

**EXAMINING THE ECONOMIC BENEFITS OF  
ELECTRIFYING AMERICA'S HOMES AND BUILDINGS**

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**HEARING**  
BEFORE THE  
**JOINT ECONOMIC COMMITTEE**  
OF THE  
**CONGRESS OF THE UNITED STATES**  
ONE HUNDRED SEVENTEENTH CONGRESS  
FIRST SESSION

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SEPTEMBER 22, 2021  
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WEDNESDAY, SEPTEMBER 22, 2021

UNITED STATES CONGRESS,  
JOINT ECONOMIC COMMITTEE,  
*Washington, DC.*

The hearing was convened, pursuant to notice, at 2:32 p.m., in Room 216, Hart Senate Office Building, Vice Chairman, Martin Heinrich, presiding.

**Representatives present:** Beyer, Herrera Beutler, Arrington, Schweikert, Estes, Trone, Peters, and Beatty.

**Senators present:** Heinrich, Lee, Kelly, Hassan, Klobuchar, Cruz, and Cassidy.

**Staff present:** Tiffany Angulo, Vanessa Brown Calder, Ron Donado, Ryan Ethington, Tamara Fucile, Devin Gould, Colleen Healy, Ismael Cid-Martinez, Adam Michel, Alexander Schunk, Nita Somasundaram, Jackie Varas, Emily Volk, Brian Wemple, and Michael Madowitz.

**OPENING STATEMENT OF MARTIN HEINRICH, VICE  
CHAIRMAN, A U.S. SENATOR FROM NEW MEXICO**

**Vice Chairman Heinrich.** This meeting will come to order. I want to thank Chairman Beyer in particular for allowing me to hold this hearing today to highlight what I see as one of the shortest actions that we need to take right now to confront the climate crisis and to advance stronger, stable and broadly shared economic growth.

And thank you to our witnesses here today who are leading experts in the growing movement for widespread electrification. The fact is that if we ever want to address our contributions to our climate problem we need to find sustainable and cost-effective substitutes for all of the devices and machines that we use today that combust fossil fuels.

And it's not just our gas-powered cars and trucks. We're also burning fossil fuels and emitting carbon pollution from our hot water heaters, our furnaces, our ovens and stoves. In addition to the climate impacts researchers are finding that burning fossil fuels in our homes, including methane or natural gas as it's commonly called, is really bad for our health.

This is particularly the case if someone in your family has asthma or other respiratory conditions. Even if you are properly ventilating your fossil combustion devices, the particulate matter in

the exhaust from your gas range stove likely includes unhealthy of harmful chemicals like nitrogen dioxide, carbon monoxide and even formaldehyde.

But the good news is that there are already better electric alternatives for each of these fossil burning machines in our homes. Each of these electric substitutes can help reduce our climate pollution and create savings on our energy bills.

Just last month I invited Secretary of Energy Jennifer Granholm to visit New Mexico. During her visit we met with homeowners in Albuquerque's International District neighborhood who are participating in an exciting demonstration project that is helping families install energy efficient and electric water heaters and air source heat pumps in their homes.

Tammy Fiebelkorn from the Southwest Energy Efficiency Project told us that installing these new appliances is reducing the burden of energy costs for these low-income families. As she put it the project is "fighting climate change while also making sure that the benefits of that fight make it to our front line and our disadvantaged communities."

That's exactly right. These new electric appliances will be much more efficient than the fossil fuel machines that they are replacing, and that could mean significant savings for these families on their monthly utility bills. Those savings can make an enormous difference for a family that's living paycheck to paycheck.

And importantly for our climate, all of these electrified machines can be powered by all the new clean and carbon pollution free electricity that we will generate in our new clean energy economy. This is how we can power our long-term economy recovery, and save families money by solving our pressing climate challenge. This is how we build back better.

We need to get to a place where each time a family sits around the kitchen table to figure out how to replace a broken furnace or stove or water heater, they choose to and can afford to install an electric machine. That's exactly why I introduced the Zero Emissions Homes Act to establish a point of sale rebates program for these new electric appliances.

Through this type of Federal investment we can make all of the long-term economic and health benefits of electrification affordable and accessible to all Americans. We have a once in a generation opportunity to make transformative investments in our energy economy.

Investments that will protect our planet, help keep our communities healthy, and promote shared prosperity. We simply don't have any more time to waste in meeting our responsibility on climate. Widespread electrification is one of the surest strategies we can pursue to finally take actions that meet the scale of this challenge.

I'd like to now turn things over to Ranking Member Lee for his opening comments.

[The prepared statement of Vice Chairman Heinrich appears in the Submissions for the Record on page 37.]

**OPENING STATEMENT OF MIKE LEE, RANKING MEMBER,  
A U.S. SENATOR FROM UTAH**

**Senator Lee.** Thanks so much Mr. Chairman. Our country needs to modernize the way we generate, transmit and distribute electricity. Over the last year devastating blackouts have harmed communities across the country from New York to California to Texas. The U.S. electric grid has at times proven inadequate for the needs of American families. However, the answer is not to spend billions of Federal taxpayer dollars to electrify every American home and business, and just as importantly, the answer is not to fundamentally alter the Federal policy to regulate energy in its generation and in its consumption.

Instead we need to unshackle American industry so that new and diverse energy sources can help create a more resilient energy future for America. It was not that long ago that American innovation unleashed the shale revolution, driving down natural gas prices and providing a cleaner energy option for homes and businesses.

We need a similar revolution if we want to modernize our electric grid. To clear a path for continued energy innovation we must reform existing regulatory policies that stand in the way of investors and discourage entrepreneurs. If we want to move our energy infrastructure into the future, we need to address environmental review.

When President Nixon signed the National Environmental Policy Act, or NEPA into law, it was meant to require agencies to consider the environmental consequences of their actions. NEPA is generally implicated when projects use Federal funds, or when they touch Federal lands which many energy projects do.

Now 50 years later this seemingly commonsense requirement has transformed into a process that requires an average of four and a half years, and sometimes two decades or even more of paperwork and litigation. The NEPA process frequently discourages and prevents critical energy infrastructure projects from being built.

The delays might be worth it if NEPA protected the environment, but environmental review is strictly procedural meaning that it doesn't actually privilege environmental protection. This means that paperwork and lawyers' fees are the most consistent result of the NEPA process.

Federal agencies can find that the action under consideration imposes environmental harm, and then theoretically decide to approve the agency anyway notwithstanding those problems.

The process even delays projects with clear environmental benefits. Without reform NEPA leaves countless energy infrastructure projects in a state of bureaucratic limbo, sidelining workers, stunting innovative new technologies, and leaving communities across the country to wait for Washington to approve their future.

That's unacceptable, it's why I've introduced the UNSHACKLE Act. This suite of bills reforms the NEPA process so that Federal agencies are better empowered to carry out the law's original intent, while also making our Nation's infrastructure projects affordable again.

The UNSHACKLE Act would require agencies to finish their environmental assessments faster, allow them to reuse paperwork that they've already generated and limit duplicative work at State

and Federal levels. It would apply a two year deadline for the completion of the entire NEPA process, provide fair legal parameters around project reviews, and allow states to handle NEPA review within their own borders.

Now these reforms shouldn't be partisan in nature. They're designed to achieve something that we can all agree on, that is more efficient, effective, Federal permitting for environmental projects. Ultimately the best energy future is one that allows the American people to innovate. Americans have made great strides pursuing breakthroughs in energy extraction production, and technological innovations in wind, solar, hydroelectric and other renewable forms of energy in the face of heavy-handed government control.

Removing existing regulatory burdens will allow Americans to build a more sustainable future. The ability to build and build more quickly will help make the U.S. electric grid more robust, resilient and reduce the frequency of outages, it will become cleaner, more affordable and more reliable power to American families and communities will be provided.

As we rebuild after the pandemic we must liberate our energy sector. We must reduce regulatory barriers to developing nuclear, hydro, geothermal and other forms of energy. These technologies can be an important part of a competitive energy sector and a diverse energy future. So let's get government out of the way and allow Americans to do what they do best. Reforming policies that get in the way of modernizing our energy infrastructure will boost economic prospects for American families, improve the environment, and enable us to build a better America.

I'm hopeful that today's hearing will convince us of the urgent need to achieve that very goal, thank you.

[The prepared statement of Senator Lee appears in the Submissions for the Record on page 38.]

**Vice Chairman Heinrich.** We have four witnesses here to share their expertise today. Our first witness will be Mr. Ari Matusiak, the CEO of Rewiring America, a non-profit that aims to electrify everything starting with the 121 million U.S. households that make the decisions accounting for 42 percent of U.S. energy related carbon emissions.

Rewiring America's mission is to revitalize the U.S. economy and tackle the climate crisis through a detailed policy agenda, including low-cost financing, and targeted regulatory and code interventions to cut the cost of energy efficient measures like solar panels and electrify each American home.

Mr. Matusiak is also a Co-Founder and Managing Partner of Purpose Venture Group, a social impact advisory firm, an incubator that builds community-centered ventures focused on combating climate and economic inequality. He served in the Obama White House as a Special Assistant to the President and Director of Private Sector Engagement where his focus was on economic policy related to jobs and competitiveness.

He has a bachelors degree in political science from Brown University and a J.D. from Georgetown University Law Center.

Our second witness will be Dr. Leah Stokes. She is an Associate Professor in the Department of Political Science and is affiliated with the Bren School of Environmental Science and Management

in the Environmental Studies Department at the University of California, Santa Barbara.

Her research areas include energy, climate, and environmental politics, with a particular focus on renewable energy. Her academic work has been published in some of the top publications in her field, including *Nature Energy*, *Energy Policy* and the *American Political Science Review*.

In 2020 Dr. Stokes published a book titled, *Short Circuiting Policy*, which examines clean energy policies to understand why states are not on track to address the climate crisis and how fossil fuel companies and electricity providers have put profit above progress by promoting climate denial and delay.

Dr. Stokes has a PhD in public policy from MIT and master's degrees from MIT's Political Science Department, and the School of International and Public Affairs, and the Earth Institute at Columbia University.

She has a bachelors degree in psychology and eStation studies from the University of Toronto.

Our third witness will be Mr. Donnel Baird, a green entrepreneur who is the CEO of BlocPower which he launched as a startup in 2012. BlocPower markets, finances, and installs solar and energy efficient technology in homes and buildings across 15 U.S. cities where it trains and hires local vulnerable populations for jobs including installing smart low-cost sensors and thermostats, and retrofitting large heating and cooling systems.

Mr. Baird aims to replace heating and cooling systems that run on fossil fuels with greener and more efficient alternatives such as electric heat pumps and solar panels. BlocPower's completed energy projects in over 1,000 buildings in the New York area helping clients from small businesses to non-profits save 20 to 40 percent on their energy bills each year.

BlocPower secured investments and partnerships with Fortune 500 companies like Goldman Sachs and Apple, and Mr. Baird was selected as a 2020 Dial Fellow by the Emerson Collective.

Mr. Baird obtained his BA from Duke University and his MBA from Columbia Business School in 2013.

Our fourth witness will be Dr. Eli Dourado. Dr. Dourado is a Senior Research Fellow at the Center for Growth and Opportunity at Utah State University. His area of focus are on the new technology and innovation needed to drive large increases in economic growth including the expedition of infrastructure deployment and the elimination of barriers for entrepreneurs.

Dr. Dourado has worked on a wide range of technology policy issues including aviation, internet governance, and crypto currency. Dr. Dourado previously worked as a senior researcher at the Mercatus Center at George Mason University, as Director of its Technology Policy Program.

Dr. Dourado has served as an advisor to the State Department on International Telecommunications Matters, and as an Economist at the Bureau of Economic Analysis. He has a BA in Economics and Political Science from Furman University and a PhD in Economics from George Mason University.

The Committee will recognize each witness for five minutes to provide remarks. Mr. Matusiak let's begin with your testimony and

then we'll continue in the order of introductions. Mr. Matusiak the floor is all yours.

**STATEMENT OF MR. ARI MATUSIAK, CHIEF EXECUTIVE OFFICER, REWIRING AMERICA, SAN DIEGO, CA**

**Mr. Matusiak.** Thank you. Vice Chairman Heinrich thank you, Ranking Member Lee, other distinguished members of the Committee. Thank you for having me in for shining a spotlight on household and building electrification, the most central path for Americans to take to cut climate change emission sin half by 2030, and to zero them out before 2050.

I am CEO of the non-profit Rewiring America, founded just over 1 year ago. Our co-founder Saul Griffith was hired by the U.S. Government to map the energy sector down to .1 percent fidelity on both the supply and the demand side. The upshot, the roughly 100 quads of energy we generate and consume as a country each year will produce about 90 percent of our emissions.

When it comes to reducing emissions much attention has been paid to the supply side as we work to decarbonize our energy supply. The conversation on the demand side has been largely focused on replacing combustion engine vehicles with electric ones.

But the residential housing sector is another and very large part of the demand side. If we are cleaning our grid, we must also clean all of the machines that use it. We cannot get to zero emissions by any date unless we do, and that means that building decarbonization is the great unmet need in our climate policy.

Indeed at Rewiring America we calculate that over 40 percent of energy related emissions in the U.S. exist as a result of decisions made around the kitchen table, what we drive, how we eat and cool our homes, how we heat our water, how we cook our food, how we dry our clothes.

There are 121 million households in American. In order to get to zero emissions by 2050 we calculate America must replace or install one billion machines across all of those households in that timeframe. The timeframe is important because these machines last for a long time, 10 to 25 years on average.

Put it this way, every time an opportunity is missed to install an efficient, electric machine, we put further pressure on hitting our 2050 target, every machine counts. For us, that is an affirming and optimistic prognosis because if those one billion machines represent about 40 percent of our emissions as a country, 65 percent if you include small businesses, then we can develop a plan for addressing them, one efficient electric machine at a time.

We don't need to wait on any moonshot technology—it all already exists. We don't need to ask Americans to sacrifice or change their lifestyles to survive. We can define our climate strategy in a way that benefits every American directly and immediately.

Those one billion machines also represent an enormous economic opportunity for America, because if we need all these efficient electric machines, so to does the rest of the world. According to our modeling, replacing carbon-dependent appliances increases household discretionary income, creates local jobs that cannot be automated or off-shored, and reduces the health costs of burning fossil fuels in our homes.

That's a triple win, on top of the fourth win of helping the emissions. Here are the numbers. At least 85 percent of households in the U.S., 103 million could save 37.3 billion dollars a year on energy bills if they were using modern electrified furnaces or water heaters instead of their current machines.

Of the households in the U.S. that would save by electrifying, 44 percent of them are low to moderate income. Each year they could save an average of \$377.00, and we estimate that by 2030 that number could go up to \$2,500.00. Outside of these direct pocket-book benefits to Americans, and especially low and moderate income Americans, electrification would create 462,000 installation jobs in the U.S. that can't be automated or off-shored.

In addition, it would further generate another 80,000 manufacturing jobs and 800,000 indirect and induced jobs. And on the healthcare front which has boomeranging effects into our economy, electrifying household appliances with address the 42 percent increased risks of children experiencing asthma systems associated with gas stoves, and the 15,500 premature deaths in the U.S. that come from outdoor air pollution from buildings.

Those are a lot of numbers. The point is this. If the upfront costs were the same, we think Americans would choose to electrify their households every single time an appliance fails and needs to be replaced. In not installing these machines, these households would be locking in emissions for one to two decades or more because of the brand new carbon dependent machines that would be installed instead.

This is a machine-by-machine plan that puts us on a path to zero emissions. It's an optimistic plan that carries with it a moral and economic imperative for action. Because not only is it the right answer for our planet, it also does right by Americans and their families today.

By the numbers there is simply no greater opportunity for the Congress to unlock another American century of economic expansion and prosperity than by investing in the electrification of our economy, starting with the American household. It is time to understand our households as the keystone of our climate infrastructure.

Encouraging these invested power to make real the opportunity before us, and to continue to use your bully pulpit to educate Americans about the role we can all play in realizing our shared future and potential. Thank you Mr. Vice Chairman and to all the members of the committee.

[The prepared statement of Mr. Matusiak appears in the Submissions for the Record on page 40.]

**Vice Chairman Heinrich.** Dr. Stokes.

**STATEMENT OF DR. LEAH STOKES, ASSOCIATE PROFESSOR OF POLITICAL SCIENCE, UNIVERSITY OF CALIFORNIA SANTA BARBARA, CA**

**Dr. Stokes.** Vice Chairman Heinrich, Ranking Member Lee, and Distinguished Members of the Joint Economic Committee good afternoon. For more than three decades scientists like me have come before Congress to warn lawmakers like you that climate change poses a dire risk to our economy.

Those warnings have now come to pass. Last year the United States experienced 22 separate billion dollar climate and weather disasters, which cost us nearly half a trillion dollars. That is the economic cost of inaction on climate change, and it is growing every year.

You already know the broad contours of what I am going to say. Congress must act now to cut carbon pollution by reducing our dependence on fossil fuels. Americans have asked you to do this for years through phone calls, letters and testimony. I'm urging you to listen, not just to me and to other scientists, but to the American people and act now on the climate crisis.

We must cut carbon pollution by 45 percent 2030 to have a chance of limiting warming to 1.5 degrees. President Biden has a plan to do that, but we need Congress to act on that plan and pass his Build Back Better agenda. This includes investing in building electrification.

Our homes are our safe places. Yet scientists are uncovering that burning fossil gas in buildings is dangerous to our health. Children living in a home with a gas stove have a 42 percent chance—increased chance of having asthma. Even when a gas stove or other gas appliance is turned off, it is still leaking, and that gas contains carcinogens like Benzene which cause cancer.

Thankfully we've got the solutions to remove pollution from our homes. We can use electric technologies like induction stoves and heat pumps. Clean electricity combined with electrification could cut three-quarters of our carbon pollution.

To accelerate building electrification, Congress must make key investments now. The goal should be to have clean appliances be the default choice for all Americans. Zero emission appliance rebates are crucial for making clean technologies accessible to all Americans. These investments will catalyze the market, creating lower costs through innovation.

