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CONGRESSIONAL TESTIMONY OF **NOAH KAUFMAN, PHD**

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BEFORE THE **SUBCOMMITTEE ON ENVIRONMENT & CLIMATE CHANGE OF THE COMMITTEE ON ENERGY & COMMERCE**, UNITED STATES HOUSE OF REPRESENTATIVES, 116TH CONGRESS

Thank you for inviting me here today to discuss solutions for economy-wide deep decarbonization. My testimony begins by describing the need for comprehensive, economy-wide climate policies and the benefits of including a price on carbon dioxide emissions. Then, I will propose four principles for integrating a carbon price into a broader policy strategy.

A comprehensive solution that focuses on emissions is critical for addressing climate change

The risks of climate change worsen as temperatures rise, and temperatures will only stabilize when global carbon dioxide emissions fall to net zero.[1] A net zero pathway requires a strategy that addresses sources of emissions across the entire economy. No other country, particularly in the developing world, will adopt strategies consistent with net zero emissions targets unless the United States commits to its own comprehensive climate strategy.

Focusing on technological progress alone will not work. Consider an analysis by the Department of Energy (DOE) that asked each DOE clean energy program for "stretch" technology goals and assumed all goals would be successfully achieved. Even if that scenario, which no risk manager would recommend counting on, U.S. emissions are projected to fall by less than one-third over the next few decades.[2]

Instead, we need a strategy that focuses on the policy objective: reduced emissions. And we need broad incentives that filter down into the nooks and crannies of our economy, eliminating the market failure that causes producers, consumers, and investors to ignore the impacts on the climate of their day-to-day decisions.[3]

A carbon price should be part of a comprehensive climate policy

A price on carbon is a fee on each ton of carbon dioxide emissions, making those responsible for the emissions pay for the damages they cause.

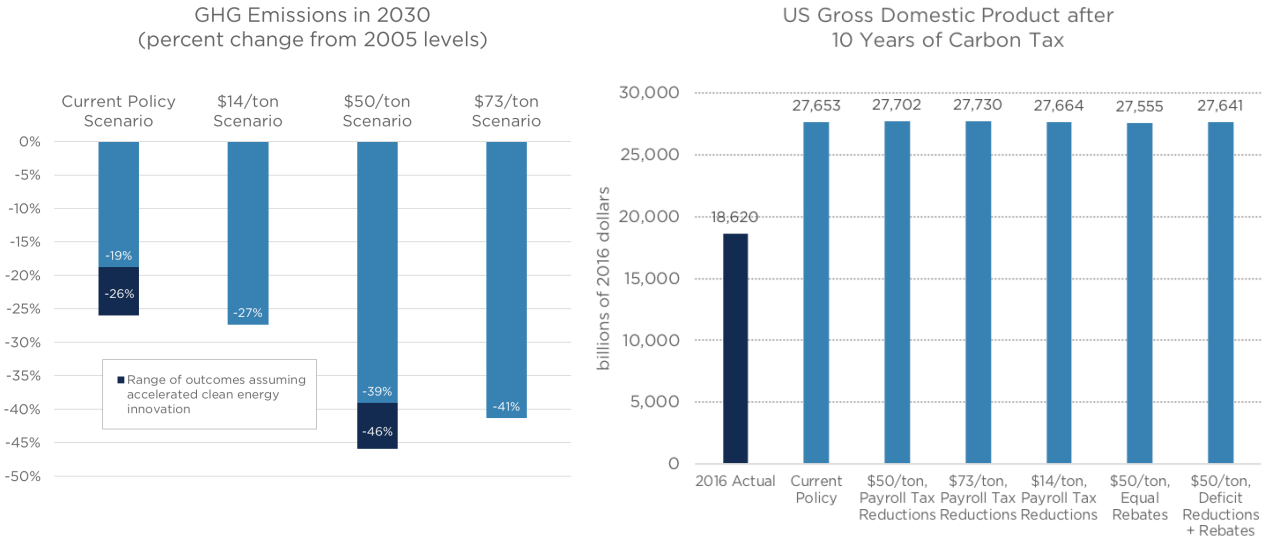
A comprehensive climate policy could be designed without a carbon price, but a carbon price is unique in encouraging emissions reductions wherever and however they can be achieved at a low cost, without needing to know beforehand what those opportunities will be. Specifically, the policy creates a financial incentive to take advantage of any opportunity to reduce emissions that costs less than the carbon price. In contrast, policies will be more costly if they dictate that emissions reductions must occur from specific sources or sectors or technologies.[4]

That is a key reason why a federal carbon price would achieve large emissions reductions at a small cost. Analysis led by the Center on Global Energy Policy at Columbia University finds that a slowly rising carbon price starting at $50 per metric ton could cause net emissions to fall to 39-46 percent below 2005 levels in the first decade.[5] That is the impact of the carbon price by itself—far greater reductions could be achieved as part of a broader strategy and over a longer time horizon.

