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Testimony of

Sara Baldwin
Director, Electrification Policy
Energy Innovation

U.S. House of Representatives Select Committee on the Climate Crisis
"Cost-Saving Climate Solutions: Investing in Energy Efficiency
to Promote Energy Security and Cut Energy Bills"

April 7, 2022

Good morning, Chair Castor, Ranking Member Graves, and Select Committee Members. Thank you for the opportunity to be speak with you all today, and it's an honor to be here. I appreciate the work of this committee, and the leadership each of you has shown in your public service, to understand climate science and work collaboratively to generate policy solutions.

I am the Director of Electrification Policy with Energy Innovation, a non-partisan climate policy think tank providing research and analysis to support policies that reduce emissions at the speed and scale required for a safe climate future. Our work is based on scientific assessments of climate change, and our policy recommendations are grounded in data, driven by our open-source and peer-reviewed Energy Policy Simulator model.[1]

I have devoted my 18-year career to advancing workable solutions to climate change because it is the one issue that truly impacts everything, and I believe it is one of the most important issues of our time. The two most recent contributions to the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (from Working Groups II and III) are sobering; both make painstakingly clear that our time to limit warming is perilously short, and the societal choices and actions taken *within the next decade* will determine our collective climate future.[2]

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[1] Available at: https://energypolicy.solutions/.

[2] IPCC, 2022: Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: *Climate Change 2022: Impacts, Adaptation, and Vulnerability.* Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press. Available at: https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf and IPCC, 2022*:* Summary for Policymakers. In: *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.001, available at https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_SummaryForPolicymakers.pdf.

The Working Group III report, issued this week, notes that limiting warming to around 1.5 degrees Celsius requires that global *greenhouse gases must peak before 2025 at the latest, and be reduced by 43 percent by 2030; at the same time, methane would also need to be reduced by about a third.*[3] Fixing the "pervasive leaky natural gas infrastructure" [4] is paramount to minimizing methane's damage within the decade.

The science tells us we must achieve net zero greenhouse gas emissions by or before 2050. That seems far away, but it takes time for policies to take effect, and to adopt new technologies. The greenhouse gases we emit into our atmosphere today will warm our world for decades. Getting on a safe climate pathway requires cost-effective solutions capable of scaling quickly.

Electrification is an essential, cost-effective strategy to achieve this goal by switching end-uses that currently run on fossil fuels to run on carbon-free electricity. For example, swapping out an old gas furnace for a more efficient all-electric air-source heat pump, or driving an electric vehicle in lieu of an internal combustion engine vehicle. As I will discuss in my testimony, electrifying buildings, transportation, and much of industry powered by a clean grid puts us on the path to achieving a stable climate, while creating jobs and improving public health. It is also a pathway to enhance energy security and ensure our global competitiveness.

The International Energy Agency's Net Zero by 2050 report calls out electrification as a core solution to achieve net zero emissions: "As electricity generation becomes progressively cleaner, electrification of areas previously dominated by fossil fuels emerges as a crucial economy-wide tool for reducing emissions. This takes place through technologies like electric cars, buses and trucks on the roads, heat pumps in buildings, and electric furnaces for steel production."[5] Similarly, the Working Group III report notes that "[s]tringent emissions reductions at the level required for a 2°C and below are achieved through increased direct electrification of buildings, transport, and industry, resulting in increased electricity generation in all pathways (*high confidence*)."[6]

All-electric technologies are considerably more efficient than fossil fuel counterparts, and this

[3] "The evidence is clear: the time for action is now. We can halve emissions by 2030," IPCC Press Release, April 4, 2022, https://www.ipcc.ch/2022/04/04/ipcc-ar6-wgiii-pressrelease/.
[4] Eric Roston, "Planet's Breakneck Warming Likely to Pass 1.5°C, UN Scientists Warn," Bloomberg, April 4, 2022, https://www.bloomberg.com/news/articles/2022-04-04/planet-s-breakneck-warming-likely-to-pass-1-5-c-un-scientists-warn?cmpid=BBD040422_GREENDAILY&utm_medium=email&utm_source=newsletter&utm_term=220404&utm_campaign=greendaily.
[5] "Net Zero by 2050: A Roadmap for the Global Energy Sector," International Energy Agency, May 2021, https://www.iea.org/reports/net-zero-by-2050.
[6] "Working Group III contribution to the Sixth Assessment Report, Chapter 3: Mitigation pathways compatible with long-term goals," IPCC Sixth Assessment Report: Mitigation of Climate Change, https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_Chapter03.pdf, 3-6.

inherent efficiency reduces fossil fuel demand with a dampening effect on prices—which helps all consumers. Because electricity is a price-stable commodity, electric technologies are far cheaper to operate and help protect consumers from volatility and price shocks.

