%
NV	28.78%	71.22%	38.79%	9.35%	19.89%	3.18%	3.72%	0.37%	2.46%	0.00%	2.83%
NH	18.34%	81.66%	42.44%	8.04%	24.06%	7.13%	3.46%	0.39%	0.84%	0.00%	1.22%
NJ	27.73%	72.27%	49.46%	10.13%	9.10%	3.59%	3.28%	0.47%	2.41%	0.00%	2.88%
NM	23.40%	76.60%	32.83%	10.34%	30.90%	2.53%	3.61%	0.28%	0.75%	0.00%	1.03%
NY	22.85%	77.15%	51.74%	10.31%	11.55%	3.56%	3.44%	0.76%	1.34%	0.00%	2.10%
NC	25.54%	74.46%	39.25%	10.03%	21.03%	4.14%	3.10%	0.23%	1.11%	0.00%	1.34%
ND	7.30%	92.70%	37.32%	11.69%	41.25%	2.44%	1.77%	0.09%	0.14%	0.00%	0.23%
OH	22.28%	77.72%	46.58%	8.10%	18.26%	4.78%	3.15%	0.16%	0.81%	0.00%	0.97%
OK	34.27%	65.73%	30.64%	10.11%	16.02%	8.96%	0.80%	0.03%	0.13%	0.00%	0.16%
OR	21.09%	78.91%	42.76%	8.89%	22.30%	4.95%	6.85%	1.18%	3.58%	0.00%	4.76%
PA	20.88%	79.12%	48.46%	8.34%	17.57%	4.76%	3.74%	0.33%	1.04%	0.00%	1.37%
RI	25.64%	74.36%	48.31%	8.05%	14.83%	3.17%	3.77%	0.76%	1.13%	0.00%	1.89%
SC	24.67%	75.33%	38.28%	10.50%	22.76%	3.79%	2.46%	0.16%	0.61%	0.00%	0.77%
SD	8.71%	91.29%	39.71%	10.62%	37.74%	3.23%	2.24%	0.13%	0.24%	0.00%	0.37%
TN	25.19%	74.81%	37.35%	10.03%	23.04%	4.40%	2.79%	0.14%	0.84%	0.00%	0.97%
TX	23.90%	76.10%	33.66%	10.94%	28.52%	2.98%	2.20%	0.15%	0.94%	0.00%	1.09%
UT	19.50%	80.50%	36.65%	9.69%	29.56%	4.59%	3.94%	0.39%	1.92%	0.00%	2.31%
VT	14.82%	85.18%	46.72%	6.77%	29.22%	2.48%	5.08%	1.10%	1.72%	0.00%	2.82%
VA	26.67%	73.33%	42.28%	9.74%	16.29%	5.02%	4.79%	0.41%	1.57%	0.00%	1.97%
WA	21.53%	78.47%	45.66%	8.15%	19.52%	5.13%	8.53%	0.74%	4.32%	0.00%	5.06%
WV	16.06%	83.94%	43.35%	10.27%	28.05%	2.26%	2.71%	0.16%	0.27%	0.00%	0.42%
WI	15.11%	84.89%	46.75%	8.36%	24.59%	5.19%	3.69%	0.22%	0.69%	0.00%	0.90%
WY	8.94%	91.06%	32.08%	12.60%	43.90%	2.49%	2.78%	0.11%	0.42%	0.00%	0.53%
U.S.	25.02%	74.98%	41.15%	9.42%	19.99%	4.41%	3.73%	0.49%	1.80%	0.01%	2.29%

Source: Figures compiled by Alliance for Automotive Innovation with new registration retail and fleet data provided by IHS Markit covering January 1, 2020 - December 31, 2020

Market share based on 14.3 million light vehicle sales in 2020.

POLICY CONSIDERATIONS | MARCH 2021 **Fuels Institute**

Proposals to Ban the Sale of Combustion Engine Vehicles

The quest to reduce emissions from the transportation sector (air pollutant and greenhouse gas emissions) has led some countries, and regions within countries, to consider policies to ban the sale of vehicles equipped with internal combustion engines (ICE). These regions represent more than 50% of global light duty vehicle sales. Such policies seek to accelerate the transition of the vehicle market to rely exclusively on vehicles which produce zero tailpipe emissions, such as battery electric vehicles and fuel cell electric vehicles.

In an effort to help policymakers and affected stakeholders better understand the potential effect of such initiatives, and to plan in advance to mitigate potential negative implications and to take full advantage of positive ones, the Fuels Institute has identified the following considerations which it believes are critical to address when crafting and implementing a ban on the sale of ICE vehicles. These considerations are presented in three categories: Environmental Impact, Market Readiness and Consumer and Stakeholder Impact. By presenting these considerations, derived from the input of a diverse set of stakeholders, it is the hope of the Fuels Institute to prompt robust and comprehensive discussions about the various options available to policymakers to pursue successful policies that balance the various needs of the market.

ENVIRONMENTAL IMPACT

What will be the cradle-to-grave (lifecycle) environmental impacts of the policy?

If the primary objective of these initiatives is to reduce the emissions profile of the transportation sector, a comprehensive cradle-to-grave analysis looking at the environmental impacts of the policy would provide policymakers with invaluable insight. Such an analysis could identify areas that deserve additional attention when crafting a policy in order to take advantage of positive attributes associated with the transition to zero emission vehicles (ZEVs) and to mitigate negative ones. To be most informative, the analysis should include at a minimum:

- The production, use, maintenance and disposal of the vehicles and parts being developed to comply with the policy as well as those being replaced, along with their associated energy components. The assessment should differentiate between vehicle classes and their use and consider how the policy might affect fleet turnover and total miles traveled within each class. For example, if the policy accelerates or slows the rate of new vehicle sales, this will affect the useful life expectancy of legacy vehicles and their related emissions.

- All phases associated with the production, transmission, maintenance and distribution of transportation energy used by ICEVs and ZEVs. This would include the exploration, production and transport of raw materials used in the manufacture of liquid fuels, electricity and hydrogen; the conversion of those raw materials to a form of energy that is consumed by a vehicle; the transmission, distribution and ultimate delivery of that energy into a vehicle, including construction and maintenance of required infrastructure; and the consumption of that energy and its associated emissions.

- The lifecycle performance of a vehicle and its energy source should be considered as a connected system, evaluating the overall impact of a vehicle and its "fuel" to provide a more holistic perspective to policymakers.

In addition to the fundamental elements of a lifecycle analysis listed above, consideration should also be given to the impact of such policies on research and development investments directed to improve the efficiency and emissions profile of ICEVs and liquid fuels. Since these vehicles will remain in operation for decades beyond the effective date of a sales ban, how might the policy affect the emissions profile of these vehicles and fuels and how might further improvement be supported?

MARKET READINESS

How might the vehicle manufacturing industry be able to produce enough qualified ZEVs to satisfy demand?

To transition its capabilities to produce only qualified ZEVs, the vehicle manufacturing industry must undergo significant change. The policy should consider the ability of the industry to manufacture affordable vehicles and transition effectively to comply with the effective date of the sales ban and determine what manner of government support might be required. Elements to consider should include:

- To determine if the industry will require government assistance (including the type of assistance and duration it might be required), it will be important to understand what vehicles will need to be produced. Questions to be answered include:

    - Will the policy affect the light-duty, medium-duty and heavy-duty vehicle sectors or just a subset of these?

    - For each sector included in the policy, how many ZEVs will need to be produced to satisfy demand leading up to and including the effective date?

    - What is the anticipated market share of each unique ZEV powertrain (i.e., battery electric, fuel cell electric, etc.) within each affected market sector?

- Some of the materials required to produce ZEVs are not required for vehicles powered by combustion engines. Consequently, their supply chains are not as fully developed. How might the industry be able to source sufficient volumes of the critical materials needed for ZEV production and how might the government be able to assist? What might be the trade-related implications associated with acquiring these materials?

- Manufacturing BEVs will eliminate the need for significant production streams within the manufacturing process, which could displace a large percentage of the existing labor force. How can the policy mitigate the consequences of displaced workers?

Will BEV charging and/or hydrogen refueling infrastructure be able to satisfy consumer demand for transportation energy?

Consumers must have reliable access to transportation energy. To support the expansion of vehicle charging and appropriate refueling infrastructure, policymakers must understand the following and create policies to support the needs of consumers:

- How much infrastructure is needed to support the number of vehicles being introduced into the market and where must it be located? This evaluation should take into consideration the actual number of facilities determined necessary by market evaluation as well as that perceived by potential drivers' as required, which could be a much larger number of facilities.

- If the policy is designed to include light-, medium- and heavy-duty vehicles, how should the infrastructure develop to support each use case scenario? For example, light-duty drivers may recharge an electric vehicle at home, office or at a retail establishment. However, a medium- or heavy-duty vehicle may rely upon a depot charging facility or an in-market facility for longer distance routes.

