U.S. average in 1973 (*2*)] to 22 mpg (approximately the current on-the-road average for new U.S. cars) would save 780 gallons of fuel or about $1000 at current U.S. fuel prices. This is a substantial saving, and the invisible hand of the market therefore assisted the federal fuel economy standards in the post-1979 period in encouraging the auto manufacturers to make available more fuel-efficient cars.

The invisible hand will be much weaker in pressing for further improvements. Only one-third as much fuel would be saved in improving automotive fuel economy from 30 to 40 mpg, for example, as was saved in moving from 14 to 22 mpg. Perhaps this is why gasoline prices approximately double those in the United States have not pushed the average fuel economy of automobiles in Europe and Japan above about 30 mpg.

Therefore, although fuel economy improvements to 50 or even 100 mpg may be cost-effective to the consumer at higher fuel prices, the market incentives to realize those savings are relatively small and any "friction" in the market is likely to result in these savings not being achieved.

There are, however, both national and international interests in improved automobile fuel economy that are not reflected in the price of gasoline. Two points are relevant to U.S. short-term interests:

1) In 1984, the United States paid $60 billion for oil imports—approximately equivalent to the amount of gasoline consumed by U.S. automobiles (*6*).

2) Aside from the defense of Western Europe, the principal rationale for the huge U.S. investment in improved capabilities for "force projection" overseas is to preserve Western access to that half of the world's oil reserves that lie under the Persian Gulf region (*7*).

In the longer term, the current oil "glut" will go the way of previous gluts and we will continue our movement out of our "fuel's paradise" (*8*) into a post-petroleum era of less-abundant and higher-cost liquid fuels for transportation. If we steadily improve automobile fuel economy, we can make the transition gracefully. Otherwise, it may well involve further traumatic and costly shocks.

Concern that large potential fuel savings for the nation might remain unrealized, even though they could be achieved at relatively low cost, inspired Congress to set federal fuel economy standards in 1975. The same reasoning moved a group of Senators to propose in 1980 that the federal automotive fuel economy standards be programmed to continue to rise from their 1985 level of 27.5 mpg to 40 mpg in 1995 (*9*). A number of official studies (*10*) found this goal to be both feasible and probably cost-effective to the consumer. However, opposition from the auto manufacturers and the ideological opposition of the Reagan Administration to governmental interference with the market resulted in the abandonment of the effort.

In the absence of new government policy initiatives, the important technological potential for improved automobile fuel economy described by Horton and Compton will therefore remain largely untapped.

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Biomass Programs

In Constance Holden's interesting synopsis of the World Resources Institute conference on biomass energy "Is bioenergy stalled?" (News and Comment, 1 Mar., p. 1018), a remark I made concerning training in bioenergy systems is quoted out of context and could easily be misunderstood. Attendees will recall that, during a presentation on "the biomass transistor" (a hypothetical, cheap, mass-manufactured, small-scale, simple but highly sophisticated device for converting raw biomass into high value products), I observed that only at the University of Hawaii and at the University of Nancy in France could a student pursue fundamental studies at the molecular level directed toward exploiting the unique thermochemical properties of biopolymers and producing high-value chemicals and fluid fuels. In the broader field of biomass combustion, gasification, and pyrolysis, fine programs exist at many universities. These include (in the United States) University of Arizona, Clarkson College, University of Connecticut, Colorado School of Mines, University of Delaware, Georgia Tech, University of Idaho, Kansas State, Florida State, Massachusetts Institute of Technology, Michigan State, Mississippi State, University of Missouri, University of Montana, Stanford University, Texas Tech, Texas A&M, University of Utah, University of Washington, and University of Wisconsin. Universities with programs in biomass fermentations are too numerous to list. When one considers federal and industry attitudes toward biomass, it is remarkable that so much activity exists in universities.

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Warren Magnuson

Colin Norman makes a grievous error in his briefing "U.S. sanctions required to enforce whaling ban" (News and Comment, 22 Mar., p. 1447) when he refers to "the late Senator Warren Magnuson."

Happily, his friends celebrated with the very much alive Warren Magnuson his 80th birthday on 12 April 1985. People concerned about whales, and all of the hundreds of millions of human beings living in a world that is benefiting from his concern for the advancement of science, especially his initiative in establishing the National Institutes of Health and the National Science Foundation, should celebrate his great public service.

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Erratum: In Gina Kolata's article "Avoiding the schistosome's tricks" (Research News, 18 Jan., p. 285), *Schistosoma mansoni* and *S. japonicum* were inadvertently interchanged in the first full paragraph of the first column on page 286. *Schistosoma japonicum* lives in the mesenteric veins of the upper (small) intestine, and *S. mansoni* lives in the mesenteric veins of the lower (large) intestine.