

**SOLVING THE CLIMATE CRISIS: MANUFACTURING  
JOBS FOR AMERICA'S WORKERS**

---

---

**HEARING**  
BEFORE THE  
**SELECT COMMITTEE ON THE  
CLIMATE CRISIS**  
**HOUSE OF REPRESENTATIVES**  
ONE HUNDRED SIXTEENTH CONGRESS  
FIRST SESSION

HEARING HELD  
SEPTEMBER 10, 2019

**Serial No. 116-9**



[www.govinfo.gov](http://www.govinfo.gov)  
Printed for the use of the Select Committee on the Climate Crisis

U.S. GOVERNMENT PUBLISHING OFFICE

38-471

WASHINGTON : 2020

SELECT COMMITTEE ON THE CLIMATE CRISIS

ONE HUNDRED SIXTEENTH CONGRESS

KATHY CASTOR, Florida, *Chair*

BEN RAY LUJÁN, New Mexico  
SUZANNE BONAMICI, Oregon  
JULIA BROWNLEY, California  
JARED HUFFMAN, California  
A. DONALD McEACHIN, Virginia  
MIKE LEVIN, California  
SEAN CASTEN, Illinois  
JOE NEGUSE, Colorado

GARRET GRAVES, Louisiana,  
*Ranking Member*  
MORGAN GRIFFITH, Virginia  
GARY PALMER, Alabama  
BUDDY CARTER, Georgia  
CAROL MILLER, West Virginia  
KELLY ARMSTRONG, North Dakota

---

ANA UNRUH COHEN, *Majority Staff Director*  
MARTY HALL, *Minority Staff Director*  
[climatecrisis.house.gov](http://climatecrisis.house.gov)

# CONTENTS

## STATEMENTS OF MEMBERS OF CONGRESS

	Page
Hon. Kathy Castor, a Representative in Congress from the State of Florida, and Chair, Select Committee on the Climate Crisis:	
Opening Statement .....	1
Prepared Statement .....	3
Hon. Garrett Graves, a Representative in Congress from the State of Louisiana, and Ranking Member, Select Committee on the Climate Crisis:	
Opening Statement .....	3
Hon. Ben Ray Luján, a Representative in Congress from the State of New Mexico, and Member, Select Committee on the Climate Crisis:	
Prepared Statement .....	5

## WITNESSES

Josh Nassar, Legislative Director, United Auto Workers	
Oral Statement .....	6
Prepared Statement .....	8
Tarak Shah, Former Chief of Staff and Under Secretary for Secretary and Energy, U.S. Department of Energy	
Oral Statement .....	11
Prepared Statement .....	13
Edward Stones, Global Business Director, Energy and Climate Change, Dow	
Oral Statement .....	19
Prepared Statement .....	20
Zoe Lipman, Director, Vehicles and Advanced Transportation Program, BlueGreen Alliance	
Oral Statement .....	25
Prepared Statement .....	27

## SUBMISSIONS FOR THE RECORD

Report, <i>Taking the High Road: Strategies for a Fair EV Future</i> , submitted for the record by Ms. Castor .....	46
---------------------------------------------------------------------------------------------------------------------	----

## APPENDIX

Questions for the Record from Hon. Kathy Castor to Josh Nassar .....	52
Questions for the Record from Hon. Kathy Castor to Tarak Shah .....	52
Questions for the Record from Hon. Ben Ray Luján to Tarak Shah .....	55
Questions for the Record from Hon. Mike Levin to Tarak Shah .....	56
Questions for the Record from Hon. Kathy Castor to Edward Stones .....	56
Questions for the Record from Hon. Kathy Castor to Zoe Lipman .....	57
Questions for the Record from Hon. Mike Levin to Zoe Lipman .....	62



## **SOLVING THE CLIMATE CRISIS: MANUFACTURING JOBS FOR AMERICA'S WORKERS**

**TUESDAY, SEPTEMBER 10, 2019**

HOUSE OF REPRESENTATIVES,  
SELECT COMMITTEE ON THE CLIMATE CRISIS,  
*Washington, DC.*

The committee met, pursuant to call, at 2:06 p.m., in Room 1334, Longworth House Office Building, Hon. Kathy Castor (chairwoman of the committee) presiding.

Present: Representatives Castor, Bonamici, Brownley, Huffman, Levin, Casten, Graves, Griffith, Palmer, Carter, and Miller.

Ms. CASTOR. The committee will come to order. Without objection, the chair is authorized to declare a recess of the committee at any time.

Today, we will discuss expanding job opportunities for America's workers in clean vehicle and clean energy technology manufacturing. As we transition to a low carbon economy, we need to make sure that the tools for that transition, such as electric vehicles, energy efficient products, and wind turbines are made right here in the good old USA.

I now recognize myself for 5 minutes for an opening statement.

First of all, I would like to say welcome back to Washington, everyone. This is going to be a busy week when it comes to climate action. We have a number of votes this week on the floor of the House to ban dangerous offshore oil drilling, to protect the Arctic Refuge. I believe it is Mr. Huffman's bill that was voted on last night to clean up diesel pollution, and to boost energy efficiency.

And our committee is ramping up its work as well. We just released a public request for information, which you can find on our website at [climatecrisis.house.gov](http://climatecrisis.house.gov). The committee is soliciting scientifically based proposals to reduce carbon emissions and to build more resilient communities across America. We want to hear your ideas. We want to hear from experts and advocates so that we can help—so that you all can help build our congressional climate action plan that will be released in the coming months.

Of course, I wish Representative Carter was here, because we really were thinking about him and his coastal Georgia district as Hurricane Dorian strengthened and charted its destructive path. Hurricane Dorian is just the latest reminder of the need for solutions that reduce carbon pollution and prepare our communities for the growing dangers of the climate crisis. Our neighbors on the East Coast are recovering from Hurricane Dorian, and the climate refugees fleeing the Bahamas right now need our support.

But I hope everyone had a productive August work period. I am grateful to Congressman Neguse who hosted our first field hearing in Boulder, Colorado. I think Rep. Graves would agree it was a fascinating time, especially at the National Renewable Energy Lab, and to hear from experts from that community that are right in the heart of coming up with solutions to tackle the climate crisis. So I am grateful to Rep. Neguse.

Last month, I also got to visit Representative Casten in the Chicago area. He hosted me to talk about climate resilience and clean energy in Illinois. And then I went to Detroit and Dearborn, Michigan, to learn more about the transition to electric vehicles. I saw the latest cutting-edge technology at Ford and at General Motors, and what that means for the auto industry, for workers, and their communities. It was a fascinating trip.

And one of the things I kept hearing on these trips is that people see addressing the climate crisis as an opportunity to lead the world in new technologies and create millions of new jobs, but they also want them to be the kind of quality, family sustaining jobs that build the American middle class.

There used to be about 20 million manufacturing jobs in America. That was 1979. Today, there are only 12.4 million manufacturing jobs in the United States. So pursuing policies that create jobs while providing solutions to the climate crisis are critical. Meeting the Paris climate goals means we are going to see a \$23 trillion clean energy market emerge between now and 2030. So we have a choice: We can build on America's competitive edge in innovation, we can help America's workers tap into that market, or we could let China eat our lunch. I think we will all choose the former. That is why we are here.

When Congress passed the Recovery Act, we provided \$88.5 billion in funding to clean energy businesses. That funding supported 100,000 clean energy projects and provided hundreds of thousands of jobs for American workers. And we can do more, much more. We need millions of workers to design, build, and manufacture wind turbines, solar panels, electric cars, new mass transit, energy efficient projects, and new industrial facilities.

But last month, we actually saw the manufacturing sector contract for the first time since 2009. But when we have a President who denies climate change, who thinks that wind turbines cause cancer, and who undermines consumers and businesses by undoing energy saving rules for cars and light bulbs, America is missing out on a huge economic opportunity. And we can't stand for that.

We need to pass long-term policies that support manufacturing in America. Clean energy technology should move from American labs to American production facilities to the enormous global market that will be willing to pay top dollar for innovative solutions to the climate crisis. I believe we can do this. I know we can do this. We must do this.

I look forward to hearing from our witnesses on how we can make a prosperous clean energy future a reality for American workers. Thank you.

And I yield 5 minutes to the ranking member.

[The statement of Ms. Castor follows:]

**Opening Statement (As Prepared for Delivery)****Rep. Kathy Castor (D-FL), Chair****U.S. House Select Committee on the Climate Crisis****Solving the Climate Crisis: Manufacturing Jobs for America's Workers****September 10, 2019**

I'm glad to see everyone back in Washington. We have a number of climate action votes on the House floor this week to ban dangerous offshore drilling, protect the Arctic Refuge, clean up diesel pollution, and boost energy efficiency.

Our committee is also ramping up its work. We just released a public request for information, which you can find on our website—[climatecrisis.house.gov](http://climatecrisis.house.gov). We want to hear your ideas and your recommendations for our Congressional climate action plan.

Hurricane Dorian is just the latest reminder of the need for solutions that reduce carbon pollution and prepare our communities for the growing dangers of the climate crisis. Our neighbors on the East Coast recovering from Hurricane Dorian and the climate refugees fleeing the Bahamas right now need our support.

I hope everyone had productive visits back to their districts. Last month, I also got to visit some of our colleagues in their districts. Representative Casten hosted me to talk about climate resilience and clean energy in Illinois. And I also went to Detroit to learn more about what the transition to electric vehicles means for the auto industry, workers and their communities.

One thing I kept hearing on these trips is that people see addressing the climate crisis as an opportunity to lead the world in new technologies and create millions of new jobs. But they also want them to be the kind of quality, family-sustaining jobs that built the American middle class.

There used to be about 20 million manufacturing jobs in America. That was in 1979. Today, there are only 12.4 million manufacturing jobs in the United States. Pursuing policies that create jobs while providing solutions to the climate crisis will be critical.

Meeting the Paris climate goals means we're going to see a \$23 trillion-dollar clean energy market emerge between now and 2030. So we have a choice. We can build on America's competitive edge in innovation. We can help American workers tap into that market. Or we can let China eat our lunch.

When Congress passed the Recovery Act, we provided \$88.5 billion in funding to clean energy businesses. That funding supported 100,000 clean energy projects and provided hundreds of thousands of jobs for American workers.

We can do more—much more. We need millions of workers to design, build, and manufacture wind turbines, solar panels, electric cars, new mass transit, energy efficient products, and state-of-the-art industrial facilities.

But last month we actually saw the manufacturing sector contract for the first time since 2009. When we have a president who denies climate change, who thinks that wind turbines cause cancer, and who undermines consumers and businesses by undoing energy saving rules for cars and light bulbs, America is missing out on a huge economic opportunity.

We need to pass long-term policies that support manufacturing in America. Clean energy technology should move from American labs to American production facilities to the enormous global market that will pay top dollar for innovative solutions to the climate crisis.

I believe we can do this. And I believe we must do this. I look forward to hearing from our witnesses on how we can make a prosperous clean energy future a reality for American workers.

Mr. GRAVES. Thank you, Madam Chair. And I also want to thank Mr. Neguse and those of you that had the opportunity to come to Colorado. The National Renewable Energy Lab was fascinating. It was. I could stay there for days, I think, and meet with those folks. It really was an impressive trip. And, of course, the other facilities, the UCAR facility, the ESRL facility and others in Colorado were all great, the ones that I had the chance to attend, but I did have to miss a few. But thanks again for hosting that hearing over there.

So today, we are talking about manufacturing jobs and the concept here is that if you create a new sector, if you create a new industry, that perhaps you have hundreds of thousands or millions of jobs in economic activity that go along with it. But as I said in the Boulder hearing, we have got to get it right, but we have got to get it right. And part of that getting it right is being very thoughtful about the policies that we are carrying out to ensure that the policies are truly benefiting the United States.

Now, the chair brought up some of the bills that are on the floor this week. And this is a perfect example of where policies are not thought out, that are actually going to undermine the very intent of the objectives they are purported to advance. And I will talk about this all day long, and my friend, Mr. Huffman, I will—I will have a discussion with you or anybody else about this.

So, for example, this week, we are pushing legislation affecting Alaska, the Gulf of Mexico, and the Atlantic that prevent energy production in the United States. When this was attempted previously, when policies were pushed to stop energy production, what happened was that we simply—we didn't stop using oil and gas; we just imported more from other countries. And so what it did is it created jobs in other countries. It caused us to export dollars and, effectively, jobs to other countries.

And so while I do share the chair's optimism and objectives to ensure that we provide clean energy solutions for Americans, I think we also have to be very thoughtful about the policies. California stopped trying to count the green jobs—article in Politico just recently—they stopped trying to count green jobs that were being created. In fact, the article goes through and undermines some of the Presidential candidates' assertion on job numbers, because they were unable to tease out or determine which jobs were created as a result of this green economy versus jobs that were otherwise created.

Much of the energy technologies that we have developed right here in our energy labs in the United States have been pirated by other countries, especially China, taking, stealing our intellectual property, then turning around and selling it to us, undermining the very innovators that came up with these ideas, these concepts, and in many cases, shuddering these domestic businesses.

For example, Tesla recently announced that they are opening up a manufacturing facility in China as opposed to manufacturing vehicles only in the United States, giving us the chance to export vehicles to China. In Mr. Stones' testimony, he talks about how, in 1997, we actually had a \$19 billion trade surplus in the chemical sector that ended up flipping because of, I assume, policies that were not properly thought out, resulted in the loss of 200,000 jobs in the United States.

And so many cases, efforts that are attempting to create jobs, result in the complete opposite. And, in fact, even in the committee memo briefing us for this hearing, it talks about the fact that converting or transitioning to electrical vehicles results in mining in China, which, of course, isn't good for the environment. I believe there was a study that was recently done that found that for every 1 pound of battery, you have 50 to 100 pounds of mining activities.

And so we need to be very thoughtful and ensure that the policies that we are advancing are creating jobs, not just anywhere, but right here in the United States, making sure that we are advancing efforts to improve our environment, helping to reduce greenhouse gas emissions, helping to ensure the competitiveness of the U.S. economy, helping to ensure competitive energy prices, and ensuring that we are not simply creating jobs in other countries as opposed to in the United States. And that, I think that there are many, many examples we could cite, including the one cited in Mr. Stones' testimony, that indicate that we could be making the wrong decisions in some cases.

So with that, Madam Chair, looking forward to witness testimony. I do want to make note that we have an aviation briefing on NextGen that was scheduled weeks ago that I do need to head over to, but I am going to try and participate in as much as I can here.

Thank you. I yield back.

Ms. CASTOR. Thank you.

Without objection, members who wish to enter opening statements into the record may have 5 business days to do so.

**Submission for the Record**

**Representative Ben Ray Luján**

**Select Committee on the Climate Crisis**

**September 10, 2019**

The manufacturing sector is the lifeblood of the American economy—responsible for nearly 13 million American jobs. These represent good-paying jobs and economic growth that directly benefit working Americans. Consider that for every \$1.00 we spend on manufacturing, \$1.82 is added to the economy. Clearly, this is an industry that must be healthy for the economy to grow.

Still, according to the EPA, the manufacturing sector is responsible for approximately a quarter of the nation's greenhouse gas emissions. This means that when Congress looks at addressing the climate crisis, Congress must look at how the manufacturing sector can innovate and evolve to reduce greenhouse gas emissions while maintaining competitiveness.

Unfortunately, since the most recent recession, we have not seen manufacturing jobs bounce back as happened after previous economic downturns. And this slow recovery has only been made worse by this administration's disastrous trade policy. Congress must do more to ensure our manufacturing sector is resilient.

Fortunately, there is a solution that is both green and supports working Americans. Within in the work of this Committee, we have a great opportunity to revive our manufacturing industry through sustainability.

Countries all over the world are looking at how they can address the climate crisis, and when it comes to manufacturing, they are going to need the right technologies. To meet this rising demand for sustainable industry, we must step up as a Country and do what we do best—innovate. And that leads to the creation of good, homegrown American jobs that support a sustainable manufacturing industry.

I appreciate the leadership of my colleague Representative Casten, who is leading the bipartisan, bicameral Clean Industrial Technology Act of 2019 which aims to do just that.

And with that, at this time I would like to welcome our witnesses.

First, Josh Nassar, is the legislative director for the United Auto-workers and is responsible for implementing the union's policy agenda and legislative strategy. Previously, Mr. Nassar was the assistant legislative director for the Service Employees International Union.

Tarak Shah is an energy policy consultant who has worked on Federal clean energy and climate policy. From 2014 to 2017, Mr. Shah served as the chief of staff and senior adviser to the Under Secretary for Science and Energy at the U.S. Department of Energy. Prior to his time at DOE, he served as special assistant to the Assistant Secretary of Defense for Operational Energy Plans and Programs at the United States Department of Defense.

Edward Stones is the global business director, Energy and Climate Change, for the Dow Chemical Company, and leads Dow's energy conservation and greenhouse gas reduction efforts. Since 1997, Mr. Stones has held several roles in manufacturing, finance, business development, and investor relations.

And Zoe Lipman directs the Vehicles and Advanced Transportation Program for the BlueGreen Alliance. Prior to joining BGA, Ms. Lipman led the National Wildlife Federation's program on fuel economy and electric vehicles.

Welcome.

Without objection, the witnesses' written statements will be made part of the record.

With that, Mr. Nassar, you are now recognized to give a 5-minute presentation of your testimony.

**STATEMENTS OF JOSH NASSAR, LEGISLATIVE DIRECTOR, UNITED AUTO WORKERS; TARAK SHAH, FORMER CHIEF OF STAFF, UNDER SECRETARY FOR SCIENCE AND ENERGY, U.S. DEPARTMENT OF ENERGY; EDWARD STONES, GLOBAL BUSINESS DIRECTOR, ENERGY AND CLIMATE CHANGE, DOW; AND ZOE LIPMAN, DIRECTOR, VEHICLES AND ADVANCED TRANSPORTATION PROGRAM, BLUEGREEN ALLIANCE**

**STATEMENT OF JOSH NASSAR**

Mr. NASSAR. Thank you very much, Chairwoman Castor, Ranking Member Graves, and members of the select committee for this opportunity. I am proud here to speak on behalf of the 1 million members and retirees of the UAW.

There is no membership organization that cares and has more direct consequences from the decisions made here in the auto industry than our members. So these issues are extremely important to us.

I first want to talk about the quality of auto jobs that we see right now. We are proud of the fact and our members are proud of the fact that we really help establish manufacturing jobs that can be middle-class jobs, and countless families are able to retire in dignity, you know, and earn a good living through manufacturing for many decades. Unfortunately, that is less and less the case today.

We have seen over the past 15 years adjusted for inflation that actually wages have dropped by more than 20 percent for both auto assembly and for parts. Twenty percent—over 20 percent. So, for us, when we are looking at what is going on, we first have to acknowledge that we have a lot of work to do with the auto jobs that exist right now, and I think, you know, there are many reasons for that.

I think, you know, many of these reasons are not directly related to this committee, but I would say they include trade policies that really, you know, reward offshoring of jobs, same with tax policies and such, and also antilabor policies. We really have weak labor laws, and our labor laws need to be strengthened. So those are some of the factors.

So what are we going to do here and how is this relevant to this work of this select committee? So I think, first of all, we have to get ahead of the curve, and the reality is, is that the entire globe is going towards more efficient vehicles, and we have to stay competitive within that race.

I think for us, we look at the, you know, the proposal that is put forward, the preferred alternative by the administration on CAFE GHG standards, and we think that is a step backwards. We urge the administration to not move forward with the preferred alternative because we really think that standards have a role to play because they really encourage investment and they also keep the industry moving ahead. And what we can see is that many, many jobs have actually been created because of this.

So, for us, I mean, there are a few other things. One is that the transition to EVs is important. It is going to take time. Right now, EVs and plug-ins are 2 percent of the market right now. So we have a chance to do this in a thoughtful way, and the reality is that there are going to be lost jobs from this transition, because the traditional engine, you know, requires quite a bit of work and a fair amount of jobs will be lost.

So what are we going to do to make sure that the jobs for the batteries and all the new technologies are made in the U.S.? Right now, we are not doing a whole lot to make sure that is the case. And according to experts, it is supposed to be that more and more of the production is going to go to China over the next few years, and projections are that only roughly 14 percent within a few years will be manufactured in the United States. It is a very small percentage.

We have also seen some investments by auto companies in next generation vehicles, but there has also been offshoring of them. There have been announcements of moving EV production from—you know, from General Motors and other manufacturers. So that is a problem.

The reality is that we can't have a situation anymore where we are just relying on the corporate sector to invest in America and ensure that those new jobs are made here. We are going to need proactive policy. We are going to need trade policies that really look to, you know, enhance those technologies. We are also going to need to move our, you know, environmental policy forward, and we really have to make sure that there are conditions where, if companies are getting tax breaks for, let's say, electric vehicles, we want to make sure those are good jobs and they are jobs that are right here in the United States.

So there is a lot of work to do. We look forward to working with this committee. And because this is a race that we can't afford to lose, I think it is very important that we focus on solutions today.

And I really appreciate this opportunity. Thank you very much. Look forward to answering your questions.

[The statement of Mr. Nassar follows:]

**Testimony of Josh Nassar  
Legislative Director, UAW**

**Before the U.S. House of Representatives, Select Committee on the Climate  
Crisis**

**Solving the Climate Crisis: Manufacturing Jobs for America's Workers**

**September 10, 2019**

Madam Chair Castor, Ranking Member Graves and members of the Select Committee on the Climate Crisis, today I will testify on behalf of the one million active and retired members of the International Union, United Automobile, Aerospace, and Agricultural Implement Workers (UAW). Thank you for the opportunity to share our views on this important topic. It is an honor to speak before this distinguished committee.

Today, I will focus on the automotive sector and its impact on workers, the environment, and our economy at large.

THE STATE OF U.S. AUTO MANUFACTURING

No other membership organization in the United States is more directly impacted by the health and stability of the domestic auto manufacturing industry than UAW members and retirees. The majority of our members and retirees work in or have retired from the auto industry. Changes in the industry and proposals to combat climate change have real life consequences for manufacturing workers, retirees, and their families.

The United States' motor vehicle industry is the cornerstone of American manufacturing jobs. Nearly one million people work in the auto and auto-parts manufacturing sectors.<sup>1</sup> Of course, the economic impact of the auto industry reaches far beyond the workers employed at the plants and their families. The domestic vehicle assembly and parts industries are vital to our manufacturing base and it is imperative that we stay strong and competitive now and into the future. When jobs from other linked industries are included, the auto industry is responsible for over seven million jobs nationwide.<sup>2</sup> The long-term health of the industry is critically important to both workers and the economy at large.

EMPLOYMENT STANDARDS IN THE U.S. AUTO INDUSTRY

UAW members are proud of their important role in creating middle class jobs that have enabled countless workers to provide for their families and retire with dignity. Unfortunately, many auto jobs are not what they used to be.

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 23 percent, while wages in the auto parts sector have declined by 22 percent.<sup>3</sup> Real wages have dropped despite remarkable increases in productivity. From 1979 to 2018, net worker productivity rose 69.6 percent, while the hourly pay of typical workers increased by a mere only 11.6 percent over 39 years (after adjusting for inflation).<sup>4</sup> To make matters worse, since 2000, the U.S. has lost of over three million manufacturing production jobs.

A holistic approach is needed to address this complex problem. Congress and the Administration must fight for workers by strengthening our labor laws. Unionized workers are more likely to have health care benefits, employer provided pension plans and safer working conditions compared to their non-union counterparts.

Congress and the Administration must enact equitable tax policies that uplift working families and not reward CEO's with massive tax breaks while incentivizing business to outsource jobs overseas.

<sup>1</sup>Bureau of Labor Statistics, "Automotive Industry: Employment, Earnings, and Hours," <https://www.bls.gov/iag/tgs/iagauto.htm>.

<sup>2</sup>Hill, Kim, Deb Menk, Joshua Cregger, and Michael Schultz. "Contribution of the Automotive Industry to the Economies of All Fifty States and the United States." Center for Automotive Research. January 2015.

<sup>3</sup>Bureau of Labor Statistics. "Average hourly earnings of production and supervisory employees." Series CEU3133610008 & CEU3133630008, Data from April 2004–April 2019. Adjusted using BLS CPI Inflation Calculator.

<sup>4</sup>Economic Policy Institute. "The Productivity-Pay Gap." July 2019. <https://www.epi.org/productivity-pay-gap/>.

Congress and the Administration need to put in place a strong industrial policy focused on education, workforce training, research and development, support for advanced manufacturing and technologies, building a 21st century infrastructure, balancing environmental and energy policy.

Of course, low wages and the lack of job security in U.S. manufacturing is far from the only serious challenge facing working people.

#### TACKLING OUR CLIMATE CRISIS

The climate crisis is real and growing. Failing to take concrete steps to address it puts us on an unsustainable course. It not only creates risks for our national security and our planet, but it is also a direct threat to our jobs, and an even bigger threat to the jobs and quality of life enjoyed by our children and grandchildren in the future.

There is no credible scientific debate on the connection between fossil fuel consumption, rising carbon dioxide levels in the earth's atmosphere, and climate change. The impact is happening in real time as the number and strength of extreme weather and climate events such as heat waves and droughts have increased over the last several decades. UAW members and retirees throughout the continental United States and Puerto Rico have suffered from extreme weather events in recent years.