We have the technologies, and they are increasingly cost-effective, but smart policies and regulations are needed to jumpstart the market.

Today, we are experiencing a perfect storm of converging factors whose root cause is our overreliance on oil and gas: volatile and high fuel prices, devastating climate events, and energy insecurity. It is important to think both about the near- and long-term impacts of any solutions or actions so that solving one problem does not exacerbate others.

As this Committee has discussed at length, the high price[7] of gas and oil is hurting Americans at the pump and at home[8] and is increasing energy burdens[9] for lower- and middle-income households.

These high prices are caused by a post-pandemic surge in consumer demand[10] for oil and gas combined with supply shocks caused by global shutdowns, extreme weather events, and Putin's war against Ukraine.[11]

Oil is a global commodity, and natural gas increasingly so, meaning oil and gas markets operate outside the boundaries of any one country. Increasing short-term domestic production can provide some immediate relief, but no amount of domestic drilling and production will insulate us from this unending cycle of price volatility.

Fortunately, electrification can stabilize prices by reducing fossil fuel demand because all-electric technologies are highly energy efficient. Today's efficient electric technologies offer a hedge against price spikes. For example, air source heat pump furnaces are two to four times

[7] "Gas Prices," AAA website, https://gasprices.aaa.com, accessed April 5, 2022.
[8] "Short-term Energy Outlook: Winter Fuels Outlook, October 2021" U.S. Energy Information Administration, March 8, 2022, https://www.eia.gov/outlooks/steo/report/WinterFuels.php.
[9] Energy burden refers to the relative proportion of your income that goes to pay energy bills, including for home heating and fueling a vehicle. Energy burden is different than an energy bill, which is the rate you pay for electricity combined with how much you use. With energy efficiency and conservation measures, even where electricity rates are high, you can reduce energy bills and help mitigate high energy burdens. According to ACEEE, 25% of U.S. households face a high energy burden (spend 6% or more of their income on energy bills), and low-income households spend three times more of their income on energy costs compared to the average non-low-income households (8.1% vs 2.3%). Source: https://www.aceee.org/energy-burden
[10] David Gaffen, Scott DiSavino, and Stephanie Kelly, "U.S. December oil demand hits highest since before pandemic – EIA," Reuters, February 28, 2022, https://www.reuters.com/business/energy/us-oil-demand-reached-highest-level-since-before-pandemic-december-eia-2022-02-28/.
[11] "Making Sense of Soaring Oil Prices," Columbia Energy Exchange Podcast, March 22, 2022, https://www.energypolicy.columbia.edu/making-sense-soaring-oil-prices.

more energy-efficient than natural gas-burning furnaces.[12] Induction stoves outperform gas stoves by about three to one.[13] Electric vehicles are nearly four times as efficient as internal combustion engine vehicles.[14]

Inherent efficiency advantages make electric technologies cheaper to operate, and electricity is more price-stable than oil and gas without global market volatility. Electricity is generated from diverse homegrown resources and electric utilities and the grid are regulated by federal, state, regional, and local entities tasked with ensuring affordable and reliable electricity for all consumers.

Today, U.S. households and businesses that rely on fossil fuels for transportation and heat are being hit with higher energy bills and gasoline bills, whereas those who live in all-electric homes or drive electric vehicles have been insulated from this price shock.

A recent analysis conducted by the Zero Emissions Transportation Association shows electric vehicles are three to five times cheaper to drive per mile than gas-powered vehicles, and in several states are five to six times cheaper to drive per mile.[15] Analysis from University of California, Berkeley, Energy Innovation, and GridLab (known as the 2035 2.0 Study) shows light-duty electric vehicles will hold a total cost of ownership advantage within the next five years.[16]

All-electric homes also save money. RMI analysis comparing new all-electric single-family homes with dual fuel homes in seven cities[17] shows that a new all-electric, single-family home has a lower net present cost than the new mixed-fuel home with lower annual utility costs in most cases.[18] All-electric new homes also yield emit 50 percent up to 93 percent fewer greenhouse gases compared to mixed-fuel homes.[19]

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[12] Claire McKenna, Amar Shah, and Mark Silberg, *It's Time to Incentivize Residential Heat Pumps,* RMI, June 8, 2020, https://rmi.org/its-time-to-incentivize-residential-heat-pumps/.

