CONTAINING CLIMATE CHANGE

15 questions related to the fate of the planet

By Raymond J. Kopp

The die is cast: our planet is going to get warmer. But the decisions we make – or don't make – will determine how fast and how hot it will get. Here in the United States, both presidential candidates are committed to serious efforts to slow the rate of climate change. But the success of any program will require good policy choices in the teeth of public skepticism and well-organized interest-group opposition.

What's the goal?

The authoritative United Nations Intergovernmental Panel on Climate Change warned in 2007 that a rise in the global average temperature beyond 1.5 degrees to 2.5 degrees Celsius (2.7-4.5 degrees Fahrenheit) would lead to grave consequences for water and food supplies. In response, the European Union decided to set the bar at 2 degrees C – a goal that would require phenomenally fast and vigorous action by the world's big economies. The United States has no official goal, but most of the recent discussion has implied that policymakers would settle for about 3 degrees Celsuis of warming.

There's a near-consensus that the principal driver of warming is carbon dioxide emissions. Late in the 17th century, before the Industrial Revolution, carbon dioxide concentrations in the atmosphere were about 280 parts per million for centuries. Currently, they are around 380 parts per million and climbing at a rate of 2 to 3 parts per million annually.

To keep the average global temperature from increasing more than 2 degrees C, it would be necessary to stabilize the carbon dioxide concentration at somewhere around 450 parts per million. A 3 degree goal would require stabilization at about 550 parts per million. Yet business as usual worldwide would lead to carbon dioxide levels in the range of 710 to 880 parts per million by the end of the century. With the concurrent rapid rise in the emissions of other greenhouse gases, primarily methane and nitrogen oxides, the atmosphere would contain the equivalent of 930 to 1,390 parts per million of carbon dioxide. At that concentration, temperatures would be somewhere between 2½ degrees and 7 degrees C higher.

At the lower end of that range the world could adapt – although it wouldn't be cheap or painless. The upper end threatens a true catastrophe, creating a climate well beyond anything in human experience.

What would it cost the global economy?

If it were cheap to reduce carbon dioxide emissions, there would be nothing to debate. But that's hardly the case.

The best guess now is that limiting the concentration to 450 parts per million would be anywhere from 3 to 10 times as expensive as allowing 550 parts per million. But stabilizing at a concentration of 650 parts per million would cost only half to one-fourth as much as at 550 parts per million.

Economic simulations suggest that the cost of holding to 550 parts per million would be significant, but would not be much of a stretch. One study, for example, shows that a vigorous climate policy aimed at this target might slow growth by 0.3 to 0.7 percent a year, still allowing the global economy to expand by 2.9 percent annually.

The burden, however, would not be spread evenly across households, industries or regions. Energy prices would rise (perhaps substantially) and these higher energy costs would have a disproportionate impact on people who commute long distances, live in very hot or cold climates, depend on electricity from coal-fired plants or use a lot of power in other ways.

Economists have tried to get a handle on the likely changes in energy prices needed to achieve various benchmark concentrations, but their projections have been knocked badly askew by the massive increase in oil prices over the past few years. This should remind us of an important truth: decisions on climate policy will not only affect what happens in the energy markets, but will also be strongly affected by them.

One line of argument holds that it would be better to do nothing now about emissions, but instead get rich as fast as possible, amassing the resources to deal with the consequences of warming later in the century. The catch here is that nobody knows for sure how fast the temperature will rise or exactly what warming will do. There is a chance – small, perhaps, but not zero – that within decades, rather than centuries, warming could cause an epidemic of floods and droughts that would be far, far more costly than cutting emissions preemptively.

How about the other countries?

No single country's commitment to cut emissions will make much difference if other big emitters aren't moving in the same direction. The world's first attempt at an international treaty on climate change, the Kyoto Protocol, suffers from a grave defect: it puts no constraints on the countries that will soon become the world's biggest sources of emissions. When the protocol was drafted, its authors accepted the principle that, since the affluent developed countries had generated a disproportionate amount of the carbon dioxide that was causing the problem, they had an obligation to take the lead on the solution. Thus, Kyoto limits the emissions from some developed countries, but leaves the question of the obligations of developing countries – notably China, India, Brazil and Indonesia – wide open. That was one of the reasons why the United States, the world's biggest emitter at the time of the treaty negotiation, refused to sign it.

