

Attachment—Additional Questions for the Record

Subcommittee on Energy Hearing on “A Smarter Investment: Pathways to a Clean Energy Future” Thursday, February 18, 2021

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The Honorable Kathy Castor (D-FL)

1. Dr. Pacala, we’re coming out of the COVID-19 pandemic and the economic devastation it has wrought. Opportunities to create good paying jobs are more important than ever from upgrading and expanding the electric grid to electrifying transportation, buildings, and industry. Could you please tell us more about what your study concluded about the potential for jobs from the transition to a clean energy economy? Which economic sectors could we expect to see revitalized? How would the average wages of these new jobs compare to the national average today? What can Congress do to facilitate the creation of high-quality jobs?

RESPONSE:

Drawing on recent trends in clean energy employment and projections of jobs created during a net-zero transition, the National Academies report *Accelerating Decarbonization of the U.S. Energy System* that formed the basis of my testimony concluded that the transition to a clean energy economy could result in a net increase in energy system employment of roughly 1 to 2 million jobs. The transition provides an opportunity to revitalize U.S. manufacturing, construction, and commercialization sectors and strengthen U.S. global leadership in clean energy and climate mitigation solutions. Clean energy jobs typically have higher wages than the current national average and often have lower education requirements, making them both attractive and accessible. The establishment of educational and training initiatives is critical for training a net-zero energy workforce, maintaining U.S. competitiveness, promoting energy innovation, and providing fair access to high-quality jobs. To facilitate the creation and security of high-quality jobs, the committee recommends that Congress do the following:

- Establish a federally authorized and funded non-profit Green Bank with a specific public mission to finance low- or zero-carbon buildings and technologies, business creation, and infrastructure.
- Ensure that Buy American and Buy America provisions are appropriately applied and enforced to cover key materials and products on federally funded projects.
- Establish a 10-year GI Bill-type program for anyone who wants a vocational, undergraduate, or master’s degree related to clean energy, energy efficiency, building electrification, sustainable design, or low-carbon technology. These programs should include a cost-of-living stipend. Such a program would ensure that the U.S. workforce

transitions along the physical infrastructure of our energy, transportation, and economic systems.

- Support the creation of innovative new degree programs in community colleges and colleges and universities focused uniquely on the knowledge and skills necessary for a low-carbon economic and energy transformation.
- Provide support for doctoral and postdoctoral fellowships in science and engineering, policy, and social sciences, for students researching and innovating in low-carbon technologies, sustainable design, and energy transitions, with at least 25 fellowships per state to ensure regional equity and build skills and knowledge throughout the United States.
- Pass the Promoting American Energy Jobs Act of 2019 to reestablish the Energy Jobs Strategy Council under the Department of Energy, require energy and employment data collection and analysis, and provide a public report on energy and employment in the United States.
- Provide manufacturing incentives through loans, loan guarantees, tax credits, grants, and other policy tools to firms that are matched with corresponding performance and wage requirements. Subsidies provided directly to manufacturers must be tied to the meeting of performance metrics, such as production of products with lower embodied carbon or adoption of low-carbon technologies and approaches.

Importantly, achieving employment and economic benefits from a net-zero transition requires programs and policies to ensure that the transition does not adversely affect certain workers or communities, but rather provides equitable access to new opportunities. Anticipated challenges – such as temporal and geographic mismatches between jobs created and lost – must be confronted proactively to avoid regional economic declines and maintain public support for decarbonization. Actions that the committee recommends Congress take to ensure a just transition include:

- Establish 2-year federal National Transition Task Force to assess vulnerability of labor sectors and communities to the transition of the U.S. economy to carbon neutrality.
- Establish White House Office of Equitable Energy Transitions that will develop criteria to ensure equitable and effective energy transition funding, sponsor external research to support the development and evaluation of equity indicators and public engagement, and report annually on energy equity indicators and triennially on transition impacts and opportunities.
- Establish a new federally chartered, independent National Transition Corporation (NTC) to complement the functions of the White House Office of Equitable Energy Transitions, to ensure coordination and funding in the areas of job losses, critical infrastructure, and equitable access to economic opportunities and wealth creation.
- Provide funds to create interdisciplinary doctoral and post-doctoral training programs, similar to those funded by NIH, which place an emphasis on training students to pursue interdisciplinary, use-inspired research in collaboration with external stakeholders that can guide research and put it to use in improving practical actions to support decarbonization and energy justice.
- Authorize and appropriate funds for the establishment of 10 regional centers to manage socioeconomic dimensions of the net-zero transition, a net-zero transition office in each state capital, and local community block grants for planning and to help identify especially at-risk communities.

