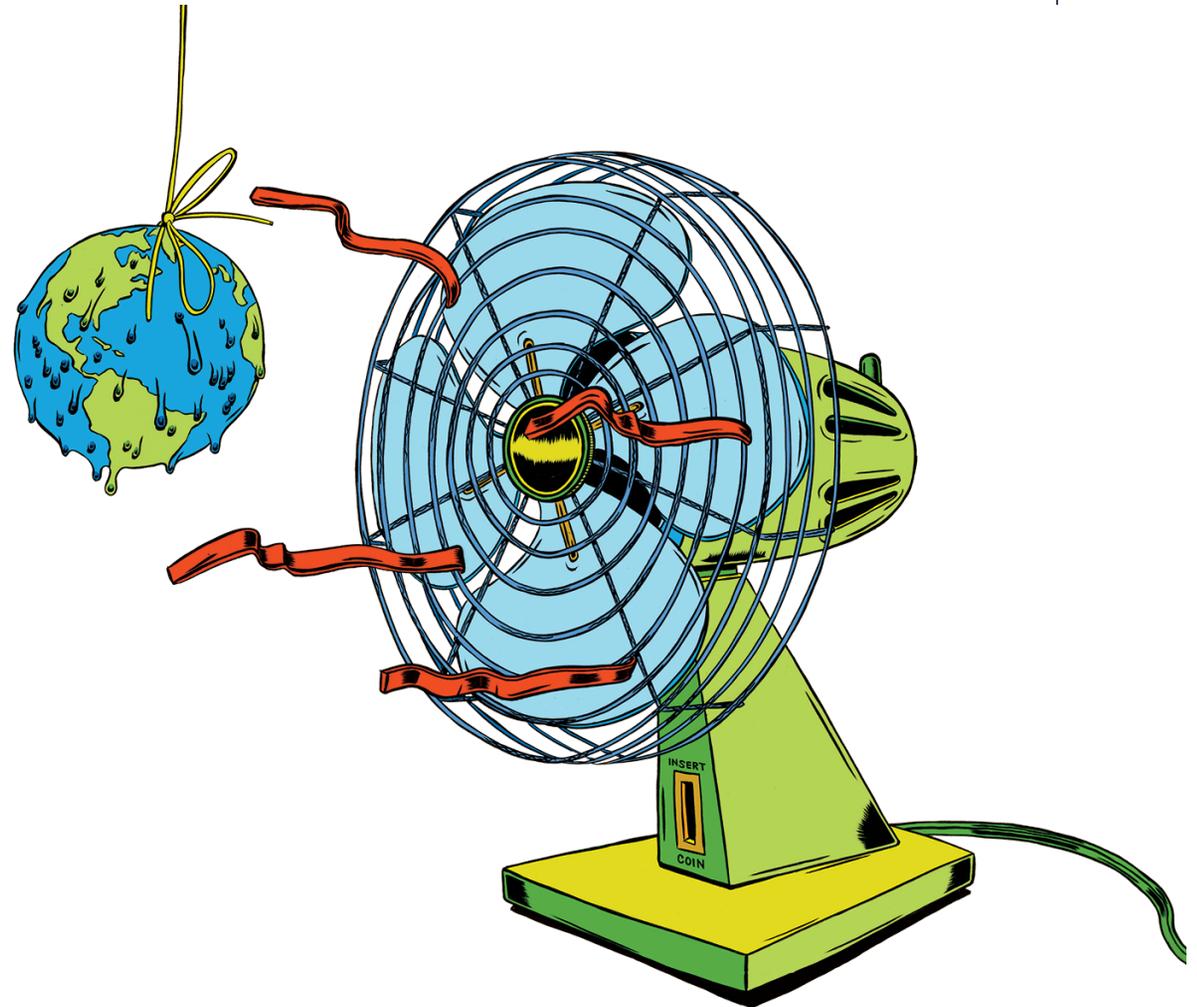


THE TAX THAT COULD SAVE THE WORLD

**Most economists agree
on how to tackle climate**



**BY MICHAEL MAIELLO & NATASHA GURAL
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change. Can politicians make it happen?

It was, perhaps, the closest that the economics profession has ever come to a consensus. In January, 43 of the world's most eminent economists signed a statement published in the *Wall Street Journal* calling for a US carbon tax. The list included 27 Nobel laureates, four former chairs of the Federal Reserve, and nearly every former chair of the Council of Economic Advisers since the 1970s, both Republican and Democratic.

“By correcting a well-known market failure, a carbon tax will send a powerful price signal that harnesses the invisible hand of the marketplace to steer economic actors towards a low-carbon future,” the economists noted. All revenue from the tax should be paid in equal lump-sum rebates directly to US citizens, they added.

