

Environmental Protection Agency standards. Indeed, environmental regulation as a key driver of intermediate-term R&D is an important issue. However, we emphasize the converse—that emerging technological realities should drive enlightened regulation. Too often, that is not the case. The PNGV program, driven principally by fuel efficiency, was hampered by inadequate coordination between technological and regulatory development. Remedying that situation requires either more effective interagency coordination or enhanced technological capability at EPA. It is unclear which of those two remedies is more easily achievable.

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Joan Ogden's otherwise informative article does not explain exactly why a hydrogen economy should be preferred over the conventional economy based on direct use of fossil fuels. The article suggests that, because nuclear power and renewable energy sources (hydropower, solar, and wind) are not expected to expand enough to support the electrolysis of seawater globally, the only realistic source for hydrogen fuel is through the reforming of petroleum or natural gas.

The process for extracting hydrogen from fossil hydrocarbons—using very hot steam, for example—will produce as much carbon dioxide as if the fuel had been burned conventionally. If that CO_2 is not sequestered by some means, preferably near the hydrogen plant, its release into the atmosphere will cause as much global warming as if it had come from a conventional car or thermal power plant.

Hydrogen fuel cells do have an advantage over fossil fuels in that they produce no nitrogen oxides or particulate pollution, but improvements to conventional combustion technology have already eliminated those pollutants to a large extent. Seemingly, then, the only reason to switch to a hydrogen-based economy would be the superior energy efficiency of fuel cells, although it is not clear how much savings will remain after inefficiencies in the reforming process are factored in.

Perhaps the global environment would be better served if we tackle a much simpler problem—extending carbon sequestration technologies, already under development for large thermal plants, down to the scale of the smallest combustion engines. We

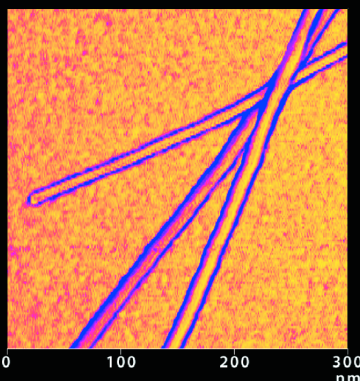
could then continue with the current infrastructure for fossil-fuel distribution and use, while avoiding the complications of producing, distributing, and storing a radically new fuel.

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The article by Joan Ogden proposes that available hydrogen technologies can address future energy and environmental challenges. More energy, though, is needed to produce a quantity of hydrogen

than can be obtained from it by combustion or by reactions in a fuel cell. Alternative fuels such as hydrogen and methanol are actually energy storage media or secondary energy carriers rather than fuels in the traditional sense. Ordinarily, we think of fuels as substances that, when burned, release more energy than is required to produce them. In addition to specifying the heat of combustion of an alternative fuel, giving its production energy value would also be helpful—and would require specifying the process of production.

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