They will also help to avoid locking in current pollution as appliances installed today may still be operating in the 2040s. This is also smart economic policy because it will avoid creating stranded costs. Additional dollars should also flow to the weatherization assistance program, to tax credits, and to grants for domestic manufacturing of clean appliances.

Congress should also invest in clean electricity through both tax credits for power producers, and grants for utilities that increase their share of clean power. Cleaner electricity will help building electrification deliver even greater benefits. All of these investments will be multiplied many times over by growing the economy, and they'll pay themselves back. Through aggressive Federal Government investments in building electrification we could create one million jobs this decade.

And many of these jobs cannot be taken overseas. If you want to have a heat pump in your home, you actually have to have an American worker install that in your home. These Federal investments are also crucial to reducing inequality and healthcare costs.

Clean buildings are important for all us, but they're particularly important for people of color who are exposed to higher levels of indoor air pollution. Federal investments can also cut energy bills

with Congress's help more than 100 million American households could save money by installing these modern electric appliances.

So cleaning up the American economy is a win/win. It creates jobs, it saves Americans money, it advances equality, and it keeps the United States competitive globally. So the climate solutions are ready. The question is speed. To deploy these clean technologies fast enough we need Congress's help.

You can act now to catalyze the market creating millions of jobs and saving everyday Americans money. I'd like to close by sharing something personal. I have two newborn babies that are two months old at home right now, and I have left them to come here and speak with all of you because I know the urgency of this moment. I'm here not just to speak on behalf of my newborn children, but on behalf of all the children in the United States.

I'm also here to speak on behalf of young people who are deeply fearful about what their future holds. And quite frankly, I'm here to speak on behalf of all of us because we are already seeing what climate change is doing to the places and the people we cherish most.

This is a pivotal moment in history. The world is watching. Either Congress will pass a bold climate investment package this fall, or we will lose the last best opportunity we have and wait another decade. We don't have anymore decades left to waste to act on the climate crisis, thank you.

[The prepared statement of Dr. Stokes appears in the Submissions for the Record on page 44.]

**Vice Chairman Heinrich.** Mr. Baird.

**STATEMENT OF MR. DONNEL BAIRD, FOUNDER AND CEO,  
BLOCPOWER LLC, BROOKLYN, NY**

**Mr. Baird.** Good afternoon. Is this on? Great. Greetings to all the members of this Distinguished Committee. My name is Donnel Baird. I grew up in a Brooklyn apartment building that did not have a working heating system. Like many of our neighbors in Brooklyn, mostly immigrant families, we heated our apartment with a gas oven, and so every night we would turn on the gas burner, open up the oven door and that was kind of how we heat everything.

My dad was a mechanical engineer, so we knew that the oven produced carbon monoxide and other toxins, and was not safe, so we opened up all the windows every night to clear the air. You don't need to be an engineer, or the CEO of a clean tech startup to know that releasing toxic gasses into your family's bedrooms is bad for public health, and that leaving windows open to mitigate the impact is a waste of resources.

I founded my climate tech startup BlocPower to help address the energy issues my family struggled with growing up. Households account for 42 percent of U.S. carbon emissions, and BlocPower is focused on greening buildings, replacing old, antiquated, fossil fuel energy systems with all electric technology.

Our business case is simple. We install clean, zero emission technology in older buildings that waste fossil fuels all over the country. We make money because the technology saves so much money to the building owner that we are able to make investments and

amortize other health measures into transactions with that save so much money that we can finance all of this.

We are able to turn a profit and leave households spending less on energy than they were before by utilizing these technologies. In the process we dramatically lower building's carbon emissions. We make them healthier and more comfortable.

In essence, we're creating both jobs and healthier buildings, and healthier communities while delivering financial and economic impact. We've completed upgrades in over 1,200 buildings, apartment buildings, schools, houses of worship, townhomes, single family buildings in New York City's poorest neighborhoods, impacting tens of thousands of families.

And we've built software to analyze the impact of these technologies on over 120 million buildings across America. I'll never forget one of our first projects in the Bronx when we were called in to convert an aging school building following a tragedy. The building had been burning fossil fuels in its basement to power the facility however, the building's ventilation system was set up improperly.

As a result air pollution from the fossil fuel system in the basement was being pumped into the cafeteria every single day contributing to chronic asthma amongst all the school children. The school nurse had 70 different zip lock bags with pieces of tape with all of the four-year-old's names on it to figure out which inhaler went to which child.

It was so poor that one day a four-year-old had an asthma attack and needed to go to the emergency room and later died. We know this is not an isolated incident. Our schools and our homes across this country need and deserve electrification. Electric buildings are better buildings.

The problems of dirty fuels and buildings are fixable. We know electric building technology works. In Brooklyn, new buildings under construction often include heat pumps. We have installed systems in hundreds of buildings throughout New York City and now coast to coast.

We have the ability to bring the same incredible electric heating technology, both the software and the hardware, to the challenges of heating and cooling in buildings. These are real benefits to families, and aggregated across America these benefits to our economy are massive.

But I want to point out that the markets have spoken. The private sector has spoken and endorsed better building electrification technology. All electric, carbon, low carbon, healthy buildings are being embraced by Apple, Microsoft, Google, Goldman Sachs, the American Family Life Insurance Company, Salesforce, the New York State Government and energy giant Exelon. And I know this because we partner with all of them and they've invested in our company to electrify American's building stock.

The government has a key role to play to ensure that the benefits of all electric buildings are accessible to all Americans. Rebates will help to reduce the upfront costs. Today we raise five private dollars for ever single government dollar that is invested.

In addition, expanding lending authority through the Department of Energy's Loan Program Office could provide significant

new capital to grid electrification across the U.S. We can make our houses smart, and all electric, and responsive to a modern cyber secure smart grid so that we can protect ourselves from climate disasters.

America can and should lead the world in innovation, manufacturing and the workforce to convert our real estate stock. Thank you.

[The prepared statement of Mr. Baird appears in the Submissions for the Record on page 50.]

**Vice Chairman Heinrich.** Dr. Dourado.

**STATEMENT OF DR. ELI DOURADO, SENIOR RESEARCH FELLOW AT THE CENTER FOR GROWTH AND OPPORTUNITY AT UTAH STATE UNIVERSITY, LOGAN, UT**

**Dr. Dourado.** Thank you Vice Chairman Heinrich, Ranking Member Lee, and Members of the Committee for the opportunity to testify today. My name is Eli Dourado, and I am a Senior Research Fellow at the Center for Growth and Opportunity at Utah State University.

I study the technologies that could bring about transformative economic growth and the obstacles they face. Climate change is a technology problem. New technologies are our only realistic hope to significantly reduce carbon emissions. The way to address climate change is not to deindustrialize society and go back to a less prosperous past. It is to charge boldly into the future.

On that, I believe we all strongly agree. There's a slogan that represents one vision of this future. Electrify everything. Like all slogans it oversimplifies. I'd like to use this opportunity to raise some nuance and offer some additional solutions that will make us more likely to achieve our decarbonization goals.

First we must be realistic about the necessary electrical system upgrades. Electrifying heating makes financial sense for many, but not all individual homeowners, but even if heat pumps make individual economic sense, they may not make collective economic sense until upgrades are available for our electric grid and generation capacity.

Mass adoption of electric heat pumps, particularly in the coldest parts of the country where they are least efficient will flip the time of peak electricity demand from summer to winter. Since our current system is only built to the capacity of the summer peak without new capacity the coldest winter days would be met with rolling blackouts at exactly the time we most need reliable energy.

Heating is a safety critical service. People die if the heating goes out. If we want to rely exclusively on electricity for heating we must invest not only in additional capacity to meet peak demand, but also in grid hardening, like placing wires underground where they can't be downed by falling trees.

Which brings me to my next point. We must make it easier to build. If we're going to do so much building, new peak load power plants, undergrounding of wires, new long distance transmission lines, and new wind and solar farms, it is worth first addressing the excessive costs of building new infrastructure in this country.

Among the chief culprits are laws that give project deponents a way to slow or stop the permitting and siting process. Laws in-

tended to support environmental justice, like the National Environmental Policy Act, have instead been weaponized by nimbies or competitors to slow progress.

Research from the Brookings Institution found that interstate highway construction costs tripled between the 1960s and the 1980s. The researchers dated the inflection point to the early 1970s which they noted was precisely when NEPA took effect.

By lengthening and adding risk to the permitting process, NEPA makes financing large capital intensive projects less attractive. Sometimes propose new subsidies for long distance transmission projects to overcome this obstacle, while subsidies for these projects may be desirable in isolation, it is unwise to spend taxpayer money to overcome a permitting obstacle that Congress created and has the tools to fix.

Congress should first remove the permitting obstacles, and then consider whether new subsidies are still necessary. Even if they are still necessary, they would return a much higher value for the taxpayer with the permitting obstacles removed.

The country would also greatly benefit from new zero carbon baseload power plants, either nuclear or geothermal. To accommodate all of this building, we need a thorough going permitting reform of the kind that has been proposed in the UNSHACKLE Act.

Third, we should avoid picking winners and losers. A downside of a strong policy focus on electric heat pumps or anything else is that it puts politicians in the role of picking the winning technology. If left to compete on a level playing field, a range of other possible solutions, including non-electric options, could help to decarbonize heating.

Some possibilities include district heating and high quality offsets from genuine carbon removal projects, instead of selecting one technology decarbonize heating on its own, Congress should achieve its goals with technology neutral policies.

Finally, the committee should recognize that the economic benefits of addressing climate change will not come from jobs, but from cheap and abundant clean energy. Consider electric vehicles. Electric vehicles have many advantages over combustion vehicles, but one of them is that they have fewer moving parts and therefore require less maintenance expense.

This reduction in maintenance requirements will translate to thousands of mechanic jobs being destroyed. Should we oppose electric vehicles, underscore? Of course not. The economic opportunity from addressing climate change comes from rethinking energy, not from creating jobs.

If we could repeat the stunning cost reductions we have observed in wind and solar energy in firm dense technologies like advanced nuclear and advanced geothermal, we could double or triple per capita primary energy use that would truly make the economy boom.

I once again thank the committee for the opportunity to testify, and I look forward to your questions.

[The prepared statement of Dr. Dourado appears in the Submissions for the Record on page 52.]

**Chairman Beyer** [presiding]. Thank you very much. Let me now recognize the Ranking Member from the State of Utah Senator Lee for his questions. Thank you.

**Senator Lee.** Thank you very much. Dr. Dourado I'd like to start with you if that's okay, and I appreciated your testimony and your insights that were very helpful. Now you've written a little bit about the promise of geothermal energy based on the fact that it's clean, it's cheap, and it's an abundant energy source, but suggested that in many ways poor policy on the books now could be standing in the way of our capitalizing on that, and benefiting from geothermal energy.

The most favorable conditions for geothermal power happen to be found in the western United States where coincidentally the Federal Government happens to control a very significant portion of all the land. Now can you tell us specifically how Federal policy could help make geothermal electricity generation more competitive, and thus more of a reality?

**Dr. Dourado.** Yes, Senator, thank you for the question. As you noted the most near term resources for geothermal are all in the west and overlap significantly with Federal lands. And geothermal has a very strong learning by doing component. Bringing technology—reporting it from the oil and gas sector, people leaving the oil and gas sector and just started the new geothermal advanced geothermal sector.

They need experience and practice, and that process of delivering power is what's going to drive the cost down and make it available eventually everywhere in the country, not just where the resources are located.

On Federal lands to get a permit to drill, whether it's an oil and gas well, or a geothermal well, you need permission from the Bureau of Land Management, and because the oil and gas industry has so much influence in Washington they were able to get a categorical exclusion from NEPA review, they only have to do you know a two week approval process to get their wells approved.

Whereas a geothermal well, it takes about two years to get an approval from the Bureau of Land Management. So I think a very promising policy would be to extend the exclusion that currently exists, under the exact same conditions that exist for oil and gas and you know just make them available for geothermal as well, and that would I think radially increase access to progress in geothermal energy in the coming you know years, within this decade.

**Senator Lee.** So let me get this straight. We've given more favorable NEPA regulatory treatment to oil and gas drilling on Federal lands, than we have to geothermal drilling on Federal land?

**Dr. Dourado.** That's exactly correct Senator.

**Senator Lee.** Geothermal sources are effectively renewable, they're not emitting things. They're not emitting carbon into the atmosphere. They're not polluting the atmosphere. The same cannot be said of oil and gas drilling. Is that correct? So why would that make any sense? What plausible defensible public policy justification could there be for treating oil and gas drilling more favorably than we treat geothermal drilling?

**Dr. Dourado.** I don't think there's any good reason for it Senator. Geothermal is a renewable technology, but it's also a vast ex-

isting reservoir, so actually the amount of geothermal energy that exists is 40 times greater than all fossil fuel energy, and all fissionable material combined.

So it's just a massive resource. It would power our economy for the next billion years, and it makes no sense that it is disfavored relative to oil and gas.

**Senator Lee.** Thank you. That's very informative. Dr. Stokes, I want to talk to you for a moment. I take it you've been involved in the development of the clean energy, clean electricity performance program. And as you know the CEPP requires significant renewable solar development.

One study produced by Princeton University suggests that land equivalent to the size of the State of West Virginia could be necessary for solar deployment in a full zero emissions transmission. Do you know about how many acres of Federal land you'd anticipate would be needed to realize the development of CEPP?

**Dr. Stokes.** Well I would say that actually clean energy sources would be eligible under that program, not just solar, and of course solar can also be put on rooftops and other buildings, so it doesn't necessarily require a lot of land.

**Senator Lee.** Sure, sure, there are other sources that could be included within it.

**Dr. Stokes.** That are included yes.

**Senator Lee.** And one of those is wind. Now the same Princeton University study suggests that an area equivalent to the acreage of Kansas, Nebraska, Oklahoma, Iowa, Missouri, and Arkansas may be needed for wind turbines to reach zero emissions. All of those states combined.

So how many acres of Federal land do you think would be needed?

**Dr. Stokes.** Well you don't have to develop renewables on Federal land. It's of course an option. And I think there may be some you know good reasons for doing it in some places. You can also do it offshore. In the case of offshore wind you can do geothermal, as Dr. Dourado's been talking about.

You can do carbon capture and sequestration, nuclear energy. The clean electricity performance program is a technology neutral approach, so it does not require the building of renewables on Federal lands.

**Senator Lee.** By the way one of the dirtiest, one of the biggest emitters as I understand it, one of the dirtier sources of pollution happens to be heating oil, would you agree with that?

**Dr. Stokes.** Heating oil, yes.

**Senator Lee.** Are there efforts underway to ban that? Is that part of your initiative?

**Dr. Stokes.** I'm not trying to ban anything, and I don't really have an initiative so to speak. I know there are efforts in New York City for example, to try to clean up heating oil in that city as that's been used for many decades in New York City. So heating oil does have significant health impacts at the building level as well as carbon pollution impacts as well.

**Senator Lee.** I see my time's expired. Thank you.

**Chairman Beyer.** Mr. Senator we thank you very much. Let me begin with just the formal Chairman's statement which is I'm so

pleased that you're here this afternoon, and I really want to thank my friend and colleague, Vice Chairman Heinrich, for bringing us together for this important discussion.

Climate change is a threat not only to our planet, but also to the health of our economy, so we need to look at the multitudes of solutions, including electrification technology. So in the interest of time I just want to submit my opening statement for the record and move right to some questions.

Mr. Matusiak, I was fascinated by all of your statistics, the 37.3 billion dollars a year savings, the 463,000 installation jobs created, 15,000 premature deaths—not happening. You didn't do the other side of it which are the jobs that go away in the gas industry, or the coal miners, something like that.

Do you have any sense when you netted out what the impact on economic growth would be from electrifying our economy? What GDP, what the increments of GDP growth might be?

**Mr. Matusiak.** Well thank you Chairman, it's wonderful being with you today and for the opportunity. By our analysis there are over the course of the next 20 years, 25 years, an opportunity to create 25 million jobs in the electrification of the economy.

Five million durable, sustainable jobs over that timeframe, and we will look at the transition of jobs across different sectors. There is a significant opportunity to retrain and to put people to work doing things that they are accustomed to doing. So for example, if we're talking about installing water heaters and furnaces, if they are electric they are heat pumps, and that is part of a transition of opportunity—of economic opportunity.

But the upshot here is that the electrification of the economy unlocks a massive opportunity. It is a massive opportunity in job creation. It's a massive opportunity in localized job creation, and it's a massive opportunity in economic catalyst in terms of—as an economic catalyst in terms of the money that flows through the economy when you start to stack the incremental jobs that are created, the incremental savings that households realize, the lower costs to communities when it comes to healthcare costs and all the rest.

And we have an opportunity to put a lot more money to work in the economy which creates a lot more jobs as you well know. And so for us the electrification strategy is not just a climate imperative, a moral imperative, frankly the path at which we get to zero emissions. It was the win/win/win strategy whereby we create the jobs that power us into the next century of economic prosperity as a country, and allow us to maintain our economic position as not just a leader in terms of our standard for the world, but in terms of the machines that we are producing and making and exporting to the other countries that will certainly need them as well.

**Chairman Beyer.** Thank you very much. Dr. Stokes you sort of made the public health case for the electrification of buildings in that kids in homes using gas stoves are at a 42 percent greater risk of having asthmas. Can you expand on that? Is this something that OSHA should be doing, or national building permit standards?

**Dr. Stokes.** Well there are actually discussions that gas appliances should come with warnings for citizens and for Americans that they pose health and safety risks, serve consumer reports,

could for example put a sticker on these appliances warning people that you know they could increase the risk of asthma, that they can be involved in emitting carcinogens into your home.

That there are significant health risks to these appliances, and it's interesting because we've lived with them in our homes for a long time. We sort of celebrated them as this wonderful innovation, but what scientists are uncovering right now with research that's ongoing is that there's a really big health side effect to burning gas in our homes. And so I think that the American people as they learn more and more about the science are going to realize that they haven't fully understood the health implications of having this in their homes, and it's possible that the American government could be doing more to help inform Americans about the risks of having gas in their homes.