The problems created by climate change are grave and include increased risk of extinction for many species, risks to fisheries and crops, reduced access to fresh water, and more extreme storms that destroy homes and threaten to devastate coastal cities.

Protecting the environment is not inherently bad for the economy and solutions exist all around us. UAW members have proven that well-crafted regulations and policies can benefit both American workers and our environment.

Last decade UAW members reached a hard-fought consensus among a wide variety of stakeholders to significantly reduce passenger vehicle emissions and raise the Corporate Average Fuel Economy (CAFE) for passenger vehicles sold in the United States. This standard demonstrated that well-constructed regulations and policies can promote investment in advanced technology, create new jobs, and make our cars more attractive in foreign markets while allowing manufacturers the flexibility they need. Fuel efficiency is improving across the industry, including many vehicles and components made by UAW members.

Standards have played an important role in incentivizing the development of more energy efficient vehicles. It is not clear to what extent they will in the future. The Administration's preferred alternative would drastically roll back fuel efficiency standards. Rolling back emissions standards risks allowing the U.S. auto industry to fall behind on advanced vehicle technology and sustainable innovation, just as other nations are promoting increased efficiency and lower emissions. It could also lead to years of litigation and uncertainty. This would not be a good outcome for workers, the economy, or the environment.

We urge the Administration to not adopt the preferred alternative.

#### THE FUTURE OF EVS

A strong, forward looking industrial policy is needed to promote the manufacturing of EVs in the United States. Again, our trade, tax, labor, and environmental policies must work in tandem to promote the manufacturing of EVs in the United States. We can promote high quality manufacturing jobs that make vehicles of the future in the U.S. in a myriad of ways, such as: advancing trade policies that strengthen U.S. manufacturing, investing in clean energy infrastructure, supporting worker training, and advancing pro-worker policies that enable workers' to collectively bargain free of employer intimidation.<sup>5</sup>

EVs are currently only one percent of the U.S. market but are projected to rise to 10 percent of the market in the mid-2020's and over 50 percent by 2040.<sup>6</sup> EVs will increase their market share, it is just a matter of how quickly. This change will not come without serious challenges.

The shift to EVs involves a fundamental change in the components that power the vehicle. We could see changes in where the most valuable auto components are made, decreased employment in powertrain manufacturing, and the entrance of corporate actors without a manufacturing base.

<sup>5</sup>UAW Research. "Taking the High Road: Strategies for a Fair EV Future." August 2018. <https://uaw.org/wp-content/uploads/2019/07/EV-White-Paper-Spring-2019.pdf>.

<sup>6</sup><https://about.bnef.com/electric-vehicle-outlook/>.

If the EV manufacturing footprint takes root outside the US, it will be extremely difficult for the U.S. to recapture that work in the future. The capital intensity and long manufacturing lead times in auto, makes the possibility of reshoring the EV market once it has left, all the less likely.

As consumer demand grows and technologies evolve, it is essential that we are building EVs in the United States. This opportunity will be lost if EV components are imported or made by low road suppliers who underpay workers. We must have an industrial policy that fosters the creation of high-quality manufacturing jobs making EVs and their components.

Most of the production footprint for tomorrow's advanced automotive technology is being developed overseas. It is projected that by 2021, 56 percent of the battery manufacturing capacity will be in China and another 19 percent will be in Europe. The U.S. will only have 14 percent of global battery production capacity. The U.S. is currently falling behind its Asian and European counterparts.

EVs and Plug-in Hybrid Vehicles made up approximately 2 percent of US passenger vehicle sales in 2018.<sup>7</sup> Given that production volumes are still relatively small, automakers are in the process of developing their EV strategies. Policy incentives at this early stage could influence where and under what conditions the cars are made.

Some automakers have made commitments to build EVs on U.S. soil, illustrating we could expand the number of America workers in high quality jobs building the cars that will help meet our climate goals.

For example:

- Ford's plans to make EVs in Flat Rock, MI<sup>8</sup>
- GM's plans to build a new EV in Orion Township, MI<sup>9</sup>
- Fiat Chrysler will build a Jeep Wrangler PHEV in Toledo, OH<sup>10</sup>

At the same time, some production has moved overseas.

For example:

- GM ended production of the Chevy Volt plug-in hybrid in February 2019. The Chevy Volt was made at GM's Detroit-Hamtramck plant, which GM has declared "unallocated."<sup>11</sup>
- Ford ended production of the C-Max Energi plug-in hybrid and the Ford Focus Electric EV in 2018. The C-Max was produced at Michigan Assembly in Wayne, MI. Michigan Assembly now makes the Ford Ranger mid-sized pickup.

Ford will begin production of EV SUV in Cuautitlan, Mexico starting in 2020.<sup>12</sup> As consumer demand grows and technologies evolve, it is essential that we are building EVs in the United States. This opportunity will be lost if EV components are imported or made by low road suppliers who underpay workers.

Countries around the globe continue to promote greater efficiency and lower emissions. The greener vehicles of the future are going to be made somewhere and other countries are preparing for these new technologies. We could see the U.S. auto industry fall behind on advanced technology, hurting the American economy and American workers.

The global market is moving towards ever more efficient vehicles, including hybrids and electric vehicles. It has been projected that by 2040, over 50 percent of new car sales globally will be electric and over 30 percent of cars on the road will be powered by batteries.<sup>13</sup> Yet, where will the batteries that power these vehicles be made? As it stands today, most of the production footprint of tomorrow's advance automotive technology will be overseas.

In addition, the demand for raw materials such as cobalt and lithium to make EV batteries often come at troubling cost. 60 percent of the world's cobalt is mined in the Democratic Republic of Congo (DRC), where child labor and other labor abuses are prevalent, and injury and death are common.<sup>14</sup> Congress should not ig-

<sup>7</sup> <http://www.ev-volumes.com/country/usa/>.

<sup>8</sup> <https://media.ford.com/content/fordmedia/fna/us/en/news/2019/03/20/ford-adds-2nd-north-american-site-to-build-battery-electrics.html>.

<sup>9</sup> <https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2019/mar/0322-orion.html>.

<sup>10</sup> <https://www.toledoblade.com/business/automotive/2018/12/01/jeep-wrangler-hybrid-coming-quietly-to-a-woods-near-you/stories/20181130116><https://media.vw.com/releases/1117>.

<sup>11</sup> <https://www.cbsnews.com/news/chevy-volt-discontinued-chevrolets-last-volt-rolls-off-the-assembly-line/>.

<sup>12</sup> <https://www.autonews.com/article/20180508/BLOG06/180509813/a-final-goodbye-to-the-ford-focus-c-max>.

<sup>13</sup> <https://about.bnef.com/electric-vehicle-outlook/>.

<sup>14</sup> UAW Research. (August 2018) "Taking the High Road: Strategies for A Fair EV Future." <https://uaw.org/wp-content/uploads/2019/07/EV-White-Paper-Spring-2019.pdf>.

nore this part of the supply chain. Congress should take measures to hold companies accountable that exploit workers throughout the entire supply chain.

EVs and autonomous vehicles (AVs) of the future will be heavily reliant on semiconductors. It is estimated that an EV/AV 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 today,<sup>15</sup> while the industry employs 100,000 fewer production workers than it did at the turn of the century.<sup>16</sup> Currently, U.S. manufacturers account for only 13 percent of the global semiconductor supply. This is because the U.S. is no longer attracting new fabrication plants. In 2011, of 27 high-volume fabrications plants built worldwide, only one was in the U.S.; 18 were in China and 4 in Taiwan. In 2018, 20 new fabrication projects had been announced in China, with total investment exceeding \$10 billion.<sup>17</sup>

#### NEXT STEPS

Federal policy must strongly incentivize investment in and production of advanced technology components and vehicles in the U.S. If the U.S. falls behind on this front, it will erode our competitive advantages in manufacturing and research. We all have an obligation to not cede the jobs and technology of the future to other countries.

The U.S. is in a race with other advanced countries to develop the automobiles and technologies of the future. While Germany and other industrialized countries have developed policies that are investing in its citizenry and infrastructure, the U.S. has instead taken a low-road approach. Corporations may develop new products in the U.S., but they have increasingly outsourced manufacturing to low-cost countries. Maintaining the status quo is not an option.

Special attention must be paid to key components that are important for the U.S. to remain relevant in vehicle parts manufacturing.

Safeguards should be put in place to ensure domestic production of strategic parts. Technologies that have been developed, primarily thanks to American R&D (for example, AVs) and regulatory requirements (emissions and fuel efficiency standards), should be manufactured in the U.S. Protecting strategic parts will help ensure U.S. manufacturers will remain industry leaders, and that all American workers will share in that prosperity.

#### CONCLUSION

American workers have a proud history of building the equipment and technologies that have made the U.S. a global leader.

As we confront the climate crisis, we urge Congress to support policies that invest in U.S. manufacturing and promote U.S. leadership in advanced auto technology. Our policies to fight climate change must promote investment in building diverse fleets of vehicles on U.S. soil with high quality jobs that contribute to stronger communities for generations to come.

We stand ready to work with you and all other stakeholders on crafting policies that are good for working people, environment, and national economy.

I look forward to answering your questions.

Ms. CASTOR. Thank you very much.

Mr. Shah, you are recognized for 5 minutes.

#### STATEMENT OF TARAK SHAH

Mr. SHAH. Thank you.

Good afternoon, Chair Castor, Ranking Member Graves, and members of the committee. It is an honor to be here.

My name is Tarak Shah, and I currently work as an independent consultant to organizations that are advancing clean energy technology and policy. For most of this decade, I worked on energy policy in the Federal Government, including as chief of staff to the

<sup>15</sup> MFOresight, "Manufacturing Prosperity: A Bold Strategy for National Wealth and Security", June 2018: <http://mforesight.org/download/7817/>.

<sup>16</sup> BLS, Quarterly Census of Employment and Wages (QCEW) for NAICS 334413, <http://www.bls.gov/cew/>.

<sup>17</sup> MFOresight, "Manufacturing Prosperity: A Bold Strategy for National Wealth and Security", June 2018: <http://mforesight.org/download/7817/>.

Under Secretary for Science and Energy at the Department of Energy from 2014 to 2017, also at the Defense Department on energy policy, and recently as an adviser to the International Energy Agency.

From those experiences, I have come to believe that the Federal Government can and should be doing more to stimulate clean energy manufacturing. Today, I would like to share with you why and how.

We know that the climate crisis requires that we completely transform the ways we use and produce energy and at a scale and pace we have never before accomplished. And one of the principal ways we will do this will be with better products, like solar panels, wind turbines, energy efficient appliances, carbon capture technologies, advanced nuclear and low carbon chemicals, steel, and cement. Added up, the world will invest nearly \$60 trillion over the next 20 years in the energy industry. All of those products are going to be manufactured somewhere, and with the right policies, that somewhere could be the United States.

In many ways, we are already well positioned. We have a national consensus that innovation is important. Our U.S. Government is the largest Federal supporter of energy R&D in the world, and our innovation system is world leading, starting international laboratories and universities and all the way to the companies and financial institutions that are deploying clean energy.

Many of the programs in the U.S. are implemented through the Department of Energy, and these include efforts like the Manufacturing USA Institutes which fund public/private teams that reduce the cost of making next-gen clean energy technologies. Other programs fund industry directly to take on clean tech challenges, like how to manufacture better semiconductors or denser batteries, but these programs barely scratch the surface of what is needed.

For example, DOE's Advanced Manufacturing Office, which funds these Manufacturing USA Institutes, along with hundreds of other clean energy manufacturing efforts, received less than 1 percent of DOE's overall funding last year. So we need to improve and better fund the tools that we have, but we also need to invent some new ones.

We can take steps in three areas, research and development, deployment, and workforce development, to do so. In the area of R&D, Congress should immediately double clean energy R&D funding across the board, including for clean energy manufacturing R&D. From my time at DOE, I know that the scientists and engineers both at headquarters and in the national laboratories are the world's leading energy technologists, and given the opportunities to support more innovative U.S. businesses, they can and will do so.

In addition, our industrial sector is probably the hardest to decarbonize. Congress should authorize DOE to establish a new R&D effort to investigate the full range of decarbonization efforts for the industrial sector, including electrification, low carbon fuels, and carbon capture utilization and sequestration. The Clean Industrial Technology Act of 2019 which Representative Casten has introduced would do exactly that.

Second in the area of deployment, Congress should reinstitute the 48C Advanced Clean Energy Manufacturing Tax Credit. From

2009 to 2017, this investment tax credit expanded domestic clean energy manufacturing nationwide and created tens of thousands of jobs at the same time.

Next, DOE already requires awardees to commit to manufacturing technologies developed with DOE funding domestically, but these requirements are toothless and still allow U.S. taxpayer funded clean energy R&D to be manufactured offshore. Congress should close this loophole and give DOE the authority to enforce these commitments.

Congress can also allow DOE's Loan Programs Office to invest in efficient heavy-duty truck and bus manufacturing.

Finally, a competitive growing manufacturing sector needs a talented workforce of engineers and technicians. Congress should authorize and fund new workforce development programs that teach skills in topics like clean energy manufacturing, robotics, artificial intelligence, and green construction.

These recommendations and more are in my written testimony and also in a forthcoming report that I have authored along with the staff at the Natural Resources Defense Council.

This is about climate change, but it is also about gaining millions of new jobs for higher living standards and new economic opportunities. Now is the time for Congress to give the Federal agencies the tools to catalyze our private sector into winning this global race.

Thank you very much, and I look forward to answering your questions.

[The statement of Mr. Shah follows:]

**Testimony of Tarak Shah**  
**Former Chief of Staff, Under Secretary for Science and Energy**  
**Before the U.S. House of Representatives, Select Committee on the Climate Crisis**  
**Solving the Climate Crisis: Manufacturing Jobs for America's Workers**  
**September 10, 2019**

Good afternoon Chair Castor, Ranking Member Graves, and members of the committee. Thank you for the opportunity to have a discussion today about how clean energy manufacturing can help address the climate crisis and create jobs in the United States.

My name is Tarak Shah. From 2014–2017, I served as Chief of Staff to the Under Secretary for Science and Energy and the U.S. Department of Energy (DOE). I now work as an independent consultant to private sector and non-government organizations that are advancing clean energy technology and policy.

INNOVATION AS THE KEY TO LONG TERM ECONOMIC GROWTH

For decades, economists have recognized that technological innovation is the principal driver of long-term growth in living standards and the broader economy.<sup>1</sup> And, according to the National Science Foundation, U.S. manufacturing firms were responsible for two thirds of the R&D conducted and paid for by companies in the U.S. in 2016.<sup>2</sup> Taken together, we know that there are critical links between manufacturing innovation and the health of our economy.

We also know that climate change is impacting us now, that if left unchecked the effects over the next century will fundamentally and negatively change the way hu-

<sup>1</sup>Moses Abramovitz, "Resource and Output Trends in the U.S. since 1870," *American Economic Review* 46, no. 2 (May 1956). <http://www.nber.org/chapters/c5650.pdf>.

<sup>2</sup>"Business Research and Development and Innovation: 2016," *National Science Foundation* (May 2019). <https://ncses.nsf.gov/pubs/nsf19318/-&>.

mans live. While it is not too late to prevent its worst potential impacts, to do so, we need to completely transform the ways we use and produce energy, and at a scale and pace never before accomplished.

Unfortunately, there is no silver bullet to ending the climate crisis. Instead, we must take steps to eliminate greenhouse gas pollution from multiple sectors at once—steps like increasing energy efficiency and zero-emitting power generation at record pace, electrifying buildings and transportation systems in order to replace fossil fuel use, transitioning industrial processes to be carbon neutral, and capturing already-emitted carbon from the atmosphere.

There are two principle ways we can achieve this transformation—first, by enacting a comprehensive set of new policies to curb pollution and deploy clean energy technologies and second, by simultaneously developing new energy technologies. Today, I will describe strategies that cut greenhouse gas emissions, while also creating millions of new jobs and better economic opportunities for Americans as well.

To share the bottom line up front, Congress has the ability to significantly alter our nation’s future by stimulating more domestic clean energy manufacturing.

#### WINNING THE GLOBAL CLEAN ENERGY RACE

Congress can make a large impact on our clean energy economy because new Federal investments and policy changes can help U.S. workers access the huge global opportunity associated with addressing climate change. The International Energy Agency estimates that nearly \$60 trillion will be invested in global energy markets over the next 20 years.<sup>3</sup> Given the enormous size of this economic opportunity, countries around the world will be competing for shares of this market, using all the tools they can bring to bear.

Much of the opportunity in this space lies in manufacturing—both in building tomorrow’s energy technologies like solar, wind, batteries, efficient appliances and carbon capture technologies and in reducing the energy demand and GHG emissions associated with everything we manufacture, particularly in energy intensive industries like petroleum refining, chemicals, iron and steel, and cement.

For many of these technologies, the U.S. has led the globe on their research and development. But without care, we risk seeing the benefits of taxpayer funded technology investments being reaped by other countries.

For example, solar photovoltaics (PV) were invented by American industry and nurtured for decades in government labs. However, about a decade ago, just as the price of the technology began to make it competitive with other forms of power generation, Chinese companies, with substantial assistance from their government, stepped in to become the world’s low-cost manufacturer.<sup>4</sup>

Today, over 60% of the world’s solar panels are manufactured in China.<sup>5</sup> In fact, China has now developed an entirely domestic solar manufacturing supply chain—from polysilicon to finished modules. The jobs associated with mining, making solar cells, module assembly, even manufacturing the equipment that makes solar panels are all now primarily based in China. In addition, that expertise is now spilling over into other high-value industries like semiconductor manufacturing. As those industries dramatically expand over the coming years, China will continue to benefit.

There are effective steps we can take now to prevent the same from happening to the next generation of low and zero carbon technologies.

#### KEY TECHNOLOGY FOCUS AREAS

Opportunities to innovate and hold manufacturing preeminence exist for technologies across the clean energy spectrum, and I will briefly mention several.

First, with solar energy, the U.S. should continue to compete. Total domestic PV capacity is expected to double over the next five years.<sup>6</sup> Capturing even some of the manufacturing associated with that increase would represent a significant economic opportunity. In addition, the U.S. leads on developing new solar technologies including multi-junction cells and perovskites, and as they commercialize, we should build them here, which will correspond with high-quality jobs for Americans.

Offshore wind is huge untapped opportunity in the U.S. Driven by state-level policy commitments, particularly in the Northeast, the market is expected to grow from

<sup>3</sup>“World Energy Outlook 2018,” *International Energy Agency* (November 2018). <https://www.iea.org/weo/>.

<sup>4</sup>Varun Sivaram, “Unlocking Clean Energy,” *Issues in Science and Technology* (Winter 2017). <https://issues.org/unlocking-clean-energy/>.

<sup>5</sup>“Renewables 2017,” *International Energy Agency* (October 2017). <https://www.iea.org/publications/renewables2017/>.

<sup>6</sup>“Solar Market Insight Report—Q2 2019,” *Solar Energy Industries Association* (June 2019). <https://www.seia.org/research-resources/solar-market-insight-report-2019-q2>.

5 turbines deployed today, to at least one thousand by 2030, which represents enough capacity to power roughly 5 million homes.<sup>7</sup> Despite this, there are no U.S.-flagged installation vessels or any domestic manufacturing centers yet built.

Nearly 10% or 231,000 of the 2.5 million workers in the domestic auto industry worked with electric vehicles (EV) in 2018.<sup>8</sup> But this industry is rapidly evolving. Domestic EV demand in other countries that manufacturing cars is higher than in the U.S. As companies in these countries develop robust supply chains and scale to satisfy domestic demand, they will also gain an exporting advantage.

Nearly one third of the cost of an EV is in the battery that powers the vehicle.<sup>9</sup> China already controls about 73% of the global lithium cell manufacturing capacity, while the U.S. has about 12%.<sup>10</sup> China has used this early lead to become the global manufacturer for electric buses.

The key driver of U.S. wind, solar and EV deployment over the past decade has been tax policy. That policy has not been stable and has introduced long-term uncertainty for companies across the supply chain, including manufacturers. In some cases, that has led to factory closures and layoffs. Congress can stave off this uncertainty by acting now to extend credits for a variety of low carbon technologies before they expire.

In the power sector, the world needs 100 times more carbon capture capacity by 2030 than it currently has to maintain a path to prevent an increase in global average temperatures of more than 2 degrees C.<sup>11</sup> Each of these facilities require huge machines—machines that can and should be built in America, not to mention the hundreds of construction jobs and dozens of permanent jobs associated with their installations and operation. The largest carbon capture facilities in the world are in the United States, but other countries are taking concrete steps to deploy this technology. We need to act now to build a CCUS industrial base in the U.S. that exports this homegrown technology around the world.

Advanced nuclear power offers another very important zero-carbon manufacturing opportunity for the United States. The nuclear supply chain already employs nearly 5,000 Americans.<sup>12</sup> Domestic small modular reactor manufacturing could also support export markets.

Hydrogen has a wide variety of potential applications, particularly in industry. For example, hydrogen produced by renewable energy can replace metallurgical coal to dramatically reduce carbon pollution emitted during steel making, providing a competitive advantage for U.S. steel industry jobs, including in steel-making regions like Representative Palmer's district. Renewable hydrogen could also act as a form of low carbon energy storage, be used to replace fossil fuels in industrial heating processes, and be converted to green fertilizers.

The U.S. has an early lead in additive manufacturing, also known as 3-D printing, thanks to early investments by the U.S. Department of Energy. As the first step in the supply chain for a variety of finished high-value energy-efficient products in the aerospace, energy, and transportation sector, it is important to continue to support development of this technology domestically.

Finally, energy efficiency products including LED bulbs, solid state power electronics, better motors, and high efficiency appliances are a source of manufacturing strength for the U.S. Manufacturing these products employed over 320,000 Americans in 2018. Many of these products are made in America and exported around the world.

All of these technologies would benefit from a long-term price signal on greenhouse gas pollution. Valuing the low/no carbon aspects of these technologies could help them better compete with existing energy resources, create spillover benefits across our economic sectors and thus spur growth in manufacturing capacity in the U.S.

<sup>7</sup>“2018 Offshore Wind Technology Market Report,” *U.S. Department of Energy* (August 2019). <https://www.energy.gov/sites/prod/files/2019/08/f65/2018%20Offshore%20Wind%20Market%20Report.pdf>.

<sup>8</sup>“2019 U.S. Energy and Employment Report,” *Energy Futures Initiative* (March 2019). <https://www.usenergyjobs.org>.

<sup>9</sup>“Electric Car Price Tag Shrinks Along With Battery Cost,” *Bloomberg New Energy Finance* (April 2019). <https://www.bloomberg.com/opinion/articles/2019-04-12/electric-vehicle-battery-shrinks-and-so-does-the-total-cost>.

<sup>10</sup>“Why China is Dominating Lithium-Ion Production,” *Forbes* (August 2019). <https://www.forbes.com/sites/rreapier/2019/08/04/why-china-is-dominating-lithium-ion-battery-production/-1e39ab423786>.

<sup>11</sup>“Tracking Clean Energy Progress,” *International Energy Agency* (June 2019). <https://www.iea.org/tecp/power/>.

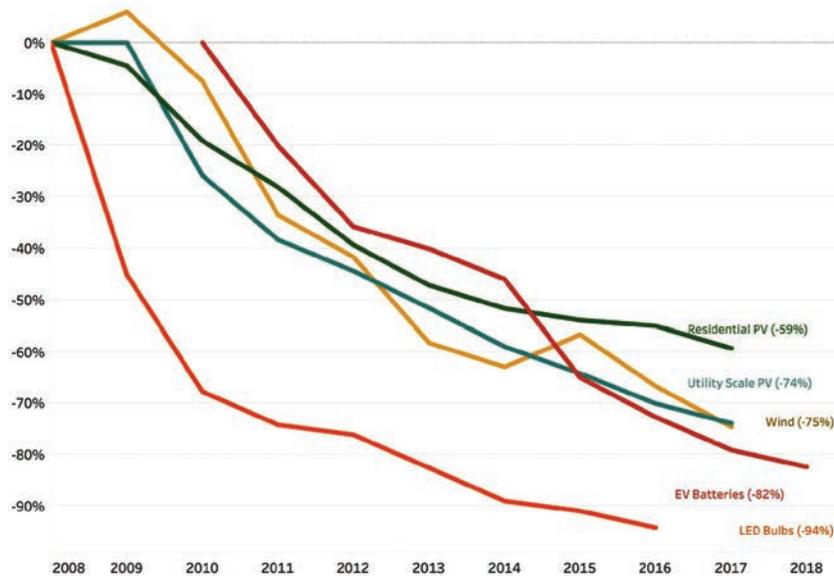
<sup>12</sup>*Ibid.* 8.

## ROLE OF THE FEDERAL GOVERNMENT

The Federal government currently supports clean energy manufacturing in two principal ways—by supporting research and development and through workforce development.