Not all economists agree that the tax should be revenue neutral in this way, but the profession has been coalescing in recent years around the idea of a carbon tax. Most prefer such a tax to the most prominent alternative policy for tackling carbon emissions, cap and trade, according to a recent poll of expert economists.

But a carbon tax seems to be a political nonstarter in the United States. The bipartisan call for action from economists over the years has been echoed by a failure to act by presidents from both parties. President Donald Trump denies the need to confront man-

made climate change. But although Barack Obama, his predecessor, in 2015 called a carbon tax “the most elegant way” to fight global warming, he didn’t push strongly for one to be introduced. “One of my very, very few disappointments in Obama when he was president is that he did not come out in favor of carbon tax,” Yale’s William D. Nordhaus told the *New York Times* last October, days after winning the 2018 Nobel Prize in Economic Sciences for his work on economic modeling and climate change.

US states have shown that they, too, can reject a carbon tax. Even in heavily Democratic Washington state, voters last year rejected (for the second time) a proposal to tax carbon-dioxide emissions. The *New York Times* published an opinion column in December by one of its former environmental reporters titled “Forget the Carbon Tax for Now,” calling it politically toxic. Days later, Paul Krugman, a *Times* columnist and 2008 Nobel laureate, wrote that he too had concluded there was no near-term political support for such a tax.

In terms of confronting climate change, the US is a laggard. Twenty-six countries and provinces have implemented some form of carbon tax, according to the World Bank, and there are another 25 emissions-trading systems. In Canada, where some provinces have introduced carbon pricing, Prime Minister Justin Trudeau is leading a charge to introduce a federal carbon tax, with 90 percent of the revenues directly rebated to citizens.

To its proponents, a carbon tax is simple and clearly beneficial. It would account for the costs of pollution that aren’t already priced into what people pay at the pump to fuel cars, send to the electric company to power homes, or offer up daily to Amazon to have

items shipped. Releasing carbon dioxide into the atmosphere is heating the planet, melting glaciers, and changing the Earth's weather patterns. These emissions cause long-term damage that could destroy the environment as we know it, and, the argument goes, a tax would give businesses, governments, and households an incentive to reduce and ultimately eliminate them.

Many believe the need for action is urgent. According to the US National Oceanic and Atmospheric Administration, carbon stored in the Earth's atmosphere is at its highest levels in 800,000 years. The effects of the warming atmosphere will be felt more quickly than anticipated, a UN scientific panel concluded last October, saying that without a global carbon tax, any temperature target will be exponentially harder to meet. However, does a tax, arguably the best economic tool that exists for addressing climate change, have any possibility of ever being implemented widely? And if not through a carbon tax, how should we put a price on carbon?

THE COST OF CARBON

Economists generally believe that we, as current users of fossil fuels (heating and air conditioning our homes, driving to work), have gotten a free ride for too long because the price we pay at the pump, however high it may seem, accounts only for the costs of extracting and refining the oil, plus profit and overhead for the company selling it. We're not paying for the costs that come later, in the form of harm to future generations—rising sea levels, destructive heat and erratic weather patterns, and social and political turmoil. The market hasn't accounted for these "external" costs because they are not embedded in the prices of the carbon-intensive goods we produce and consume today.

As a result, we ignore those costs, carbon emissions are high, and the burden falls on others down the road.

This puts democracies in a particular political pickle. When a commuter burns a tank of gas and belches exhaust, the brunt of the bill is passed to future generations. The same is true for people who fly in planes, or leave their lights or appliances switched on, using electricity often supplied by burning coal. The free ride has gone on for so long, how can anyone convince the current generation of consumers, many of whom are skeptical that the government's role should be expanded, that the bill should land on them?

Carbon emissions create an economic externality, when the costs of an economic activity are borne by neither the producer nor the consumer. Economists would have us measure the cost of the externality and add it to the price of the good. If producing plastic coffee pods releases carbon dioxide into the atmosphere, for example, the price of pods at the grocery store would reflect that. The idea is that adding to the costs of pollution will eventually reduce pollution, as businesses and consumers find money-saving alternatives.

However, the amount today's consumers should pay for tomorrow's problems is far from settled science. Nordhaus, one of the first economists to consider the role of the changing climate in economic growth, pioneered a climate-change model that estimates the social cost of carbon emissions and has become something of an industry standard. But models involve various discount rates and significant assumptions, yielding vastly different estimates, and there's disagreement about whether or not to attempt to include costs associated with unknown but potentially catastrophic events

caused by climate change, such as reduced biodiversity or even war. Should carbon be priced at \$30 a ton, or \$300?

The most important number you've never heard of

A carbon tax is meant to impose costs on carbon usage that the market price doesn't capture, effectively increasing the price of a barrel of oil or a tank of gasoline to account for future environmental and health damages. But what is the price of carbon? That, according to the University of Chicago's Michael Greenstone, is "the most important number you've never heard of." And it is up for debate.