- What type of infrastructure will be needed, by when and at what capacity? For light-duty electric vehicles, charger speed capabilities and overall capacity will vary greatly by location being serviced (i.e., home, office parking structure, grocery store, fast food restaurant, convenience store) and overall demand will grow as the share of electric vehicle owners with access to secure, off-street parking begins to normalize with the population. A similar scenario will materialize for hydrogen refueling stations depending on the type of vehicle being serviced. Understanding what will be required will help the market determine an appropriate deployment strategy to most effectively service consumers.

- Who should be responsible for building the infrastructure? What is the appropriate role for vehicle manufacturers, government agencies, utilities, retail businesses, others? How might infrastructure deployment be funded? How can public and private efforts to build infrastructure be best coordinated to minimize duplicative installations while recognizing and servicing gaps in deployment?

- How might the availability of transportation energy for vehicles that run on electricity be assured during power-disrupting events (i.e., hurricanes)? What type of backup systems will be required to satisfy demand during power outages and to support regional evacuation events?

How might electricity generation and transmission systems best prepare for the additional demand?

A significant share of the non-combustion engine vehicle market is assumed to be powered by electricity. Understanding the relationship between this new source of demand and the current state of the electricity generation and transmission sector will be essential to developing and communicating a comprehensive policy that ensures consumers have reliable access to transportation energy while not compromising their access to electricity for other daily requirements.

- As the market transitions to greater reliance on electric vehicles, what are the estimated changes in electricity demand associated with the market growth of this segment? What is the expected pace of demand growth over time and what incremental changes must be made to the electricity systems to evolve with the vehicle market? How might these changes vary by region and how might the various utilities (i.e., investor owned utilities, public utilities, rural electric cooperatives) servicing these regions best prepare to satisfy consumer demand? What adjustments must be made to the existing systems, how long might this take, how much might this cost and how will it be funded? How might the policy assist such evaluation and preparation?

- How might the utility sector best prepare for spikes in demand associated with periods of peak charging? How might drivers of electric vehicles be encouraged to incorporate responsible and predictable charging behavior into their daily activities to reduce spikes in demand that might challenge the efficiency of the electricity system? How might the policy encourage and support development of technologies/services/billing practices to protect the system from unpredictable spikes in demand (i.e., battery storage, distributed energy, time-of-use rates)?

- As reliance on electricity for transportation increases, how might policy be crafted to support efforts to reduce the environmental footprint of the electricity generation and transmission sector while supporting a potential increase in capacity to satisfy demand?

CONSUMER AND STAKEHOLDER IMPACT

How might such policies affect consumers, especially those individuals located in economically depressed or rural communities?

Access to affordable and reliable transportation is critical and the transition to ZEVs will affect consumers very differently, depending upon their circumstances. Understanding the travel needs of different communities can help policymakers mitigate negative consequences for any segment of the population, especially those living in economically depressed and rural communities. Some key elements to consider when crafting policy include:

- Many residents in lower income neighborhoods may not have access to secure, off-street parking and therefore may not have the option to recharge a vehicle at home. In addition, for both lower income and rural communities, ZEV market growth could be slower than in other markets which could affect charger deployment strategies. How might the policy ensure that deployment of infrastructure provides reliable and affordable access to recharging facilities for these consumers?

- Many traditional refueling locations have equipment that is nearing the end of its expected useful life. As such policies will require the market transitions away from ICE vehicles, it may not be possible to generate a return on the investment in new equipment required to keep these facilities operational, especially in lower income and rural communities. As a result, some facility owners may choose to close these locations permanently. With ICEVs expected to remain in operation for decades, how can policies be crafted to ensure residents in these communities have equitable access to transportation energy?

- Lower income consumers often rely upon the used vehicle market for their transportation needs. As ICE vehicles are phased-out, how might their relative value in the used vehicle market change and how might the market for used ZEVs develop? What impact might this have on lower income consumers? If vehicles become less affordable for these consumers, how will extending the useful life of their vehicles affect their total cost of ownership? In addition, how might extending the life of older ICE vehicles affect the overall emissions objectives of the policy? What can be done to mitigate these potential consequences?

- As the market transitions away from liquid fuels, the economics of producing and delivering fuel to consumers will change. How might this affect affordability of fuel for consumers driving ICE vehicles? Likewise, as demand for electricity to power new ZEVs increases, how might that affect affordability for electricity both for transportation, residential, industrial and commercial uses?

For sectors of the market that have invested significantly in infrastructure and systems to support the traditional transportation energy market, how might a policy to transition to ZEVs address potentially stranded assets and negatively affected labor sectors?

The legacy transportation fuel system is extensive and affects stakeholders in a wide variety of economic sectors. How these are affected and what transition opportunities are available should be of significant interest to policymakers. The following major sectors, among others, are likely to be affected by a transition to ZEVs:

- Petroleum Industry – The United States consumes 390 million gallons of finished gasoline and 169 million gallons of diesel fuel every day. The industry that produces, distributes and delivers this energy employs millions of workers, supports hundreds of thousands of businesses and has billions of dollars invested in infrastructure. As ICE vehicles are phased-out and demand for these products decreases, how might the policy provide opportunities for these workers and businesses to transition and repurpose exiting assets?

- Agricultural Communities – Federal policies developed to support biofuels were designed in part to support farming economics. The United States blends a significant volume of ethanol and biomass-based diesel, demand for which would phase out along with petroleum as ICE vehicles are replaced with ZEVs. How might the policy provide opportunities for the U.S. farming and biofuels sectors to repurpose existing assets and open new markets for agricultural commodities?

- Vehicle Sector – Beyond the manufacture of vehicles, an entire industry has been built to support and service ICE vehicles. A transition to ZEVs, most of which have far fewer moving parts and require less maintenance, will eliminate the need for many of these businesses and associated jobs. How might the policy provide for the technical training and new employment opportunities for these displaced entities and workers?

For government programs that rely upon fuel taxes for revenue, how might these funds be replaced as the market transitions away from fuel sales?
According to the U.S. Energy Information Administration (EIA), in December 2020 sales of gasoline and diesel fuel generated tax revenues for federal, state and local governments equal 22% of the average retail price, resulting in an average of $0.484 and $0.570 per gallon, respectively. Because the majority of revenues are assessed on a fixed cents-per-gallon basis rather than as a percent of the sale, these values were consistent with the revenues generated from fuel sales over the past 15-plus years.

- Of the revenues collected for fuel excise taxes, the Federal Highway Trust Fund receives $0.183 and $0.242 from each gallon of gasoline and diesel sold, respectively. (The Federal Leaking Underground Storage Tank Trust Fund receives $0.01 per gallon.) The assessment has frequently struggled to generate sufficient revenues to satisfy the needs of infrastructure construction and maintenance. A transition away from liquid fuels will eventually eliminate this source of funding, although the need for infrastructure construction and maintenance will continue. What mechanisms can be implemented to generate revenues to fund the nation's infrastructure needs and how might they affect consumers and various sectors of the transportation economy?

- Federal, state and local government agencies rely upon fuel taxes for purposes beyond the Highway Trust Fund. Based upon EIA's data, in December 2020 these additional fees generated $0.30 and $0.327 per gallon of gasoline and diesel fuel, respectively, for other programs. How might these agencies replace lost revenue following the transition away from liquid fuels?

What might be the overall costs and/or savings associated with implementation of the policy?
Banning ICE sales likely will significantly affect the economy and these effects should be carefully considered when crafting policy.

- Consideration should include societal costs incurred by the government, various affected stakeholders and consumers, as well as the economic opportunities created by the transition to ZEVs.

- Anticipated benefits of the policy, including the economic value of avoided GHG emissions, should be compared with associated costs to provide policymakers with an opportunity to consider provisions that may balance benefits with costs.

SUMMARY

The transition from the current transportation market to one that will rely exclusively on ZEVs is a significant undertaking with far reaching implications for the economy as a whole, as well as individual consumers and families. Only by seeking a comprehensive understanding of the potential opportunities and challenges associated with such efforts can policymakers devise strategies to successfully achieve their objectives in the most efficient and equitable manner possible. The considerations outlined in this paper represent a starting point and the Fuels Institute encourages policymakers and stakeholders to continually ask questions in order to develop the best solutions possible.

About the Fuels Institute

Founded by NACS in 2013, the Fuels Institute is a nonprofit tax-exempt social welfare organization under section 501(c)(4) of the Internal Revenue Code. We are dedicated to evaluating issues affecting the vehicles and fuels markets. We commission comprehensive, fact-based research projects that are designed to answer questions, not advocate a specific outcome. Our reports address the interests of industry stakeholders—from business owners making long-term investment decisions to policymakers considering legislation and regulations that affect these markets.