[13] Micah Sweeney, Jeff Dols, Brian Fortenbery, and Frank Sharp, *Induction Cooking Technology Design and Assessment,* ACEEE, *2*014, https://www.aceee.org/files/proceedings/2014/data/papers/9-702.pdf.

[14] "All-Electric Vehicles," U.S. Department of Energy, https://www.fueleconomy.gov/feg/evtech.shtml

[15] *Comparing the Operating Costs of Electric Vehicles and Gas-Powered Vehicles*, Zero Emissions Transportation Association, April 2022, https://drive.google.com/file/d/1_d6OXxWpF6GzBjZiFP3oj0QqQTM1P5io/view.

[16] Amol Phadke, N. Abhyankar, J. Kersey, T. McNair, U. Paliwal, D. Wooley, O. Ashmoore, R. Orvis, M. O'Boyle, R. O'Connell, U. Agwan, P. Mohanty, P. Sreedharan, and D. Rajagopal, *Plummeting Costs and Dramatic Improvements in Batteries Can Accelerate Our Clean Transportation Future*, University of California, Berkeley Goldman School of Public Policy, Energy Innovation, and Grid Lab, April 2021, http://www.2035report.com/transportation/wp-content/uploads/2020/05/2035Report2.0-1.pdf?hsCtaTracking=544e8e73-752a-40ee-b3a5-90e28d5f2e18%7C81c0077a-d01d-45b9-a338-fcaef78a20e7.

[17] Austin, Texas; Boston, Massachusetts; Columbus, Ohio; Denver, Colorado; Minneapolis, Minnesota; New York City, New York; and Seattle, Washington.

[18] The two modeled scenarios have nearly equivalent utility bills in Boston and Seattle.

[19] Claire McKenna, Amar Shah, and Leah Louis-Prescott, "All-Electric New Homes: A Win for the Climate and the Economy," RMI, October 15, 2020, https://rmi.org/all-electric-new-homes-a-win-for-the-climate-and-the-economy/.

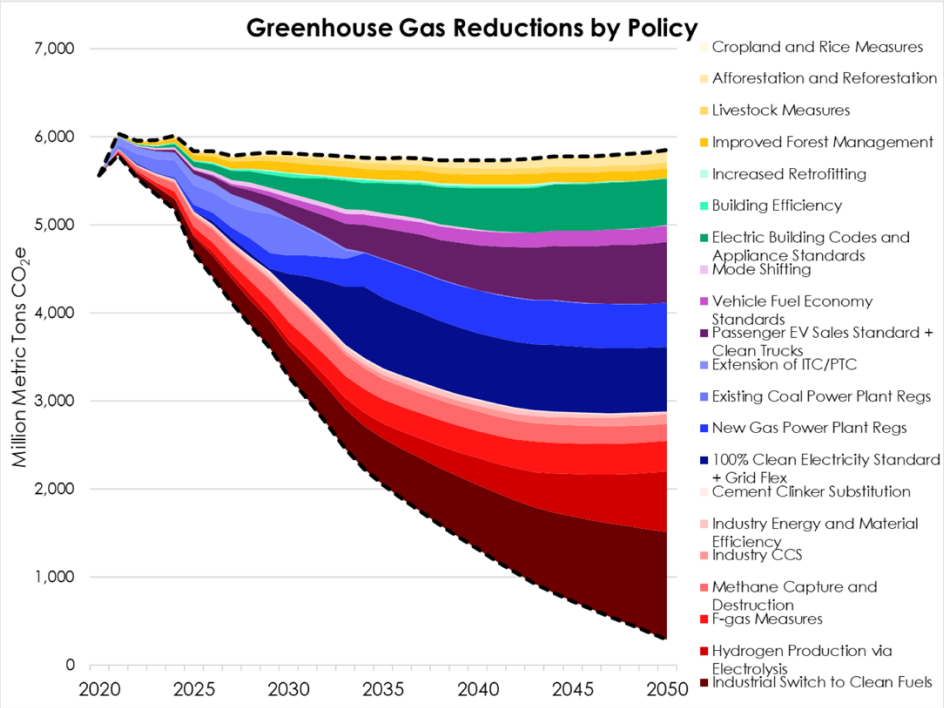
Although the promise of energy savings is enticing, many consumers face upfront cost barriers and challenges accessing financing. Though costs are declining ahead of most projections, policies, regulations, and incentives can bring down costs further, level the playing field for all-electric technologies. Upfront incentives, applied at the point-of-purchase, are highly effective tools for equitable market transformation.[20]