The notion that polluters should bear the public health and environmental costs of their activities was pioneered by Yale's William D. Nordhaus, who received the Nobel Prize in Economic Sciences in 2018. Nordhaus developed a model to estimate the social cost of carbon, which is the present value of the net harm caused by every ton of carbon dioxide released into the atmosphere.

This cost could be used to establish policies, such as the rate for a carbon tax. But it can also be used to set electricity rates, emissions caps, federal land leases, energy subsidies, and more. In the United States, the government started using a social cost of carbon during former president Barack Obama's administration.

Determining this value involves considerable uncertainty, however; it is dependent on the details of how the figure is calculated. Various US government agencies were using different costs until Greenstone and other researchers formed an interagency working group to establish a single federal value. After updates, that settled near \$50 for 2020 in current dollars. The Trump administration has

since disbanded the working group, and it changed assumptions in its models so that the social cost of carbon it recognizes falls to almost zero.

One detail in the calculation is the discount rate. Whatever the number, any dollar spent today to mitigate environmental damage would presumably be worth more 100 years from now, when the environmental benefits of using less carbon are realized. That's why, when trying to determine the social cost of carbon in today's dollars, economists need to apply a discount rate, as businesses do when they evaluate projects based on discounted-cash-flow analysis. The lower the discount rate applied, the higher the overall social cost of carbon. Under Obama, the government used a range of discount rates, from 2.5 to 5 percent, tending toward the lower end of the spectrum. The Trump administration uses a higher range, 3–7 percent.

Yale's Stefano Giglio, Harvard's Matteo Maggiori, and New York University's Johannes Stroebel studied discount rates independently of climate change—by studying the housing markets in the United Kingdom and Singapore, where homes can be purchased outright or leased for contracts lasting 50 to 999 years—and conclude that over very long time periods (a century or more), the rates are extremely low, lower than implied by most economic theory. (See “How much should we pay to mitigate climate change?” Fall 2014.) There's increasing consensus among economists that the discount rate should be between 2 and 3 percent, says NYU's Peter Howard.

A bigger issue in calculations, he says, is that many difficult-to-measure events and impacts, such as some nonmarket damages, socially contingent damages, and systematic changes to the climate, are missing from the models. There's generally scientific agreement about how climate change will affect future temperatures and precipitation, but it's harder to predict how it will change things such as

storms, monsoon seasons, ocean patterns, biodiversity and habitat loss, national security, recreational goods and services, and so on.

The harder it is to model such aspects, the more likely it is they'll be excluded from economic models of climate change. Because of this, he says, potential catastrophic impacts and tipping points have been largely ignored in standard models that determine a social cost of carbon.

And should the models at least reflect the risk of such scenarios occurring, as well as the amount of risk we're willing to take that potentially irreversible environmental and societal changes might occur?

Beyond that, the US, like other governments, has primarily focused on calculating a domestic social cost of carbon, considering only costs to the US. But the effects of climate change aren't contained by country borders.

The University of Chicago hosts and coleads the Climate Impact Lab, where Greenstone and academics from several institutions are working on calculating a global social cost of carbon. That comprehensive number will be based on detailed localized data on sea-level rise, temperature, precipitation, and humidity; millions of observations related to climate and social welfare; and empirically-based projections. When established, the global value could be fed into energy and climate policies worldwide. It will also be used to create a groundbreaking map that will show localized effects of climate change.

“There are a lot of reasons to believe the current estimates are more of a lower bound,” Howard says of today's carbon-cost estimates. “As we gain more information, and new research is integrated into the best models, I expect that the social cost of carbon will increase.”

Stefano Giglio, Matteo Maggiori, and Johannes Stroebel, “Very Long-Run Discount Rates,” *Quarterly Journal of Economics*, February 2015.

Peter Howard and Derek Sylvan, “Expert Consensus on the Economics of Climate Change,” *Report from the Institute for Policy Integrity*, December 2015.

William D. Nordhaus, “Estimates of the Social Cost of Carbon: Background and Results from the Rice-2011 Selection Model,” *Working paper*, October 2011.

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Whatever it is determined to be, it could be added to the cost of oil when it’s purchased by the barrelful, natural gas when it’s fed into a pipeline, or coal when it’s mined. “The insight economists have is that the most efficient way of doing this is through the pricing of carbon emissions, or the pricing of all climate-forcing emissions,” says University of Gothenburg’s Thomas Sterner. “And one of the reasons is that such pricing will catch new sources of emissions. Otherwise, we tend to focus a lot on the ones we know, such as from airlines, meat, cars, etc. If you just take these on one by one, some other sector is going to find new ways of using oil and coal—like through heating outdoor pools, as it’s lovely to have a heated pool outdoors in the Arctic region, where I live. So the only method that will catch all of these, and in a reasonably efficient manner, is through pricing carbon.”