I also want to note that I am helping to lead the Princeton Net-Zero America project, a comprehensive national-level modeling effort that examines several technological scenarios to achieve a net-zero transition by mid-century and quantifies the scale and cost of physical assets, institutional change, and human-resource efforts for all sectors over time. In contrast to the National Academies report, the Princeton Net-Zero America project does not look at policy but has a high level of spatial definition that helps to illustrate the extraordinary scale of the transition, including the potential impacts on jobs.

The Princeton analysis, which is separate from the National Academies study but was referenced within it, shows that all but a handful of states will see steady increases in energy jobs during a 30-year transition to net-zero. The exceptions are some coal-producing states (i.e., West Virginia and Wyoming), which will see a continuation of the current downward trend in coal employment, and states most reliant on oil and gas production (i.e., Texas, Oklahoma, and Louisiana), which will generally see net energy job losses beginning in the late 2020s when oil and gas demand declines because of increased deployment of renewable electricity and vehicle electrification. However, net-zero industrial jobs (i.e., net-zero steel, cement, chemicals, etc.) are not included in this analysis. There would be more than enough of these jobs to eliminate the net fossil job losses in the few states that would experience them, if appropriate policies were developed.

These results helped motivate the Academies report's focus on developing tools for states and local governments to pre-emptively address this transition. They also motivate the committee to put even greater emphasis on jobs and jobs transition during its second report (expected 2022). I believe that this is one of the most critical issues, if not the most critical issue, that needs to be addressed in the United States' transition to a net-zero economy.

2. Dr. Pacala, we want to ensure that all Americans experience the benefits of the transition to a clean energy economy. Given the recent winter storm in Texas and the Southern Plains, how would upgrading and expanding the electric grid increase resilience and benefit everyday Americans? How can Congress support hardening and weatherizing grid infrastructure?

RESPONSE:

Electrification of energy services in transportation, buildings, and industry and production of carbon-free electricity are two primary technological goals during the first 10 years of a transition to net-zero emissions. Additionally, access to electricity is known to improve the standard of living, health, and education of households; and the literature indicates that all else equal, communities disconnected from larger electricity grids face higher electric costs.

Therefore, upgrading and expanding the electric grid to make it accessible to every American is an attractive proposition. In the future, if the American power industry seeks to take advantage of high-quality wind and solar resources, expanding the electric grid will be even more essential.

At the same time, measures must be taken to ensure that the grid remains reliable and resilient to avoid situations like those that occurred following recent winter storms and/or other extreme

weather events (including heat waves, storm surge, coastal and riverine flooding, derechos, and wildfires).

The committee recommends several policies aimed toward these goals:

- Congressional authorization for DOE and FERC to plan, fund, permit, and build additional electrical transmission, while requiring fair public participation measures to ensure meaningful community input in the planning and siting activities.
- Congressional appropriations to increase electrification of tribal lands through direct financial assistance for the build-out of electricity infrastructure through DOE-IE grant programs.
- Congressional authorization for rural electric cooperatives and private companies to expand broadband for rural and low-income customers.
- Congressional directive to FHWA to expand the EV charging infrastructure on interstate highways and to DOE to invest in EV charging for low-income businesses and residential areas.
- A tripling of Congressional appropriations to DOE to invest in low- or zero-carbon RD&D, which will include funding for technologies that improve grid reliability and resilience such as clean firm electricity generation (e.g., advanced nuclear) and energy storage (e.g., low-cost, long-duration batteries).

Notably, two other committees of the National Academies have produced reports that address these important electric grid resilience issues:

- [The Future of Electric Power in the U.S.](#) (2021); and
- [Enhancing the Resilience of the Nation's Electricity System](#) (2017).

3. Dr. Pacala, your study notes that renewable energy interconnection costs are higher in the United States than in other countries. Could you please elaborate on that? What can Congress do to help alleviate this situation?

RESPONSE:

The specific text in the committee's report refers to high soft costs associated with deployment of renewables—those associated with permitting, interconnecting, and the like. The relatively high renewable energy interconnection costs in the United States stem in part from the current federal/state jurisdictional split around transmission infrastructure (in which FERC regulates transmission planning and access and states approve transmission facilities) as well as the fact that interconnection policies and practices vary across regions of the country (for interconnections to the bulk power system) and across distribution systems (e.g., for utility-scale and rooftop solar systems).