Clean energy manufacturing R&D is supported by a variety of programs at the Department of Energy and concentrated in the Advanced Manufacturing Office (AMO). Over the past few decades, several technologies fostered by DOE have left the lab and entered the market with great success. These include solar panels, wind turbines, grid-scale batteries, and LED light bulbs (see Figure 1). In each case, DOE has supported both the initial development of the technology and subsequent innovations in manufacturing these products to bring down costs.

Figure 1: Cost Reductions in Major Clean Energy Technologies



Source: Natural Resources Defense Council, Revolution Now. <https://www.nrdc.org/revolution-now>

**Key Message: Federal investments have driven down the price of clean energy over the past decade.**

DOE sponsors programs to make U.S. manufacturers more competitive vis-à-vis foreign competitors. For example, the Innovation in Manufacturing Competitiveness program in the Solar Energy Technology Office funds projects that are helping rebuild the solar module industry and supply chain in America.

AMO pursues a large variety of programs to do the same, including through the Manufacturing USA Institutes, a national network of federally sponsored manufacturing institutes, each with their own technological concentration, but designed to accelerate U.S. manufacturing as a whole. For 2019, Congress appropriated \$320 million for the Advanced Manufacturing Office, or less than 1% of DOE's overall appropriation.<sup>13</sup>

In addition, through the R&D tax credit, the Federal government rewards companies for performing research in the U.S. It was made permanent in 2015 and has provided companies over \$11B in credits annually in recent years. This tax credit generally benefits all firms, including clean energy manufacturers who perform R&D.

Government labs are also playing a role, not only in developing new technology, but in supporting energy and manufacturing innovators. Programs like Cyclotron

<sup>13</sup> "Joint Explanatory Statement of the Committee of Conference," *U.S. Congress*. September 2018. [https://docs.house.gov/billsthisweek/20180910/Joint\\_Statement.pdf](https://docs.house.gov/billsthisweek/20180910/Joint_Statement.pdf).

Road at Lawrence Berkeley National Laboratory support entrepreneurial scientists and engineers through a two-year fellowship program, giving them access to the unique expertise and world-class facilities of the laboratory. Fellows in the program work on hard science products like microelectronics, carbon nanotubes, fibers and polymers, and electrochemical storage devices. Once commercialized, these products will create innovative manufacturing jobs across the country.<sup>14</sup>

DOE also supports some workforce development programs, which are important to ensure that domestic manufacturers can access a trained pool of engineering and technical talent to meet demand from the growing clean energy market. Programs like the Solar Instructor Training Network and the Collegiate Wind Competition have been successful in training the next generation of clean energy professionals. DOE's Industrial Assessment Centers also train the next generation of collegiate engineers as they perform energy audits at small and medium sized manufacturing facilities around the country. As a result of this program, students are given valuable learning experiences while American businesses receive energy saving advice.

#### THE FEDERAL GOVERNMENT CAN DO MUCH MORE

With Congress' help, the Federal government can do much more to support clean energy manufacturing in three primary ways—focusing and strengthening its support of manufacturing R&D, deploying advanced energy manufacturing technologies, and ramping up workforce development programs. Taking these steps will not only help strengthen the competitiveness of U.S. manufacturing, but also help increase U.S. exports and support domestic job and wage growth.

Many of these recommendations and others are included in a forthcoming report I have written along with staff at the Natural Resources Defense Council. I look forward to sharing the full report with the Committee.

In the area of R&D, Congress should immediately double funding for the entire suite of federal energy innovation efforts, including advanced clean energy manufacturing. DOE programs are oversubscribed—meaning that there are many more qualified research applicants than there is funding available. Additional funding will yield faster clean energy innovation. Congress should also make manufacturing competitiveness and exports an explicit authorized goal of DOE research.

In addition, because many technology options to decarbonize the U.S. industrial sector are currently very expensive or non-existent, DOE should establish a new R&D effort to investigate the full range of decarbonization options for the industrial sector, including electrification, low-carbon fuels, and carbon capture, utilization, and sequestration (CCUS). H.R. 3978, the Clean Industrial Technology Act of 2019, which Representative Casten has introduced, would do exactly this.

In the area of deployment, Congress should reinstitute the 48C Advanced Clean Energy Manufacturing Tax Credit. That tax credit, jointly administered by DOE and the Department of the Treasury from 2009 to 2017, provided \$2.3 billion in funding through a 30% investment tax credit to hundreds of firms around the nation.<sup>15</sup> These firms used the funding to expand domestic manufacturing capacity for parts and equipment for clean energy projects.

Funding helped American manufacturers expand production for efficient HVAC systems, cleaner trucks, efficient lightbulbs, smart power electronics, electric vehicles and SUVs, wind turbines, lithium-ion batteries, and much more. These projects generated tens of thousands of jobs while making our economy cleaner and more efficient. A new program, double the size of the previous one, could help stimulate manufacturing supply ecosystems for the next generation of clean energy technologies.

Under a provision of the Bayh-Dole Act, DOE's Energy Efficiency and Renewable Energy (EERE) and Advanced Research Projects Agency-Energy (ARPA-E) programs require award applicants to submit U.S. Manufacturing Plans.<sup>16</sup> These plans state an awardee's commitment to manufacture technologies resulting from DOE awards in the United States.

Congress should ask DOE to strengthen this requirement by applying it to all applied energy RDD&D programs (not just EERE and ARPA-E) and to develop rec-

<sup>14</sup>"Cyclotron Road 2018 Impact Report," *Lawrence Berkeley National Laboratory*. (2019). <https://www.cyclotronroad.org/>.

<sup>15</sup>"48C Phase II Advanced Energy Manufacturing Tax Credit Program Fact Sheet," *U.S. Department of Energy* (December 2013). <https://www.energy.gov/downloads/48c-phase-ii-advanced-energy-manufacturing-tax-credit-program-fact-sheet>.

<sup>16</sup>"Determination of Exceptional Circumstances Under the Bayh-Dole Act for Energy Efficiency, Renewable Energy, and Advanced Energy Technologies," *U.S. Department of Energy* (September 9, 2013). [https://www.energy.gov/sites/prod/files/2014/01/f6/DEC\\_for\\_Energy\\_Efficiency\\_Renewable\\_Energy\\_%26Advanced\\_Energy.pdf](https://www.energy.gov/sites/prod/files/2014/01/f6/DEC_for_Energy_Efficiency_Renewable_Energy_%26Advanced_Energy.pdf).

ommendations for strengthening proposed manufacturing plans. Specifically, the current law gives the Federal government very few mechanisms to enforce the commitments that awardees make in their plans. These mechanisms could include clawback provisions for intellectual property or financial compensation for U.S. taxpayer sponsored technology that is manufactured offshore.

Congress can also expand the remit of DOE's Loan Programs Office's Advanced Technologies Vehicles Manufacturing program. The program provides loans to automotive or automotive component manufacturers to build or expand manufacturing facilities that produce fuel-efficient vehicles. The program has supported the production of more than four million fuel-efficient and electric vehicles, including Tesla's California factory and Nissan's Tennessee factory, which produces the Leaf.<sup>17</sup> While the program has \$17.7B in loan authority left, it is not currently allowed to invest in efficient heavy-duty truck and bus manufacturing. Congress can expand ATVM's authority with no additional scoring implications and, in doing so, support new manufacturing facilities and jobs in the U.S.

Additionally, incentives to develop regional ecosystems focused on the manufacturing of new energy technologies, like new battery chemistries, multi-junction solar cells, perovskites, and others discussed today will help grow the economy. These ecosystems are made up of strong supply chains, workforce development programs, investors, and national labs and universities (i.e. sources of innovation) and will create more jobs and make it more likely that the manufacturing of these technologies will stay in the U.S.

Stronger trade and environmental standards with effective enforcement provisions could help even the playing field for U.S. manufacturers of clean energy. Foreign firms that manufacture clean energy products while polluting the environment have a leg up on U.S. firms that are subject to stricter state and Federal laws. Cross-border adjustment mechanisms that price carbon and other pollution could help ensure that U.S. manufacturers are not disadvantaged for stewarding the planet.

U.S. manufacturers have a history of developing innovative, energy efficient products. DOE's Appliance Standards program sets and implements minimum energy performance standards for appliances and devices in our homes, businesses, and factories. These appliance standards have already saved consumers nearly \$1 trillion dollars over the past three decades.<sup>18</sup> By implementing rigorous appliance standards, innovative American firms would have an advantage over less efficient foreign products, thereby incentivizing U.S. manufacturing and creating jobs domestically.

Finally, California has recently instituted a "Buy Clean" procurement policy for steel, glass, and insulation purchased for state-funded projects. The policy considers a manufacturer's GHG emissions in state purchasing decisions, rewarding those manufacturers that have invested in pollution reduction. Congress should require the Federal agencies to adopt this policy, require that such products be made in America, and expand it to other finished goods and construction materials.

And to develop and deploy these technologies, we need a competitive, growing manufacturing sector that has the workforce, the engineering talent, and capacity to innovate in order to meet the dual challenges of producing more clean energy and reducing the use of carbon emitting fuels.

Workforce development programs that teach skills in topics like clean energy manufacturing, robotics, artificial intelligence, and green construction are lacking and required. Such training programs should be conducted in partnership with industry, to provide a clear pathway to job placement. In addition, these programs should be coordinated with other agencies, including the National Science Foundation and the Departments of Labor and Education. DOE workforce development programs also must include diversity and inclusion as a key criterion. Finally, DOE's Manufacturing USA Institutes could be tasked with workforce development for both engineers and technicians in their focus areas.

Taking these steps will help maintain our national human capital lead, which is an important factor that firms consider when choosing where to locate their facilities.

#### CONCLUDING THOUGHTS

The United States is competing in a global clean energy race, along with every other country on the planet. Whoever wins will lead the planet in addressing climate change—which is the most serious challenge of our time—while also gaining

<sup>17</sup>"Advanced Vehicles Manufacturing Projects." *U.S. Department of Energy* (June 2017). <https://www.energy.gov/lpo/advanced-technology-vehicles-manufacturing-atvm-loan-program>.

<sup>18</sup>"Saving Energy and Money with Appliance and Equipment Standards in the United States," *U.S. Department of Energy* (June 2017). [https://www.energy.gov/sites/prod/files/2017/01/f34/Appliance\\_and\\_Equipment\\_Standards\\_Fact\\_Sheet-011917\\_0.pdf](https://www.energy.gov/sites/prod/files/2017/01/f34/Appliance_and_Equipment_Standards_Fact_Sheet-011917_0.pdf).

the millions of jobs, the higher living standards, and the other economic opportunities that accompany it. Everything about our national innovation model—our world-leading academic and National lab systems, the entrepreneurial spirit of our private sector, and our national technological embrace tells me that we can win this race.

What we need now is for Congress to give the Federal agencies the tools to catalyze our private sector into taking that leading position.

Thank you very much for holding a hearing on this important topic.

Ms. CASTOR. Thank you.

Mr. Stones, you are recognized for 5 minutes.

#### STATEMENT OF EDWARD STONES

Mr. STONES. Chairwoman Castor and Ranking Member Graves and members of the committee, thank you for the opportunity to share Dow's action plan to address the impacts of climate change.

At Dow, we accept the scientific consensus that climate change caused by human activity has serious consequences and must be addressed. We believe the time is now for the U.S. Congress to establish a market-based price on carbon.

I am accountable for delivering power and steam at Dow's 14 company-owned generation facilities and at more than 100 manufacturing facilities globally. Our manufacturing facilities rely on almost 7 gigawatts of reliable and cost-effective power and steam.

Dow is one of the world's leading manufacturers of chemicals, plastics, and advanced materials, with about 15,000 of our 37,000 employees based here in the United States. We have invested billions of dollars into our U.S. operations over the last decade because we intend to continue as the country's premier material science company.

Addressing climate change is one of the greatest technical, social, and economic problems ever faced by humanity and one in which the U.S. must take a leadership role. By 2040, humanity's energy consumption is expected to increase by 28 percent over 2015. By 2050, the population is expected to grow by another 2 billion people, and power demand is going to grow by 30 to 50 percent. Despite this, the International Panel on Climate Change has called for global carbon neutrality in that time. So society is faced with a challenge of meeting increased energy demand while simultaneously eliminating net emissions.

Since the industrial revolution, economic growth has always been accompanied by increased energy usage and emissions. Although the need for action is clear, the time scale required for solutions will be decades, not years.

Dow's approach to climate change is deeply rooted in the company's ambitions and values. According to Bloomberg, we are the leading user of renewable energy in the petrochemical industry with more than 700 megawatts under contract. Our products insulate, they dampen noise and vibration enabling lighter vehicles, they enable concentrated solar facilities, we seal buildings, and we keep food clean and fresh. On average, for each unit of carbon emitted by the chemical processes in our industry, our products will save two to three units of carbon emissions over their lifetime.

Our processes are highly efficient, but are approaching a limit on what can be achieved through incremental improvements. Further substantial emission reductions will require a paradigm change supported by technology breakthroughs.

Dow is leading on that front with the announcement of a retrofit of one of our mixed-feed crackers in Louisiana with a proprietary fluidized catalytic dehydrogenation, or FCDh, technology. That will reduce our greenhouse gas emissions by roughly 20 percent versus conventional technology.

Partnership and government engagement are necessary to drive many of the technology actions that will make meaningful impacts, such as deploying CCS. We have to rely on our partners in government and industry to provide a network grid where we can store or use the carbon we capture. There is also a role for government in catalyzing the next generation nuclear technology.

Finally, governments need to ensure the playing field is level, rules don't overlap, feedstock is treated differently than fuel and not unfairly penalized, and liability is addressed. Society needs a holistic approach that is sustainable, reliable, and affordable. Many regulations focused on just one or two of these pillars—or one or two of these pillars leading to significant unintended consequences such as carbon leakage where U.S. regulations are out of sync with the rest of the world and manufacturers move operations to less stringent locations. We need broad, global policy alignment, and the United States needs to be a leader. The consequences of getting this wrong are dire for both the environment and economy.

For example, a \$19 billion U.S. chemical industry trade surplus in 1997 became a deficit from 2001 to 2007 as feedstocks and energy became economically unavailable for the industry. More than 200,000 jobs were lost in our industry and assets were shut down permanently. We cannot afford for this to happen again.

The chemical sector has seen hundreds of billions of dollars of investment over the past handful of years because of abundant and affordable energy resources. An affordable, reliable, and sustainable energy policy environment is critical for the industry to remain globally competitive.

Thank you for the opportunity to be here today. We look forward to working with members of the committee and interested stakeholders.

[The statement of Mr. Stones follows:]

**Testimony of Edward Stones  
Global Business Director for Energy and Climate Change, Dow**

**Before the U.S. House of Representatives, Select Committee on the Climate Crisis**

**Solving the Climate Crisis: Manufacturing Jobs for America's Workers**

**September 10, 2019**

INTRODUCTION

Chairwoman Castor and Ranking Member Graves, and members of the Committee, thank you for the opportunity to share Dow's perspective on actions we are taking to address climate change, and the impact these actions have on our ability to compete globally. My name is Edward Stones, and I am the Global Business Director for Energy and Climate Change within Dow's Feedstocks & Energy business. In this role I am accountable for delivering power and steam at Dow's 14 company-operated generation facilities, as well as steam, utilities, and energy services to more than 100 manufacturing facilities globally. I also have responsibility for Dow's energy conservation and greenhouse gas emission reduction efforts, and provide business guidance for the Company's global advocacy efforts in energy sustainability and climate change.

## DOW INTENDS TO REMAIN THE PREMIER MATERIAL SCIENCES COMPANY

Dow was founded in Midland, Michigan in 1897, and is one of the world's leading manufacturers of chemicals, plastics and advanced materials. We supply thousands of products to customers in approximately 160 countries, connecting chemistry and innovation with the principles of sustainability to enable everything from fresh water, food, and pharmaceuticals to insulation, paints, packaging, and personal care products. About 15,000 of Dow's 37,000 employees are based in the United States.

Dow has invested billions of dollars into its U.S. operations over the last decade because we intend to continue as the country's premier materials science company—today and well into the future. That means innovating and growing here in the U.S. while competing globally. The regulatory environment in the U.S. will frame our ability to deliver on that promise. We believe the time is now for the U.S. Congress to establish a market-based price on carbon, so the U.S. can continue to lead the world in new product development while reducing impact on the environment.

## GLOBAL SCALE OF THE CHALLENGE

Addressing climate change is one of the greatest technical, social and economic problems ever faced by humanity. Today, the earth has roughly 7 billion inhabitants, about 1 billion of whom live with limited access to energy, and another 1 billion of whom have no power in their homes or communities. Human activity causes greenhouse gas (GHG) emissions of more than 50 billion tons/year of CO<sub>2</sub> equivalents (CO<sub>2</sub>e).<sup>1</sup> Between 2010 and 2030, the world's middle class is expected to double in size, and by 2040, humanity's energy consumption is expected to increase by 28% vs. 2015.<sup>2</sup> By 2050, the population is expected to grow by another 2 billion people, and power demand will grow by 30 to 50 percent.<sup>3</sup> Despite this increase in demand, the International Panel on Climate Change has called for the globe to be carbon neutral by sometime between 2040 and 2055 so as to preserve the chance to limit temperature increases to less than 1.5 degrees Celcius.<sup>4</sup> Together, these points suggest humanity must both increase energy usage dramatically and simultaneously eliminate net emissions.

However, historical data suggest the energy economy is unlikely to evolve quickly. Since the industrial revolution, economic growth has been accompanied by increased energy usage and emissions. Global energy demand doubled from 1995 to 2015.<sup>5</sup> From the time energy sources achieved five percent of the global energy demand, it took coal fifty years to supply 40 percent of that demand, crude oil fifty years to supply 30 percent, and natural gas fifty years to supply 20 percent. Renewables do not yet supply 5 percent of the global energy demand.<sup>6</sup> Although the need for action is clear, the time scale required for solutions will be decades, not years.<sup>7</sup>

## DOW'S APPROACH TO REDUCING CARBON EMISSIONS

We accept the scientific consensus that climate change caused by increasing greenhouse gas emissions from human activity has serious consequences for the planet and society if left unaddressed. Dow's approach to climate change is deeply rooted in the Company's ambitions and values:

- Our ambition is to become the most sustainable materials science company in the world, and we strive to make a positive impact on society and the planet in everything we do.
- Protecting the planet is one of our three core values.
- Our 2025 Sustainability Goals aim to help lead the transition to a sustainable planet and society.

In 2015, Dow embarked on its third and most ambitious set of 10-year sustainability goals—the 2025 Sustainability Goals. Dow's sustainability journey has evolved from focusing on operational efficiency (footprint), to product solutions to world challenges (handprint), to recognizing that only through collaboration can we join others to accelerate the progress toward a sustainable planet (blueprint). The 2025 goals are centered around building blueprints for a sustainable planet, which are aligned to the UN Sustainable Development Goals and integrate public policy solutions, science and technology, and value chain innovation. The aim is to build

<sup>1</sup> UN Environment Emissions Gap Report, 2018.

<sup>2</sup> 2017 International Energy Outlook, US EIA.

<sup>3</sup> *Ibid.*

<sup>4</sup> The International Panel on Climate Change special report on global warming of 1.5 C (2018)

<sup>5</sup> Richard Newell and Daniel Raimi (2018)

<sup>6</sup> V. Smil, Scientific American 2014, based on IEA data

<sup>7</sup> Grateful acknowledgement is made to Jason Bordoff of Columbia University for compiling the data presented.

solutions between government, business and society that generate shared values and are long lasting, scalable, and transformative. We know there are others who share our blueprint vision, and we want to join existing conversations and convene new ones on how we as companies and organizations can accelerate sustainable practices through collaboration.

Dow's 2025 goals are designed to harness Dow's innovation strengths, global reach and the passion of our employees to expand the Company's impact around the world, driving unprecedented collaborations to develop societal blueprints that will facilitate the transition to a sustainable planet and society.

Through our 2025 Sustainability Goal on World-Leading Operations Performance, Dow is committed to driving environmental benefits for our communities and the world. Making our operations as efficient as possible is not only important for the environment, but also makes clear business sense. We continue to actively:

- Maintain our absolute GHG emissions at or below our 2006 baseline, though we will grow globally by 2025.
- Obtain 750 MW of energy from renewable resources by 2025 (Dow is already one of the largest users of renewable energy in the chemical industry).
- Offset new emissions of Priority Compounds, VOC's and NO<sub>x</sub>, though we will grow globally by 2025.

#### DOW PRODUCTS CONTRIBUTE TO REDUCING OUR CUSTOMERS' EMISSIONS

Dow materials help customers and brand owners reduce the energy demand and carbon emissions of many of their products. On average, for each unit of carbon emitted by the chemical industry's processes, the resulting products will save 2 to 3 units of carbon emission over their lifetime.<sup>8</sup>

- Polyurethane provides thermal insulation, vibration dampening, and noise abatement in building structures and transportation applications.
- Heat transfer fluids enable concentrated solar facilities, which provide clean energy to more than 500,000 homes.
- Silicone sealants for buildings reduce emissions 200 Kg CO<sub>2</sub>e per Kg of silicone.

Advanced Polyethylene enables down-gauging, reducing the packaging materials required while preserving performance.

#### RESPONDING TO THE PHYSICAL EFFECTS OF CLIMATE CHANGE

Dow is experiencing the physical effects of climate change in two areas: manufacturing sites with hurricane exposure, and through water scarcity concerns. Forty to fifty percent of our volume is produced in the U.S. Gulf Coast with high exposure to hurricanes. In those locations, we have already implemented a host of mitigating factors like improved levy systems to prevent flooding, enhanced 'greenbelt' areas to separate us from local communities, designing equipment specifically to sustain adverse weather, and water conservation programs. At the same time, there are places around the globe where water scarcity due to increased drought is a real concern. We've taken actions there—with our local communities—to improve those situations.

We factor in all of these potential risks when making decisions about existing or future asset investments. We believe the consequences for these types of events will continue to increase unless society—and government—take action.

#### THE NEED FOR NEW TECHNOLOGY DEVELOPMENT

Dow's approach to carbon emissions has transitioned beyond an initial focus on energy efficiency and meeting renewables targets to additionally developing and deploying new technologies, and ensuring a corporate wide focus on carbon reduction at our sites and with our customers.

We believe the transition to a lower carbon economy will require unprecedented cooperation between business and government. It is important that policymakers fully appreciate the technological, economic and societal challenges of such a transition. Achieving meaningful emissions reductions will require equally significant technology breakthroughs, which will take time, resources, and collaboration.

Despite continuous improvement, the high efficiencies of industry's current processes mean we are approaching a limit in the emission reduction that can be achieved through incremental improvements. Achieving further substantial carbon

<sup>8</sup>Innovations for Greenhouse Gas Reductions: A Life-Cycle Quantification of Carbon Abatement Solutions Enabled by the Chemical Industry, International Council of Chemical Associations, 2009, Amsterdam.

emission reductions will require a paradigm change supported by technology breakthroughs.

Over 96 percent of all manufactured goods are directly touched by the business of chemistry, which is why the chemical sector is the key to achieving breakthrough technology solutions to enable downstream emissions reductions. On average, for each unit of carbon emitted by the chemical industry's processes, the resulting products will save 2 to 3 units of carbon emission over their lifetime.

Dow is pursuing innovative chemical processes to deliver step changes in emissions intensity for our own operations and for others once fully commercialized, likely around 2030. The Company recently announced a retrofit of one of our mixed-feed crackers in Plaquemine, Louisiana with proprietary fluidized catalytic dehydrogenation (FCDh) technology. This technology will allow Dow to lower energy usage and associated greenhouse gas emissions by roughly 20 percent when compared to conventional propane dehydrogenation technologies, thereby improving our overall sustainability.

Most sources of process heat today rely on fired heat, and few options exist for low carbon alternatives. This makes carbon capture and storage (CCS) and next generation nuclear critical technology and policy solutions. CCS needs to be explored at sites where a destination for CO<sub>2</sub> is available as it may be the only technically available control technology today. State and federal governments have a role to play in defining and enabling the infrastructure required for collecting and moving captured CO<sub>2</sub>. Funding for approaches to utilize captured carbon beneficially (CCU) also will be helpful. Next generation nuclear facilities are an additional potential source of zero-carbon steam and power. Governments have a role to play in catalyzing the development and deployment of new nuclear technologies as well, and in expediting the permitting and construction processes.

#### SOLVING THE ENERGY TRILEMMA WHILE MAINTAINING INDUSTRIAL COMPETITIVENESS

One of the key actions to lower overall carbon emissions of the industrial sector is to lower the carbon footprint of the sector's purchased power. Dow is on the leading edge of integrating renewable energy into our manufacturing operations. The Company is already one of the largest users of renewable energy in the chemical industry, and we are well on our way to surpassing our goal of obtaining 750 MW of energy from renewable sources by 2025.

A major challenge facing society in the pathway to a lower carbon intensity—especially in the electricity sector and for industrial consumers—is the energy trilemma of affordability, sustainability, and reliability. Both the reliability and quality of the power grid are of paramount importance in ensuring the competitiveness of the industrial sector. Many of the regulations focus on one or two of these pillars alone, and often with significant negative consequences for the other legs of the trilemma. Instead, a holistic approach is needed to avoid unintended consequences.