Further, the analysis shows that the differences in U.S. gross domestic product between scenarios with and without a carbon price are well under 1 percent (see Figure 1).[6] These studies are of course imperfect—for example, they ignore the economic benefits of avoided regulations and the innovation stimulated by the carbon price—nevertheless, given the large emissions reductions the carbon price would achieve, it is notable that studies suggest roughly zero impacts on the overall growth of the U.S. economy.[7]

Minimizing the costs of emissions reductions is not only beneficial to top-line indicators like economic growth, but also means a lower economic burden on everyone, and these lower costs should enable a more rapid pace of emissions reductions. For any policymaker with the goals of deep decarbonization and a strong economy, putting a price on carbon dioxide emissions is a no brainer.

Figure 1: Impacts of a Federal US Carbon Price on Emissions and Gross Domestic Product



Notes: The analysis examined three scenarios with carbon taxes starting in 2020, as well as the current policy scenario for comparison. In the a $14/ton scenario, the tax starts at $14 per metric ton (in 2016 dollars) and rises by about 3 percent annually (above inflation); in the $50/ton scenario: the tax starts at $50 per metric ton and rises by about 2 percent annually; in the $73/ton scenario, the tax starts at $73 per metric ton and rises by about 1.5 percent annually. The emissions analysis was conducted by the Rhodium Group, and the economic analysis was conducted by Rice University's Baker Institute.

Source: Kaufman N. & Gordon K. "The Energy, Economic & Emissions Impacts of a Federal US Carbon Tax." Columbia University Center on Global Energy Policy. July 2018.

Integrating a carbon price into broader policy strategy

The decision to include a carbon price in a comprehensive climate policy strategy should be easy,[8] but *how* a carbon price is integrated into a broader policy strategy will influence its effectiveness and its acceptability to the American people. In what follows, I will offer four policy principles that address valid concerns with economywide climate solutions:

#1. Protect those who cannot afford price increases

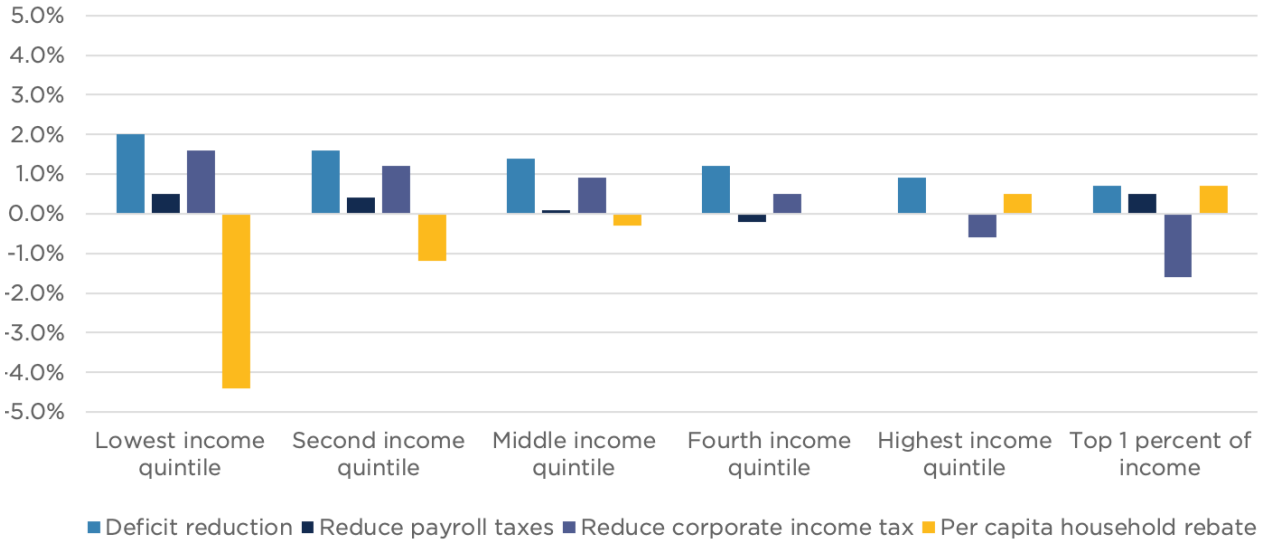
Americans who have trouble paying energy bills or maintaining adequate heating or cooling services cannot afford to pay more. With a well-designed carbon price, they do not have to.