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Fuels Institute

U.S. Energy Information Administration

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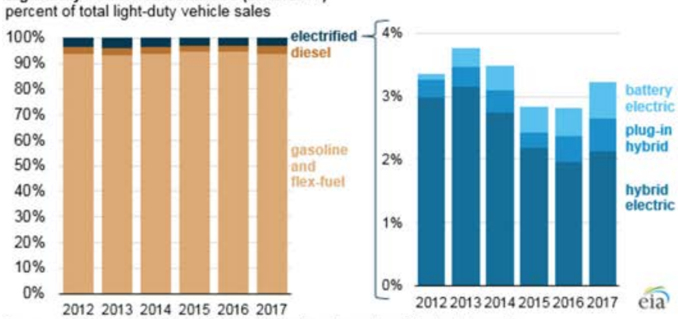
Today in Energy

May 22, 2018

Electrified vehicles continue to see slow growth and less use than conventional vehicles

Light-duty vehicle sales shares (2012-2017)
percent of total light-duty vehicle sales



Source: U.S. Energy Information Administration, based on Wards Automotive
Note: Other fuel types such as hydrogen, propane, and compressed natural gas collectively accounted for less than 0.05% of light-duty vehicle sales in these years.

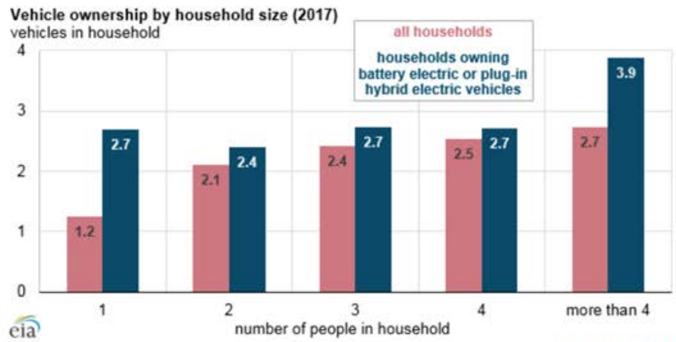
Electrified vehicles (hybrid electric, plug-in hybrid electric, and battery electric) have been sold as high fuel economy alternatives to conventional gasoline vehicles for a number of years but collectively have been slow to gain market share in the United States.

From 2012 through 2017, electrified vehicles consistently accounted for between 2.5% and 4.0% of total light-duty vehicle sales, even as the number of available models increased from 58 to 95. Hybrid electric vehicles accounted for the largest share of electrified vehicles, but their share of sales has fallen as plug-in hybrid electric (PHEVs) and battery electric vehicle (BEVs) shares have slightly increased.

The BEV share of total light-duty vehicle sales has grown the most since 2012 but only accounted for 0.6% of 2017 sales. The PHEV share grew from 0.1% to 0.5% and non-plug-in hybrid electrics declined from 3.0% to 1.9% of total light-duty vehicle sales between 2012 and 2017, based on Wards Automotive sales data.

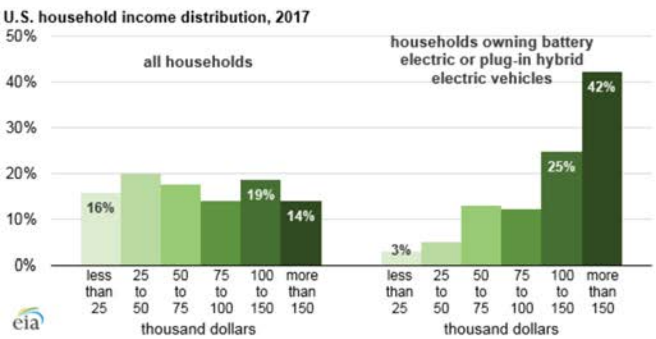
Several factors may account for the limited growth in these vehicles. Gasoline prices have remained relatively low in recent years, and the fuel economy of conventional vehicles has increased—factors that diminished the potential fuel savings of switching to electrified vehicles. Initial purchase prices for many electrified vehicles remain relatively high, especially for several PHEV and BEV models, despite federal and state incentives. Also, in most locations, limited charging infrastructure for plug-in vehicles has hindered wider adoption.

Data from the 2017 National Household Travel Survey conducted by the U.S. Department of Transportation offers insight into the use and ownership of electrified vehicles. Households that own BEVs and PHEVs tend to have more vehicles per household, owning 2.7 vehicles compared with the household average of 2.1 vehicles. BEVs and PHEVs also tend to be used about 12% less than other vehicles in terms of annual mileage per vehicle.



Source: U.S. Energy Information Administration, U.S. Department of Transportation National Household Travel Survey

About one-third of all households have annual incomes higher than $100,000. However, about two-thirds of households with BEVs or PHEVs have incomes higher than $100,000. Households with annual incomes lower than $25,000 account for about 16% of all households but about 3% of BEV- and PHEV-owning households.



Source: U.S. Energy Information Administration, U.S. Department of Transportation National Household Travel Survey

Principal contributor: David Stone

Biden's E.V. Bill Punishes the Poor

townhall.com/columnists/georgelandrith/2021/05/04/bidens-ev-bill-punishes-the-poor-n2588924

Opinion

The opinions expressed by columnists are their own and do not necessarily represent the views of Townhall.com.

Source: AP Photo/Rich Pedroncelli, File

Throughout the 2020 presidential campaign season, then-candidate Biden continually promised that he would not raise taxes on households making less than $400,000 per year. It was a promise echoed again by the White House just over a month ago, but the so-called American Jobs infrastructure plan rolled out by the administration pulls a bait-and-switch on the American people, particularly the working poor and ethnically diverse communities.

A key component of the Biden plan is the push for a nationwide transition to electric vehicles, which takes up some $174 billion in subsidies from the package, but one of the largest problems with the proposal is its disregard for the negative downwind effects it would have on those at the lower rungs of the economic ladder. As of 2019, the average cost of an electric vehicle was $55,600, far greater than the cost of other vehicles more affordable for lower income families. In fact, another recent study showed that the average income of electric car owners is at least $100,000 per year, well over even the middle-income line. While the Biden plan throws truckloads of money at other angles of the electric vehicle issue, it does nothing to address the fact that lower income households simply cannot afford electric vehicles. To make matters worse, electric vehicles only account for 2 percent of vehicle sales in the U.S., even though they have been an option for vehicle purchasers for a significant period of time. The Biden plan is catering to a niche segment of an industry, in a show of political nepotism for a pet campaign promise while slapping the American worker in the face in the process.

An aggressive plan like Biden's calls for significant bumps in energy and electric grids. Even currently, with a transportation budget of $1.5 billion, electric companies have almost $1 billion more in requests for expansion, and this is the case notwithstanding the drastic increase in energy grids that the Biden plan would implement. More electric grids cost the utilities more to operate, meaning large spikes in utility costs.

California provides an example of this type of policy gone wrong, as it invests the most of any state into electric vehicle infrastructure yet has increasing issues with blackouts, high utility costs, and general cost-of-living increases. For instance, as of 2010, SDG&E, the major energy provider in the San Diego and southern California region, has seen consistent rate increases. Conversely, utility disconnections due to overdue bills and payments has also steadily climbed within this time period, suggesting that ratepayers are finding it more difficult to keep up with rising costs. Even more specifically, those burdened with these rate hikes are disproportionately minority groups in disadvantaged communities, who shoulder these costs for the benefit of disproportionately affluent areas that can afford EV's.

Additionally, American seniors are keenly affected by these rate hikes. Per an AARP testimony in 2019 in Arizona, "twenty percent of Arizonans 65 and older rely on Social Security as their sole income source. Fifty percent get a substantial portion of their income from Social Security...[which] is about $17,500/year...Older Arizonans have much higher medical costs so many already [are forced] to choose today between, food, rent, medical care and very limited transportation...they cannot afford higher electric utility rates much less for electric vehicles." Yet again, ratepayers are being conscripted to subsidize a service that they do not use, at the cost of their own well-being.

These specific examples are simply the tip of the iceberg. If the Biden E.V. plan is implemented, the consequences would be far more drastic than even the current rate hikes. If less fortunate groups are not benefiting from electric vehicles, why should they be forced to pay for them? Spiked electric utilities affect the poor and vulnerable more negatively than any other economic demographic. Utilities are a difficult commodity to live without, particularly within a family, and they should not be burdened with rate hikes for services they do not use. Simply put, lower income households are not driving electric vehicles, and the

Biden plan not only gives them no incentive or ability to do so but punishes them for costs incurred by wealthier households, all while claiming victory because rate hikes caused by government action aren't technically a tax. Tax or not, the cost to the American people is the same. The ploy is a cruel bait-and-switch tactic that misleads the American people and should raise red flags about the Biden administration's friendliness to the American worker.

George Landrith, President of Frontiers of Freedom, is a board member of the Energy Equality Coalition.