The most significant consequence of poorly crafted regulations would be carbon leakage, where U.S. regulations were out-of-sync with the rest of the world and manufacturers moved operations to locations with less stringent requirements. We need broad, global alignment on greenhouse gas emissions reduction programs, and the U.S. needs to be a leader. The consequences for getting energy policy wrong are dire. For example, a \$19 Billion U.S. chemical industry trade surplus in 1997 became a deficit from 2001–2007 as resources became economically unavailable for industry.<sup>9</sup> Over this period, more than 200,000 jobs were lost in our industry.<sup>10</sup>

Real world data clearly show the value of natural gas as a key driver for resolving the trilemma. From 2008–2017 in the U.S., natural gas increased its share in power generation dramatically, displacing outdated coal fired plants that were retired because of unfavorable economics. Germany, on the other hand, subsidized a substantially increased mix of renewables, replacing mostly nuclear plants. During this time, the U.S. CO<sub>2</sub> emission intensity for power decreased by much more than in Germany while electricity was delivered to the average household at less than one-half of the price. Today, emission intensity in the U.S. is lower than in Germany, demonstrating the importance of natural gas-fired power generation as the stabilizing, cost-efficient anchor in the transition to a lower emission future (EIA, UBA).

<sup>9</sup>US Dept. of Commerce data for SITC Code 5 (Chemicals and Related Products) from [tse.export.gov](http://tse.export.gov) website.

<sup>10</sup>US Bureau of Labor Statistics employment for Chemicals and allied industries in 2007 vs 1997, <https://www.bls.gov/oes/tables.htm>.

## IMPACT OF GRID DESIGN AND POWER REGULATION ON INDUSTRIAL CONSUMERS

The technical aspects of grid design matter a great deal to industrial consumers. When considering renewable energy policy and grid design, policymakers need to account for the intermittency and peak load variability that comes along with integrating large amounts of renewable energy into the grid. Industrial processes operate on a continuous basis making us a consistent and predictable energy consumer. In return, we rely on a similarly consistent and reliable supply of power and steam to manufacture our products. This is best provided by a portfolio of energy supplies which includes both renewables and gas fired cogeneration.

Some of the technical challenges associated with integrating renewable power into the grid are outside of our control, including access to abundant and affordable low-carbon power capacities. Similarly, we are seeing reductions in the quality of the power received from the grid at our facilities in terms of inertia and frequency control. Additionally, the intermittency of renewable power supplies dramatically increases the volatility of power markets—including run ups from ~\$30/MWh to \$9000/MWh for power during several hours this summer in Texas.

With respect to power grid planning and renewable energy policy development, we would like the Committee to consider the following major points:

- Cogeneration/Combined Heat and Power (CHP) are an important part of efficiently meeting future power demand.
- In 2018, emissions of carbon dioxide (CO<sub>2</sub>) by the U.S. electric power sector were about 33% of total U.S. energy-related CO<sub>2</sub> emissions.<sup>11</sup>
- Federally driven solutions may cause unintended regional consequences.
- The ISO framework is the best way to address regional specific power needs. This model preserves state authority, maintains transmission owner withdrawal rights, and includes a cross section of stakeholders from the region.
- Federal agencies (i.e. FERC) have a role in defining the criteria under which regional ISO's operate. Attention needs to be paid to the impact of renewables on the power grid (i.e. through factors such as spinning inertia, ramp rate, load factors, seasonality, etc.).
- Federal policy should continue to encourage widespread utilization of cogeneration at industrial plants and large facilities. Examples:
  - Right to sell cogeneration/Combined Heat and Power (CHP) generated energy or capacity to a utility at avoided costs and/or open access market based rates.
  - Cogeneration/CHP considered eligible resources for efficiency and carbon emission reduction.

In Germany, the Netherlands, Australia, the UK, and the U.S., clean energy targets have had significant unintended consequences, resulting in wide day and night swings in power pricing and highly unattractive investment environments for power producers. Over time, gas and coal generation are retired, leading to higher risk of blackouts, etc.

## GOVERNMENT POLICIES ON CLIMATE

Partnership, collaboration, and government engagement are necessary to drive many of the actions that will make meaningful impacts. For example, partnership will be needed to deploy CCS, which will likely be needed on some of our processes and for power generation grid stability. In those cases, we will work on how to capture the carbon, and rely on our partners in government and industry to provide a network grid where we can store or use the carbon we capture. Governments also need to ensure the playing field is level, rules do not overlap, feedstock is treated differently than fuel and not unfairly penalized, and liability is addressed.

We believe the time has come for Congress to put in place a federal policy to protect against the worst impacts of climate change. Taking action now allows us to meet the challenge at the lowest overall cost to society. We believe a market-based price on carbon is the most efficient and effective way to lower greenhouse gas emissions. Dow has been working proactively through trade associations and coalitions to advocate for a federal solution. We are proud to be founding members of the newly announced CEO Climate Dialogue, a group of U.S. and global Fortune 500 CEOs that are committed to advancing climate action. The goal of the group is to urge Congress to enact a market-based approach to climate change.

To the extent that Congress considers a policy framework to address climate change, we believe public policy should:

<sup>11</sup> US EIA FAQ website, accessed 9/6/2019. <https://www.eia.gov/tools/faqs/faqs.php?id=77&t=11>.

- Recognize and value the chemical industry's use of hydrocarbon feedstocks (in both traditional and nontraditional forms) that are transformed into products rather than emitted as CO<sub>2</sub>.
- Eliminate federal regulations that are made duplicative or unnecessary through the enactment of comprehensive federal regulations.
- Prioritize regulations at the federal level instead of creating a patchwork of state and/or regional levels. Regulations should be harmonized, and state and/or regulations made duplicative or unnecessary should be eliminated.
- Recognize industry's allocation of time and resources to deliver efficiencies and breakthrough innovation by protecting it from the broad legal liabilities of climate change.
- Dedicate revenue generated as a result of carbon pricing exclusively to developing new technologies to avoid future emissions, and/or support infrastructure required to capture emissions or enable lower carbon emissions.
- Establish a standard protocol to account for the emissions that are avoided through the use of manufactured products, and generate credits that can be applied against the emissions of the manufacturer. Similar protocols should be established for re-used CO<sub>2</sub> (i.e. through Carbon Capture and Utilization).

The key to continued manufacturing competitiveness is a well-executed, comprehensive energy policy which addresses supply and demand, energy security, and environmental objectives.

#### CONCLUSION

Thank you for the opportunity to share Dow's perspective on reducing industrial sector greenhouse gas emissions, and the actions we have taken to reduce the impact of our own operations and those of our customers. There is an important role for Congress to play in crafting a federal regulatory framework that achieves meaningful emissions reductions at the lowest possible cost to society. We look forward to working with members of the Committee and all interested stakeholders on this important issue.

Ms. CASTOR. Thank you very much.

Ms. Lipman, you are recognized for 5 minutes.

#### STATEMENT OF ZOE LIPMAN

Ms. LIPMAN. Thank you, Chairwoman Castor, Ranking Member Graves, and distinguished members of the select committee. My name is Zoe Lipman, and I am the director of the Vehicles and Advanced Transportation Program at the BlueGreen Alliance, a national partnership of labor unions and environmental organizations. On behalf of my organization, our partners, and the millions of members and supporters they represent, I want to thank you for convening this hearing.

Earlier this summer, BlueGreen Alliance, alongside our labor and environmental partners, released Solidarity for Climate Action, an ambitious concrete platform to address the dual crises of climate change and increasing income inequality, simultaneously fighting climate change, reducing pollution, and creating and maintaining good paying union jobs.

Our plan puts American workers at the forefront of the discussion to fix these pressing problems. Rebuilding American manufacturing is a key part of this plan. We cannot rebuild American prosperity if we fall behind the rest of the world in building the technologies of the future or if working people in the communities they live in fail to see the gains from innovation and a cleaner economy.

The next generation of investments in advanced clean vehicles, energy, and infrastructure must be made here and result in the kinds of good paying jobs that Americans need. This strategy should include, I will say, many of the things that we have heard on the panel already:

- Major new investments to spur domestic manufacturing of rapidly growing clean technologies, plus increased funding for research and development and deployment and to translate that innovation into manufacturing, supply chain development, and good jobs.
- Investments to transform our existing industries, spurring clean and efficient domestic materials production, and to make energy intensive industries more efficient and competitive globally.
- A focus on environmentally, economically, and socially responsible mining, reclamation and recycling of the materials necessary for a clean and secure future; and strong labor, environmental, procurement, and safety standards to strengthen manufacturing and ensure good paying jobs across these advanced technology fields.

This includes using tools proven to create and improve job quality, like project labor and community benefit agreements, Buy American, Davis-Bacon prevailing wage, and policies that ensure the use of domestic, clean, and safe materials made by law-abiding corporations for all public spending and across the supply chain.

Finally, fair and enforceable trade agreements are critical and so are common sense tax, procurement, and border adjustment policies to stop offshoring either jobs or pollution overseas.

Over the past decade in the auto sector, for example, American workers and businesses have proven that we can rebuild American manufacturing through strong action on climate. Today, in a recovered profitable and competitive industry, hundreds of thousands of American manufacturing workers are building the advanced components, materials, and technology that go into making our cars, trucks, and SUVs cleaner while saving consumers billions and deeply cutting emissions. Unfortunately, just as smart policy choices aided in manufacturing recovery, poor choices will cost them.

The administration's moves to roll back these long-term standards threaten more than 89,000 of tomorrow's manufacturing jobs. We cannot afford to go backward. We need to retain and extend globally leading standards and we need to act now in an aggressive agenda to manufacture the next generation of advanced and electric vehicles, materials, and technology in the United States.

There is no doubt that the energy, transportation, and technology sectors are changing rapidly, and all too often, workers have borne the brunt of change. But while technological change is inevitable and necessary, wasteful and inequitable disruption is not. Nothing should stop us from building clean energy technology with good jobs in America, but it doesn't happen by itself.

In some factories, for example, EVs and EV components are built on the same production lines in the same plants with the same good union jobs as conventional technology, but not enough of our clean vehicle and clean energy jobs are good paying family supporting jobs and not enough are in communities that have seen good jobs disappear. Creating high-quality jobs across the country, especially in clean energy, vehicles, efficiency adaptation, and resilience, requires strengthening workers' rights on the job, removing barriers to organizing, and raising and extending labor standards, plus a serious investment in work-based training and apprenticeships and reinvestment in hard hit communities across the nation.

To rebuild American prosperity, the clean economy must go hand-in-hand with making high-quality, family-sustaining union jobs accessible to all. Adopting an aggressive, worker-centered agenda to address the climate crisis will build a stronger U.S. manufacturing sector, benefit workers, communities, the economy, and the environment.

Thank you for this opportunity. I look forward to your questions. [The statement of Ms. Lipman follows:]

**Testimony of Zoe Lipman  
Director, Vehicles and Advanced Transportation Program, BlueGreen  
Alliance**

**Before the U.S. House of Representatives, Select Committee on the Climate  
Crisis**

**Solving the Climate Crisis: Manufacturing Jobs for America's Workers**

**September 10, 2019**

Thank you Chairwoman Castor, Ranking Member Graves, and distinguished members of the select committee. My name is Zoe Lipman, and I am the Director of the Vehicles and Advanced Transportation program of the BlueGreen Alliance, a national partnership of labor unions and environmental organizations. On behalf of my organization, our partners, and the millions of members and supporters they represent, I want to thank you for convening this hearing today regarding the opportunities that the clean energy economy can provide to rebuild American competitiveness manufacturing and good jobs.

Our nation faces the dual crises of climate change and increasing economic inequality. These crises are inextricably linked, as are their solutions.

That's why earlier this summer the BlueGreen Alliance, alongside our labor and environmental partners, released Solidarity for Climate Action, an ambitious, concrete platform to address these crises simultaneously, fighting climate change, reducing pollution, and creating and maintaining good-paying, union jobs across the nation.<sup>1</sup>

We need to plan for the future and American workers must be at the forefront of that discussion.

One key strategy for tackling both climate change and the challenges faced by working people nationwide is rebuilding American manufacturing. We recognize that we cannot rebuild prosperity if we fall behind the rest of the world in building the technologies of the future, or if working people and the communities they live in fail to see the gains from innovation and a cleaner economy. We need to act now to ensure the next generation of investments in advanced, clean vehicles, energy, and infrastructure are made here in the United States and that those investments result in the kinds of good-paying jobs that are out of the grasp of too many Americans.

In Solidarity for Climate Action, the BlueGreen Alliance and our partners call for aggressive action to ensure that America remains competitive, that our manufacturing sector is strong, and that we retain our spot as an innovative leader. The nation needs a national strategy to lead in clean and emerging technology production, including:

- Major new investments to spur domestic manufacturing and supply chain development in rapidly growing clean technologies, as well as increased funding for research, development, and deployment to ensure that American innovation is translated into good jobs and cutting edge manufacturing in the United States;
- Investments to transform our existing industries, including investing in efficient domestic materials production and energy-intensive manufacturing to both limit emissions and make them more efficient and competitive globally;
- A focus on environmentally, economically, and socially responsible mining projects, as well as reclamation and recycling initiatives to ensure we're creating the materials necessary for a clean and secure energy future here in the United States;
- Strong labor, environmental, procurement, and safety standards to strengthen manufacturing and ensure that jobs across these advanced technology fields are good-paying jobs. This includes using tactics proven to create and improve job quality—like project labor and community benefit agreements, Buy American, Davis-Bacon prevailing wage, and policies that ensure the use of domestic, clean, and safe

materials made by law-abiding corporations—for all public spending and throughout the supply chain;

- Ensuring that trade agreements are enforceable, fair for all workers, and benefit the environment and the climate; and

- Using common sense tax, procurement, trade enforcement, and border adjustment policies to stop offshoring and the leakage of jobs—and pollution—overseas.

Rebuilding American manufacturing through leadership on climate action is not just possible in theory. Over the past decade American workers and businesses have proven that theory in the in the auto industry. Building on bipartisan agreements in 2007 energy bill, a new generation of strong, smartly structured clean vehicle standards—coupled with deliberate manufacturing policy and investment—not only helped avoid catastrophe at the heart of U.S. manufacturing, but sped up the recovery, rebuilt automaker profitability and competitiveness, and brought back hundreds of thousands jobs, all while building exceptional vehicles that deeply cut pollution and saved consumers and businesses money.

The BlueGreen Alliance and its partners have long tracked the impact of standards on manufacturing jobs and investment in the auto industry. Under globally leading fuel economy and greenhouse gas (GHG) standards, automakers and suppliers invested billions in innovative plants and technology in the United States,<sup>ii</sup> and across the country, hundreds of thousands of manufacturing workers are building the advanced components, materials and technology that goes into cleaner cars, trucks, and SUVs. What's more, taken together, the vehicles built today are achieving the nation's largest ever reductions in climate pollution.

#### POLICY MATTERS

Unfortunately, just as sound policy choices helped underpin a recovery in manufacturing in America's auto industry, stepping back from globally leading standards will cost them. Recent efforts by the administration to rollback these long-term standards—together with counter-productive corporate tax incentives that further discourage investment in domestic manufacturing and workers—are threatening these gains. They are putting today's and tomorrow's jobs at risk, driving future manufacturing investment overseas, and setting us back in an urgent race to attract the next generation of advanced and electric vehicle technology in the United States.

Data from the Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration's (NHTSA) shows the proposed rollback would cut approximately \$30 billion per year in investment in advanced technology and cost 60,000 jobs, and that's without taking into account the potential impact of missing the boat on the next generation of automotive innovation in America. A recent analysis conducted by the BlueGreen Alliance looking specifically at the impact on manufacturers who build advanced vehicle technology in the United States, found the potential impact on jobs to be even more substantial, concluding that the proposal would result in more than 89,000 of tomorrow's jobs lost or foregone.<sup>iii</sup>

At a time when countries worldwide are rushing to capture the next generation of vehicles, manufacturing and jobs, we cannot afford to go backward. We need to retain and extend globally leading vehicle standards, and we need to act now on an aggressive agenda to manufacture the next generation of advanced and electric vehicles—and the strategic materials and technology that goes into them—in the United States.

#### NOW IS THE TIME FOR AN ADVANCED AND ELECTRIC VEHICLE MANUFACTURING AGENDA

An advanced and electric vehicle manufacturing agenda would couple strong globally leading standards and targets, which give companies the certainty they need to invest, with an aggressive push to manufacture vehicles and strategic components here in the United States. The key elements of that agenda include:

- Make a robust investment to spur advanced and electric vehicle and technology manufacturing and supply chain—whether through new programs or through expansion of the loan, grant, and tax programs we have today to help companies build, retool, or convert manufacturing plants in America. Further, to enhance the benefits for the economy, communities, and working people, we should:

- Incentivize responsible labor, community, and supply chain practices and prioritize reinvestment in existing or idle facilities and in deindustrialized, impacted, underinvested communities;

- Prioritize economically strategic and emerging technology and materials; and

- Encourage consortia of assemblers and suppliers—and small- and medium-sized manufacturers—and aid states and municipalities in investing in local priorities and clusters.

- Act to responsibly produce critical minerals and materials and to launch new domestic recycling and reclamation projects;
- Boost public investment in electric vehicle (EV) fleets and infrastructure and ensure that all public spending supports efforts to build critical components here and to secure and build good family supporting jobs;
- Make globally competitive levels of investment in research and development and ensure innovation is translated into domestic manufacturing and growth of supplier networks; and
- Enact fairer trade, labor, and corporate tax policies that can stem advanced tech offshoring and exploitative labor practices while driving a new generation of investment in domestic plants, workers, and training.

Finally, the experience, opportunities, and challenges we have in the iconic auto industry underscore some broader lessons for how we ensure the clean economy, innovation, and technological change deliver to working people.

#### THE CLEAN ECONOMY CAN AND MUST DELIVER FOR WORKING PEOPLE

Energy, transportation, tech industries are changing rapidly. This is both a tremendous opportunity and a significant challenge. All too often in recent decades workers have borne the brunt of change. But what we've seen is that while *technological change is inevitable, wasteful and inequitable disruption is not*.

Nothing should stop us from building clean tech with good jobs in America—but it doesn't happen by itself. In the auto industry for example, in many factories, EVs and EV components are built on the same production lines, in the same plants, with the same good union jobs, as conventional vehicles. If anything, higher labor standards and better working conditions in parts of the industry enable more effective and efficient manufacturing systems.

The technology does not dictate job quality, or whether we rebuild Americas manufacturing vitality, but the choices corporations and policy makers make on offshoring and outsourcing and investing in workers and communities do. In this industry, we've shown that, with smart policy developed with stakeholders at the table, successful innovation can be an industrywide undertaking, not a zero sum game. We can engage every part of the industry and secure and build jobs across existing and emerging technologies, while innovating across all types of vehicles and delivering gains for all types of consumers, and we can achieve—indeed perhaps it's the only way to achieve—groundbreaking pollution reductions.

And, as we move to clean and innovative mobility across the transportation sector, it's not just manufacturing jobs at stake, and having labor and community stakeholders at the table makes all the difference. New research shows that in commercial transportation—where drivers are contingent or often misclassified as independent contractors—deployment of clean technology can also be more difficult.<sup>iv</sup> Similarly, in the absence of clear standards, new “innovative mobility” technologies like autonomous vehicles, ride sharing, and ride hailing may not deliver on promised labor, safety, equity, and environmental benefits. Proactive engagement of stakeholders and agreed public policy framework are critical to ensure the public sees the benefits of technological change, and this would shape innovation itself—helping to guarantee that we do not lock in innovative technology with exploitative business models.

These lessons hold true across the clean economy. We have the opportunity to retain and create millions of high quality jobs while implementing bold solutions to climate change. We know this is possible because we are building good high skilled union jobs today in manufacturing and in the trades in transit, energy efficiency retrofits, pipefitting and offshore wind, just to name a few. At the same time not enough of the clean energy jobs created or promised are good-paying, family-supporting jobs, nor are these jobs in communities that have seen good jobs disappear. The clean economy must do more for working people who have seen wages fall, and economic mobility and power in the workplace decline. Unions—which empower workers, ensure quality jobs, and sustain families—are an essential vehicle to confront the economic insecurity most Americans face.

A commitment to high-quality job creation across the economy—but especially related to clean energy, vehicles, adaptation and resilience—means strengthening workers rights on the job, removing barriers to organizing, raising and extending labor standards, investing in work-based training, registered apprenticeships, enhanced equity, community benefits and community preparedness. To rebuild American prosperity, the future of energy, manufacturing, transportation, infrastructure, and resilience must go hand in hand with making high-quality, family-sustaining, union jobs accessible to all.

## CONCLUSION

Today, our key economic and political challenges include reorienting the American economy around the essential and growing clean and resilient technologies of tomorrow, while addressing the challenges working people are facing right now. Acting now to adopt an aggressive, worker-centered agenda to address the climate crisis is amongst the most compelling opportunities we have to meet America's challenges and capture its most exciting opportunities—for the U.S. manufacturing sector, workers, communities, the overall economy, and the environment.

## REFERENCES

<sup>i</sup>BlueGreen Alliance, "Solidarity for Climate Change," June 2019. Available online: <https://www.bluegreenalliance.org/solidarity>

<sup>ii</sup>BlueGreen Alliance, *Driving Investment: How Fuel Efficiency Is Rebuilding American Manufacturing*, January 25, 2018. Available online: <https://www.bluegreenalliance.org/resources/driving-investment-how-fuel-efficiency-is-rebuilding-american-manufacturing/>

<sup>iii</sup>BlueGreen Alliance, *Tech@Risk: The Domestic Innovation, Technology Deployment, Manufacturing, And Jobs At Risk In Stepping Away From Global Leadership On Clean Cars*, August 1, 2019. Available online: <https://www.bluegreenalliance.org/resources/techrisk-the-domestic-innovation-technology-deployment-manufacturing-and-jobs-at-risk-in-stepping-away-from-global-leadership-on-clean-cars/>

<sup>iv</sup>UC Berkeley Labor Center, *Truck Driver Misclassification: Climate, Labor, and Environmental Justice Impacts*, August 22, 2019. Available online: <http://laborcenter.berkeley.edu/truck-driver-misclassification/>

Ms. CASTOR. Well, thank you to all of the witnesses for your very compelling testimony. I recognize myself 5 minutes to ask questions.

I have to say, after touring through Illinois and Michigan during August, my great takeaway was, boy, the global race is on for building the fuel-efficient and electric vehicles of the future. I heard from the experts at GM and Ford, how they are going all in on electric vehicles, but they are very afraid that U.S. policy is going to take a backseat and let other countries capture the market, because this is a very competitive global market.

And I think the average person, the average American understands that when you have a more fuel-efficient vehicle or an electric vehicle, you are going to save money at the pump and there are significant health benefits. Gosh, the electric school buses of the future—I see that over time, all the school districts are going to be driving electric school buses because of the benefits, but there are some very significant roadblocks right now.

Ms. Lipman, you highlighted that everyone understands how the Trump administration is trying to roll back fuel economy standards. There is a huge fight on. Go into a little more detail for us on how globally leading fuel economy and emission standards help create more manufacturing jobs in America and investment by the U.S. auto industry.

Ms. LIPMAN. I would be happy to, and this is something we have been tracking for years. In this sector, we really have an example of how globally leading emission standards coupled with deliberate manufacturing policy have underpinned a dramatic recovery in the industry, bringing back hundreds of thousands of jobs, returning to record sales, profitability, and competitiveness for the industry.

In 2017, we found 288,000 manufacturing workers in 1,200 factories and 48 States building the specific technology that goes into improving fuel economy and creating advanced vehicles. We also saw over \$76 billion invested just by the automakers alone (the previous numbers included the suppliers). Some of this was certainly business as usual, but much additional came from retooling factories more frequently, buying additional technology, and en-

hancing investment in innovation, and it illustrated how investments to meet these standards translated directly into a multibillion dollar investment in manufacturing communities across the country.

Unfortunately, just as smart policy underpinned the recovery, bad policy can reverse it. And as I mentioned in my statement, we are seeing a proposal to roll back these policies today. The administration's own analysis of the rollback found that it would result in \$30 billion a year less in manufacturing investment and a loss of 60,000 future jobs. We find in analysis we just completed, more than 89,000 jobs could be foregone in the future.

Strong long-term standards not only boost investment in manufacturing directly, but they provide the certainty for companies to make decisions about whether or not to invest in America for the long term, and we risk losing that next generation of technology just at a time when countries worldwide—

Ms. CASTOR. Well, and I want to get Mr. Nassar's comment on this because I am hearing it from workers too. They want these jobs. They know these are the jobs of the future. They don't want the electric vehicles to be built in China and have China eat our lunch. We need to be the leader. So what is your view, what is UAW's view of the Trump rollback of fuel economy, and what else do we need to be doing to make sure the Trump administration doesn't undermine consumers and their pocket books and good American jobs?

Mr. NASSAR. Well, I think—first of all, thank you for the question. I think as far as the preferred alternative that the administration put forward by flatlining standards in the years ahead, it really goes backwards from investments that are already being made, first of all, because the automakers have to plan well in advance so it is a problem. It is also leading to an awful lot of litigation and uncertainty of where we are heading, and that is creating a lot of problems.

