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11 essential questions for designing a policy to price carbon

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Economists widely advocate establishing a price on carbon as a central means of reducing greenhouse gas emissions and the risks of global climatic disruption and ocean acidification. To be sure, a price on carbon is necessarily one part of a broader climate policy portfolio that includes diplomatic engagement, research, investments in adapting to a changing climate, assistance for vulnerable populations, and other aspects of the challenge.

But because market forces can be powerful and efficient agents for change, a policy to price carbon is arguably an indispensable part of the solution. Here we focus on one way to price carbon: through a tax or fee.

When it comes to developing an actual policy, a host of devilish details arise. Any carbon levy legislation would have to address a number of key design decisions—and serious tradeoffs arise across nearly all of them. How, for example, would the policy balance giving certainty to firms that make long-term investments, but still allow for updates as information, technology, and outcomes evolve?

What follows are eleven essential design questions to consider when designing a carbon charge. Each question has several potential answers with their own considerations, pro and con (recognizing that one person's pro can be another person's con). To inform your own thoughts on how a price on carbon should work, imagine you are a policymaker and think through how you would address each of the following questions. The goal here is to elucidate at a high level the options for carbon pricing policy design, not to build the case for a carbon price itself or quantify the benefits or costs of specific approaches. The hyperlinks will take you to further reading, but are not necessarily endorsements.

Click on a question below to jump to its discussion:

1. What is the name of the carbon pricing policy?

Here we're talking about a policy that economists typically call a carbon tax. This is shorthand; the tax is based on tons of carbon dioxide (CO_2) and might cover non-CO_2 greenhouse gases (such as methane, nitrous oxide, and certain industrial gases) as well, for example at a rate weighted by the global warming potential of each gas relative to CO_2. Acap-and-trade or hybrid program can also impose a price on carbon emissions, but here we are focusing on the design of policy that sets a carbon price rather than an emissions quantity, recognizing that the various approaches can be designed to be similar in practice.

"Tax" is the term economists apply to most revenue instruments. Because imposing a new tax is potentially politically fraught, some people advocate calling a carbon pricing policy something besides a tax, such as a fee, levy, charge (PDF), or adder. Some would advocate referring not to carbon, but to climate pollution or some other term for greenhouse gas emissions. The best label is a judgement call; a variety of terms will appear here, but they all refer to the same thing.

A few points about using "tax" as a descriptor:

- Most existing state and federal fuel charges (e.g., on transportation fuels and coal) are called excise taxes, i.e. taxes like cigarette and alcohol taxes that apply on goods based on their volume or quantities, not their price.
- "Tax" is the legal term that applies to most collections by the U.S. Treasury's Internal Revenue Service (IRS). The IRS also collects "user fees" for services it provides, such as making special determinations like whether a specific employer's retirement plan meets IRS requirements.

Pros and cons of referring to the policy as a tax:

- A term other than tax may improve the appeal of the policy and make it easier for policymakers to vote for it.
- However, using a term other than tax could prompt charges of trying to hide the fact that the policy is functionally equivalent to a tax.
- Calling the policy a "tax" may be more attractive if it is part of a tax shift or swap, meaning at least some of the revenue is used to reduce other taxes.

Finally, the terms "penalty" and “fine” have unique considerations. For one thing, they carry the inaccurate connotation of emitters being in violation of the rules; when the IRS imposes penalties, it’s because someone underpaid their taxes. Also, fines and penalties are not typically deductible against business income.

2. What greenhouse gas (GHG) sources and gases does it cover?

Every tax needs a base to which it applies. Most obvious would be carbon dioxide. CO2 is known to contribute to climatic disruption and ocean acidification: it accounts for around 81 percent of all U.S. GHG emissions from human activities (PDF); 76 percent of total U.S. GHG emissions are CO2 from fossil fuel combustion. Since not all fossil fuels have the same carbon intensity, a levy on their carbon (either the carbon content before combustion or the carbon dioxide in their combustion gases) would raise the relative price of fossil fuels in proportion to their propensity to disrupt the climate. For example, natural gas has about half the carbon per unit of energy than coal. Renewables and nuclear power don’t emit carbon, so those energy sources would not be taxed. Some sources of non-fossil CO2 (for example from cement production) and some non-CO2 gases (such as landfill and coal bed methane emissions) may be feasible to tax. Including small sources expands the administrative burden, so it may be worth establishing some emissions threshold below which emissions are not subject to the charge.

All else equal, the more greenhouse gases and sources that are subject to the price, the greater the emissions reductions it will produce. Broad coverage also equalizes marginal incentives for abatement (the cost of that last ton of emissions reduced) across the economy. This ensures that investment in emissions abatement goes to the least-cost strategies and can lower the overall cost of achieving any particular emissions goal. It also incentivizes technology development across a wide range of emissions-reducing applications. However, for any given carbon price, broader coverage raises the scope of the macroeconomic impacts of the tax.

Policymakers could limit the pricing policy to certain sectors. For example, if a regulatory approach such as the Clean Power Plan covers the electricity sector, then policymakers could control emissions in other sectors with a fee. Likewise, if policymakers want a supplement or replacement for the tax on gasoline, they could impose a carbon tax only on diesel fuel and gasoline. This approach would produce less abatement and revenue than a GHG levy with broader coverage. It would also result in inefficient disparities in abatement incentives across sectors and may neglect opportunities for cost-effective environmental benefits.