If Congress passes serious climate legisla-

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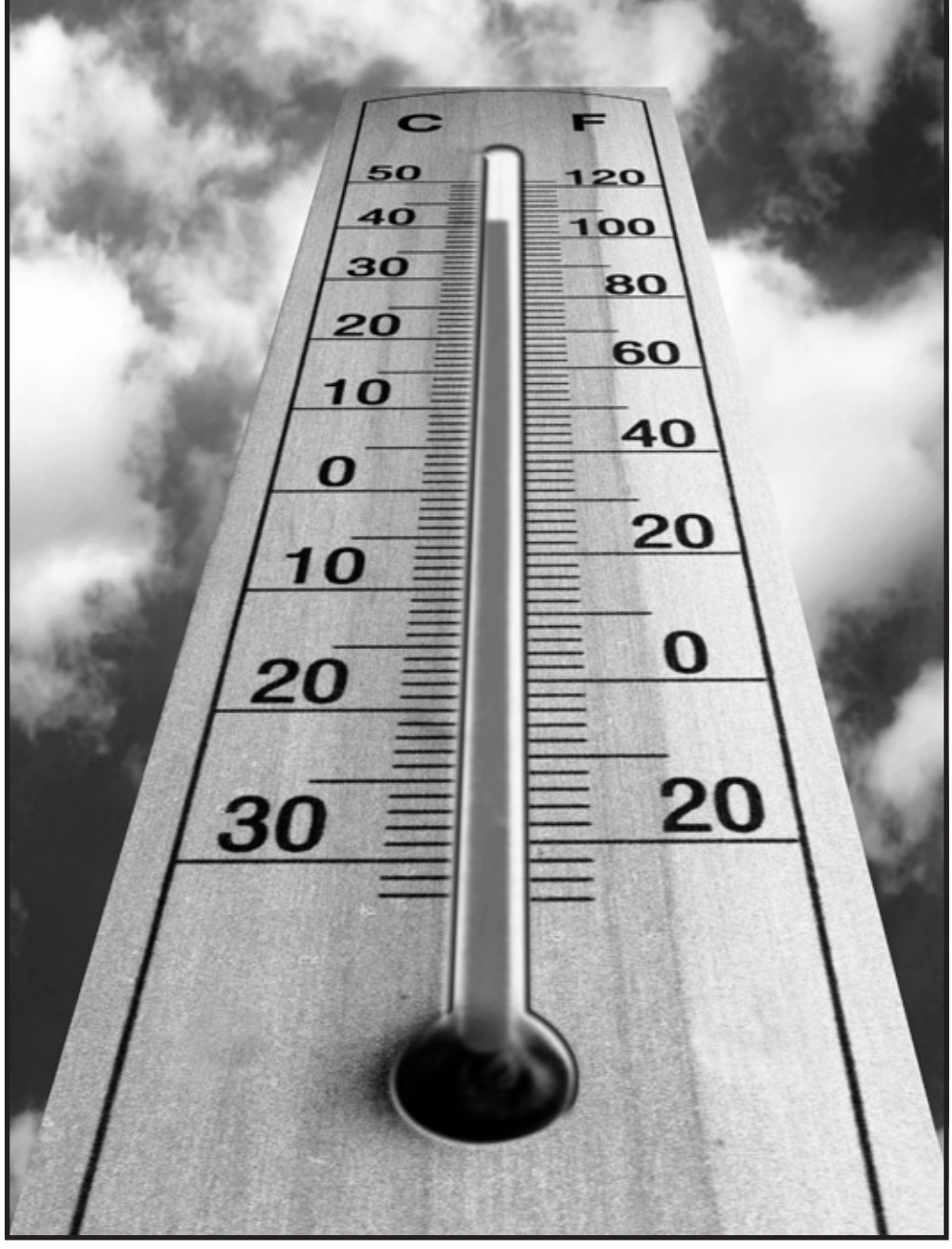

tion soon, the United States will gain some leverage to assert leadership in organizing a worldwide effort. But policymakers will have to come up with persuasive reasons for the developing countries to join – most likely, financial incentives and technological help that make the cleaner alternatives to conventional coal-fired electricity generation more attractive.