**Chairman Beyer.** Great thank you very much. Dr. Dourado you talked about the misuse of NEPA, and people weaponizing it and the like, and that the rise of the citizen voice. Is there something wrong with having a citizen voice in this process, especially when you look back at all the times when citizens had no voice?

**Dr. Dourado.** You know Senator, Mr. Chairman I believe democracy is very important and I think it's most important at election time. And I think in many other decisions I think it's better if we let the wheels of government turn without involving every member of the community that might have an objection to a project.

We need to let projects go forward if we want to build in this country.

**Chairman Beyer.** Thank you very much for that perspective. My time is up. I will now recognize my friend from Arizona, Mr. Schweikert.

**Representative Schweikert.** Thank you Mr. Chairman. I have a couple things here. It was interesting Senator Lee actually asked one of the things that's actually—and look I'm a westerner, I've actually never seen fuel oil heating, but I've seen the data on it and it's absolutely unhealthy, it's filthy. I'm almost surprised that the reaction from all witnesses wasn't absolutely you know if natural gas appliance needs labeling of this and that, the others need to be pulled out immediately.

So I'm just a little surprised by that. Mr. is it Dourado, what's the best way to pronounce it, the doctor from Utah.

**Dr. Dourado.** Dourado.

**Representative Schweikert.** I'm sorry. I have to learn to actually wear glasses. I actually want to walk through one of my personal fixations, and I care a lot about this because being from the desert southwest we have the largest nuclear power plant in the country, but we also have tremendous photovoltaic and actually some decent hydroelectric.

Are you familiar with the SunZia power line? In the middle of New Mexico is one of the greatest wind assets in the United States. And California functionally contracted for this wonderful wind generated asset. We're approaching 20 years to move the power line to get it permitted because it crosses a number of jurisdictions.

Oddly enough the real problem had been the government jurisdictions. So in some ways it becomes actually a fraudulent nar-

rative here when we say we want to exploit our wind assets, and then without the same breath my friends, and I don't care what side of the aisle you're on, don't also articulate saying we need major NEPA reform to actually move the power generated from those wind assets. And help me understand.

Because this is one it crosses through Arizona, hits the Palo Verde hub as you probably know if you specialize in electricity and then would move to the L.A. basin. But seriously, you talk to the investors on this and today they say we wouldn't do this again. You know something that was going to take six, seven years, now is approaching 20 years.

How common do you run into this? What would you do in NEPA reform?

**Dr. Dourado.** You know I talk to a lot of companies including hard tech startups that run into NEPA issues all the time. It is ubiquitous throughout the economy that you know at various times you need Federal Government approval for something, and that brings in NEPA—some sort of NEPA review.

A lot of times it isn't an environmental impact statement. I think the Federal Government only finalizes about 200 environment impact statements a year, but they do about 12,000 environmental assessments per year. And each of these is hundreds of pages long, you know, sometimes thousands of pages of appendices, it takes multiple years, and it just adds a tremendous entirely procedural burden on a lot of projects.

So I think it's a very significant obstacle to building in this country.

**Representative Schweikert.** And I wasn't going to burden everyone. We have a whole binder of little charts of photovoltaic projects, actually even some power coming out of Earth Energy, and you can't move the lines. One other one just, have you seen the charts that talk about over the next few years carbon emissions, predicted greenhouse emissions in the United States are going to go up.

And a lot of it is because we are about to remove much of our baseload nuclear off the grid, and by removing that baseload nuclear you know our generation base is truly impaired. What is your understanding on that dataset?

**Dr. Dourado.** I think that's generally correct, and you know as an example New York City just closed down one of its nuclear facilities saying it would be replaced with renewable energy, and it was replaced with fossil fuels, so it was fossil fuels that made up the load that was missing from the shutdown nuclear plant.

So I think it's important to not only keep open our existing nuclear plants, but to figure out what we can do on nuclear licensing to make it more cost effective to the nuclear clients including advanced small modular reactors that are the next generation of nuclear facilities.

**Representative Schweikert.** Thank you. Mr. Chairman if you'll give me time I'm going to submit for the record some articles about technology of extraction of uranium from sea water as well as an article from a Noble Prize Laureate physicist talking about the use of hyper pulse lasers to break down spent nuclear materials as making it inert, and the fact that we may be at the time

where if we truly embrace technology we may have the virtual cycle upon that and with that I yield back.

[Article links submitted by Representative Schweikert appear in the Submissions for the Record on page 60.]

**Vice Chairman Heinrich** [presiding]. Without objection those will be added to the record. I appreciate my friend from the House bringing up the issue of SunZia, I would just point out as someone who has been deeply involved in that project for most of that period that it's actually the state based Public Regulatory Commission and the former Governor who objected to SunZia.

They actually had a final environmental impact statement and the record of the decision, so I don't think NEPA is to blame there. I think what we probably need is Federal backstop authority for transmission planning, something which is included in the bipartisan infrastructure package and will facilitate much more transmission in this country.

Mr. Baird, I want to ask you, your firm is doing this every day. Can you talk a little bit from that perspective. Have your clients seen health impacts, positive health impacts from these changes?

**Mr. Baird.** Thank you, Senator. We are working with MIT as well as Columbia Mailman School of Public Health to measure air quality and asthma impact across the population in New York City, to measure the impacts on air quality and reductions in air pollution from electrifying buildings.

And they are significant. They are so significant that the New York State government has opened an R&D exploration of the reduced impact on Medicaid and Medicare costs because of reduced emergency room visitation due to chronic asthma. The hospital systems in New York they know which apartment buildings overproduce chronic asthmatics.

They can give you a list of six or 700 apartment buildings in the Bronx which has the highest asthma rates in America, and they can say these are the apartment buildings in the Bronx that are overproducing asthma even relative to other folks in the Bronx.

And if we can green and electrify those buildings we do dramatically reduce indoor air pollution caused by burning fossil fuels. There's 5,000 buildings in the Bronx that burn oil in their basements for heat and for hot water which means it burns every single day, as whether it's summer or winter there does need to be oil burned for hot water, cooking, and showering.

And so we do believe that there are multiple academic multi-year studies that will indicate that a reduction in air pollution will have a dramatically positive impact on asthma. This is going to end up being like lead sir, gas and oil in buildings. It's going to be like lead.

We're going to look back on it five years from now and say what were thinking? How could we subject our children, the next generation to these toxins.

**Vice Chairman Heinrich.** Would you characterize I think one of the words I've heard is deindustrialization, characterize your buildings and what the residents of these buildings start with and end with, and would you characterize them as more or less advanced technological, et cetera.

**Mr. Baird.** We characterize our buildings and our processes. We want to turn old, antiquated, fossil fuel wasting, unhealthy you know systems in basements where no one wants to go, and no one wants to breathe.

We are bringing low income residents and school children who attend schools in the Bronx into the future by giving them the most modern technology that is available, and it is the opposite of deindustrialization. It is using all of the innovation and machine learning and hardware and software from Silicon Valley which funds my company, and we are bringing that to bear in our neglected real estate sector across America to move them into the modern era and make people healthier and safer.

**Vice Chairman Heinrich.** So let's get to the hard questions. Which ones of you actually own an induction stove? Because I think that's the elephant in the room. So for Dr. Stokes or Mr. Baird, I have to admit my own bias in thinking that oh how can I cook without gas until I cooked with an induction stove.

So tell me about that contrast because everything else I think are things that people are going to naturally gravitate toward the obviously more efficient, more advanced heat pump solutions, but with natural gas we did such a good job convincing ourselves that it was the right way to cook, tell me about that.

**Dr. Stokes.** Yes, there's been a marketing campaign for a long time to sell gas to the American people, and you know we believe cooking with gas that it is the better way to cook. But what we're realizing is that we're not asking people to go back to the electric coils which we can all agree are terrible, we are asking people to go to as Donnel would put it, the Tesla of their stoves right?

Induction stoves are safer. They don't heat up. They basically use magnets to transfer to other surfaces the heat, and so they're safer, and of course they're not emitting these toxins into homes like the carcinogens that we've talked about, particular matter, things that cause asthma.

I honestly think the American people don't know in some ways all the risks of gas stoves in their homes and how much the technology has come ahead. And what we've got to do is make that technology the same cost as putting in a new gas stove, make it affordable, and that's where Congress can really help out with those zero emissions appliance rebates.

**Vice Chairman Heinrich.** Thank you. My time is expired, but I'm going to hopefully stick around for a second panel if I can. Congressman Estes and then we'll have Congressman Peters after him.

**Representative Estes.** Well thank you Mr. Chairman and thank you to all our witnesses for being here today. You know before the COVID-19 pandemic our economy had taken off thanks in part to policies that valued America's energy independence. And today as we try to recapture that economic boom that we saw before the pandemic, I worry that many companies who fought hard to stay afloat during COVID will ultimately fail with the rising tide

of government mandates that make everything more expensive for them including energy.

And the higher cost to power small businesses and homes will negatively affect both consumers as well as the family budget. The fact that nearly 80 percent of all U.S. energy comes from gas, oil and coal with wind and solar accounting for roughly 10 percent, so before we look at maybe what could be called unrealistic plans to remove fossil fuels completely from the U.S. economy, we should look at how do we focus on getting more efficient across the spectrum.

And we certainly don't need special tax credits to subsidize electric vehicles for millionaires to ride in California, particularly when my middle class folks in Kansas have to pay for that write off on the Tesla.

So I'm a big advocate of an all of the above energy strategy that prioritizes American energy independent, embraces the spectrum of fossil fuels and renewable energy and doesn't necessary focus on Washington picking winners and losers through these big subsidies.

On the other side it looks a lot like an anything but strategy that demonizes fossil fuels and clean energy like nuclear. An everything but policy is bad for our economy and environment. We've seen the fracking and natural gas have reduced natural greenhouse gas emissions more than any other technology in the past two decades, and innovation in that sector were driven entirely by the private sector, not by some top down government mandates.

Dr. Dourado research has shown that lower income households spend more of their budget on energy bills. For example a 2015 report found that households with less than \$30,000.00 annually in income spend 23 percent of their after tax income on energy, while households making over 50 percent annually spent just 7 percent of their after tax income on energy.

How do higher energy costs impact lower income families?

**Dr. Dourado.** Thank you Representative Estes. That is correct that poorer families spend a higher percentage of their budget on energy, and I think because energy is a necessity, and this is true across the board of almost all necessities that they affect the poorest the most.

I think it's extremely important that we focus on increasing productivity growth in our energy sector, and use the opportunity afforded through conversations like this to drive progress in our energy system across the board including next generation technologies like advanced nuclear and advanced geothermal.

I think that productivity will you know disproportionately help the poorest Americans.

**Representative Estes.** Thank you. Also, Dr. Dourado you noted in your writing that the current structure of Federal subsidies for clean energy generation significantly favors some forms of power over others. Senator Lee talked earlier about on Federal lands gas being favored over geothermal. But isn't it also true that solar power is favored over geothermal?

And how does that uneven nature of government subsidies affect clean energy production in the United States, and wouldn't a more

neutral approach spur greater creation of what could ultimately be cheaper forms of energy for the future?

**Dr. Dourado.** I think it would be an excellent idea to take a very close look at the permitting that we do on all forms of energy on Federal land, and see you know what is the maximum scope for processes like categorical exclusions that would simplify permitting for you know for solar and for geothermal, and for anything else that we might want to do.

So I think maximizing use of you know both legislative or administrative categorical solutions with that regard to the energy selected I think would be very good for productivity.

**Representative Estes.** Thank you. You know one of the things, and I'm about to run out of time, but one of the things that I noted as we looked ahead at energy production is that some of the renewables, the most likely ones we've talked about today in terms of wind and solar are the least productive in terms of being efficient.

And so we need to make sure that as we look to the future that we can have a total generating capacity that provide our electric needs into the future, so thank you Mr. Chairman and I'll yield back.

**Vice Chairman Heinrich.** Representative Peters.

**Representative Peters.** Thank you Senator Vice Chairman Heinrich for holding this important hearing. Also for mentioning the backstop authority for interstate high voltage transmission which we worked on together, and I hope we can pass that out of the House next week.

It's great to be joined by climate advocates, electrification experts, and even a fellow San Diegan in Mr. Matusiak, good to see you on this side of the country. And before I start I just want to say too to Mr. Schweikert. Count me in on the people who want to deal with NEPA in the context of climate action.

We have a very short time to get to where we need to, and I think we really have to look hard at the paperwork we put the people through particularly for things that are explicitly environmentally beneficial and I would love to work with you on cutting down the time of that.

Mr. Matusiak I'm interested in the scale of this project. This is a tremendously ambitious idea. Can you tell me kind of what you mean by electrifying everything? What does that mean in terms of time and cost and resources? And then I'm going to ask you kind of if you were us, how would you set up a program in terms of funding and incentives that would get us there?

**Mr. Matusiak.** Well thank you Congressman Peters. It's nice to see you here in Washington, and hopefully get to see you on the other side of the country too.

**Representative Peters.** The better side.

**Mr. Matusiak.** Where it's less humid and you know nicer weather. I would just say a couple of things. I think for us the conversation about electrifying everything is just a math question. How do we get to zero emissions and how do we do that as quickly as possible?

It's really electrifying almost everything. It's really focusing on our energy emissions, and our energy use in the country accounts for 90 percent of emissions. So by transitioning and electrifying the

economy a few things happen. The first thing that happens is that we actually cut in half the amount of energy that we use as a country because the reality is that electric machines are much more efficient than non-electric ones.

It turns out that the heat pumps that we're talking about today for people's homes are three times more efficient than the machines that they would replace. They are more efficient and they cost less to operate than any other kind of machine on the market.

So once we start electrifying the economy on our supply side, we have an opportunity actually lower the amount of energy, reduce the amount of energy we use as a country because it turns out that electrification is the efficiency. But where we focus, and where we had spent a lot of time thinking about is the demand side of the question.

Because when you electrify the supply side, when you decarbonize our supply, you still have machines on the other end that have to use the power that we are producing. And the opportunity that we have is to start thinking about the American households as the keystone of our infrastructure because every single one of those households as we go forward in the future, will have cars in the garage with batteries between the wheels.

They can have heat pumps in their homes that actually also serve as batteries, and each of those homes become a way for us to better balance the grid, to have better resilience, and to actually save Americans a lot of money so that they can plow it back into the economy.

**Representative Peters.** Just to make sure that we get to where I need to go is I understand that from the perspective of new construction, it's relatively easy to understand. What would you do to accomplish the retrofit of existing buildings?

**Mr. Matusiak.** By our analysis most of American homes in the United States will save money on their bills if the front end costs of these machines, these efficient electric heat pump machines are the same as the ones that they would be replacing. And so really, Senator Heinrich has introduced a bill for rebates to lower the front end costs of these machines to make them the same as the ones that they would replace.

We are convinced that Americans will choose those options if they are given the opportunity. And in addition to the rebates that we've talked about in terms of lowering the front end costs I would add two other things.

The first is low cost financing because these machines last a very long time, 10 years, 15 years, 20, 25 years. We can amortize the costs over a long period of time to further reduce the monthly cost to the American homeowner. The second thing that I would add on top of the rebates is actually goes to regulation.

We can lower the cost to the American consumer by making it easier for these machines to be installed, and ensuring that we have American workers who are trained to do that.

**Representative Peters.** I'm going to run out of time. I guess the other thing for us to look at as we go forward is one of the issues with the deployment of solar for instance is that people who have the upfront money to put those in are somewhat advantages, and it ends up with people that can't afford the upfront costs sub-

sidizing the others. And I would like to make sure that we come up with a way to ensure that that doesn't happen in this instance. And Mr. Chairman the San Diegans have used up my five minutes.

**Vice Chairman Heinrich.** Senator Cruz.

**Senator Cruz.** Thank you Mr. Chairman. Welcome to each of the witnesses. The advocates of the Green New Deal like to pitch their proposals in high sounding rhetoric, but the reality of their proposals are that they would do four things.

They would hurt the poor. They would hurt the working class. They would give special benefits and subsidies to the rich, and they would hurt the environment. The advocates of the Green New Deal like to pretend that they follow the science, that the laws of supply and demand somehow don't apply to them.

And they pretend that by spending trillions of dollars we're saving money. In a country that is blessed with vast natural resources we should be paying a fraction of the price for electricity and gasoline, but because of bad policies at the local, State and Federal level, Californians pay on average twice as much per kilowatt for electricity and a dollar more per gallon of gas, as people in Texas and most of the country.

And if you want to understand the Green New Deal it is to bring the failed energy policies of California to force them on the rest of the country. And for anyone who might pause to say well what's so wrong with that you could look no further than a census report released this month, September 2021 that concluded out of 50 states which state has the highest level of poverty.

The answer is of course the State of California as it was the year before, as it was the year before, as it was the year before. California according to the Census Bureau's latest calculation 15.4 percent of California residents lived in poverty from 2018 to 2020. There's only one place in the United States that exceeds the poverty level for California, and that is the place we find ourselves right now the District of Columbia.

The District of Columbia has the highest poverty level California has the second. Now what do those two jurisdictions share in common? They are governed exclusively by Democrats. They are governed by policies that drive up the costs of working class people, of low income people, and at the same time give generous subsidies to millionaires, so the proposals we had before sort of force Americans to shift from the gas furnace to a heat pump.

They are to force Americans to shift from their car or truck in their driveway to a much higher priced electric vehicle, to give them no choice in the matter. But not only that in doing so to hurt the environment. Right now a significant percentage of electricity is produced by coal-fired plants.

As a very practical step if you are shifting from a gas to an electric vehicle in a jurisdiction where your electricity is coming from coal, you are moving to a dirtier and more environmentally damaging way of travel. It's also worth noting that of every country on earth there's one country that has reduced CO<sub>2</sub> more than any other country, and that is the country we are in right now the United States of America.

