What can we do?

We're not lacking for creative solutions in dealing with climate change. Four leading experts—José Goldemberg, Amory B. Lovins, Stephen Schneider, and M. S. Swaminathan—provide proposals on how we can curb carbon dioxide emissions, reduce global temperatures, sustain economic growth, and summon the necessary political leadership.

Increase renewable energy production

JOSÉ GOLDEMBERG: Secretary of State for the Environment of the State of São Paulo, Brazil

he simple answer is to address the causes of climate change. Its main causes are well known—fossil fuel consumption, which assumes responsibility for greenhouse gas emissions, along with changes in land use, deforestation, and methane emissions.

Fossil fuel consumption represents 80 percent of the energy used in the world. To reduce its subsequent emissions, we should use energy more efficiently in buildings and transportation, increase renewable energy sources, and accelerate the development and deployment of new energy technologies—carbon capture and storage among them. Energy efficiency is the equation's low-hanging fruit, and it's already yielded tangible success. Without the adoption of serious measures to increase energy efficiency since 1970, energy consumption would have been 49 percent higher in 2000.

In 2001, renewables represented approximately 14 percent of the world's energy consumption. However, only 4.5 percent of this was in the modern forms—hydro, biofuels, wind, and geothermal. Traditional biomass—used very inefficiently in developing countries for

cooking—constitutes the other 10 percent. We possess several options for the production of electricity, but the modernization of biomass use for biofuel production presents a unique source of clean, renewable fuel for transportation, particularly ethanol from sugarcane in Brazil.

If we pursue such renewables, their share of the world's energy usage could easily reach 20 percent by 2020.

Stop wasting energy

AMORY B. LOVINS: CEO, Rocky Mountain Institute

ike the Hubble Space Telescope's mirror, climate protection got spoiled by a sign error. All the empirical evidence shows that climate solutions are profitable not costly, as saving fuel costs less than buying fuel. Many leading companies are making billions of dollars in profits by cutting their fuel waste and hence their carbon emissions. This convenient truth makes political obstacles to climate protection less daunting: Eventually, politicians who lament climate protection's supposed costs, burdens, and sacrifices will join the parallel universe of practitioners who routinely achieve competitive advantage by wasting less fuel.

Raising global energy productivity by just 2 percent a year, not the 1 percent

a year assumed by economic theorists, would stabilize carbon emissions; raising it by 3 percent a year would stabilize climate. That's not so hard: The United States has long achieved roughly 3 percent a year, California 4 percent, China (until 2001) 5 percent, and leading corporate energy-efficiency efforts 5–8 percent—all with strong financial gains.

Energy efficiency, the main tool for profitable climate protection, could actually do the whole job if pursued to its modern potential, typically with expanding rather than diminishing returns (i.e., radical savings at *lower* capital cost, now demonstrated in two dozen sectors but awaiting a revolution in design pedagogy and practice). For example, uncompromised trucks, cars, and planes with tripled efficiency using current technology would repay their respective extra capital costs within one, two, and five years at current U.S. fuel prices.

Now add alternative supplies. Two-fifths of global fossil-fuel carbon emissions come from burning oil and another two-fifths from electricity production. Redoubling U.S. oil efficiency and displacing the rest with saved natural gas and advanced biofuels can eliminate U.S. oil use by the 2040s at an average cost of \$15 per barrel. That's a fifth of the recent oil price, so this transition will be led by business for profit. Innovative public policies can support, not distort, the business logic without needing new fuel taxes, subsidies, mandates, or national laws. Early implementation is encouraging.

As for electricity, "micropower"—smallscale generation that emits little or no carbon dioxide—provided a sixth of the world's electricity and a third of its additional electricity in 2005. It added 8-11 times more new capacity and four times more energy than nuclear power, which it now outproduces. Micropower is financed by private risk capital—unlike any new nuclear project. Micropower and "negawatts" (saved electricity) now provide at least half of the world's new electrical services, and recognizing their 207 "distributed benefits" (such as lower financial risk from small, fast projects than from big, slow ones) will widen their

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already decisive economic advantage by another tenfold.