It sounds easy, but uncertainty over the true cost of carbon is one barrier. Use too high an estimate, cautions Chicago Booth’s Robert H. Topel, and a tax can do more harm than good. Moreover, passing the cost on in this way, regardless of how governments choose to apply or structure it, is essentially a tax on consumption. That is one source of

pushback, because unless offset by other credits, a carbon tax can be regressive if poorer consumers spend a greater percentage of their income on things such as fuel and electricity.

Tax reform is tricky. Late last year, French president Emmanuel Macron sought to implement high fuel taxes in France specifically to target carbon emissions—hiking the gas tax while reducing wealth taxes for the rich. This resulted in violent riots throughout Paris. Protesters scrawled graffiti on the Arc de Triomphe, calling Macron “President of the Rich” and warning that “we cut off heads for less than this.” On December 4, 2018, French prime minister Édouard Philippe announced that the government would bow to the protesters and that the planned diesel-fuel tax hikes would be suspended. “No tax deserves to endanger the unity of the nation,” he said in a television address to the country.

A PROXY FOR POLITICS IN GENERAL

While the politics of pricing carbon are difficult locally, global political schisms are another obstacle to implementing any plan to reduce carbon emissions. The planet is divided into 195 countries that share a single atmosphere, and the atmosphere doesn’t much care where emissions come from, as the impact on climate is the same.

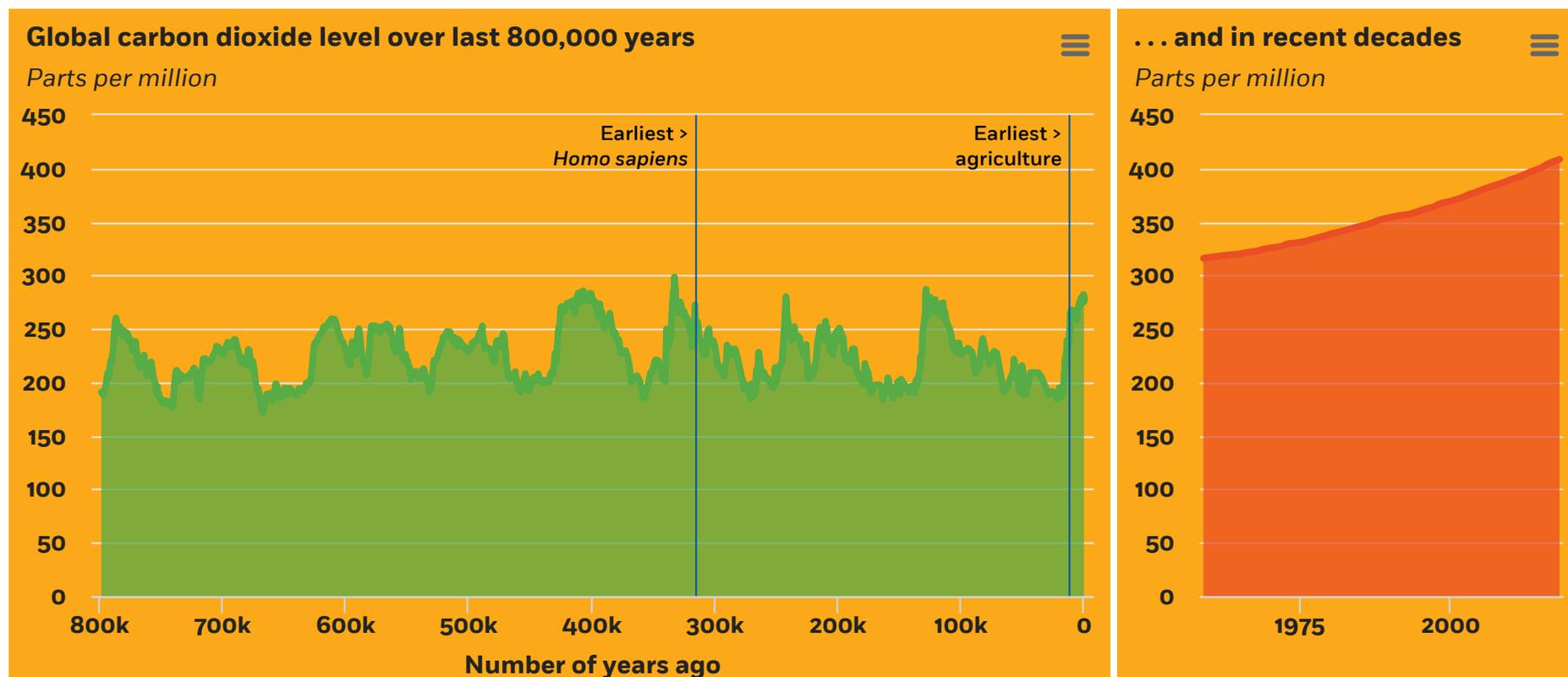
Meanwhile, no country or state wants to hurt its economic competitiveness. “A region or nation that moves ahead of its neighbors on climate policy can potentially put its own carbon-intensive firms at a disadvantage. This is a major policy concern,” write Stanford’s Lawrence H. Goulder and Andrew R. Schein in a 2013 paper. While the US, the

European Union, and China have the heft to lead the world in a greener direction, all must contend with the demands of their local politics.