The United States of America has reduced CO<sub>2</sub> emissions steadily. They peaked in 2007 and they have been steadily declining

ever since. Right now today we emit the same amount of CO<sub>2</sub> as we did in the early 1990s, and even less methane, despite having a population of 60 million more. Now why is that?

The principle driver of our steady reduction in CO<sub>2</sub> is the substitution of natural gas for coal production in electricity. If the advocates of the Green New Deal actually believed their rhetoric that reducing CO<sub>2</sub> was a good thing, they wouldn't fight tooth and nail to kill natural gas production, to kill natural gas pipelines to shut it down.

Mr. Matusiak, your biography says that you are a Managing Partner of an advisory firm focused on addressing climate change and economic inequality. Suppose that the electrification policy you've testified about today were to be implemented fully and entirely, what would be the temperature affect by the year 2100 using the EPA's own climate model?

**Mr. Matusiak.** Thank you Senator Cruz. I haven't done that calculation on the back of this testimony, but what I would say is that if we were going to fully implement the climate policy we're talking about today we would be ensuring on a voluntary basis that homeowners all across the country, households all across the country would be able to elect to purchase a heat pump water heater, a space heater, inductive stove.

**Senator Cruz.** Sir if you haven't done the research on what the climate benefit would be from the policies you're advocating using the EPA's own model I'll tell you what they would be according to the EPA's own model in 2100, so 80 years from now global temperature would be lowered by 0.173 degrees Celsius.

And in exchange for that you would impose trillions of dollars of costs on African-Americans, on Hispanics, on low income Americans, and you would drive up poverty across the country. It's difficult to ascertain why that's good for this country.

**Mr. Matusiak.** So I would just respond by saying a couple things. The first is that 40 percent of our emissions come from decisions made around the kitchen table in the households all across America.

The effect of the policy that we are talking about here today is to drive 40 percent of those emissions down to zero. The component piece of that with respect to America's contribution to global emissions would be the 40 percent of America's contribution to global emissions.

**Senator Cruz.** Do you dispute the EPA number?

**Vice Chairman Heinrich.** The gentleman's time has expired.

**Mr. Matusiak.** The effects on American households would be to put money back into the pockets of American families because the reality is that people are paying way too much on their energy bills, and those energy bills as was stated earlier by one of your colleagues are in elastic. People have to—

**Senator Cruz.** Do you dispute—

**Vice Chairman Heinrich.** Thank you for your patience Mr. Matusiak. Congressman Trone has been—

**Senator Cruz.** Don't want him to answer that one?

**Vice Chairman Heinrich.** I would be happy to let him answer that.

**Senator Cruz.** Good. I would welcome. Do you dispute the EPA number?

**Mr. Matusiak.** I didn't hear the question I'm sorry.

**Senator Cruz.** Do you dispute the EPA number that the effect of all these proposals by the year 2100 would be to decrease global temperature by 0.173 degrees Celsius?

**Mr. Matusiak.** What I know is what we are stacking in terms of emissions as a country. And what I know is what our North Star needs to be, and our North Star needs to be to get to zero. And the only way to get to zero is to electrify as many of the things as we can in this economy thank you.

**Vice Chairman Heinrich.** Congressman Trone thanks for your patience.

**Representative Trone.** Mr. Chairman would it be okay if I asked a few questions rather than give a partisan speech?

**Vice Chairman Heinrich.** It would.

**Representative Trone.** That'd be great. Let's do it then. Mr. Baird your testimony discussed some of the incredible work that BlocPower LLC's been doing in solar energy efficient technology, and you also highlighted how your company employs people in vulnerable populations. One of my top priorities in Congress is criminal justice reform. I'm very passionate about connecting justice impacted individuals with the resources to build back a better life.

How do you think the transition to the greener energy technology will impact the job market for disadvantaged folks like our justice impacted individuals?

**Mr. Baird.** Thank you sir for the question. I sit on the board of the New York Federal Reserve Bank back in New York. And one of the things we look at is construction data. And across the country our ability to build new buildings, retrofit existing buildings, and do construction across America is impacted by the fact that folks from our generation—me and Dr. Stokes, we don't necessarily want to go work for our baby boomer parents plumbing company it turns out.

We want to be on YouTube as an influencer. And so there is a shortage of highly skilled construction workers across America that is impacting our economic productivity. We think there's a massive opportunity here in front of all of us to train and to employ into economically and environmentally productive work—jobs, returning citizens to install heat pumps, to assess buildings in need of furnace upgrades or replacements to keep our kids healthy at home and in school.

And in New York City we are actually partnering with the city government. Right now we're hiring 1,500 young adults who are at risk of gun violence as defined by the District Attorney in all five boroughs. These folks have witnessed gun violence, they've been impacted by gun violence in high crime, low income neighborhoods in New York City.

And so we're hiring hundreds and hundreds of these young people. We're training them in cutting edge software out of Silicon Valley. How do you build a 3-D model of a building with a three dimensional camera on top of your construction hat, so that not only can they participate in the current construction economy, but they

can participate in innovating and leading and ensuring that American construction workers are at the forefront of innovation.

**Representative Trone.** I think that's fantastic Mr. Baird, and my company has hired over 500 returning citizens and it's good we can do good business, and do right by other folks too.

**Mr. Baird.** They work harder in fact sir as I'm sure you know because when you find the right folks they are indeed very focused and ready to work in a way that other folks may not be.

**Representative Trone.** And we have a better retention rate.

**Mr. Baird.** Correct.

**Representative Trone.** Mr. Matusiak if we could jump over. This administration has put back the Build Back Better Plan to invest in the American people and our economy. It's vital this plan works to ensure individuals have access to technology that's safe for them and the planet.

The President's plan is an opportunity to lay out the groundwork for long term change. How can we ensure these investments through Build Back Better can be targeted to help address disparities we have in electrification.

**Mr. Matusiak.** Thank you Congressman. Wonderful question. The reality is we have to be aware of the price disparities that face American households when it comes to not just the energy burden of their current bills, but also what it's going to mean for them to electrify.

One of the things Senator Heinrich has done through his legislation is introduce a bill that would recognize those disparities by putting increased dollars in the form of consumer point of sale rebates to low and moderate income households as compared to those who are not.

Those are the kinds of approaches we need to take. We need to be eyes open to the costs associated with the transition, enabling low and moderate income families who frankly have the most to gain from the transition by electrifying their homes, and enabling them to participate in that transition, and making sure as a matter of public policy that we are putting the thumb on the scale and investing and enabling them to do so.

**Representative Trone.** Mr. Chairman thank you I yield back.

**Vice Chairman Heinrich.** Representative Arrington.

**Representative Arrington.** Mr. Chairman thank you and thank you panelists. I'm from Texas. I share some of my colleagues sentiments if not all of them, and I understand that there are good intention folk on both sides of this issue with respect to the electrification of our country and our power systems.

And I don't judge or impugn the motives of those who want to do it. I think it's all in the way we approach it, and I think the way my colleagues are approaching it on the Democrat side is just too extreme, it's too radical, it's too abrupt, it's going to be too costly.

It's not balanced with respect to what we need to continue to grow our economy, not just for the opportunities and the prosperity for America, but vis-à-vis our adversaries and our competitors. We need to look at questions fundamentally that I think are inconclusive like the human activity, industrial activities, contribution to

overall relative to the ebb and flow of our carbon and greenhouse gas emissions.

I think we need to make decisions also with respect to the United States contribution, again relative to the rest of the world including China and other much larger polluters, and much bigger problems.

So I'm just very concerned about what I think is ideologically driven. I really do. Like I said I think a lot of this is inconclusive. We have been blessed with fossil fuels. And there's not hardly a thing in this room, including the microphone, our smart phones, the glasses that Dr. Dourado's wearing, our clothes, medical devices that don't have hydrocarbon component parts.

Actually 90 percent of the products that we use have some petrol chemical element to them. And the natural gas shale revolution has been a gift to the United States, and again not just our quality of lives, but for consumers to have affordable ways to heat and cool their home and get to and from work, to give us a competitive advantage to China who does not share our values.

And to give us energy independence. It's been remarkable. And I'm concerned Mr. Chairman, about the hostility. And I hear it from my Ways and Means colleagues, with all due respect to Mr. Beyer, he made mention at a hearing that we were going to burn up the planet. I don't think that's right.

I think we need to manage emissions. We need to steward our environment, but we've got to be smart about this. I don't have a prepared speech here, and I'm not going to try to rail on anybody in particular. I just think it's a fool's errand to try to radically transform the greatest economy in the world and have this in a way that picks winners and losers.

I mean if you're going to accelerate technology by battery story and the production, sustainability, reliability of renewables, at least let the market drive it, and let's have technology neutral government intervention, so that we can make sure the right technologies are being brought to bear to get us where we're going.

I think we're way too focused on the clean and the reduction, and it's very *de minimis* in terms of our global contribution. You can take away all of transportation and it's going to be really a 1 percent, 2 percent reduction globally. Why not be rational and smart in the heat of emotional debates on both side? Have an all the above approach.

I generate—I say I, my district generates more wind energy than any district in the country, three times California. But I'm also on top of the largest oil base in the world. And we coexist peacefully, and we are transitioning I think responsibly. So you know I should have a question here I know, but I'm very concerned about the path we're on.

I think it's extremely irresponsible. I think there's a lot of radical climate alarmist and ideologues driving this, and I think it's going to ruin the greatest economy in the world. And China is going to pounce on us, and they're just waiting for us to trip up. But I have to say I've seen the enemy and the enemy is us.

Let's work together on an all the above in a smart and logical and responsible transition. That would be my plea to my colleagues, and I'm sorry I went over time. I had some questions, but I will yield back because I've expired—at least my time has.

**Vice Chairman Heinrich.** Representative Beatty.

**Representative Beatty.** Thank you Mr. Chairman, to my colleagues and to all of our witnesses. Clearly, we have different opinions that you've heard today. I guess that could be the beauty of having testimony, winners and losers, radical.

Sorry my colleague from Texas left because Mr. Chairman I wanted to remind him about talking about those failures of energy policies in other states. I think it was earlier this year that his home State of Texas had a colossal failure of its electric grid, and it led to blackouts and price gouging for electricity costs, and this happened because they refused to make the investments necessary to harden their grid, while my colleagues Democrats are trying to Build Back Better in the budget reconciliation.

But he might not have remembered that because I think maybe he was on vacation somewhere. But with that to the witnesses, Mr. Baird, as Chair of the House Financial Services Diversity and Inclusion Subcommittee, I have routinely sought ways for more venture capital investments to find its way to minority- and women-owned companies.

According to the business database Crunchbase, women-led startups receive roughly 2.3 percent of venture capital investments in 2020, and another study found that black-owned startups only received around 2.9 percent of venture capitals in 2019.

Can you tell me as an African-American male who founded a very successful startup and secured venture capital investments from one of the largest venture capital firms in the country, can you discuss your experience in securing venture capital investment, or any thoughts that you may have on how to increase the minority-owned startups receiving venture capital?

**Mr. Baird.** Thank you for the question Congresswoman, and for your leadership on financial services. When starting our company we met with 200 venture capitalists back to back to back. Everyone told us no for a variety of reasons. The real reason was they weren't quite comfortable with the risk that our company, and perhaps my profile as a founder signified.

Early stage venture capital investing is like dating it turns out. There actually are non-verbal communications, and were you part of this fraternity or sorority and these things really matter at the stage of investment before a company has proven itself in the marketplace, before it has customers, before it has revenue, before it has traction.

And early stage investor is taking a bet on the founder and you often—too often find according to the statistics that you outlined that since most venture capitalists are men they too often are not comfortable investing in women and will say things like, “Oh well, that's interesting. Let me ask my wife if this is a good company for me to invest in.”

So that is a problem. For me we were very fortunate to win a clean energy contract for two and a half million dollars from the U.S. Department of Energy. It was competitively bid. We bid and competed against some of the largest engineering firms in America, but the Department of Energy at that time was responsive to innovation, and to technology and software, and worked with us collaboratively—in fact bent over backwards.

Once we won the contract to help us access the capital, the legal services, the accounting services that we needed to further qualify to actually begin the contract. I think there's a major opportunity when we look at HUD. You don't see that kind of small business innovation budget at HUD in the same way as you do at the Department of Defense, Department of Agriculture, the U.S. Department of Energy.

And so I think it is important to look into what are the ways that we can fund innovation out of HUD. We hosted the EPA Administrator Michael Regan in the Bronx to visit one of our schools that we've electrified on Monday.

And he suggested an interagency working group with himself, the Secretary of Energy, and Secretary Fudge at HUD to begin to look at how BIPOC climate tech startups could work together to partner with the Federal Government to deliver the climate type solutions that our communities need, particular with respect to the infrastructure spending that's coming down.

How do we prepare communities that have been historically disenfranchised to access the capital that they are entitled to?

**Representative Beatty.** Thank you, thank you Mr. Chairman.

**Vice Chairman Heinrich.** Senator Klobuchar.

**Senator Klobuchar.** Well very good thank you Mr. Chair, thank you Vice Chair as well as Senator Lee for this hearing. I'm going to start with the exciting world of appliances, or as I call it building a fridge to the next century.

Okay. So one example of this is that we have a co-op. We have a lot of electrical co-ops in our state, the highest number per capita of any state, interesting electric co-ops. And it's a different scale of development of course of energy innovation. But one called the Steele-Waseca Co-op, developed a program where customers who purchased a solar panel would receive a free water heater with a demand control switch.

And they showed me all these people purchased solar panels not for their farms, actually they were outside of the—right outside of the co-op, but then they got this water heater. So Mr. Matusiak, Dr. Stokes, can you comment on ways to speed up the deployment of cleaner appliances, not just water heaters, anything. Senator Hogan and I actually end up doing a bill on this, but that's another story, so go ahead.

**Mr. Matusiak.** Well, Senator Klobuchar thank you so much for the question. It's an honor to have that conversation with you. Just if you ever look at your water heater in your house you might see that yellow sticker that tells you how much the yearly energy costs are and just to give you a window into maybe that sticker, and what it could say.

A conventional gas water heater has a yearly energy cost of \$293.00. High efficiency gas \$271.00. A modern heat pump electric water heater \$104.00. There's a reason why the co-op in your state is giving free heat pump water heaters out with the solar panels.

It is because once you start electrifying one thing in the house it becomes easier to electrify other things in the house and the savings stack on top of one another. And so for us what is really critical is that we get started. Every single day in Minnesota and

across the country water heaters are failing, furnaces are failing, people are changing out stovetops.

Appliances have useful lives, then they come up and they need to be swapped out. And homeowners are not actually experts when it comes to water heaters and furnaces. I have yet to meet a single American or anybody that I have talked to who has said I can't wait for that new model water heater to come out next year because I'm absolutely upgrading, that's not how it works.

And so therefore, what needs to happen is that the front end cost of these machines need to be at the same level as the ones that they would otherwise have a choice to buy. If they are, the savings will be apparent, the benefits will be apparent, and our firm belief is that American families will vote with their wallets and bring the climate benefits along with them.

**Senator Klobuchar.** Okay. Do you want to just quick add anything to that Dr. Stokes?

**Dr. Stokes.** Sure. I would just like to elevate the work of Vice Chairman Heinrich with his Zero Emissions Home Act which may be slightly renamed, that is working on rebates for Americans so that it is more affordable to get these appliances.

**Senator Klobuchar.** Exactly.

**Dr. Stokes.** Yes that's what we really need in Build Back Better Plan.

**Senator Klobuchar.** Okay very good. Mr. Baird one of the things we also have found challenging is non-profits and making sure that a lot of them are in older buildings, and then they've got limited resources that they want to do for whatever their work is, or the churches, the synagogues, mosques, and another bill we did actually did something with that to make it easier for non-profits, and actually it's included, it's in the bipartisan infrastructure bill.

Talk about how we can make that easier and why that's a good idea, and then I have one last quick question for you Dr. Dourado, so if you could keep it to 30 seconds Mr. Baird.

**Mr. Baird.** Thank you Senator Klobuchar. I'll give you an example of a church in Westchester, New York. We reduced their greenhouse gas emissions by 70 percent, 7-0, which was great for all the millennials and Gen Zers to encourage them to attend services because their church was addressing the climate crisis which is important for their generation.

But we also saved them \$25,000.00 a year which they were able to reinvest in you know raises for Sunday school teachers and other items. Using the rebates that Dr. Stokes spoke about are very important to helping all Americans access the benefits of clean energy technology.

**Senator Klobuchar.** Okay. You did it in 30 seconds. It was impressive. Dr. Dourado you talked about in your testimony diversified carbon free energy resources, streamlined permitting. We've got about 75 million in the bipartisan infrastructure bill for states to establish their own permitting programs and giving Federal agencies the direction to evaluate, and look at permitting timelines. I'm especially obsessed with this with the pandemic and how things got disrupted and then trying to get things done and approved.

I think if anything it's gotten worse. Can you—over the last two years. Can you speak to the importance of streamlining and investing in efficient permitting?

**Dr. Dourado.** Yes Senator. I think it's critical and I think in particular it creates a lot of value even if we are going to do subsidies. I think combining it, subsidies with streamlined permitting returns higher value to the taxpayer because you're not just subsidizing people to go through this painful permitting process that often has not very much point, so I think adds a lot of value.

**Senator Klobuchar.** Thank you. Thank you. Thanks Mr. Chair and Mr. Vice Chair.

**Vice Chairman Heinrich.** Thank you Senator. There's interest in folks in doing a second round. If it's okay with everyone I'd like to suggest that the second round be limited to three minutes, and I'll stick around as long as I possibly can. Chairman Beyer.

**Chairman Beyer.** Thank you Senator very much. With respect to my friend from Texas who is really my friend. I just want to quote from August 9, IPCC at the U.N. quoted 14,000 different studies. They said that changes in climate today have little parallel in human history. The last decade is quite likely the hottest the planet has been in the 125,000 years. The world's glaciers are melting and receding at a rate unprecedented in at least the last 2,000 years.

