Conventionally, carbon pricing takes place when the government either creates a cap-and-trade scheme or a carbon tax. But we've begun to see carbon prices popping up in other interesting ways. The idea of putting a price on carbon seems to have influence well outside of the classic tax-or-trade models.

For instance, carbon pricing has moved beyond the public sector. According to a 2016 survey, 140 global companies included a "shadow price" in their investment decisions. Some firms go farther. One major American bank applies a carbon price to the operations of borrowers in considering credit risks. A leading software company actually charges its business groups a small carbon fee and uses the funds to support internal efficiency initiatives, green power, and carbon offset projects. If nothing else, these business actions reflect an expectation that emitting carbon will become increasingly costly in the future.

Here's another example: Rather than using cap-and-trade, Washington State has adopted the "trade" but not the "cap." In contrast to California, Washington State has adopted a distinctive hybrid of conventional regulation and emissions trading. The state's Clean Air Rule went into effect in January 2017. The rule requires major emitters of greenhouse gasses to limit and reduce carbon pollution and incentivizes investments to reduce fossil fuel use and accelerate use of clean energy. Unlike California, the state didn't set a statewide cap on emissions. Instead, each facility is assigned its own emission reduction pathway, using its average baseline emissions in 2012-2016 as a baseline. Thereafter emissions must decrease at a rate of 1.7% per year. Every three years, a facility must demonstrate that it met its reduction goals or face penalties. There is also a reserve of emission reduction units (ERUs) to accommodate new facilities. (In effect, the emissions ceiling is the sum of the targets for all individual plants still in operation plus the ERUs used from the reserve fund, but the state itself never sets an explicit target for statewide emissions.) The state allows trading of ERUs and says that trading will also be allowed with out-of-state programs when those are approved.

Even further from the conventional carbon pricing models, Australia has come up with what might be called a "reverse carbon tax." The Australian government is committed to cutting emissions to 5% below 2000 levels by 2020 and to 26-28% below 2005 levels by 2030. Firms can receive emission credits through verified emission reductions below business as usual. The government pays for the credits, using a reverse-auction so that the company offering to reduce emissions for the cheapest price wins the auction. To ensure that these emissions reductions aren't offset by increases elsewhere, a "safeguard mechanism" caps the emissions of the

140 largest sources at the highest historical level. Five auctions had been held as of the end of 2016, resulting in 435 projects securing carbon abatement contracts to deliver 189 million tons of abatement at an average price of AU$11.83.

From an economist's point of view, the Australian scheme is very similar to a carbon tax even if it looks quite different. The "tax" isn't paid out of the firm's checking account. Instead, it consists of the lost opportunity to be paid for reducing emissions. This opportunity cost is a hit to the firm's potential profits just as much as actually paying the tax. Theoretically, at least, it should have much the same incentive effects as an actual tax.

As compared with conventional taxes and trading systems, these methods of carbon pricing have costs as well as benefits. The corporate scheme's primary purpose isn't to deal with an externality but to anticipate future government action. Still, the effect is that a future government carbon price starts limiting emissions well before it is actually adopted, simply because firms are already internalizing it. The Washington State scheme imposes lower costs on laggard firms that had high emissions in the baseline period, correspondingly penalizing those that had already started cutting emissions. On the other hand, because it is more focused on cuts at individual facilities, the Washington approach may be more appealing to environmental justice advocates than California's more conventional cap-and-trade system. The Australian scheme misses out on the opportunity to use revenues from carbon pricing for other desirable programs or to reduce other taxes. It also seems unfair that firms causing harm to the planet should be subsidized to mend their ways. One of its advantages, however, is that it is able to include the full range of emissions-causing activities, not just emissions from the energy system. The Washington and Australian have another advantage: they were apparently politically feasible in a situation where something like the California approach was not.

On the other hand, these schemes will find it difficult to link with other jurisdictions. Perhaps for this reason, Virginia's governor recently directed the state's environmental agency to come up with a plan to limit power plant emissions that "includes provisions to ensure that Virginia's regulation is 'trading-ready' to allow for the use of market-based mechanisms and the trading of carbon dioxide allowances through a multi-state trading program."

On the whole, I think the priority should be on the conventional mechanisms of carbon taxes or cap-and-trade. Besides being easier to link or at least coordinate

with other jurisdictions, they respect the polluters-pay principle (unlike Australia's system), and do not depend on industry initiative or taxpayer funding to operate. But the other alternatives are intriguing. They also show the breadth of the carbon-pricing concept and its adaptability to different institutional and political settings. And they provide further evidence of the ingenuity and creativity with which people remold ideas to achieve their goals.