Still, were opposition to carbon taxes limited to only pocketbook matters such as prices at the pump, governments might be able to sway opinion with offsetting incentives, including lower taxes on food and clothing or health care. But there might be deeper forces at play, particularly in the US, according to Topel. In “Some Dismal Economics of Climate Policy,” a May 2018 talk he gave at the University of Chicago’s Becker Friedman Institute, he offers an alternative explanation for why the carbon tax has not been implemented—which boils down to the role of government.

Putting aside the political toxicity in the US of taxes in general, and the issue of whether people believe or deny scientific consensus about global warming, Topel focuses on what he sees as a more fundamental schism between the political Left and Right. The Left, he says, is happy to expand the size of government, while the Right doesn’t want to. A carbon tax could massively increase government revenues.

Topel assumes a rate of \$41 per ton of spent carbon. Current consumers paying freight for the cost of carbon would pay a tax of \$41 per ton, adjusted alongside either inflation or the cost of capital (another fierce point of debate) over time. “The textbook solution is to set a tax on carbon equal to the social cost of carbon and be done with it,” says Topel.



US National Oceanic and Atmospheric Administration

By making carbon more expensive, the measure would theoretically dissuade people from using it—but also grow government. Topel estimates a carbon tax would raise \$280 billion to \$300 billion in revenues, the equivalent of about 10 percent of current annual federal spending. The political Left would support this, but the political Right would not—and therefore right-leaning carbon-tax opponents have a rational basis for their stance.

Moreover, would this government growth be worthwhile? The point of a carbon tax is to pressure businesses and consumers into curbing the consumption of oil, electricity, or whatever else is creating harmful emissions. But a \$41-per-ton tax translates to about 35 cents per gallon of gas, which might not be enough of an incentive to greatly shift driving habits—at least in the short run—in any consequential way, he says. If either the demand for or the supply of oil, or any other carbon-based good, is highly inelastic, the government could collect billions of dollars in tax revenue for a pretty small environmental payoff.

Topel calculates that when it comes to oil, a carbon tax generates \$100–\$400 of government revenue for every \$1 of avoided climate harm. “Waste avoided is less than 1 percent of taxes collected,” he says. If one’s view is that more than 1 percent of government spending is wasteful, he argues, the tax ultimately increases waste and reduces welfare—and like it or not, the opinion that the government is wasteful is widespread.

This gives carbon-tax opponents even more ammunition. Anyone who thinks the government is at least slightly more wasteful than the private sector can make a case that the tax would make the world worse, not better.

WHAT ABOUT A REVENUE-NEUTRAL TAX?

But what if the tax could be made revenue neutral, so that any funds that flow to the government as a result of the tax would be reinjected into the economy, holding the size

of government (as well as government waste) constant? On the surface, this would seem to reassure critics.

Former Secretaries of State George P. Shultz (a onetime Chicago Booth dean) and James A. Baker III, alongside former Senate majority leader Trent Lott (Republican of Mississippi) and former Senator John Breaux (Democrat of Louisiana), formed a political action committee in 2018 called Americans for Carbon Dividends. With support from the energy industry, they have pushed for a revenue-neutral carbon-tax plan that they paint as palatable to conservatives and government skeptics. They promote a path to revenue neutrality that involves what they call carbon dividends and Topel describes as the “parachute drop”: any funds the government raises through a carbon tax would be transferred back to the public as a lump-sum payment. Other regulations on emissions would be dropped, because prices would be optimal.

Politically, this may be the best option. In the *Wall Street Journal*, the statement by prominent economists holds that a carbon tax should “be revenue neutral to avoid debates over the size of government.” The parachute-drop plan “kind of sways them a little bit,” Topel says of carbon-tax skeptics, channeling them when he says, “Oh, you’re going to give the money back, and the government’s not going to grow, maybe I’m going to get some of that back.” The parachute drop could involve notable trade-offs. Exxon, for example, gave \$1 million to Americans for Carbon Dividends and supports a revenue-neutral carbon tax—but in exchange for limited liability protection against lawsuits that emerge from carbon-related damage claims. This doesn’t factor into Topel’s analysis. In Canada, Trudeau’s government this past October announced a carbon tax that would

return most of the revenue, in the form of “Climate Action Incentive payments,” to residents of some provinces.

