Cleaning up on carbon

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Both national and global climate policy must redirect its focus from setting a price on carbon to promoting the rapid deployment of clean technologies.

As is typical of most climate legislation now being proposed, America's Climate Security Act, which recently went before the US Senate, aimed at reining in greenhouse gas emissions primarily by setting a price on carbon dioxide. Although hailed as landmark legislation, the proposal, which died after it failed to muster close to the required 60 votes, would not have put the nation on the path required to help avert catastrophic climate change.

The proposed act, also known as the Boxer–Lieberman–Warner Bill after its lead sponsors, sought to regulate carbon dioxide by setting a legal limit or cap on emissions and allowing emitters to trade their carbon allowances or quotas on a national market. Through a variety of cost containment measures, it would have enabled polluters to avoid cutting their own emissions now, instead allowing them to offset up to 30 per cent of their emissions allowances against other — mostly non-energy-related — projects and to borrow as much as 23 per cent of any year's emissions from the future, with the promise of making equal or greater reductions later.

But the science has already moved far past the legislation. It is now clear that we can no longer base our efforts to tackle climate change on hopes of reducing our own emissions at some point in the future or on letting others reduce emissions for us. The latest assessment report from the Intergovernmental Panel on Climate Change (IPCC), together with other recent scientific studies on carbon-cycle feedbacks, should have led to a radical revision of national and global climate legislation.

OMINOUS OUTLOOK

The goal of climate mitigation is to avoid dangerous human-caused impacts, which science suggests would mean limiting total warming to 2 °C above preindustrial temperatures. In turn, this would require keeping atmospheric concentrations of carbon dioxide below 450 parts per million (p.p.m.). According to the IPCC's Fourth Assessment Report in 2007, model studies based on our current understanding of climate–carbon-cycle feedbacks suggest that to stabilize carbon dioxide levels at 450 p.p.m. could require that cumulative emissions over the twenty-first century reach only about 490 gigatonnes of carbon (GtC), which equates to less than 5 GtC per year[1].

Similarly, stabilizing atmospheric carbon dioxide levels at 1,000 p.p.m. would require cumulative emissions this century of only about 1,100 GtC. In other words, if annual emissions average 11 GtC this century, we risk the real, terrifying prospect of seeing 1,000 p.p.m. carbon dioxide in the atmosphere and a 'best estimate' warming of a staggering 5.5 °C by the end of the century.

GETTY

Climate policy must focus on the rapid deployment of existing clean technologies on large scales, such as the installation of 1 million 2-megawatt wind turbines.

Carbon emissions from the global consumption of fossil fuels are currently above 8 GtC per year and rising faster than the most pessimistic economic model considered by the IPCC[2]. Yet even if the high price of energy from fossil fuels and power plants combines with regional climate initiatives to slow the current rate of growth somewhat, we will probably hit 11 gigatonnes of carbon emissions per year by 2020.

WEDGES OF PROGRESS

What would then be required merely to keep global emissions frozen through most of the rest of the century? I use the 'stabilization wedges' approach put forward by Robert Socolow and Stephen Pacala of Princeton University to answer that question qualitatively. As Socolow and