Viral Video: Black Police Officer Tees Off on Demonization of Law Enforcement

Guy Benson

Attachment—Additional Questions for the Record

Subcommittee on Energy
Hearing on
"The CLEAN Future Act: Driving Decarbonization of the Transportation Sector."
May 5, 2021

Dr. Amol Phadke, Staff Scientist and Deputy Department Head, International Energy Analysis, Department Lawrence Berkeley National Laboratory, Affiliate and Senior Scientist, Goldman School of Public Policy, University of California Berkeley

The Honorable Kathy Castor (D-FL)

1. Dr. Phadke, the 2035 Transportation Report finds that there are "no insurmountable barriers" to significant scale-up of EV supply chains. It also highlights the potential for recycling to improve materials efficiency and create jobs. **How can investments in materials R&D and recycling infrastructure strengthen battery and EV supply chains? What is the current state of EV battery recycling infrastructure in the U.S., and what investments can we make to ensure that battery materials are recovered and reused efficiently?**

RESPONSE:

Investments in materials R&D and recycling infrastructure can play a critical role in strengthening battery and EV supply chains.

- **The US Department of Energy (DOE) has recently outlined A National Blueprint for Lithium Batteries which makes a clear case of how investments in materials RD&D and recycling infrastructure strengthen battery and EV supply chains. On materials RD&D, this blueprint states:**
  The pipeline of R&D, ranging from new electrode and electrolyte materials for next-generation lithium-ion batteries, to advances in solid-state batteries, and novel material, electrode, and cell manufacturing methods ***remains integral to maintaining U.S. leadership.*** *The R&D will be supported by strong IP protection and rapid movement of innovations from lab to market through public-private R&D partnerships such as those established in the semiconductor industry. Further three specific goals have been identified for materials RD&D to support strengthening battery supply chains. They include 1. Support the development of materials processing innovations to produce cobalt- and nickel-free active materials and enable scale up 2. Develop cobalt- and nickel-free cathode materials and electrode compositions that improve important metrics*

such as energy density, electrochemical stability, safety, and cost and outperform their current commercial, imported counterparts 3.Accelerate R&D to enable the demonstration and at-scale production of revolutionary battery technologies including solid-state and Li-metal, that achieve a production cost of less than $60/kWh, a specific energy of 500 Wh/kg, and are cobalt- and nickel-free.

- **Cost-effective battery recycling is a promising way to secure raw materials, reduce waste, and create high-quality jobs**. One study suggests that 15 jobs are created to recycle every 1,000 metric tons of end-of-life lithium-ion batteries (Akram, 2020). Multiple systems and processes already exist to recover rare earth metals from used batteries. Battery recycling will be especially important for the United States as it achieves high-volume EV manufacturing in the 2020s and 2030s. The United States could meet about 30%–40% of anticipated demand for lithium, nickel, manganese, cobalt, and graphite in passenger EVs with recycled battery materials by 2035 (Reichmuth 2019). In order to achieve this future, investments in materials R&D and recycling infrastructure must be made.
- **We can see the effectiveness of these investments in the case of China and their current domination of the EV market.** To date, China is the only country with a dedicated vehicle battery recycling policy (Reichmuth 2019). This outcome was a result of China's focus on building capacity at every stage of the battery and EV supply chain. China used their NEV credits towards the promotion of battery recycling infrastructure and supported the burgeoning market of battery recycling and materials R&D through a series of subsidies and incentives for newly formed battery companies.
    - This investment has made China the leader in battery recycling, and also strengthened their domination of material processing and battery production.
    - As of 2019, China recycled around 67,000 tons of lithium-ion batteries or 69 percent of all the stock available for recycling worldwide.
- Material development and recycling infrastructure are critical components of EV supply chains, and investments made in them allow a market ecosystem to develop in which the pace of EV innovation is accelerated.
- The current state of EV battery recycling infrastructure is relatively nascent. This is a result of the United States' broader lag in the development of a global lithium-ion battery production market with China standing at 75% of total capacity, per a Wood Mackenzie report.
- In June, DOE announced new policy actions to scale up domestic battery manufacturing and technology supply chains. These actions include strengthening US manufacturing requirements around battery production, the development of a national blueprint for domestic advanced battery supply chains, financing for battery manufacturers, and federal procurement of stationary battery storage. However, these plans do not outline specific investments to enhance the United States' battery recycling capacity.

- Recycling battery materials is a critical pathway for American companies to stay competitive in a tightening global supply chain and develop a larger stake in the battery materials market. China currently has over 80% of the world's lithium refining capacity, over 60% for cobalt, and more than a third of global nickel refinement according to the same Wood Mackenzie report.
- American companies and research labs have recognized this need and are already working to develop domestic recycling technology and facilities. General Motors is investing in raw material recovery through recycling and reuse of their excess scrap.
    - **GM has partnered with battery maker Ultimatum and battery recycling company Li-Cycle to use hydrometallurgy[1] to derive cobalt, lithium, nickel, and other useful materials for battery production**. Li-Cycle has stated that 95% of the repurposed scrap material can be used in the production of new batteries.
    - **Other American companies include Redwood Materials which takes Tesla batteries that do not meet quality standards and through a combination of pyrometallurgical[2] and hydrometallurgical processes, repurposes the battery into lithium carbonate, cobalt sulfate, and nickel sulfate**.The company said it can recover between 95-98% of a battery's nickel, cobalt, copper, aluminum, and graphite, and over 80% of its lithium.
- **DOE's Argonne National Laboratory is leading the ReCell center, a program dedicated to finding ways to improve lithium-ion recycling techniques.**
    - A key goal of the center is the support of direct recycling. Rather than smelting or breaking down the materials with acid, direct recycling allows components from the battery with complex nanostructures to be reused. That way, raw materials do not have to go through a costly step in being processed back into usable components. The processes for direct recycling have worked in lab trials, but a scalable economic model has yet to be developed.
- **Government support and investment in burgeoning technologies like the ones mentioned here will give the United States a competitive edge in terms of a more efficient battery recycle and reuse industry.**

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[1] **Hydrometallurgy is the less common approach to recycling but initial results showcase it as the more sustainable option.** The process involves soaking the battery cells in acids to dissolve the metals into a solution. This causes a higher amount of useful materials to be drawn out, including lithium. The process is more involved than smelting, and requires the recycler to reprocess the cells, removing plastic casings and draining the charge on the battery.

[2] Pyrometallurgy involves burning batteries to remove unwanted organic materials and plastic. This process produces a fraction of the original material, leaving behind copper, or some nickel and cobalt from the cathode. It is done in a fossil-fuel powered furnace, and a lot of aluminum and lithium are lost in the process. This process is not efficient from an energy and materials standpoint but pyrometallurgical smelters are commonland are ready to take on the rising supply of end-of-life batteries.

2. Dr. Phadke, the pandemic has been a powerful and tragic reminder of the importance of equitable access to clean air for all Americans. Studies have shown that exposure to air pollutants increases the risk of severe impacts, including death, from COVID-19. What are the health and environmental benefits of transportation electrification? Who is most impacted by transportation-related pollution, and how can Congress ensure that these communities are among the first—not the last—to benefit from electrification?

RESPONSE:

What are the health and environmental benefits of transportation electrification?

- Our study finds that accelerating EV adoption would save 150,000 premature deaths and avoid $1.3 trillion in health and environmental damages between 2020 and 2050.
- Gasoline- and diesel-powered vehicles harm human health and the environment via emissions of pollutants such as fine particulate matter, nitrogen oxides, and sulfur oxides as well as greenhouse gas emissions that contribute to climate change. These emissions disproportionately impact low-income communities, communities living close to the highways, and communities of color. Ensuring a 90% clean grid by 2035, would avoid additional 85,000 premature deaths and over $1.7 trillion in health and environmental damages between 2020 and 2050.
- Vehicle electrification and grid decarbonization also contributes to the DRIVE Clean scenario's combination of accelerated EV sales, a 90% clean electricity grid, and additional electrification of buildings and industry results in 45% economy-wide GHG emissions reductions by 2030, relative to 2005 levels.

Who is most impacted by transportation-related pollution, and how can Congress ensure that these communities are among the first—not the last—to benefit from electrification?

- African American, Latino, and low-income households in California are exposed to 43%, 39%, and 10% more $PM_{2.5}$ pollution, respectively, than white households (Reichmuth 2019). Broadly speaking, communities of color face higher risk from particulate pollution, and living or working near highways or heavy traffic is particularly risky (ALA 2020). Thus the health benefits of transport electrification would notably benefit low-income communities and communities of color, where vehicle pollution is worst.
- There are several strategies that could enhance access to affordable electric vehicles and charging infrastructure to communities affected by vehicular air pollution. The strategies could include higher economic incentives / subsidies / tax rebates for low-income households, subsidizing public charging infrastructure and EV charging prices in low-income / frontline communities, prioritizing electrification of heavily trafficked highway

/ freight routes that pass through affected communities by supporting truck charging infrastructure and subsidizing electricity prices etc.