Regardless, this kind of approach “doesn’t actually work,” according to Topel, who says that the parachute-drop approach ignores the interplay between a carbon tax and existing taxes. The US government already taxes carbon in direct and indirect ways that exceed the social cost of carbon, he says. These include the federal income tax, since consumers buy carbon-based products with posttax money, as well as sales taxes, including on gasoline. Unless the social cost of carbon is greater than the existing tax wedges—and at \$40 per ton, it isn’t—the “tax and give it back” strategy is likely to reduce welfare. Returning revenue raised by a tax “sounds like a really easy solution, but it doesn’t work if you’re not reducing distortions somewhere else” in the tax system, Topel says. “They’re saying ‘just stick money in an envelope and send it back,’ but that is unlikely to reduce distortions or improve welfare in a world where taxes are already high.”

Coastal house prices don’t account for climate risks

Flooding in coastal areas is one of the more dramatic and oft-discussed elements of climate change, but people still buy and sell Miami condos and retire to little beach towns in the southern United States. If the science is sound and markets are efficient, flood risk should be priced into the value of these properties. A recent study suggests that the market isn’t quite so efficient.

To see how climate-change belief affects prices, University of British Columbia’s Markus Baldauf and Lorenzo Garlappi and Chicago Booth’s Constantine Yannelis focus on US real estate, citing its



importance to the country's economy and the fact that people hold properties for a long time. "Its long-duration nature exposes it to the type of long-run risks that emanate from climate change," they write, adding that it is the most important asset for most US households.

Current risks such as natural disasters and floods are factored into real-estate prices and insurance premiums, according to the researchers. But what about future risks, such as changing weather patterns?

To answer that, the researchers looked at areas that could be subject to flooding in the future due to rising sea levels. They used a database of home sales that they cross-referenced with maps of projected flooding and surveys of people's beliefs in climate change.

The analysis suggests that regardless of the scientific consensus, "differences in beliefs about climate change have a significant impact on house prices." In communities predominantly made up of climate-change deniers, homes that were projected to wind up underwater sold for about 7 percent more than similar homes in communities made up of people who believed that climate change is real and imminent. Although the researchers say their analysis is agnostic about whether deniers are underreacting or believers are overreacting to the long-term risks of climate change, they conclude that the differing beliefs about those risks "have significant impact on the US real-estate market."

Markus Baldauf, Lorenzo Garlappi, and Constantine Yannelis, "Does Climate Change Affect Real Estate Prices? Only If You Believe in It," Working paper, August 2018.

[See less](#)

But can economists design a policy accordingly to come up with an optimal tax? Topel says a different path to revenue neutrality would yield welfare gains: offsetting carbon-tax revenue by reducing income or other taxes by an equivalent amount, which he says would prevent the government from growing while reducing distortions in economic incentives. Other versions of this idea might return revenue in the form of payroll taxes, or by eliminating regulations and taxes on industries that rely less on fossil fuels and have a smaller carbon footprint. British Columbia's carbon tax is accompanied by personal income tax cuts and a low-income tax credit.

The only problem? Topel doesn't think the US voting public would trust elected officials to follow through on that proposal—as many people have different ideas about what to do with revenue raised from a tax, and the government cannot commit to maintaining lower taxes. Consider the National Resources Defense Council's view of a carbon tax. “While a carbon tax can be an important part of a comprehensive program to cut our carbon footprint and to hold polluters accountable, it must be accompanied by strong limits on carbon emissions, including those under existing authority granted by the Clean Air Act and all other existing legal tools,” says a spokesperson in a statement. Topel sees this as evidence of groups not trusting that markets, even if armed with better-balanced incentives, would solve the problem of climate change. They would still push for more government involvement in the market in the form of regulation, and perhaps also subsidies and investment in green-energy research.

“Just about all of us agree a carbon tax can't stand alone; it has to be part of a suite of policies,” explains the Carbon Tax Center's Charles Komanoff, an environmental activist who says US carbon-tax advocates including him are focusing in 2019 on persuading

members of Congress to include a carbon tax in any Green New Deal they propose. “A carbon tax is going to be passed only when there is a strong Democratic majority in Congress and a Democratic president. And the Democratic majority is going to insist on investing some of the carbon tax revenues to transition to a lower-carbon economy. The window has closed on an era when we might have been able to pass a pure carbon tax. I don’t see that window opening again for a long time.”

The only hope for securing voter support for a carbon tax may be to focus on the almighty dollar, says University of Chicago’s David A. Weisbach. People should be attracted to the amount of revenue a carbon tax could raise over the course of a decade, not just climate-change benefits. If the tax raises \$1 trillion, that would both move the economy in a more environmentally responsible direction and fund any number of value-improving projects.