Managing carbon fluxes from terrestrial ecosystems, such as agricultural soils and industrial forests, will be important to stabilizing GHG concentrations. Some of these carbon stock changes could be included under a carbon pricing policy, but doing so would involve policy design issues unique to these sectors, like figuring out how and whether to give credit for carbon stored in forests that may burn down later. In some cases, it may be better to use policy options other than carbon pricing for these sectors.

3. What's the initial price and how does it change over time?

The starting rate and trajectory of the price are integral to the outcomes of the policy. All else equal, research shows that higher carbon prices will produce greater economic burdens but higher emissions abatement than lower carbon prices.

Not all sectors will respond at the same speed. For example, abatement is likely to come more slowly in the transport sector than the electricity sector, owing to the greater availability of low-cost, low-carbon technologies for power generation than for transport.

A carbon price that stays constant will reduce emissions for a time, but eventually emissions will probably start going up again owing to economic growth. Emissions will be still lower than they would have been without the policy, but they won't necessarily keep going down. Accordingly, most economists would advocate a carbon price trajectory that goes up over time at a pace that encourages continued abatement even as the economy grows.

There's a limit to how high the price can go and still encourage additional abatement. Carbon prices that are controversially high (however that is interpreted) can raise the risk that Congress will amend or repeal the policy. If investors believe the future price might be reduced, expected carbon prices could fall significantly below the statutory price and investors would pursue less abatement than they would if they thought the statutory price path would remain intact.

Options for setting a carbon price path and their pros and cons:

1. Congress could set a carbon fee equal to the present value of the environmental and social damages produced by each additional ton of CO2 emissions (or the equivalent in other GHGs), a value called the social cost of carbon (SCC).

- In theory, setting the tax path at the SCC would equate marginal damages to marginal costs and ensure that the abatement costs are justified by the benefits.
- The White House has adopted an estimate of the SCC for federal agencies (PDF) to use in analyzing the costs and benefits of regulations and other policies that affect GHG emissions. The SCC grows gradually over time in real terms. Congress could use this set of values to set the trajectory of the tax.
- In practice, using the SCC may have drawbacks. That's because the estimated SCC is really a range of values that depend heavily on the discount rate, the appropriate value of which is much disputed. The SCC also involves large uncertainties and depends on judgements like whether to count just benefits to the United States or global benefits. It is also subject to sharp revision as new analyses become available. Also, the SCC adopted by the White House, however analytically developed, is ultimately controlled by the Executive branch. Congress may wish to control more directly the carbon price trajectory.

2. Another option is to establish a formula for the tax rate that evolves over time, for example with a specified initial value and change each year, such as a percent increase over inflation or an increase of $X per year.

- This would have the advantage of providing clear information for businesses and households that make long-term capital decisions and investments in new technology. It would also be relatively easy to administer, parties could reliably project their tax liabilities, and budget authorities could straightforwardly score the pending revenue.
- Without other policy measures or adjustments, this approach would not guarantee a particular emissions outcome. This could complicate ensuring compliance with aninternational pledge that is framed in emissions levels in a particular year.
- A formula like this would not take into account important developments, such as new evidence on the SCC, evolving climate pledges by the United States or other countries, macroeconomic conditions, and other outcomes that are important to stakeholders. This suggests some kind of periodic review and/or revision of the price trajectory would be warranted—more on that below.
- If the escalation is not capped at some point, the carbon price may become politically unsustainable or exceed estimates of the benefits of abatement.

3. An ambitious start and/or rapid increase would reduce emissions more quickly and spur technology development and deployment more sharply by increasing the returns to low carbon investments.

- It would also raise more revenue in the short run, which could help jump start whatever goals the revenue is meant to pursue. An ambitious start or rapid increase could also ensure that the environmental performance of the policy quickly surpasses the regulatory alternative.
- An ambitious start would create a bigger jump in fossil energy prices, which may galvanize opposition to the policy even as it motivates change. It would rapidly make some existing capital (like power plants or industrial facilities) uneconomic.

4. A modest start and gradual increase would allow businesses and households time to adjust their activities and lower their tax burdens.

- A gradual start and ramp up would impose lower abatement costs and help some companies preserve their international competitiveness. It would allow U.S. diplomats time to coordinate carbon pricing policies with other countries before the prices become more ambitious.
- It would also provide modest near-term climate benefits, particularly in sectors like transportation in which low-carbon alternatives are currently relatively costly.
- This approach may also make it harder to achieve deep decarbonization targets by mid-century. For example, a low carbon price may not prevent the irreversible decommissioning of higher-cost nuclear power that may be important for longer-term deeper decarbonization.
- A gradual price increase raises the probability that investors deploy lower—but not zero—carbon technologies like natural gas at greater scale. This could achieve modest climate goals cost effectively but may turn out to be uneconomic if climate policy becomes more stringent later.
- Even a modest carbon fee that rises slowly can raise enough revenue to lower other taxes, the deficit, or accomplish other fiscal goals. For example, according to CBO (see option 35 on page 176), a greenhouse gas tax that starts at $25/ton CO2-equivalent could raise over $1 trillion in the first 10 years.

