Our addiction to fossil fuels (oil and coal) is killing us. Oil alone is responsible for smog, nitrogen oxides and fine particles--in sum, urban air pollution--which is killing an estimated 50,000-60,000 Americans each year.[1] To these deaths we must add the regional and global consequences of oil and coal-related pollution: regional destruction of forests, crops and fish by acid rain, and the mounting threat of severe floods, harsh droughts, devastating storms, large forest fires, and ruinous declines in crop yield--which are the most likely consequences of global warming.[2] Other, lesser, consequences of our oil addiction include massive oil spills, wildfires devastation by oil exploration activities, and occasional small wars.

Now technical developments during the past eight years have made it realistic to say we can end our use of fossil fuels in the U.S. and worldwide. All we have to do is decide to do it.

A realistic alternative to oil and coal is hydrogen fuel produced by solar energy, according to a thorough study by the Center for Energy and Environmental Studies at Princeton University, funded by the National Science Foundation.[3]

According to the study, hydrogen fuel produced from water by the action of electricity--particularly electricity created by the sun's rays striking photovoltaic cells--offers a realistic substitute for all our current fossil-fuel uses high-temperature heat in industry, low-temperature heat for space-heating, and liquid fuels for transportation. Hydrogen could do it all, the study's authors say, and solar cells are the best way to make the hydrogen.

For many years, photovoltaic cells ("solar cells") have been expensive toys. A photovoltaic cell is a sheet of dark blue glass with a pair of wires attached. When the cell is placed in direct sunlight, electricity becomes available in the wires. There are no moving parts except electrons moving inside the cell, producing the electric current. (You can buy solar cells for as little as $4.00 from Edmund Scientific, 101 East Gloucester Pike, Barrington, NJ 08007-1380; phone (609) 547-8880.)

Technical advancements in the past 15 years--and especially in the last eight years--have reduced the manufacturing costs for solar cells steadily, and now such cells offer a realistic alternative to nuclear power and to coal-burning power plants. Furthermore, data from a decade--of manufacturing now allows conservative estimates of continued reductions in manufacturing costs that are very likely to achieved in the next five years. The age of solar hydrogen is at hand.

As a fuel, hydrogen is almost an environmentalist's dream come true. When hydrogen burns, it emits no carbon monoxide, no carbon dioxide (the main source of global warming), no volatile organic compounds (the main source of urban smog), no fine particles (the chief killers in urban air), and no sulfur oxides (the main source of acid rain). The only pollutant created is nitrogen oxides, which can be controlled by various means (depending on the kind of combustion device the hydrogen is fueling). The main byproduct of hydrogen combustion is water vapor when the hydrogen (H) and oxygen (O) combine into H2O.

The particular solar cell technology used as the basis for the Princeton study is called amorphous silicon. Unlike older solar cells which were usually round and an inch or two in diameter, amorphous silicon cells are now manufactured by spraying a thin film onto sheets of regular plate glass 4' x 4' or even larger. The raw material in such cells is silicon derived from sand, so no raw material shortages stand in the way of large-scale production.

Nuclear power stations and coal-fired power plants make best economic sense when they are built large (1000 megaWatts [one gigawatt] is the average power plant today); each such plant requires an investment of billions of dollars. In contrast, there are no economies of scale to be achieved in solar-hydrogen plants beyond a 5-to-10 megaWatt facility that would cost only $4 to $10 million to manufacture. These modular units could be combined to give power output of any desired size to meet any conceivable need. Furthermore, the modular nature of solar-hydrogen plants makes them ideal for construction of demonstration-scale units to show that real alternatives to oil are within reach.

To achieve the necessary efficiencies to make solar-hydrogen plants affordable as a total substitute for oil, they would have to be sited where the sun shines most; the world's deserts would be the best candidates for location of such facilities. The hydrogen would then be piped to consumers through gas pipelines. The land area needed to produce hydrogen equivalent to all U.S. oil would be 24,000 square miles--about 0.5% of total U.S. land area, or 7% of U.S. deserts. The land area needed to collect solar energy to produce hydrogen equivalent to the world's entire oil production in 1987 would total 205,000 square miles or about 2% of the world's desert area.

