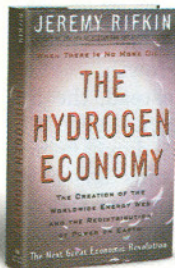


ENERGY

THE HYDROGEN BALM?

Author Jeremy Rifkin sees a better, post-petroleum world



Lately, interest in hydrogen as an energy source has gone from a simmer to a boil. Believers say harnessing hydrogen could wean the world from oil, slow global warming, and lift billions out of poverty.

Even President Bush has called fuel cells, which turn hydrogen into electricity, "the wave of the future." On Sept. 5, an ad hoc coalition of companies including DuPont and 3M asked Congress to spend \$5.5 billion over the next decade to advance fuel-cell development.

And now the hydrogen movement has a marquee spokesman. Jeremy Rifkin, liberal social critic and best-selling author, has written a book published this month called *The Hydrogen Economy: The Creation of the Worldwide Energy Web and the Redistribution of Power on Earth*. Although Rifkin is no expert on the physics, he gives the hydrogen cause a social dimension. He argues that cheap hydrogen could make the 21st century more democratic and decentralized, much the way oil transformed the 19th and 20th centuries by fueling the

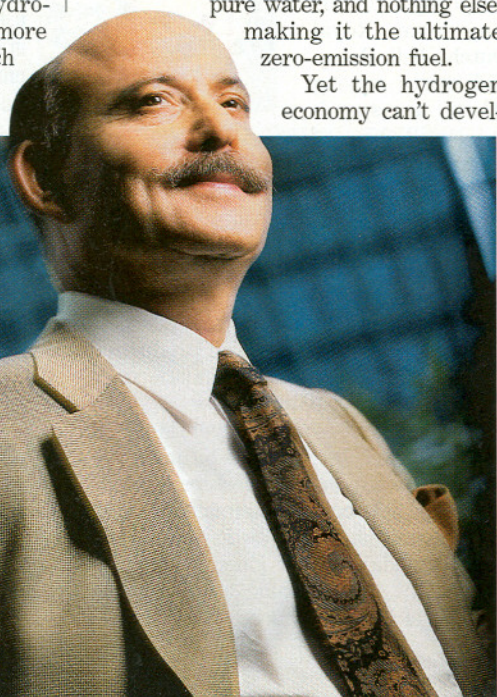
rise of powerful corporations and nation-states. With hydrogen, writes Rifkin, "Every human being on earth could be 'empowered.'"

The hydrogen hype, however, may be too much, too soon. While hydrogen's abundance and cleanliness make it the favorite as the fuel of the future, fossil fuels still have a cost advantage. And it's not obvious that even when hydrogen does come into widespread use, democracy will follow. "I don't see the logical connection quite that clearly," says Amory Lovins, the Colorado scientist and environmental advocate who has spent 30 years proselytizing for hydrogen and renewable energy sources.

In the future hydrogen economy, as it is widely envisioned, electricity from clean, renewable sources such as the sun and wind will be used to derive hydrogen from other substances—mostly natural gas at first, then water, the purest source. The hydrogen can be stored, then consumed in fuel cells where it's needed—say, to power a motor vehicle or to heat a building. Combining hydrogen and oxygen in fuel cells generates electricity, pure water, and nothing else, making it the ultimate zero-emission fuel.

Yet the hydrogen economy can't devel-

**RIFKIN: OIL
OUTPUT
WILL PEAK
BY 2020**



op until there's a sharp drop in the cost of clean sources of electricity, such as from solar cells or wind turbines. That's because hydrogen, unlike oil or coal, doesn't exist in nature in a consumable form. It must be broken apart from oxygen, carbon, and other atoms. It actually takes more electricity to free the hydrogen than you get later by consuming the hydrogen in fuel cells.

Why bother producing hydrogen at all if you've already got supercheap electricity from the sun and wind? Mainly because hydrogen, like gasoline, packs a lot of energy into a small space. And unlike the sun or wind, it can be consumed where and when it's needed. For instance, cars and trucks can run on fuel cells powered by hydrogen generated from wind turbines, while they could never run directly off wind power. The ability to derive and store hydrogen transforms on-and-off energy sources like the sun and the wind into dependable bulwarks of the power system. And since hydrogen is the most abundant element in the universe, there is no danger of running out.

Even many oil companies believe in hydrogen for the long term. Royal Dutch/Shell Group and BP PLC, among others, are spending millions of dollars a year researching alternatives to oil. The question is when the transition will occur. Rifkin writes that it must happen soon because global production of conventional oil is likely to peak between 2010 and 2020. That may be rushing things. While pessimistic geologists predict oil production will peak by 2006, the optimistic ones place the date at 2040 or later.

There's plenty of unconventional oil in the ground, too. Tarlike bitumen deposits in sandy soil in western Canada and Venezuela contain as much oil as all the conventional deposits in the Middle East. Canada's Suncor Energy Inc. produces light, sweet crude at an operating cost of just \$8 a barrel, vs. a market

price of \$29 a barrel. And production costs keep falling. Says CEO Richard L. George: "It's biased to say we're going to advance all those renewable technologies at a record pace but the technology of fossil fuels is going to stand still."

So it's unlikely that a shortage of oil will be the factor that forces the transition to a hydrogen economy. And if history is any guide, an energy-hungry world is unlikely to quit oil voluntarily, based on concerns about global warming or overdependence on the Middle East. For instance, the U.S. has refused to ratify the Kyoto Protocol aimed at limiting greenhouse gases, citing unacceptable harm to economic growth.

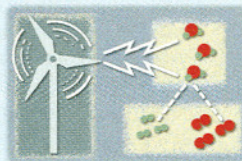
Instead, the hydrogen economy will dawn when systems based on renewables and hydrogen beat hydrocarbons in straight competition for consumers' dollars. On that score, there has been progress, but there's still a ways to go. One indication: Renewables, excluding hydro-power, account for only 2% of U.S. electricity generation, despite years of subsidies. And fuel cells remain niche products, still too expensive to replace gasoline and diesel engines.

As for the social implications of a shift to hydrogen, even Rifkin acknowledges the obstacles blocking his decentralized, democratic hydrogen utopia. Multinational corporations are already vying to control the design, production, and sales of the devices that produce and consume hydrogen. Electric utilities may even own and maintain the fuel cells in people's homes. What's more, the Internet-based World Wide Web, a predecessor to Rifkin's "hydrogen energy web," hasn't yet ushered in the age of empowerment predicted by its advocates—though it is early to draw conclusions on that score. It would be nice if the high hopes for hydrogen aren't just a lot of gas. Such a future, however promising, is likely to be a long time coming.

By Peter Coy in New York

THE HYDROGEN ECONOMY

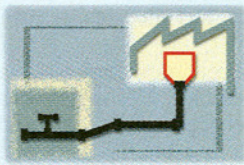
CREATION Electricity generated from renewable sources, such as solar cells



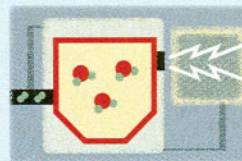
or wind turbines, is used to break water into hydrogen and oxygen

TRANSPORT

The pressurized hydrogen is shipped by pipelines and container trucks to fuel cells in buildings, factories, or vehicles



USAGE Inside a fuel cell, hydrogen recombines with oxygen in the air to generate electricity, which can be used for power in buildings or to propel cars and trucks



Data: BusinessWeek