We worked hard with a lot of stakeholders to build a consensus before and we could do it again; we just need the political will to do that.

Ms. CASTOR. Great. Mr. Griffith, I recognize you for 5 minutes.

Mr. GRIFFITH. Thank you very much, Madam Chair, and I appreciate it.

I want to start by looking at a concept that Mr. Stones put forward in his written testimony, which was the trilemma, the energy trilemma which states that you have got to try to balance all three: affordability, sustainability, and reliability. And I think all of those are important, and sometimes we forget about that.

And, Mr. Shah, I like a lot of things, believe it or not, that the Department of Energy did when you were there, because I am big on research. The one thing I would point out, when we are looking at this trilemma of affordability, is that we need to be doing research on not just the renewables and increase that research, but we need to have parity with our fossil fuel research as well.

And I would point to an article that appeared in the Roanoke Times on August 18 of this year, where it talks about a new technology that is being developed in my district in Pulaski County, and Virginia Tech is now working on it to come up with a proto-

type, based on a decade of work, roughly, where they are using solid sorbents. They create a filter which can be used on smokestacks of any manufacturing facility or coal-fired power plant. And what it does is, is that the emissions come through this filter, it has got different compartments with the solid sorbents, if I am saying that correctly, and what happens is, is that there is a combination; the chemicals then combine with the various things that we don't want in our air—carbon dioxide, SO<sub>x</sub>, NO<sub>x</sub>, et cetera—pulls it out, but it leaves it in a form because it is not a jumbled mess. Most of the filters today can filter that stuff out, but you end up with a jumbled mess that you can't sell. This gives you a product you can sell so you can sell the nitrogen to fertilizer companies. You can sell the arsenic to, you know, folks who use arsenic for poisons or whatever they are using it for, and you can pull out the carbon.

So what do you say about that? I mean, shouldn't we be increasing—instead of putting all of our eggs into the basket of the renewables where everybody is working on it, but as a fossil fuel rich country, shouldn't we also be doing a lot of research to clean up the fossil fuel production that we have or whatever manufacturing? And this seems like a great project among many others, I am sure.

Mr. SHAH. Absolutely. This is a huge global economic opportunity and we have got to be working on every sector. When you look at the IPCC reports, they say that we are not going to be able to achieve the two-degree scenario without both carbon capture use and sequestration and advanced nuclear, in addition to renewables and storage and all. So it is “and, and, and”. We have got to do it all. And you know what? Virginia Tech is leading the way.

Just earlier this year, they got \$2.4 million from DOE's Fossil Energy Office to look at how to produce ammonia more efficiently. So, you know, we got to work across the board, and I think you are absolutely right.

Mr. GRIFFITH. Well, I appreciate that very much.

Mr. STONES, I imagine Dow might be very interested in that kind of technology as well.

Mr. STONES. Well, we do provide, you know, products to help with carbon capture. We believe very strongly that carbon capture is one of the processes required to deal specifically, especially with processed heat, which is a very important issue for our industry.

Mr. GRIFFITH. Well, what I love about this one—and I hope it takes off. I don't know if it will or not, but this is what research is about, is trying to figure out different things that will happen. But what I love about this is, is that we can do all kinds of things with it and you end up with a product you can then resell; you just don't have to store it away somewhere or isolate it, and I think that is great.

And when you are looking at your trilemma and you look at affordability—by the way, that is MOVA, I am always looking for investment in my district, so you might check them out, have your folks check them out. But I was recently in Turkey on this same line trying to find some manufacturing jobs for one of the counties in my district that wanted their—they are targeting some Turkish companies, and one of the questions that every manufacturer asked

us was, what is the cost of your energy? And I think that is important.

And you pointed out we lost 200,000 jobs when we didn't have the feedstock. That translates to coal and natural gas feedstocks from making chemicals, doesn't it? And when the price went up so high it wasn't affordable, we lost those jobs elsewhere. When the price of natural gas came down because of research and development, those jobs came back, did they not?

Mr. STONES. Yeah. So I think—

Mr. GRIFFITH. The answer is yes. You can keep go ahead, but I want to make sure everybody understands the answer was yes.

Mr. STONES. I think what happened in that instance is that technology and innovation led to revitalization of the energy economy and specifically initially around shale gas, but then eventually around shale oil.

Mr. GRIFFITH. And I think if we get parity between renewables and fossil fuels, we can have more breakthroughs that will continue to have some of our traditional jobs but at a cleaner output. And I appreciate it.

My time is up, and I have to yield back. Thank you, sir. Look forward to discussions down the road.

Ms. CASTOR. Ms. Bonamici, you are recognized for 5 minutes.

Ms. BONAMICI. Thank you, Chair Castor. Thank you to all of our witnesses.

I am glad that we are focusing on manufacturing jobs for America's workers today. I think this is a conversation we need to have every time we are talking about the climate crisis and especially with the focus on transportation today.

As the chair said, the global race is on, and as Mr. Nassar and Ms. Lipman noted, why would we go backwards when other countries are going forward. It just doesn't make any sense.

We talk a lot here on the Hill about infrastructure and passing an infrastructure package. Look at all the potential with charging stations and the technologies with fast charging, and there is just so much that can be done and there are a lot of jobs in that.

So we know that we need to reduce harmful emissions. We know, as we transition to a clean energy economy, that we need significant Federal investment in research and development of advanced clean energy technologies. I also serve on the Science, Space, and Technology Committee, so we look at complementing Federal high-risk, high-reward programs like ARPA-E, with regional partnerships that could spur the development of both early stage innovation and help move new technologies beyond laboratory research to market development.

I am actually working on a bill to support the creation and expansion of regional public-private partnerships to foster that environment of innovation and job creation at the local level, but also part of that is to accelerate smart market deployment of clean energy technology.

So, Mr. Shah, you in your testimony did talk about the value of the DOE supporting both the initial research and development of clean energy technologies and the subsequent innovation in manufacturing to drive down market costs. So how can we strengthen research and development to avoid that commercialization valley of

death that we hear about for new clean energy technologies and support the supply chains for accelerated clean energy development?

Mr. SHAH. Thank you for the question. You know, I think you are absolutely right, we need to do this. We need to support innovation ecosystems, and the way do that is to take a holistic approach, where we adequately fund R&D, we adequately fund deployment, and we support workforce development for the industries of the future.

So in Oregon, for example, DOE has been supporting NuScale, and advanced nuclear is a big, hard problem. And it has taken years of investment, but for nearly a decade now, DOE has been seeding this industry through investments in companies like NuScale. They have completed their first initial reactor design which is under review, and that was done with Federal support. They are now seeking long-term purchase contracts. They are working with DOE and Congress to determine how to build manufacturing capacity here. And what is exciting and important about that is it is not just for domestic industry, but it is also a huge potential export opportunity.

So I think to answer your question, you just have to look holistically. We have to think about industrial policy, not just doing one or the other; we have to do it all.

Ms. BONAMICI. Thank you. And NuScale is not like the old nuclear reactors, just like manufacturing jobs of today are not like the old manufacturing jobs of the past.

So, in Oregon, on the workforce issue, we have numerous examples of strong registered apprenticeship programs that have the training, the portable credentials, high wages, and a pathway to a permanent job. We have the Oregon Manufacturing Innovation Center that is kind of a public-private partnership with academia and the workforce.

So, Ms. Lipman, Mr. Shah, Mr. Nassar, you all highlight how the clean energy sector could help create high-quality good paying jobs. Registered apprenticeships and paid on-the-job training opportunities provide us with an opportunity to support individuals that might face barriers. So where do you see Federal workforce investments being the most useful—preapprenticeship programs, sector partnerships, more registered apprenticeships? Where do you think the best approaches are? Maybe just quickly because I am running out of time. Thank you.

Mr. Nassar, go ahead.

Mr. NASSAR. Just really quick. Well, I think, frankly, once again, all of them are needed, but one thing that is going on is the administration, unfortunately, has a proposal on apprenticeships which would actually bring things backwards because it would let apprenticeships move forward that have much lower standards.

Ms. BONAMICI. Not a supporter of IRAPs.

Mr. NASSAR. And we collectively bargain, by the way, for a lot of these good apprenticeship programs.

Ms. BONAMICI. Okay. I am going to let Ms. Lipman get an answer in quickly.

Ms. LIPMAN. Yes. I would underscore the importance of work-based training and registered apprenticeship, preapprenticeship

programs. I would say we also are very proud that our full partnerships supported the PRO Act and the importance of raising labor standards, facilitating workers' rights in organizing, and the ability to secure and improve jobs.

Ms. BONAMICI. Absolutely. We want these to be good paying jobs.

And I see that my time is expired. I yield back. Thank you, Madam Chair.

Ms. CASTOR. Thank you.

We have three votes on the floor. So at this time, the committee will recess, and then we will reconvene 5 minutes after the last vote is called.

Thank you.

[Recess.]

Ms. CASTOR. Okay. The committee will come to order.

Mrs. Miller, you are recognized for 5 minutes.

Mrs. MILLER. Thank you, Chairwoman Castor and Ranking Member Graves, and to all of you—all for being here today.

Mr. Stones, how has the cost of energy changed over the last 15 years?

Mr. STONES. So over the last 15 years, the price of energy has been relatively volatile, and it has ranged from a period of history where the United States has been very, very competitive on energy. There was a period of time in the 2001 to 2007 period when it wasn't.

But natural gas, for example, has traded probably between, frankly, zero and maybe \$25 a million BTU, and probably is about 2.50 right now.

Mrs. MILLER. So, basically, right now it is down?

Mr. STONES. Right now, technological innovation has occurred in the oil and gas space which allows a reduction in the cost of those—of energy in both natural gas and oil. But we have also seen a significant decrease in the price of renewables. So those are also much cheaper today than they were historically.

Mrs. MILLER. How has the low cost in energy positively impacted Dow's business?

Mr. STONES. So, basically, we rely on competitive and reliable energy prices to remain competitive globally and allow, for example, the investment of approximately \$12 billion over the last, say, 10 years in the Gulf Coast where we have started up a new cracker, a new propane dehydrogenation facility. The one we just—

Mrs. MILLER. Can you speak closer, please?

Mr. STONES. Sorry. We have invested about \$12 billion over the last 10 years or so in the Gulf Coast to produce more products here, including a new ethylene cracker and a new propane dehydrogenation facility and the derivatives thereof.

Mrs. MILLER. So that is a good thing?

Mr. STONES. It is a good thing, yes.

Mrs. MILLER. Okay. Mr. Nassar, how important is the price of electricity in manufacturing vehicles?

Mr. NASSAR. Oh, it is absolutely an important input, for sure. No question about that.

Mrs. MILLER. How important is that same price in maintaining manufacturing jobs?

Mr. NASSAR. The price of electricity is an important aspect, but it is one of many. I would say trade policy and a whole bunch of other things too are important in whether those jobs are here or elsewhere.

Mrs. MILLER. If the price of electricity were to triple, how would that impact jobs and union jobs in manufacturing?

Mr. NASSAR. Well, I would need to get back with you with precise numbers. I don't have that. But whenever you have major increases in costs, you know, that is going to impact the bottom line, which will impact employment for sure.

Mrs. MILLER. Absolutely.

Mr. Shah, can you elaborate on successful carbon capture projects in the United States?

Mr. SHAH. Sure. The United States has some very large carbon capture facilities, including Petra Nova, which is a new facility that has been stood up in Texas. In addition, there is a facility in Illinois that sequesters carbon that comes out of an ethanol plant. So it is a technology that remains nascent, but if we are to maintain 2 degrees or less of warming, we really need to ramp up CCUS technologies, along with a whole host of other clean energy technologies like renewables and storage.

Mrs. MILLER. Are there any other plants in the making that you can see?

Mr. SHAH. There are. But again, this is a new industry, and additional Federal support could help speed deployment of these types of facilities.

Mrs. MILLER. Thank you.

How can we reduce the price of carbon capture so that it is able to be exported globally?

Mr. SHAH. Right. I think that is exactly the right question, how do we create the manufacturing jobs to build carbon capture technologies here in the U.S. and move them to the rest of the world. And I think, as with many other nascent industries, Federal support has been really important in the past. So the U.S. Department of Energy Office of Fossil Energy is focused on carbon capture utilization and sequestration technologies, has been really important in the past, and I think that Congress should continue its strong support there.

Mrs. MILLER. Thank you. I yield back my time.

Ms. CASTOR. Thank you. Ms. Brownley, you are recognized for 5 minutes.

Ms. BROWNLEY. Thank you, Madam Chair.

And I certainly concur with your comments at the beginning of the meeting that we are in a global race towards the clean energy future, without question.

I was recently in India and was there for India's independence day and had a chance to hear the President of India speak. And during that speech, he set some very, very high standards for India with regards to electrification of his country as well as electric vehicle goals.

And so, you know, thinking about that race, there is China that is literally next door, and China is leading the way in this area, and they will be the ones to capture that market. And India is a very valuable market and would give us huge export opportunities

in this space. It is the most populated country in the world, and 10 years from now, it is going to be the third largest economy in the world. So we need to get going.

So, Mr. Nassar, I wanted to ask you, in your written testimony, you talked about some of the things that other countries are doing to develop the automobiles and technologies of the future, and you referenced the country of Germany. And you said they were investing in its citizenry. What do you mean by that exactly?

Mr. NASSAR. Well, first of all, they have a dual path, right? They have a path when it comes to—you know, kind of university, traditional academic, but they also have a, you know, manufacturing apprenticeship path that lasts a long time. But, you know, it all matters. You know, if you have a healthy population, you know, healthcare matters. There is a whole—you know, the whole litany of things as far as having a solid foundation for folks.

Ms. BROWNLEY. And so, you know, on the line of—on the line of apprenticeships, so, you know, in terms of looking towards the future, in terms of looking at new technologies, and in terms of automation and factories, sort of all of these issues—and I know labor unions across the country, they all have—you know, internally, within their own organizations, they have apprenticeship programs for their particular trade, and some of these emerging technologies and job possibilities.

Can you speak a little bit to what unions are doing across the country in relationship to apprenticeships for the future?

Mr. NASSAR. Sure. Well, I think, first of all, you know, this is an area where collective bargaining, where workers having a voice really matters, because a lot of the apprenticeship programs and investments are agreed to in the context of a collective bargaining agreement.

But a lot of times, what it is, is it is really focused on making sure incumbent or existing employees, you know, have the skills to do the—to upgrade to do the new jobs. So it is not—you know, part of it is trying to get new folks into the stream, but it is also trying to make sure the people that are already working there, you know, can take those jobs as they advance.

Good communication and work between the company and the workers is key. And I would argue labor unions help that, not hurt it.

Ms. BROWNLEY. Thank you.

And the last question I really have, and it is really for anybody on the panel that would like to answer it. In terms of, you know, in the Trump administration, in the Department of Energy, EPA, there have been so many rollbacks that have taken place. And we do know that there is an employment dip in the last two—in the first two quarters, I think, of this year.

Does anybody have any data in terms of a relationship of rollbacks and workforce? I mean, intuitively you would think, yes, there is a nexus there. Or is it a drop in the economy or—

Ms. LIPMAN. Certainly. Rolling back regulations has really been shown over the last several years not to be what either manufacturing or workers need. I mentioned earlier the sort of grave potential impacts on manufacturing jobs from the automotive rollback.

Similarly, our methane rules would potentially build jobs across that sector.

We also have seen rollbacks of labor standards and workplace safety and community and chemical safety. None of those are good for workers or communities and working people generally. And in addition, they are not what we need to—to build the competitive, high-skill economy for the future.

Ms. BROWNLEY. And with the BlueGreen Alliance—I have a few more seconds—I know it is basically an alliance between the environmental community and the labor community. Do you have any interaction really with private industry and your influence, perhaps, on what the industries are doing?

Ms. LIPMAN. Absolutely. We definitely do talk with companies. We work with a number. And I think we would just underscore how important it is to bring all of those constituencies to the table to develop real practical policy that both works for the American economy and workers but also can deeply cut emissions.

Ms. BROWNLEY. Thank you.

Thank you, Madam Chair. I yield back.

Ms. CASTOR. Thank you.

Mr. Palmer, you are recognized for 5 minutes.

And the acoustics in this room are not very good. So for members and for our witnesses, speak directly into the microphone and try to elevate your voice a little bit. Thanks.

Mr. PALMER. And some of us need a little help hearing anyway, so—

Appreciate the opportunity to be here. Thank you, Madam Chairman.

I want to follow up on Congresswoman Miller's questions about the price of electricity and the cost of manufacturing vehicles. She asked how important is the price of electricity regarding electric vehicle manufacturing.

How important would that be if the government did not subsidize the purchase of electric vehicles? Would they be affordable to the average American?

Mr. NASSAR. As far as the price of electric vehicles, I mean, they do have to absolutely come down, but they also have to be more attractive to folks. That is why I think, you know, also investing in infrastructure matters and such. But we need to up the demand for electric vehicles in order to have a more vibrant market and make sure they are made here.

Mr. PALMER. Well, making them more attractive, is that in the context of it—like a BMW is attractive to a lot of people, but most people can't afford a BMW. Do you mean more attractive that way or more attractive—did you mean more affordable?

Mr. NASSAR. I meant more affordable. But also attractive in the sense of people—you know, if you have more charging stations everywhere, then people have more confidence in their ability to purchase. There is some research along those lines.

Mr. PALMER. Increasing the range?

Mr. NASSAR. Right.

Mr. PALMER. Along the same line, though, when you talk about all of this in context—and I am fine with electric vehicles. I have

actually driven a Tesla. It is quite a ride. Can't afford one, but quite a ride.

If you double or triple the cost of electricity for manufacturing but you also double or triple the cost of households' electricity, that is going to have an impact on people's ability to buy an electric vehicle.

Mr. NASSAR. Sure. And I would also add that, you know, frankly, wages for a lot of manufacturing workers haven't kept up. And, you know, a lot of—way too many auto workers can't afford the products they build. And, you know, we believe the old Henry Ford principle in that regard.

Mr. PALMER. Yeah. Well, you know, we get locked into this discussion about wages a lot of times and we lose sight of the fact that it is compensation. Compensation actually has gone up quite a bit, but it is gone up in regard to health benefits, what the companies are having to pay for health benefits, and that takes away from what can be out there on that little rectangle box on the check.

But I want to point out that China's electric vehicle sales had grown by 126 percent, but by May of this year, I think they had gone down to 2 percent. And China is looking at doing away with their subsidies. I think they are putting about \$60 billion a year into subsidies. If you don't subsidize these vehicles, I think it is going to be a very difficult market, a very limited market.

So to your point, we have got to find a way to make these vehicles more affordable, more practical for folks. Particularly where I live, they want to drive a full-size pickup because it is not just a vehicle to drive; it also has a utility value. And that is a big issue.

I also want to talk about something Mr. Shah brought up about the—how much technology has improved our ability, particularly in natural gas. And there was a study that came out from Harvard, the Harvard Business School, and the Boston Consulting Group, that was entitled American's Unconventional Energy Opportunity. And it talked about the tremendous opportunities we have in reducing our trade deficit through the shale revolution—through the fracking revolution and shale in particular.

There have been various studies done. One was by IHS in New York, Daniel Yergin's group—I believe it was Daniel Yergin's group—that showed that over a 15-year period, just in exporting crude oil, that it would generate another \$1.3 trillion in government revenues—new government revenues. I think there was another study—I can't remember who did it—that showed that over a 20-year period, 25-year period, it would add a trillion dollars to GDP.

I will commend the Department of Energy in the previous administration and the current administration, what is being done in that regard, and the people who are leading this effort in technology to put the United States into a position where we reduce our trade deficits, we make energy affordable and cleaner.

And with that, Madam Chairman, I will yield the balance of my time.

Ms. CASTOR. Thank you.

And, Mr. Palmer, you will be interested to know when we visited with the automakers in Michigan a few weeks ago, they have big plans for electric SUVs and electric trucks. And they did say some

will be built in the U.S., but some will be built overseas. So we need policies to ensure that those vehicles are going to be built here in the good old USA.

Mr. PALMER. May I comment to that? Have you ever driven a Tesla?

Ms. CASTOR. I have. And I have driven the Volt and the Bolt, and they are fun to drive. And I love it. You don't have to stop at a gas station. One of the—

Mr. PALMER. You don't have to hit the brakes.

Ms. CASTOR. No, you don't have to hit the brakes. And the costs are lower to maintain. There are fewer parts to them.

So that is one of the issues we have to grapple with. There is a whole supply chain out there right now for building the parts that go into our cars. And if we are not going to have as many parts being manufactured in America, what are the policies to ensure that those manufacturing jobs stay here, that they expand, and we don't lose ground.

Mr. PALMER. If I may, I would like to commend you on that perspective, because building these cars, and particularly the batteries, overseas adds to emissions. Because a lot of the places that are building the batteries are using coal-fired power generation, where here in the United States, our CO<sub>2</sub> emissions have actually declined. They have gone up over there. So if we build them here, and we want to encourage you to build it all here, it actually reduces emissions.

Ms. CASTOR. And what was interesting is that the Tesla battery is being built in the U.S. Some of the others are not. But those rare earth metals are an issue. We have talked about it before in the hearing, and these are the issues we have to grapple with as we transition to the clean energy economy.

Mr. PALMER. Mercedes is building their batteries in Alabama.

Ms. CASTOR. God bless America.

And, Mr. Levin, you are recognized for 5 minutes.

Mr. LEVIN. Thank you, Chair Castor. I appreciate you holding the hearing today. It is an incredibly important topic.

I always remind people that jobs are the reason that this whole transition of clean energy economy really is a win-win. It is good for our planet, good for our health, and good for workers.

And while my friend Mr. Graves was here, I reminded him of a new report that clean energy jobs in California now outnumber jobs in the fossil fuel industry 5 to 1. The report was based on an annual survey of businesses, called the U.S. Energy and Employment Report, which used to be put out by the Department of Energy but was discontinued in 2017 after President Trump took office. Fortunately, two nonprofits have picked up the ball to provide that data.

And as Chair Castor said, the clean energy technology of the future can be built here or abroad. I want to ensure that it is built here. I have introduced the Zero-Emission Vehicles Act with my friend, Representative Neguse, to accelerate market trends and ensure that 100 percent of new light-duty vehicles are zero emissions by the year 2040, of new sales.

This legislation, paired with research and development funding, strong labor protections, and appropriate tax incentives will keep our domestic automakers competitive and facilitate the adoption of

zero-emission vehicles built here in the United States by American workers.

And, Mr. Nassar, I appreciate you being here to represent the UAW. At home, I drive a Chevy Volt, a plug-in hybrid EV, built by UAW Local 22. I am very grateful to your members for building such a great car.

And when I had a chance to speak with Mary Barra, the head of GM earlier this year, I expressed my disappointment with her that they were discontinuing production of the Chevy Volt. She assured me, however, that GM is committed to an all-electric future, introducing, I think, something like 20 new models, all-electric models, in the coming years. So I hope that they have a union label on them just as my Chevy Volt has a union label on it.

Ms. Lipman, I wanted to ask you a couple of questions. I appreciated that you touched on the need in your testimony, you talked about developing battery reclamation and recycling initiatives. Lithium ion battery recycling is key to making EVs more sustainable, keeping battery materials in the country, and making the United States competitive in the battery space.

The resale center at the Department of Energy works to foster the development of cost-effective battery recycling by stimulating research and convening experts from across the United States in order to drive down battery costs to DOE's \$80-per-kilowatt-hour goal. The center also partners with UC San Diego, in my district, in its very important work that will reduce the cost of EV ownership.

Ms. Lipman, do you see any other programs we can be funding or other policies that can be adopted to help develop battery recycling capabilities? And are there any State-level initiatives that can help inform our work at the Federal level?

Ms. LIPMAN. Thanks. Yes. And this issue is one that has come up over and over again about how we ensure that the materials that we critically need for clean energy technologies are built here and that we are not offshoring either those jobs or the emissions.

We would add, in addition to the valuable program you mentioned, that we definitely need a national strategy on how we ensure we have a secure and clean energy future in the U.S. that would include looking at the full range of production, recycling, and reclamation of these products and materials.

Secondarily, we are very interested in a wide range of direct programs we have in the U.S. or could have around investing in manufacturing, our loan and grant and tax programs for clean energy manufacturing, and there is no reason why recycling and reclamation projects, especially first-in-kind deployment of these projects, shouldn't be included under those kinds of programs for support as well. There are important things we could do on supply chain accountability to encourage folks to utilize this kind of project and initiative.

And I guess I—I don't know off the top of my head of programs that are helping at the State level, except to say that I know in conventional batteries, we used to do much more recycling in the U.S., and a lot of that did get offshored to unfortunate jobs and environmental outcomes.

Mr. LEVIN. Thank you. Perhaps you can get back to us with any other ideas.

And I will use the balance of my time just to mention that Senator Cortez Masto and I have introduced the Green Spaces, Green Vehicles Act which would fund charging infrastructure on public lands across the United States and help convert National Park Service and U.S. Forest Service fleets to zero-emission vehicles.

Honored to be working on this issue with you, and look forward to more in the years to come. Thank you for being here.

Thank you, Chair.

Ms. CASTOR. Thank you.