The upside to electrification is that we already have the technologies we need to start electrifying more end-uses today, without compromising performance. We don't have to wait for a new technology breakthrough or an unproven, costly alternative to become viable[21] because conversion can occur incrementally using existing electrical infrastructure. In the U.S., 25 percent of homes are already all-electric,[22] and almost half of single-family homes are appropriately wired for all-electric appliances.[23] Many buildings have sufficient electrical capacity to switch to all-electric appliances today, though older buildings might require electrical upgrades like a new panel or wiring. Consumers replacing older equipment, appliances, and vehicles can opt for all-electric options. Or, when building or buying new, they can choose all-electric options, avoiding potentially costly upgrades down the road. However, model and product availability to meet consumer needs is closely tied with policy support. As such, it is important for policies to send strong market signals to manufacturers, contractors, distributors, and dealers to encourage them to make and sell high performing, energy-efficient all-electric products.

More relevant to this Committee, electrification plus a clean grid puts us on a climate stable path while creating jobs, improving public health, and ensuring global competitiveness. Energy Innovation's U.S. Energy Policy Simulator modeling shows that electrification policy pathways combined with a clean grid—powered by a diverse mix of carbon-free resources like wind, solar, geothermal, hydroelectric, paired with batteries, existing nuclear and gas, and demand-side resources—can cut emissions, increase gross domestic product $570 billion per year in 2030 and $920 billion in 2050, and create more than 3.2 million new job-years by 2030 and 5 million new job-years by 2050.[24] The wedge graph below shows U.S. emissions under

[20] Sam Abuelsamid, "EV Purchase Incentives Need to Shift to Point-of-Sale Rebates," Guidehouse Insights, June 24, 2021, https://guidehouseinsights.com/news-and-views/ev-purchase-incentives-need-to-shift-to-point-of-sale-rebates.
[21] Sara Baldwin, Dan Esposito, and Hadley Tallackson, *Assessing the Viability of Hydrogen Proposals: Considerations for State Utility Regulators and Policymakers*, Energy Innovation, March 28, 2022, https://energyinnovation.org/publication/assessing-the-viability-of-hydrogen-proposals-considerations-for-state-utility-regulators-and-policymakers/.
[22] "One in Four U.S. Homes is All Electric," U.S. Energy Information Administration, May 1, 2019, https://www.eia.gov/todayinenergy/detail.php?id=39293.
[23] Pecan Street, *Addressing an Electrification Roadblock: Residential Electric Panel Capacity*, https://www.pecanstreet.org/panel-size-paper-update/, page 1.
[24] Robbie Orvis and Megan Mahajan, "A 1.5°C NDC For Climate Leadership by the United States," April 2021, https://energyinnovation.org/wp-content/uploads/2021/04/A-1.5-C-Pathway-to-Climate-Leadership-for-The-United-States_NDC-update-2.pdf.

business-as-usual and the 1.5°C Scenario, including how much each specific policy reduces emissions through 2050. Although these are illustrative pathways, the electrification policies for buildings, transportation, and industry all contribute significant emissions reductions.



Transportation is the largest source of U.S. GHG emissions, contributing 29 percent of all emissions in 2019 and rising, unlike the electricity sector. Annual transportation emissions grew 22.9 percent between 1990 and 2019—the largest growth in annual emissions from any sector.[25] The 2035 2.0 Study showed that reaching 100 percent electric sales for all new cars and trucks by 2035 would cut transportation-related GHGs 93 percent, and put the U.S. on a path to net zero economy-wide emissions in 2050, avoiding the most devastating impacts of climate change. This would also create more than 2 million jobs in 2035 as compared with business-as-usual.[26] Adding more emphasis on domestic manufacturing would only amplify those job numbers.

