

message. Reduction of energy usage will in the long run result in improved competitiveness for US industry, lower cost of living, a better environment and greater national security. Searl and Starr also support such investment, but apparently only at a rate driven by short-term economic factors. Investment in improved efficiency will almost always pay off in the long term, but typical payback times are longer than acceptable to shortsighted American planners.

To give an example of one means of lowering energy usage, I was impressed to learn that modern Japanese homes do not waste heat by continuously storing hot water. The water is heated en route when needed. This type of system may be available in the US, but I had not seen it before.

Perhaps the most important lesson we can learn from the Japanese is the merit of adopting ideas from other people. I agree with the authors that we should not "feel guilty" about our current inefficiencies, which we inherited. However, neither should we excuse ourselves from the obligation to plan for a better future.

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SEARL AND STARR REPLY: We are pleased with the attention that "Japan: Not an Energy Efficiency Model" has received. It was our intent to go beyond the simple, and we believe naive, per capita energy use figures commonly quoted in order to achieve some understanding of why energy consumption per capita is so much less in Japan than in the US, and in particular to see if the major cause of the difference was the use of more energy-efficient (that is, thermodynamically efficient) technology than in the US. We found that at the aggregate level much of the higher US per capita consumption in the transportation and residential sectors was due to demographic and geographic factors, not technology. We also concluded that the largest energy-using sector in the US, the energy conversion and distribution section, was more efficient than the Japanese sector. And as Sebastian Kuhn implies, the efficiency difference is even greater if geography is considered.

The letters exemplify the confusion that exists when one uses such terms as "efficiency," "conservation" and "waste." Are we talking about economic efficiency, thermodynamic efficiency or even some broader efficiency concept that includes social and environmental factors? We be-

lieve that comparisons solely on the basis of per capita energy use tend to obscure many of the economic, demographic and geographic factors. It would be useful to look in even more detail than we have at the reasons for the lower Japanese energy use per capita, and further at how we in the US would have to change our technology or end-use practices to achieve less energy use per capita, and then to disclose for public consideration the costs and benefits of a reduction in US per capita use.

In addition to geographic and demographic factors, it is obvious that energy prices may be a factor in the lower Japanese energy consumption. We agree that energy prices should theoretically include full economic, environmental and social costs. However, higher energy prices in other countries appear to be due to economic costs and revenue-raising taxes rather than to measures to cover environmental costs. Further, high energy costs appear to have serious short-run (and perhaps long-run) adverse effects on economic growth. One need only look at economic growth after the 1973 oil embargo and after the 1979-80 price increases to see such an effect. Increased energy prices do not provide a free lunch!

Turning to some of the specific comments, Kuhn speaks about "massive energy waste in this country." He provides no data and seems to be begging the question, since it was our contention that much of the higher level of energy use has explanations rooted in our geography and standard of living and is *not* evidence of technological inefficiency or large-scale negligence.

Kuhn suggests that the greater efficiency of the largest energy-using sector in the US, the conversion sector, is irrelevant, since other, end-use sectors determine the primary demand. Certainly that output of this sector is the integrated demand of other sectors, but the input is determined also by the losses incurred in conversion and distribution. The US energy conversion and distribution sector is even more efficient than we indicated, owing to the geographic factor of 3.6.

Regarding our explanation for the transportation sector difference, Kuhn says, "This kind of pseudoscientific argument completely misses more relevant explanations, such as the substantially higher average fuel efficiency of Japanese cars." There seems to be some difference in data here. According to "Fuel Efficiency of Passenger Cars" (International Energy Agency, 1991), in 1979 the Japa-

nese passenger car fleet used 72% as much fuel per mile as the US fleet. In 1986 the Japanese fleet used 83% as much as the US fleet. Japanese use for later years is not reported, but by 1988 US use was essentially the same as that of Japan in 1986. It does not appear that differences in fuel efficiency can come close to explaining the factor-of-3.6 difference in per capita transportation use. We agree with Kuhn's contention that we would all benefit from a more efficient transportation system.

Art Hobson's letter clearly recognizes differences in the definition of "efficiency." He appears basically to accept our identification of the reasons for differences in per capita energy use, but believes that the US could "alter our population density patterns, our 'geography,' by discouraging urban sprawl and rehabilitating our cities." He may be right, but that is a sociologic, demographic and economic matter, not chiefly an energy issue.

Robert Close makes several useful observations and seems to understand the implications of our discussion. We disagree with his statement that "investment in improved efficiency will almost always pay off in the long term." In general an investment in one area reduces the amount of investment available for some other area. For example, are all energy-efficiency investment options more valuable to society than, say, investments in medical care?

In summary, we still believe that per capita energy use comparisons are a simplistic and naive basis on which to make judgments about energy efficiency. We agree that more economically and technically efficient technologies should be used in the US, no matter where they are developed. It does not appear that the US is generally negligent in this respect.

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Where Did Pauli Make His 'Wrong' Remark?

Please: Can anyone quote a definitive source for the statement, attributed to Wolfgang Pauli after he listened to a boring seminar, "But it isn't even wrong"? This seems consistent with Pauli's acerbic European humor. Our excellent librarians can't trace its origin definitively.

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