Well, Mr. Carter, at the outset of the hearing, I expressed my relief that Hurricane Dorian did not head to Coastal Florida, Coastal Georgia. So I know—

Mr. CARTER. Yes. Thank you.

Ms. CASTOR. We have been thinking about you over the past few weeks. And you are recognized for 5 minutes.

Mr. CARTER. Well, thank you. I appreciate that very much.

And I thank all of you for being here. This is certainly important. Manufacturing is important obviously in our Nation, and it is also important in the First Congressional District of Georgia that I have the honor and privilege of representing.

As a matter of fact, in the Savannah area alone, we have over 18,000 manufacturing jobs that we value, as you can imagine. And as the home to two major seaports, the Port of Savannah, the third largest—third busiest container port in the country, and the Port of Brunswick, manufacturing is extremely important.

I want to ask you, Mr. Stones, how important is the cost of energy to Dow Chemical?

Mr. STONES. The cost of energy is critically important. It needs to be affordable, sustainable, and reliable. And that provides the competitive base of our company and our investment strategy.

Mr. CARTER. So do energy costs play any kind of role in where you decide to put a plant?

Mr. STONES. Absolutely. We will invest where we can get the most competitive energy in the world.

Mr. CARTER. So how would—if you had increased energy costs here in the United States, what kind of impact would that have on your decisionmaking?

Mr. STONES. So, you know, we—we shared that in the—the kind of 2001 to 2007 period, the chemical industry lost about 200,000 jobs versus 1997. When we reinvented—you know, the industry had more technology, innovation in oil and gas and then eventually also in renewables, that helped us to make decisions to invest \$12 billion over the last sort of 10-year period.

Mr. CARTER. Sure, sure. Well, you know, whether it be Democrats or Republicans or Independents, you know, we all want to curb climate change and have a greener environment and make our society greener. But I worry a lot about government mandates and specifically about the bureaucracy that sometimes can cause companies a lot of problems.

And I was just wondering, can you share with us some of the innovations that Dow Chemical has done on your own accord to become greener and more efficient?

Mr. STONES. So, you know, for example, the plant I had mentioned earlier, the fluidized catalytic dehydrogenation, or FCDh, which is a mouthful to say, is a new process technology which should reduce the emissions versus comparable technologies by about 20 percent.

We also very much invest in our products. So, for example, every kilogram of silicon we sell typically saves about 20 kilograms of CO<sub>2</sub> emissions. We also do things like lightweighting for vehicles that allow dampening and sound insulation, among other things. We have packaging for food, which preserves the freshness and the cleanliness of the food, which is very important globally.

And, for example, concentrated solar is developed from our technologies for heat transfer fluids. So investing in the product space as well as the manufacturing processes, because the—you know, for every—basically, for every kilogram of CO<sub>2</sub> we use in our processes, we save two to three in the products, the life cycle of the products.

Mr. CARTER. And that is your own innovation; that wasn't anything the government was forcing you to do or mandating or—

Mr. STONES. We believe in bringing to the market what the products that the—the industry and the companies that we serve want.

Mr. CARTER. And I think that is very important, because as we go through this process, it is going to be important for the private sector to be involved. So what I want to ask you is, how can we in government encourage that? And how can we—how can we incentivize that short of tax credits or whatever?

Mr. STONES. So I think, you know, we would say that there is a logical place for government in things like ensuring—carbon capture as a technology isn't that tough. You know, it is a known technology. It is being developed. A lot of good work has been done. What is difficult is carbon reuse and the carbon grid network that needs to be put together.

Right now, if we had a carbon capture stream at one of our facilities, there is nowhere—there is nobody to take it from us. There is no place to store it. So enabling that grid is critically important in this space.

We also need to make sure that the regulation of the energy industry doesn't create adverse price spikes. You know, for example, just this month, we had \$9,000 power in Texas. You know, it is normally 30, just so everybody is clear. And that volatility needs to be, you know, managed and understood.

Mr. CARTER. Right, right. Well, let me—you know, let me compliment you and let you know that I applaud your efforts in the private sector of trying to do this. This is exactly what we need done. And we need the relationship and the cooperation of the private sector. And that is why I am so excited about the future, particularly as it relates to climate change, because I am convinced that the greatest innovators, the greatest scientists are right here in the United States of America. So I am really looking forward to this. So thank you very much. Thank all of you for being here.

And I yield back.

Ms. CASTOR. Mr. Casten, you are recognized for 5 minutes.

Mr. CASTEN. Thank you, Madam Chair. Thank you so much to the witnesses.

And I want to start—I want to—I am delighted to hear that there is a bipartisan commitment to cheap energy. I am delighted to hear this concern about making sure that we get to a point where fossil energy and clean energy reach cost parity. But we need to recognize that the fossil energy ain't going to be happy about that, because they are going to take a revenue hit.

Clean energy is cheap energy. The idea that a commitment to making energy cleaner is a commitment to making energy more expensive, as a technical term, it is stupid.

In 2007, the price of natural gas spiked. We all know that. Natural gas is a volatile commodity. Solar energy is not a volatile commodity. It is zero margin; it stays on the margin.

Since 2007, the carbon intensity of the United States grid has fallen by 26 percent, the price of power has fallen by 6 percent. The reason for that is completely obvious. If you deploy zero marginal cost technology, a commodity that prices on the marginal cost falls. Thank you. Let's do more of it.

A decision not to invest in clean energy on the basis of economics is like a decision not to travel to Denver because you are afraid of shark attacks. It is dumb.

Now, that is a tremendously great opportunity, because it means that we have tons of space to lower the carbon intensity of our grid per dollar of GDP. We can do what our trading partners have done. We can significantly improve the efficiency of our economy, both in our electric sector, making our homes more efficient, deploying renewables. And that is terrific, but it ain't going to get us all the way there.

And I think the challenge that we have is that there are huge chunks of our economy that use fossil energy as a chemical input. And anybody who stands here and says I have a path to zero carbon better explain how we are going to make fertilizer, how we are going to make silicon, how we are going to make steel, how we are going to make cement, how we are going to feed 7 billion people without fertilizer, how we are going to build a solar panel on a concrete pad without silicon, cement, and steel.

And, you know, there are names like Haber and Bosch and Fischer and Tropsch and Bessemer, who we all learn as a young chemical engineer, who created these processes that depend on, and we have an opportunity right now to invent the technologies that are going to get us there in the future.

And, Mr. Shah, I was delighted to hear you give a shout-out to my clean energy technology bill, because that is exactly what we are trying to do, is saying, you know, one of the buckets we have got we can be greedy about. The other buckets, we have got to invent new stuff.

And so my question for you, given your DOE experience, can you expand on what R&D is currently going on at DOE to lower the carbon—figure out how to make low carbon products, and then why—you know, given as we have advanced manufacturing op centers, why is it important that we consolidate and prioritize those activities into one space?

Mr. SHAH. Thank you. And just on the first point you made about wind and solar, you know, prices have gone down—thank you—50 to 75 percent since 2009, and more innovation and more deploy-

ment will help make energy even cheaper for renewable energy for American businesses. So wind and solar are a really good bet.

Now, on the industrial sector, you know, this is a really hard sector to decarbonize. Added up, it is about 22 percent of our Nation's GHG emissions. And we have identified solutions, as you said, in the transportation sector, in the building sector, in the power sector, to reduce GHG emissions. But the industrial sector is big, it is hard, it is diffuse, and we are having a little bit of a harder time. We haven't gotten as far technologically as we have in these other sectors.

You know, the Department of Energy's Advanced Manufacturing Office is authorized by Congress to work on industrial efficiency. It is not authorized right now to work on GHG emissions reduction, to work on industrial electrification, to work on alternative fuels for industrial processes.

So the bill that you have put forward does exactly that. It is a big gap, one of the biggest gaps in DOE's current authorization. And it is part of a slew of R&D bills that are moving through Congress right now: wind, R&D solar, R&D grid modernization, storage, fossil, nuclear. It is really exciting to see Congress working on these bills right now, because DOE hasn't been reauthorized since 2005, and doing so could really help us move forward with climate policy.

Mr. CASTEN. Terrific.

And just with the few seconds that I have left, for Mr. Stones, way back when I was a young chemical engineer, I think Dow was the leader on polylactic acid. I did some work on levulinic acids and biomaterials. I know Dow has been out in the front on figuring out how to make nonfossil derived biomaterials—or hydrocarbon materials for a long time.

Talk about what it means if DOE—you know, the Federal Government, in some capacity, can figure out how to make fertilizer without fossil fuels, plastics without fossil fuels, silicon, what does that mean for you, and what role do you see between what you can do in the private sector and where the need is in the public sector to lead some of that innovation?

Mr. STONES. So we absolutely will embrace technology. We are very happy to work with partnerships with the governments and various functions.

I am familiar with the PLA process. That actually was sold off many years ago. We had a really hard time making the economics work.

Mr. CASTEN. That was a long time ago. I was in grad school.

Mr. STONES. I understand. But certainly, you know, I think, you know, setting a stable power and—and working on process heat is incredibly important.

We are very concerned about things like, you know, there being a place for us to put the carbon we captured through a network of carbon capture and that sort of thing. And certainly our products, we are going to continue innovating.

We do produce products, for example, with different types of power and steam. We do use renewable steam in Latin America where there are trees, where they grow very quickly. It is much more difficult to do that in the U.S.

Mr. CASTEN. Thank you. I yield back.

Ms. CASTOR. Well, thank you again to our witnesses for your testimony.

I would like to remind everyone what I stated at the outset of the hearing. The committee has issued a request for information. A lot of the ideas on solving the climate crisis are not going to come from Washington, D.C.; they are going to come from the private sector, experts, academics, advocates all across the country.

If you go to [www.climatecrisis.house.gov](http://www.climatecrisis.house.gov) or find us through Twitter @climatecrisis, you can access our request for information. The deadline for proposals is November 22.

I would also like to ask unanimous consent to enter into the record the UAW EV report called “Taking the High Road: Strategies for a Fair EV Future”, of spring of 2019.

Without objection.

[The information follows:]

**Submission for the Record**

**Representative Kathy Castor**

**Select Committee on the Climate Crisis**

**September 10, 2019**

ATTACHMENT: *Taking the High Road: Strategies for a Fair EV Future*. United Automobile Workers, 2019.

This report is retained in the committee files and available at:

<https://uaw.org/wp-content/uploads/2019/07/EV-White-Paper-Spring-2019.pdf>

Ms. CASTOR. All members will have 10 business days within which to submit additional written questions for the witnesses. I ask the witnesses to please respond promptly if you receive additional questions.

Thank you very much. The hearing is adjourned.

[Whereupon, at 4:17 p.m., the committee was adjourned.]

**United States House of Representatives Select Committee on the  
Climate Crisis**

**Hearing on September 10, 2019, “Solving the Climate Crisis: Manufacturing  
Jobs for America’s Workers”**

**Questions for the Record**

**Josh Nassar**

**Legislative Director**

**United Auto Workers**

THE HONORABLE KATHY CASTOR

**1. Do you support the United States rejoining the Paris climate agreement? If yes, why?**

Yes, we strongly support rejoining the Paris climate agreement. It is painfully clear to our members that the climate crisis is real, and its scope is global. International cooperation and commitment to action, like the Paris Climate Agreement, are a must for addressing the crisis. Failing to take concrete steps to address climate change at the global level puts us on an unsustainable course. Ignoring climate change only creates risks for our national security and our planet, but it is also a direct threat to our jobs, and an even bigger threat to the jobs and quality of life enjoyed by future generations. This is why the UAW supports a broad policy

agenda to address climate change, including emissions regulations, investment in sustainable infrastructure and the green economy, and international cooperation.

The UAW, based on experience, rejects the idea that fuel efficiency and environmental regulations lead to closed plants and lost jobs. Protecting the environment is not inherently bad for the economy and solutions exist all around us. Fuel-efficient vehicles, clean energy, clean manufacturing, renewable energy and other advanced technologies are an opportunity to create new middle-class jobs with good pay, good benefits and economic security. Our economy is changing in real time and UAW members already design and build advanced cars and trucks, advanced engines and transmissions, lighter materials and other advanced green products.

Consumers and governments worldwide expect greener products. Europe and China are developing advanced green technologies at a brisk pace. Products for a green economy should be made here but we fear they will not be if we remain on the current course in Washington, D.C. The United States must be a producer and exporter of advanced technology products, not jobs. We have an obligation to safeguard the future of our jobs, families, communities and our planet.

**2. Please discuss technologies and components that are being manufactured in the United States today by UAW members to reduce emissions and improve efficiency.**

The UAW represents 225,000 workers in auto vehicle and auto parts manufacturing, many of whom are working to produce vehicles and components with improved efficiency and reduced emissions. Whether it is electric vehicles (EVs), autonomous vehicles (AVs), plug-in hybrids (PHEVs), more efficient internal combustion vehicles, or other key vehicles components optimized for efficiency, UAW members are already building the vehicles of the future. To ensure that the UAW members build the next generation of advanced technology vehicles, we need policies that promote investment in domestic production of the latest technologies.

*Electric Vehicles & Plug-In Hybrids:* UAW members are playing a role in the development of PHEVs, EVs, and AVs. Currently, the UAW represents around 1,600 workers at General Motors' Orion, MI assembly plant where the Chevrolet Bolt electric vehicle and Cruise autonomous test vehicle are produced. Automakers have announced future investments that will bring additional EVs and PHEVs to UAW-represented assembly plants. These include:

- GM plans to build a second EV at its plant in Orion MI.<sup>1</sup>
- Ford will build the 2020 Ford Escape PHEV in Louisville, KY,<sup>2</sup> is upgrading its Chicago, IL assembly plant to make the hybrid Ford Explorer and PHEV Lincoln Aviator,<sup>3</sup> and plans to build a new EV in Flat Rock, MI.<sup>4</sup>
- Fiat Chrysler plans to build a Jeep Wrangler PHEV in Toledo, OH<sup>5</sup> and is preparing three assembly plants in Michigan for future plug-in hybrid production of Jeep vehicles.<sup>6</sup>

The UAW advocates for automaker investment in the domestic production of advanced technology vehicles in order to create quality jobs. But other decisions by automakers raise concerns about their commitment to US production of advanced technology vehicles.

- GM ended production of the Chevrolet Volt plug-in hybrid in February 2019. The Chevrolet Volt was made at GM's Detroit-Hamtramck plant, which GM has declared "unallocated" for future products.<sup>7</sup>
- Ford ended production in Wayne, MI of the C-Max Energi plug-in hybrid and the Ford Focus Electric EV in 2018.<sup>8</sup>
- Ford is beginning production of its first EV SUV in Cuautitlan, Mexico starting in 2020.<sup>9</sup>

*More Efficient Traditional Vehicles:* Electric vehicles and plug-in hybrids are just one part of a broader trend of improved fuel economy and reduced emissions in the auto industry. In the past decade, real world fuel economy has improved across all vehicle segments, from sedans to pickups.<sup>10</sup> UAW members not only assemble many of those vehicles, they also produce key components that improve vehicle efficiency.

For example, the UAW represents roughly 25,000 workers in automotive engine and transmission assembly in Indiana, Michigan, New York, Ohio, and Tennessee. Many of these workers are producing the latest technologies in internal combustion engines that are driving incremental improvements in fuel economy and emissions reduction fleetwide, such as engines with turbocharging, direct fuel injection, and cylinder de-activation or transmissions with 9 or 10 speeds. UAW members build cutting edge technologies in the heavy duty as well light duty motor vehicle sector.

Continued investment in US manufacturing to produce cleaner, more efficient products show that future technology trends in the auto industry can be a win-win for workers and the environment. This win-win is only possible if manufacturers commit to investing in production in the U.S., government trade and industrial policies promotes U.S. production of advanced technology, and workers have a voice in

the workplace to ensure the resulting jobs provide quality pay, benefits, and safety. Congress needs to make sure our laws provide sufficient incentives for domestic investments and remove perverse incentives that favor foreign investments over domestic.

**3. What are other countries doing to secure their piece of the market in the global clean vehicle economy? What can we learn from them?**

The auto industry is facing a new shift in technology with the proliferation of electric vehicles (EVs). This shift is an opportunity to re-invest in U.S. manufacturing. But this opportunity will be lost if EVs or their components are imported or made by low-road suppliers who underpay workers. In order to preserve American jobs and work standards, what is needed is a proactive industrial policy that creates high-quality manufacturing jobs making EVs and their components.

Other countries are ahead of the US on creating an EV supply chain by proactively promoting domestic production. China is promoting domestic production of EVs and EV components by favoring domestic firms and subsidizing its domestic EV market. Because of these policies, automakers are orienting their EV strategies toward China. And European countries have recognized that EVs could lead to key vehicle components being imported and are taking actions to promote a domestic supply chain.

*Will the U.S. Lose Out on the EV Supply Chain?*

No one knows for sure. Unfortunately, this is a distinct possibility. Automakers, governments, and other key stakeholders have shown a commitment to develop and produce EVs. Where those vehicles and components will be made remains an open question.

A January 2019 *Reuters* analysis of automaker investment announcements found over \$300 billion in pledged investment for vehicle electrification, with \$39 billion announced by U.S.-based automakers, \$139.5 billion from Germany-based automakers and \$57 billion from China-based automakers. However, the report also found a large portion of those investments from U.S. and German automakers are destined for China to address the country's tightening EV regulations.<sup>11</sup>

Besides competition over where EVs will be assembled, there is a global competition for control of the new EV value-chain. The prime example of this race is lithium-ion batteries. Lithium-ion batteries are the most valuable component in EVs. This has sparked a race to develop the production capacity to meet growing battery demand and it is this race that will determine the geography of much of the EV value chain.

Based on developments so far, the U.S. is falling behind Asian and European countries in lithium-ion battery capacity. It is projected that by 2023, 62% of battery manufacturing capacity will be in China and another 14% will be in Europe. North America will only have 12% of global battery production capacity.<sup>12</sup>

*China & Europe Are Taking Action:* How are other countries getting ahead on electric vehicle technology? It is through industrial policy that uses targeted, proactive policies to increase demand for EVs and promotes domestic production of vehicles and components.

For example, China has set ambitious targets for the new energy auto industry. This includes a sales target of 1 million EVs and plug-in hybrids in 2020 and 3 million in 2025. It calls for 80% global market share in EV batteries and electric motors by 2020, and to have two Chinese OEMs enter the global top 10 in sales by 2025.<sup>13</sup>

China has increased demand from consumers by offering a variety of purchase subsidies, tax breaks, and in-kind benefits to EV buyers. China has also stimulated demand through government procurement policies that mandate a portion of vehicle purchases are EVs or hybrids. As a result, China is leveraging its position as the world's largest automotive market and leading the world's largest automakers to orient their EV strategies toward China.

China has structured these incentives to support domestic production. For example, consumer subsidies are only applied to cars with government-approved batteries that favor Chinese-made batteries and government procurement is directed toward domestically produced vehicles.<sup>14</sup>

It is not just China that sees the importance of the new EV value chain. The European Union and its members countries have recognized that the lack of a domestic battery manufacturing base will undermine the region's competitiveness,<sup>15</sup> especially if the growth of EVs leads to key vehicle components being imported from elsewhere.

In a speech to the EU Members of Parliament, Vice President of the European Commission Maros Sefcovic put the issue in stark terms. "*The European battery market is expected to create four to five million new jobs. These can be jobs here in Europe or somewhere else*".<sup>16</sup>

To address these concerns, steps are being taken by European governments to develop a European-based EV supply chain. For example:

- In October 2017, the European Commission announced the creation of the European Battery Alliance. The goal of the alliance is to develop a “complete value-chain“ for manufacturing batteries in Europe<sup>17</sup> by coordinating with governments and stakeholders throughout the battery supply chain, including major European companies in the chemical, automotive, and engineering sectors.<sup>18</sup>
- In April 2019, the French and German governments announced plans for a state-subsidized battery cell consortium between automaker PSA, its German subsidiary Opel, and French battery maker Saft that will result in large battery factories in each country.<sup>19</sup>

*Policy Lessons to Lead on EVs:* What is needed is a proactive industrial policy that promotes the production of EVs and their components in the U.S. under higher road conditions that benefit American workers and the communities that rely on manufacturing jobs.

- **Infrastructure:** Vehicle electrification requires building a charging infrastructure for drivers and upgrading our energy infrastructure to meet electricity demand while ensuring electricity production is as green as the EVs themselves. This is an opportunity to create quality jobs to build, install, and maintain EV infrastructure.
- **Training:** Workers will need new skills and displaced workers will need re-training programs. Strong industrial policy should include every effort to re-train and place workers in quality jobs, provide strong economic support for workers during transition periods, and create robust government jobs programs to guarantee quality jobs for all those seeking work. We must expand training and apprenticeship programs that anticipate the types of future skills needed to produce, install, operate, and service products and equipment that utilize the new technologies which will be transforming our workplaces.
- **Trade and Tax Policy:** The economic potential of EVs will be lost if their components are imported. Advanced vehicle technology should be treated as a strategic sector to be protected and built in the U.S. Trade and tax policies should be aimed at ensuring EVs are manufactured in the U.S.
- **Tax policy should incentive domestic manufacturing.** Sadly, the opposite is often true today. Tax policies must hold companies accountable for eliminating jobs domestically by moving their operations offshore.
- **Environmental Policy:** Strong environmental standards can be structured as a win-win for the environment, workers, and the economy. Environmental policy should be used to address climate change while also promoting investment in future technologies that create quality jobs in the process.
- **Manufacturing Incentives:** Government incentives can promote production of EVs and EV components in the U.S. Such incentives should be used in a targeted way to promote a domestic EV supply chain and enforce high-road manufacturing practices.
- **Government Procurement:** Government EV fleet purchases, from cars to public transportation, can be a tool to spur demand and create cleaner transportation. Such purchases should be used to promote high-road jobs by considering where vehicles are assembled, their level of domestic content, and the labor conditions under which they were produced.
- **Consumer Incentives:** Consumer incentives are a tool to create a robust domestic EV market. This will encourage companies to orient their EV strategies toward the U.S. market. Consumer incentives should also be used to promote high-road domestic EV production. Incentives should be based on where the vehicle and its contents were produced and under what labor conditions.

#### **4. In your testimony, you referenced new technologies such as autonomous vehicles. What policies should Congress adopt to ensure that new technology trends in the transportation sector are good for the environment and for workers?**

While autonomous vehicles are in the early stages of development and years away from widespread deployment, it is important to establish standards today that ensure AV producers and operators are accountable to key stakeholders tomorrow. Advocates for AVs point to many potential benefits in safety, sustainability, and mobility, but those goals will only be fully reached if we have policies that take into account the impact AVs will have on jobs, communities, and the environment.

There is little dispute AVs will be disruptive. One study predicts that autonomous passenger vehicles and heavy-duty trucks could combine to eliminate 1.3 to 2.3 million workers' jobs by 2050, with most job losses occurring in the latter years.<sup>20</sup> Many more jobs will be radically changed. Congress should promulgate regulation and

policies that provide a comprehensive plan for addressing job displacement for workers in the transportation sectors. Unlike inadequate retraining programs meant to address job losses due to unfair trade policies, workers and communities should be held harmless from rapid technological change. AV regulations should ensure that the pace of AV deployment is driven by safety, security, sustainability, and efficacy and not used as a strategy to cut costs and destroy quality jobs. It is incumbent on Congress to ensure this transition is just. The UAW believes Congress should enact legislation that not only ensures American firms are global leaders in advanced transportation technology, but that affords American workers a just transition.

*Developing Domestic Supply Chains:* The mass production of AVs will create a valuable and strategic new supply chain in AV-specific components related to electronics and electrical architecture, semiconductors, graphic processing units, computer processing units, lidar, radar, cameras, and other sensors. As with EV-specific components, these AV-specific components represent an economic opportunity to re-invest in US manufacturing to produce the most advanced vehicle technology.

This opportunity will be lost if these key AV components are simply imported. Too often, corporations develop new products in the U.S., but outsource manufacturing to low-cost countries with weak labor and environmental regulations—limiting the environmental benefits of electric-autonomous vehicles. *Based on historical experience, once these supply chains are established outside of the U.S., they will be difficult to re-shore. Federal policy must strongly incentivize investment in and production of advanced technology components and vehicles in the U.S. The UAW recommends:*

- *Research and Development Grants Tied to U.S. Production:* Federal support for AV research and development should include incentives or mandates that commercialized production is done in the U.S.
- *Federal Subsidies for Manufacturing of Cutting-Edge Products:* Federal subsidies for manufacturing of AVs and AV components can be an important tool to incentive domestic production and should be targeted in a way that develop a full supply chain of domestically produced AV-specific components.
- *Support Trade Policy That Protects Strategic Cutting-Edge Components:* Trade policy should include safeguards for domestic production of strategic parts to ensure workers benefit from the new technology and the technology is made with the highest levels of safety and security.

*Developing an Infrastructure for the 21st Century:* New infrastructure will be required to regulate how AVs interact with their surroundings, including re-investment in traditional infrastructure and the development of new ‘smart’ infrastructure. Building new infrastructure is an opportunity to create quality jobs by mandating high-road labor standards and incentivizing the use of domestically manufactured equipment. The design of AV infrastructure must fairly address the concerns of key stakeholders and prioritize safety, quality job creation, environmental sustainability, and the well-being of local communities where the vehicles are being deployed.