Atmospheric levels of carbon dioxide have not been this high in at least 2 million years. Ocean levels have risen 8 inches on average over the past century, and the rate of increase has doubled since 2006. Heatwaves have become significantly hotter since 1950 and last longer in much of the world.

Bursts of extreme heat in the ocean which can kill fish, sea birds and coral reefs have doubled in frequency since the 1980s, and I believe we have just come through the hottest summer on record. I'm going to stick with burning up the planet.

By the way I wish that were not true. I mean nothing would thrill me more than science to come through and say we misunderstood climate change, but for the moment I think I'm going to stick with the 14,000 studies.

Mr. Baird, tell us about the business model. Can you really make a profit and have homes save energy and save costs? What's their payback, how many years?

**Mr. Baird.** Thank you for the question sir. We have a credit line with Goldman Sachs for 50 million dollars. We did 36 months of extensive financial due diligence with the team at Goldman Sachs in order to answer your question. The Goldman folks, they are interested in environmental sustainability, but they are more interested in profit.

And they invested this capital with our company because we were able to demonstrate that on a unit economics basis per building, we were able to generate significant savings. A 70 percent reduction in energy usage dramatically lowers energy costs so significantly that you can use those savings as part of your financial underwriting.

So if you're spending \$50,000.00 per year on energy right now and that baseline cost comes down to \$25,000.00. You now have \$25,000.00 worth of savings which you can use as part of your fi-

nancial payback. For large heat pump projects in New York City we see paybacks within 7 to 15 years, and we think that a financial product—we and Goldman believe that you can kind of almost create like a green mortgage where a rebate from the utility company, or from the Federal Government would be used, almost like a credit enhancement, or an FDIC guarantee at the end of that 15 year term.

**Chairman Beyer.** Thank you Mr. Baird very much.

**Vice Chairman Heinrich.** Representative Arrington.

**Representative Arrington.** Thank you. I'm looking at Steve Koonin's book. He was an Obama Administration Senior Official at Department of Energy. It says hurricanes and tornadoes are becoming more fierce. Climate change will be an economic disaster, surging sea levels.

He said you've heard all of these presented as fact, but according to science all these statements are profoundly misleading. And he goes on to say that these are not definitive, they're unsettled—that's the name of his book. So I get it. It's sincere. I'm not going to question again your motive.

I think the reality is when you look at for example just the combustion engine, and just the transportation. Our transportation systems driven by hydrocarbon fuels contributes 4 percent globally to the greenhouse gas emissions.

If you put everybody in an electric vehicle you're probably not going to be able to accomplish this goal on planes and trains all the way, but you just do the electric vehicles. And you have your charging stations. You've got to get electricity somewhere. By the time you get to netting out the emissions from charging the cars it's 1 percent. It's less than 1 percent.

And we're going to try to subsidize the entire electric vehicle industry and put everybody in an electric car, the math doesn't work to your point. It's a math problem at that point. I mean we could do it, but we're 28 trillion in debt. We're not paying any of this.

And look I'm going to say the Republicans are just as guilty in not paying for stuff. That's the biggest threat to our country, not climate change. I'd say obesity is a bigger threat to our country, and the disease states that follow. I'd say opioid epidemic is a bigger threat. It's more immediate. I'd say inflation is a bigger concern to most Americans.

But I'll get to a question because I think you get the point about where I sit and stand on this issue. And I'd like to be objective about it, but on this whole electrification and the data that I went through on how much we would actually reduce our carbon footprint relative to the global pollution, Dr. Dourado what's the smartest way to get us to the goal of a reduction in carbon emission if that's your thing, and maybe it's wise to manage that down as we already are and lead the world.

How do we accelerate that so that we're not subsidizing things that don't get us there most efficiently and effectively for the goal, for the taxpayer, for the economy, and for all the other things quite frankly that don't get much consideration? Clean gets all the love, but reliability and affordability ought to be in the mix don't you think, and can you answer that question it's very broad.

And thank you again Mr. Chairman for the additional questions and Mr. Beyer is my friend and I respect his position.

**Vice Chairman Heinrich.** And next time I'll bring a bag of question marks for all of our folks to. Go ahead.

**Dr. Dourado.** Yes Congressman as I testified I believe like the way to do it is through technology, which I am gratified that we are talking about technology today. I think but I think it's a wide range of technologies include next generation, nuclear and geothermal.

I think to really advance the whole suite of technologies that we'll need to reduce our carbon emissions we need to take a very close look at permitting, and make it easier to build in this country, build all kinds of new infrastructure across the board. And use sort of technology neutral policies to get us there.

**Vice Chairman Heinrich.** Thank you. I think I want to talk a little bit about math because comparing us to the rest of the world in our missions does miss the point that we are I believe the second biggest emitter in the world today after China, but we're also the largest historical emitter, so we put a lot of this stuff in the atmosphere in the first place and got us to where we are today in terms of parts per million in that atmosphere.

Now my friend from Texas, not Congressman Arrington, but the other friend from Texas who was here for a little while said that if you plug an electric vehicle into a coal-fired power plant it's dirtier than a gas vehicle. That math doesn't work, and it doesn't work because an internal combustion engine is only about 30 to 35 percent efficient.

Whereas an electric motor is well over 90 percent efficient in most applications. So even if you plug into a power plant that's not true. But if you plug in in Texas where so much of their power comes from wind it gets even cleaner. So I do think the math here matters.

And one of the most fascinating things that I learned from the work that Rewiring has done, and the work that Saul Griffith has done on primary energy is the realization that if we electrify we can actually cut our primary energy in half. Mr. Matusiak can you elaborate on that, and explain why that is.

**Mr. Matusiak.** Yes thank you Senator Heinrich. The shorthand is electrification is the efficiency because as you just said electric motors are three times more efficient than fossil fuels ones. Just for clarification, cars represent 15 percent of the U.S. emissions, 12 percent of our energy emissions, but the important point is that every single one of the machines that we're talking about is an appreciating climate asset because you're talking about the demand side where people are buying things, holding on to them for 10, 15, 20, 25 years, while the grid is getting cleaner and cheaper.

And so when it comes to Senator your question about why electrification enables us to save so much energy in the end, it is because of the technology embedded in these machines, and what they enable us to do. One other additional point that I would just make which is important, is that every single one—most of these machines, we're talking about the heat pumps and the cars, are also part of the grid.

They go to the resilience of our whole grid because we are starting to put aspects of the grid's storage in garages and in basements across 121 million households in the U.S. That helps us manage load over the day. It helps us respond if there is ever a failure like there was in Texas, or like there was after Hurricane Ida.

And it enables us to ensure that we have households who can maintain power and work and persist with their day to day activities when there is a grid failure. You can't do that if you have a battery in your garage, and a gas-fired furnace in your basement. The two things need to talk to each other.

**Vice Chairman Heinrich.** But if you have an F150 and the lights go out, you can run you can even plug in your house, and that's what today was all about. I want to thank Chairman Beyer for scheduling this hearing and for participating.

I want to thank all of our members who came and participated today, and I want to thank our witnesses. The record is going to stay open for three business days and with that this hearing is adjourned.

[Whereupon the hearing adjourned at 4:21 p.m.]

## **SUBMISSIONS FOR THE RECORD**

PREPARED STATEMENT OF HON. DONALD BEYER JR., CHAIRMAN,  
JOINT ECONOMIC COMMITTEE

Mr. Vice Chairman,

Climate change is a threat not only to our planet and our health but also to our economy. It is a crisis that becomes more deadly and costly every year. Just this past month, we witnessed catastrophic weather events from fires in the West to hurricanes in the South to flooding in the Northeast—events that devastated communities. But it isn't just homes in the path of this extreme weather that are susceptible to the negative consequences of climate change. We know that every American household feels its effects, and that low-income families and marginalized communities are disproportionately impacted.

To limit global warming and the expensive and life-threatening extreme weather events that come with it, we, as a Nation, must act now to aggressively move toward a zero-carbon economy. To achieve our climate goals, we must look at a multitude of solutions.

Electrifying homes and buildings is an important component of addressing the existential threat of climate change. The benefits of electrification go beyond the environmental and health benefits of lower global temperatures. Electric devices are safer and cheaper to operate than alternatives. These technologies help reduce residential energy costs, which boosts household disposable income—a boon to local businesses across the country—and improves public health outcomes.

Unfortunately, the upfront cost of investing in residential electrification technologies and appliances can be a significant obstacle for many families. Economic barriers and a lack of financing options may stand between homeowners and long-term investments in lower-cost electric appliances. We know that many households lack the financial capacity to spend upfront on improvements that will generate future savings. Research tells us that more than 1/3 of American families would struggle to afford a \$400 emergency, and most of these upgrades are precisely that type of emergency.

Another challenge consumers face in investing in residential electrification is that many older homes and buildings in the United States were not built to accommodate complete household electrification. Older housing stock often requires building upgrades to handle modern electric devices. Additionally, the ideal time to upgrade to the latest technology is often when an in-service device fails; however, coordinating more involved upgrades takes time that owners may not have when a furnace dies on a freezing winter evening. Furthermore, many of the skilled trade workers who install household appliances lack the time and resources to become trained on new technologies, creating additional supply chain barriers.

A number of market failures also stand in the way of broad adoption of electrification technologies. For example, landlords and homebuilders, who purchase many of the appliances families use, do not pay the operating costs of these units or breathe the air they operate in, creating incentives to underinvest in technology, safety and efficiency.

Market failures disproportionately impact low-income households, which spend the largest share of rent on utilities. This is particularly true in rural areas where many houses are connected to the electric grid, but are forced to pay high heating bills because HVAC systems have locked them into using high-cost fuels like propane or oil-fired heat. This mismatch can be even more acute with manufactured and mobile homes, a key source of affordable housing. Mobile homes use more energy per square foot than traditional construction and often rely on high-cost fuels, especially in rural settings.

Well-designed policies can help overcome a number of economic barriers and market failures that stand in the way of the adoption of electrification technologies.

This is why I, along with my colleague Rep. Earl Blumenauer of Oregon, recently introduced the Energy Efficient Commercial Buildings Act, which helps building owners with the costs of installing energy-efficient technology. Electrifying buildings puts businesses in a position to leverage investments in clean electricity into reduced emissions and lower energy bills. We must make these opportunities available to families and residential building owners as well.

We must also implement policies that make it easier for all families to upgrade to the latest zero-emissions technology to ensure that the gains from building electrification are broadly shared. Policies, such as point of sale rebates, would help families capitalize on opportunities to replace outdated and inefficient appliances, save money on energy bills and live in safer homes with less indoor pollution.

The scale of the challenges our planet is facing as a result of climate change is great. We must take this opportunity to deploy every tool at our disposal to meet

the moment. Investments in electrification technologies can—and should—be part of that solution.

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PREPARED STATEMENT OF HON. MARTIN HEINRICH, VICE CHAIRMAN,  
JOINT ECONOMIC COMMITTEE

This hearing will come to order.

Thank you, Chairman Beyer, for joining me to hold this hearing today to highlight what I see as one of the surest actions that we need to take right now to confront the climate crisis and to advance stronger, stable, and broadly shared economic growth.

And thank you to the witnesses here today who are leading experts in the growing movement for widespread electrification.

The fact is that if we ever want to address our contributions to our climate problem, we need to find sustainable and cost-effective substitutes for all the machines we use today that burn fossil fuels.

And it's not just our gas-powered cars and trucks.

We are also burning fossil fuels and emitting carbon pollution from our hot water heaters, furnaces, clothes dryers, ovens, and stoves.

In addition to the climate impacts, researchers are finding that burning fossil fuels in our homes, including methane—otherwise known as “natural” gas—or home heating oil, is really bad for our health.

This is particularly the case if someone in your family has asthma or other respiratory conditions.

Even if you are properly ventilating your fossil combustion devices, the particulate matter in the exhaust from your gas-range stove likely includes unhealthy levels of harmful chemicals like nitrogen dioxide, carbon monoxide, and even formaldehyde.

But the good news is that there are already better electric alternatives for each of these fossil-burning machines in our homes.

Each of these electric substitutes can help reduce our climate pollution and create savings on our energy bills.

Just last month, I invited Secretary of Energy Jennifer Granholm to visit New Mexico.

During her visit, we met with homeowners in Albuquerque's International District neighborhood who are participating in an exciting demonstration project that is helping families install energy efficient and electric water heaters and air-source heat pumps in their homes.

Tammy Fiebelkorn, from the Southwest Energy Efficiency Project, told us that installing these new appliances is reducing the burden of energy costs for low-income families.

As she put it, the project is “fighting climate change while also making sure that the benefits of that fight make it to our frontline and disadvantaged communities.”

That's exactly right.

These new electric appliances will be much more efficient than the fossil fuel-powered machines they are replacing.

And that means significant savings for these families on their monthly utility bills.

Those savings can make an enormous difference for a family living paycheck to paycheck.

And, importantly for our climate, all of these electrified machines can be powered by all the new clean and carbon pollution-free electricity that we will generate in our new clean energy economy.

This is how we can power our long-term economic recovery and save families money by solving our pressing climate challenge.

This is how we can build back better.

We need to get to a place where every time a family sits around a kitchen table to figure out how to replace a broken furnace, stove, or water heater, they choose to and can afford to install an electric machine.

That's why I introduced the Zero-Emissions Homes Act to establish a point-of-sale rebates program for these new electric appliances.

Through this type of Federal investment, we can make all of the long-term economic and health benefits of electrification affordable and accessible to all Americans.

We have a once-in-a-generation opportunity to make transformative investments in our energy economy—investments that will protect our planet, help keep our communities healthy, and promote shared prosperity.

We simply don't have any more time to waste in meeting our responsibility on climate.

Widespread electrification is one of the surest strategies we can pursue to finally take actions that meet the scale of this challenge.

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PREPARED STATEMENT OF HON. MIKE LEE, RANKING MEMBER,  
JOINT ECONOMIC COMMITTEE

Our country needs to modernize the way we generate, transmit, and distribute electricity. Over the last year, devastating blackouts have harmed communities across the country, from New York to California to Texas. The U.S. electric grid has at times proven inadequate for the needs of American families.

However, the answer is not to spend billions of Federal taxpayer dollars to electrify every American home and business, and just as importantly the answer is not to fundamentally alter Federal policy to regulate energy generation and consumption. Instead, we need to unshackle American industry so that new and diverse energy sources can help create a more resilient energy future.

It was not that long ago that American innovation unleashed the shale revolution, driving down natural gas prices and providing a cleaner energy option for homes and businesses. We need a similar revolution if we want to modernize our electric grid.

To clear a path for continued energy innovation, we must reform existing regulatory policies that stand in the way of investors and discourage entrepreneurs. If we want to move our energy infrastructure into the future, we need to address environmental review.

When President Nixon signed the National Environmental Policy Act—or NEPA—into law, it was meant to require agencies to consider the environmental consequences of their actions. NEPA is generally implicated when projects use Federal funds or touch Federal lands, which many energy projects do.

Fifty years later, this seemingly commonsense requirement has transformed into a process that requires an average of four and a half years—and sometimes almost two decades—of paperwork and litigation. The NEPA process frequently discourages and prevents critical energy infrastructure projects from being built.

The delays might be worth it if NEPA protected the environment. But environmental review is strictly procedural, meaning that it doesn't actually privilege environmental protection.

This means that paperwork and lawyers' fees are the most consistent result of the NEPA process. Federal agencies can find that the action under consideration imposes environmental harm and then theoretically decide to approve the project anyway. The process even delays projects with clear environmental benefits.

Without reform, NEPA leaves countless energy infrastructure projects in a state of bureaucratic limbo, sidelining workers, stunting innovative new technologies, and leaving communities across the country to wait for Washington to approve their future.

That's unacceptable, and it's why I've introduced the UNSHACKLE Act. This suite of bills reforms the NEPA process so that Federal agencies are better empowered to carry out the law's original intent, while also making our Nation's infrastructure projects affordable again.

The UNSHACKLE Act would require agencies to finish environmental assessments faster, allow them to reuse paperwork, and limit duplicative work at State and Federal levels. It would apply a two-year deadline for completion of the entire NEPA process, provide fair legal parameters around project reviews, and allow states to handle NEPA review within their own borders.

These reforms shouldn't be a partisan issue. They are designed to achieve something that we all can agree on—more efficient, effective Federal permitting for infrastructure projects.

Ultimately, the best energy future is one that allows the American people to innovate. Americans have made great strides pursuing breakthroughs in energy extraction, production, and technological innovations in wind, solar, hydro-electric, and other renewable forms of energy in the face of heavy-handed government control. Removing existing regulatory burdens will allow Americans to build a more sustainable future.

The ability to build, and build more quickly, will help make the U.S. electric grid more robust, resilient, and reduce the frequency of outages. It will provide cleaner, more affordable, more reliable power to American families and communities.

As we rebuild after the pandemic, we must liberate our energy sector. We must reduce regulatory barriers to developing nuclear, hydro, geothermal, and other

forms of energy. These technologies can be an important part of a competitive energy sector and a diverse energy future.

Let's get government out of the way and allow Americans to do what they do best. Reforming policies that get in the way of modernizing our energy infrastructure will boost economic prospects for American families, improve the environment, and enable us to build a better America. I am hopeful that today's hearing will convince us of the urgent need to achieve that goal.

Thank you.



## Testimony to the Joint Economic Committee

### "Examining the Economic Benefits of Electrifying America's Homes and Buildings"

Ari Matusiak, CEO, Rewiring America

September 22, 2021

Vice Chairman Heinrich (presiding), Chairman Beyer, and other Distinguished Members of the Committee, thank you for having me and for shining a spotlight on HOUSEHOLD AND BUILDING ELECTRIFICATION, the most central path for Americans to take to cut climate-changing emissions in half by 2030 and zero them out by 2050.

