Letters

Global Warming

In their recent Policy Forum "Global warming" (17 Nov., p. 868), William Fulkerson *et al.* argue for a broad and "balanced" energy technology research and development (R&D) effort as a prudent response to the greenhouse effect. We think the way the authors have framed the issue, that is, implying that an increased R&D investment is our major insurance against global warming, reflects too narrow a perspective on the basic policy and technological issues. Although we fully support energy R&D, the fact that currently viable options, especially energy efficiency and natural gas, are available needs to be more widely recognized; and a supportive policy environment needs to be established to encourage their use as well as the use of new technologies produced through R&D (*1*).

While climatologists and others continue to argue over the magnitude and timing of the greenhouse effect, response strategies first need to focus on options that are already cost-effective and attractive for other social and environmental reasons. The phaseout of chloroflurocarbons and large-scale reforestation are examples of two options that have received strong support. In the area of energy, the authors' statement that "none of the nonfossil energy sources are ready to be substituted competitively for fossil fuels at the scale necessary to reduce CO_2 emissions" incorrectly implies that there are no currently viable alternatives and that we must wait for R&D, with its corresponding uncertainties, to bring these technologies to fruition. This slights the significant contribution of energy efficiency technologies that, in many cases, are cheaper than fossil fuels (*2*).

Fulkerson *et al.* also neglect the policy framework in which new technologies must compete. Spending for R&D can be squandered unless a simultaneous effort is made to support commercialization of promising technologies and to create a "level playing field" in which new technologies can compete fairly (*3*). Commercialization efforts, which government R&D programs have had to downplay in recent years, need to be revitalized through an increased emphasis on demonstration projects and appropriate support to entrepreneurs willing to commit a share of their own finances to new enterprises. Creating a level playing field means, at a minimum, ensuring that government support mechanisms, for example, subsidies, tax incentives, rate structures, treat fossil and nonfossil energy sources equally. Taking this a step further, states such as New York and California are now considering or have implemented programs to credit nonfossil sources on the basis of their environmental and social benefits when evaluating alternative options for additional electric generating capacity. These and other policies are necessary parts of an effective global warming mitigation strategy that will significantly enhance the returns from R&D expenditures.

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REFERENCES

1. D. A. Lashof and D. A. Tirpak, Eds., *Policy Options for Stabilizing Global Climate* (Draft report, Environmental Protection Agency, Washington, DC, 1989).
2. E. Hirst, *Federal Roles to Realize National Energy-Efficiency Opportunities in the 1990s* (ORNL/CON-290, Oak Ridge National Laboratory, Oak Ridge, TN, 1989).
3. B. D. Solomon and T. D. Georgianna, *Energy Econ.* 9, 183 (1987).

Response: The letter by Solomon and Adler illustrates how easily one can be misunderstood. Generally, we agree with the points they make. Although our focus was on the need for research and development (R&D), we certainly agree that other polices should be pursued if they can both mitigate or reduce greenhouse emissions and are socially justified for other reasons as well. Promoting adoption of more energy-efficient and economical technologies is an excellent example, and we said so emphatically.

The fact remains, however, that nonfossil energy sources are not yet ready to substitute for fossil fuels at the large scale required, at competitive costs, and with worldwide public acceptance. R&D [or better research, development, and demonstration (RD&D)] can improve the nonfossil sources dramatically. It can also improve technologies for using fossil energy more efficiently. Doing this RD&D as a shared public-private sector endeavor is likely to be cost-effective insurance against the expensive possibility that the world will choose to move rapidly away from fossil fuels to reduce the rate of climate change. Furthermore, it is prudent to intensify research efforts now, as lead times to commericalize new technologies will be significant.

Finally, providing and facilitating adoption of better technologies that will prove attractive to developing nations and will also moderate CO_2 emissions is a major RD&D challenge. It is for the developing nations that the need for low-cost nonfossil sources is most acute.

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BEIR V: Implications for the Nuclear Workforce

The National Academy of Sciences fifth report on the biological effects of ionizing radiation (BEIR V) (*1*) (News & Comment, 5 Jan., p. 22) indicates a need for "tighter" control of nuclear worker exposure. But BEIR V's "increased risk" needs modification when applied to male adults in the nuclear workforce for the following reasons.

1) The BEIR V risk assessment is based on statistical analysis of cancer mortality among atomic bomb survivors in Hiroshima and Nagasaki. The latest Radiation Effects Research Foundation (RERF) report (*2*) shows a computed excess of 252 cancer deaths among 5734 nonleukemic cancer deaths. Some 74 of 2007 observed stomach cancer deaths are attributed to radiation. Had Americans (whose incidence of stomach cancer is much lower than that of the Japanese) been exposed at Hiroshima and Nagasaki, the number 74 would have been less than 10.

2) Tables 2-5 through 2-33 in (*2*) tabulate risk for 27 types of cancer—an average of less than 10 excess cancer deaths per cancer type observed from 1950 through 1985. The number of male cancer deaths is much smaller because 3 of every 5 survivors are female and 56 excess deaths are specific to female organs. This leaves an insubstantial statistical basis for assessing male radiation risk.

3) The bulk of the collective exposure (72%) in Hiroshima and Nagasaki was about 50 rem—the mean dose was 132 rem per survivor. The average dose for half a million U.S. nuclear power workers (1969–1988) was 1.2 rem accumulated over the work career. BEIR V statisticians constructed five different models to bridge the gap between these two types of exposure.