In the U.S. nearly 90 million residential housing units and 4 million commercial buildings burn fossil fuels for space and water heating and cooking, and those buildings contribute 13 percent

[25] "Greenhouse Gas Inventory Data Explorer," United States Environmental Protection Agency, https://cfpub.epa.gov/ghgdata/inventoryexplorer/#allsectors/allsectors/allgas/econsect/all.
[26] Amol Phadke, et al., *Plummeting Costs and Dramatic Improvements in Batteries Can Accelerate Our Clean Transportation Future*.

of our nation's GHG emissions.[27] Rewiring America analysis shows that we can avoid 166 million metric tons of carbon dioxide (CO_2) emissions by deploying heat pump technology across 104.7 million households (or 87 percent of U.S. households) today.[28] Building and retrofitting electrified homes and buildings across the country will require hundreds of thousands of skilled workers, creating more than 460,000 installation jobs, 80,000 manufacturing jobs, and 800,000 indirect and induced jobs in the U.S.[29]

Even if we power our electric vehicles and homes with today's grid (which is not yet 100 percent carbon-free), we will still reduce net emissions. A Union of Concerned Scientists study shows that electric vehicles are already cleaner than gas vehicles in all states, regardless of regional differences in grid mix.[30] We have an opportunity to begin reducing emissions today with the adoption of efficient electric technologies, while we continue to drive towards a carbon-free grid.

However, given the slow pace of capital stock turnover,[31] we need to start electrifying as many end-uses now as feasible to be on the path to climate stability by 2030 and ultimately 2050.

Electrification will also improve public health and reduce harmful air pollution indoors and outdoors. Nearly half of all U.S. residents live in counties with unhealthy ozone and particle pollution,[32] and more than 20,000 die prematurely[33] every year from transportation pollutants. Transportation electrification will reduce a major source of harmful air pollutants, which disproportionately impact economically disadvantaged and communities of color[34], children, pregnant women, and the elderly. The 2035 2.0 study found that electrifying cars and trucks would avoid 96 percent of the premature deaths caused by transportation pollution.[35] Similarly,

[27] Sara Baldwin and Hadley Tallackson, *Making Buildings Better*, Energy Innovation, December 2021, https://energyinnovation.org/wp-content/uploads/2021/12/Making-Buildings-Better-in-the-Build-Back-Better-Act.pdf.
[28] "Benefits of Electrification," Rewiring America, https://map.rewiringamerica.org.
[29] "Benefits of Electrification," Rewiring America, https://map.rewiringamerica.org.
[30] David Reichmuth, "Electric Vehicles are Cleaner than Gasoline—and Getting Better," Union of Concerned Scientists Fact Sheet, May 2020, https://www.ucsusa.org/sites/default/files/2020-05/evs-cleaner-than-gasoline.pdf.
[31] Amanda Myers, "The Capital Stock Turnover Problem for 100% Clean Energy Targets," Greentech Media, November 18, 2019, https://www.greentechmedia.com/articles/read/the-capital-stock-turnover-problem-for-100-clean-energy-targets.
[32] *2020 State of the Air Report,* American Lung Association, https://www.stateoftheair.org/assets/SOTA-2020.pdf.
[33] Kenneth Davidson, N. Fann, M. Zawacki, C. Fulcher, and K. Baker, *The recent and future health burden of the U.S. mobile sector apportioned by source*, Environmental Research Letters, Volume 15, Number 7, July 6, 2020, https://iopscience.iop.org/article/10.1088/1748-9326/ab83a8.
[34] American Lung Association *2020 State of the Air Report.*
[35] Amol Phadke, et al., *Plummeting Costs and Dramatic Improvements in Batteries Can Accelerate Our Clean Transportation Future.*

all-electric appliances and stoves can significantly reduce toxic air pollution in homes[36] and cut outdoor air pollution damaging to human health.[37]

Electrification is synergistic with updating the electric grid to improve reliability, and more electric end-uses will cut per unit consumer costs. U.S. electric utilities have historically invested $30 billion per year into the grid, and more investments will be needed to support more electrified end-uses.[38] But these investments will make the grid stronger and more reliable and resilient.[39] Increased electricity demand from electrification will spread grid upgrade expenses over a much larger sales volume, lowering the cost per unit of electricity and benefitting 100 percent of U.S. residents that use electricity.[40] Combined with demand response and distributed energy resources, all-electric buildings provide unique load flexibility and other benefits, including integrating more renewable energy and expanded electric vehicle charging. For example, electric appliances can be programmed to respond to grid conditions and price signals, and if set up to do so, can provide valuable grid services and demand response when called upon by utilities. New smart grid funding from the bipartisan Infrastructure Investment and Jobs Act (IIJA) for will support continued deployment of these functions and capabilities at scale.[41] All-electric equipment can also be supported with distributed or community solar and battery storage to increase resilience when the grid goes down. No such back-up technologies exist for oil and gas equipment – which are also subject to grid outages. For example, you cannot pump gasoline or use most modern gas furnaces without electricity.