I am CEO of the nonprofit Rewiring America, founded just over one year ago by Saul Griffith and Alex Laskey. Saul was hired by the U.S. government, through DOE and ARPA-e, to map the energy sector down to .1 percent fidelity on both the supply side and the demand side. The roughly 100 Quads of energy we generate and consume as a country each year produce 90 percent of our emissions. When it comes to reducing emissions, much attention has been paid to the supply side as we transition through tax credits, clean and renewable electricity standards, and other government and market incentives to decarbonize our energy supply. The conversation on the demand side has been largely focused on replacing combustion engine vehicles, which comprise almost a third of our greenhouse gases, with electric vehicles.

The residential housing sector is another – and very large – part of the demand side. But when it comes to our emissions, we have principally understood our housing in two ways: as an opportunity for energy efficiency to reduce consumption, or as a location for solar or (very rarely) some other renewable energy source to further transition and clean our supply.

These are both important and laudable strategies. But the simple truth is that if we are cleaning our grid, we must also clean the machines that use it. We cannot get to zero emissions by any date unless we do. And that results in the realization that building decarbonization is the great unmet need in our climate policy.

Indeed, at Rewiring America we calculate that over 40 percent of energy-related emissions in the U.S. exist as a result of decisions made around the kitchen table: what we drive, how we heat and cool our homes, how we heat our water, how we cook our food, how we dry our clothes, and myriad other machine-based decisions from lawnmowers to firing up dinner on our outdoor grills.

There are 121 million households in America. In order to get to zero emissions by 2050, we have calculated America must replace or install one billion machines across all of those households in that timeframe. The timeframe is important, because these machines last for a long time: 10 to 25 years, on average. Every time a water heater needs replacement in America, it presents an opportunity to install an efficient, electric heat pump alternative. Every time that opportunity is missed, we put further pressure on hitting our 2050 target. Every machine counts.

For us, that is an affirming and optimistic prognosis. If those one billion machines represent around 40 percent of our emissions as a country, then we can develop a plan for addressing them, one efficient electric machine at a time. We do not need to wait on any moonshot technology: it has all already been invented. We do not need to ask Americans to sacrifice or change their lifestyles to survive: indeed, their lives will improve with efficient, electric appliances and equipment. And we can define our climate strategy in a way that benefits every American directly and immediately, designing policies that ensure the economic, health, and climate benefits of electrification are shared equitably by all, especially where they were systemically denied in the fossil fuel era.

The one billion machines also provide a window into the economic opportunity at hand for America. Because, if we need all of these efficient, electric machines, so too does the rest of the world. If America invests in making them, imagine the manufacturing boom we could create.

Prior to some heroic legislative heavy lifting in the last year to address this policy gap, by yourself and some others Mr. Vice Chairman, that has been a real missed opportunity in American policy. According to our modeling at Rewiring America, replacing carbon-dependent appliances increases household discretionary income, creates local jobs that cannot be automated or offshored, and reduces the health costs of burning fossil fuels in our homes. That is a win-win-win (three wins) on the economic front. All in addition to the emissions reduction, or fourth, win.

One way to capture these wins is with the following numbers:

- At least **85 percent of households in the United States** — 103 million — could **save \$37.3 billion a year** on energy bills if they were using modern, electrified furnaces and water heaters instead of their current machines. This is money that will flow through our economy, having multiplier effects that easily justify this investment.
- Of the households in the United States that would save by electrifying, **44 percent are low- and moderate-income**. Each year, they would save an average of \$377. Many would save **up to \$493 per year** on average.
- The savings are biggest for the **64.9 million households in the United States** across every county who are currently using electric resistance, fuel oil, or propane and

would **save \$496 per year** on average. 67 percent of households using natural gas would also save on annual energy bills. The number of households that would save and the average savings will continue to increase given the trajectory of heat pump technology improvements.

- Those average savings of \$496/year should not be short-handed to a hundred lattes. The Federal Reserve tells us that 4 in 10 Americans would have trouble meeting a \$400 or more emergency expense if needed.
- Outside of these direct pocketbook benefits to Americans and especially low- and moderate-income Americans, electrification would create **462,430 installation jobs** in the United States. In addition, it would further generate **80,000 manufacturing jobs and 800,000 indirect and induced jobs**.
- And on the healthcare front, which has boomeranging effects into our economy as well, electrifying household appliances would address the **42 percent increased risk of children experiencing asthma symptoms and unhealthy indoor air quality** associated with gas stove use. Furthermore, outdoor air pollution from residential buildings currently accounts for **15,500 premature deaths in the United States** per year.

Those are a lot of numbers. The point is that – just in terms of return on investment over time – Mr. Vice Chairman, if the upfront costs were the same, we think Americans would choose to electrify their households each and every time an appliance fails and needs to be replaced. In fact, in not installing a heat pump to heat or cool air, an induction cooktop, an electric heat pump water heater or clothes dryer, and an upgraded circuit breaker box to handle it all, these households would be locking in emissions for a decade or more into the future because of the brand-new, carbon-dependent machines that would be installed instead.

Equalizing the upfront cost of these appliances at the top of this decade will have market-driving effects that will eventually reduce the need for government subsidies. Point of sale rebates can accomplish this, as you have proposed in the Zero-Emission Homes Act, but that is the subject of another day in another committee.

Finally, after years of inaction on the climate crisis, we know we are walking up a cliff to prevent the most catastrophic level of warming. So, while these household upgrades are vital to get to zero emissions, they would also make the most important infrastructure in America – where Americans spend the majority of their time – safer, healthier, and more resilient. If our 121 million homes and vehicles are also backup batteries and energy generators, we are a much more resilient nation facing the challenges to come.

We thank you for your bold leadership on electrifying the U.S. economy, creating jobs, improving health, and driving down the catastrophic impacts of climate change. By the numbers, there is

simply no greater opportunity for the U.S. Congress to unlock another American century of economic expansion and prosperity than by investing in the electrification of our economy, starting with the American household. We encourage you to use your vested powers to make real the opportunity before us, and to use your bully pulpit to educate Americans about the role we all can play in realizing our shared future and potential.

Thank you, Mr. Vice Chairman.

**Statement on “Examining the Economic Benefits of  
Electrifying America’s Homes and Buildings”**

Joint Economic Committee

Dr. Leah Stokes  
Associate Professor, University of California Santa Barbara

September 22, 2021

Vice-Chairman Heinrich, Ranking Member Lee, and distinguished members of the Joint Economic Committee, good afternoon.

Thank you for inviting me to discuss the economic benefits of building electrification. My testimony represents my views only.

My background is in public policy, with a focus on energy and climate change. I received my doctorate in Public Policy from the Massachusetts Institute of Technology, where I also received a master’s from MIT’s Political Science Department. Previously, I received an MPA in Environmental Science & Policy from the School of International & Public Affairs (SIPA) and the Earth Institute at Columbia University. I am currently an Associate Professor at the University of California Santa Barbara. For more than 15 years, my research has focused on energy policy, particularly clean energy and other related solutions to the climate crisis.

**The Economic Imperative of Acting on the Climate Crisis through Building  
Electrification**

For decades, climate scientists have warned that climate change poses a dire threat to our economy. The Intergovernmental Panel on Climate Change (IPCC), an international scientific body, has made it clear that to limit global warming to

1.5°C, we must cut carbon pollution by 45% below 2010 levels by 2030.<sup>1</sup> This decade is therefore crucial to avoiding the worst impacts of climate change on the American economy.

Unmitigated climate change is already costing the US economy billions of dollars each year. In 2020, the US experienced a record 22 separate “billion-dollar” weather and climate events, generating almost half a trillion in US economic damages.<sup>2</sup> Scientists have shown how these disasters - from wildfires to hurricanes to flooding events - are made stronger and more frequent by climate change.<sup>3</sup>

To address the climate crisis, and limit warming to 1.5 °C, scientists have also found that no new fossil fuel infrastructure can be built. Existing fossil fuel assets already endanger this target.<sup>4</sup> Hence, installing any new fossil fuel infrastructure at this point is a poor economic decision: Either these assets will be in use for decades, leading to greater warming and associated economic damages; or these assets will need to be retired before they are fully depreciated. Both of these outcomes are suboptimal economically. Hence, at all scales — from gas furnaces, to cars, to gas power plants and fossil fuel pipelines — we need to stop building new fossil fuel infrastructure.

This includes new and existing infrastructure in the US buildings sector such as gas hot water heaters, gas stoves, gas clothes dryers, and gas furnaces. Emissions from direct combustion of these fossil fuels in buildings account for 12 percent of US carbon pollution.<sup>5</sup> Unfortunately, carbon pollution from the building sector has been growing, rather than decreasing, over the past decade: since 2010, carbon pollution from buildings has risen 5%. This only increases the urgency of cleaning up our building sector.

Thankfully, we have the solutions we need to begin cutting carbon pollution from buildings. We can use clean electricity to power our buildings, rather than relying on onsite combustion of fossil fuels. Electrification is a powerful economic pathway that can

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<sup>1</sup> Intergovernmental Panel on Climate Change. 2018. [Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C](#).

<sup>2</sup> National Oceanic and Atmospheric Administration, National Centers for Environmental Information. [“Billion-Dollar Weather and Climate Disasters: Time Series.”](#)

<sup>3</sup> US Global Change Research Program. 2018. [Fourth National Climate Assessment, Volume II: Impacts, Risks, and Adaptation in the United States](#).

<sup>4</sup> Tong et al. 2019. [“Committed emissions from existing energy infrastructure jeopardize 1.5 °C climate target.”](#) *Nature*.

<sup>5</sup> U.S. Energy-Related Carbon Dioxide Emissions, 2019, See: <https://www.eia.gov/environment/emissions/carbon/>

solve these challenges while also generating economic growth, reducing health impacts, and protecting Americans from deadly climate change-linked disasters. As the grid continues to become cleaner over the coming decade, it will prove the catalyst for economy-wide decarbonization. Clean electricity combined with electrification of buildings, transportation and around half of heavy industry can cut carbon pollution 75% below current levels. Further, we know what policies are necessary to accelerate this electrification process, delivering economic benefits and climate stability at the same time.

### **The Economic Benefits of Building Electrification**

Building electrification is an economic win-win: it will create jobs while advancing income equality and racial equity.

First, building electrification will create millions of jobs in the United States. From the manufacturing of space and water heaters, kitchen ranges and dryers, to their installation by electricians and plumbers, an aggressive commitment to building electric would create 1.1 million new direct and indirect jobs over the next ten years.<sup>6</sup> Investing in building electrification here at home will also ensure that the United States remains an innovator within a growing global market.

Second, building electrification is crucial to reducing inequality in America and reducing healthcare costs from indoor air pollution. People of color are exposed to higher-than-average levels of air pollution, with residential gas combustion and commercial cooking among the largest sources of these disparities.<sup>7</sup> Indoor gas pollution in low-income households is compounded by typically smaller housing unit sizes, more family members living and cooking under the same roof, poor air ventilation, and the use of stoves or ovens for additional heating in winter.<sup>8</sup> Perhaps most troubling, children living in a home where gas is used for cooking have a 42% increased risk of having asthma, currently and over their lifetimes, according to a meta-analysis of 41 studies.<sup>9</sup>

<sup>6</sup> Center for American Progress and Rewiring America, 2021. [To Decarbonize Households, America Needs Incentives for Electric Appliances.](#)

<sup>7</sup> Tessum et al. 2021. "[PM2.5 pollutants disproportionately and systemically affect people of color in the United States.](#)" *Science Advances*.

<sup>8</sup> Sivarajan, D. 2020. "[Pollution is coming... from inside the house.](#)" *Climate Solutions*.

<sup>9</sup> Lin et al. 2013. "[Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children.](#)" *International Journal of Epidemiology*.

At the same time, energy burden — the amount of a household's income spent on utility bills — in communities of color can be as much as three times higher than average households in these same communities, a difference that is linked in part to lower energy efficiency.<sup>10</sup>

Building electrification represents a significant opportunity to cut energy bills for American households, and reduce this income and racial inequality. According to modeling by Rewiring America, more than 103 million households (85%) could save money on energy bills by installing a modern electric appliance, saving roughly \$360 per year on average.<sup>11</sup> Forty-five million of these households are low-to-moderate income, for which energy bills represent a significant portion of household spending. Overall, the average US household could save \$2500 if an appropriate policy mix is put in place to support electrification, with some households saving as much as \$4000.<sup>12</sup>

### **Federal Investments and Policy to Support Building Electrification**

To accelerate building electrification, Congress should make key investments. The primary goal of federal policy should be to make zero-emission appliances the default purchase for all Americans.

Key investments include federal support for zero-emission appliances and whole home retrofits, which can speed up the deployment of heat pumps while increasing energy efficiency. Zero-emission appliance rebates are particularly important for making clean appliances accessible to low income Americans, who otherwise may not be able to afford crucial upgrades. These policies will help catalyze a market for clean, efficient appliances, which as deployment grows, will lead to lower costs through learning-by-doing. They will also help avoid locking in carbon pollution, as appliances installed today may still be operating 20 years from now, in the 2040s.

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<sup>10</sup> American Council for an Energy-Efficient Economy. 2016. [Lifting the High Energy Burden in America's Largest Cities: How Energy Efficiency Can Improve Low-Income and Underserved Communities](#).

<sup>11</sup> Rewiring America. 2021. [Bringing Infrastructure Home: A 50-State Report on US Home Electrification](#).

<sup>12</sup> Rewiring America. 2021. [Household Savings Report](#).

Additional federal dollars should also flow to the Weatherization Assistance Program (WAP) to ensure low income Americans can also enjoy a safer, healthier home environment free of indoor air pollutants and other health concerns. WAP also deploys proven weatherization measures that help households reduce their heating and cooling needs while bolstering the home infrastructure necessary to electrify. All told, WAP can help reduce low-income households' energy bills and make sure they are not left behind in the energy transition.

The federal government should also invest to help catalyze the domestic manufacturing of zero-emissions appliances. This could involve paying manufacturers for every appliance they manufacture, with additional support for those made with unionized labor. Furthermore, federal incentives should encourage distributors to carry these appliances and contractors to offer them to customers. Every part of the industry needs to be engaged to unlock key barriers to market adoption.

Tax credits are another important tool that Congress can use to accelerate adoption of zero-emissions appliances, particularly for higher-income Americans. Overall, these federal investments will be multiplied through additional economic activity and job creation.

In addition, clean electricity investments are complementary to building electrification investments. Legislation introduced in the House of Representatives focuses on investing in growing clean electricity through both tax credits for power producers and grants for utilities that increase their share of clean power. These efforts will help building electrification deliver even greater benefits over time. Notably, given the electricity mix we currently have, residential building electrification would reduce 180 million metric tons of carbon emissions today; this figure more than doubles on a 100% clean grid.<sup>13</sup>

Federal investments can also help amplify state and local leadership on building electrification. Already, more than fifty cities have adopted building codes that aim to reduce fossil gas. For example, numerous cities in California have adopted building code policies that limit or prohibit gas in new buildings.<sup>14</sup> Lawmakers in New York City have introduced a bill to ban gas in new and significantly renovated

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<sup>13</sup> Zurofsky et al. "[Rewiring Communities](#)."

<sup>14</sup> Sierra Club. 2021. "[California's Cities Lead the Way to a Gas-Free Future](#)."

buildings.<sup>15</sup> In line with the state's climate emissions reductions goals, Colorado plans for 90 percent of its buildings' water and space heating needs to be met by electricity in 2050.<sup>16</sup> Massachusetts has committed to electrifying 1 million of 2.5 million homes — 40% of the state's total homes — by 2030.<sup>17</sup> In 2020, Maine set a target to have high-performance heat pumps installed in 245,000 homes (totalling 48% of the housing stock) by 2030—demonstrating the promise of electrified home heating systems, even in colder climates.<sup>18</sup>

In sum, we have the policy and technology solutions at the ready—today. It is a matter of deployment and market adoption. It is a matter of levelizing the costs of the technology as the market catches up to the enormous demand needed to meet the climate crisis. It is a matter of smart policy solutions that support the market — and in doing so, create economic opportunity for households to save money, invest in their communities, and create jobs.

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<sup>15</sup> New York City Council. 2021. [Int. No. 2317](#).

<sup>16</sup> Colorado Energy Office. 2021. "[Greenhouse Gas Pollution Reduction Roadmap](#)"

<sup>17</sup> Massachusetts. 2021. [Clean Energy and Climate Plan for 2030](#).

<sup>18</sup> Maine Climate Council. 2020. [Maine Won't Wait: A Four-Year Plan for Climate Action](#).

September 22, 2021

**Testimony of Mr. Donnel Baird to the U.S. Congressional Joint Economic Committee**

I was born right down the street, here in our nation's capital. My parents had moved to America in search of a better and a healthier life. In their home country, they lived near a group of mineral mines which had negative health consequences for my family, causing my mom to lose several pregnancies.

I grew up in a Brooklyn apartment with no heat. Like many of our neighbors, we heated our apartment with a gas oven. Every night, we would turn on the gas burner, open up the oven door. My dad was a mechanical engineer; we knew the oven produced carbon monoxide and other toxins and was not safe. So, we opened the windows to help clear the air. You do not need to be an engineer, or the CEO of a clean tech startup, to know that releasing toxic gases into homes is bad for public health, and that leaving windows open to mitigate the effects is a waste of resources.

I founded BlocPower, my climatetech startup, in part, to help address the energy issues my family struggled with growing up. Households account for 42% of US energy-related carbon emissions and BlocPower is focused on the greening of buildings, by replacing old antiquated fossil fuel energy systems with all-electric technology.

The business case for BlocPower is simple. BlocPower installs clean, zero-emission technology in older buildings that use fossil fuels around the country. BlocPower makes money because this technology saves so much in energy and other costs that with the right transaction and incentive structure, BlocPower is able to turn a profit and leave households spending less on energy than before. In the process we dramatically lower buildings' carbon emissions, make them healthier and more comfortable to live in. In essence, we create both jobs and healthier communities, while delivering value.