5. Tying the carbon price to other tax changes (or vice versa) could help ensure the tax shift is revenue neutral, meaning that the policy package does not increase or decrease overall revenues to the federal government.

- This can be attractive to stakeholders who wish to ensure that the policy does not grow government.
- Ensuring exact revenue neutrality each year may lead to fluctuations in the carbon price or rates on other taxes that complicate the administration of the program and raise uncertainty for private sector investment decisions. The approach in British Columbia suggests that some such linkages are feasible.

Especially over the long run, it's hard to predict how emissions levels and other outcomes will respond to any particular carbon price trajectory, even one in which the real price on carbon increases predictably each year. Thus it may make sense to build in a regular review of relevant information and plan for orderly updates to the carbon price trajectory (or other policies) depending on how things turn out. Any process for updating the carbon price path would introduce uncertainty for investors. Some would end up making abatement choices or undertaking R&D projects that turn out to be ill-suited to the revised policy. Thus, the updating question involves balancing the benefits of taking into account new information in policy-setting and the costs of any uncertainty introduced into investment incentives. This is probably one of the most difficult issues in the design of a carbon price policy.

Considerations regarding the process of revising the carbon price path

Some stakeholders focus on ensuring that emissions outcomes move towards a particular annual or cumulative goal. For example, what happens if the carbon tax isn't producing emissions levels consistent with achieving the United States' international commitments? Is there some process by which the tax path is increased, or is there some other policy approach that kicks in? Some stakeholders may be especially concerned about this question if the carbon pricing legislation repeals, suspends, or otherwise reduces EPA's authority to regulate GHGs via the Clean Air Act (see question #7). They want to be sure that down the road that the tradeoff was a good deal for the climate. Certainly, if the president and Congress agree, they can legislatively change the carbon pricing policy at any time. But this is likely a heavy political lift and provides little reassurance to those most worried about emissions outcomes.

Congress could delegate the updating of the tax to the Executive Branch or a third party, such as an expert panel, with guidelines on the objectives they should pursue. However, Congress generally eschews delegating tax rates, and in some cases certain legal issues arise if Congress delegates significant matters. A number of other approaches, short of delegation, could inform or prompt changes in the carbon price path, including expert reviews, fast track authority, and automatic carbon price updates. It makes sense to conduct reviews of the carbon price every few years, for example to coincide with 5-year rounds of commitments under the UN Framework Convention on Climate Change (UNFCCC). Alternatively, the policy could trigger reviews in specific circumstances, such as hitting or not hitting certain emissions outcomes.

Policymakers could set a quantitative relationship between the carbon tax rate and the emissions outcomes, for example to raise the tax or its growth rate if emissions are higher

than expected. This would encourage more certain emissions outcomes and boost support for the policy amongst some stakeholders. However, it might complicate the Congressional negotiations around a carbon price bill because not only would legislators have to agree on a tax path, they'd have to agree on the update process and any potential emissions targets or triggers that are embedded in it. Making updates infrequent and setting new tax values years in advance may simplify the administration of the policy and give more certainty to investors. If prospective increases are large, emitters might hasten their activities to take advantage of lower near-term tax rates. Using cumulative emissions rather than annual emissions would make adjustments less volatile.

Another approach could link emissions outcomes to amendments to other policies, such as regulatory authority (see question #7) or how the revenue is used (question #6). For example, if emissions are higher than expected, so are revenues. Policymakers could target the extra revenue towards further emissions abatement, such as a reverse auction for emissions reductions, incentive payments for soil or forest carbon sequestration, or international funds, such as the Green Climate Fund.

In theory, an updating process could also result in a lower fee trajectory, for example if the process allows taking into account factors such as: economic outcomes are worse than expected; new technologies can decarbonize the economy at unexpectedly low cost, so a big tax isn't necessary; or new scientific evidence suggests climate change is less damaging than previously thought. A policy design that can raise OR lower carbon prices introduces another dimension of uncertainty for investors. This could dampen investments in lower carbon technologies that would only find a market at higher carbon prices.

4. Who pays the carbon charge?

Any carbon pricing policy has to identify a particular set of actors who would be responsible for paying the charge. For example, the charge could apply to producers, processors, or distributors of fossil fuels, or it could apply to those who actually burn the fuels, such as power plants and industrial facilities – or even individuals when they put gasoline in their cars. We call this the point of taxation. In general, the economic outcomes don't depend on which entities pay the levy to the government. Taxed firms will pass costs along to suppliers, consumers, and workers to the extent they can through prices and wages.

Pros and cons of different points of taxation:

- Each fuel has a different chain of supply, so there are different points at which the government could impose the carbon charge. Applying the charge at the chokepoint of each fuel's distribution system would minimize the number of taxpayers and maximize the coverage of the policy. However, it may then be appropriate to give credits to downstream firms in cases where the carbon doesn't end up in the atmosphere (see question #10). A chokepoint approach would not work as well if certain downstream sectors are exempt from the tax. For natural gas and petroleum, the chokepoint of the distribution system may closer to midstream (at processing and refining facilities) than upstream at wellheads. The Congressional Research Service estimates (PDF) that the levy could apply to fewer than 2,300 entities and yet cover 80 percent of U.S. domestic GHG emissions.