A recent study found that on-demand transportation, which in the future may include autonomous vehicles, has significantly increased vehicle congestion.<sup>21</sup> Increased congestion could offset some of the freedom of movement and reduced environmental impact that electric AVs promise. A well-designed public transit system could counteract these inherent problems. Going forward, public transit should be the anchor that allows for proper and limited use of AVs. Requiring integration with a metro areas mass transit system would allow for public input on a system’s priorities, its environmental impact, and job quality.

*Developing a Just Transition for Workers:* Federal AV regulations or policies must include a comprehensive plan for addressing job displacement for workers in the transportation sectors, including negotiating job protections and retraining programs with labor organizations and funding a robust safety net to support displaced workers and provide them with new jobs. The burden of technological change should not be carried by working people.

*The government should intervene to help identify, and train workers for, the high value-added jobs associated with autonomous vehicles.* AVs will also create new types of transportation jobs. AV testing and fleet operation will require safety drivers, software operators, remote drivers, dispatchers, mechanics, cleaners, call center operators or customer service workers. Any AV operator that receives public support or permission to use public infrastructure should have to meet job quality standards. It is vital that the AV industry is not modelled on the “gig-economy”, with low-wages, contract labor, lack of benefits, and job insecurity. If these jobs are going to offset some of the job displacement of AVs, they must be good paying jobs that come with benefits, safety, and a voice in the workplace.

**5. Congress has provided incentives for consumers to expedite deployment of electric vehicles. When crafting these incentives, how can Congress ensure workers benefit from this expanding sector?**

Incentive programs to promote EV adoption must strongly encourage domestic production and high-quality jobs for workers to stabilize the middle class. Programs must be designed to promote manufacturing motor vehicles, batteries and components on U.S. soil and to hold manufacturers accountable for working conditions. For far too long, companies have received extensive support from taxpayers only to turn around and shirk their responsibilities to U.S. workers and our economy.

Publicly funded incentives are an essential component to stimulating a robust EV market. There continue to be barriers to widespread adoption of EVs. One major reason is higher vehicle prices, driven by the high cost of EV batteries. Although analysts project that electric vehicles will likely become price competitive with traditional vehicles in about a decade,<sup>22</sup> EV sales would need to accelerate on a shorter timeline in order to reduce emissions and combat the climate crisis.

*Incentives with labor standards should be required for all EV consumer incentives programs, government procurement policies, and manufacturing subsidies.*

Consumer incentives for vehicle purchases or residential charging installations are a policy tool that can increase the adoption of cleaner vehicles and nurture this new market. Consumer incentives should also be used to promote quality domestic jobs manufacturing EVs by considering where the vehicle was assembled, the level of the vehicle's domestic content, and the conditions under which the vehicle and components were produced, including wages, benefits, health and safety, and freedom of association.

In addition to labor standards, it is critical that EV incentives are offered across all types of passenger vehicles. Nearly all EVs and PHEVs available for sale in the last few years have been sedans, with few options for larger vehicles. Yet, consumers have moved away from sedans in favor of crossovers, SUVs, and pickups. Nationwide, car sales declined by 30% between 2013 and 2018, while all other segments grew.<sup>23</sup>

Reaching mass-adoption of EVs and PHEVs will require electrifying larger vehicle segments. Manufacturers are expanding beyond EV sedans and are starting to offer models that will include pickups, crossovers and SUVs. Consumer incentives for PHEVs and EVs should be structured to encourage automakers to offer electrified options in all segments.

For electrification to reach the broadest swath of consumers and vehicle segments, incentives should always include PHEVs. PHEVs are an important option for consumers who live in regions with limited charging infrastructure because they can combine gas and electric mileage for longer range. PHEV are often a more affordable option as well. The 2018 sales weighted average MSRP for PHEVs was more than \$10,000 cheaper than for EVs.<sup>24</sup> It is also likely that the first electrified versions of many larger vehicles will be PHEVs, with full EVs coming to market later.

*Procurement Policy:* Government EV fleet purchases, whether it is cars or public transportation, can be a tool for spurring demand and creating cleaner transportation. And EVs are well-suited for fleet purchases due to their operating cost advantages.<sup>25</sup>

These purchases can also be a tool to push EV production toward a high-road path, by conditioning such purchases upon standards of social responsibility. Such purchase policies would incentivize manufacturers to establish a production footprint in the U.S. and ensure that production has the positive economic impacts that come with quality manufacturing jobs.

*Manufacturing Incentives:* The electrification of the auto industry is still in its early stages and auto manufacturers are responding to a combination of regulatory requirements and consumer demand. The next few years will see the introduction of many new EV models, with nearly all major automakers setting ambitious goals for EVs and plans to spend over \$300 billion globally to transition to electric vehicles.<sup>26</sup>

While some manufacturers have made plans to invest in domestic EV production, without additional policy guidance and market growth, much of the industry could move overseas, compromising the quality of jobs and vehicles.

Policymakers should consider programs to stimulate investment in domestic EV assembly, including retooling existing plants, building new plants for EV assembly, as well as building batteries or other components. Such programs should ensure high quality jobs, and opportunities for workers to transition from building conventional combustion engines or parts to electric vehicles without loss of wages and benefits.

## REFERENCES

- <sup>1</sup> <https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2019/mar/0322-orion.html>
- <sup>2</sup> <https://www.bizjournals.com/louisville/news/2019/04/02/ford-unveils-new-louisville-built-escape-photos.html>
- <sup>3</sup> <https://www.freep.com/story/news/local/michigan/detroit/2019/07/22/ford-upgrading-chicago-assembly-plant-adding-450-jobs/1801125001/>
- <sup>4</sup> <https://media.ford.com/content/fordmedia/fna/us/en/news/2019/03/20/ford-adds-2nd-north-american-site-to-build-battery-electrics.html>
- <sup>5</sup> <https://www.toledoblade.com/business/automotive/2018/12/01/jeep-wrangler-hybrid-coming-quietly-to-a-woods-near-you/stories/20181130116>
- <sup>6</sup> <https://media.fcanorthamerica.com/newsrelease.do?id=20661&mid=>
- <sup>7</sup> <https://www.cbsnews.com/news/chevy-volt-discontinued-chevrolets-last-volt-rolls-off-the-assembly-line/>
- <sup>8</sup> <https://www.autonews.com/article/20180508/BLOG06/180509813/a-final-goodbye-to-the-ford-focus-c-max>
- <sup>9</sup> <https://www.thedrive.com/news/27066/ford-will-split-electric-vehicle-manufacturing-between-mexico-and-united-states>
- <sup>10</sup> <https://nepis.epa.gov/Exe/ZyPDF.cgi/P100W5C2.PDF?Dockey=P100W5C2.PDF>, p. 15
- <sup>11</sup> <https://graphics.reuters.com/AUTOS-INVESTMENT-ELECTRIC/010081ZB3HD/index.html>
- <sup>12</sup> <https://www.visualcapitalist.com/battery-megafactory-forecast-1-twh-capacity-2028/>
- <sup>13</sup> [http://english.gov.cn/policies/infographics/2015/06/02/content\\_281475119391820.htm](http://english.gov.cn/policies/infographics/2015/06/02/content_281475119391820.htm)
- <sup>14</sup> [http://www.nbr.org/downloads/pdfs/eta/heller\\_brief\\_092717.pdf](http://www.nbr.org/downloads/pdfs/eta/heller_brief_092717.pdf)
- <sup>15</sup> [http://europa.eu/rapid/press-release\\_STATEMENT-17-3861\\_en.htm](http://europa.eu/rapid/press-release_STATEMENT-17-3861_en.htm)
- <sup>16</sup> [https://ec.europa.eu/commission/commissioners/2014-2019/sefcovic/announcements/speech-launch-friends-eu-battery-alliance-european-parliament\\_en](https://ec.europa.eu/commission/commissioners/2014-2019/sefcovic/announcements/speech-launch-friends-eu-battery-alliance-european-parliament_en)
- <sup>17</sup> <https://ec.europa.eu/transparency/regdoc/rep/1/2017/EN/COM-2017-675-F1-EN-MAIN-PART-1.PDF>, page 10
- <sup>18</sup> <https://www.euractiv.com/section/electric-cars/news/airbus-style-eu-battery-alliance-splits-before-take-off/>
- <sup>19</sup> <https://www.reuters.com/article/us-france-germany-industry/france-and-germany-commit-to-european-electric-battery-industry-idUSKCN1S80SF>
- <sup>20</sup> [https://research.upjohn.org/up\\_technicalreports/36/](https://research.upjohn.org/up_technicalreports/36/)
- <sup>21</sup> <https://advances.sciencemag.org/content/5/5/eaau2670>
- <sup>22</sup> *Bloomberg New Energy Finance*, “Electric Vehicle Outlook 2018”: <https://about.bnef.com/electric-vehicle-outlook/>
- <sup>23</sup> *WardsAuto*, Sales Data
- <sup>24</sup> Argonne National Laboratory, March 2019, “Assessment of Light-Duty Plug-In Electric Vehicles in the United States, 2010–2018”: <https://publications.anl.gov/anlpubs/2019/03/151081.pdf>, page 16
- <sup>25</sup> [https://www2.deloitte.com/content/dam/insights/us/articles/3851\\_FoM-Power-and-utilities/DeloitteInsights\\_FoM-P&U.pdf](https://www2.deloitte.com/content/dam/insights/us/articles/3851_FoM-Power-and-utilities/DeloitteInsights_FoM-P&U.pdf), page 6
- <sup>26</sup> <https://graphics.reuters.com/AUTOS-INVESTMENT-ELECTRIC/010081ZB3HD/index.html>

**Questions for the Record****Tarak Shah****Former Chief of Staff, Under Secretary for Secretary and Energy****U.S. Department of Energy**

THE HONORABLE KATHY CASTOR

**1. Could you please describe overall funding levels for federal energy innovation efforts? In the context of the climate crisis, are these levels adequate and are there any areas that deserve special emphasis?**

The last comprehensive official survey of U.S. Government clean energy R&D funding levels was completed in 2016. At the time, the Office of Management and Budget found that Congress had enacted \$6.4B in clean energy R&D funding in FY 2016 across the government, \$4.8B (or approximately 75%) of which was appropriated to the U.S. Department of Energy (DOE).

Since then, Congress has increased funding to DOE’s science and clean energy programs by about 20%. Congress deserves credit for increasing DOE funding even as the current administration has proposed gutting federal energy innovation programs.

Even so, the rate of increase in energy innovation funding is not fast enough. Along with nearly two-dozen other countries, the United States committed to doubling its national clean energy innovation programs between 2016 and 2021. Other countries are making good on their commitments. If the United States does not, the jobs and economic opportunities associated with these types of catalytic government investments will flow to the countries that are stepping up to the plate.

In the United States, we are particularly underinvested in energy innovation in the transportation, buildings, and industrial sectors, in comparison to their shares of greenhouse gas (GHG) emissions. Congress should more than double clean energy innovation efforts in these areas.

**2. In your testimony, you mentioned that there are programs at the U.S. Department of Energy (DOE) that focus on industrial efficiency improvements. Should the mandate for these programs be updated in the context of the climate crisis, and if so, how? Please feel free to reference specific DOE programs.**

The U.S. industrial sector is the source of about 22% of our GHG emissions. DOE's Advanced Manufacturing Office (AMO) works to help reduce these emissions by improving energy efficiency in our nation's factories. While there is much more to do to improve the energy efficiency of our industrial processes, there are thermodynamic limits on how much efficiency can be achieved. In other words, the industrial sector will always generate some greenhouse gas emissions even if energy efficiency is implemented fully. Therefore, to get to net zero by 2050 (as is required to prevent the worst impacts of climate change), industry must capture those remaining emissions.

Given the research challenges and large capital requirements of innovation in this area, the federal government needs to lead the way. Carbon capture, utilization, and sequestration (CCUS) technologies, electrification of process heat, and substitution of low-carbon fuels for fossil fuels hold promise for the industrial sector but need more research to reduce costs and commercialize.

The current legislative authorization for DOE, last updated in 2005, does not mention climate change (Energy Policy Act of 2005, Section 902). In addition, the authorized goals for AMO (Energy Policy Act of 2005, Section 911) are exclusively focused on industrial energy efficiency. So much has changed in our energy sector since 2005. Congress should comprehensively update DOE's statutory goals to include climate considerations, both at the agency level, and to authorize AMO to develop a broader set of industrial decarbonization solutions, including industrial CCUS technologies. H.R. 3978, the Clean Industrial Technology Act of 2019 would promote this goal.

In addition, DOE should elevate the level and widen the focus of its buildings and industrial RD&D by raising the level of the office from the current Deputy Assistant Secretary for Energy Efficiency to a new Assistant Secretary for Buildings and Manufacturing.

**3. In your testimony, you mentioned the potential for offshore wind development in the United States. What policies should Congress adopt to scale up deployment of this vast, clean resource?**

DOE estimates that more than 2,000 GW, or two times the combined generating capacity of all U.S. electric power plants of offshore wind resources exist in the state and federal waters of the United States and the Great Lakes. While not all of this will be realistically developed, to date, we have 30 MW of operating offshore wind in the U.S. That equals .0015% of our potential capacity.

Furthermore, these offshore wind resources are near coastal population centers, which need new clean energy resources, but face onshore land constraints. In addition to funding additional research into offshore wind technologies, Congress should extend the federal Investment Tax Credit for offshore wind. Without action, the credit is set to phase out this year, cutting off investments in offshore wind, just as the costs for this technology is beginning to support widespread deployment. In addition to extending the tax credit for offshore wind, Congress should consider mechanisms to facilitate investments in transmission infrastructure to bring the robust offshore wind energy to load centers.

**4. In your testimony, you mentioned that DOE appliance standards have saved consumers almost \$1 trillion dollars. Could you please describe additional ways that new technologies can help consumers save money? What are some examples?**

DOE's appliance standards program sets minimum efficiency levels for 60 commercial and consumer products, such as refrigerators, lighting, washing machines, dryers, and heating and cooling systems. Working with industry, this program brings together manufacturers, consumer advocates, environmental advocates and states to continually raise the game on the efficiency of appliances in our homes and businesses.

The standards program has driven remarkable efficiency gains in household appliances and equipment. For example, today, the typical new refrigerator uses one-quarter the energy than in 1973—despite offering 20% more storage capacity and being available at half the retail cost. Since 1990, new washing machines use 70%

less energy, air conditioners use 50% less energy, and dishwashers use 40% less energy.

Overall, these standards already help save consumers \$1 trillion over the past 30 years, and will save them another \$1 trillion over the next decade. Put another way, the program helps the average family nearly \$500 per year through lower energy bills. This also has the effect of reducing GHG emissions.

Congress requires DOE to update these standards every six years, but the current administration has slowed this process, and in some cases is attempting to roll back existing standards. Over time, this will mean that Americans will pay higher energy bills and emit more GHGs than they would if DOE was updating these standards.

Doing so also weakens U.S. industry. American manufacturers are always at the technological cutting edge, and they are the best positioned globally to develop new products that meet energy efficiency standards. By rolling back these standards, the current administration is giving foreign competitors with inefficient technologies an advantage over domestic companies. DOE should instead be strengthening the standards, which would increase energy efficiency and save consumers even more money on energy costs.

**5. In your testimony, you mentioned how policies could be strengthened to ensure that projects that receive funding from DOE have domestic manufacturing plans. Could you expand upon what Congress should do to better safeguard domestic production of taxpayer-funded technologies?**

Under a provision of the Bayh-Dole Act, DOE's Energy Efficiency and Renewable Energy (EERE) and Advanced Research Projects Agency-Energy (ARPA-E) programs require award applicants to submit U.S. Manufacturing Plans. These plans state an awardee's commitment to manufacture technologies resulting from DOE awards in the United States.

Congress should ask DOE to strengthen this requirement by applying it to all applied energy RDD&D programs (not just EERE and ARPA-E) and to develop recommendations for strengthening proposed manufacturing plans. Specifically, the current law gives the Federal government very few mechanisms to enforce the commitments that awardees make in their plans. At most, DOE could bar an entity that violated the terms of its U.S. Manufacturing Plan from competing for future awards.

Stronger mechanisms could include clawback provisions for offshored intellectual property or financial compensation for U.S. taxpayer sponsored technology that is manufactured offshore. DOE is well suited to address the pros and cons of strengthening the requirements and enforceability of these plans.

**6. In your testimony, you mentioned that support from DOE programs, particularly in the Advanced Manufacturing Office, helped drive down the price of clean energy technologies. Could you please provide examples of how the Manufacturing USA Institutes have produced real results for the U.S. economy and clean energy in particular? How could Congress help these existing institutes meet the scale of the climate crisis?**

The Manufacturing USA Institutes are a national network of federally sponsored manufacturing institutes, each with their own technological concentration, but designed to accelerate U.S. manufacturing as a whole. DOE sponsors six of these institutes, focusing on topics like solid-state power electronics, advanced composites, and chemical manufacturing.

The first of these institutes, Power America, is approaching its fifth year in operation. Based on manufacturing advances developed at Power America, a foundry in Texas is the first in the world to manufacture 6-inch Silicon Carbide (SiC) wafers. SiC semiconductors represent a revolutionary new design for computer chips. Computer chips are at the base of the supply chain for every clean energy technology—so if we can build them here, we have an advantage when it comes to building all the things they are in as well—from solar technologies to electric vehicles (EVs) and beyond.

Congress and DOE originally agreed to support these institutes for five years, at which time they would become self-sustaining. Other countries with similar technology-specific clean energy manufacturing institutes support their entities indefinitely. This is because experience shows that it takes more than five years to build enterprises on the scale of these institutes. Congress and DOE should work together to determine a new, competitive funding mechanism to support these institutes after their initial five years of funding ends. The advances they have made are substantial, and the investments U.S. taxpayers have made risk being stranded without additional federal support. In addition, because the model has been so successful, Congress should ask DOE to identify new potential topic areas that would be well suited for the institute model.

**7. What are other countries doing to secure their piece of the market in the global clean energy economy? What can we learn from them?**

Other countries have holistic, sector-centric models to address the climate crisis. For example, some countries like the U.K. have set overall carbon budgets by sector and then are applying a comprehensive range of solutions, including R&D, market and deployment incentives, workforce development, and regulation to achieve their goals.

Yet other countries are examining future technologies on a case-by-case basis and deciding if they want to lead the market. For example, a decade ago, China looked at solar PV manufacturing and decided to become the world leader. Because of their expertise in solar manufacturing, they are now a world leader in semi-conductor manufacturing, which has enabled them to become a world-leading computer manufacturer. And because future clean energy products like EVs are heavily digitized, they now have an advantage in that space.

The United States should be looking at the future clean energy business in much the same way other countries are—based on both the moral imperative and the size of the economic opportunity. Upon examining technologies like next generation solar, offshore wind, EVs, carbon capture, advanced nuclear, renewable hydrogen, energy efficient appliances and others, we would recognize that we have historical strengths in each of these areas.

With the right combination of catalytic tools from the federal government, we can lead the world on each of these technologies. But it takes a comprehensive array of federal programs, not ad hoc, one-time interventions by Congress and the federal agencies.

**8. Congress has provided incentives to wind and solar companies to expedite deployment of this zero-carbon source of electricity. When crafting these incentives, how can Congress ensure workers benefit from this expanding sector?**

For those wind and solar products that are imported into the U.S., Congress should ensure that trade agreements with the countries they are manufactured in include rigorous labor and environmental standards. In other words, American workers who build solar panels and wind turbine components should not be penalized for making a fair wage or building them without destroying the environment. A number of trade deals are in various stages of development with countries that send their solar and wind products to the U.S. at the moment, so this is a crucial time to ensure such protections are put in place.

THE HONORABLE BEN RAY LUJÁN

**1. Given the magnitude of the industrial decarbonization challenge, I'd like to ask you, Mr. Shah, on how we can begin to address such a problem. Given that we need to reduce emissions from a wide range of manufacturing processes, such as steel, iron, aluminum, concrete, chemicals, and a whole host of other products that are essential for our economy, are there existing technologies that we can build and learn from and adapt to suit the needs of reducing emissions from manufacturing?**

This is an important question because the Environmental Protection Agency reports that 22% of U.S. emissions come from the industrial sector. When examining the range of solutions by sector, industry is generally thought of as the most difficult to decarbonize from a technological perspective. On the other hand, industrial emissions are well known, and relatively concentrated, which means that once we begin to apply solutions, they can make a big difference quickly.

The solution set is two fold. One, there must be a financial imperative for industry to decarbonize. Right now, there is no a market signal that would either incentivize or disincentivize industry to pollute. Incentives could come in the form of a tax credit for reducing emissions, either through efficiency, electrification, low-carbon fuels, or carbon capture, utilization, and storage (CCUS). The 45Q tax credit is a start, but without clear guidance from IRS, remains difficult for companies to access. Even after guidance is promulgated, more incentives are required. Disincentives to pollute can also spur action. For example, implementing a price on carbon pollution would also stimulate quick action to reduce GHGs from industry.

For these financial incentives to work, we also need new technological solutions for industrial energy efficiency and CCUS. For 2019, Congress appropriated \$320 million for DOE's Advanced Manufacturing Office, or less than 1% of DOE's overall appropriation. There is a huge array of energy innovation options for industry, but we are not examining them robustly because we have not made it a funding priority. More funding is needed. In addition, the authorized goals for AMO (Energy Policy Act of 2005, Section 911) are exclusively focused on industrial energy efficiency. As Congress considers updating DOE's statutory mandate, it should authorize AMO to perform research on industrial CCUS technologies.

**2. When we talk about innovation in the manufacturing sector, we are going to need to find new ways for the federal government to partner with the private sector, academia, and philanthropy. We have seen some agencies establish non-profit foundations to better support their missions. For example, the Foundation for the National Institute of Health has raised over \$1 billion dollars and supported over 550 projects. I have introduced the bipartisan, bicameral IMPACT for Energy Act, which would create a foundation for the Department of Energy. Should we consider these models to accelerate the development and deployment of clean energy technologies at the Department of Energy? How could a non-profit alongside the Department of Energy assist the Department in its mission and better leverage federal resources?**

99% of U.S. energy infrastructure is in the hands of the private sector. That means that the federal government cannot transform our energy mix without active participation from the private sector. That is why accelerating the commercialization of research and technology through increased access to private sector funding and new models for public-private partnership is critical.

As it has done with other federal agencies, a DOE Foundation could be an important tool to address early-stage gaps in the energy innovation cycle, which are hampering DOE's ability to spur the adoption of transformative technology in the market. Congress rightfully included a study by the National Association of Public Administration in the FY2020 appropriations to look at this question, because there is a lot to learn about what this opportunity could deliver.

In general, new energy technologies have a particularly difficult time getting to the market because they require a significant amount of capital and very long commercialization timelines. They also are deployed into an incumbent dominated market with large barriers to entry. These barriers could potentially be overcome through unique partnership models created by a foundation where communication and collaboration between the private sector and the DOE can be facilitated. These models have already been demonstrated by the Foundation for the National Institutes for Health and the CDC Foundation.

Over the last several years DOE has experimented with hubs, consortia, Energy Frontier Research Centers, and institutes. These new research models are important funding experiments. The DOE Foundation could serve as another model—one built off of an already proven experiment—and I encourage DOE and Congress to further consider the idea.

THE HONORABLE MIKE LEVIN

**1. Mr. Shah, in your testimony, you described the California “Buy Clean” procurement policy. How does a “Buy Clean” policy incentivize U.S. manufacturing?**

The State of California recently instituted a policy that requires the state to take the emissions related to producing steel, glass, and insulation from different manufacturers into account. For example, all things being equal, if one steel company produced lower emissions steel than another, the State would give that company preferential treatment in purchasing.

The federal government is a huge purchaser of finished goods and construction materials. This, for example, includes cement and steel for federal highways, glass and concrete for housing projects, and vehicles for the federal fleet. If the federal government instituted a similar set of ‘buy clean’ provisions, it would incentivize competition among producers to reduce the amount of GHGs released when manufacturing their products.

**2. If Congress were to adopt a Federal “Buy Clean” policy, what essential elements would need to be part of the policy?**

“Buy clean” policies must apply equally to all products, regardless of whether they are produced inside or outside of the U.S. Without such a provision, manufacturers could be incentivized to produce highly polluting products outside of the U.S. for import, harming domestic manufacturing.

The monitoring and verification of companies GHG certifications are also important. Many proposed or enacted ‘buy clean’ policies around the world rely on established eco-labels or other certification programs. However, not all certifications are created equal, so strong rules need to be put in place early to make sure companies are operating on a level playing field.

In addition, acquisition officials should be able to examine the overall life-cycle costs of a product, to include weighing the long-term environmental benefits of a clean product, as opposed to simply awarding a contract to the lowest bidder.

Finally, federal agencies should be able to continuously raise the bar for purchased products, as lower GHG options appear on the market, without seeking additional authorization from Congress.

