United States House of Representatives
Select Committee on the Climate Crisis

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"Making the Case for Climate Action: The Growing Risks and Costs of Inaction"

Questions for the Record

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<u>The Honorable Kathy Castor</u>

1. **The benefits of climate policies like a clean energy standard include pollution reduction, public health benefits, job creation and economic development benefits, and more. The Social Cost of Greenhouse Gases might help quantify some of these concerns, but not all of them. How would you recommend that Congress account for all of the benefits of climate and clean air policies when developing legislation?**

It is true that the social cost of greenhouse gases will capture the benefits associated only with the reduction of those greenhouse gases. Indeed, there are other benefits from climate policies, and good policy will account for all of them. Importantly, the current regulatory process has a long track record of accounting for a wide set of benefits, critically including improvements in local air quality and the resulting health benefits. I think it would be very powerful if Congress required regulatory reviews that measure the benefits that regulations actually deliver, not just those that they are projected to deliver. Currently, regulations are only formally evaluated ex ante which, of course, is the moment that we know the least about how they will perform. The results from ex post evaluations could be used to improve policy on a continuing basis.

In testimony I presented to the Senate Subcommittee on Regulatory Affairs and Federal Management in 2015, I proposed the development of a Regulatory Analysis Division within the non-partisan Congressional Budget Office (Greenstone, 2015). This is an idea originally introduced by Senator Klobuchar. It would help to ensure that we are getting what we intend out of the regulatory process. I would be happy to have a further discussion about how such an institution could be useful in confronting the climate crisis.

2. **Any net costs associated with climate policies like a clean energy standard will depend on the impact of complementary policies like infrastructure investments and transmission build out, investments in innovation leading to cost reductions in renewables and storage, and strategic use of demand response and load flexibility. Would you agree that Federal policy can be designed to minimize the net costs of climate policies?**

Federal policy can certainly be designed to minimize the net costs and maximize the net benefits. Often the best way to understand these costs and benefits is to conduct real world analyses of these policies. For example, you mentioned the net costs associated with clean energy standards. For years, states have pursued similar programs, renewable portfolio standards (RPS). We've learned from studying these RPS programs that they often exclude some carbon-free electricity sources, favor some sources over others, and limit the degree of trade across regions. These and other limitations have made electricity more expensive for consumers and RPS policies less cost effective in reducing emissions than they could have been (Greenstone et. al., 2020). Drawing on the lessons from state RPS programs can help guide the most effective clean energy standard. Such a standard would be flexible and technology neutral, link to carbon reduction policies in other sectors, and be paired with complementary policies that facilitate grid integration and directly support technological innovation (Roadmap, 2021).

Additionally, there is a central role for the federal government to support research and development, as well as demonstration, in cases where the private sector is unlikely to fully participate. The climate crisis provides many opportunities for the federal government to play this role, ranging from supporting the development of carbon removal technologies to foundational infrastructure investment.

3. **You've recommended that the federal government account for the disproportionate climate impacts in benefit cost analyses through equity weighting. How might the Social Cost of Carbon incorporate these disparate impacts and evaluate impacts differently based on who is being affected?**

Standard economic theory and empirical observations from insurance markets suggest that people are risk averse, valuing a dollar more in times of economic hardship than in good economic times. The same logic extends across individuals; a dollar is worth more to someone in poverty than to a wealthy person. When computing the SCC, these principles can be applied to the valuation of climate damages using standard economic tools that calculate the premium people typically pay to protect themselves against outcomes that dramatically reduce their income. Just as individuals are willing to pay more for financial assets that provide insurance in hard times, societies may be willing to pay more for investments in climate change mitigation that disproportionately protect the poor. In plain English, societies tend to care more about a low-income family losing $1,000 (e.g., due to climate change) than Jeff Bezos losing $1,000 precisely because the $1,000 loss is much more meaningful to the low-income family.