- An upstream charge imposes the price at the start of the fossil energy distribution system, such as at the coal mine mouth, natural gas wellheads, oil wells, and international borders. The carbon content of coal per ton produced can vary a lot across different coal deposits, as may the carbon content of oil. Thus, a well-targeted upstream approach would need to keep track of the differences and apply the appropriate fee.
- To fully cover GHG emissions in the fossil fuel supply chain, emissions in the fuel production process, for example natural gas flaring and venting should be taxed as well.
- A mid- to downstream approach would price fossil carbon at power plants and other large industrial facilities. This could build on EPA's GHG reporting system for large stationary sources. It could also allow emissions to be measured by continuous emissions monitoring (CEM) equipment that these facilities use to comply with existing pollution regulations. However, in some co-firing facilities, the CEM approach might make it hard to distinguish CO2 emissions from fossil fuels and those that derive from biomass (which may not be subject to the carbon charge) in the fuel supply.
- A fully downstream approach, such as carbon-based surcharges on household natural gas bills, would make the price signal more obvious to consumers– what economists call saliency. This could be more environmentally effective if it makes people pay more attention to (and reduce) their energy consumption, but regular reminders of the tax might also engender more opposition. The value of tax salience at the household level may be limited because many of the most significant emissions reduction strategies are further upstream, such as in the fuel choice for electricity generation. Downstream approaches could involve vastly more taxpayers and may exclude relatively small emitters.

5. Who collects the revenue?

The legislation must give authority to collect the tax or fee to a specific federal agency. The most likely candidates would be the U.S. Treasury and the Environmental Protection Agency (EPA).

The U.S. Treasury currently collects several federal fuel-related excise taxes, including a tax on most coal produced in the United States (PDF) that funds the Black Lung Disability Trust Fund. The agency has deep expertise in collecting and managing large flows of funds. It would be the logical collection authority for any policy labeled a tax, although Treasury could do the job even if the label is something other than tax.

The EPA collects emissions data from large emitters and enforces limits on those emissions. For example, EPA could collect GHG fees from the sources the agency already regulates (see question #4). Even a modest carbon charge would produce far more revenue than EPA has ever handled, and giving EPA what amounts to taxing authority (even if the policy is labeled a fee) would be opposed by some stakeholders.

6. What happens to the revenue?

One of the biggest challenges of designing a carbon charge is working out what to do with the revenue. This question has big implications for its political appeal, distributional outcomes, and overall net benefits of the policy. (Some ways to price carbon, like a cap-and-trade program that gives away free allowances or a hybrid program, wouldn't involve

the government collecting revenue, but they would involve resource allocations with similar underlying implications.)

Assuming we are in the mode of designing a tax-like policy, policymakers can pursue at least three alternative policy goals (PDF) with the considerable revenue from the tax:

1. **Offset the new burdens that a carbon price places on consumers, producers, communities, and the broader economy**
2. **Support further efforts to reduce greenhouse gas emissions or build resilience to climatic disruption**
3. **Fund priorities unrelated to climate**

Each of these approaches has strengths and weakness, and important tradeoffs across different goals arise. One of the most important aspects of this question (although it's not easy to predict) is how the use of revenue affects the potential for a legislative deal and, after that, the political durability of the program. Climatic disruption and ocean acidification are challenges that will span generations, so the long-term persistence of the carbon price is critical. Many emissions-reducing investments involve large expenditures on long-lived capital, such as power plants and industrial facilities. A carbon pricing policy that businesses and individuals believe will endure will be more environmentally successful and more economically efficient than one that people think may not survive the next election or recession.

Requiring strict revenue neutrality, meaning that all the revenue is devoted to rebates or tax cuts, may appeal to people who don't want climate policy to grow the overall size of the federal government. It also has downsides. Some policy goals, such as assistance to displaced coal workers, could be better pursued by spending the money directly, rather than indirectly through the tax system.

Here some the advantages and disadvantages of different ways to use the revenue:

1. Offset economic burdens.

The economic outcomes of a carbon tax (not counting the economic implications of lower emissions) fall broadly into three categories. Economic effects will depend on whether the carbon levy replaces or supplements other climate policies (see question #7), and the effects can vary by region (for example, because the carbon intensity of electricity and driving patterns vary), by socioeconomic status, and other factors.

- The first category of economic effects is the direct incidence of the fee on people in their roles as consumers, workers, and shareholders. If energy prices go up, the things people buy may be more expensive. That's probably the dominant effect, but some burden could fall on workers and capital income. For example, people who work for a coal company or live in a town that relies on the coal industry may receive lower wages or lose their job. Shareholders of fossil-intensive businesses may see their capital gains and dividend income fall.
- The second category results from all the shifts in economic activity caused by the new relative prices. Savings and investment will change, as will the value of the dollar and the pattern of international trade. We call these the macroeconomic outcomes.

- The third category results from what happens to the revenue. The economic literature shows that how the revenue is used is important to both the distributional consequences of the program (who the tax impacts, by income level and other demographics) and the macroeconomic outcomes. For example, the outcome for any one individual or the economy as a whole would be different if all the revenue goes back to households in equal rebates than if the government uses the revenue on infrastructure or to fund reductions in other taxes.