The payments of the carbon price become government revenue. The most straightforward way to protect those who cannot afford price increases is to use the revenue to provide compensation for the increase in expenditures caused by the carbon price: such payments are often called "carbon dividends."

As a general rule-of-thumb, using ten percent of the revenue from the carbon price for carbon dividends to households in the bottom twenty percent of the income distribution ensures the carbon dividend payments to these households are larger than the payments of the carbon price from these households.[9]

Some policymakers will prefer to provide larger payments to low-income households, to ensure that even outlier households are protected. Others will prefer to protect middle-class households as well. These goals can be readily achieved by using more than 10 percent of the revenue for carbon dividends. For example, one recent proposal in the House of Representatives and Senate would use over half of the carbon pricing revenue to pay a monthly carbon dividend to households with annual incomes below $150,000.[10] Another proposal, which has more than 70 cosponsors in the House of Representatives, uses nearly all revenues for carbon dividend payments to all Americans, which creates a highly progressive policy (see Figure 2).[11]

Figure 2: Change in Tax Burden as a Percent of Pre-Tax Income in 2025 for a $50/Ton Carbon Tax Scenario



Notes: Assumes a carbon tax of $50 per metric ton (in 2016 dollars) is implemented in 2020 and increases by 2 percent annually (above inflation). Each bar in the figure reflects a different assumption about how 100 percent of the carbon tax is used. The "per capita household rebate" scenario assumes all revenues are used for carbon dividends. The analysis was conducted by the Urban-Brookings Tax Policy Center.

Source: Kaufman N. & Gordon K. "The Energy, Economic & Emissions Impacts of a Federal US Carbon Tax." Columbia University Center on Global Energy Policy. July 2018.

Time and again, we see people around the world respond with outrage when energy prices are raised in ways perceived as unfair.[12] Notably, a recent national election in Canada saw about two-thirds of the country vote for parties that support the national carbon pricing policy that includes protections for low- and middle-income households.[13]

A well-designed carbon price will not impose additional burdens on Americans who cannot afford them. What Americans truly cannot afford are ever-increasing climate change impacts, which disproportionately harm the poor.[14]

#2. Keep U.S. industries on a level playing field with foreign competition

Imposing economywide climate policies raises concerns about the competitiveness of domestic companies compared to foreign companies whose products are not taxed or regulated comparably. A poorly designed climate policy could cause U.S. businesses to lose market share or flee the country, risking economic harm and emissions leakage (i.e. emissions sources relocating abroad).

Fortunately, there are multiple ways to avoid these outcomes. The most common approach, included in all eight carbon prices proposed in Congress this year, is a border carbon

adjustment (BCA).[15] Under a BCA, policy makers define a set of industries that are most at risk based on their energy-intensity and trade-exposure (e.g. steel, cement), require importers of these products to pay a fee, and provide rebates to exporters of the same products. The United States, which is the major trading partner for so many countries, would thus be implementing its carbon price in the global marketplace.

Another way to keep industries on a level playing field is to provide compensation to offset the payments of the carbon price, similar to the protection for households described earlier. Economists have proposed paying trade-exposed industries an amount equal to the expected payments of the carbon price for a representative company in each industry. That way, if these companies can reduce their emissions, they will receive the same subsidy but pay less in taxes.[16]

Of course, U.S. businesses do not need protection from foreign competitors that face comparable climate policies. The European Union and Canada are two of the three largest trading partners of the United States, and they are well ahead of the United States in terms of the stringency of their climate policies.

