



## CLIMATE CHANGE

## IPCC Report Lays Out Options for Taming Greenhouse Gases

**BANGKOK**—Reining in climate change won't bankrupt the world economy and won't require technological miracles. But we'll have to start soon. That is the mostly upbeat conclusion from Working Group III of the Intergovernmental Panel on Climate Change (IPCC), which met behind closed doors for 3 days last week here in the Thai capital.

The fruit of the working group's labor is a 35-page document that lays out options—and their price tags—for reducing greenhouse gas emissions to head off catastrophic climate change. The most ambitious plan, which would stabilize greenhouse gas levels in the atmosphere (measured in equivalents of CO<sub>2</sub>) below 535 parts per million (ppm), would come with an estimated 3% decrease in global gross domestic product (GDP) by 2030 compared to business as usual. Less ambitious targets come cheaper. The easiest option—aiming for under 710 ppm, 50% higher than the current atmospheric concentration of long-lived greenhouse gases of 460 ppm—could yield a small net gain for the global economy.

The report—the executive summary written by 33 of the several hundred contributing authors of a review of major economic model-

ing studies due to be released in September—concludes that getting from today's greenhouse gas-intensive economy to any of these targets is achievable with currently available tools such as shifting to alternative energy sources, boosting energy efficiency, and reducing deforestation, coupled with a suitable mix of caps, taxes, and economic incentives. But other scientists warn that reality will present harder choices than the models suggest. "The only reason for economists to make forecasts is to make astrologers look good," says Martin Hoffert, a physicist at New York University who has criticized earlier IPCC studies.

### Last-ditch editing

Reaching consensus on these take-home messages was easier than expected. Media reports had predicted bitter disputes between IPCC member countries. For example, China was expected to insist on softening statements that might suggest that its fast-growing and fossil-fueled economy might need to be slowed, whereas the United States was expected to bully for nuclear power. But in fact, says Dennis Tirpak, a climate policy analyst who heads the climate change unit at the Organisa-

◀ **All smiles.** Demonstrators outside the IPCC meeting reflected the mellow mood of negotiations inside.

tion for Economic Co-operation and Development in Paris and one of the summary's authors, "the atmosphere was quite civilized."

China did put its foot down—over the adjective used to characterize the scientific evidence behind estimates of the cost of achieving emissions targets. China urged that the quality be downgraded from "high" to "medium." The motivation was "only to protect the scientific integrity of the IPCC," says co-author Dadi Zhou, a climatologist and deputy director of the Energy Research Institute in Beijing. Others who spoke with *Science* agree. "China had a valid point, and we adopted it," says co-author Jayant Sathaye, an energy policy analyst at Lawrence Berkeley National Laboratory in California.

In the end, only two short passages in the report fell short of unanimous approval. One was four lines stating that with a price of \$50 for a ton of emitted CO<sub>2</sub>, nuclear energy would be cost-effective in providing nearly a fifth of global electricity—with the caveat that "safety, weapons proliferation and waste remain as constraints." Even that cautious endorsement sparked what Sathaye calls an "adrenaline-fueled" discussion ending with firmly anti-nuclear Austria insisting on a footnote saying that it "could not agree with this statement." The other sticking point was a passage on forestry, which drew fire on technical grounds from a delegate from Tuvalu.

The final result is a document that strikes a far more optimistic tone than did the previous three mitigation reports. At least, that was the mood of the IPCC's buoyant press release, which has been echoed by the media since its release.

### Climate crystal ball

But hidden within the text of the report are abundant references to uncertainties and caveats that have gone largely unmentioned.

For one, many scientists are muttering, the report is only as good as its models. To explore mitigation options, the IPCC uses two distinct strategies. Bottom-up models break the economy down into sectors and predict how different mixes of technologies will cut carbon emissions in each. Top-down models simulate whole economies to compare how different global strategies, such as carbon ▶



## Meanwhile, Back in Washington ...

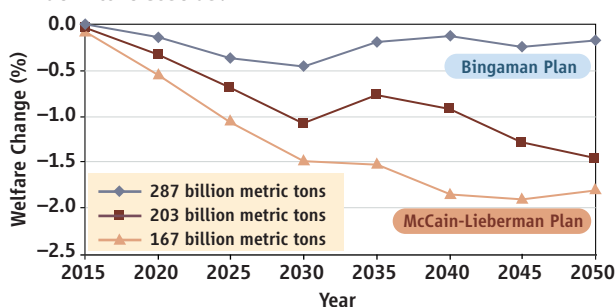
After playing a minor role for years in the U.S. Senate's Energy and Natural Resources committee, a molecule had a coming-out last week: carbon dioxide. The committee was drafting a bill meant to broaden energy independence, including measures on ethanol production, energy efficiency, and carbon sequestration.

But when a Republican senator from coal-rich Wyoming proposed a measure to boost the production of fuel made from gasified coal, panel Chair Jeff Bingaman (D-NM) balked. Concerned that the technology was unproven and could release too much CO<sub>2</sub> into the atmosphere, he asked Democratic members—even those from other coal-rich states, such as newly elected Jon Tester of Montana—to hold the line against the measure. The amendment failed on a party-line vote. Tester said he could support the technique later but that storing carbon emitted from coal-to-liquid facilities was a priority. "The carbon issue is that important," he said.