  In general, lower-income households spend a higher percentage of their income on energy and other goods whose prices would go up under a carbon tax. Economic modeling also suggests that some of the greatest impacts of a carbon price will be on the coal industry, leading to a sharp decline in coal production and consumption. Carbon tax revenue could soften the burden on lower-income households and coal workers and their communities. Doing so will require may a small fraction of carbon tax revenue (20 percent or less, depending on the definition of low income and how much revenue there is), leaving substantial resources for other purposes.

  Revenues could go directly to reducing energy bills. This would have the advantage of directly offsetting the tax embodied in energy prices, but it would blunt incentives to reduce energy consumption, an important channel of emissions reductions. It also wouldn't compensate people for burdens embodied in prices of other goods and services, which is where a significant portion of the tax incidence will end up.

  Recycling revenue into broader cuts in payroll, personal, and business taxes can help offset the economic burden of the carbon tax and facilitate pro-growth tax reforms. Some studies suggest that a well-designed tax swap could substantially offset the macroeconomic costs of the carbon price -- maybe even more than offset it. However, since most taxes are paid by relatively well-off people, a tax swap can combine a regressive excise tax with a regressive tax cut.

  A more progressive approach would use the revenue for direct rebates to households. If rebates are divided equally (adjusted for household size), then most people, especially poor households, would be even better off than before the carbon tax. That's because, even though their carbon fee burden is a relatively smaller share of their overall income, higher income people pay more in absolute terms and the revenue would be redistributed across all household. Rebates (a.k.a. dividends) may improve the attractiveness and durability of the program as people receive tangible benefits, even as they experience higher energy prices.

  One downside of rebates, though, is they don't do anything to reduce the macroeconomic costs of the existing revenue system; the carbon tax just makes it worse. Thus, in most studies, the estimated aggregate GDP and welfare costs of a fee and dividend approach tend to be worse than for the tax swap options. Also, unlike other approaches, dividends require keeping track of individual recipients, establishing their eligibility, and making regular payments.

2. Pursue more emissions abatement and build resilience.

Some people tend to think a carbon charge would be a kind of fee-for-service, meaning that the revenue should pay for emissions reductions or other environmental improvements. In fact, that's how some of the current carbon pricing policies in the United States work. Someevidence suggests that this spending has contributed to the environmental benefits of existing cap-and-trade programs, in part because the carbon price signals have been relatively low.

However, the potential to fund emissions reductions is not why economists emphasize the importance of a price on carbon. Rather, they see the tax itself (provided it is meaningful in magnitude) as the main driver of abatement; it changes the relative price of fuels so that lower carbon options become relatively more attractive than their carbon-intensive alternatives. The new relative prices also improve the prospective returns to new low-carbon technology. Thus, market forces, not the revenue, are the key to the carbon pricing policy's environmental outcomes. Moreover, if policymakers are unsatisfied with the pace of clean energy adoption or emissions reductions, research suggests it is generally far more efficient to raise the carbon price than to subsidize alternatives.

A modest carbon price path could bring in over $1 trillion in the first decade (for a score of an illustrative carbon tax, see CBO's deficit reduction option #35 here) and more after that. That's more than Congress would ever appropriate for clean energy or other climate-related spending, and probably more than could be spent wisely, especially to the extent the revenue ends up compensating people for what they'd do anyway or inducing them to do things that cost more than the social cost of carbon.

That said, there's a case for spending to fill gaps—reducing emissions the tax may miss or reducing the potential damages of extreme weather events, sea level rise, or oceanic acidification. Some emissions aren't suitable for taxing (see question #2), so for those, otherincentives may be warranted. The challenge would be to avoid overspending on any one line item, deploying resources inefficiently, and fueling concerns that the carbon fee would become a slush fund for politicians' pet projects—thus undermining its political durability.

Since there is no particular connection between the amount of revenue a carbon tax raises and the appropriate level of spending on R&D, adaptation, or other climate goals, earmarking, say, a certain percentage of the revenue for such purposes would not necessarily make fiscal sense. Likewise, from a fiscal policy standpoint, it would be wise to ensure the benefits of climate-related spending are at least as high as other ways the revenue could be used. On the other hand, if emissions levels turn out to be higher than expected, one option would be to channel extra revenue to emissions-abating or resilience-building activities (see question #3).

3. Fund priorities unrelated to climate.

Policymakers have any number of other options for using the revenue provided they can agree. For example, the United States faces a large projected budget deficit. Using carbon tax revenue to lower the deficit and the resulting debt could prevent cuts in Social Security and other popular benefits, an increase in other taxes, or the accumulation of debts that cause problems down the road. Indeed, using carbon tax revenue to reduce the deficit could be one of the most fiscally responsible options. The challenge, though, is that at the

moment, interest rates are very low, so the carrying cost of new debt is also low; thus, few policymakers are focused on the issue. Plus, some stakeholders are skeptical that new revenues would really go one-for-one into deficit reduction; unless the money is spoken for by rebates or tax cuts, they believe the revenue would grow federal spending.

Another option would be to use the revenue for spending both parties agree on. One approach would be to bolster spending on infrastructure, for example to compensate for the real declines in funds going to the highway trust fund. Some infrastructure investments mightboost economic growth, and some might not.

Yet another approach would be for the federal government to rebate the revenues back to states and let them decide what their needs are. The challenge there would be to design an apportionment formula; even while policymakers like the idea in principle, they may have a hard time dividing the pie in practice.