**Questions for the Record**

**Edward Stones**

**Global Business Director for Energy and Climate Change**

**Dow**

THE HONORABLE KATHY CASTOR

**1. In your testimony, you reference the fact that the Dow Chemical Company is one of the largest users of renewable energy in the chemicals industry. What Federal policies could facilitate greater use of renewable energy by companies like Dow?**

Technologies such as energy storage and demand-response need support to reach the point of economies of scale. Both of these technologies should form part of a broad, cost-competitive environment for large companies such as Dow. Both are essential to grid stability in the long term, and will be needed for further gains in renewables penetration.

Over the past years the renewable energy markets in the United States grew thanks in part to the federal support received through the Renewable Electricity Production Tax Credit (PTC) and the Business Energy Investment Tax Credit (ITC). Onshore wind and solar energy reached technologies of scale, making them cost-competitive in comparison to traditional means of creating power, thus expanding their accessibility to large users such as Dow. Today, both onshore wind and solar technology are competitive beyond the federal support received through the PTC and the ITC, so that continued federal credits are unnecessary.

Information from the Renewable Energy Buyers Alliance, based on publicly announced contracted capacity of corporate Power Purchase Agreements, Green Power Purchases, Green Tariffs, and Outright Project, shows that in 2014 there were eight transactions with a volume equal to 1.2 GW of capacity; by year-end 2018 there were seventy-five transactions with a total volume of 6.36 GW of capacity. Since 2014 companies have contracted almost 20 GW of renewable energy capacity.

Until there is wide spread adoption of energy storage options, which we foresee post 2030 at the earliest, gas fired energy generation will be required to offset renewable energy intermittency. Additionally, companies like Dow require process heat in significant amounts, with high temperatures and pressures. Few options other than nuclear exist for low carbon alternatives or renewables. Carbon Capture and Storage (CCS) and Carbon Capture, Utilization, and Storage (CCUS) are critical technologies and policy solutions. State and federal governments have a role to play in defining and enabling the infrastructure required for collecting and moving captured CO<sub>2</sub>. Next generation nuclear facilities are also potentially a source of zero carbon steam and power, as well as grid reliability.

**Questions for the Record**

**Zoe Lipman**

**Director, Vehicles and Advanced Transportation Program**

**BlueGreen Alliance**

THE HONORABLE KATHY CASTOR

**1. What types of Federal policies should Congress enact to facilitate greater manufacturing of clean vehicle and clean energy technologies in the United States?**

An effective advanced and electric vehicle manufacturing agenda would couple strong globally leading standards and targets—most notably globally leading, strong, long-term fuel economy and vehicle greenhouse gas (GHG) standards—which give companies the certainty they need to invest in America, together with an aggressive push to manufacture vehicles and strategic components here in the United States.

The key elements of that agenda include:

- A robust investment to spur advanced and electric vehicle (EV) and technology manufacturing and supply chain. This could include:
  - New programs to support establishing, upgrading or converting domestic clean vehicle and technology manufacturing—such as an industrial bank, new bonds, grants, or revolving loan programs.
- Expansion of the loan, grant, and tax programs we have today to help companies build, retool, or convert manufacturing plants in America. These include, for example, the Advanced Technology Vehicles Manufacturing (ATVM) loan program, 48C manufacturing tax credit, the Section 132 manufacturing conversion grant program, and others. Across these programs, to enhance the benefits for the economy, communities, and working people, we should:
  - Incentivize responsible labor, community, and supply chain practices and prioritize reinvestment in existing or idle facilities and in deindustrialized, impacted, underinvested communities;
  - Prioritize economically strategic and emerging technology and materials; and
  - Encourage consortia of assemblers and suppliers—and small- and medium-sized manufacturers—and aid states and municipalities in investing in local priorities and clusters.
- Act to responsibly produce critical minerals and materials and to launch new domestic recycling and reclamation projects—as discussed further below;
- Boost public investment in EV fleets and infrastructure and ensure that all public spending supports efforts to build critical components here and to secure and build good family-supporting jobs. This means:
  - Improving, enhancing, and extending the applicability of long-standing procurement standards and tools such as Buy America/n and Davis Bacon prevailing wage—as well as newer procurement approaches that enhance labor standards, workers’ rights, career pathways, equity and community benefits—to ensure the use of domestically manufactured, clean, and safe vehicles and infrastructure and to raise labor standards throughout the supply chain; and
  - Ensuring all public spending—such as tax incentives, loan, grants, and bonds—also support—and do not undermine—the manufacturing of domestic clean vehicle technology in America, and promoting high labor standards, and safe and healthy manufacturing throughout the supply chain.
- Make globally competitive levels of investment in research and development and ensure innovation is translated into domestic manufacturing and growth of supplier networks. This could include, for example:
  - Establishing and implementing a national clean energy and technology manufacturing strategy;
  - At least doubling funding for research, development, and deployment (RD&D) to levels commensurate with competitor nations, and enhancing and emphasizing initiatives focused on translating tax-payer funded R&D into full-scale deployment and manufacturing;
  - Establishing coordinated RD&D and manufacturing initiatives aimed at capturing the full supply chains for critical clean technologies—such as EV cells, batteries, and related electronics—in the United States; and
  - A focus on developing and deploying innovative recycling and reclamation initiatives for key materials in the advanced automotive supply chain.
- Enact fairer trade, labor, and corporate tax policies that can stem advanced tech offshoring and exploitative labor practices while driving a new generation of investment in domestic plants, workers, and training.

**2. How could Federal policies encourage greater reclamation and recycling of lithium-ion batteries from electric vehicles? Are there any promising state policy models that could be an example?**

Federal policy makers should make it a priority to explore ways to jump-start domestic efforts to responsibly reclaim and recycle key economically strategic materials—such as lithium—and to spur deployment of innovative circular economy processes and products.

Past experience with conventional lead acid automotive batteries has shown that very high recycling rates are possible, but that moving the recycling processes to other countries both costs jobs in the United States, and can result in serious lead pollution and exposure problems in the host country if there are less stringent environmental standards and oversight.<sup>1</sup>

With the new generation of lithium ion automotive batteries (and any subsequent battery chemistries), developing economically, socially and environmentally responsible recycling processes domestically will be critical and can also help ensure a more secure domestic supply of lithium. The same is true of many other comparatively rare minerals and materials that are part of advanced vehicles.

There may also be important second life use of electric vehicle batteries, and any recycling processes likely should be coordinated with increasing use of similar batteries for residential, commercial, and utility energy storage.

Federal policies that could spur the development of effective advanced battery recycling include, for example:

- Develop a national strategy to ensure we are creating the materials necessary for a clean and secure energy future here in the United States;
- Include investment to spur domestic projects to responsibly reclaim and recycle strategic minerals and materials—or to deploy circular economy technologies—as one of several key priorities for an industrial bank, or revolving loan fund, as discussed above; and
- Enhance funding to develop and deploy new recycling and reclamation approaches through existing grant, loan, tax, and other clean energy investment incentives.

BlueGreen Alliance is just now beginning a review of state level policies that may be relevant—so we are unable to answer this portion of the question comprehensively—but initial assessment suggests that, a) encouraging states to address recycling proactively as the industry matures will be extremely valuable, and b) across materials recycling and reclamation, some federal role to sustain effective recycling programs across the inevitable wide swings in global commodity prices will be essential.

**3. In your testimony, you mentioned the potential for offshore wind development in the United States. What policies should Congress adopt to ensure that American workers benefit from deployment of this vast, clean resource?**

The potential for responsible offshore wind development in the United States is indeed substantial. According to the U.S. Department of Energy, if we utilized even one percent of the nation’s technical potential offshore wind capacity, we could power nearly 6.5 million homes. We have the technology to harness wind power off the coasts of at least half of our states, and the industry is rapidly expanding both domestically and internationally.<sup>ii</sup>

With this industry expansion comes tremendous potential to create and sustain quality, union jobs. Jobs in the offshore wind industry include designing the wind farm; constructing the onshore substations; laying cable interconnections; erecting the turbines; permitting; manufacturing rotor and nacelle controls, gearboxes, drive trains, generator and power electronics, steel towers, electrical wiring, advanced polymers, and coatings; construction; and operations and maintenance. Trades included in these various stages include operating engineers, pile drivers, millwrights, welders, electrical workers, utility workers, ironworkers, steelworkers, and machinists.

Estimates put job creation potential off the Atlantic Coast alone at somewhere between 133,000 and 212,000 jobs per year in the United States.<sup>iii</sup> Additionally, the National Renewable Energy Laboratory (NREL) cites that the Atlantic coast states could create \$200 billion in new economic opportunity, as well as over 43,000 high-paying, permanent jobs, simply by developing 54 GW of their 1,283 GW offshore wind energy potential.<sup>iv</sup>

In order to truly capture the full benefits and potential of these projects, it is critical that they are built by skilled workers who are paid family-sustaining wages, with project labor agreements in place, and with materials manufactured here in the United States.

Offshore wind projects rely heavily on skilled labor and advanced manufacturing for construction, installation, maintenance, and operations. For example, the Block Island project—a comparatively small, demonstration project—created more than 300 jobs in the state alone<sup>v</sup> for local unionized craftsmen in ten different building trades locals, working for 30 unionized contractors and subcontractors.<sup>vi</sup> This was thanks—in large part—to the project labor agreement (PLA) in place for Block Island.

PLAs are particularly critical in these projects because they bring coordinated, proactive planning to complex projects; provide crucial benefits to local communities in terms of skills training, employment opportunities, and future workforce development; and ensure that the most productive and skilled craft labor is available to work on a project. In addition, as wind farms and their components age, skilled workers in operations and maintenance will continue to prove necessary to the operation of the farms, so it is important to ensure that jobs throughout the life cycle of a wind farm are quality, family-sustaining jobs

In addition to the construction phase of these projects, a critical component of the job creation potential for the offshore wind sector is the vast manufacturing supply chain that offers major opportunities for growth in a variety of sectors.

As the industry grows, sourcing components domestically represents a significant opportunity to help revitalize American manufacturing. The Special Initiative for Offshore Wind's recent white paper predicts an almost \$70 billion buildout of U.S. offshore wind supply chain by calculating growth in a number of sectors, which include wind turbines and towers; turbine and substation foundations; upland, export, and array cables; onshore and offshore substations; and marine support, insurance, and project management.<sup>vii</sup>

Finally, the development of wind energy off our coasts can also provide important and much needed support to local communities in our coastal states. Community benefit agreements, designed in coordination with organized labor and local community organizations, help maximize a project's contribution to local communities, and ensure that local communities support the project in question.

If we do this right, the American people can feel confident that emerging industries—such as offshore wind—will secure employment today and support the creation a new generation of family-supporting jobs across the nation.

By supporting a wide variety of workforce development strategies targeted at this burgeoning sector, including union training and apprenticeship programs, legislation like the H.R. 3068 the Offshore Wind Jobs and Opportunity Act can also help ensure that workers have access to the skills training they need to take advantage of this important and emerging industry.

#### **4. What are other countries doing to secure their piece of the market in the global clean energy economy? What can we learn from them?**

Worldwide, countries are rushing to capture the economic benefits of the rapidly growing clean energy economy—and they are using the full range of policy tools to do so. If it is to compete, the United States needs a much more aggressive and coordinated strategy to capture the innovation, investment, jobs, and manufacturing gains from the clean economy.

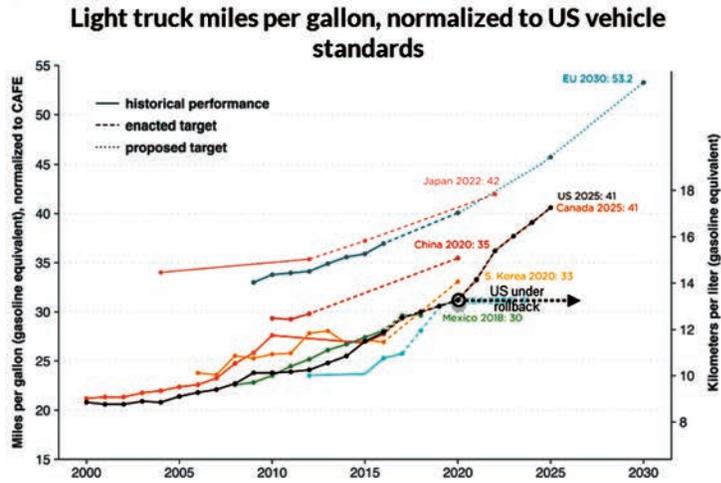
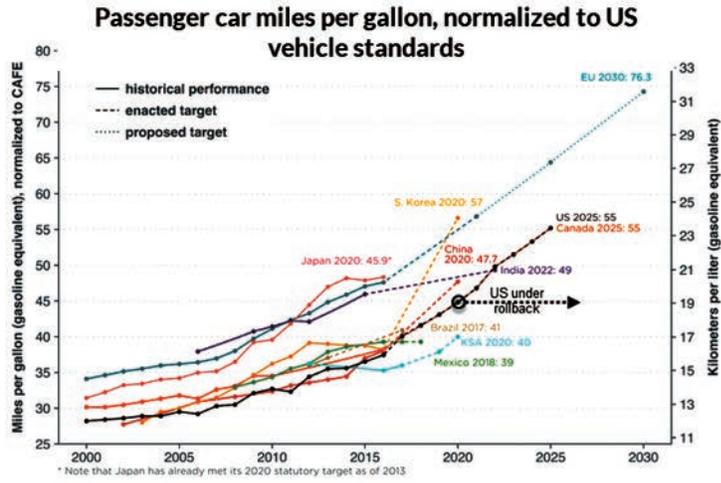
BlueGreen Alliance has not itself carried out any recent detailed research on global policy shifts, but a number of our partners and allies have focused on this question, and we would urge the committee to engage them further on this topic. Drawing on their expertise, however, and looking at the EV industry as an example, we make a few high-level comments about what is needed:

- *Coordinated strategy and industrial policy:* Both in China and the European Union, as well as elsewhere, countries are developing comprehensive long term strategies to deploy and produce EVs and the key technologies that go into them. These strategies often include energy and emissions targets and regulations, consumer and industry incentives, and economic development and manufacturing strategies working together. The United Auto Workers's recent report *Taking the High Road: Strategies for a Fair EV Future* provides a brief summary of EV policy, incentives, and approaches globally.<sup>viii</sup>

- *Long-term policy leadership:* Strong, certain, long-term emissions standards and targets are critical to giving manufacturers the certainty about future markets necessary to make large long-term investments in advanced technology manufacturing. Where countries' markets lead, investment follows. Over the past decade U.S. vehicle emissions standards have moved to equal or exceed those worldwide. As shown in Figure 1 below, however, a rollback of current fuel economy standards would put other nations back in the driving seat. The Motor Equipment Manufacturers Association—the largest automotive supplier association—has testified to the impact that this change in direction and continued uncertainty could mean to decisions multinational corporations make with respect to where they located their advanced technology manufacturing.<sup>ix</sup>

- *Turning innovation into manufacturing and jobs:* A number of countries, but particularly Germany and the EU, have more comprehensive programs for coupling R&D, commercialization, manufacturing, and workforce development and a focus on developing expertise and manufacturing across the full electric propulsion supply chain.<sup>x</sup> Many opportunities exist to better coordinate and fund U.S. RD&D and manufacturing programs, and to better ensure that taxpayer funded innovation, patents, and intellectual property are turned into to domestic manufacturing and jobs gains.

Figure 1: Comparison of vehicle emissions standards worldwide. Underlying diagrams come from the International Council on Clean Transportation (ICCT)<sup>xi</sup> with titles and bars showing rollback added by BlueGreen Alliance.



**5. In your testimony, you described the Solidarity for Climate Action principles labor unions and environmental groups developed jointly. The principles include a call for a commitment to high-quality job creation across all sectors of the economy, but especially related to clean energy, adaptation, and resilience. There are existing domestic manufacturing plants that could be retooled or converted to focus on manufacturing advanced and electric vehicles and other new technologies. What kind of Federal policy could incentivize companies to invest in upgrading these plants?**

There is a lot more federal policymakers could do to help ensure we manufacture advanced and electric vehicles and technology—and other clean energy, technology and materials—in existing manufacturing plants, and that America’s manufacturing workers and communities see the benefits of technological innovation and change.

As discussed above, an effective clean technology manufacturing agenda would couple globally leading energy and vehicle standards and targets—which give companies the certainty they need to invest in America—with an aggressive push to manufacture vehicles and strategic components here in the United States.

As part of a robust and coordinated manufacturing agenda, any new industrial bank or revolving loan program should prioritize investment in existing or idle facilities and in deindustrialized, impacted, underinvested communities. There is also room to better utilize existing programs. The ATVM Loan Program, for example, expressly funds manufacturing retooling and plant conversion and could be improved and expanded to be applicable to a wider range of facilities. Similarly, Section 132 of the Energy Independence and Security Act of 2007 created a program to provide grants specifically to convert existing or recently closed facilities to build clean vehicle technology—but was never funded by congress.

In addition, policymakers need to stop and reverse actions and policies that encourage plant closures and offshoring and drive the jobs of the future overseas. This includes:

- Realigning corporate tax and finance rules and incentives to encourage investment in domestic plants and workers and to discourage outsourcing and offshoring—particularly in critical energy and technology sectors; and
- Ensuring that any NAFTA replacement includes strong, fair, and enforceable labor and environmental standards and that existing trade rules and remedies are improved and enforced.

Finally our energy and climate policy choices matter. For example, since 2007 smartly structured fuel economy and vehicle GHG standards have driven tens of billions of dollars in reinvestment in American manufacturing across the automotive supply chain.<sup>xii</sup> As we discuss in detail in our recent report *Tech@Risk*, the proposed rollback or radical weakening of these standards not only puts jobs in today’s factories at risk, it discourages future investment to locate, upgrade, retool, or convert American factories to build the clean vehicle technologies of the future at the potential cost of nearly 90,000 future manufacturing jobs.<sup>xiii</sup>

**6. Congress has provided incentives to wind and solar companies to expedite deployment of this zero-carbon source of electricity. When crafting these incentives, how can Congress ensure workers benefit from this expanding sector?**

As discussed above, all our major incentives and public investments—not just those in infrastructure—can and should be structured to ensure they create good jobs and build strong clean energy manufacturing industries in America.

Congress should consider requiring strong procurement policies that ensure the use of domestic, clean, and safe materials and technology made by law-abiding corporations throughout the supply chain for all purchases made with public funds provided by tax incentives. In addition, Congress should consider requiring mandatory labor standards for employers accepting clean energy tax incentives—including prevailing wages, safety and health protections, project labor agreements, community benefit agreements, local hire, and other provisions and practices that prioritize improving training, working conditions, and project benefits.

The *Good Jobs for 21st Century Energy Act* recently introduced by Senator Merkley and 10 co-sponsors provides an initial example of some such policy provisions with respect to energy tax credits.<sup>xiv</sup>

THE HONORABLE MIKE LEVIN

**1. Ms. Lipman, what are your views on a Federal “Buy Clean” policy?**

The manufacture of raw building materials like steel and cement produces 11% of total global greenhouse gas emissions and is on the rise. But because these commodities are exported around the world, the countries that consume them rarely ac-

count for the carbon it took to produce them, and manufacturers are not rewarded for making low-carbon products.

Buy Clean policies help close this “carbon loophole” by helping ensure taxpayer dollars are spent on climate-friendly materials for infrastructure and building projects. Wide-scale adoption of Buy Clean state and federal purchasing programs would reward companies that are cleaner and more efficient. It would give American manufacturers and workers a tremendous opportunity to take the lead in growing markets for low-carbon products, and help prevent the offshoring of pollution and jobs overseas.

**2. If Congress were to adopt a Federal “Buy Clean” policy, what essential elements would need to be part of the policy?**

In crafting a policy of this kind, it is essential to work together with agencies, business, labor, and other key stakeholders to develop a strong solution and policy framework.

A key design consideration should be the impact of this policy on the U.S. industrial sector and the competitiveness of our manufacturers. The policy must result in a strengthening of U.S. manufacturing and ensure quality manufacturing jobs here in the United States. Without careful attention to the trade exposed nature of these industries, unintended consequences could occur. This consideration should inform policy design, including structure and application of the standard.

At a federal level it would be helpful to identify what products the federal government procures by agency above a certain de minimus threshold, in order to craft a policy that is most efficient and impactful. In general, however, the policy could be structured in the following ways:

- Apply to procurement of all construction materials for public building and infrastructure projects;
- Apply to procurement of products within a material type, rather than between material types; and
- Create a selected list of “eligible materials” determined by domestic manufacturing, current emissions levels, and potentially considering trade exposed products.

Congress could also consider incorporating high labor standards and land, air, and water pollution into procurement determinations. We believe this could work in tandem with Buy Clean, where the federal government would set emissions, pollution and labor standards for an “eligible entity” to be able to be considered for federal public projects.

Finally, any Buy Clean policy must go hand in hand with complementary policies that invest in U.S. manufacturing. Ultimately, Buy Clean policy should make U.S. industry stronger and more competitive. These investments should include funding and financing for investments to reduce emissions in the industrial sector, technical assistance, and increased funding for research, development, demonstration, and deployment of the transformative technologies that will be required to decarbonize the industrial sector.

REFERENCES PAGE

<sup>i</sup>The Washington Post, “A dangerous export: America’s car-battery waste is making Mexican communities sick” February 26, 2016. Available online: [https://www.washingtonpost.com/sf/national/2016/02/26/a-dangerous-export-americas-car-battery-waste-is-making-mexican-communities-sick/?utm\\_term=.6c896e6c67bc](https://www.washingtonpost.com/sf/national/2016/02/26/a-dangerous-export-americas-car-battery-waste-is-making-mexican-communities-sick/?utm_term=.6c896e6c67bc)

<sup>ii</sup>U.S. Department of Energy (DOE), Office of Energy Efficiency & Renewable Energy, “Computing America’s Offshore Wind Energy Potential,” September 9, 2016. Available online: <https://www.energy.gov/eere/articles/computing-america-s-offshore-wind-energy-potential>

<sup>iii</sup>Center for American Progress. “Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy.” Political Economy Research Institute, University of Massachusetts Amherst, [http://www.peri.umass.edu/fileadmin/pdf/other\\_publication\\_types/per\\_i\\_report.pdf](http://www.peri.umass.edu/fileadmin/pdf/other_publication_types/per_i_report.pdf)

<sup>iv</sup>National Renewable Energy Laboratory, *Large-Scale Offshore Wind Power in the United States*, September 2010. Available online: <https://www.nrel.gov/docs/fy10osti/40745.pdf>

<sup>v</sup>Deepwater Wind, “Block Island Wind Farm.” Available online: <http://dwwind.com/project/block-island-windfarm/>

<sup>vi</sup>Deepwater Wind, “Block Island Wind Farm begins commercial operations,” December 12, 2016. Available online: [www.dwwind.com/press/americas-first-offshore-wind-farm-powers/](http://www.dwwind.com/press/americas-first-offshore-wind-farm-powers/)

<sup>vii</sup>Stephanie A. McClellan, *Supply Chain Contracting Forecast for U.S. Offshore Wind Power*, March 2019. Available online: <https://www.ceoe.udel.edu/File%20Library/About/SIOW/SIOW-White-Paper--SupplyChain-Contracting-Forecast-for-US-Offshore-Wind-Power-FINAL.pdf>

<sup>viii</sup>United Auto Workers, *Taking the High Road: Strategies for a Fair EV Future*, Spring 2019. Available online: <https://uaw.org/wp-content/uploads/2019/07/EV-White-Paper-Spring-2019.pdf>

<sup>ix</sup>Motor & Equipment Manufacturers Association, *Fuel Economy Standards: Investments and Jobs in The U.S. are on the Line*, November, 2018. Available online: <https://www.mema.org/sites/default/files/2018%20MEMA%20CAFE%20White%20Paper%20-%20FINAL.pdf>

<sup>x</sup>United Auto Workers, *Taking the High Road: Strategies for a Fair EV Future*, Spring 2019. Available online: <https://uaw.org/wp-content/uploads/2019/07/EV-White-Paper-Spring-2019.pdf>

<sup>xi</sup>International Council on Clean Transportation, Chart library: Passenger vehicle fuel economy. Available online: <https://theicct.org/chart-library-passenger-vehicle-fuel-economy>

<sup>xii</sup>BlueGreen Alliance, *Driving Investment: How Fuel Efficiency is Rebuilding American Manufacturing*, January 25, 2019. Available online: <https://www.bluegreenalliance.org/resources/driving-investment-how-fuel-efficiency-is-rebuilding-american-manufacturing/>

<sup>xiii</sup>BlueGreen Alliance, *Tech@Risk: The Domestic Innovation, Technology Deployment, Manufacturing, and Jobs at Risk in Stepping Away From Global Leadership on Clean Cars*, August 1, 2019. Available online: <https://www.bluegreenalliance.org/resources/techrisk-the-domestic-innovation-technology-deployment-manufacturing-and-jobs-at-risk-in-stepping-away-from-global-leadership-on-clean-cars/>

<sup>xiv</sup>Senator Jeff Merkley, H.R. 3068, the Offshore Wind Jobs and Opportunity Act, July 18, 2019. Available online: <https://www.merkley.senate.gov/news/press-releases/merkley-trumka-senate-democrats-announce-major-new-legislation-to-create-good-paying-jobs-in-the-transition-to-clean-energy-2019>