The skirmish "shows how global climate change has arrived as an issue in the debate on energy" in Washington, D.C., says Jim Presswood, a lobbyist for the Natural Resources Defense Council. Last year, when the Republican party controlled Congress, the amendment probably would have passed, Presswood says. But when Democrats took over in January, they made climate change a top priority, and the new speaker of the House of Representatives, Nancy Pelosi (D-CA), set 4 July as a target deadline to pass a House bill that would cap U.S. emissions of greenhouse gases.

Since then, several factors have fallen into place: One longtime opponent of carbon limits, Democratic Representative John Dingell of Michigan, is listening, with a series of hearings on the idea. And the Edison

### What will it cost us?



**Price club.** MIT modeling studies suggest that policies placing different limits on greenhouse gas emissions will have varying impacts on the average U.S. citizen's wealth. Figures are cumulative amounts emitted between 2015 and 2050.

Electric Institute, which represents American utilities, recently signaled its openness to emission limits—provided they cover all industries and include price controls. President George W. Bush's emphasis on research and voluntary measures no longer holds sway.

But 4 months into their rule, Democrats are beginning to realize that the new mood in Congress won't translate into new laws overnight. Pelosi has pushed back her timeline as efforts to pass a carbon bill have collided with international implications and state interests—most importantly, coal. Some observers are already saying that major new policies will have to wait until after next year's presidential election.

For sure, science is getting a different reception on Capitol Hill. ▶

taxes or fixed greenhouse-gas stabilization targets, will play out through market forces. Each approach has its drawbacks. Bottom-up models tend to ignore economics, whereas top-down models smooth over the differences between regions and sectors. In 2001, the two approaches were often at odds. The good news, says Sathaye, is that "for the first time, the range of results from bottom-up and top-

down models are starting to converge." However, enormous wiggle room remains.

One problem is that bottom-up models don't cope well with lifestyle: the preferences that drive people to choose one mix of technologies over another. For example, the report suggests that a broad portfolio of alternative energy sources, such as solar and biofuels, could cut projected annual CO<sub>2</sub> emissions in

the year 2030 by 5 to 7 gigatons at no cost at all, thanks to savings in energy efficiency. But that conclusion is misleading, says author Richard Richels, an economic modeler at the Electric Power Research Institute in Palo Alto, California, because it ignores the implicit cost of making people choose something they don't want. "If

it's advantageous, why aren't people doing it?" Richels asks.

Since 2001, researchers have worked to make the models more realistic by incorporating such "market feedback," says Billy Pizer, an economist with Resources for the Future in Washington, D.C., who co-authored a related chapter in the full mitigation report. But it's one thing to account for people's illogical behavior and quite another to persuade them to change it. "It's stuff that pays for itself that people don't do," he says.

Steady progress has been made with top-down models, says Jae Edmonds of the College Park, Maryland, office of the Pacific Northwest National Laboratory. The modelers are now accounting for more regional details, such as the availability of land area for biofuels and the potential for storing coal-plant carbon emissions underground. They have also expanded the models to include emissions of greenhouse gases other than CO<sub>2</sub>, such as methane. Doing so has lowered the top-down estimates of mitigation costs. "The reason is that you have other opportunities to reduce ▶

**"The atmosphere [of the negotiations] was quite civilized."**

—Dennis Tirpak,  
Organisation for Economic  
Co-operation and Development



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Hearings by at least 15 panels since January have touched on everything from the environmental impacts of expanding biofuel production to the effects a cap would have on Detroit's automakers. Climate scientist Stephen Schneider of Stanford University in Palo Alto, California, says the "cordial" and inquisitive atmosphere of the three hearings at which he has testified this year are a welcome contrast to the previous "20 years of combat on the Hill" he's endured, much of it over the very existence of the problem. Longtime foes of carbon restrictions are laying down arms. "My view is changing, as is the view of much of the energy industry," Representative Rick Boucher (D-VA) said in February, crediting the "deeply solidified" scientific consensus.

After years of relatively sporadic hearings about confronting climate change, aggressive lobbying by industry, nonprofit activists, and scientists has fueled more than 100 legislative proposals on the topic—about a dozen with mandatory emissions limits. But the deluge of new input "doesn't necessarily make it simpler to get things done," says David Hunter, an aide to Senator Susan Collins (R-ME).

Right now the most aggressive emissions limit proposal in Congress belongs to Representative Henry Waxman (D-CA), who wants to cut U.S. emissions 83% from current levels by 2050. A recent analysis by researchers at the Massachusetts Institute of Technology (MIT) suggests that the measure would cut the average citizen's available income by about 2% by 2050. It would yield an approximate 460 parts per million (ppm) level of CO<sub>2</sub> in the atmosphere if China and India begin by 2025 to cut their emissions and by 2050 to stabilize them. That level, roughly 20% higher than today's, would still mean "additional warming of twice to three

times [what] we have seen over the last century," the MIT study concluded.