#3. Improve economic opportunity in coal-dependent communities

Only one US industry is likely to see immediate and significant harm from a well-designed climate policy strategy: the coal industry.[17]

Coal production in the United States fell by one-third between 2007 and 2017, while its market share in the U.S. electricity system fell from about one-half to about one-quarter. Projections of the U.S. energy system show this decline continuing gradually under current policies. However, even a moderately stringent climate policy could create existential risks for the U.S. coal industry (see Figure 3).[18]

Coal is no longer needed for reliable and affordable electricity in the United States, and the rapid decline of coal use would be great news for our public health and for the climate. After all, coal is the most carbon-intensive fossil fuel, and it produces harmful local pollutants that cause diseases and pre-mature deaths.[19]

These benefits would be small consolation to regions of the country that are highly dependent on the coal industry, many of which are already struggling mightily due to the decline in production over the past decade (caused primarily by low natural gas prices[20]). In the most coal-dependent counties, the industry is directly responsible for one-third to one-half of county government revenues. The decline of a dominant industry risks downward spirals in local governments' fiscal conditions, including the inability to raise revenue, repay debt, or provide basic public services.[21]

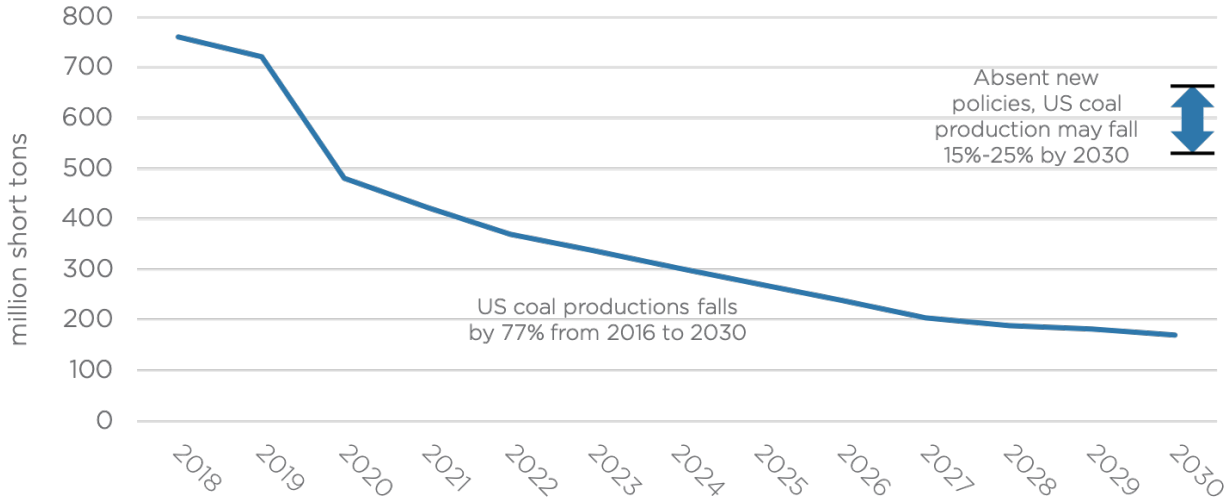
Fortunately, compared to the resources of the federal government, the size of this problem is small because the production of coal is so geographically concentrated. Over one-third of US coal production is from one county in Wyoming and nearly 90 percent of U.S. production is from just 50 counties.[22] The coal mining industry employs just over 50,000 workers, down from 860,000 in the 1920s.[23]

A small fraction of revenue from a federal carbon price in the United States could fund billions

of dollars in annual investments that provide economic opportunity to coal-dependent communities and direct assistance to coal industry workers, including fulfilling pension obligations. Alternatively, support for coal communities could be provided in separate legislation, or perhaps as part of a broader program to support rural communities across the country that have similarly seen rapid declines in their dominant industries.

Coal industry workers spent generations, often at the expense of their own well-being, providing the energy that powered a good part of the American economy.[24] These communities have earned the support of their country as it transitions to a low-carbon economy.

Figure 3: Projected US Coal Production with a $25/ton Carbon Price in the Electricity Sector



Notes: The projections assume a carbon price is applied to the U.S. power sector starting at $25 per metric ton in 2020 and increasing at 5 percent (above inflation) each year.

Source: The $25/ton carbon price scenario is a "side case" from U.S. Energy Information Administration's (EIA) Annual Energy Outlook 2018 report. The projections absent new policies are from EIA's Annual Energy Outlook 2019 and Rhodium Group's 2018 "Taking Stock" report. .

#4. Surround the carbon price with policies that enable even faster and cheaper emissions reductions

A carbon price will be most effective when implemented across the entire economy (where feasible). However, even a price that covers all emissions is just one part of an economywide climate strategy.