Though largely unnoticed, these dramatic market shifts in technology and scale are well under way. ("Clean energy" received around \$63 billion of global investment in 2006, about a tenth of total energy investment.) And the new technologies for both supply and efficiency will continue to wallop traditional competitors in the marketplace, buying more climate solution per dollar and per year. Conversely, when central planners buy costlier and slower options such as nuclear power, they reduce and retard climate protection: Nuclear displaces 2-10 times less coal-burning per dollar than micropower or efficient use, and does so more slowly.

In short, the climate problem is neither necessary nor economic; instead, it's an artifact of not using energy in a way that saves money. We can prevent climate change by taking markets seriously—letting all ways to save or supply energy compete fairly at honest prices, no matter the type, technology, location, size, or ownership.

Raymond Williams wrote, "To be truly radical is to make hope possible, not despair convincing." So what are we waiting for? Ourselves.

Condensed from a fuller annotated text posted at www.rmi.org/sitepages/pid173.php#C06-10.

Employ market incentives

STEPHEN SCHNEIDER: Climatologist, Stanford University

s national governments continue to jockey for and against significant global actions to curtail climate change, cities and states are already on the march, achieving great strides by using a mix of performance standards for efficient buildings, vehicles, and appliances. Likewise, corporations are moving to implement internal policies to

reduce emissions, while developing marketable skills and products that they can employ when the world eventually accepts the need for significant emissions cuts.

But eventually market incentives must exist to discourage using the atmosphere as a waste dump for tailpipe and smokestack emissions. Despite the fact that carbon-reducing mitigation costs represent a small fraction of the world economy's projected growth rate, a shadow price on carbon still disadvantages some special groups. These groups include coal miners and the autoworkers who manufacture oversized, gas-guzzling cars. It also includes the poor, for whom increasing energy prices will appear as a regressive tax.

Nevertheless, we cannot hold the climate's sustainability hostage to these special problems. Instead, we need to both protect the commons with positive performance incentives and tough emissions constraints, as well as develop equitable actions such as providing alternative employment opportunities, subsidizing new technology development that gives preference to documented workers in mining or large-emitting industries, and making side payments to poor people or nations to allow them to participate in a carbon-constrained economy.

A creative combination of positive incentives for efficient performance, shadow prices on threatening emissions, and equity side payments to particularly affected groups meets the necessary criteria for both fairness and political buy-in. It's also important to create accessible resources to aid in the adaptation activities of groups particularly vulnerable to the projected impacts of climate change, especially groups that contributed little to the atmospheric burden in the first place.

Finally, we need an honest political media debate, not the absurd "journalistic balance" dictum that pits "end of the world" deep ecology groups against "good for you" individual-rights think tanks. In most scientific assessments, those two extreme positions constitute the lowest probability outcomes. Worse still, this false "balanced

reporting" creates confusion and does not present a fair perspective on the mainstream assessments of climate change science and potential impacts.

Find a political will

M. S. SWAMINATHAN: President, Pugwash Conferences on Science and World Affairs, Chennai, India

he type of climate change we recently began experiencing results from human activity; therefore, only humankind can fix it. The World Commission on Environment and Development titled its 1987 report "Our Common Future" to emphasize that, whoever the culprit, our ecological fate is intertwined, as nature does not recognize political frontiers. Along with understanding the causes of adverse changes in temperature, precipitation, and the sea level, we also know the solutions. The Global Conventions on Climate Change and Biodiversity, as well as the Montreal and Kyoto Protocols provide guidelines for restoring harmony between humankind and nature.

Unfortunately, the political will essential for curbing both unsustainable lifestyles and the expanding "greed revolution" remains dormant. We urgently need to find this political will and fuse it with professional skill and people's participation in hopes of solving the impending disaster. One suggestion: A joint meeting of the G-8 and G-20 leaders that would yield an action plan on how to solve the problem. The meeting's structure should mirror that of a pope's election, meaning the participants don't leave until they agree upon a realistic solution.

Sadly, climate change will cause more harm to those living in poor nations since they lack the coping capacity to meet the consequences of reduced precipitation, higher temperatures, rising sea levels, and the increasing frequency of coastal storms and tsunamis. Without a better common present, there cannot be a better common future.