Despite their advantages, all-electric technologies are nascent relative to their fossil fuel-powered counterparts, and they stand to benefit from strong policies to jumpstart the market. Government policies, strong standards, and regulations can enable mainstream adoption, allowing more consumers to benefit from these technologies. Rigorous performance and efficiency standards are the foundation upon which policies should be built, reducing consumer costs, leveling the playing field for businesses, and amplifying the impact of other policies. For example, the U.S. Department of Energy and U.S. Environmental Protection

[36] "Combustion Pollutants in Your Home - Guidelines," California Air Resources Board, https://ww2.arb.ca.gov/resources/documents/combustion-pollutants-your-home-guidelines, accessed April 5, 2022.
[37] Dr. Yifang Zhu, R. Connolly, Dr. Y. Lin, T. Mathews, Z. Wang, *Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California*, UCLA Fielding School of Public Health, Department of Environmental Health Sciences, April 2020, https://ucla.app.box.com/s/xyzt8jc1ixnetiv0269qe704wu0ihif7.
[38] Amol Phadke, et al., *Plummeting Costs and Dramatic Improvements in Batteries Can Accelerate Our Clean Transportation Future.*
[39] Katherine Hamilton remarks for the Federal Energy Regulatory Commission Technical Conference on Electrification and the Grid of the Future, Docket No. AD21-12-000, April 29, 2021, https://www.ferc.gov/media/panel-1-katherine-hamilton-world-economic-forum.
[40] Baldwin, et al., *Assessing the Viability of Hydrogen Proposals*.
[41] Ellie Long, "Here's How the Infrastructure Bill Improves the Grid," Alliance to Save Energy, November 22, 2021, https://www.ase.org/blog/heres-how-infrastructure-bill-improves-grid.

Agency's work updating energy conservation standards for space- and water-heating equipment can save U.S. consumers and businesses more than $100 billion on energy bills through 2050 while reducing cumulative CO_2 emissions by more than 500 million metric tons.[42] Similarly, EPA's recent update to tailpipe emissions standards will reduce GHG emissions 3.1 billion tons by 2050, representing 50 percent greater emission reductions than their less stringent proposed standards, and will unlock $190 billion in net benefits, including reduced climate change impacts, improved public health from lower pollution, and cost savings for vehicle owners.[43]

But, more is needed.

We need practical and equitable incentives to help reduce upfront cost of electric technologies and send market signals. One of the biggest barriers to uptake is the slightly higher incremental cost of all-electric appliances and equipment. The International Council on Clean Transportation projects that electric vehicles will reach upfront price parity with gas vehicles within the next two to three years for shorter-range vehicles and within four to six years for longer-range vehicles.[44] Until that transpires, government leadership can help bridge this gap and get more consumers in price-stable electric vehicles.

Congress' passage of the incentives for new and used electric vehicles[45] and electric equipment for buildings[46] at the end of last year was an important first step in addressing this barrier. Ideally, such incentives would be integrated into any future policies under consideration by Congress and the Senate.[47] Any future policies should include provisions that ensure equity, expand access, and meaningfully address environmental justice**.** For example, including incentives for used electric vehicles would help the millions of U.S. residents that choose not to buy or cannot afford a new vehicle. Appropriate income caps, capping the vehicle value, and

[42] ASAP analysis based on Mauer, J. and A. deLaski, "A Powerful Priority: How Appliance Standards Can Help Meet U.S. Climate Goals and Save Consumers Money." 2020. Available at https://appliance-standards.org/sites/default/files/Powerful_Priority_Report.pdf. Products evaluated included residential and commercial gas-fired furnaces, boilers, and water heaters.

[43] "EPA Finalizes Greenhouse Gas Standards for Passenger Vehicles, Paving Way for A Zero-Emissions Future," US Environmental Protection Agency, December 20, 2021, https://www.epa.gov/newsreleases/epa-finalizes-greenhouse-gas-standards-passenger-vehicles-paving-way-zero-emissions; and "Final Rule to Revise Existing National GHG Emissions Standards for Passenger Cars and Light Trucks Through Model year 2026," US Environmental Protection Agency, https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-revise-existing-national-ghg-emissions.