Policymakers should strive to adopt measures that enable more cost-effective reductions of greenhouse gas emissions than a carbon price would achieve on its own (see Figure 4).[25] Categories of policies and regulations that fall into this category include the following:

- ***Funding innovation***. Accelerating innovation in low-carbon technologies will not lead to deep decarbonization by itself, but it will ease the shift away from carbon-intensive

activities, both in the United States and abroad. In the hardest-to-decarbonize sectors, innovation is needed to create viable low-carbon alternatives.[26] In sectors where viable solutions already exist, innovation will enable faster and cheaper transitions. Absent government support, the private sector will underinvest in technological progress because it does not capture the full benefits of the emergence of new and improved goods and services. Private investors also prefer short-term payoffs with minimal risk, while the most important innovations often arise from long-term investments with many failures along the way. Governments can fill these voids with policies that encourage low-carbon solutions throughout the innovation process.

- ***Supporting the emergence of low-carbon solutions***. Displacing incumbent carbon-intensive options requires more than simply developing low-carbon solutions. Consumers are often hesitant to shift to new products because they are perceived as risky (sometimes they are right). Early adopters of technologies provide benefits for those who come later through "learning-by- doing" (i.e., production costs fall as manufacturers gain experience) and "learning-by-using" (i.e., future producers have more information about the characteristics and success of the technology).[27] The federal government should encourage these early adopters with subsidies and supportive infrastructure. For example, in the electricity sector, this may include temporary tax incentives for the critical applications of a low carbon grid.[28] In the transportation sector, it may include funding infrastructure that makes drivers more comfortable shifting to alternative-fueled vehicles or shifting away from vehicles altogether.

- ***Encouraging energy savings***. A carbon price alone will not fully address barriers to cost-effective reductions in energy use, particularly in the residential sector. After all, consumers often have insufficient or inaccurate information, they may lack investment capital, and they may heavily discount the future. Moreover, those purchasing major appliances (e.g., landlords) may not be the same as those who pay the monthly bills. Well-designed policies, such as energy efficiency standards and programs, can overcome these barriers and reduce the demand for energy at a relatively low cost.[29]

