DRIVING DEEP DECARBONIZATION

As green energy costs drop, we should shift the emphasis from economy-wide carbon pricing to sectoral policies

James H. Stock

World leaders have accepted the warnings of scientists that global temperatures must increase by no more than 1.5 or 2 degrees Celsius to avoid severe damage to the Earth's ecosystems and to human health and welfare. According to recent surveys, the general public increasingly agrees on the need for climate action.

As a result, many countries and some subnational entities have set ambitious targets for reducing greenhouse gas emissions. This past spring, the United Kingdom adopted a target of 78 percent emissions reductions by 2035, relative to 1990 levels. In the United States, the Biden administration announced a (nonbinding) goal of reducing net greenhouse gas emissions by 50–52 percent by 2030, relative to 2005. At the subnational level, several US states, including California, Colorado, Massachusetts, and New York, have legislated targets to approach or reach net zero emissions by 2050.

The climate crisis is too important to let these goals turn into failed promises. What policies are needed to turn these ambitious targets into action?

Economists' standard prescription is to implement a robust economy-wide price on carbon. A carbon price that starts at a moderate rate and grows predictably will incentivize individuals to use lower-carbon sources of energy than fossil fuels and will induce firms and power generators to switch away from fossil fuels to low-carbon primary sources of energy. An economy-wide carbon price efficiently obtains emissions reductions from sectors or uses where they are least costly while keeping costs manageable in applications difficult to decarbonize. Moreover, depending on how it is implemented, revenues from a carbon price can be used to reduce distortionary taxes elsewhere or to provide needed public investment.

A frequent response to this prescription is that it ignores the political reality that carbon pricing, especially through a carbon tax, is unpopular. Despite considerable efforts over decades, only a small fraction of worldwide carbon emissions is covered by a carbon pricing program, and among those programs that do exist, the carbon price is typically low.

Now there is an additional reason to question this focus on economy-wide carbon pricing: it was developed when green energy was expected to remain far more expensive than fossil fuels. In many parts of the world, however, green energy, especially wind- and solar-generated power, is either less expensive than fossil fuel generation or is likely to become so soon. Costs of technologies to use green electricity—electric vehicles, for example—have also fallen dramatically. How does climate policy advice change for a world where it could be cheaper to be green?

Three externalities

Policies for the energy transition confront (at least) three externalities: the greenhouse gas externality; the innovation externality; and, in some cases, network (or chicken-and-egg) externalities. The greenhouse gas externality arises because the cost of damages to others, now and in the future, is not borne by those who burn fossil fuels. The innovation externality arises because the financial gains from innovation generally cannot be fully appropriated by the innovator. This externality justifies public financial support for basic research but also extends to other aspects of innovation, such as non-appropriable learning by doing in production and management. In the context of the energy transition, the network externality typically stems from built infrastructure. An example is electric vehicles (EVs) and charging stations: a lack of charging stations holds back demand for EVs, but a lack of these vehicles holds back the private supply of charging stations. In this case, there can be two stable equilibria: one with few EVs and charging stations and one with many EVs and charging stations.

Environmental economists have historically focused on the greenhouse gas externality, and with good reason: for the past hundred years, it has been significantly cheaper to emit carbon dioxide than not to when producing and using energy. When that is the case, the goal of climate policy is to encourage efficient self-restraint through policies such as carbon pricing and energy efficiency standards and to encourage changes in behavior, such as flying and driving less.

But two things have changed. First, the cost of *producing* clean electricity by wind and solar power has fallen dramatically, to the point that, in some parts of the United States, building new grid-scale solar and wind systems is less expensive than running existing coal and natural-gas-fired generators. Second, for some applications the cost of *using* clean energy may soon be lower than that of using fossil fuels, although this varies a good deal depending on the sector.

Making it cheaper to be green

The prospect of cheap green energy requires a fundamental shift in how we think about climate policy—from how we can make it more expensive to be dirty to how we can make it cheaper to be green. Whether we actually reach a low-cost green equilibrium is far from certain, however: whether we get there, and how quickly, hinges on policy.

With multiple market failures, efficient policy needs multiple policy instruments. Because all sectors and all countries are different, there is no single elegant one-size-fits-all combination of instruments. Rather, the most efficient suite of policies for one sector is generally not the most efficient suite for other sectors. An efficient mix of climate policy instruments must be crafted to address market failures, technological status, and institutional challenges at a more nuanced level.

Consider, for example, light- and medium-duty vehicles. The price of a new EV is on track to fall below that of comparable conventional internal combustion engine vehicles during this decade. This price decline is driven by the ongoing, remarkable decline in battery prices, manufacturers' increasing experience in producing EVs, and improved battery technologies on the horizon. Moreover, EVs are less expensive to operate and maintain than conventional vehicles.

But the transition to EVs is not a sure thing, and in any event it can be expedited and supported by policy. In particular, the chicken-and-egg externality of charging stations poses some significant challenges. Absent adequate slow (level 2) charging stations, EV owners must provide their own charging capacity—which means a dedicated parking space where they are able to install a charger. Not surprisingly, EV purchases heavily skew toward higher-income families with their own garages, which in turn affects the types of EVs produced. Policy to support reliable widespread overnight or at-work charger availability could help overcome this chicken-and-egg problem, thereby accelerating the transition and ensuring a larger EV share.