[44] Nic Lutsey and Michael Nicholas, *Working Paper: Update On Electric Vehicle Costs in the United States Through 2030*, The International Council on Clean Transportation, April 2, 2019, https://theicct.org/publication/update-on-electric-vehicle-costs-in-the-united-states-through-2030/.

[45] *Electric Vehicle Incentives in the Build Back Better Act*, Energy Innovation, November 2021, https://energyinnovation.org/wp-content/uploads/2021/11/Electric-Vehicle-Incentives-in-the-Build-Back-Better-Act.pdf.

[46] Baldwin, *Making Buildings Better*.

[47] A University of California, Davis study documented the efficacy of EV tax incentives for middle- and moderate-income earners, finding federal tax credits are one of the most important incentives for owners of moderately-priced EVs. Source: https://escholarship.org/uc/item/0x28831g

limiting the incentive based on the vehicle price will ensure the electric vehicles tax incentive is available to as many people as possible, while excluding high-income individuals and households that are far less likely to need an incentive to motivate their purchase decisions. Higher incentives for electric equipment located in multi-family housing and for frontline and underserved communities are other examples of common-sense policy provisions that merit future consideration to ensure an equitable transition.

Ensuring seamless adoption of electric technologies needs sufficient support for the infrastructure and workforce supporting them. The IIJA was a good start, allocating $7.5 billion to help build-out a national electric vehicle charging network to reduce range anxiety and ensure equitable access to charging for people in rural and urban communities.

Although I've not touched on it in detail today, more support is needed for industrial electrification. Direct GHG emissions from the U.S. industrial sector make up roughly a quarter of the nation's total, yet very few policies and programs are focused on this sector. Industrial operations are an untapped opportunity to provide greater price stability for Made in America commodities by shifting more industrial processes to run on electricity. Lawrence Berkeley National Lab research shows industrial electrification could reduce fuel price risks and improve product quality in some industrial processes, noting that many essential industrial electrification technologies exist, but the diversity of processes and high levels of process integration make solutions more complex.[48] More funding is needed for research, development, and demonstration of electrification of low- to medium-heat industrial process heating and new programs to help address the economic and regulatory challenges to industrial electrification. Two existing tools that can and should be leveraged for this purpose are DOE's ARPA-E[49] program and the America COMPETES Act.[50]

More support for domestic manufacturing of electric appliances and domestic production of the key minerals and raw materials needed for electric vehicles, batteries, electric appliances, and other clean technologies will improve America's competitiveness and insulate our economy from supply chain disruptions, as we electrify more end uses. Immediate steps to increase domestic supply chain of electric technologies through incentives for domestic manufacturing and domestic production of essential minerals and raw materials will ensure those jobs are

[48] "New study explores prospects and approaches for increased electrification of buildings and industry," Lawrence Berkeley National Lab, April 9, 2018, https://emp.lbl.gov/news/new-study-explores-prospects-and-approaches.
[49] "Technologies," ARPA-E, https://arpa-e.energy.gov/technologies.
[50] "America Competes Act," Public Law 110-69, Authenticated U.S. Government Information, August 9, 2007, https://www.congress.gov/110/plaws/publ69/PLAW-110publ69.pdf.

created here and not outsourced. President Biden's recent invocation of the Defense Production Act for critical minerals is an important first step in this direction.[51]

Policies should consider workforce development opportunities and challenges inherent to technological changes. Electrification can create millions of jobs, but workers will need access to training, professional development, and in some cases incentives to help them retool or make necessary upgrades. The IIJA, for example, provides dedicated funding for workforce training in the power, buildings, and industrial sectors. As more policies are considered, they should continue to account for the workforce transition already underway.

In conclusion, the urgency of our climate crisis combined with the inherent volatility of fossil fuels requires that we work quickly to scale solutions that replace fossil fuel end-uses and equipment with zero-carbon alternatives. We cannot wait until 2030 or later to start. Electrification is a viable solution that offers a path to reduce our dependence on fossil fuels in the near- and long-term, support the decarbonization of buildings, transportation, and some industry, reduce consumer costs, improve public health, and create jobs. Smart policies will electrify the movement and energize our economy.

Thank you for your time and I look forward to questions and discussion.

[51] Steven Mufson and Paulina Villegas, "Biden to use Defense Production Act for U.S> critical-minerals supply," The Washington Post, March 31, 2022, https://www.washingtonpost.com/climate-environment/2022/03/30/critical-minerals-defense-production-act/.