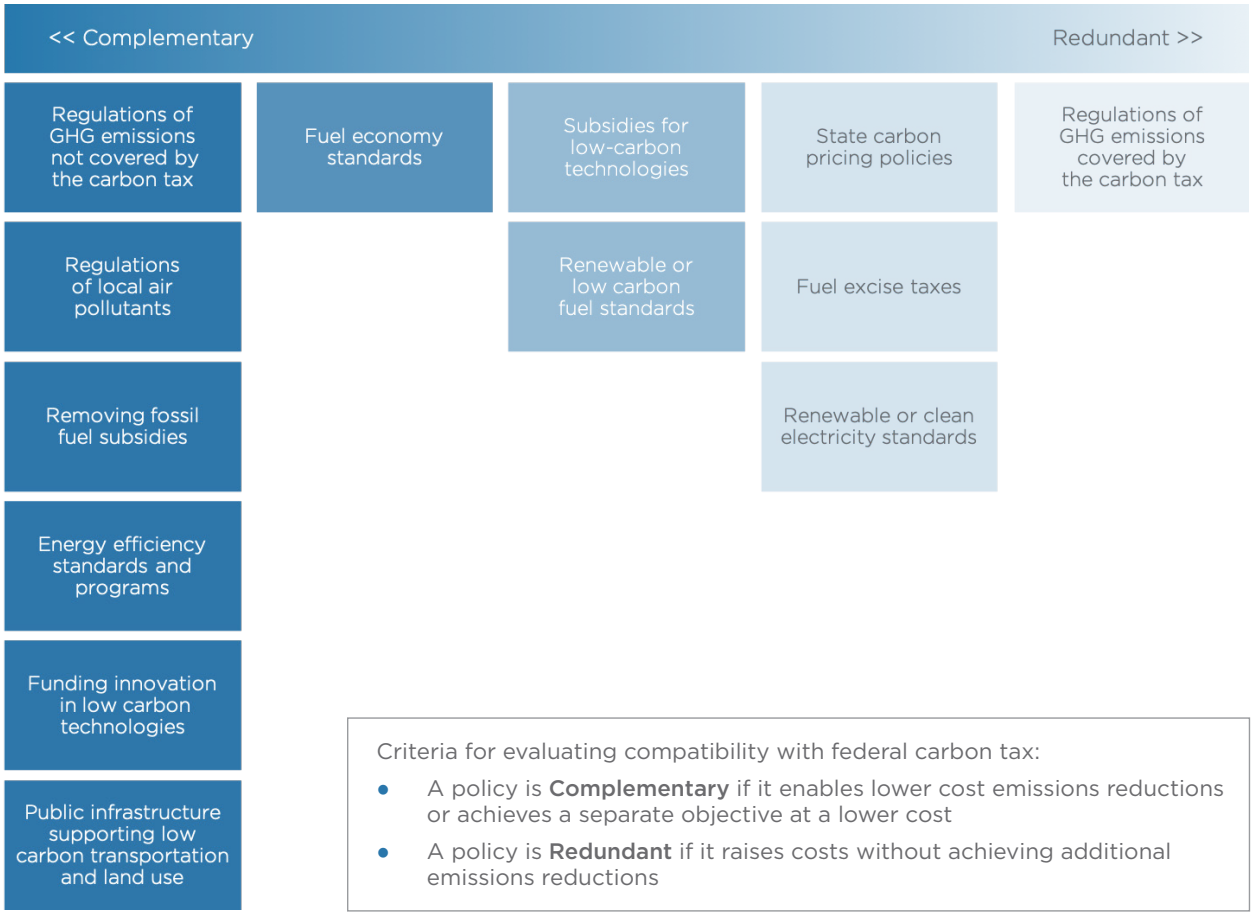
- ***Encouraging reductions in net emissions that are uncovered by the carbon price***. All recently proposed carbon prices cover about 80 to 90 percent of gross U.S. greenhouse gas emissions, including nearly all carbon dioxide emissions from the energy system. However, administrative difficulties (e.g. monitoring) will prevent covering all sources and sinks of carbon dioxide emissions with a carbon price. The land sector is a prominent example, where emissions from agriculture and livestock contribute roughly 10 percent of U.S. gross emissions and forests and soils sequester roughly 10 percent of emissions.[30] Well-designed policies can provide incentives to reduce net emissions from U.S. lands and other sources left uncovered by the carbon price.[31]

Other policies are more redundant with a carbon price, meaning they may impose administrative or compliance costs without achieving significant additional emissions reductions. Depending on the policy details, categories of policies that may not be necessary alongside a carbon price include:[32]

- Federal regulations of the same emissions covered by the carbon price.

- Subsidies for the deployment for relatively mature and widely used technologies.

Figure 4: The Compatibility of a Federal Carbon Tax and Other Policies that Reduce Emissions



Notes: The criteria and categorizations are not exact sciences. It is often difficult to identify a policy's objective or evaluate its cost-effectiveness. In addition, the extent to which a policy complements a carbon tax depends on the nature of the carbon tax. For example, with a lower carbon tax rate, fewer emission reductions would be achieved, and additional policies may be needed to make up the difference between the outcome and a science-based emissions reduction target.

Source: Gundlach J, Minsk R, and Kaufman N. "Interactions between a Federal Carbon Tax and Other Climate Policies." Columbia University Center on Global Energy Policy. March 2019.

By implementing a comprehensive suite of climate polices, including carbon prices that are designed for consistency with emissions targets[33], the United States can put itself on a pathway to deep decarbonization while meeting the growing demands on its energy system and lands and maintaining a thriving economy.[34]

Conclusion

I want to applaud the Committee for taking on the challenge of crafting a strategy to build a 100% clean economy. It is the quintessential role of government to protect Americans from the harmful consequences of greenhouse gas emissions. However, as I learned when I helped to develop the United States Mid Century Strategy for Deep Decarbonization, the scope of this problem can make the task seem overwhelming. You have hundreds of decisions to make, and you will hear strong opinions about every single one.

My advice is, don't let the complexity distract you from the actions that can move the needle.

Let's establish an incentive to reduce net emissions across the entire economy. Let's develop low-carbon solutions and enable them to compete on a level playing field. Let's protect American families and businesses that cannot afford price increases, and let's support coal communities.

With that, I look forward to your comments and questions.

Notes

1. Matthews H. and Zickfeld K. 2012. "Climate response to zeroed emissions of greenhouse gases and aerosols." Nature Climate Change 2, 338–341. doi:10.1038/nclimate1424.