7. Does it change other federal climate and energy policies, and if so how?

Existing federal policies that seek to reduce GHG emissions include energy-efficiency standards, fuel economy standards, subsidies for renewable electricity and electric vehicles, and biofuel mandates. Under its Clean Air Act (CAA) authority, the EPA is implementing the Clean Power Plan to control CO2 emissions from the electricity sector. Similar rules for other sectors could follow, which begs the question: if Congress adopts a new carbon pricing policy, what should happen to all those other programs?

Different people come to very different conclusions on this and there are reasonable arguments on both sides. A price on carbon can reduce the net benefits of other policies to reduce GHG emissions by paying people to do things they would do anyway or lowering the use of energy that is clean as a result of the tax, for example. Some would argue that if electricity prices reflect the environmental damages associated with electricity production and consumers have good information about the energy use of the products they buy, then why shouldn't consumers (rather than federal agencies) decide what products best serve their needs?

On the other hand, the carbon price may not be high enough to encourage all abatement that is justified by the SCC. It might not spur new technology that will be needed in deeper decarbonization scenarios, and the pricing strategy may not address all of the market failures involved in the climate challenge. For example, even with a price on carbon, the private sector is likely to undersupply basic research and development on energy-efficient and low-carbon technologies; imposing a carbon price doesn't build an economic case for repealing basic research programs. Moreover, a regulatory approach like the Clean Power Plan could be a backstop if the carbon price turns out to be less effective than expected and Congress doesn't update the price path (see question #3). Politically, some kind of policy trade may be necessary to pass a carbon tax, but at this point it is far from clear what form that might deal might take. Here we consider some options.

Pros and cons of different options for changing (or not) other federal climate and energy policies:

We begin with the opposite extreme approaches, both of which would be vigorously opposed by key stakeholders. Thus they are more illustrative than plausible scenarios.

- First, policymakers could preserve all other climate and energy policies and add the carbon fee to them. If the goal is to maximize emissions abatement without regard to policies' cost effectiveness, then a carbon fee could supplement all of those other measures. In some cases, a carbon price of sufficient magnitude would make other regulations redundant. For example, estimates suggest that a price of $30 per ton of CO2 or more by 2030 (PDF) would exceed the ambition reflected in the Clean Power Plan targets (see the map on page 18 in the linked document). In others, the carbon price makes regulations easier to achieve. For example, higher gasoline prices create greater demand for fuel efficient vehicles and thus help steer market conditions towards compliance with tightening corporate average fuel economy standards. A downside of layering price and regulatory measures is that it preserves policies that create costly distortions across abatement opportunities (like different standards in different states and sectors) that raise the cost of a given emissions target or provide few environmental benefits. For example, there may little abatement value-added in subsidizing new solar panels in areas in which the grid is already decarbonized.
- Alternatively, policymakers could dismantle or amend the preponderance of other relevant climate and energy policies. For example, the legislation could permanently preempt EPA's authority to regulate GHGs under the Clean Air Act. The Department of Energy could convert its energy efficiency standards for appliances, light bulbs, and industrial coolers and freezers into labeling requirements. With a carbon tax administered by the IRS, EPA could also reduce its mandatory GHG emissions reporting. In addition, because the tax promotes the market for energy efficient vehicles and induces less driving, Congress could repeal the 2005 Renewable Fuel Standard. In theory, the administration also could scale back fuel economy standards for passenger cars and light-duty trucks, but that is likely infeasible since the federal standards arise in part from automakers' interest in avoiding multiple state-level standards.

The middle ground between these two extremes is large indeed. Describing all the potential compromises is beyond our scope here and is actually a fruitful area for new research. A few basic options come to mind:

- Suspend development of new GHG regulations under the Clean Air Act, but allow the Clean Power Plan to stand.
- Deem states and sources to be compliant by default with the Clean Power Plan through a certain date, even if they take no action. If, after that date, emissions have not fallen to a specific level, restore the requirements for state implementation plans to achieve state-specific targets.
- Preempt some rules and preserve others. For example, Congress could revoke the Clean Power Plan but retain fuel economy standards.
- Don't revoke tax credits for clean energy, but let them expire at the existing statutory date.
- Phase out existing regulations if the carbon price shows results.
- Phase in new regulatory authority if the carbon tax doesn't show results.

8. Does it constrain state-level policies?

One environmental advantage of a federal carbon tax over an otherwise equivalent cap-and-trade system is that in a tax context, sub-federal climate policies are more likely to produce additional abatement. That's because in a national cap-and-trade world, if a state adopts more stringent rules, it simply frees up emissions allowances that can be used in other states. In contrast, a federal carbon tax incentivizes abatement nationwide up to a marginal cost equal to the tax (or rather, the expected tax trajectory); inducing abatement above that without federal intervention would be each state's prerogative.

However, disparate state policies can be costly for firms and the differences can create inefficient investment incentives. A federal carbon tax law could override a patchwork of state policies. This could increase corporate support for a federal carbon price, but it would prevent jurisdictions with higher willingness to pay from exercising their preference for greater environmental protection. Preempting state measures could also provoke costly and protracted litigation by states that want to keep their existing policies.