“You can do good stuff with that money,” he says. Topel counters: “To many, that’s the problem.”

ALTERNATIVE 1: CAP AND TRADE

Voters, even in the US, may yet come around to supporting carbon taxes. Among the surveys suggesting that Americans have an appetite for confronting climate change, one conducted in November 2018 finds that 70 percent of Americans believe climate change is happening. Moreover, 49 percent of respondents said they would support a carbon tax if the revenues were rebated to households, and 67 percent said they would support a carbon tax if revenues were put toward environmental restoration. “These

findings appear to run counter to the conventional wisdom about the most politically appealing version of a carbon tax and to recent efforts by the federal government to step back from environmental protection,” said University of Chicago’s Michael Greenstone, director of its Energy Policy Institute, when the results were released in January. The survey was conducted by the Associated Press-NORC Center for Public Affairs, with funding from the Energy Policy Institute.

But political polarization still makes a carbon tax an unlikely prospect in the US, at least in the short and medium run. “There is very low to no chance that a carbon tax would be implemented by the federal government in the near future,” Weisbach says.

So what are the alternatives? Emissions trading, also known as cap and trade, is the most prominent. Both taxes and cap-and-trade systems can raise revenues, through either taxes or emissions permits. While a tax establishes a price for carbon and lets the market set the amount of emissions, a cap-and-trade system works in reverse, establishing a cap for emissions and letting the market set a price for carbon. Typically, the government produces and either hands out or auctions off a limited number of pollution permits, creating a market for permits and establishing a market-based cost. The US used such a system to reduce the pollutants that cause acid rain. An attempt to set up a nationwide cap-and-trade system was proposed but failed to become law during the Obama presidency.

“The problem with such cap-and-trade programs is that they, in essence, give the revenue from a Pigovian tax lump sum to

Put a price on carbon, already



a regulated entity. Why should an electric utility, for example, be given a valuable resource simply because it has for years polluted the environment? That does not strike me as equitable,” wrote Harvard’s N. Gregory Mankiw in 2009. He says he still supports that position, seeing cap and trade as less desirable. “Of course, cap-and-trade systems are better than heavy-handed regulatory systems. But they are not as desirable, in my view, as Pigovian taxes coupled with reductions in other taxes.”

But, if properly designed, either cap-and-trade or a carbon tax could work well, although the outcomes depend greatly on details, write Goulder and Schein. “The performance of the two approaches depends critically on specifics of design. Indeed, the design of the instrument may be as important as the choice between the two instruments.” They also suggest countries could pursue a hybrid policy

We asked experts: What’s the most effective step governments should take to combat climate change?

“ The most important requirement of any measure is that there must be a cost to emitting carbon, some reasonably high price of carbon. This, in turn, is most easily achieved by carbon taxes; but if these are resisted, there are alternatives, including fee and dividend systems, or cap and trade. Additional instruments may be subsidies for new green technologies.

This is a difficult issue, one of the difficult issues of this century. It really is of enormous importance that we get something that works and set a high price for carbon soon. It’s a second-order issue, which method you use; I would go for any that works. A carbon tax is most efficient, but that doesn’t matter that much.



that combines the cap-and-trade approach with a price floor, price ceiling, or both, to reduce volatility.

Richard L. Sandor, CEO of Environmental Financial Products, which helps set up cap-and-trade systems worldwide, says

that while academic economists can prove the superiority of either method, he sees emissions trading as the preferred way to proceed. “I just don’t get it because sulfur dioxide proved the case,” he says, adding that the program to reduce SO₂ cost \$2 billion at most to implement and has led to \$120 billion in benefits, including reduced medical expenses associated with lung disease. “The program reduced emissions by 90 percent below 1990 levels. In my experience, as a practitioner, that’s a far superior result compared to a tax. I believe that cap and trade allows for the achievement of reductions at the lowest possible cost.”

Cap-and-trade programs are running in California, the northeastern and mid-Atlantic US, the EU, and, most recently, China. The EU’s cap-and-trade program for carbon has seen significant variability in terms of permit prices, and the rollout of its second trading period coincided with the 2008–09 financial crisis, which helped depress emissions and prices. If permit prices are low, some see it as an indication that emissions caps were too lax, less stringent than what most cost-benefit analyses would recommend. However, says Goulder, the low prices reveal both a weakness and a strength of the EU system, the strength being “it shows that the [emissions] cap could be met at relatively low cost.”

–Thomas Sterner

University of Gothenburg

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Also, a tax establishes a more-certain price signal for households or companies making long-term decisions—but cap and trade creates more-predictable emissions reductions.

