Hirsch's jeremiad that the United States is heading into another energy crisis combines faulty analysis with self-interest to produce bad policy advice for the nation. Basically, he argues that it should be national policy to inflate oil prices in the United States so that domestic producers, including his employer, will have greater incentives to explore. But it was not the domestic producers who took us from the days of gas lines and exponentially rising crude oil prices to the current situation of glut in all energy markets as far as the eye can see. It was domestic consumers, who learned they could get by quite nicely on less energy, and production from places such as Mexico and Canada, who were not in OPEC, that broke the back of OPEC. What we learned from the days of the so-called "energy crisis" was that there is no need to panic as long as we are willing to let markets work.

Right now the world is awash in oil (and the United States is similarly swimming in natural gas, coal, uranium, and electricity). This vast change is truly remarkable to anyone who remembers the dire warnings of the Senate Energy Committee in 1979 that Saudi Arabia, then producing around 12 million barrels of crude per day, was soon going to top out at 16 million barrels per day and then we would all freeze in the dark. Hirsch's figure 2 shows Saudi production at well under 3 million barrels per day for 18 months. Iran and Iraq are each capable of increasing their current production by a factor of 5 or 6, at least. I see no reason to believe that oil will again be in short supply in the future, where a cartel can exercise market power.

I would not be troubled if the United States finds itself buying 70% of its oil abroad, as long as the stuff was plentiful and cheap. I see no compelling evidence to support Hirsch's assertion that "as worldwide oil production comes into closer balance with demand, OPEC will regain market control and be able to force up prices." Indeed, his policy prescription seems to be to drive up prices now, artificially, rather than let them slide up gradually as the market comes into better balance.

The predictions of energy crisis ahead that seem to be emerging from the petroleum industry and its supporters remind me of something a former boss told me when I was working at the National Institutes of Health. "Remember," he said, "more people are getting rich from cancer than are dying of it."

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Hirsch's article invites four questions:

- If oil will soon be scarce and expensive, why aren't oil companies, as rational profit-seekers, betting on their own forecasts by spending far more on exploration?
- If depletion of U.S. hydrocarbon resources is worrisome, why is it in the public interest to subsidize depleting them even faster?
- If depletion is already so advanced, and the sustainable alternatives that Hirsch agrees we will "eventually" need will take a long time to adopt, shouldn't we be starting now, not further stalling, an orderly transition to them?
- If, as his opening quotation from the Department of Energy's Energy Research Advisory Board (ERAB) states, "energy use and reserve predictions have been consistently inaccurate," why trust those he cites?

Hirsch is right to be concerned about oil depletion. Yet he devotes only three dismissive sentences to the primary solution, which ERAB states thus: "Conservation and more efficient end-use technologies can be enormously important." For example, full use of advanced windows could save more oil, or gas fungible for oil, than Alaska supplies (1/5 of U.S. demand); 1 year's rapid deployment force budget, spent to cut buildings' heat losses, could about eliminate Mideast oil imports; and rolling back car efficiency standards from 27.5 to 26 miles per gallon will probably waste oil faster than the Arctic National Wildlife Refuge, or now-forbidden areas offshore California, could provide it. Improving buildings *or* cars could eliminate U.S. oil imports before new Arctic or offshore oil, synfuels, or power plants could come on line, and at a five to ten times lower cost.

Future needs for oil, and the rising import dependence which Hirsch decries, are not fate but choice. Saving oil takes time and costs money—but less than the 5 to 10 years times $50 billion to $100 billion per year and the $30+ per barrel cited by Hirsch for new oil. The U.S. oil industry, after a century's development, delivered in 1986 a dwindling 22×10^{18} joules at rising real cost. In contrast, the U.S. energy-saving "industry" developed over the past 13 years delivered in 1986 some 30×10^{18} joules, increasing by several percent per year, at falling real cost. Investing more money and attention in the former and less in the latter risks repeating the unhappy history of the 1973–1974 and 1979–1980 oil shocks: a failed government supply-side response overwhelmed by a successful market demand-side response.

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Hirsch speaks of "the long period required to crank up industry activity after the 1973 crisis . . . [a] doubling of the 1973 drilling level required more than 6 years, in spite of large financial incentives and large pressures from the government and public." That is the industry line; but what was the industry *really* doing in that time? By and large it was leaving exploratory drilling to the wildcatters while it bought up coal mines and competing energy threats such as Raytheon. It did go in for fantastically expensive offshore projects that virtually assured a killing at the bonanza price of oil and, do not forget, we all lived in the happy expectation that the price would reach $80 a barrel and stay there. Offshore development has much of the attraction that the cattleman finds in public grazing lands, and the industry does not have to put out that galling 3/16 to 1/4 royalty.