Determining and enumerating in a federal statute the range of state policies to preempt may be complicated. For example, would the federal law obviate state renewable electricity standards regardless of whether they'd bind under the carbon fee? How about state and regional cap-and-trade programs, like the Regional Greenhouse Gas Initiative? Would federal preemption make a distinction between regulations and subsidies that both have the effect of reducing emissions? What if controlling GHGs is an ancillary outcome of states' efforts to control other pollutants? Would that be preempted, too? Would states be prohibited from controlling GHGs that aren't covered by the carbon price? This issue generates more questions than answers.

In some instances preemption of state policies may be unnecessary as some states would voluntarily roll back their existing regulations if the federal government adopts what they view as an appropriate federal policy. Indeed, a number of states like California have made clear that they are taking action precisely because the federal government has not.

9. Does it allow offsets (alternatives to paying a fee)?

This question asks whether the government should allow firms to comply with their carbon fee obligations by surrendering credits generated by GHG offset projects. For example, the policy could, in lieu of payments to the federal government, accept certified emissions reduction credits associated with domestic reforestation projects (or other domestic sources that aren't covered by the fee) or credits from emissions abatement projects outside the United States. The United States could also allow regulated firms to purchase emissions allowances from GHG cap-and-trade systems abroad, such as the European Trading System, and surrender those allowances on a ton-for-ton basis towards their U.S. tax obligations.

Allowing international offsets or GHG allowances in the U.S. carbon pricing system could result in very different investment patterns than would arise in a system that does not. The outcomes are hard to predict. To the extent that firms can acquire offset credits for a price lower than the prevailing carbon price, compliance costs would be lower -- but so would abatement in the covered sectors. To the extent the U.S. carbon price policy allows firms to

buy international emissions allowances, the environmental outcome of the U.S. tax would depend on the stringency of other countries' policies.

Disadvantages of allowing offsets

Any of these approaches would undeniably complicate the development and the administration of the carbon pricing policy. Federal agencies don't have established ways of validating offset credits, so they may need to rely on third parties. Offsets and/or an unlimited linkage with international allowance systems would make it difficult to estimate the revenue from a U.S. carbon tax because authorities would have to project not only covered emissions but also how many offsets would be turned in, in lieu of tax payments.

Offsets could substantially lower the revenue from the program. Some wouldn't view this as a disadvantage, but it would certainly complicate a tax swap arrangement. If allowing international offsets/allowances results in large flows of money leaving the United States, political opposition to the program may arise. While possibly inducing additional low-cost abatement outside the U.S. energy sector, allowing offsets could blunt incentives to transform the U.S. energy system. This could complicate long term efforts to decarbonize the U.S. economy.

Offsets necessarily involve measuring emissions reductions relative to a counterfactual, and this discretion can result in credits that aren't real reductions. International offsets may be particularly hard to oversee properly. Third party certifiers may provide a reliable approach, but the government would have to oversee their accreditation.

Advantages of allowing offsets

If administered carefully, allowing offsets would incentivize real abatement outside sectors covered by the tax. In essence, the forgone revenue could be "spent" on additional abatement (this is a key difference from a cap and trade system, where offsets do not result in additional abatement). The net environmental result of allowing offsets depends on the validity of the credits and what the purchasing firms would have done if the offsets weren't available. International offsets can help fund forest protection and restoration in vulnerable global ecosystems, potentially offering both climate and ecosystem benefits. Some of the downsides of offsets could be addressed by limiting their use, for example by placing a cap on the share of each firm's tax liability that can be met with offsets.

10. Does it give credits or rebates for certain activities?

Carbon that is not emitted into the atmosphere should arguably either not be subject to the carbon charge or eligible for a rebate of some kind. There are three main contexts in which this issue arises:

1. Fossil carbon that ends up embodied in a product.

Products that contain carbon that originates from a fossil fuel include petroleum distillates, plastic, waxes, and fertilizer. Producers of such goods could receive tradable tax credits,

rebates, or direct payments that would compensate them for the carbon charge embedded in the price they pay for their inputs. If the carbon tax is imposed at the refinery level, it may also be possible to (fully or partially) exempt the products from the tax at that stage. For the tax base to match actual emissions, products that have embodied carbon must be accurately identified and tracked. Embodied carbon that is released subsequently, for example plastics that are burned in municipal waste combustion facilities, should arguably be taxed at that stage.

2. Carbon that is stripped from combustion gases and stored safely.

Carbon capture, use, and storage (CCUS) technologies can divert CO2 from combustion gases from power plants and industrial facilities and store them in underground geologic formations. In some cases, producers pump the CO2 underground to boost production of oil wells (hence the use part of CCUS). Other strategies for storing carbon in long-lived solid materials are also under development. As of now, CCUS technologies have not been deployed at scale and are still expensive relative to other ways of reducing emissions. In combination with a price on fossil carbon, a rebate for stored carbon could incentivize developing and deploying such technologies.

One approach would be to provide a rebate in the amount of the carbon tax. This would equate the marginal incentive to store carbon with the incentive not to emit it in the first place. However, if CCUS technologies arise that can be deployed at a large scale at a reasonable price, it may make sense to revise the tax/rebate to peg it to the cost of the backstop technology. For example, if it costs $50/ton to store the carbon, but the rebate and the tax are both $100/ton, then the program would pay far more for carbon storage than necessary to achieve the same environmental outcome.