China in 2017 launched a carbon market that is expected to become the world's largest carbon-trading program. Unlike the EU's cap-and-trade system, which starts with the premise of capping emissions on the basis of historical levels, China's system is "rate-based" and so will allocate emissions allowances according to a variety of benchmark emission-output ratios. In a 2018 paper, Goulder and Richard D. Morgenstern, of the nonprofit research institution Resources for the Future, called China's adoption of a carbon-trading system "a major step for climate change policy" that "could encourage carbon pricing policies elsewhere." However, they write that the success of the program in reducing emissions will depend fundamentally on the details of how the Chinese government calculates allowable emissions. "Internationally, much is riding on this program," they write. "If successful, it could serve as a positive model and encourage other nations' climate policy efforts. Failure could impede the adoption of emissions trading programs in many parts of the world."

ALTERNATIVE 2: GREEN TECHNOLOGY

If neither a tax nor a trading system succeeds, it could mean the climate future depends largely on fossil-fuel alternatives and new technologies becoming cheaper to use and more competitive. This is happening—somewhat.

The cost of solar panels dropped 85 percent between 2010 and 2018, as China's manufacturers entered into (and flooded) the market, reports solar photovoltaic

research company PVInsights, while the cost of battery storage has dropped 82 percent, according to Bloomberg New Energy Finance.

Thanks to falling battery prices, electric-vehicle adoption worldwide will increase substantially between 2025 and 2030, Jeffrey Osborne, an analyst at Cowen Inc., has predicted. A 2017 report from Cowen says battery cost declines and carbon-dioxide restrictions will make internal combustion engines more expensive. “Government plays an important role in funding advanced R&D in partnership with the private sector as well as creating the regulatory framework and parameters to encourage competition, allowing the market to separate winners from losers rather than mandating a certain technology,” Osborne writes in the report. Add to this list advances in agriculture, urban planning with networked “smart” technologies, and more-efficient robots.

A long way to go

More than 50 national and regional programs worldwide address only a small fraction of global carbon emissions.

Subsidies, essentially the flip side of a tax, can be used to create incentives and help make wind, solar, and other renewable energies cheaper and more competitive compared with gas and coal. “It’s smart to start by subsidizing new technology,” argues Sterner, who says subsidies can help pave the way for a tax, as it makes it harder for opponents to claim there are no alternatives to fossil fuels. Germany was the first country to subsidize green technology on a large scale and was followed by China, whose subsidy of its solar industry drove down world prices 80 percent

Share of annual greenhouse emissions covered by every known carbon tax and emissions-trading system in the world

Based on global emissions in 2012



between 2008 and 2013—and caused the collapse of solar stocks in the US and Europe. Sterner concedes subsidies can be disruptive but says they also speed up a perhaps-inevitable technological transition. “Time is of the essence here. We’re in a hurry to get rid of carbon emissions.”

But ultimately, much depends on the price of fossil fuels, which are cheap and abundant. In a sign of its commitment to fossil fuels, the Trump administration has been pushing to approve exploration for oil in Alaska’s Arctic National Wildlife Refuge, which was formerly off-limits but could begin producing oil within a decade.

“If the past 35 years is any guide, not only should we not expect to run out of fossil fuels any time soon, we should not expect to have less fossil fuels in the future than we do now. In short, the world is

likely to be awash in fossil fuels for decades and perhaps even centuries to come,” write Chicago Booth’s Thomas Covert, University of Chicago’s Greenstone, and MIT’s Christopher R. Knittel in a 2016 study. They find, among other things, that at a then-current battery cost of \$325 per kWh, “the price of oil would need to exceed \$350 per barrel before the electric vehicle was cheaper to operate.”

Covert warns that the technology to extract fossil fuels is also improving, perhaps as fast as battery and solar technology is. Fossil fuels got even cheaper with the development of fracking technology. If engineers are able to extract methane hydrates under the ocean bed in a commercial fashion, fossil fuels could get cheaper still.

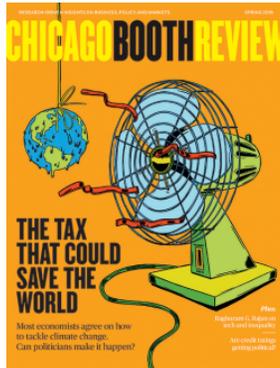
The researchers conclude that the market, absent policy action, isn't going to have a great enough effect to slow climate change. In that case, what's the best way to proceed? Pursue a politically infeasible tax? Embrace cap and trade? Spend more time and money crafting incentives for basic research and commercializing clean technology?

The issue is urgent, but the timing is terrible. Every new study confirms the need for the world's big economic powers to act promptly and decisively. At the same time, political polarization and the rise of populism has turned the tide against international cooperation and global thinking.

Economics may offer some practical guidance through this mire. While economists may disagree on this, as on every other issue, there is also an emerging consensus among scholars on the need for action of some kind. As Covert notes, "Almost everybody in the environmental-economics community would prefer a tax policy or a cap-and-trade policy than no policy at all."



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