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"Cleaner, Cheaper Energy:
Climate Investments to Help Families and Businesses"

Questions for the Record

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The Honorable Kathy Castor

1. **Dr. Varadarajan, how would the Build Back Better Act help utilities and communities choose clean power generation strategies that work for them?**

The proposed Build Back Better Act (BBBA) offers a suite of incentives to make it much less expensive for utilities and communities to make the choice to shift to clean power – using the technologies and strategies that work best for them while maintaining or improving reliability. Most important among these are provisions that make clean energy tax credits more readily useable by utilities and communities to reduce the cost to customers of employing a broader range of clean technologies and strategies.

In more detail, compared to existing tax credits, the BBBA credits are more easily monetized, longer in duration, and treat competing clean technologies more equitably. As a result, the credits will be more flexible in application, expanding the ranks of eligible entities, increasing the timeframe for their use, and empowering customers and communities to select climate-sustaining solutions that are also tailored to local circumstances. This flexibility should boost grassroots engagement in furtherance of a clean future and also help deliver a better return on fiscal investment for taxpayers.[i]

The improved BBBA tax credits:

- **Reward Performance:** BBBA newly provides solar asset owners with the option to claim the production tax credit (PTC) that has fueled the growth of the wind industry over the past two decades—and which wind developers have generally chosen in favor of the investment tax credit (ITC) currently available to both technologies. With BBBA, solar and wind will be eligible under the existing PTC through 2026, after which time a new Clean Energy Production Tax Credit (45BB) will kick in.

  Unlike the ITC, which is claimed all at once when a project is placed in service and is typically calculated on the basis of a "fair market value" open to dispute, the PTC rewards output, providing a credit for each unit of energy generated over the first decade of operations. As such, the interests of solar asset owners, taxpayers, climate advocates, and ratepayers are aligned in favor of cost transparency and demonstrated decarbonization performance.

- **Enable Fair Competition:** the PTC is not subject to "tax normalization." Normalization is a legal restriction within the tax code that compels regulated investor-owned utilities (IOUs) to keep a portion of benefits of the ITC for investors, the argument being that investors must benefit from an "investment" credit. Customers are allowed only to receive a fraction of the financial value of the credit attenuated over the long operating life of their solar assets. In contrast, unregulated entities—such as renewable developers—are free to pass on the benefits of the ITC to their customers as dictated by market competition, a more economically rational way to balance the interests of investors and consumers. Put simply, because unregulated developers are not subject to normalization restrictions, they can sell electricity at lower prices than IOUs, even when technology and capital costs are the same. (However, by hindering full and fair competition, normalization likely allows third-party developers to demand higher prices for solar than would be the case without the constraint. For a commodity product like solar generation today, such a barrier to competition has no compelling justification.)

  The normalization disadvantage has created a conflict between the business interests of IOUs—which sell electricity to nearly 50 million households and 7 million business accounts in 49 states—and solar deployment. Utility opposition can be explained by how regulated IOUs make investment decisions and earn profits. Before an IOU builds a power plant, it must prove to its regulator that the investment is prudent. Prudency considers cost relative to other ownership options. Third-party solar power purchase agreements are unattractive for IOUs, which earn profits for their shareholders by investing in and owning assets. IOUs therefore lack the financial motivation to accelerate solar deployment. In this context, an IOU's financial interests are likely best served by resisting the transition to solar.

  The PTC option will provide a route around the normalization barrier and accelerate progress toward America's climate goals. Indeed, according to modeling from the Rhodium Group, allowing renewables to choose between the ITC and PTC would double emissions reductions by 2031 compared with a straight 10-year extension of the current tax credits.[ii]

- **Improve Policy Efficiency:** BBBA provides for direct pay of tax credits. Most clean energy developers and utilities do not have the tax liabilities necessary to claim tax credits at their full present value. The prevailing solution has been to negotiate complicated tax equity workarounds—which reduce the value of the tax credits passed down to consumers. Changing these tax credits to permit direct pay would enable developers to realize the credit's whole value, further lowering the cost of clean energy. The change would also open up the credits to investors currently excluded from direct access to tax credits, such as not-for-profit and governmental entities.