3. Fossil carbon that is exported from the United States.

Exported fossil fuels will produce carbon emissions outside the United States when they are combusted. Some would argue that since the carbon in exported fuels doesn't appear in the official UNFCCC inventory of U.S. GHG emissions, those emissions are really the responsibility of other countries, not the United States. Should policymakers price exported carbon or not?

Rebating a carbon tax on exported fuels (or exempting them in the first place) would prevent the carbon fee from making U.S.-produced fuels (especially coal) less competitive in international markets. This is a special case of a border carbon adjustment (see question #11). Export rebates would be valuable for fossil fuel exporters. The funds the government gives out in export credits/rebates would be revenue foregone for other uses.

The question arises whether exempting exported fuels from the carbon fee would forgo an opportunity to induce emissions abatement abroad. The answer depends on the extent to which U.S. fuel exporters can pass along the carbon price to their buyers. In general, international energy markets are competitive, so it is unlikely that an export exemption forgoes significant climate benefits. Rather, U.S. fuel producers that cannot pass along the carbon price would most likely lose market share and/or profits.

On the other hand, fossil fuel production itself impacts the environment, generating GHG emissions in the production process and degrading local environments during mining or drilling. These impacts could argue for taxing exported fuels. However, it may be the case that fossil energy production in the United States is cleaner than production

elsewhere. Thus, discouraging domestic production by not rebating for exports could inadvertently raise emissions by promoting fossil fuel production elsewhere.

Some stakeholders may argue that pricing all carbon, whether consumed domestically or abroad, is important symbolically, even if it doesn't reduce emissions.

11. Does it include measures to reduce effects on U.S. competitiveness and emissions leakage?

In most cases a carbon price is passed through to consumers via higher prices for the goods and services that have fossil energy or other emissions in their supply chain. However, under certain market conditions, the carbon prices will not flow through to consumers, even in the long run. Some U.S. firms produce goods in a fossil fuel-intensive process, and they compete directly with firms in countries that do not regulate greenhouse gases. We call these energy-intensive, trade-exposed (EITE) firm. For example, U.S. steelmakers may be concerned that domestic buyers of steel would turn to foreign competitors, who could produce steel more cheaply with untaxed fossil fuels abroad. Likewise, U.S. exporters of chemicals that use taxed fossil fuel inputs are less able to compete in those export markets with manufacturers that use inputs that are not taxed.

These competitive effects could lower the environmental benefits of a U.S. carbon tax by driving production and new investment to countries with less ambitious climate policy. This shift is known as emissions leakage. Overall, the evidence on the likely magnitude of leakage suggests that the problem is not, macroeconomically speaking (PDF), likely to be large. However, the outcomes could be very important for certain industries and workers(PDF), and competitive disadvantages would be more important the larger the U.S. carbon price is relative to that in other countries.

The first, best outcome is for the United States to leverage its domestic action into analogous action by other countries. Any problems for EITE industries from a carbon policy derive directly from unequal efforts across countries. And all major economies must reduce emissions to stabilize concentrations of GHGs in the atmosphere.

In addition to international cooperation, some of the other design elements could help ease concerns for EITE firms:

- The carbon tax could start modestly, giving all firms time to lower their carbon-intensity (see question #3).
- The carbon tax revenue could fund reduction in other taxes that make U.S. firms less competitive (see question #6).
- The carbon fee could replace more costly regulatory approaches (see question #7).

Assuming that after all those other approaches are taken into account EITE concerns still remain, the question arises whether to include special provisions to address them, and if so, what. The special provisions would need to last only as long as significant and trade-distorting policy differences persist.

A number of policy measures have been proposed (PDF). One consideration for all of them is the extent to which they conform with World Trade Organization (WTO) rules. The legal issues are complex, and we won't go into them here. Some would argue that if reasonable measures to address emissions leakage are incompatible with WTO rules, then authorities should work within the WTO to change those rules.

Options include: border adjustments (BA) (PDF), tax exemptions, and output-based rebates.A BA approach would tax imports (PDF) of GHG emissions-intensive goods from less-regulated regions by an amount that reflects the difference between the carbon policy in the originating country and the United States. The idea would be to specify carefully the most energy-intensive traded goods (such as aluminum) and set import tariffs on those goods from countries with substantially weaker climate policy. This is less straightforward than it sounds because many countries adopt policies, such as renewable electricity mandates, that do not clearly equate to a carbon price. Further, the carbon intensity of an EITE good may vary a lot within a country, or even within a firm. Finally, introducing BAs could give rise to unwieldy and protectionist policies if not carefully limited.

Another approach would either exempt EITE industries from the carbon tax or reduce its rate. This approach forgoes both revenue and the potential for cost-effective emissions abatement. It also introduces large returns to lobbying for the exemption.

A third proposal involves giving EITEs some kind of credit or rebate in proportion to their output. Output-based rebates, as this approach is known, operate as a subsidy to production and incentivize emissions-intensive firms to keep up production even as its input costs go up. This approach helps reduce the potential loss of jobs in those industries, but it also helps keep prices of energy-intensive goods lower than they would otherwise be, reducing the environmental benefits of the tax.

Finally, the overall effect of the carbon tax on EITE firms depends on what happens to the revenue. As noted above, tax reforms could offset some of the competitive effects on EITE firms, even if the reform is not targeted just to them. And it may be possible to construct an efficiency-enhancing tax reform targeted to EITEs.

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