- Heavy-duty trucks contribute a disproportionate share of vehicle emissions. They constitute only 5% of U.S. on-road vehicles but are responsible for 36% of particulate emissions, suggesting that electrifying trucks can have an outsized influence on emissions and human exposure to pollutants (Kodjak 2015). As such, it is important to prioritize electrification of freight corridors that run directly through these communities.
- Similarly electrification of diesel trains and inland ships should be a priority. Near elimination of air pollution from diesel electric trains by 2025-2030 is technically feasible at net costs nearing zero by retrofitting them with battery tender cars. This new opportunity is created by recent dramatic declines in battery prices and renewable electricity rates that were seldom anticipated just a few years ago (see Popovich et al 2021, forthcoming). Converting the existing 24,000 freight locomotives to battery electric will: Eliminate NOx and PM emissions from the sector, saving 19,013 lives in disadvantaged communities (by 2050 over BAU; Generate ~250 GWh of mobile batteries that can be deployed to the grid during extreme events; Avert up to 1 billion metric tons CO_2; Achieve net cost savings of $204 billion.
- For most individuals and businesses, the ability to utilize EV incentives hinges on their ability to access fair financing. **Traditional financing options are not readily available to those with lower incomes, poor or no credit, and high debt-to-income ratios.** In addition, communities of color, the elderly, and low-income households are often targeted by predatory lenders and face disproportionate financial discrimination.
- The push to achieve an electrified transportation future creates a growing need for new financing models and innovative funding programs that significantly expand consumer and business access to EVs (and other clean energy and clean transportation options). These include green banks, community developed financing institutions (CDFI), microfinance, tariff-based financing, and sustainable capital ventures.
- Where they exist, they can and should be leveraged to maximize the impact of any incentive programs. Working alongside policymakers, the financial sector, private businesses, and utilities are key to developing and implementing workable financing options that meet the needs of more consumers and businesses and in particular those communities that face structural hurdles to financial access can be supported by federal, state and local governments in creating access to EVs.
  - An example of this can be seen with California's Clean Cars 4 All Program which supports lower-income consumers in acquiring cleaner technology vehicles by retiring their older, higher-polluting vehicles and upgrading to a cleaner vehicle or an alternative mobility option of their choice. This program has been recently expanded by Governor Gavin Newsom in the latest CA budget in order to center frontline communities in California's ambitious ZEV sales targets.

- Other barriers to entry for frontline communities in accessing EVs include lack of charging infrastructure investment in disadvantaged communities which makes the purchase of an EV particularly unrealistic for these communities.
  - Prioritizing federal investment in **public fast charging** in these communities can also ensure more equal opportunities for purchasing.
  - Incentives for buildings, in particular apartment buildings, to provide fast charging.
  - Prioritizing electrification of freight corridors that run directly through these communities.

3. Dr. Phadke, President Biden says that when he thinks about solving the climate crisis, he thinks about jobs. That's how Democrats in Congress view it too, especially as we work toward a pollution-free transportation sector. In your testimony, you say that electrifying the transportation sector will create jobs across the economy. What types of jobs will be created by Federal investments in electrification and where could they be located? The 2035 Transportation Report also considers the falling cost of EVs. Do you expect that consumers will save money by buying EVs?

RESPONSE:

What types of jobs will be created by Federal investments in electrification and where could they be located?

- Though economic recovery seems just within reach, major sectors of the U.S. economy remain devastated by the COVID-19 pandemic. Already with the American Rescue Plan Act of 2021, substantial resources have been allocated to help individuals, families, and businesses. Enacting policies that rapidly electrify America's transportation sector present an opportunity to put more Americans back to work, and put more money back into consumers' pockets.
- **The DRIVE Clean scenario, where EV's constitute 100% of new vehicle sales by 2035, supports consistent job gains during 2020-2035, peaking at over 2 million jobs in 2035.** These employment gains are mostly induced jobs (1.4 million), spurred by $1 trillion in consumer savings that the electric vehicle transition will bring by 2035. Assuming the same unionization rates by industry today, in 2035 union jobs will increase by 276,000, while non-union jobs will increase by 1.8 million.
- The direct job impacts due to vehicle electrification are also positive overall. Altogether, gains in direct electricity and fuel sector jobs in 2035 (790,000) offset direct job losses in the auto sector (483,000). In 2035, job gains caused by the push to achieve a 90 percent clean electricity system with significant load growth are concentrated in construction (228,000), electrical equipment (105,000), and electricity delivery (197,000), and should be relatively evenly distributed among states as investment in clean electricity is ubiquitous. Direct impacts in auto manufacturing remain relatively unchanged.
- After 2035, net-job impacts of vehicle electrification remain positive but start to decrease due to stable renewable build-out rates and decreasing power sector and vehicle operation and maintenance costs, though any job figures after 2035 remain highly uncertain.

The 2035 Transportation Report also considers the falling cost of EVs. Do you expect that consumers will save money by buying EVs?

- Consumers save substantially on electric vehicle ownership due to decreased repair costs. However, reduced vehicle maintenance has a negative impact on jobs in vehicle repairs.
- Historically, EV sales have been hindered by two consumer-cost disadvantages: the total cost of ownership (TCO) and upfront prices of EVs have both been high in relation to internal combustion engine (ICE) vehicles.
- Our results show, however, that electric heavy-duty trucks already hold a TCO advantage today, and light-duty EVs will overtake ICE vehicles in TCO terms within 5 years (Figure 1).
- In addition, light-duty EVs will reach upfront price parity with their ICE counterparts in the mid to late 2020s, while electric HDTs will approach upfront price parity with diesel trucks in the mid to late 2030s.
- Significant barriers remain, but the total consumer cost savings and societal benefits of accelerated vehicle electrification are staggering. Achieving 100% electrification of new vehicle sales puts the United States on a 1.5°C pathway for economy-wide decarbonization while yielding substantial human health and environmental benefits and saving consumers $2.7 trillion in vehicle spending – approximately $1,000 in household savings each year – over the next 30 years. If light-duty vehicle electrification is delayed to 2035 in accordance with many currently proposed transportation electrification goals, we leave significant cost savings on the table.

Figure 1. TCO for EVs (bars) vs. ICE vehicles (lines), showing TCO parity achieved by 2023 for LDVs (left and center) and an existing TCO advantage for HDTs (right). Upfront costs include taxes. Maintenance costs of EVs include battery replacement cost.

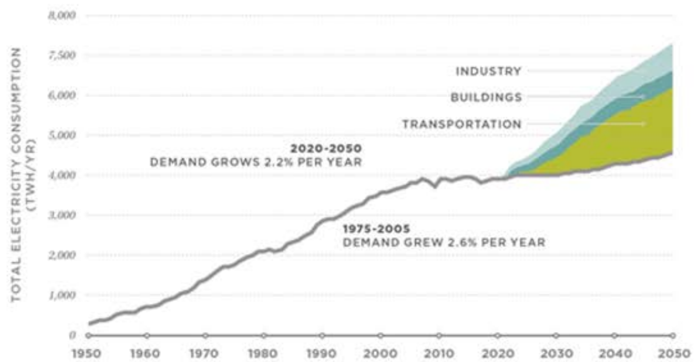
4. Dr. Phadke, I am working on legislation to help upgrade and expand our electric grid to bring affordable clean energy to more homes across America and to support electrification in transportation, buildings, and other sectors. **What kinds of grid upgrades will be needed to support EV infrastructure build-out and the goal of 100% electric vehicle sales by 2035?**

RESPONSE:

- By 2035, 100% new vehicle sales electrification, coupled with a 90% clean electricity generation target, would require a significant change in the composition of U.S. electricity supply and demand, with wind, solar, hydro, and nuclear making up 90% of supply (up from about 40% in 2020), and demand increasing by about 35% over 2020 levels. The electricity demand would increase by over 70% by 2050.
- While such demand increase is significant, it is not historically unprecedented. Between 2020 and 2050, we find that the combined demand growth due to vehicle, buildings, and industrial electrification would be approximately 2% per year, consistent with the 2.6% average historical growth in the electric sector during 1975–2005.
- To ensure a 90% clean grid and meet the additional electricity demand, about 110 GW of wind and solar energy capacity needs to be installed annually (Figure 2). This also requires about 30 GW (190 GWh) of battery storage (2- to 10-hour batteries) each year. For reference, the United States installed around 31 GW of new utility-scale renewable capacity in 2020, despite the pandemic (SEIA 2021; ACP 2020). This ambitious target will require strong policy support, but it is not unprecedented internationally. China installed 120 GW of wind and solar capacity in 2020 (Murtaugh 2021). We find that the average electricity generation cost in 2035 would actually be slightly lower than 2020 electricity costs owing to the steep renewable energy cost reductions and higher system utilization enabled by increased electrification. The benefit derives from the complementary load profiles of different types of EV charging and electric loads in the building sectors—electricity use is higher due to electrification, but it is more evenly distributed across seasons. Finally, we find that even with additional electric loads, the 90% clean grid is dependable without coal plants or new natural gas plants through 2035.
- In 2035, the additional electricity demand is dominated by EV charging (Figure 4). Public chargers are primarily used during the day and home chargers in the evening, helping to smooth the electricity demand across all hours of the day. Small load increases from building electrification occur mostly in winter due to space heating. The higher winter load results in more efficient renewable energy use, because net peak load occurs in summer, with significant renewable energy curtailment in winter and spring. The

higher winter load reduces renewable energy curtailment in those months, which also reduces the need for battery capacity.