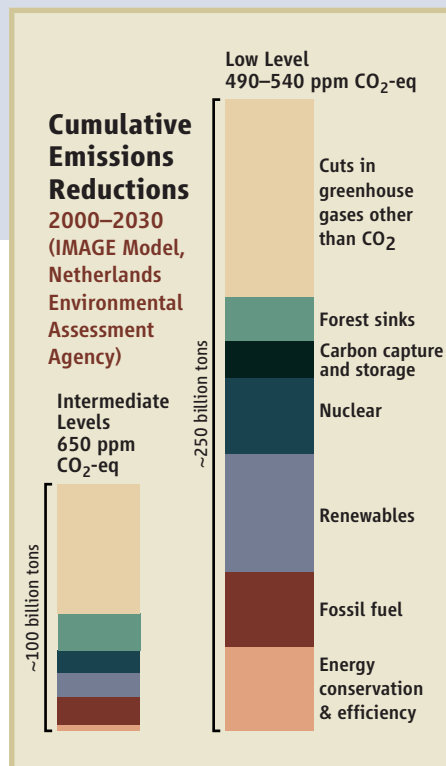
But few believe that bill can fly now, as a less aggressive approach, pushed by senators Joe Lieberman (D-CT) and John McCain (R-AZ), failed in 2005, attracting only 38 votes. So others, including Bingaman, have sought consensus by setting the emission bars lower. Bingaman's carbon-trading proposal includes a so-called safety valve that limits the price that industry and, subsequently, consumers must pay for emitting CO<sub>2</sub>. The MIT analysis predicts that Bingaman's approach would cost citizens only 0.5% of available income by 2050 while holding CO<sub>2</sub> in the atmosphere to about 490 ppm.

Some lawmakers say it's crucial to pass some bill—even a flawed one—soon. Early U.S. action, they argue, could spur the crucial participation by India and China in an emissions-control regime. "If we take 10 years to get started, the problem will be harder to deal with then," says Representative Tom Udall (D-NM). But others, including editors at the left-leaning *New Republic* magazine, have urged the Democrats not to accept compromises for the sake of expedience. "There won't be many chances to get this right, and Democrats will need to wait until they can go for broke," a March editorial declared.

Privately, lobbyists on each side of the issue say that only a committed president can muster the political force to broker a deal. Presidential con-

tenders such as John Edwards, senators McCain and Barack Obama (D-IL), have championed forceful proposals to contain greenhouse gas emissions. Meanwhile, the timeline is the one thing that's becoming clear: "It'll take a ways to pass comprehensive greenhouse legislation," says Hunter.

—ELI KINTISCH



emissions," says Sathaye. For example, a land-fill emitting methane can be cheaper to deal with than a coal plant, but such advantages were lost in previous simulations.

But top-down models can still run aground on the shoals of international politics. One rosy prediction is that an imposed cost of \$100 per ton of CO<sub>2</sub>—equivalent to an extra \$1 per gallon at the pumps—could yield a cut of 17 to 26 gigatons of CO<sub>2</sub> by 2030, as much as 38% of estimated emissions under a fairly carbon-intensive forecast. But this assumes that the whole world participates in carbon trading and that markets are free and transparent. Given current Indian and Chinese wariness towards carbon caps, says Pizer, "that's not politically likely."

### Spin control

Now that the debate over the content of the 1000-page Fourth Assessment Report is done, the battle is shifting to its interpretation. Many IPCC scientists say they are uneasy with the optimistic spin put on the report. "I think something that is being underplayed... is the scale of the mitigation challenge," says Brian O'Neill, a climate policy modeler at the International Institute for Applied Systems Analysis in Vienna, Austria, who contributed to a chapter

**Diet plan.** The IPCC report drew on models that calculated global portfolios of emissions reductions needed to reach various target levels of greenhouse gases in the atmosphere.

on mitigation scenarios. "To limit warming to something near the European Union's stated goal of 2°C, global emissions have to peak within the next decade or two and be cut by 50% to 80% by midcentury." That's a tall order, O'Neill says—and it could get a lot taller if global temperatures turn out to be more sensi-

tive to increases in greenhouse gases than the IPCC has been assuming. "My point is not that there should be more gloom and doom," says O'Neill, but "a message that says that we have to stay below 2°C, but don't worry, it will be easy and cheap, just doesn't add up."

Other researchers say the report's insistence that current mitigation strategies can suffice gives short shrift to future research. That's a mistake, says Hoffert: "It is ludicrous to think a greenhouse-gas emissions price, cap, or tax alone will get you to stable concentrations of [greenhouse gases]." New technologies will be critical, he says, and unless policymakers pave the way with measures such as a gradually increasing carbon tax, they will not be competitive. And Richels fears that if the takeaway message is that mitigation is cheap, societies "may not be as motivated to invest in the future" for such research.

Overall, the question of whether mitigation is "affordable"—be it 0.3% or 3% of global GDP—is "a difficult one to answer," says Sathaye. But some say that when stakes are overwhelmingly high, purely economic reasoning misses the boat. "What did World War II cost us economically?" asks Hoffert. "Does the question even make sense?" —JOHN BOHANNON  
With reporting by Eli Kintisch.