Paying to clean up the backyards of people who can't vote in American elections would be a bitter pill for Congress to swallow. But the fact that American makers of energy-efficient equipment and technology would profit along the way would make the medicine go down more easily. One can also imagine a deal in which capital and technology are exchanged for commitments from China, India, Brazil and others to reduce emissions from sectors that are in direct competition with energy-sensitive United States industries, like steel.

4 Wait for technology?

So far, American policy has been to prevaricate until technology is available that cuts emissions without raising costs. And so far, experience suggests that the necessary technologies won't be developed or deployed until policy makes it more expensive to emit carbon dioxide than it is now. Technology development is a complement to carbon dioxide regulation, not a substitute.

By almost every reckoning, federal money will be needed to speed the process. But that cash must be backed by leadership if the subsidies are to be effective. The Bush administration, for example, recently acknowledged that its major initiative in zero-emissions electricity generation, coal-fired plants in which the carbon dioxide would be captured and stored rather than being emitted, was too expensive to see through to completion. Congress, for its part, is having second thoughts about the host of incentives it offered to encourage production of ethanol. The result of those incentives has been a sharp increase in the price of corn, the cheapest domestic feedstock for ethanol, without much evidence of net reductions in emissions.

Cap-and-trade, or a tax on emissions?

Congress seems willing to accept the principle that charging emitters of carbon dioxide for the privilege is a necessary component of any meaningful climate policy. There are two ways to manage that: taxes on tonnage, or caps on total emissions. Both are simple in concept but likely to be extremely complex in practice. Although economists have vigorously debated which option is more appropriate in theory – most prefer taxes – neither is a hands-down winner. Everything depends on the details.

The case for a tax begins with the idea that it is straightforward: you emit, you pay. But Congress would be under heavy pressure to soften the blow for specific industries (per-

TOM LANGFORD

haps steel, cement and coal-dependent utilities), regions of the country (like the low-density West?), and demographic groups (like the rural poor?). Fairness, you could argue, demands no less. But that also means undermining the incentives to reduce carbon dioxide emissions in precisely those parts of the economy that are emitting the most. Everywhere one turns, it seems, questions of fairness collide with calculations of economic efficiency and administrative simplicity.

A cap-and-trade system would set an emissions limit for the whole country, then reduce the limit over time. Every emitter would get permits to dump carbon, but proportionately fewer each year. Emitters that could cut down relatively cheaply could (and presumably would) sell their excess permits to emitters that couldn't.

Cap-and-trade can work: the United States is already running highly successful cap-and-trade markets for two air pollutants, sulfur dioxide and nitrogen oxides, while the European Union is making reasonable progress with a market for carbon dioxide.

Note that while carbon taxes and cap-and-trade both work by creating incentives to emit less, there is one big difference. A tax sets the level of the financial burden per ton on emitters, but leaves it to them to decide how much to emit. A cap-and-trade program, by contrast, fixes total emissions but leaves it to the market to set the price. And the resulting uncertainty about cost in a cap-and-trade program has proved a major political sticking point.

There is a way to compromise. A cap-and-trade program could include a "safety valve" in the form of a maximum price for a permit. If the free-market price hit that maximum, the government would sell as many permits as demanded at that price. The issue then becomes, of course, what price to set for the safety-valve permits. Set it very low, and the policy has little or no impact on total emissions; set it very high, and it becomes no safety valve at all.

The bottom line here is that policy can determine the price of emissions reductions or the volume of reductions, but not both. Congress (and both presidential candidates) seems inclined to embrace cap-and-trade, in part because it generates certainty about emissions levels and in part because it would not impose new taxes. But there's no magic bullet here.

Who's regulated?

The conventional way of controlling pollution is to regulate the big sources – for example, limiting emissions from industrial smokestacks, but not from household cleaning chemicals. In the case of carbon dioxide, the giants are the electric utilities and the big industrial users of gas, oil and coal. The European cap-and-trade program focuses on precisely these emitters.

If a similar approach were used in the United States, about 13,000 sources that create about half of the country's carbon dioxide emissions would be regulated. But that, of course, would leave out the other half, including the hundreds of millions of cars and trucks.

A better alternative is to go as far "upstream" as possible in the fossil-fuel-distribution chain, regulating output from coal mines, petroleum refineries, natural-gas pipelines and importers. That way, the program would effectively cover nearly all of the carbon dioxide (including the important transportation emissions) by regulating just 3,000 sources.