- Distribution grids will require upgrades to support increasing electric loads from vehicle charging. We find that two types of distribution system upgrades would be required: primary distribution costs such as distribution transformers and feeder lines driven by coincident peak EV charging (coincident peak load); and secondary distribution costs such as lines connecting distribution transformers to homes, driven by the interconnection of EV chargers (connected load). We find that annual revenue requirements for distribution system upgrades range from $0.7 to $2.8 billion per year by 2035 and $2.8 to $20 billion per year by 2050. Even at the high end, this is a fraction of the $162 billion of annual distribution revenue requirement projected for 2050 by the 2021 Annual Energy Outlook. Additionally, the added EV charging load would actually reduce average $/kWh distribution rates. The 2021 AEO projects a national average distribution cost of $0.03397/kWh based on retail sales of 4,748 TWh in 2050. We find that end-use electrification would result in an average distribution rate of $0.03221/ kWh, a reduction of $0.0018/kWh or 5%. Furthermore, simple managed charging solutions such as time of use (TOU) rates could reduce distribution costs by 50% or more. Note that the key drivers of distribution upgrade costs vary widely and are location-specific, so such nationwide estimates are necessarily approximate.
- Increased electrification and pervasive renewable energy and battery storage deployments require investments mainly in new transmission spurs connecting renewable generation to existing high-capacity transmission. While massive renewable energy investments require about three times more spurline investment compared with a No New Policy (baseline) scenario, the total transmission investments add only 0.2 cents/kWh to the total system costs. Recent studies that account for low renewable energy and battery storage costs indicate similar findings (Jayadev et al. 2020). Studies that assume much higher renewable energy costs or do not consider substantial battery storage find higher levels of additional bulk transmission are required (Clack et al. 2017, NREL 2012). Further work is needed to understand transmission needs more precisely.



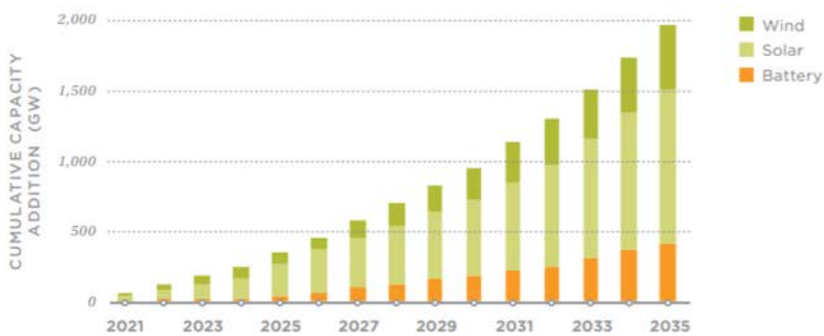


Figure 2. Average annual U.S. electricity demand growth, 2020–2050 (top) and average U.S. renewable energy capacity additions necessary to support the DRIVE Clean scenario, compared to projected renewable energy capacity additions in the United States through 2035 (bottom). The United States must add approximately 110 GW of new wind and solar each year through 2035.

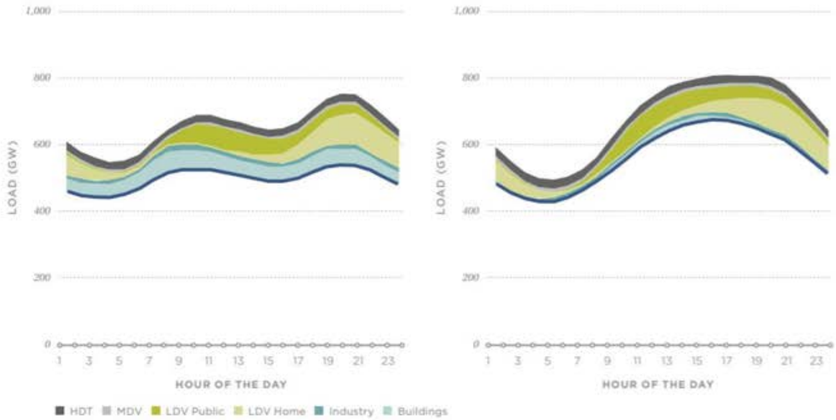


Figure 3. Average hourly load profile in the DRIVE Clean scenario during January (left) and July (right), 2035. The baseline load (with no additional electrification) is shown by the black line, while the areas in color show the additional load due to electrification of each end-use.

Attachment—Additional Questions for the Record

Subcommittee on Energy
Hearing on
"The CLEAN Future Act: Driving Decarbonization of the Transportation Sector."
May 5, 2021

Mr. Joe Britton, Executive Director, Zero Emission Transportation Association

The Honorable Scott Peters (D-CA)

1. Critics have said that power grids across the United States are unstable and not equipped to handle an increase in load that electric vehicles may bring. Can you please explain how and if electric vehicles would affect the grid?

RESPONSE:

ZETA RESPONSE:

Electric vehicle charging can provide a variety of benefits to the overall power system, such as improved grid management, reliability, resilience, and overall ratepayer affordability. In addition, utilities and customers can take advantage of the flexible and geographically distributed nature of EV loads through vehicle-grid integration (VGI), price signaling (like time-of-use), and optimized charging.

Optimized charging presents a key opportunity for EVs to soak up excess energy, like solar, that may otherwise be curtailed. For instance, there are often excess solar resources available in the morning hours – when demand is lower – and an increase in electricity demand in the afternoon and evening hours when the sun is down. Smart charging and incentives to EV owners to recharge during peak solar hours help drive down costs for consumers and allow the grid to utilize more renewable energy, and shift demand in a way that benefits all grid users. And studies have shown that with new clean energy capacity added to the grid, it will grow more dependable and we will see increasingly lower wholesale costs than today.[1]

The overall capacity on the system (e.g., distribution circuits) may need to be upgraded as EV adoption increases, but PG&E and Southern California Edison, who have the largest footprint of EV adoption, have found that EV charging "increased utility revenues more than they have increased utility costs, leading to downward pressure on electric rates for EV-owners and non-EV owners alike." The reason is that EVs can help shave the peaks and the valleys of power

[1] https://www.2035report.com/transportation/evs-the-power-grid/

demand, where additional energy utilization in non-peak hours drives revenue without additional generation costs. In other words, EVs can help increase the efficient use of the power grid.[2]

These EV charging benefits can be managed and improved using smart statewide or local programs to incentivize charging during non-peak hours.[3] Because EVs can charge any time they are plugged in, they can also serve as an energy storage resource or participate in demand response programs that provide additional grid benefits.

The Honorable Doris Matsui (D-CA)

While investing in electric vehicle (EV) charging infrastructure expansion, we should also explore the deployment of technologies that will maximize the lifecycle of charging equipment and improve consumer access and reliability at public charging stations. One effort to compliment the expansion of EV charging infrastructure consists of installing network-capable, interoperable "smart" EV chargers at public stations. These smart chargers are capable of being monitored and managed remotely, provide usage patterns data, and can help consumers see whether a charging port is in use or broken.

1. What do you think are the benefits of investing in network capable "smart" EV chargers, compared to non-networked chargers, as a part of the EV charging infrastructure expansion?

RESPONSE:

ZETA RESPONSE:

From a federal policy perspective, there are a diversity of approaches to expand EV charging. For example, smart chargers would benefit areas where remote monitoring and online management tools would increase "uptime." Increasing uptime would mean that more chargers will consistently be online and available to charge. Their networked capability also creates the ability to have variable pricing, which can incentivize charging at times when there is excess power on the grid ("time-of-use" pricing) to help reduce power loads at peak demand. Similarly, networked chargers collect data, which can be useful for understanding charging behavior, costs, use cases, and to help plan for future installations and upgrades.

There are, however, use cases where networked charging is not necessary or cost-effective. Non-networked chargers are less expensive to purchase because they do not require integrated technology, and the installation may be more straightforward and less costly. Nonetworked chargers are sufficient for single-family homes and many multi-unit housing uses. They may also be preferable from a cost standpoint in areas without reliable internet service where the benefits of networked capabilities are limited. Of course, non-networked chargers can still be "network

[2] https://www.synapse-energy.com/sites/default/files/EVs-Driving-Rates-Down-8-122.pdf

[3] https://www.nytimes.com/2021/01/29/climate/gm-electric-cars-power-grid.html

capable," meaning that if internet access reaches that area, they would be capable of being networked in the future.[4]

2. How will "smart" chargers enhance EV charging infrastructure and improve our communities' access to EV charging stations?

RESPONSE:

ZETA RESPONSE:

Smart chargers can be remotely monitored, increase uptime, and expand access because they are connected to the internet. Because prices, availability, and power can be accessed remotely for smart chargers, they can more easily be located by drivers using charging locator applications that show prices, location, and availability.

Further, as noted above, smart chargers can be utilized to make electricity more affordable at non-peak times of the day when the grid is producing excess power (base load), and otherwise would be curtailed. This may be especially valuable to price-sensitive consumers looking to reduce their transportation and fueling costs.

