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Further Musings on the Hydrogen Economy

Dr. Reuel Shinnar

The reaction to my article, "Demystifying the Hydrogen Economy" (Nov. 2004; pp. 5-6), was overwhelmingly positive, and I am grateful to the respondents who expressed kind words. But, let me offer further insight into points raised by some respondents. I object only to the idea that we can depend on hydrogen as the major source of energy with which to fuel our economy. I have no objection to specific uses of hydrogen, some of which (as in refining) are very important and should be increased. I also agree with Dr. Hirsch that we should continue and even increase basic and exploratory research. Regrettably, the research program proposed by the DOE has very few exploratory elements.

It would not be sensible to anticipate that research will lead to a full hydrogen economy. Renewable energy is expensive and it should not be wasted. Solar and nuclear power generate only electricity, and electrons are much better energy carriers than hydrogen. Through research, the economic penalty of converting electricity to hydrogen may be reduced from a factor of six to a factor of three, but, it will still be too expensive. For this reason, I disagree with Dr. Hirsch's assertion that we will ultimately need hydrogen for cars.

A better solution for the foreseeable future is a hybrid car with a large battery that can be charged from the grid. A car that is fully dependent on the electric grid for fuel is limited to 100 miles, but, a hybrid car with a battery sufficient for a range of 60 miles and has no limit on the length of its trips is a feasible and affordable solution. Over 80% of such a car's energy can be supplied by renewable electricity and only 20% need come from gasoline. Hybrid cars would use only 10% of the gasoline currently consumed. The cost of owning and driving such a car would be less than one-third the cost of driving a hydrogen car, and they can have a more immediate impact on the reduction of smog and greenhouse emissions.

In his letter, Bernard Lee (Jan. 2005, p. 6) seems unaware of the advantages of thermal solar energy, which has already been implemented successfully in Los Angeles, CA. Here, large plants were able to store energy in a high heat transfer fluid with almost 100% thermal efficiency. The current cost of thermal solar energy is already competitive with nuclear energy and it is a cheaper way to provide energy that is controllable and variable.

I agree with Michael Simpson (Jan. 2005, p. 6) that the DOE should play a major role in changing our energy supply structure. But, the answer is neither the hydrogen economy, nor is it exploratory research. Research will not make renewable energy cheap enough to be implemented without high penalties for greenhouse emissions though our dependence on power from coal. If the DOE is to play a central role, the agency must be transformed from a research-oriented agency to a mission-oriented one with clear goals. Like NASA, the DOE should begin to use competitive bidding in the free market to implement its goals. All the technology we need already exists and the agency should focus solely on improving what we already know and have.

The alternative is to repeat DOE's two great debacles of the past when over \$20 billion (in today's money) was spent on the first hydrogen economy. That research was based on the illusion that it would be cheaper to make hydrogen from a nuclear reactor using a closed-cycle of chemical reactions than by generating electricity for the electrolysis of water. As an elementary thermodynamic analysis could have pre-

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dicted, the program was a total flop because electrolysis is cheaper and thermally more efficient by a magnitude. In the second \$20 billion debacle, most of the large development efforts by DOE failed because they relied on technologies such as high-temperature filters that never worked. The only useful technology that emerged from the program was a power plant that was based on an oxygen-blown coal gasifier developed by Texaco that used a low-temperature liquid phase sulfur removal process that effectively filters out all particulates. This useful project was developed under the leadership of EPRI and, intentionally, it used only proven technologies.

The DOE's past failures should be enough to convince us that the implementation of any large policy program should be based only on proven technologies. Exploratory research that can lead to new findings is important, but, must first be proven on a smaller scale before it is funded for large-scale development. The mirage of the hydrogen economy is ideal if our government or our society does not want to do anything other than to pretend to be taking action. I find it hard to believe that scientists and engineers are happy to cooperate in creating such cynical illusions. Since we all agree that our energy problems are extremely urgent, it is time for our profession to raise its collective voice and speak up.

We Want to Hear From You

What's your opinion about the hydrogen economy and/or the LNG debate (see the following pages). Please send your comments by one of three ways:

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Select letters will be published in a future issue of *CEP*.

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