

Sustainable Developments

Climate Change after Bali

Do the math: affordable new technologies can prevent global warming while fostering growth

BY JEFFREY D. SACHS



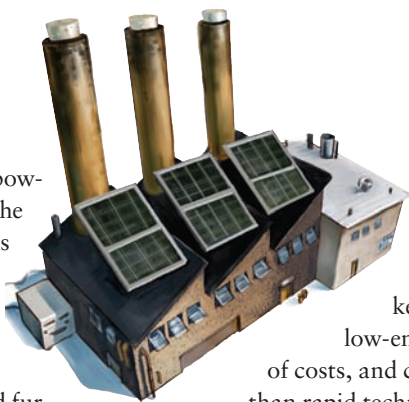
Last December's agreement in Bali to launch a two-year negotiation on climate change was good news, a rare example of international cooperation in a world seemingly stuck in a spiral of conflict. Cynics might note that the only accomplishment was an agreement to talk some more, and their cynicism may yet be confirmed. Nevertheless, the growing understanding that serious climate-control measures are feasible at modest cost is welcome.

The arithmetic is becoming clearer. If the rich nations continue to grow in income and the poor ones systematically narrow the income gap with successful development, by 2050 the global economy might increase sixfold and global energy use roughly fourfold. Today's anthropogenic carbon dioxide (CO₂) emissions are around 36 billion tons annually, of which 29 billion are the result of fossil-fuel combustion and industrial processes, and another seven bil-

lion or so are the result of tropical deforestation. Roughly speaking, every 30 billion tons of emissions raises CO₂ levels by around two parts per million (ppm). The current atmospheric concentration of CO₂ is around 380 ppm, up from 280 ppm at the start of the industrial era in 1800. Thus, to arrive at 440 ppm by midcentury—a plausibly achievable “safe” level in terms of its likely climate change consequences but only 60 ppm more than the current one—cumulative emissions should be kept to roughly 900 billion tons, or roughly 21 billion tons a year on average until 2050. This goal can be achieved by ending deforestation (on a net basis) and by cutting our current fossil-fuel-based emissions by one third.

So here is the challenge. Can the world economy use four times more primary energy while lowering emissions by one third?

A promising core strategy seems to be the following: Electricity needs to be made virtually emission-free, through the mass mobilization of solar and nuclear power and the capture and sequestra-



tion of carbon dioxide from coal-burning power plants. With a clean power grid, most of the other emissions can also be controlled. In less than a decade, plug-in hybrid automobiles recharged on the grid will probably get 100 miles per gallon. Clean electricity could produce hydrogen for fuel-cell-powered vehicles and replace on-site boilers and furnaces for residential heating. The major industrial emitters could be required (or induced through taxation for tradable permits) to capture their CO₂ emissions or to convert part of their processes to run on power cells and clean electricity.

Carbon capture and sequestration at coal-fired power plants might raise costs for electricity as little as one to three cents per kilowatt-hour, according to a special report of the Intergovernmental Panel on Climate Change. The mass conversion of the U.S. to solar power might involve an incremental cost of roughly four cents per kilowatt-hour, with overall electricity costs on the order of eight to nine cents per kilowatt-hour. These incremental costs imply far less than 1 percent of the world's annual income to convert to a clean power grid. The costs in the other sectors will also be small. The fuel savings of low-emissions cars could easily pay for batteries or fuel cells. Residential heating by electricity (or co-

generated heat) rather than by home boilers will generally yield a net savings, especially when combined with improved insulation.

The Bali negotiations will succeed if the world keeps its eye on supporting the speedy adoption of low-emissions technologies. Issues of blame, allocation of costs, and choice of control mechanisms are less important than rapid technological development and deployment, backed by a control mechanism chosen by each country.

If the less polluting technologies pan out at low cost, as seems possible, the rich countries will be able to afford to clean up their own energy systems while also bearing part of the costs to enable the poor to make the needed conversions. Climate control is not a morality play. It is mainly a practical and solvable technological challenge, which, if met correctly, can be combined with the needs and aspirations for a growing global economy. ■

Jeffrey D. Sachs is director of the Earth Institute at Columbia University (www.earth.columbia.edu).



An extended version of this essay is available at www.SciAm.com/ontheweb

MATT COLLINS

Forum

NASA's Flimsy Argument for Nuclear Weapons

Nukes will not be needed to guard against dangers from space

BY THOMAS GRAHAM, JR., AND RUSSELL L. SCHWEICKART



On January 4, 2007, the *Wall Street Journal* published an op-ed entitled “A World Free of Nuclear Weapons,” written by an impressive array of statesmen: former secretary of state George Shultz, former secretary of defense William Perry, former secretary of state Henry Kissinger and former senator Sam Nunn of Georgia. In the article the authors worried that the likelihood of international terrorists acquiring nuclear weapons is increasing. They asserted that “unless urgent new actions are taken, the U.S. soon will be compelled to enter

a new nuclear era that will be more precarious, psychologically disorienting and economically even more costly than was Cold War deterrence.” Invoking President Ronald Reagan’s call in the 1980s for the abolition of all nuclear weapons, they endorsed “setting the goal of a world free of nuclear weapons and work-

ing energetically on the actions required to reach that goal.”

Recently, however, a counterargument has been advanced—by NASA. In 2005 Congress ordered the space agency to analyze the alternatives that it could employ to divert a near-Earth object (NEO)—an asteroid or comet—if one was found to be on a collision course with our planet. Last March, NASA submitted a report entitled “Near-Earth Object Survey and Deflection Analysis of Alternatives,” having first coordinated its response with the White House, the Department of Defense and the Department of Energy. In its report NASA chose to analyze only the highly improbable threat posed by large NEOs, which very rarely strike Earth, in lieu of the more realistic danger of a collision with one of the cohort of smaller NEOs, which are far more numerous. What is more, the report emphasized the effectiveness of nuclear explosions in providing the force to deflect an NEO from a collision course, but it completely neglected the need for precision in such a procedure.

COURTESY OF THOMAS GRAHAM, JR. (top); COURTESY OF RUSSELL L. SCHWEICKART (bottom)