4. **Your testimony provided helpful background on the work to value the social costs of carbon and other greenhouse gasses, which will help evaluate policy actions to reflect a fuller scope of costs and benefits. You, along with others, including FEMA's National Advisory Council, have recommended that agencies use a lower discount rate to ensure that we do not pass on the heavy economic burdens on to future generations. What are the changes that you are seeing in the capital markets that prompts your recommendation for a lower discount rate? What discount rate would you recommend that the federal government use for infrastructure investments?**

U.S. government agencies generally follow the Office of Management and Budget's (OMB's) recommendations in Circular A-4, which was formed in 2003 and uses 3 percent and 7 percent discount rates in cost-benefit analyses (OMB, 2003). These two values were justified based on observed market rates of return: the 3 percent discount rate was a proxy for the real, after-tax riskless interest rate associated with U.S. government bonds at the time. The 7 percent rate was intended to reflect real equity returns like those in the stock market at the time.

The 2010 Interagency Working Group on the Social Cost of Carbon (IWG) set 3 percent as the central case to be consistent with guidance from the OMB regarding the interest rate on U.S. government bonds.

This decision was also motivated by asset pricing theory and the assumption that climate damages are uncorrelated with overall market returns (Greenstone et al., 2013).

However, there have been substantial changes in global capital markets since the publication of Circular A-4 in 2003 that make it challenging to justify 3 percent as an accurate estimate of the real return on riskless investments. For example, the average ten-year Treasury Inflation-Indexed Security (TIPS) rate since its inception (2003-present) is just 1.01 percent. This is illustrated very clearly in Figure 1. Similarly, recent research suggests that the equilibrium real interest rate has declined substantially since the 1990s (Bauer and Rudebusch, 2020).

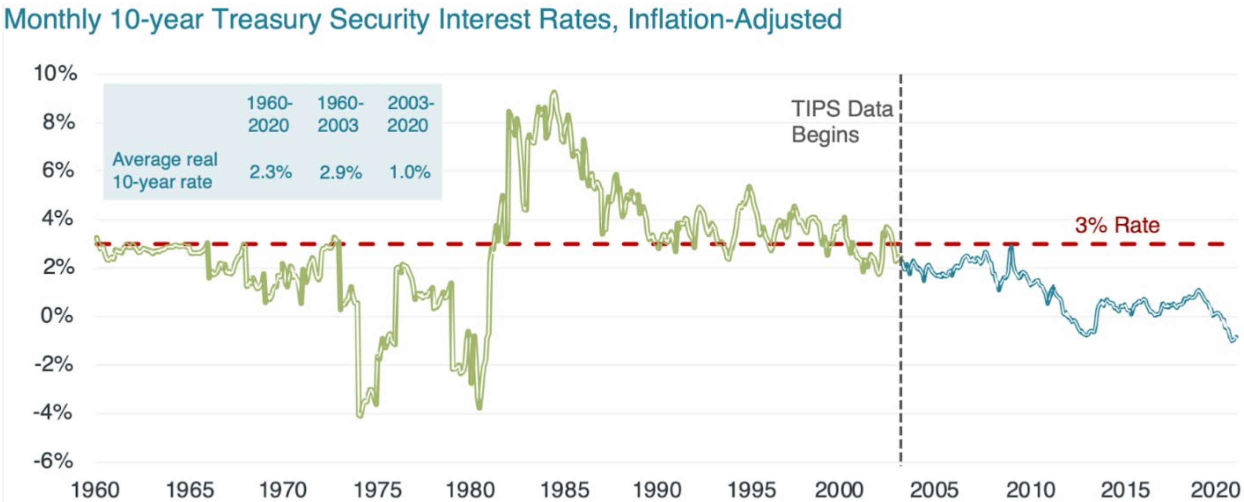

Figure 1: Monthly 10-year inflation-adjusted Treasury security interest rates. Figure shows monthly 10-year Treasury security interest rates, adjusted for inflation, from 1960 to 2020. Nominal interest rates, Treasury Inflation-Indexed Security (TIPS), and inflation data were retrieved from the Federal Reserve Bank of St. Louis. The TIPS rate is available starting in January 2003. Interest rates prior to 2003 are imputed by subtracting the annual inflation rate from the nominal interest rate.