The Honorable Kathy Castor (D-FL)

1. Mr. Britton, the recently released 2035 Transportation Report from UC Berkeley finds that there are "no insurmountable barriers" to significant scale-up of EV supply chains. It also highlights the potential for recycling to improve materials efficiency and create jobs. How can investments in materials R&D and recycling infrastructure strengthen battery and EV supply chains? What is the current state of EV battery recycling infrastructure in the U.S., and what investments can we make to ensure that battery materials are recovered and reused efficiently?

RESPONSE:

ZETA RESPONSE:

With coordination, smart incentives, and appropriate policies, the U.S. can regain a competitive advantage in domestic battery supply chains and battery recycling in particular.

Battery recycling is a promising American innovation that can help free us from reliance on China for critical materials. Recycling technology is already delivering on a promise to reclaim 95% of criticalmaterials in a commercially competitive way. ZETA member companies – including the

[4] https://afdc.energy.gov/fuels/electricity_infrastructure.html

Mr. Joe Britton
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American Battery Technology Company (ABTC), Redwood Materials and Li-Cycle – utilize cutting-edge recycling technologies to separate and process these minerals from used batteries and convert them into storage cells and new EV batteries.

While over 69% of the world's lithium battery recycling occurs in China, ABTC is currently permitting and building a lithium-ion battery recycling facility in Fernley, Nevada. This facility would quadruple the current annual U.S. lithium carbonate equivalent supply to 20,000 metric tonnes a year. By recovering critical materials and selling high-quality metals back into the battery market, recyclers in this sector are forging a path for sustainability and supply chain security. An advanced battery investment tax credit would help these technologies grow and scale to help secure the domestic supply of critical materials, drive economic development, and create a circular economy for batteries to help achieve sustainable results for decades to come.

Additionally, Enel is embarking on Second Life, a partnership with Nissan Leaf. This initiative disassembles batteries at the end-of-life and repurposes them for large stationary storage systems. Rivian, too, is designing their batteries for both first-life vehicle applications and a post-vehicle second life in energy storage. Congress and the Department of Energy (DOE) should engage in public/private partnerships and fund research and development to help deploy repurposed batteries, use sustainable materials in battery manufacturing (i.e. reclaimed/recycled rare earth metals), and standardize battery module design and build for easier disassembly, repair or recycling. This is similar to the Battery Processing and Manufacturing provision in the Senate Energy and Natural Resources Infrastructure package (section 20007) which we hope to see enacted.

Currently, there are not any federal incentives in place for consumers to recycle their electronic devices. Investment in consumer incentives to return batteries for recycling or second-life opportunities will improve rates of recycling. Consumers are required to locate a facility and return batteries, which is burdensome for people without easy access to such facilities, or who have not been made aware of recycling programs. Additionally, there is not federally aligned guidance from the Environmental Protection Agency, the Department of Energy, and the Department of Transportation directing producers or consumers on how to properly recycle EV batteries, which may also be encouraged through public-partnerships. Without federal guidance, it poses complications for manufacturers making decisions about end-of-life uses for their batteries, and causes barriers for recycling companies. The federal government should o establish a working group across agencies to provide consistent battery guidance for recycling companies, battery manufacturers, and consumers on the reuse and recycling for all lithium-ion batteries. This would also improve the domestic critical mineral supply chain.

Recently, the Senate Committee on Energy and Natural Resources passed a bipartisan title as part of a larger infrastructure package. In this legislation, there is a provision which creates a Battery Material Processing Grant program (section 20009), which focuses on small- and medium-sized manufacturers to enable them to build new or retrofit existing manufacturing and industrial facilities to produce or recycle advanced energy products in communities where coal mines or coal power plants have closed. ZETA strongly supports initiatives to ensure that the United States reclaims global leadership by returning mineral processing and battery manufacturing to domestic companies. We hope to see this bipartisan provision included in the final package.

2. Mr. Britton, the pandemic has been a powerful and tragic reminder of the importance of equitable access to clean air for all Americans. Studies have shown that exposure to air pollutants increases the risk of severe impacts, including death, from COVID-19. What are the health and environmental benefits of transportation electrification? Who is most impacted by transportation-related pollution, and how can Congress ensure that these communities are among the first—not the last—to benefit from electrification?

RESPONSE:

ZETA RESPONSE:

The Union of Concerned Scientists has noted that in the Mid-Atlantic, communities of color breathe in 66% more pollution from the transportation sector.[5] And the impacts of this pollution was laid bare by the pandemic, where studies have found that "that someone who lives for decades in a county with high levels of fine particulate pollution is 8% more likely to die from COVID-19."[6] Reducing mobile-source emissions in the transportation sector through electrification is a unique opportunity to reduce these public health impacts, especially in disproportionately impacted communities. Congress can help accelerate these emissions reductions through EV consumer incentives, funding for infrastructure and strong performance and emissions standards.

Electrification will benefit those at high-risk for health complications, but it is acutely important for those living in and around ports and transportation corridors that are especially vulnerable to mobile-source emissions. The diesel-powered trucks in the medium-and heavy-duty sector disproportionately emit not only greenhouse gases, but the most deadly pollutants like particulate matter, nitrous oxide, and sulfur dioxide which have been shown to disproportionately cause premature death and chronic health conditions in communities of color.[7] These vehicles comprise only 10% of vehicles on the road, but amount to almost a third of carbon emissions and over half of the harmful pollutants that worsen public health impacts.[8] Congress should prioritize the electrification of this class of vehicles because electrification will provide outsized and accelerated improvement in air quality for these communities.

3. Mr. Britton, I am working on legislation to help upgrade and expand our electric grid to bring affordable clean energy to more homes across America and to support electrification in transportation, buildings, and other sectors. What kinds of grid

[5] https://www.ucsusa.org/resources/inequitable-exposure-air-pollution-vehicles

[6] https://www.hsph.harvard.edu/news/hsph-in-the-news/air-pollution-linked-with-higher-covid-19-death-rates/

[7] https://advances.sciencemag.org/content/7/18/eabf4491

[8] https://www.ucsusa.org/sites/default/files/2019-12/ReadyforWorkFullReport.pdf

upgrades will be needed to support EV infrastructure build-out and the goal of 100% electric vehicle sales by 2035?

RESPONSE:

ZETA RESPONSE:

As we move forward towards a clean energy economy, we must continue to modernize the electrical grid to meet the growing demand for electrification. EV charging presents a key opportunity to soak up excess energy, like solar, that may otherwise be curtailed. For instance, there are often excess solar resources available in the morning hours – when demand is lower – and an increase in electricity demand in the afternoon and evening hours when the sun is down. Smart charging and incentives to EV owners to recharge during peak solar hours help drive down costs for consumers and allow the grid to utilize more renewable energy and shift demand in a way that benefits all grid users. And studies have shown that with new clean energy capacity added to the grid, it will grow more dependable and see increasingly lower wholesale costs than today.[9]

Overall capacity on the system (e.g., distribution circuits) may need to be upgraded as EV adoption increases, but PG&E and Southern California Edison, who have the largest footprint of EV adoption, have found that EV charging "increased utility revenues more than they have increased utility costs, leading to downward pressure on electric rates for EV-owners and non-EV owners alike." The reason is that EVs can help shave the peaks and the valleys of power demand, where additional energy utilization in non-peak hours drives revenue without additional generation costs. In other words, EVs can help increase the efficient use of the power grid.[10]

[9] https://www.2035report.com/transportation/evs-the-power-grid/

[10] https://www.synapse-energy.com/sites/default/files/EVs-Driving-Rates-Down-8-122.pdf

Attachment—Additional Questions for the Record

Snbcommittee on Energy
Hearing on
"The CLEAN Future Act: Driving Decarbonization of the Transportation Sector."
May 5, 2021

Mr. Josh Nassar, Legislative Director, The International Union, United Automobile, Aerospace, and Agricultural Implement Workers of America (UAW)

The Honorable Kathy Castor (D-FL)

1. Mr. Nassar, the recently released 2035 Transportation Report from UC Berkeley finds that there are "no insurmountable barriers" to significant scale-up of EV supply chains. How can Federal policy strengthen supply chains and support American workers?

RESPONSE:

Thank you for the question. We need a comprehensive, whole of government approach to our supply chain problems. Centering the needs of American workers and seeing them as foundational for growing manufacturing will be critical to strengthening our supply chains. In addition to increasing supply chain transparency, Congress and the Biden Administration should invest in workers' training, support good wages and benefits, and defend workers' rights to organize and collectively bargain. Investing in making these products domestically with good American jobs will help strengthen our supply chains.