Although the committee did not explicitly address these interconnection issues for renewables (and indeed the report overall focused on myriad efforts under federal jurisdiction—e.g., bulk power systems—rather than state jurisdiction—e.g., distribution system policies and practices), the committee did observe that there are actions that Congress could (and should) take to address hurdles in determining the need for and siting of new transmission enhancements to support renewable and other zero-carbon generation resource portfolios.

These include the following committee recommendations:

- Congress should establish a U.S. National Transmission Policy to enable a high-voltage transmission system to support the nation's (and states') goals to achieve net-zero carbon emissions in the power sector.
- Congress should amend the Federal Power Act to authorize and direct FERC to require transmission companies and regional transmission organizations to analyze and plan for economically attractive opportunities to build out the interstate electric system to connect regions that are rich in renewable resources with high demand regions; this is in addition to the traditional planning goals of reliability and economic efficiency in the electric system.
- Congress should amend the Energy Policy Act of 2005 to assign to FERC the responsibility to designate any new National Interest Electric Transmission Corridors and to clarify that it is in the national interest for the U.S. to achieve net-zero climate goals as part of any such designations.
- Congress should authorize FERC to issue certificates of public need and convenience for interstate transmission lines (along the lines now in place for certification of gas pipelines), with clear direction to FERC that it should consider the location of renewable and other resources to support climate-mitigation objectives, as well as community impacts and state policies as part of the need determination (i.e., in addition to cost and reliability issues) and that FERC should broadly allocate the costs of transmission enhancements designed to expand regional energy systems in support of decarbonizing the electric system.

The report also recommends that DOE fund studies and policy evaluations aimed at reducing the soft costs of clean energy technologies (including interconnection) and notes that Congress could direct them to do so.

The Honorable Peter Welch (D-VT)

1. Your National Academies of Science Decarbonization Report outlines the ambitious steps needed to take in the next decade to avert a climate disaster. Can you please elaborate on how much renewable generation needs to be installed this coming decade in order to reach our clean energy goals and specifically reach a zero-carbon power sector by 2035?

RESPONSE:

The report recommends that carbon-free electricity represent roughly 75 percent of U.S. generation by 2030 and 100 percent by 2050 or sooner. Reaching these goals will require deploying 250-300 GW of new wind and 280-360 GW of new solar by 2030, so that wind and solar represent 45-55 percent of electricity nationwide by that date, up from 10 percent today. Given the projected increases in energy demand, approximately 2 billion MWh of new carbon-free generation needs to come online during the 2020s. Such deployments represent additions that are multiples of what the United States has experienced in recent decades.

The committee's analysis identified various other efforts needed before 2030 to meet clean electricity goals, including:

- retiring coal-fired capacity or retrofitting it with carbon capture systems,
- preserving existing nuclear generation,
- keeping installed capacity of natural gas-fired generation roughly constant,
- deploying 10-60 GW/40-400 GWh of battery energy storage capacity,
- expanding long-distance transmission capacity by about 120,000 GW-miles, and
- reinforcing distribution networks to accommodate increases in aggregate peak demands.

2. Can you please explain why energy efficiency standards are so important to implement in combination with federal climate policies which would naturally lead to massive increases in electrification?

RESPONSE:

As stated in the report, "Energy and materials efficiency is one of the most cost-effective near-term approaches to reduce energy demand and associated emissions." Increased energy efficiency can reduce the total electric capacity and output needed to meet the projected growth in electricity demand. Assuming, as the committee does, that achieving economy-wide net-zero emissions by mid-century will require significant steps to electrify buildings, vehicles, and industry (and will thereby increase overall demand for electricity), doing so through strategies that improve energy efficiency in these sectors will be critically important.

Thus, in anticipation of such demand increases, the committee recommends that Congress direct federal agencies to adapt and strengthen existing efficiency standards for appliances, buildings, and transportation and to establish a clean manufacturing standard. Improvements in energy efficiency will also help to control energy costs and provide emissions reductions in hard-to-electrify sectors such as aviation, long-distance shipping, and chemical manufacturing.

Importantly, given that the committee's recommended carbon price (\$40/tCO₂, rising at 5% per year) is insufficient to achieve net-zero emissions on its own, setting energy efficiency standards helps to ensure that private sector decisions align with decarbonization goals.