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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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.

4) The atomic bombs produced an instantaneous flash of radiation, whereas U.S. workers accumulate their exposure gradually over several years. BEIR V concedes that this distributed dose could be two to ten times less biologically effective than a single exposure, but it does not incorporate a correction factor in its models. BEIR III (*3*) introduced a 2.25-fold dose effect correction in its model.

5) BEIR V increases risk assessment in part because of greater than expected cancer deaths among those who were under age 20 at the time of bombing. Such an effect would not apply to nuclear workers, who are exposed at an average of less than 30 years of age.

If one takes these factors into account, the BEIR V risk assessment increase of about 350% dwindles to about 70% when applied to the nuclear workforce exposure. Nothing has really happened that would lead to a tightening of radiation controls for a U.S. workforce whose lifetime radiation exposure averages 5% above that to which all Americans are exposed. BEIR V concludes its risk assessment with this final sentence: "At such low doses and dose rates, it must be acknowledged that the lower limit of the range of uncertainty in the risk estimates extends to zero" (*1*, p. 181). The risk is speculative and may be zero.

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2. Radiation Effects Research Foundation. *Life Span Study Report 11. Part 1* (National Academy Press, Washington, DC, 1989).
3. Committee on the Biological Effects of Ionizing Radiations, *The Effects on Populations of Exposure to Low Levels of Ionizing Radiation* (National Academy Press, Washington, DC, 1980).

In his article "Academy panel raises radiation risk estimate," Marshall describes the National Council on Radiation Protection and Measurements (NCRP) as "an industry advisory group." This description is not correct. The NCRP is a not-for-profit corporation chartered by the U.S. Congress in 1964 "[t]o collect, analyze, develop and disseminate in the public interest information and recommendations about (a) protection against radiation and (b) radiation measurements, quantities and units particularly those concerned with radiation protection. . . ."

The Council has 75 members—scientists, engineers, and medical personnel from a broad base of disciplines related to radiation protection matters, drawn from academic and scientific institutions across the country. Its support comes mainly from the branches of the federal government that are concerned with radiation protection and from the scientific societies involved in radiation research and related fields who make up its group of collaborating organizations.

Its principal function is to undertake studies and produce reports providing radiation protection recommendations, assessments of exposure to the U.S. population, guidance and information in specific areas of radiation protection, and comparable evaluations for nonionizing radiation. These reports now number more than 100 and are widely used and referred to in professional circles.

The Council maintains informal working relationships with some industry groups, and its reports are closely followed by both users and regulators; but it receives very little financial support from industry, and it

has not accepted any special role with respect to industry.

Council members serve voluntarily, as do the approximately 500 additional professionals who serve on its committees. All of these persons regard highly their responsibility to serve in the public interest.

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RU 486 Development

To the well-written article by Jeremy Cherfas entitled "Dispute surfaces over paternity of RU 486" (News & Comment, 24 Nov., p. 994), we would like to add the following, and as far as we are concerned, final comments.

A number of confused allegations cited in the article could tend to accredit the idea that RU 486 is the result of a blind screening. We want to state kindly but firmly that the discovery of the properties of RU 486 and the related class of compounds is the logical result of a classical research approach, familiar to anyone well acquainted with drug design. This is quite different from any "stumbling," although some of the results had not been clearly expected, which is indeed the hallmark of true research. The approach followed by the Roussel researchers can easily be traced back from the evidence of laboratory records, research reports, scientific papers, and finally patents (see, for instance, EP 0 057 115). Up to now, the Roussel research team has not been aware of playing anybody's score in this matter, nor of the existence of any "composer and conductor."

We feel it most unfortunate to have had to enter into this argument, but we resented the recent, and for the first time clearly stated, claims about the design of RU 486 (News & Comment, 22 Sept., p. 1323) as an issue concerning the dignity of all the scientists and technicians once involved in the project and, as a matter of fact, the dignity of the whole of Roussel's research.

This being said, we consider that any further argument on our part would be superfluous and that it is not worth making a personal grievance of anything whatsoever, especially not questions of scientific credit. Everyone will agree that the practice of science, as well as the reports made of it, should tend toward the greatest possible objectivity and rely on factual evidence. And this is, in this instance, our only motivation.

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Waste Site Cleanup

Philip H. Abelson is correct in describing the Environmental Protection Agency's (EPA's) Superfund track record as poor (Editorial, 1 Dec., p. 1097), but his call for the Department of Energy (DOE) to lead the federal government's effort to clean up the nation's abandoned or inactive hazardous waste sites is a bit like suggesting that Pandora knows best how to close the box. If cost of decontamination is any measure of the mess created, there is ample evidence that DOE and its contractors know how to pollute. The price tag for tidying up at DOE's 3700 sites is estimated to be $130 billion. There is little evidence, other than the DOE report (*1*) to which Abelson makes reference, however, that the department has the capacity or the will to clean up.

DOE has a spotty record regarding environmental compliance and no demonstrated