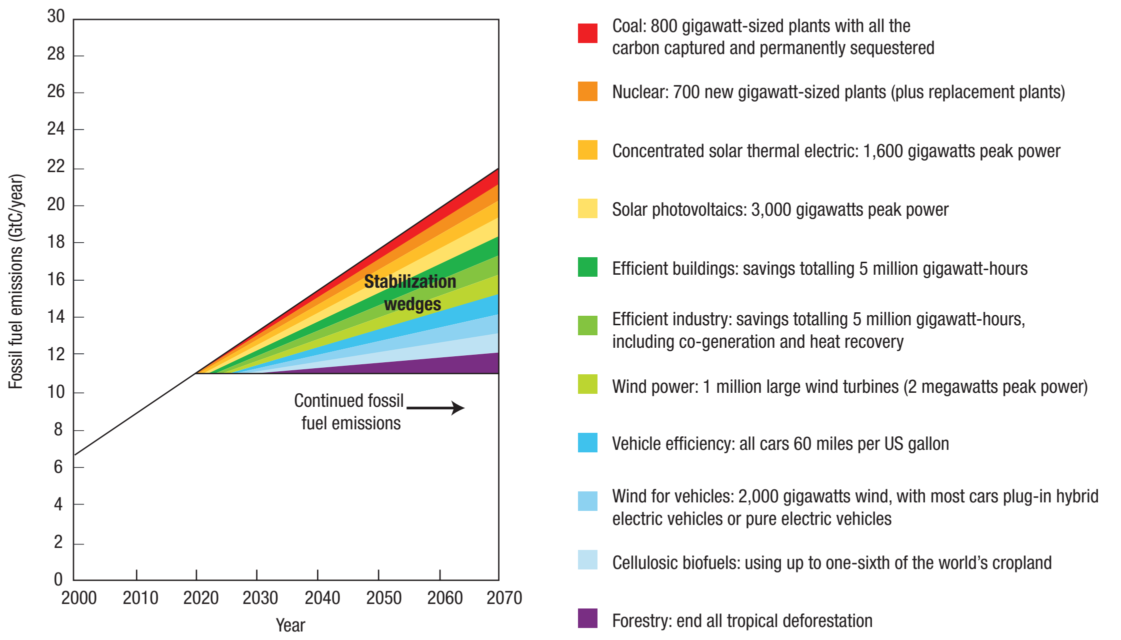

Figure 1 Strategy for stabilization. The top line represents business-as-usual global carbon emissions (in GtC) from fossil fuel combustion projected through 2070. Each of the 11 coloured wedges represents a different climate strategy that is deployed globally beginning in 2020 and avoids 1 GtC/year by 2070. Continued through 2100, this flat emissions path of 11 GtC/year would bring global carbon dioxide concentrations of 1,000 p.p.m. if accompanied by climate–carbon-cycle feedbacks anticipated by the IPCC. The 'wedges' approach is not analytically rigorous in that Socolow and Pacala[3] do not know the business-as-usual baseline — they don't specify, for instance, how many nuclear plants will be built in the absence of climate policies. Because the IPCC's own economic models do not present a clear baseline, this should not be seen as a fatal flaw; nonetheless, the wedges above should be taken as qualitative rather than prescriptive. Strong efforts would also be required to decrease other greenhouse gases, but they are not the focus of this article. This figure is inspired by Socolow and Pacala's stabilization wedges[3] but does not represent the views of the original paper's authors or of Princeton University's Carbon Mitigation Initiative. Modified from the original with permission from Princeton University and AAAS.

Pacala explain[3], "A wedge represents an activity that reduces emissions to the atmosphere that starts at zero today and increases linearly until it accounts for 1 GtC/year of reduced carbon emissions in 50 years." So the planet would need 11 wedges to keep emissions flat at 11 GtC per year from 2020 to 2070. Figure 1 shows one possible version of those wedges.

Each of these wedges represents a staggering amount of effort by both the public and private sectors. For instance, one wedge of coal with carbon capture and storage represents a flow of carbon dioxide into the ground equal to the current flow of oil out of the ground. It would require, by itself, recreating the equivalent of the planet's entire oil delivery infrastructure over the course of five decades. And achieving all 11 wedges would still keep us on a path towards atmospheric levels of 1,000 p.p.m. of carbon dioxide by 2100 and a variety of catastrophic impacts, including the extinction of most species, the desertification of one-third of the planet, and a return to temperatures not seen since the Earth was ice-free.

If we are to have confidence in our ability to stabilize carbon dioxide levels below 450 p.p.m. emissions must average less than 5 GtC per year over the century. This means accelerating the deployment of the 11 wedges so they begin to take effect in 2015 and are completely operational in much less time than originally modelled by Socolow and Pacala, say in 25 years. As a result, in 2040 global emissions would be at about 4 GtC per year. We would then have six decades to cut emissions in half again (or by more if the science deems it necessary), which would require an equally impressive effort.

STRATEGIC PURSUITS

This suggests that if we want to avoid dangerous warming — and maintain the option of keeping the temperature increase even lower than 2 °C above pre-industrial temperatures — then climate legislation needs to be refocused on immediate action. The current emphasis is on spending years putting in place a cap-and-trade system with myriad cost containment provisions in the hope that it will ultimately lead by the 2020s to setting a price for carbon that will get us onto the right path in terms of technology and emissions.