Who gets emissions permits, and on what terms?

Washington could simply give away permits to the regulated firms. But the permits could also be sold at auction, or given to the states, which could distribute them as they please. Or, of course, a little of each.

There are no economic reasons to link permit distribution to historical emissions rates or to give them away. Legislation – the Lieberman-Warner bill – that came to the Senate floor briefly last June, before succumbing to a Republican filibuster, would give emitters one-third of the permits in the first year and less each year thereafter.

Serious money is at stake. The United States currently generates about 6 billion tons of carbon dioxide a year. If, as is entirely plausible, the market price of tradable permits is somewhere between $10 and $50 a ton during the next decade, the permits would be worth somewhere between $60 billion and $300 billion a year.

What happens to the revenue?

The Lieberman-Warner bill would earmark about a quarter of the revenue from the initial sale of emissions permits for the development of alternative-energy technologies and of ways to adapt to a warmer climate. Some of that revenue would go to individuals to ease the burden of higher energy prices. Some would go to the states, and some to development of a process for capturing carbon dioxide and storing it underground.

Any bill with a real chance of passage would come under heavy pressure to deal with the fairness issue. Congress might manage this with tax rebates at the low end of the income ladder, or perhaps with a rebate on Social Security taxes. But with so much money on the table, the interest group jockeying is bound to become baroque.

How can we level the international playing field?

Higher energy costs are sure to be passed through in prices, affecting the competitiveness of some manufactured goods in international markets. Typically, the impact would be small, since, on average, energy accounts for less than 2 percent of manufacturing costs. But there are important exceptions, including oil refining, primary metals, cement and paper. And that raises the prospect of exporters from countries lacking a similarly expensive climate program being able to undercut American competitors. One possible remedy is to distribute free emissions permits to threatened producers. Another is to tax imports from the offending countries and provide rebates to American exporters.

Both options are problematic. The United States has long supported open trade, and a border tax or preferential treatment of domestic industries might well violate existing trade rules. In the end the only viable solution to the competitiveness problem is an international agreement, particularly with China, India and other rapidly developing countries, to undertake comparable emissions-reduction efforts.

How about the other greenhouse gases?

Carbon dioxide from fossil fuels accounts for about 80 percent of greenhouse gas emissions in the United States. That leaves about 4 percent from carbon dioxide from sources other than fuel combustion, 7 percent from methane, 7 percent from nitrous oxides, and 2 percent from a variety of fluorinated gases.

Gases from industrial processes like the manufacture of cement or steel could be brought under a cap-and-trade program. Emissions of several fluorinated gases (used in aerosols and refrigeration, for example) are already sharply constrained by international agreements to protect the ozone layer, and other fluorinated gases could be added to that regime. These other emissions are well worth pursuing, since their containment would be comparatively inexpensive.

What happens to power plants?

Some industries will inevitably require special attention. The top one is electricity generation, which creates about 40 percent of total emissions. If there is to be any hope of limiting atmospheric concentrations to 450 parts per million, virtually all carbon dioxide emissions from power-plant generation must end in the next few decades. This means that coal- and natural-gas-fired power plants must either be shut down or that virtually all the carbon dioxide emitted by these fuels must be captured and stored (likely underground).

Several of the gases (sulfates, nitrates) coming out of utility smokestacks are already tightly regulated. And a number of states are moving ahead with plans to curb carbon dioxide emissions from power plants within their borders – or, in the case of California, from all plants delivering electricity to the state.

To some policymakers, the industry's previous experience with regulation invites an effort to curb carbon emissions solely through the electric utilities alone. That's a bad idea. Regulating only the utilities would mean, among other things, a faster rise in power rates, which would encourage consumers to shift from electricity to direct use of fossil fuels like natural gas.

Even if all emissions were regulated, limits on utilities would have a significantly different impact from one region to another. The Midwest depends much more heavily on coal than any other part of the country. The South, by contrast, generates more power with natural gas, which yields roughly twice as much electricity per ton of carbon emitted. The Northeast, for its part, depends more heavily on non-emitting nuclear power, while the Pacific Northwest is blessed with clean hydropower. Any climate policy that puts a price on carbon emissions, then, will seem unfair to consumers in the coal-dependent Midwest.