Overall, my judgement is that there is now a compelling case for a riskless discount rate of no higher than 2 percent and this should apply to climate and standard infrastructure investments. I have reached this conclusion by applying the same criteria that were applied to set the 3 percent discount rate in 2003.

5. **What is your research finding about the economic impacts of climate change for coastal regions, and how might climate impact their economic productivity against rising seas and risks from coastal storms?**

The Climate Impact Lab that I co-direct is doing a great deal of research on the impact of climate change on coastal regions. Impacts in coastal regions are driven by two factors: the amplification of tropical and extratropical cyclone (i.e. hurricane) storm tides due to average sea level rise and the change in the frequency and intensity of these cyclones. However, coastal impacts are distributed highly unequally, with larger impacts felt in eastern coastal states. Locations with dense capital stocks (such as the New York city area), as well as Gulf Coast regions and most of Florida, are projected to experience the greatest magnitude of economic impacts. Earlier research (Hsiang et al., 2017) finds that sea level rise alone raises the direct annual economic damage by 0.6 to 1.3 percent of state gross domestic product in South Carolina, Louisiana, and Florida. If we follow a scenario close to that laid out by the Paris accords, average annual economic impacts by the end of the century are likely to cost tens of billions of dollars---double that under a continued high emissions scenario. These damages only account for direct flood damages and do not consider other costs like business interruption (e.g., Basker and Miranda, 2018) or other fiscal costs that could be many times larger than direct damages (e.g., Deryugina, 2017).

Changes to storm patterns are even more uncertain than sea level rise, but the best estimates suggest that the magnitude of damages caused by changing storms will be roughly on par with that of sea level rise. Sea level rise and storm patterns are of course related, and the magnitude of storm related damages in the second half of the century are strongly controlled by sea level rise because greater sea level rise leads to greater flood damages from storm surges. In specific work related to New Jersey, my colleagues have discovered that since 1980, the number of homes at risk of frequent flooding in the state has more than doubled (27,000 buildings worth about $15 billion), and the number of homes expected to experience at least one hurricane-driven flood event during a 30-year mortgage has increased by about 70,000 ($60 billion in value). In non-coastal New Jersey counties, the odds that the average home would experience hurricane force winds has increased from more than a one-in-two hundred risk to somewhere between one-in-one hundred and one-in-thirty risk. Average annual losses from hurricanes in New Jersey today are expected to be about $0.6 billion to $1.3 billion higher than in 1980.

6. How will the climate crisis affect the cost and reliability of energy supply?

Climate change is expected to affect all aspects of the energy system. Warmer temperatures are expected to increase U.S. electricity consumption while decreasing direct consumption of other fuels (i.e. natural gas, oil, coal) that are typically used for heating (Rode et al., 2021). Although future warming is projected to increase average electricity consumption, it is expected to have an even larger impact on peak load. Peak load is projected to increase by 18 percent under a high emission scenario, requiring substantial investment in peak generating capacity. Installing an additional 18 percent of capacity in the United States at current prices would cost around $180 billion (Auffhammer et al., 2017).

There is limited research on the effects of climate change on energy costs and reliability, and much remains unknown. However, some themes emerge from the literature:

1) Hydropower facilities require water. If precipitation and temperature patterns change such that dams receive less water or lose more water to evaporation, then hydropower supply may decline (van Vliet et al. 2013, Bartos and Chester 2015).

2) Thermoelectric power plants such as nuclear and fossil fuel plants require cooling water for their safe operation. Changes to precipitation patterns may affect the supply of cooling water due to reductions in stream flow. Increases in temperature warm rivers where cooling water is discharged and may increase curtailments of power production as river temperatures exceed regulatory thresholds (Förster and Lilliestam 2010, van Vliet et al. 2012, Bartos and Chester 2015).