Under existing law, companies monetize a cash benefit from the ITC and PTC only if they can offset taxes due in that year. Otherwise, the credits must be "carried forward" for possible future use. RMI analysis of financial disclosures shows that in 2019 IOUs had aggregate tax liability sufficient to build less than 4 GW of new solar and storage per year—roughly enough capacity to replace just one or two coal plants.[iii] Over the last two decades, policymakers have put in place "bonus depreciation" provisions to incentivize investment to fight recessions. These provisions allowed companies to immediately deduct as an expense from their pre-tax income very large share—or, in some cases, even all—of the investment they make in new capital assets. Utilities therefore often do not owe enough in taxes to see a current cash benefit from the existing ITC and PTC. Depending on state regulatory practices, this inability to monetize can result in a financial burden—a carrying cost—for customers or shareholders.[iv]

A utility can currently opt to purchase clean power from a third-party developer or partner with tax equity investors—large financial institutions that have found a market selling their tax liabilities to developers—to realize the benefits from tax incentives for their customers. However, the use of tax equity often comes with higher financing costs that reduce the amount of tax incentive benefits that can be passed on to customers. And, as noted in connection with the normalization issue, reliance on third-party capital is at odds with the core of the utility business model, which is to deploy utility shareholder capital.

Public power agencies and many cooperative utilities will also benefit from direct pay. As not-for-profit entities, these utilities do not currently have direct access to clean energy tax credits. Instead, they must rely on private-sector developers and investors as intermediaries. But these private entities have capital costs well above the low-cost debt that not-for-profits and governments can access for their fossil investments.

While IOUs, public power agencies, and cooperatives owned around 55% of total generating capacity in the US in 2019, their corresponding shares of wind and solar were only 15% and 11%, respectively. Direct pay can significantly improve the ability of these entities—currently responsible for 80% of the emissions from coal in the power sector—to deliver cost savings from transitioning to carbon-free electricity.

- **Incentivize Critical Reliability-Boosting Technologies:** BBBA allows stand-alone battery storage and transmission to qualify for the up to a 30% ITC with direct pay. Both storage and transmission are critical for allowing the grid to absorb a higher penetration of variable clean energy while also allowing a much larger and diverse group of communities (e.g., along transmission routes and in areas where storage is valuable even without collocated generation) to benefit from clean energy tax incentives.

- **Extend the Duration of Availability of Credits:** The new BBBA credits—the 45BB PTC for wind and solar and the 48F ITC for wind and solar and stand-alone storage—will be available in full through the earlier of 2031 or when the US electric sector achieves a 75% emissions reduction from 2021, while the ITC for transmission is set to be available through 2026. These are longer horizons than have been available for clean energy for much of the last decade, which has seen the PTC and ITC repeatedly face phase-outs and phase-downs that have been relieved by short-term (often 1-year) extensions. The BBBA approach will increase investor confidence, counter "fear of missing out" decision making, and mitigate logistical and construction bottlenecks that have been exacerbated by previous phase-out and phase-down deadlines.

In sum, BBBA provides far more flexible incentives for clean energy, with new and expanded tax credits that

- utilities and customers can choose to claim (or not claim) depending on their needs and preferences;
- enable communities to act on their own, by directly accessing tax credits through public power entities as well as via individual investments in technologies such as stand-alone storage that invite modular deployment,
- achieve technology-neutrality with regard to wind and solar, and
- sustain existing nuclear plants and also incentivize hydrogen technologies and carbon capture and storage, giving utilities and communities more options for clean power tailored to local conditions. As variable renewable energy penetration increases, such "firm" resources can help maintain grid stability.

2. **In your view, how will the Infrastructure Investment and Jobs Act promote electric grid reliability and how would the Build Back Better Act build on that foundation?**

The Infrastructure Investment and Jobs Act (IIJA) provides billions of dollars to reduce the grid impact of extreme weather events that are increasing in frequency as a result of climate change, including $5 billion for grid resilience and reliability upgrades and $3 billion for smart grid technologies.[v]

IIJA also includes incentives to build out transmission and distribution lines and gives meaningful authority to help federal agencies navigate land use disputes that often delay grid improvements. Grid expansion that keeps pace with renewable deployments is critical for future grid reliability.