2. United States Department of Energy. "Energy CO_2 Emissions Impacts of Clean Energy Technology Innovation and Policy". January 2017. https://www.energy.gov/sites/prod/files/2017/01/f34/Energy%20CO2%20Emissions%20Impacts%20of%20Clean%20Energy%20Technology%20Innovation%20and%20Policy.pdf.

3. Bordoff, J. "Getting Real About the Green New Deal". Democracy. March 25, 2019. https://energypolicy.columbia.edu/research/article/getting-real-about-green-new-deal.

4. Kaufman N, Obeiter M, & Krause E. "Putting a Price on Carbon: Reducing Emissions." World Resources Institute. January 2016. https://wriorg.s3.amazonaws.com/s3fs-public/Putting_a_Price_on_Carbon_Emissions.pdf.

5. Kaufman N. & Gordon K. "The Energy, Economic & Emissions Impacts of a Federal US Carbon Tax." Columbia University Center on Global Energy Policy. July 2018. https://energypolicy.columbia.edu/sites/default/files/pictures/CGEP_SummaryOfCarbonTaxModeling.pdf.

6. Ibid.

7. Barron A, Fawcett A, Hafstead M, McFarland J, & Morris A. "Policy Insights from the EMF 32 Study on US Carbon Tax Scenarios. Climate Change Economics", Vol. 9, No. 1 (2018).

https://www.worldscientific.com/doi/abs/10.1142/S2010007818400031.

8. There are two primary methods of pricing carbon: carbon taxes and cap-and-trade programs. Carbon taxes directly establish a price on carbon in dollars per ton of emissions. A cap-and-trade program limits the total quantity of emissions per year. This limit is enforced using tradable emissions permits that any emissions source must own to cover its emissions. The market for buying and selling these allowances creates the carbon price in a cap-and-trade program. Real-world policies often combine elements carbon taxes and cap-and-trade programs, therefore ensuring some degree of certainty for future emissions outcomes and carbon prices.

9. See page 4 of: Caron J, Cole J, Goettle J, Onda C, McFarland J, & Woollacott J. 2018. "Distributional implications of a national CO_2 tax in the U.S. across income classes and regions: A multi-model overview." Climate Change Economics, 9(1), 1840004. Also, see page 15 of: Kaufman N, Larsen J, Mohan S, Herndon W, Marsters P, Diamond J, & Zodrow G. "Emissions, Energy, and Economic Implications of the Curbelo Carbon Tax Proposal." Columbia University Center on Global Energy Policy. Working Paper. July 2018. https://energypolicy.columbia.edu/sites/default/files/pictures/CGEP_CurbeloCarbonTaxBillAnalysis_0.pdf.

10. Press release from Senator Chris Coons. "Sens. Coons and Feinstein, Rep. Panetta introduce bill to price carbon pollution, invest in infrastructure, R&D, and working families." July 25, 2019. https://www.coons.senate.gov/news/press-releases/sens-coons-and-feinstein-rep-panetta-introduce-bill-to-price-carbon-pollution-invest-in-infrastructure-randd-and-working-families.

11. Kaufman N, Larsen J, Marsters P, Kolus H & Mohan S. "An Assessment of the Energy Innovation and Carbon Dividend Act." Columbia University Center on Global Energy Policy. November 2019. https://energypolicy.columbia.edu/sites/default/files/file-uploads/EICDA_CGEP-Report.pdf.

12. Prominent recent examples include the "Yellow Vests" protests in France and the protests in Ecuador following the proposed ending of certain government fuel subsidies.

13. The only major political party in Canada to oppose carbon pricing in advance of the 2019 election was the Conservatives, receiving 34 percent of the vote.

14. The White House. "United States Mid-Century Strategy for Deep Decarbonization." November 2016. https://unfccc.int/files/focus/long-term_strategies/application/pdf/mid_century_strategy_report-final_red.pdf.

15. What You Need to Know About a Federal Carbon Tax in the United States." Columbia University Center on Global Energy Policy. October 2019. https://energypolicy.columbia.edu/what-you-need-know-about-federal-carbon-tax-united-states.

16. Gray, W. B., and G. E. Metcalf (2017): "Carbon Tax Competitiveness Concerns: Assessing a Best Practices Income Tax Credit," National Tax Journal, 70(2), 447–468.