The limits of a strategy built around carbon pricing can be seen in the European Union's Emissions Trading Scheme, the world's largest system for pricing carbon and trading permits. A full decade after signing the Kyoto Protocol, European nations finally have in place a cap-and-trade system with a significant price for allowances, namely US$40 per metric ton of carbon dioxide. Yet utilities in Italy, Great Britain, the Czech Republic and Germany are reported to still be pursuing new coal-fired plants[4], so we must clearly go beyond pricing carbon. The United States simply cannot wait another decade to find out whether domestic cap-and-trade legislation will drive carbon dioxide to a high enough price to curb emissions growth sharply.

We already know the most urgent strategies needed to stop emissions from rising — a prohibition on new traditional coal-fired plants, and the use of low-carbon technologies for all new power provision. So why should we not simply require that legislation focus directly on those outcomes? Industrialized nations should directly adopt legislation requiring all new coal power plants to meet an 'emission performance' standard that limits their output of carbon dioxide to levels that are achievable with carbon capture and storage systems. Until wealthy nations take this step and show that it can work, developing countries will not be encouraged to do so — and without such action it is difficult to see how we will escape the current trajectory of escalating global emissions.

At the same time we need to adopt a series of aggressive strategies for technology deployment, which should include tax credits, loan guarantees or other incentives for low-carbon technology, demonstration projects of technologies such as carbon capture and storage, a standard for electricity generation involving renewable or low-carbon options, a low-carbon fuel standard, tougher standards for fuel economy and appliances, and utility regulations that create a profit for investments in efficiency. These are all features of the climate plan of the Democratic presidential nominee, Barack Obama[5], but are not part of the announced climate strategy of Republican presidential nominee John McCain, whose plan starts by allowing unlimited offsets[6].

RAPID RESPONSE

Although it has recently been argued that "enormous advances in energy technology will be needed to stabilize atmospheric carbon dioxide concentrations at acceptable levels"[7], on the contrary it would seem that "humanity already possesses the fundamental scientific, technical, and industrial know-how to solve the carbon and climate problem for the next half-century"[3].

In fact, such is the urgent need to reverse emissions trends by deploying a multitude of low-carbon technologies that we *must* rely on technologies that either are already commercial or will very shortly be so. Fortunately, venture capitalists and public companies have begun to inject many billions of dollars into the development and short-term commercialization of most plausible low-carbon technologies. Governments should now focus their R&D spending on a longer-term effort aimed at a new generation of technologies for the emissions reduction effort after 2040, but the notion that we need a Manhattan Project or Apollo programme for technology development is mistaken. Instead, what is urgently needed is an effort of that scale focused on the deployment of technology.

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Some may believe that stabilizing atmospheric carbon dioxide concentrations below 450 p.p.m. is so difficult that we should seek to stabilize them at 550 p.p.m. or higher. But from a policy perspective, stabilizing at 550 p.p.m. is not much easier to achieve than levelling off at 450 p.p.m. — it still requires employing the vast majority of the wedges described here in under five decades, starting very soon. And yet the scientific evidence suggests that reaching 550 p.p.m. could have much graver consequences, for example destroying a large fraction of the permafrost[8,9], which houses a third of the carbon stored in soils globally. Much of this carbon would be released in the form of methane, a far more potent greenhouse gas than carbon dioxide, and could thus trigger more rapid climate change. Delay therefore risks crossing climate thresholds that would make efforts at emissions reduction far harder, if not almost impossible.

The latest science suggests that national and global climate policy is seriously misdirected. We must aim at achieving average annual carbon dioxide emissions of less than 5 GtC this century or risk the catastrophe of reaching atmospheric concentrations of 1,000 p.p.m. A carbon price set by a cap-and-trade system is a useful component of a longer-term climate strategy. Implementing such a system, however, is secondary to adopting a national and global strategy to stop building new traditional coal-fired plants while starting to deploy existing and near-term low-carbon technologies as fast as is humanly possible.

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