BBBA will build upon IIJA by adding and expanding tax credits for firm clean resources, transmission, and battery storage systems. RMI further recommends the inclusion of an ITC tax normalization opt-out for transmission and stand-alone storage to allow utilities to fully pass on these benefits to customers. Even if third-party ownership of such assets is less established than is the case with solar generation, the potential for normalization to misalign utility interests and clean energy policy goals (while also increasing customer costs) is nevertheless without compelling justification.[vi]

3. **RMI's analysis showed that states all across the country can benefit from the clean energy tax credits included in the Build Back Better Act. Could you please explain how consumers in states such as Indiana or Ohio can benefit from these clean**

energy tax credits even if the renewable resources in their states are not quite as abundant as those in other regions of the country? Specifically, if states like Indiana and Ohio build relatively less new clean energy generation within their boundaries, what would make it possible for their residents to experience some of the economic benefits?

Even in states like Indiana and Ohio that cannot match the insolation of the Southwest or the wind energy of the Great Plains, clean resources are often already economic to build. In Indiana, for instance, the Northern Indiana Service Company plans to retire its entire coal fleet by 2028 and replace them with cheap renewables, which will reduce carbon emissions by 90%, save customers $4 billion, and promote local jobs and economic development.[vii]

With BBBA, clean energy economics will improve across the country. Individual investment decisions will still need to assess resource quality, proximity to load, and the value of geographic diversification in regional power systems. New clean energy technologies, such as offshore wind on the Great Lakes, or hydrogen plants with CCS and nuclear small modular reactors (SMRs) on former coal plant sites, may also play a role in anchoring new investment in Midwestern states, thanks in no small part to the BBBA's more expansive tax credits.

Because of Indiana and Ohio's current high reliance on expensive coal and low renewable penetrations (9% in Indiana and 3% in Ohio),[viii] consumer savings from BBBA's clean energy provision will be very large, even if net reductions in in-state shares of generation occur. In fact, RMI's analysis found that BBBA tax credits would deliver larger ratepayer savings to Indiana than any other state, *over $800 million per year* by 2030. Ohio could see over $100 million in savings annually by 2030.[ix]

4. **Fossil energy production requires extraction that has transformed huge swaths of the American landscape and oceans. How do solar and wind energy compare in terms of their use and impact on US lands and waterways to deliver similar energy services?**

A 2013 NREL study shows that if powered on solar power alone, the United States would need about 22,000 square miles of solar panels—about the size of Lake Michigan—to *generate the entire country's electricity*.[x] A similar analysis to generate the entire country's electricity from wind turbines showed that they only needed about 1,200 square miles of wind turbines, or about the size of Rhode Island.[xi] These equate to approximately 0.7% and 0.03% of the total land area in the continental United States. And a new analysis by Lawrence Berkeley National Lab has found that older estimates of solar density are out of date, with solar panel density increasing by over 50% from 2011–2019, and energy generation increasing by over 25% over that same time period.[xii]

Critics of renewables often point to these estimates and then suggest that fossil fuel generation – which occurs at centralized power plant facilities that occupy a much smaller footprint – have a much smaller impact on the landscape. But a fair comparison must take into account land used for upstream processes like fuel storage, refinement, and transportation, and, much more importantly, the ongoing annual need for *additional land every year* for fuel extraction, such as mining and drilling, just to maintain existing consumption.

With this wider frame, the land intensity of renewables compares very favorably with fossil energy.

For example, analysis of U.S. data shows that 1.8 million Gigawatt-hours (GWh) of electricity from were generated from coal in 2009, which required disturbing over 117,000 acres in additional land in the process. This means that each additional acre of new land disturbed by coal mining ultimately generated 15 GWh of electricity in 2009.[xiii] Fossil gas produced in new wells using hydraulic fracturing in dry shale or tight gas formations generally generate a total of between 20-50 GWh of electricity over the life of the well per acre of land disturbed, primarily within the first five years of drilling.[xiv]

However, unlike coal or gas generation which will need to disturb additional lands every year just to maintain production levels, solar and wind installations can continue generating electricity on the land they occupy indefinitely. Assuming (conservatively) a capacity factor of 25.7% and 0.5 acres of land per 3-megawatt wind turbine, a 3-megawatt wind turbine produces approximately 13 GWh per acre each year. However, over a 30-year asset life, a single 3-megawatt wind turbine can generate 200 GWh while significantly disturbing just a half-acre of land.[xv] Fixed-tilt solar installations in the US, on the other hand, would appear to be much less land-efficient at first glance, as an acre of land produces on average 0.4 GWh of electricity per year.[xvi] But that facility can generate 12 GWh over 30 years without the need for additional land. Moreover, unlike coal mines, solar facilities can also be located on rooftops or other lands that are primarily used for other purposes. This means that our estimate likely overestimates the new land that needs to be disturbed to generate electricity from solar PV.

