EPA's Plan for Cooling the Global Greenhouse

A new report lists a dozen plausible actions that, if begun in the 1990s, could reduce global warming 60% over the next century

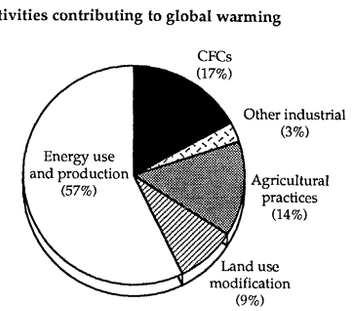
THE GOOD NEWS on global warming, according to a draft report* to Congress by the Environmental Protection Agency (EPA), is that the surging growth of "greenhouse gases" can be slowed down.

The bad news is that doing so will require price increases for coal and oil; lots of solar power devices; more use of nuclear and biomass energy; new forests all around the planet; a sharp cutback in the manufacture of chlorofluorocarbons and related products; a lower per capita demand for cement; new ways of producing rice, meat, and milk; gas capture systems in landfills, including those in the developing world; and an unusual degree of cooperation among the developed and the developing nations. If all these things begin happening in the early 1990s, the rate of gas buildup may level off in the 22nd century.

If nothing is done, the resulting temperature increase by year 2100 could be enormous, according to EPA, ranging from a minimum of 2° to 3°C in a slowly developing world to a high of 5° to 10°C in a rapidly changing world. For reference, the difference between the mean annual temperature in Boston and Washington is only 3.3°C, and the total global warming since the peak of the last ice age was about 5°C—a change, EPA says, that "shifted the Atlantic Ocean inland by about 100 miles, created the Great Lakes, and changed the composition of forests throughout the continent." With a reversal of deforestation, a cutback on fossil fuel use, and a virtual ban on chlorofluorocarbons, the impact could be reduced 60%, so that global warming by 2100 would be no more than 0.6° to 1.4°C.

EPA released these thoughts in a report on 14 March, a few days after someone leaked the study to the press. The $2.5-million project originated in a request from Congress in 1986 for "an examination of policy options that, if implemented, would stabilize current levels of atmospheric greenhouse gas concentrations." The three-volume collection of mild policy statements and much sharper research papers will undergo an expert review at EPA's Scientific Advisory Board on 4 April. An interagency review will follow, leading to a final report in midsummer.

A companion study—examining how the gas buildup may affect life in the United States—was commissioned at the same time in 1986. It appeared in draft form last fall (*Science*, 28 October, p. 510) and will be completed in a few weeks. Both are to be used by U.S. delegates to the Intergovernmental Panel on Climate Change (IPCC), a group formed in 1988 to coordinate a global attack on greenhouse gases.



EPA's estimate of greenhouse gas emissions contributing to global warming in the 1980s.

The spotlight fell on the IPCC on 30 January when James Baker III gave his maiden speech as Secretary of State at an IPCC gathering. Referring to the greenhouse problem, Baker said: "We face the prospect of being trapped on a boat that we have irreparably damaged—not by the cataclysm of war, but by the slow neglect of a vessel we believed to be impervious to our abuse . . . . The political ecology is now ripe for action."

Within the IPCC, Britain heads the panel on scientific research. The Soviet Union leads the effort to forecast the impact on the global climate. And the United States directs the panel on "response strategies." The new EPA study therefore is likely to become the Bible for officials who must tell other governments what they ought to do about global warming.

In a sense, the authors of the EPA study failed to carry out the assignment, because they did not show ways to "stabilize" the accumulation of gases, as the Senate wanted. Instead, they focus on the more modest goal of slowing the rate of increase. When they began looking at the data, they found that a stabilization plan would be too hard, requiring draconian cutbacks of carbon dioxide output of 50 to 75%. To create more plausible options, they lowered their goals and looked for new sources of pollution to attack.

Previous studies focused on fossil fuels as the main source of gases. This new analysis goes further, taking into account everything from cow flatulence (a source of methane) to tropical forest destruction. Having more items in the pollution "budget" makes it possible to suggest a variety of modest cuts rather than one or two huge ones. It also makes it possible to spread the pain around, sharing the burden politically and geographically.

One significant achievement, says a leader in this effort, is that "we have produced an analysis that is more comprehensive than any before." The National Aeronautics and Space Administration developed a chemical model of the atmosphere expressly for this project, described as a "crude analytical framework" that will permit future researchers to test out various gas control scenarios. Another achievement is the use of a comparative "sensitivity analysis" with four different models of the carbon cycle to rate the effectiveness of policy options. It reveals sharply different forecasts of temperature change by the end of the next century, suggesting the final temperature increase could be roughly 20% cooler or 20% warmer than the central forecast. Another "speculative" carbon cycle theory suggests the temperature in 100 years could be 40 to 60% hotter than the central forecast.

The report makes no direct recommendations but suggests a few actions. It points out that "no single country or source will contribute more than a fraction of the gases that will warm the world." Although the United States, Europe, and the Eastern Bloc now contribute about three-fifths of the total output, their shares will decrease and the developing world will soon dominate the picture. "All nations will need to adopt measures to stop the buildup of greenhouse gases if climate change is to be effectively limited."

The most effective short-term actions, EPA says, would be to limit chlorofluorocarbon production, accelerate the replacement of old machinery with new energy-efficient technology, reverse the destruction of the forests, and encourage tree-planting. The report also urges governments to "assure that the prices of fossil fuels and other sources of greenhouse gases reflect their full

**Policy Options for Stabilizing Global Climate* (draft), Office of Policy, Planning, and Evaluation, Environmental Protection Agency, February 1989.

social costs," which means that prices should be increased. Notably lacking in this study are projections of cost and evaluations of institutional barriers to change. These will come later, in another report, the authors say.