I will never forget one of BlocPower's first projects, when we were called in to convert an aging school building following a tragedy. This building had been burning fossil fuels in the basement to power the facility; however, the building's ventilation system was not set up correctly. As a result, air pollution from the basement was being pumped into the cafeteria, contributing to chronic asthma amongst the schoolchildren. The school nurse had to manage over 70 cases of asthma at the school. The air was so poor that one day a four-year-old student needed to be taken to the emergency room following a severe asthma attack. Tragically, this child died.

We know this is not an isolated incident. Our schools and our homes across this country need and deserve electrification. Electric buildings are better buildings.

Across the country, we are starting to see communities rethink the role buildings play in keeping people healthy. This type of shift in thinking is not new. Just as our country changed its behaviors of using lead-based paint once the severe health consequences of it were understood, we need to rethink how we power furnaces and ovens in buildings. We know that fossil fuel

powered ovens and furnaces are so unhealthy, producing so much nitrogen dioxide and carbon monoxide, and as a result causing serious health consequences.

The problems of dirty fuels in buildings are fixable.

We know this technology works. In Brooklyn, new buildings under construction often include heat pumps--the challenge is how to retrofit existing buildings to include heat pumps. We have installed efficient energy systems in schools, houses of worship, and several hundred apartment buildings in New York City. We are retrofitting an apartment building on the Lower East Side of Manhattan as we speak today. The workforce exists. In New York City right now, we are training 1,000 new workers from disadvantaged communities to install these systems.

We also have the ability to bring the same incredible technology, software and hardware, to the challenges of heating and cooling and making hot water in buildings. The tech is safe, uses modern software, and cloud computing, and is 100% all electric. It saves money, it makes these spaces more comfortable to live in, it eliminates so many cumulative health risks, like asthma, and many more acute ones, like carbon monoxide poisoning.

These are real benefits to families. Aggregated across America, these benefits to our economy are massive. Billions of dollars a year in health savings, billions more in disposable income families save on energy bills and spend in local communities, or save towards a more secure future.

The markets have spoken, and endorsed this better technology. All electric low carbon healthy buildings are being embraced by Apple, Microsoft, Google, Goldman Sachs, American Family Life insurance company, Salesforce, the NY State government. Our startup works with all of them.

The government has a key role to play to ensure that the benefits of all electric buildings are available to all Americans. Rebates can help reduce the upfront costs of American converting their homes to all electric, so that it's more affordable. Rebates can also help leverage government money with private sector capital. Today, we raise five private dollars for every government dollar in our partnership with Goldman Sachs. In addition, expanding lending through the Department of Energy's Loan Program Office could provide significant new capital to grow electrification across the U.S.

Electrification can save families money and create jobs in urban America and rural America. We can train the high skilled tech-enabled construction workers that our country needs. Not just to electrify buildings, but to build new homes and install new infrastructure across America. We can make our houses smart, and electric, and responsive to a modern smart grid, so that we can protect ourselves from climate disasters.

America should lead the world in innovation, in manufacturing and workforce to convert the world's buildings to renewable electricity. Congress can and should help ensure America is positioned to lead in that market. Thank you.

## TESTIMONY



## **Additional Solutions to Help Decarbonize the American Economy**

September 22, 2021

**Testimony Before the US Congress Joint Economic Committee**  
**Hearing: Examining the Economic Benefits of Electrifying America's Homes and Buildings**

**Eli Dourado, Senior Research Fellow at the Center for Growth and Opportunity  
at Utah State University**

Thank you, Vice Chairman Heinrich, Ranking Member Lee, and members of the committee for the opportunity to testify today on electrification as a strategy to address climate change. My name is Eli Dourado. I am a senior research fellow at the Center for Growth and Opportunity at Utah State University. I study the technologies that could bring about transformative economic growth and the obstacles they face.

Climate change is a technology problem. New technologies are our only realistic hope to significantly reduce carbon emissions. The way to address climate change, then, is not to deindustrialize society and go back to a less prosperous past. It is to charge boldly into the future. On that, I believe, we all strongly agree.

There is a slogan that represents one vision of this future: "Electrify everything."

Like all slogans, it oversimplifies. I'd like to use this opportunity to raise some nuance and offer additional solutions that will make us more likely to achieve our decarbonization goals.

To this end, I recommend this committee focus on the following priorities as it considers its electrification agenda:

- Be realistic about necessary electrical system upgrades
- Make it easier to build
- Avoid picking winners and losers
- To make the economy boom, clear the way for cheap and abundant clean energy

*The views expressed in this testimony are those of the author(s) and do not necessarily reflect the views of the Center for Growth and Opportunity at Utah State University or the views of Utah State University.*

### **Be realistic about necessary electrical system upgrades**

Electrifying heating makes financial sense for many, but not all, individual homeowners. According to research from the Rocky Mountain Institute, electric heat pumps would lower costs for customers replacing oil or propane heating systems and for most new construction, but not usually for customers using modern natural gas furnaces.<sup>1</sup> The economics are generally worse in colder regions of the country, as air-source heat pumps operate less efficiently the colder the air is outside.

Even if heat pumps make individual economic sense, they may not make collective economic sense until upgrades are available for our electric grid and generation capacity. Mass adoption of electric heat pumps, particularly in the coldest parts of the country where they are least efficient and most utilized throughout the year, will flip the time of peak electricity demand from summer to winter. Since our current system is only built to the capacity of the summer peak, without new capacity, the coldest winter days would be met with rolling winter blackouts at exactly the time we most need reliable energy.

Furthermore, heating is a safety-critical service. People die if the heating goes out. A study by the National Center for Health Statistics found that twice as many Americans die from excessive cold as excessive heat.<sup>2</sup> The United States has one of the least reliable electricity grids in the developed world.<sup>3</sup> If we want to rely on electricity for safety of life, we must invest in grid hardening, like placing wires underground where they can't be downed by falling trees. It is not sufficient to simply add long-distance transmission lines from low-cost wind and solar farms. If local grids go down, people could die.

To completely electrify heating, then, is not as simple a solution as some of its proponents say it will be. It would require building new reliable peak capacity and hardening the existing grid.

### **Make it easier to build**

If we are going to do so much building—new peak-load power plants, undergrounding of wires, new long-distance transmission lines, and new wind and solar farms—it is worth first addressing the excessive cost of building new infrastructure in this country. Among the chief culprits are laws that give project opponents a way to slow or stop the permitting and siting process. Laws intended to support environmental justice, like the National Environmental Policy Act (NEPA), have instead been weaponized by NIMBYs or competitors to slow progress. For example, Vineyard Wind, the US's first large-scale offshore wind farm, currently faces three lawsuits under NEPA, including one by a rival solar developer.<sup>4</sup> These lawsuits threaten to extend an already protracted permitting process.

Research from the Brookings Institution found that Interstate highway construction costs tripled between the 1960s and the 1980s.<sup>5</sup> The researchers attributed the increase in cost to the rise of "citizen voice" and dated the inflection point to the early 1970s, consistent with the major culprit being NEPA, which took effect on January 1, 1970.

<sup>1</sup> Sherri Billimoria et al., "The Economics of Electrifying Buildings" (Rocky Mountain Institute, 2018), [https://rmi.org/wp-content/uploads/2018/06/RMI\\_Economics\\_of\\_Electrifying\\_Buildings\\_2018.pdf](https://rmi.org/wp-content/uploads/2018/06/RMI_Economics_of_Electrifying_Buildings_2018.pdf).

<sup>2</sup> Jeffrey Berko et al., "Deaths Attributed to Heat, Cold, and Other Weather Events in the United States, 2006–2010," National Health Statistics Reports 76 (National Center for Health Statistics, July 30, 2014), <https://www.cdc.gov/nchs/data/nhsr/nhsr076.pdf>.

<sup>3</sup> Ula Chrobak, "The US Has More Power Outages than Any Other Developed Country. Here's Why," Popular Science, August 17, 2020, <https://www.popsoci.com/story/environment/why-us-lose-power-storms/>.

<sup>4</sup> Miriam Wasser, "Fishermen Challenge Federal Approval Of First Large-Scale Offshore Wind Project," WBUR, September 13, 2021, <https://www.wbur.org/news/2021/09/13/roda-fishermen-lawsuit-vineyard-wind-boem>.

<sup>5</sup> Leah Brooks and Zachary D. Liscow, "Infrastructure Costs," Hutchins Center Working Paper 54 (Brookings Institution, August 2019), [https://www.brookings.edu/wp-content/uploads/2019/08/WP54\\_Brooks-Liscow\\_updated.pdf](https://www.brookings.edu/wp-content/uploads/2019/08/WP54_Brooks-Liscow_updated.pdf).

By lengthening and adding risk to the permitting process, NEPA makes financing large, capital-intensive projects less attractive. Some have proposed new federal subsidies for long-distance transmission projects to overcome this obstacle.<sup>6</sup> While subsidies for these projects may be desirable in isolation, it is unwise to spend taxpayer money to overcome a permitting obstacle that Congress created and has the tools to fix. Congress should first remove the permitting obstacles and then consider whether new subsidies are still necessary. Even if they are still necessary, they would return much higher value for the taxpayer with the permitting obstacles removed.

Furthermore, as I noted above, we need more than just long-distance, high-voltage transmission lines. We need new, peak-load power plants, and we need to harden the local grid. In addition, the country would greatly benefit from new, zero-carbon baseload power plants, either nuclear or geothermal. To accommodate all of this building, we need thoroughgoing permitting reform of the kind that has been proposed in S.717, the UNSHACKLE Act. Comprehensive permitting reform would make the electrification agenda significantly more plausible and attractive.

### **Avoid picking winners and losers**

A downside of a strong policy focus on electric heat pumps is that it puts politicians in the role of picking the winning technology. If left to compete on a level playing field, a range of other possible solutions, including non-electric options, could help to decarbonize heating.

For example, many people underrate the benefits of district heating. Cities like Copenhagen, Reykjavik, and Boise have had district heating for years. While Reykjavik and Boise's systems rely on low-temperature geothermal heat, Copenhagen's, which covers 97% of the city and much of the surrounding area, is powered by waste heat from waste incineration plants and combined heat and power plants.<sup>7</sup> Boise's system powers the city's downtown and costs only \$1000 per winter month to operate.<sup>8</sup> Between district heating and smaller systems, direct-use geothermal systems in Iceland supply 90% of the country's heating needs.<sup>9</sup>

Historically, such geothermal systems as exist in Boise and Reykjavik have depended on the availability of a suitable low-temperature geothermal resource. Modern drilling technology now makes it possible to construct such a resource virtually anywhere in the country. A modern, direct-use geothermal district heating system could supply an entire city with cheap, clean, non-electric heat. By avoiding a technology-specific subsidy, we could let competition and entrepreneurs, not Congress, determine the best way to decarbonize heating.

Carbon removal strategies are also an exciting piece of the solution. Enhanced weathering and ocean alkalization seem like especially promising approaches, removing carbon dioxide from the atmosphere at a fraction of the cost of other known methods. If we could remove atmospheric carbon dioxide so cheaply on an arbitrarily large scale, it might not matter that some homes in the colder regions of the country stick with natural gas heat.

Instead of selecting one technology to decarbonize heating on its own, Congress should avoid picking winners and losers.

<sup>6</sup> For example, S.1016 in the current Congress.

<sup>7</sup> "C40: 98% of Copenhagen City Heating Supplied by Waste Heat," C40 Cities, November 3, 2011, [https://www.c40.org/case\\_studies/98-of-copenhagen-city-heating-supplied-by-waste-heat](https://www.c40.org/case_studies/98-of-copenhagen-city-heating-supplied-by-waste-heat).

<sup>8</sup> McKenna King, "An inside Look at the Largest Geothermal Heat System in the US," WCPO, December 6, 2018, <https://www.wcpc.com/news/national/an-inside-look-at-the-largest-geothermal-heat-system-in-the-us>.

<sup>9</sup> "Direct Use of Geothermal Resources," National Energy Authority, accessed September 14, 2021, <https://nea.is/geothermal/direct-utilization/nr/91>.

### **To make the economy boom, clear the way for cheap and abundant clean energy**

Addressing climate change does not have to be bad for the economy, but the political focus on job creation is economically backward. Electric vehicles have many advantages over combustion vehicles, but one of them is that they have fewer moving parts and therefore require less maintenance expense. This reduction in maintenance requirements will translate to thousands of mechanic jobs being destroyed. Should we oppose electric vehicles on this score? Of course not.

To an economist, a job is a cost, not a benefit. A new job is a requirement to allocate scarce labor resources to solve a particular problem at an expense that ultimately falls on the consumer. It would be better, economically speaking, if the problem and the expense vanished, along with the job. Nothing is more likely to derail our response to climate change than turning it into a jobs-creating boondoggle.

If not in jobs, where does the economic opportunity from climate change lie? Rethinking energy.

We have observed stunning cost reductions in wind and solar energy production over the last two decades. Even so, wind and solar by themselves are not up to the task of powering the entire country. We need to take advantage of additional carbon-free energy sources that are not only cheap, but also firm, dense, and able to be sited anywhere: advanced nuclear and advanced geothermal technology.

Modern small modular reactors provide safe and efficient nuclear power in an appealing form factor, but they, along with the rest of the nuclear industry, have been hobbled by overregulation. The Nuclear Regulatory Commission's approval process costs hundreds of millions of dollars.<sup>10</sup>

Advanced geothermal energy is a resource more than 40 times greater than all the fossil fuels and fissionable material on the planet combined.<sup>11</sup> Yet it is hobbled by permitting problems on federal lands. Oil and gas wells can get approved by the BLM in two weeks. The same wells for geothermal purposes take two years.<sup>12</sup>

If we solve these policy problems, we could double or triple per capita primary energy use while reducing net carbon emissions below zero. That would truly make the economy boom.

I once again thank the committee for the opportunity to testify, and I look forward to your questions.

<sup>10</sup> Jason Crawford, "Why Has Nuclear Power Been a Flop?," *The Roots of Progress*, April 16, 2021, <https://rootsofprogress.org/devanney-on-the-nuclear-flop>.

<sup>11</sup> Wes Hermann and A. J. Simon, "Global Exergy Flux, Reservoirs, and Destruction" (Global Climate and Energy Project at Stanford University), accessed September 15, 2021, [https://gcep.stanford.edu/pdfs/GCEP\\_Exergy\\_Poster\\_web.pdf](https://gcep.stanford.edu/pdfs/GCEP_Exergy_Poster_web.pdf); Eli Dourado, "The State of Next-Generation Geothermal Energy," *Elicourado.com*, July 6, 2021, <https://elicourado.com/blog/geothermal/>.

<sup>12</sup> Eli Dourado, "The Biggest No-Brainer in All of Energy Policy," *The Center for Growth and Opportunity*, November 2, 2020, <https://www.thecgo.org/benchmark/the-biggest-no-brainer-in-all-of-energy-policy/>.

RESPONSE FROM MR. ARI MATUSIAK TO QUESTION FOR THE RECORD SUBMITTED BY REPRESENTATIVE PETERS

**Mr. Matusiak, there are concerns about the clean energy industry not sufficiently providing union jobs. How is the electrification industry advancing union jobs and how can our programs better support U.S. workers? I am specifically interested in apprenticeship opportunities and local hiring opportunities in this sector.**

First, thank you for your timely question on the economic opportunity that electrification offers to U.S. workers. The electrification industry, or market, is nascent, providing an important window to shape its development with the American people—and American workers—at its center. To that end, designing programs that both catalyze the market and support local good-paying jobs is critical. Rewiring America estimates that one billion machines need to be replaced and installed to fully electrify our residential sector.<sup>1</sup> This will require U.S. workers in every segment of the market, from manufacturing to installation to sales. Indeed, according to our analysis, a wholesale commitment to electrification will create 25 million net jobs over the next 15 years with five million new jobs sustained by 2050.<sup>2</sup> By 1) investing in high-quality training and placement programs, 2) enabling contractor companies to train and hire U.S. workers, and 3) incentivizing domestic manufacture and assembly of the machines necessary to electrify, the U.S. Congress can ensure that the U.S. provides the opportunity for local jobs in every zip code while prioritizing U.S. leadership and competitiveness on the global market.

Household electrification depends on the mobilization of local U.S. workers who will provide the contracting, installing, rewiring, and maintenance of and for the machines that heat and cool our homes, heat our water, cook our food, and dry our clothes. These jobs are impossible to be offshored or automated, thus necessitating a skilled workforce available in every state, county, and zip code.<sup>3</sup> The inherent need for the broad distribution of these jobs creates an opportunity to train and place local workers in the predominantly small businesses that will offer these services to communities across the country. Apprenticeships play a natural role here as workers transition from their training into their newfound roles. Congress can fund such job creation programs through grant programs, as it is currently considering both in the Infrastructure Investment and Jobs Act and reconciliation legislation, which together comprise the President's Build Back Better Agenda.

Contractor companies exist throughout the country and will have to scale up their capacity to meet the needs for an accelerated household electrification drive. This also applies to union-hiring businesses that mainly service multifamily buildings. Incentives via tax breaks or direct grants can be used by these companies to hire workers, including apprentices, and provide for their training. By providing such support, Congress can enable these small businesses and larger entities to bring on new workers with good-paying wages.

Lastly, the job opportunities electrification will create are not limited to highly localized jobs for the installation of the electric machines—these machines must also be made, assembled, and distributed across the country. By supporting manufacturers to assemble, produce, and stock the machines domestically, America can bolster its manufacturing capacity. In doing so, new good-paying union jobs will be created, while also ensuring U.S. competitiveness on the global market, critically, as demand for these modern electric machines dramatically increases. And as these machines are used in mission-critical and public-health situations (e.g. cold rooms, protecting against extreme heat or cold), having these machines within our shores also bolsters U.S. resiliency. Manufacturers and distributors can be encouraged to build domestic facilities via incentives in the forms of tax credits and direct grants.

In sum, the electrification market is poised for a once-in-a-generation expansion both domestically and internationally. U.S. workers should lead the way in the making, transporting, selling, and installing of the machines required. The opportunity for the creation of local good-paying jobs, including apprenticeships and union labor, is ours to bolster. Congress has within its power the ability to fund important incen-

<sup>1</sup> See Rewiring America's "One Billion Machines" report by Saul Griffith, PhD and Sam Calisch, PhD, June 2021.