3) High temperatures pose a challenge to keeping thermoelectric power plants cool enough to function properly. Recent research shows that on the hottest days, power plant capacity can be reduced by more than 10 percent because the air and water used to cool the plants is too warm. These effects will be magnified as hot days become more frequent under future warming. Under 2 degrees Celsius of global warming, power plant outages from hot days are projected to nearly double relative to present-day levels (Coffel, 2021).

4) More anecdotally, recent experiences in California and Texas demonstrate that increased demand for heating and cooling, as well as damage to energy infrastructure caused by disasters like wildfires, can affect grid stability. This occurs for two reasons: the decreased supply as facilities or transmission infrastructure may be temporarily lost, and the peak demand increases during times of extreme weather.

7. **What are the anticipated effects of the climate crisis on workers and U.S. labor productivity? What are the labor sectors that will be the most affected?**

Climate change is expected to lead to substantial losses to labor supply, increased discomfort to workers, and impaired labor productivity. Labor supply has been found to be negatively affected by extremely hot days. While all sectors are affected, the effects are especially large in weather-exposed sectors such as agriculture, mining, construction, and manufacturing. A day with maximum temperature above 100 degrees Fahrenheit has been shown to reduce labor supply by up to one hour per worker in these sectors, relative to a day with a maximum temperature of 75 degrees F to 80 degrees F (Graff Zivin and Neidell, 2014). Under a high emissions scenario, overall U.S. labor supply losses in 2099 are projected to be comparable to losing roughly half a million full-time-equivalent workers, and the increased labor disutility from a warmer climate is valued at roughly 0.5 percent of 2099 U.S. Gross Domestic Product (Rode et al., 2021).

Recent research also finds evidence consistent with declines in productivity on hot days, both at micro and macro levels. Cachon et al. (2012) find that days with a maximum temperature above 90 degrees F reduce production in U.S. automobile plants, with six such days in a week being associated with an 8 percent decline in production relative to a week with no such days. These types of effects are reflected in aggregate measures. Behrer and Park (2017) find that one additional day above 95 degree F causes a 0.23 percent reduction in county-level payroll per-capita in non-agricultural, weather-exposed sectors.

The Honorable Garret Graves

1. **In an exchange with Representative Miller, you stated that natural gas "should certainly be available" as an energy source in the United States. I agree with that and believe that U.S. produced natural gas should play an important role in meeting global demand, particularly given the low lifecycle emissions profile compared to global competitors such as Russia. Should U.S. produced natural gas continue to be part of our efforts to reduce emissions and provide affordable energy both domestically and globally? Isn't it important to continue to develop technologies, such as carbon capture, that allow for the utilization of natural gas with much lower emissions – particularly given projections of 40% and greater increased global demand for natural gas in the coming decades? Given the fact the Russian natural gas exported to China has a lifecycle emissions profile 47% greater than U.S. LNG exported to China, should we really be pursuing energy policies that could potentially eliminate natural gas as an energy source in the U.S. or that unilaterally make the lower emission resource less competitive globally than our higher emitting competitors?**

Natural gas is an essential player in the national and global energy mix, and it is important that we develop low-cost technology—namely, carbon capture and sequestration (CCS)—to make natural gas not just low carbon but no carbon in the future. The best approach is a price on carbon or a properly designed, technology-neutral clean electricity standard that allows lower or zero carbon technologies to compete on a level playing field. Like a carbon tax or cap-and-trade system, a clean electricity standard that includes natural gas with CCS would allow the market to decide fuel choices, while accounting for their climate impacts, and provide the profit motive to industry to drive investment in lower carbon technologies, like natural gas with CCS. All of these policies can be designed to protect lower income Americans through progressive rebates and to protect U.S. competitiveness through border tax adjustments.

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