An example of such policy is an amendment introduced by Sen. Debbie Stabenow (D-MI) to the Clean Energy for America Act (S.2118), which would continue a $7,500 consumer credit for electric vehicles but add for the next five years a $2,500 bonus for autos assembled in the United States and another $2,500 for meeting certain worker focused labor standards. The $12,500 rebates would apply as a rebate on tax returns. After five years a vehicle must be assembled in the U.S. for consumers to be eligible to receive a $10,000 base credit and an additional $2,500 bonus credit for vehicles that are union made or apply worker focused labor standards. This is a positive step forward and if passed into law, will strengthen our supply chains and support American workers.

2. Mr. Nassar, President Biden says that when he thinks about solving the climate crisis, he thinks about jobs. That's how Democrats in Congress view it too, especially as we work toward a pollution-free transportation sector. How can we ensure that our Federal investments support good, union jobs with high labor standards, located right here in America?

RESPONSE:

Thank you for the question. We believe Congress must pursue a win-win strategy that is good for both workers and our environment. In our view, corporations that receive taxpayer dollars must be required to use those dollars to manufacture in the United States. Corporations must also be held accountable to the workers they rely on. This means they should be required to maintain high labor standards, which includes respecting workers' right to join a union. Congress needs to make significant investments if we are to be a leader in building the cars and trucks of the future and those investments need to be made in the United States in support of good union jobs.

We need a strong industrial policy focused on education, workforce training, research and development, support for advanced manufacturing and technologies, and creating penalties for companies that turn their back on American workers.

Lastly, Congress must advance equitable tax policies that uplift working families instead of incentivizing businesses to outsource jobs overseas. For example, the 2017 Tax Cuts and Jobs Act (TCJA) encouraged the outsourcing of U.S. manufacturing jobs. Because of this law, multinational corporations pay at most only half that rate on their offshore profits as they do on their earnings here at home, creating an incentive to ship jobs overseas. The UAW urges Congress to eliminate anti-worker offshoring incentives by setting a minimum tax on the foreign profits of multinationals equal to the statutory corporate tax rate on domestic profits.

Attachment—Additional Questions for the Record

Subcommittee on Energy
Hearing on
"The CLEAN Future Act: Driving Decarbonization of the Transportation Sector."
May 5, 2021

Mr. David Jankowsky, Founder and President, Francis Energy

The Honorable Kathy Castor (D-FL)

1. Mr. Jankowsky, President Biden says that when he thinks about solving the climate crisis, he thinks about jobs. That's how Democrats in Congress view it too, especially as we work toward a pollution-free transportation sector. In your testimony, you note that your company plans to build charging networks every 50 miles across the heartland, including in rural, underserved, tribal, and disadvantaged communities. How would Federal investments to build out charging infrastructure grow economies and create jobs around the country?

RESPONSE:

Federal investment in the creation of a comprehensive direct-current fast charging (DCFC) network across the United States will create hundreds of thousands of good-paying jobs. These jobs will be created to develop, engineer, procure, construct, operate and maintain DCFC networks across the country. As a direct result of this job creation, these DCFC networks will enable the success of the electric vehicle (EV) eco-system, begetting even more jobs, across an array of supporting technologies. The development, construction and operation of electric vehicle (EV) charging stations requires the skill of workers from a number of trades. By investing in charging infrastructure, the federal government will incentivize the hiring of workers who might otherwise be forced to change industries as our economy undergoes a transformational shift. From engineers - mechanical, structural, electrical, and environmental - who design systems to construction workers who pour concrete to the utility workers interconnecting the systems to the grid, this industry will provide domestic workers a secure future, as the overwhelming majority of these jobs cannot be outsourced. Charging-station operators and technicians are burgeoning middle-class occupations in some markets already. With federal investment, some estimate 40,000 technicians alone will be needed by 2030. According to the Rocky Mountain Institute, EV charging is "the largest growth sector in the U.S. electricity market for the foreseeable future."

2. Mr. Jankowsky, I am working on legislation to help upgrade and expand our electric grid to bring affordable clean energy to more homes across America and to support electrification in transportation, buildings, and other sectors. What kinds of grid

upgrades will be needed to support EV infrastructure build-out and the goal of 100% electric vehicle sales by 2035?

RESPONSE:

While the United States grid, in most regions, has sufficient capacity to support short-term EV growth - because of decreases in energy consumption in the recent past - investments for grid upgrades will be necessary in the near- to long-term. Planning has already begun. In fact, some states have mandated that utilities develop plans to accommodate the inevitable increase in power loads resulting from the electrification of transportation. Future demands on the grid will correlate with utilization rates and existing grid capacity. Those areas undergoing a more rapid transition to EVs will experience greater stress on their grids. Utilities and other power generators must forecast both the amount of charging which will take place and the time of day at which it occurs. Investments in new distribution and storage technologies, and modernization of our outdated grid will be necessary to facilitate the transition to EVs. Most experts agree that distributed energy resource management is the most effective tool to prepare for the future.

Mr. AJ Siccardi
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Attachment—Additional Questions for the Record

Subcommittee on Energy
Hearing on
"The CLEAN Future Act: Driving Decarbonization of the Transportation Sector."
May 5, 2021

Mr. AJ Siccardi, President, Metroplex Energy, Inc.

The Honorable Jerry McNerney (D-CA)

1. Mr. Siccardi, electric utilities, such as PG&E in my home state, have worked to use funds approved by state regulatory commissions to bolster EV infrastructure options for customers. In fact, PG&E and 7-Eleven recently announced a partnership to deploy DC fast chargers. If fuel retailers benefit from these investments, why have your groups (the National Association of Truck Stop Operators, National Association of Convenience Stores, and Society of Independent Gas Marketers Association) partnered with the American Petroleum Institute on a multi-state effort to stifle investments in EV program filings at the state level?

RESPONSE:

Thank you, Congressman McNerney, for raising this question. I am pleased to have the opportunity to correct some mistaken information that has been provided to you, and perhaps to others. RaceTrac is a member of the National Association of Truck Stop Operators (NATSO), the National Association of Convenience Stores (NACS), and the Society of Independent Gasoline Marketers of America (SIGMA) and has had a representative on the Board of Directors of each organization. Those three organizations *were not and are not* members of the group that the American Petroleum Institute and others participated in on the above-referenced issues.

Our trade associations – NATSO, NACS, and SIGMA – have taken a separate and different approach to electric vehicle (EV) infrastructure issues. We want more EV infrastructure and our three associations have worked to identify opportunities for the industry to participate in the development of EV infrastructure. That infrastructure will only proliferate in the way that EV drivers need if a robust private market for EV charging develops such that businesses have a profit motive for investing in EV charging infrastructure. Some significant investments, like 7-Eleven's, are happening. In fact, NATSO in 2020 partnered with ChargePoint, the world's largest EV charging network, to create the National Highway Charging Collaborative. The Collaborative has committed to leveraging $1 billion in capital to deploy charging at more than 4,000 travel plazas and fuel stops that serve highway travelers and rural communities. NATSO and ChargePoint are well on their way to achieving that goal. Despite the investments noted above, we see the need for changes to the marketplace to ensure businesses are incentivized to invest in this space and there is a level playing field that enhances price-competitive offers and prevents monopolization by any one sector. We all know that such monopolization ultimately stunts growth and innovation in markets and hurts consumers.

And, we favor utility investments in electricity infrastructure to facilitate development of EV charging, including with ratepayer funds, with the exception of the use of ratepayer funds on the EV chargers themselves. Major investments in power generation, electric grids, line extensions and more by electric utilities will be necessary to provide the capacity to support widespread adoption of EVs. We recognize and support that.

But, the chargers themselves should be treated differently. That is because, given the ability of EV drivers to move their vehicles to different providers and seek the best pricing and service in the marketplace, EV chargers lend themselves to a competitive market. Drivers can go to any charging provider they wish based on price, location, other products and services offered, or any other criteria drivers prioritize. Traditional electricity pricing is not set up that way. Instead, it assumes that electricity is being provided to fixed locations – such as a home or business structure – where it only makes sense for one provider to pay to connect electricity to those locations. Given these differences, there is simply no reason to make ratepayers pay for EV chargers themselves. EV drivers can pay for those chargers as they purchase electricity.

If utilities want to own and operate EV chargers, then they should do so using unregulated funds that are not part of rate filings that provide guaranteed returns. These should be competitive investments so that there is a level playing field in which utilities and private sector businesses all need to recover their capital investments and make a profit. That level of competition will ensure that everyone in the EV charging market will have incentives to compete vigorously to offer consumers the best prices and services they can.

Partnerships between utilities and convenience retailers are a good way to make all of this happen in the most effective and consumer-friendly way. Utilities are needed to help provide much of the infrastructure to get a site ready for EV charging – particularly where more advanced and higher capacity chargers are going to be used. Meanwhile, convenience retailers not only have experience aggressively competing on price for drivers' business, they also have locations that drivers are used to visiting and provide the products, drinks, foods, restrooms and other amenities that drivers have come to expect when they stop to fuel their vehicles.

We want to work cooperatively with the utility industry to enhance EV charging offerings. We just want Congress to ensure that that occurs in a competitive market on a level playing field that inures to the benefit of EV drivers and the future development of the market.