And, of course, acreage devoted to wind and solar can continue to produce through successive asset generations, in theory boosting the efficiency of land use in perpetuity. Note that we must be careful to account for the additional land used for mineral extraction globally to construct successive generations of solar and wind farms as well. However, as we discuss below, these challenges can be overcome by following best practices for recycling and reuse. All in all, the renewable nature of these resources indeed implies that in the long run they are likely to be far more land-efficient compared to coal or fossil gas resources.

5. **Could you please explain how building electrification would benefit low-income households? How would it protect them from indoor air pollution? How would it reduce energy costs?**

This winter Americans will see home energy bills increase significantly, in large part due to spiking natural gas costs.[xvii] The burden will weigh most heavily on the 4.8 million households already facing energy insecurity.[xviii] Fortunately, electrification of household heating and cooking, *when combined with a switch to renewable resources that rely on free fuel from the sun and wind,* will help insulate low-income households from energy price volatility.

Electrification will also reduce air pollution from burning gas, wood, and biomass, practices that contribute to more negative health effects than burning coal in many states.[xix] Household combustion is the main reason that the indoor environment is often more polluted than the outdoors.[xx] In low-income communities where respiratory diseases are prevalent, building electrification will have an outsized beneficial impact on health outcomes.

While new all-electric, single-family homes are now less expensive to build and operate than new traditional mixed-fuel homes,[xxi] the BBBA adds a suite of incentives to help retrofit older buildings, particularly those occupied by low-income households. Particularly noteworthy are the High Efficiency Electric Home Rebates, two-thirds of which must be directed to low-income and tribal communities, and the Home Energy Performance-Based Whole-House Rebates and Training Grants.

6. **Like all technologies, clean energy technologies can lose efficiency or wear out over time. However, clean energy technologies typically have long productive lifespans. The National Renewable Energy Laboratory estimates solar panels maintain productivity for at least 20-25 years, and electric vehicles batteries are commonly warrantied for 8-10 years, with NREL data showing batteries can last well beyond that timeframe. When clean energy technologies do have to be retired, what opportunities do we have in the United States to reuse and recycle critical materials used in the production of clean energy technologies such as solar panels and EV batteries?**

Based on RMI review of regulatory filings, including numerous integrated resource plans (IRPs), the anticipated depreciable life of utility-scale solar (and wind) assets is typically 30 years or longer. This greater asset utilization (compared with the NREL assumption of 20-25 years) implies significantly reduced recycling needs.

When retirement and recycling is necessary, solar panels are about 80% glass and aluminum by weight, both materials which already have extensive recycling supply chains.[xxii] Copper and silver are also significant inputs and can be readily recovered and reused.

Recycling pathways for wind are admittedly more complicated. Turbines are made primarily of either glass or carbon fiber blended with epoxy resin, which makes separating the materials difficult for recycling. However, innovative processes have been developed to recycle current wind turbine materials, such as a recent announcement by GE to recycle wind turbines for cement production, as well as new technologies under development that would make recycling future wind turbines much easier.[xxiii]And wind manufacturers are stepping up their commitments to eliminate turbine waste and shift to recycling.

Electric vehicle batteries primarily use lithium-ion battery packs. Although the recycling industry here is currently in an early stage, it is beginning to scale,[xxiv] driven by projected payback periods of under one year for demonstration scale plants (ca. 1,000 tons per year) [xxv] and an expected global annual EV battery recycling need of nearly 400,000 tons by 2025.

As innovation progresses, technologies improve, and demand increases, recycling costs will fall and recycling production will rise. A similar process happened with the current lead-acid battery, used in current gasoline-powered cars, where a recycling industry scaled up as those batteries became dominant, and we now recycle 98% of lead-acid batteries.[xxvi]

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