17. Kaufman N and Krause E. 2016. "Putting a Price on Carbon: Ensuring Equity." World

Resources Institute. April 2016. https://wriorg.s3.amazonaws.com/s3fs-public/Putting_a_Price_on_Carbon_Ensuring_Equity.pdf.

18. Morris A, Kaufman N & Doshi S. "The Risk of Fiscal Collapse in Coal-Reliant Communities." Columbia University Center on Global Energy Policy. July 2019. https://energypolicy.columbia.edu/sites/default/files/file-uploads/RiskofFiscalCollapseinCoalReliantCommunities-CGEP_Report_080619.pdf.

19. In 2016, there were 64,200 premature deaths in the U.S. due to ambient particulate matter (PM2.5) air pollution, of which 8,600 were due to coal combustion. Impacts are largests on minorities and low-income households. See: Lancet 2019; 394: 1836–78. https://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(19)32596-6.pdf.

20. Stock, JH. Testimony to the United States House Committee on Natural Resources, Subcommittee on Energy and Mineral Resources, hearing on "The Future of the Federal Coal Program." July 2019. https://scholar.harvard.edu/files/stock/files/written_statement_stock_future_of_federal_coal_071119_01.pdf.

21. Morris A, Kaufman N & Doshi S. "The Risk of Fiscal Collapse in Coal-Reliant Communities." Columbia University Center on Global Energy Policy. July 2019. https://energypolicy.columbia.edu/sites/default/files/file-uploads/RiskofFiscalCollapseinCoalReliantCommunities-CGEP_Report_080619.pdf.

22. U.S. Energy Information Administration. "Annual Coal Report." October 3, 2019. https://www.eia.gov/coal/annual/.

23. Morris A, Kaufman N & Doshi S. "The Risk of Fiscal Collapse in Coal-Reliant Communities." Columbia University Center on Global Energy Policy. July 2019. https://energypolicy.columbia.edu/sites/default/files/file-uploads/RiskofFiscalCollapseinCoalReliantCommunities-CGEP_Report_080619.pdf.

24. Houser T, Bordoff J, and Marsters P. "Can Coal Make a Comeback?" Columbia University Center on Global Energy Policy. April 2017. https://energypolicy.columbia.edu/sites/default/files/Center%20on%20Global%20Energy%20Policy%20Can%20Coal%20Make%20a%20Comeback%20April%202017.pdf.

25. Gundlach J, Minsk R, and Kaufman N. "Interactions between a Federal Carbon Tax and Other Climate Policies." Columbia University Center on Global Energy Policy. March 2019.

26. Friedmanm J, Fan Z, and Tang K. "Low Carbon Heat Solutions for Heavy Industry: Sources, Options, and Costs Today." Columbia University Center on Global Energy Policy. October 2019.

27. Kaufman N, Krause E, and Desousa K. "Achieving U.S. Emissions Targets with a Carbon Tax." World Resources Institute. June 2018. https://wriorg.s3.amazonaws.com/s3fs-public/us-emission-targets-with-carbon-tax.pdf.

28. Sivaram V and Kaufman N. "The Next Generation of Federal Clean Electricity Tax Credits."

Columbia University Center on Global Energy Policy. June 2019. https://energypolicy.columbia.edu/sites/default/files/file-uploads/NextGenTaxCredits_CGEP_Commentary_Final.pdf.

29. Kaufman N, Krause E, and Desousa K. "Achieving U.S. Emissions Targets with a Carbon Tax." World Resources Institute. June 2018. https://wriorg.s3.amazonaws.com/s3fs-public/us-emission-targets-with-carbon-tax.pdf.

30. Ibid.

31. The White House. "United States Mid-Century Strategy for Deep Decarbonization." November 2016. https://unfccc.int/files/focus/long-term_strategies/application/pdf/mid_century_strategy_report-final_red.pdf. See Chapter 5.

32. Gundlach J, Minsk R, and Kaufman N. "Interactions between a Federal Carbon Tax and Other Climate Policies." Columbia University Center on Global Energy Policy. March 2019.

33. Kaufman N. "Alternatives to the Social Cost of Carbon in Taxes and Subsidies." Columbia University Center on Global Energy Policy. June 2018.

34. The White House. "United States Mid-Century Strategy for Deep Decarbonization." November 2016. https://unfccc.int/files/focus/long-term_strategies/application/pdf/mid_century_strategy_report-final_red.pdf.

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