<sup>2</sup> See Rewiring America's "Mobilizing for a Zero Carbon America: Jobs, Jobs, Jobs, and More Jobs; A Jobs and Employment Study Report" by Saul Griffith, PhD, Sam Calisch, PhD, and Alex Laskey, July 2020.

<sup>3</sup> See Rewiring America and the Coalition for Green Capital's Rewiring Communities: A Plan to Accelerate Climate Action and Environmental Justice by Investing in Household Electrification at the Local Level report by Adam Zurofsky, Jeffrey Schub, John Rhodes, Tony Curnes, and Sam Calisch, PhD, May 2021.

tives that will support each segment in the market to train, place, and hire this new workforce, 25 million strong.

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RESPONSE FROM MR. ARI MATUSIAK TO QUESTION FOR THE RECORD SUBMITTED BY  
REPRESENTATIVE HERRERA BEUTLER

**We continue to hear of moving the U.S. toward zero emission electricity. As a member of the Conservative Climate Caucus, I think preserving our economy and environment do not have to be mutually exclusive goals. In Washington State hydropower accounts for roughly 70 percent of clean energy across the state. There is even a 1300 Megawatt (MW), 20 hour Goldendale pumped storage project in my district that would provide more than 3,000 jobs.**

- **What role do the witnesses see pumped storage and hydropower playing in the path to more renewable energy not only in Washington State, but across the Nation?**

Thank you for your question. At Rewiring America, we agree that preserving our economy and environment are not mutually exclusive goals. Indeed, with thoughtful policy, these two goals can each work to support the other, fueling a zero-emissions today and tomorrow.

During the hearing, the fact that the United States is blessed with abundant natural resources was accurately raised. One state where this is particularly true is Washington State that has significant hydropower resources. By utilizing pumped storage, hydropower and other renewable energy generation sources can be used to fully supply the state's energy needs and, potentially, to supply other states as well. Indeed, renewable energy resources, when paired with storage, can solve any reliability issues, providing clean energy and resilience to communities across America.

If electrification is the path that will carry our Nation to a zero-emission future, electric appliances and machines can be seen as the bridge between clean electricity supply and energy demand. As our energy supply increasingly goes toward the generation of electricity, we also need to ensure that the machines they would power are installed and ready to go. The more households that are connected to fossil fuel infrastructure through their everyday appliances, the harder it will be to transition away from fossil fuels. Further, because these machines have long useful lives with an upper range of a few decades, not replacing these machines with clean electric options jeopardizes our ability to reach our climate goals. Specifically, our analysis makes clear that the electrification of the one billion small machines in Americans' homes is necessary for the U.S. to reach zero emissions by 2050. This trajectory is in line with what the science unequivocally tells us is necessary if we are to avert the worst consequences from climate change. Thus, while these machines may serve everyday functions (keeping our homes warm or cool, heating our water, cooking our food, drying our clothes, and driving us to work), their impact is significant. Through electrification, these machines can be a part of the solution, supporting the vast renewable resources powering the grid.

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RESPONSE FROM DR. LEAH STOKES TO QUESTION FOR THE RECORD SUBMITTED BY  
REPRESENTATIVE PETERS

**Dr. Stokes, there are concerns about the clean energy industry not sufficiently providing union jobs. How is the electrification industry advancing union jobs and how can our programs better support U.S. workers? I am specifically interested in apprenticeship opportunities and local hiring opportunities in this sector.**

It's critical that we see higher unionization rates in the clean energy economy. In the power sector, one important policy change is allowing the tax credits (ITC and PTC) to include a "direct pay" mechanism. Since many utilities do not have significant amounts of Federal tax liability (or in some cases any), this makes it difficult for them to develop clean energy projects. If utilities are able to develop more clean energy projects, it is likely that there will be higher unionization rates in the sector as utilities tend to work with unionized labor more than independent power producers.

In building electrification, the Federal Government could create a manufacturing grant program that supports companies that create American made products, including with unionized labor.

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RESPONSE FROM DR. LEAH STOKES TO QUESTION FOR THE RECORD SUBMITTED BY  
REPRESENTATIVE HERRERA BEUTLER

**We continue to hear of moving the U.S. toward zero emission electricity. As a member of the Conservative Climate Caucus, I think preserving our economy and environment do not have to be mutually exclusive goals. In Washington State hydropower accounts for roughly 70 percent of clean energy across the state. There is even a 1300 Megawatt (MW), 20 hour Goldendale pumped storage project in my district that would provide more than 3,000 jobs.**

- **What role do the witnesses see pumped storage and hydropower playing in the path to more renewable energy not only in Washington State, but across the Nation?**

Hydropower is a crucial resource in our clean energy electricity mix because it can match the output of other renewable energy sources, like wind and solar. The same is true of pumped storage. That being said, we have already developed the vast amount of hydropower resources available in the United States. If all the unused, potential hydropower resources were built out in the United States, they would only supply an additional 5 percentage points of clean power. For this reason, a broader array of clean energy technologies must be pursued alongside hydropower if we aim to clean up our electricity sector this decade. Pumped storage may prove an important solution as the electricity system balances higher levels of intermittent resources.

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RESPONSE FROM MR. DONNEL BAIRD TO QUESTION FOR THE RECORD SUBMITTED BY  
REPRESENTATIVE HERRERA BEUTLER

**We continue to hear of moving the U.S. toward zero emission electricity. As a member of the Conservative Climate Caucus, I think preserving our economy and environment do not have to be mutually exclusive goals. In Washington State hydropower accounts for roughly 70 percent of clean energy across the state. There is even a 1300 Megawatt (MW), 20 hour Goldendale pumped storage project in my district that would provide more than 3,000 jobs.**

- **What role do the witnesses see pumped storage and hydropower playing in the path to more renewable energy not only in Washington State, but across the Nation?**

Thank you so very much for your extraordinary leadership. We salute the courage with which you represent your district, not only with regard to your membership in the Conservative Climate Caucus, who's work we would be happy to support in any way that's helpful, but all the courage you displayed on behalf of parents of young children everywhere and Americans who cherish democracy everywhere.

We agree with you, and with Washington State: Hydroelectric power and storage MUST play a larger and larger role in our energy ecosystem.

In particular, we have been excited to learn of advances in micro-hydro electric power technology, where micro-hydro turbines are able to generate electricity with minimal disruption to natural ecosystems and waterways. Natel Energy is a wonderful example of micro-hydro electric power technology, and I'd be happy to arrange a briefing for your team about micro-hydro power and storage if helpful.

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RESPONSE FROM DR. ELI DOURADO TO QUESTIONS FOR THE RECORD SUBMITTED BY  
REPRESENTATIVE HERRERA BEUTLER

**1. Last Congress my bill, the Better Energy Technology Act (Best Act) which was later signed into law, set clear goals for technology development in energy storage. In my home state of WA, Pacific Northwest National Laboratory (PNNL) has been a leader for the Department of Energy and DOE is moving forward on the design and construction of the Grid Storage Launchpad right in Washington State which will further cement our region's leadership in the energy storage development.**

- **Dr. Dourado, could you talk about the importance of modernizing the grid and how grid storage could lead to a more secure energy future?**

The electricity grid must be designed to meet several requirements at the same time. First, it must have adequate capacity to serve all customers at the moment of peak annual demand. Second, it must be designed to be reliable in the event of natural disasters such as storms and earthquakes. Third, it must be capable of

keeping the supply and demand of electricity in perfect balance at every moment of every day.

It's this third requirement that implicates grid storage. If we switch a significant fraction of our generation capacity to intermittent sources like wind and solar, it is vital that we pair it with adequate storage capacity to enable shifting the supply of electricity to when it is demanded. That storage could come from batteries, pumped hydro, compressed air storage, hydrogen production, and possibly other sources. Additionally, more dynamic electricity pricing would be a good way of economizing on the storage needed, since momentarily high prices could induce some customers to shift their electricity consumption to times when prices were lower.

**2. We continue to hear of moving the U.S. toward zero emission electricity. As a member of the Conservative Climate Caucus, I think preserving our economy and environment do not have to be mutually exclusive goals. In Washington State hydropower accounts for roughly 70 percent of clean energy across the state. There is even a 1300 Megawatt (MW), 20 hour Goldendale pumped storage project in my district that would provide more than 3,000 jobs.**

- **What role do the witnesses see pumped storage and hydropower playing in the path to more renewable energy not only in Washington State, but across the Nation?**

Hydropower accounts for about 6–7 percent of the electricity generated in the United States. With full development of the country's hydropower resources, it's possible that it could reach 10–11 percent of generation capacity, before accounting for increases in total generation needed for the transition to electric vehicles and other forms of electrification. Additional firm, dispatchable electricity generation, of the kind that hydropower provides, helps the grid accommodate additional intermittent sources, like solar and wind energy. Hydropower, then, is not only renewable in its own right, it helps facilitate the addition of other renewable sources to the energy mix.

Pumped storage has several advantages over batteries. It is able to cycle deeply every day without degradation. Pumped storage can also last much longer than today's batteries. The challenge is in properly siting pumped storage facilities, especially considering potential damage to river ecosystems. But since the battery supply chain is likely to be pushed to its maximum merely to meet demand for electric vehicles, it's hard to imagine a future where wind and solar are a large part of our energy supply and pumped storage does not play a significant role.

Representative Schweikert – Submission of Two Articles for the Joint Economic Committee Hearing Record of September 22, 2021.

Links follow:

– Lasers could cut lifespan of nuclear waste from “a million years to 30 minutes”, says Nobel Laureate - <https://bigthink.com/the-present/laser-nuclear-waste/#rebellitem1>

– Uranium Seawater Extraction Makes Nuclear Power Completely Renewable  
<https://www.forbes.com/sites/jamesconca/2016/07/01/uranium-seawater-extraction-makes-nuclear-power-completely-renewable/?sh=3b6d6c8e159a>

**JEC HEARING:  
EXAMINING THE BENEFITS OF ELECTRIFYING  
AMERICA'S HOMES AND BUILDINGS  
DOCUMENTS FOR THE RECORD  
REWIRING AMERICA  
SEPTEMBER 27, 2021**

We thank Vice Chairman Heinrich (presiding), Chairman Beyer, and all other Distinguished Members of the Joint Economic Committee for the opportunity to testify on September 22, 2021 regarding the economic benefits of building electrification. Please accept this submission to the record concerning additional points of consideration from topics discussed at the hearing.

**Electrification End-Use Supports Multitude of Primary Energy Sources, Including Geothermal**

Electrification is an effective decarbonization strategy for the impressive reasons discussed in the testimonies given at the JEC hearing. We would like to reiterate four key reasons: 1) viable alternative end-use technologies that perform just as well as, and, indeed better than, incumbent fossil fuel technologies are commercially and widely available today, 2) electrification of home and building appliances allows for and supports a multitude of primary energy sources to be developed, without picking a winning source of primary energy, 3) on today's grid, electrification of home appliances already reduces emissions in every state, and these benefits will continue to increase as the grid becomes cleaner, and 4) over 85 percent of American households stand to save money, today, on their energy bills by completing an electrification project, with an average savings of \$362 every year,<sup>1</sup> a number that will also continue to increase as the technology improves.

On the first point, the wide scale availability of the essential technologies needed for building electrification means that electrification is a strategy that can be deployed now to support our national climate goals in both the near and medium terms. The barriers that we need to overcome for widespread adoption are policy- and market-related, not technology-related, making this a problem Congress and business leaders can solve today. In doing so, the economic benefits are profound, with the creation of 25 million net new jobs in the coming decades.

On the second point, electrification of the end-use machines at peoples' homes, businesses, schools, places of worship, and all other buildings that Americans rely on does not necessarily pick any one type of primary energy generation that would produce the electricity needed for these machines. These electric appliances run equally well on solar, wind, geothermal, nuclear, or any other form of electricity generation. Indeed, geothermal energy is an exciting primary energy source that may play a key role in our nation's electricity supply, especially as enhanced geothermal systems are developed that can exploit resources beyond the currently-used hydrothermal reservoirs. It is estimated that such systems could supply up to 10% of U.S. electricity demand.<sup>2</sup> Furthermore, the potential for geothermal energy as it

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<sup>1</sup> Rewiring America, [Bringing Infrastructure Home: A 50-State Report on U.S. Home Electrification](#), June 2021.

<sup>2</sup> U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, [How an Enhanced Geothermal System Works](#), accessed September 2021.

relates to electrification is not limited to the supply of electricity. On the demand side, ground source heat pumps use electricity to extract heat present in the earth,<sup>3</sup> and supply space and water heating at extremely high efficiencies for households across the country. All told, making electrification more accessible and affordable for American households and businesses expands, not limits, the primary energy sources we can utilize, enabling a competitive American electricity sector.

On the third point, a common refrain is that electrification does not reduce emissions if the electricity comes from dirty sources like coal fired power plants. The fact of the matter is that in every state, given grid generation mixes, switching from fossil fuel space and water heating to electric reduces emissions today.<sup>4</sup> An often overlooked reason for this is that the natural gas supply chain including production and distribution leaks significant amounts of methane, the main component of natural gas and an extremely potent greenhouse gas. Beyond the emission impacts of electrification today, as the grid gets cleaner, the benefits increase. Even conservative projections of future grid mix<sup>5</sup> show a steady reduction in carbon intensity of U.S. electricity generation, making electrified appliances an appreciating climate asset over their lifetimes.

Lastly, these electrified appliances can save significant amounts of money for American households on energy bills. Rewiring America has analyzed this extensively, finding that roughly 85% of households have an electrification project that can save on bills.<sup>6</sup> Independent studies confirm these findings, for instance, the ubiquitous yellow EnergyGuide appliance labels. A common gas water heater is labeled to cost \$293 per year for the average American household. A high-efficiency gas water heater costs \$271 per year, while an electric heat pump water heater costs just \$104 per year to run.

#### **Impacts on Global Warming from Household Electrification**

At the JEC hearing, it was raised that if U.S. homes were electrified, then global temperature reduction by 2100 would be 0.173° C. A citation was not provided, and thus, we cannot deny nor affirm the validity of this statement or the methodology used to compute the assertion. Rather, we can explore the impacts of a 0.173° C temperature reduction as well as the emissions we know we can avoid through residential electrification in the U.S.

As a thought experiment, let's assume the 0.173° C figure was derived using sound methodology. Let's also assume that this figure factored in only carbon emissions from building electrification, and not all of U.S. carbon and other greenhouse gas emissions. If it was true that electrifying the appliances in our homes and other buildings in the U.S. alone would result in a roughly 0.2° C reduction in global temperature in the year 2100, this would be a tremendous feat. Although these numbers may seem small and thus insignificant, the opposite is true. Consider that the IPCC AR6 Working Group I report confirmed that the world must limit the global temperature rise to 1.5° C above pre-industrial levels to avert the worst effects from anthropogenic climate change. We are already at 1.1° C above pre-industrial

<sup>3</sup> This heat is actually a combination of true geothermal crustal energy along with energy from incoming solar radiation that heats the ground, with the proportion of each varying by system type and location.

<sup>4</sup> Sierra Club, [New Analysis: Heat Pumps Slow Climate Change in Every Corner of the Country](#), April 2020.

<sup>5</sup> U.S. Energy Information Administration (EIA), [Annual Energy Outlook 2021](#), February 2021.

<sup>6</sup> Rewiring America, [Bringing Infrastructure Home: A 50-State Report on U.S. Home Electrification](#), June 2021.

levels, leaving just 0.4° C of temperature rise before we hit our global target. If we knew we could avoid almost 50 percent of this remaining temperature budget by simply electrifying the appliances in our homes in just the U.S., this would be an incredible assertion to make, proving the immense opportunity for the climate, the economy, and for U.S. leadership.

While we cannot confirm the figure espoused, we are able to confirm that carbon emissions from human activities contribute to global temperature rise, as the IPCC unequivocally confirmed in August of 2021. We know that we can trace the amount of carbon dioxide in our atmosphere, which reached 414 parts-per-million as of September 2021, the highest it has been in at least the last 800,000 years.<sup>7</sup> Human beings have never existed on this planet with this level of atmospheric carbon dioxide concentrations. As stated earlier, we know that human activities have raised the Earth's temperature by 1.1° C since pre-industrial times, leaving us a precious 0.4° C of additional warming before reaching the 1.5° C threshold that scientists have, again, unequivocally stated is the threshold we must meet or remain under. This is the climate crisis we face. In economic terms, the costs of each additional degree of warming are stark. For instance, the difference in economic damages between 1.5C and 2.0C are estimated to be \$15 trillion.<sup>8</sup>

Our climate crisis is an energy crisis with nearly 90 percent of U.S. emissions stemming from our energy sector. Of those emissions, 42 percent come from decisions made at our kitchen tables: how we heat and cool our homes, heat our water, cook our food, dry our clothes, and drive to work. As we said in our testimony, our north star is to eliminate these emissions on the path to zero. The technologies we need to provide these same functions to American households with the same or better performance exist today. And these technologies rely on electricity, complementing our economy-wide efforts to decarbonize our primary energy generation and electricity supply. We know that America can lead the world in reaching climate targets and employ millions of Americans in the process.

#### **In Sum**

We end with gratitude for the opportunity to testify to the Joint Economic Committee on the economic benefits of building electrification. We appreciate your leadership on protecting and providing continued economic prosperity for all Americans, and commend your recognition that the climate crisis is an unparalleled threat to this prosperity. The science is clear: we must decarbonize. Fortunately, we know that household electrification is an essential component of an effective decarbonization strategy and that the technology we need is available today, providing an opportunity for economic development in communities all across the country.

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<sup>7</sup> NASA, [Evidence. Climate Change: How Do We Know?](#). Accessed September 2021.

<sup>8</sup> IPCC, [Special Report on Impacts of 1.5°C Global Warming on Natural and Human Systems, Chapter 3](#), 2018.