Photovoltaic panels need not block out the sun and kill desert vegetation; long rectangular panels on stilts, spaced appropriately to allow sunlight to strike the desert beneath them as the sun moved across the sky would allow vegetation, wildlife, and even domestic animals to thrive beneath them.

To replace all U.S. oil used today, the water needed to produce the hydrogen would add about 2% to U.S. per capita water usage. The water would not be destroyed, of course, but it would be moved from the place where the hydrogen was made to the place where the hydrogen was burned.

The Princeton study considers each of the competing alternatives and concludes that hydrogen is the best fuel and that solar cells are the best way to make the hydrogen. The study considers biomass (growing vegetation and burning it for fuel), nuclear energy, natural gas (methane), and synthetic fuels from coal. Each of these competing technologies has benefits and costs. Biomass requires 10 times as much land as solar cells and a great deal more water. Nuclear power--even if the nuclear waste problem could be solved--suffers from one unsolvable: each year a single reactor creates enough plutonium to manufacture 20 nuclear bombs, and we have seen in recent days that even facilities being actively inspected by the international atomic police can extract plutonium from reactors right beneath the policemen's nose.[4] Coal-based fuels produce carbon dioxide that promises without doubt to heat up the planet sooner or later, causing major disruptions of atmosphere and related systems (such as rain and food production). Natural gas suffers from the same unsolvable problem.

The German automobile firm, Daimler-Benz has produced a hydrogen-powered automobile already. The Billings Energy Corp. of Provo, Utah has manufactured a hydrogen-powered bus. Several countries (Italy, New Zealand and Canada) have already demonstrated the feasibility of a gaseous-fuel infrastructure for transportation (in other words, pipelines, tanks, filling stations, and so forth).

People fear hydrogen, principally because of the Hindenburg airship disaster at Lakehurst, NJ, in 1937, which killed 36 people. However, analysis of natural gas, gasoline and hydrogen reveals that each fuel has particular hazards associated with its manufacture, storage, transportation and use and that for each fuel procedures and precautions can be developed for safe handling.[5]

The final chapter of the Princeton study offers a scenario for shifting from an oil-based economy to a solar-hydrogen economy. Even a speedy transition would take several decades; the pace of the transition will depend upon our willingness to make the necessary investment in new facilities. Our willingness to invest depends upon our concern for the wellbeing of the planet and the services it provides to humankind.

[2] These effects are the ones we should expect as the buildup of so-called greenhouse gases continues, according to Stephen Schneider of the National Center for Atmospheric Research (a federal research laboratory); see chapter 1 in Schneider's book GLOBAL WARMING (San Francisco: Sierra Club Books, 1989).

[3] Joan M. Ogden and Robert H. Williams, SOLAR HYDROGEN: MOVING BEYOND FOSSIL FUELS (Washington, DC: World Resources Institute, 1989). 123 pgs.; $12.50 plus $3 shipping from WRI Publications, P.O. Box 4852 Hampden Station, Baltimore, MD 21211. Phone (800) 822-0504 or (301) 338-6963; Visa, Mastercard and purchase orders accepted.


IMPORTANT CONFERENCE COMING UP

The third annual Scientific Assembly for Environmental Health is coming up October 11 and 12 in Columbus, Ohio. We highly recommend this conference to our readers. There are three series of workshops: one for physicians, one for lawyers, and one for activists. The basis of the grass-roots movement for environmental justice is concern for our health and the health of our children. This conference is where the rubber meets the road. High-quality, focused presentations abound. For more information contact Linda King, Environmental Health Network, P.O. Box 1628, Harvey, LA 70058; phone (504) 362-6574.

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