The problem for policymakers is to even the regional burden without reducing incentives to burn much less coal.

The hope is that the utility industry will be able to develop carbon-capture-and-storage technologies or switch to renewable fuels at a reasonable cost. But there is considerable doubt that the permit prices under a cap-and-trade program would be high enough to spur technology development and deployment fast enough and far enough. Therefore, extra incentives are worth considering.

One possibility is a performance standard requiring utilities to generate a minimum amount of power from renewable sources like wind. Another is a technology standard imposing a ceiling on emissions per unit of electricity produced from new plants. A third is demand management, reducing consumption of electricity through improvements in, say, building codes or appliance-efficiency standards. While there may be a case for such supplementary policies, they will come at a higher cost than cap-and-trade alone.

How do we regulate cars?

The amount of carbon dioxide that a car emits depends on how many miles it is driven, how many miles it goes on a gallon of fuel, and how much fossil carbon is contained in each gallon. A broad policy like cap-and-trade or a tax is the only regulatory instrument that provides incentives to adjust all three factors. But supplementary policies may also be useful to ease the transition to a low-carbon transportation system.

In the face of higher prices, people cannot quickly reduce their consumption of gasoline by much. Hence, a rise in the cost of driving that makes a real dent in tailpipe emissions may cause serious economic and social dislocation, as we've already seen in the rapid increase in gasoline prices in the last year.

To make emissions charges more palatable in political terms, it might make sense to supplement the conservation incentive of high gas prices with some combination of mandates and subsidies to encourage production of high-mileage cars and renewable liquid fuels. There are already federal programs to support both, but they could be altered with an eye toward getting a bigger bang for a buck. However, in light of the spectacular increase in oil prices, it is not clear that more incentives to reduce gas consumption are needed. Fuel-efficient vehicles are selling at a premium, and automakers are rushing to meet the demand.

What do we do about agricultural emissions?

A warming climate probably won't impair this country's ability to feed itself or to remain a major exporter of agricultural products. But patterns of production may be changed substantially. A warmer climate will raise output in the Great Lakes region, for example, but probably diminish output in the South. The resulting economic dislocation will put pressure on Congress to soften the blow.

Farming produces little carbon dioxide but is a big emitter of two potent warming gases, methane and nitrous oxide. The methane comes from farm animals' digestive processes and the nitrous oxide from the breakdown of fertilizers and nitrogen-fixing crops like soybeans and alfalfa. All told, the gases generated by agriculture account for nearly 15 percent of all greenhouse gas emissions in

the United States. These emissions are not easily contained by regulation, but one could imagine indirect incentives: a requirement that processors and distributors of agricultural goods buy emissions offsets, encouraging them to obtain their raw materials from farmers who contain emissions.

But the current push for biofuels complicates the picture. Congress has spent heavily to promote corn-based ethanol fuel. That has contributed to the sharp increase in grain prices, which in turn has raised the prices of meat, eggs, milk and other foods. Making ethanol from inedible plants would have less impact on food prices, but the technology to do that isn't nearly ready for prime time. Until it is, Washington should be wary of making ethanol part of any climate change solution.

How do we save forests?

Deforestation – the destruction of huge swaths of a natural sink for carbon sequestration – now accounts for approximately 20 percent of global carbon emissions, more than the contribution of cars and trucks. The majority of these emissions come from developing countries, where forests are being cleared for agriculture, timber and fuel. Rising prices for soy, palm oil and beef have added to the economic incentives to convert forests to farmland.

Forest conservation and restoration is a very low cost way to fight climate change. What's more, it could be done now, before governments get their acts together to impose more-comprehensive climate-change programs. And fortunately, the international community seems poised to integrate forest management into emissions-reduction strategies. The Lieberman-Warner bill would provide credits for saving tropical forests that could be sold for cash in the cap-and-trade market.

Can we act in time?

Climate change is already happening, at an unknown pace. And the auguries are not good: the melting of polar ice seems to be proceeding more rapidly than earlier projections suggested. Scientists studying the record of past climate change in rocks and glacial ice cores note that natural warming has occurred over a matter of years rather than centuries.

So the answer is not known. Dangers of unpredictable magnitude will thus cast a long shadow until an ambitious global emissions-containment policy is in place.