All predictions about the rate of gas accumulation and its impact on global temperatures are riddled with uncertainty. But, as this report points out, it is not important to resolve the scientific issues before taking action—an attitude that contrasts with the Reagan Administration's approach to acid rain controls.

Many steps that could be used to slow the buildup of greenhouse gases also could bring immediate social benefits, such as reducing urban pollution and limiting dependence on foreign oil. The report's message is activist. It suggests that governments should not seek an airtight case to justify intervention. Even modest steps to control emissions will improve the atmosphere in the next century. ■ ELIOT MARSHALL

German Computer Spy Ring Broken

The arrest of three young West German techno-vandals in March ended an investigation of computer spying that lasted more than 2 years and spanned several continents, linking a U.S. military base in Japan, the Lawrence Berkeley Laboratory (LBL) in California, and a variety of German universities and research institutes.

Two of the three suspects were released without charges. An unnamed third stands accused of espionage. In all, eight hackers are under suspicion for belonging to a group that snooped through electronic networks, receiving pay from the Soviet KGB.

After a preliminary review last week, the U.S. Department of Defense reported on 16 March that no real damage had been done. Daniel Howard, the assistant secretary of defense for public information, told reporters that the West Germans "did not penetrate secure programs" and "it does not appear that there was any compromise of classified information."

While the hackers failed to get classified U.S. data, they apparently did acquire some industrial secrets, according to reports in Europe. The companies involved have not confirmed this information. But Klaus Brunnstein, a computer specialist at the University of Hamburg, writes that if the thieves did take designs for a megabit (1-million bit) chip and sophisticated design software from the Thomson Company of France and N.V. Philips of the Netherlands, as rumored, then "the advantage and value for the U.S.S.R. cannot be overestimated."

Two members of the group have been identified in the West German press as drug addicts, suggesting they were motivated by money, not politics. The German Panorama TV news team, which broke the news in early March, asked Brunnstein to examine computer logs seized in the apartment of one suspect, Markus Hess, 27, of Hanover. Brunnstein saw protocols for what he calls the "famous NASA hack" of 27 July 1987, in which the agency's space physics or SPAN network was invaded by someone searching for "secret" data. It contains none.

Hess was released uncharged, in part, Brunnstein says, because evidence was taken illegally. It included records of successfully cracked passwords. In a reprimand for those who make the hacker's job easy, Brunnstein notes disapprovingly that at the universities of Pisa, Pavia, and Bologna, INSALATA is a favorite password.

The first person to detect the broader pattern of espionage and alert the police was an astronomer at LBL, Clifford Stoll. He has since moved to the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts. Stoll says he had a hard time getting an inquiry launched in 1986. "When we first took it to the FBI, they laughed at us," he says, because the violation looked trivial. The only evidence Stoll could produce was a 75-cent discrepancy in LBL's charges for the use of computer time. Someone with no account had used the computer for a short time. Stoll eventually persuaded the FBI and others that an undeliverable bill, no matter how small, hinted at a major breach in security.

At Stoll's suggestion, LBL decided in 1986 not to slam the gates shut on the criminal but to watch his behavior surreptitiously and follow him to his home. Stoll gives a thorough account of this "Wily Hacker" investigation in the May 1988 edition of *Communications of the ACM*. The intruder was tracked all across the United States, where he took advantage of a loophole in a defense contractor's computer in McLean, Virginia, to romp through dozens of interconnected networks.

By baiting the LBL network with bogus files on the use of computers in the Strategic Defense Initiative, officials tempted the hackers into dallying on long distance lines for up to an hour. In this way, the source was tracked back through an intricate series of connections to Hess in West Germany. ■ ELIOT MARSHALL

Fraud Review May Be Taken from NIH

Congress won't be satisfied that biomedical research is properly policed until NIH is stripped of its dual role as funder and watchdog. No matter what steps NIH takes to strengthen its oversight offices, "the system clearly exhibits the appearance of the proverbial 'fox guarding the chickens,' " according to the assessment of one observer who has privately circulated a memo on the subject. A reading of Capitol Hill suggests the assessment may be right—at least for now.

Legislation that is expected to be introduced in the House by Representative John Dingell (D–MI and others would take the current fraud office out of NIH and place it in the office of the assistant secretary for health in the Department of Health and Human Services (HHS).

A more radical move is also being suggested. Take the Recombinant DNA Advisory Committee (RAC), the fraud office, and the office responsible for protecting the rights of research patients and animals and move all three into HHS, thereby ridding NIH of all responsibility for overseeing its own regulations in areas where it both supports and regulates research.

Meanwhile, a proposal to create a new Office of Scientific Integrity within the NIH director's office has just been published in the 16 March *Federal Register*. In line with a recent recommendation from the Institute of Medicine, that office would not only investigate allegations of fraud and misconduct but also set guidelines for promoting high ethical standards in research.

This proposal, which comes from the Administration, also calls for an Office of Scientific Integrity Review to be established under the assistant secretary of health in the Department of Health and Human Services (HHS). Among its jobs would be to make sure that NIH and other HHS research agencies are doing what they should to carry out various policies for preventing and investigating misconduct. Layer upon layer.

Scientific conduct has become a hot topic on Capitol Hill and the debate that is anticipated for this spring is likely to be heated. ■ BARBARA J. CULLITON

Next Science Adviser?

George B. Rathman, the chairman of a California biotechnology company, wants to be President George Bush's science adviser. The Amgen, Inc., executive has the backing of Senators Robert Dole (R–KS), Pete Wilson (R–CA), and Edward M. Kennedy (D–MA). ■ MARK CRAWFORD