My guess for the future is no better than anyone else's, but I do know what we are waiting for: the golden times when cars are lined up for miles behind the pumps and widows are freezing and the price of oil is $80 a barrel. That time will probably come, but the question is, Will the industry buckle down to the businesslike fact that in the developed and "exploited" fields most of the oil is still in the ground and can be got out a lot more cheaply than the romantic offshore stuff—especially if it is in the Atlantic and not really there?

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Response: Ivanhoe believes the numbers I quoted for remaining U.S. oil resources are "unduly optimistic and misleading." I disagree but support his contention that there is considerable uncertainty in such projections. My disagreement is based upon the credibility of the references that I cited. Those sources are well respected and reflect a considerable body of knowledge developed over a long period. Nevertheless, it must be recognized that resource estimation is a very inexact science because our current understanding of geology does not allow accurate large-scale extrapolation due to the enormous complexity of the phenomena involved.

I am personally optimistic regarding remaining U.S. oil reserves and the potential for a dramatic recovery in U.S. oil production. My basis is the very significant advances of the past few years in geological and geophysical science. These provide the explorationist remarkably better pictures of the subsurface, which allow identification of oil reservoirs heretofore hidden except to accidental discovery.

As exciting and revealing as these new technologies are, they still involve considerable uncertainties, which I believe probably conceal significant resources. Furthermore, as we and others go back into known oil fields, we continue to discover areas that were overlooked and horizons that were drilled through without noting significant accumulations of oil.

The larger question is, What production will be possible from these various sources at what oil price? At $18 per barrel, U.S. production could continue to decrease at maybe 8% to 10% per year. At, say, $35 per barrel, the United States could probably regain or surpass our early 1980s production and maintain it for decades. Eighteen dollars appears to be reality; $35 does not appear likely.

Lovins makes a number of points; I will comment on two. First, he argues that continued improvements in efficient energy utilization are possible, desirable, and inadequately covered in my article. I totally agree. The DOE Energy Research Advisory Board (ERAB) has projected possible further U.S. energy efficiency gains of 20% to 30% by the year 2000, and I believe such improvements are physically attainable. The original draft of my paper had a much longer section on conservation, quoting ERAB.

The answer to Lovins' questions about why "oil companies [aren't] spending more on exploration" is the same as to the question of why the drive for greater U.S. energy efficiency has stalled and even reversed [the 65 mile-per-hour speed limit, CAFE (Corporate Average Fuel Economy) relief, and so forth]. The problems are low oil prices and government policies.

Low oil prices severely limit the exploration that can be economically justified under the current U.S. tax structure. That tax structure was basically established during the high profit period of the late 1970s and early 1980s. It has not been revised to accommodate the new realities that followed the 1986 oil price collapse. Tax structure changes could lower effective costs and thereby stimulate a dramatic expansion of new U.S. exploration and production.

Low oil prices also severely dampen the economic driving force for additional energy conservation. The only possible counter to that situation is government policy change, which could mandate continued energy efficiency improvements. When the stakes are as high as they are in energy, an either-or policy seems to me to be foolhardy. I believe that both increased U.S. exploration-production and increased energy efficiency are in the national interest, and I favor policies that would stimulate both.

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Erratum: In Constance Holden's article "NIMH finds a case of 'serious misconduct' " (News & Comment, 27 Mar., p. 1566), the location of the Oakdale Regional Center for Developmental Disabilities was incorrectly given as Illinois. The center is in Oakdale, Michigan.

Erratum: In the 1 May AAAS News (p. 610), four paragraphs that should have appeared under the heading "Pacific Division meets in San Diego, 14–18 June," incorrectly appeared under the heading "*SB&F* focuses on science in the middle grades." The misplaced text (p. 611) begins, "In addition, several field trips are scheduled. . . ." and ends, "or call 415-752-1554."

Erratum: In Jean L. Marx's Research News article "Oxygen free radicals linked to many diseases" (30 Jan., p. 529), Benedict Lucchesi (whose name was misspelled) was incorrectly described as expecting to initiate clinical trials of superoxide dismutase and catalase in human heart attack patients who undergo reperfusion therapy.