On the other hand, a moderate carbon tax is likely to have little effect on EV purchases, because the cost impact is small (a \$40/ton carbon tax implies \$0.36 for a gallon of gasoline). In fact, there is a substantial literature that investigates whether car buyers properly take into account fuel prices when they purchase a vehicle; that literature tends to find that purchasers only partially account for fuel prices. For light- and medium-duty vehicles, addressing the network externalities and innovation externalities for advanced batteries is more effective and impactful than carbon pricing. Because those policies aim to facilitate the transition from the current low-EV equilibrium to a stable, low-cost high-EV equilibrium, those transitional policies have a limited duration and one-time costs.

In contrast, aviation is a major and growing source of carbon dioxide emissions and appears quite difficult to decarbonize. Currently there is enthusiasm about low-carbon sustainable aviation fuel. Such fuel can be produced through conventional pathways such as conversion of waste vegetable oils and oil crops to renewable jet fuel or through advanced pathways—for example low- or negative-carbon alcohols, such as ethanol from energy grasses, converted to jet fuel.

In its 2021 *Annual Energy Outlook*, however, the US Energy Information Administration projected the price of petroleum jet fuel to be \$2.77/gallon in 2050 (2020 US dollars). The prospect of sustainable aviation fuel competing with petroleum jet fuel at \$2.77/gallon, unaided by an implicit or explicit carbon price, is daunting. A switch to sustainable fuel depends on robust funding to address the innovation externality and, when those fuels become available at scale, a high carbon price (either an explicit price or a clean fuel standard for aviation). Especially if the carbon price is implemented through an aviation fuel standard, this phasing could be critical: implementing a fuel standard too soon runs the risk of preferencing first-generation fuels without adequate support for scalable fuels with zero or negative carbon footprints, as has been seen in the failure of the US Renewable Fuel Standard to promote second-generation low-carbon ethanol. Sustainable aviation fuel works in standard jet engines and uses much the same infrastructure as petroleum jet fuel, so network externalities matter less. For aviation, this suggests policy that strongly supports the development and commercialization of advanced, scalable, and truly low-carbon sustainable aviation fuel now and a credible commitment to a high sectoral carbon price in the future.

In the power sector, all three externalities figure prominently in the transition. In the United States, new wind and solar power generation is less expensive than coal and natural gas in some but not all parts of the country. As a result, US power sector modeling suggests that a national policy that effectively puts a price on carbon—such as a clean electricity standard—is necessary to achieve substantial near-term decarbonization, say 80 percent by 2030. Deeper decarbonization will likely require significant innovation-driven cost reductions in storage technologies. In addition, the infrastructure of the US power sector restricts the ability to transmit green electricity from regions with high renewable resources to demand centers.

The power sector also faces serious institutional challenges, such as the regulatory and physical ability to use time-of-day pricing and load management and the institutional and political problems of siting new transmission capacity. For the power sector, supporting research and development of long-term storage technologies and addressing multiple infrastructure and institutional limitations are essential. The necessary first step, however, is a sectoral policy, such as a clean electricity standard, that has the effect of placing a price on carbon.

This is not to say that an economy-wide carbon tax is undesirable: the decarbonization from a clean electricity standard, and its limited effect on power prices, could be accomplished by an economy-wide carbon tax combined with government subsidies for renewable power, and that tax would yield some decarbonization from other sectors as well. For aviation, an economy-wide carbon price could, two decades from now, support the use of still-expensive low- or zero-carbon alternatives to petroleum jet fuel. But this reasoning suggests that pursuing an economy-wide carbon price is a lower priority today than it was when it was expensive to be green. Economy-wide carbon pricing, while desirable, by itself is neither efficient nor, at politically plausible prices, sufficient to drive deep decarbonization.

How can economists help?

I have focused on the economic case for shifting from economy-wide pricing to sectoral policies. That case is strengthened by the evident aversion of the political system to explicit pricing. But the political benefit of sectoral policies—their less visible costs than economy-wide pricing, in part because nonexperts often do not fully understand them—also exposes them to inefficiencies. Given the scale of the decarbonization challenge, it is critical that such policies be as cost-effective as possible. We cannot afford to spend trillions of dollars on policies that fail to achieve deep decarbonization.

Sectoral climate policy design questions are often nuanced. How can a charging station policy be designed to maximize electric vehicle adoption and use instead of simply providing inframarginal transfers for stations that would be built anyway?

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Is investing in green industrial policy—for example, subsidizing domestic battery production—a cost-effective way to reduce emissions in the long run? Are subsidies for purchasing electric vehicles likely to be passed through to the consumer and thereby stimulate sales? What policies will most efficiently support the robust development of low-carbon sustainable aviation fuels?

Economists are good at disentangling incentives, anticipating unintended consequences, and assessing the costs and benefits of candidate policies. One practical challenge for economists working on sectoral policies is that those policies can become highly detailed; another is that policy is evolving on a time scale faster than that of academic economists. This is where the world's economic policy institutions, like the IMF, can play a critical role by enhancing and providing nuanced, sectoral expertise to promote the transition to a greener—and in many cases, cheaper—energy future. FD

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