RED HERRING

SCENARIOS

A new energy revolution.

THE PONDEROUS energy industry is about to be transformed by the same gales of creative destruction sweeping through other industries as small-scale technologies and knowledge-intensive services replace big, dumb, asset-intensive products and services. A series of energy revolutions shaped the economic landscape at the beginning of the 20th century. A similar set of revolutions is under way today and will realign the winners and losers in the energy industry.

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At the turn of the last century there were three big drivers of change in energy markets: 1) The use of electricity was spreading rapidly and was generated centrally by ever-larger coal-fired power plants. Small electric motors made factories and homes run more efficiently. Today, electricity accounts for about 11 percent of total energy use. 2) The automobile began its long path to dominance. Today, cars use 17 percent of all energy. 3) Fossil fuels—from coal to oil to natural gas—increasingly replaced wood, water, wind, and animal oils as sources of power. Industries like steel and cement were huge users of fossil fuels. Burning fossil fuels currently accounts for about 85 percent of all energy use.

At the beginning of the 21st century the pace of electrification is continuing as nearly all energy use is moving toward electricity. In steel and cement making, new industrial processes for producing heat electrically are replacing the burning of fossil fuels. More and more of that electricity will be generated closer to the end user. Even the automobile is becoming electric—we can foresee the end of the internal combustion engine. Finally, we are seeing a movement away from fossil fuels and toward hydrogen. We might even see a surprise revival of nuclear power to produce hydrogen.

Behind these changes are several forces. First, of course, is new technology. At the core is a historic reversal in economies of scale. Until the early '70s, ever-larger power plants meant greater efficiency. Now, new technology is creating higher levels of efficiency at an ever-smaller scale. First came combined cycle gas turbines (CCGT) and now turbo generators (very small-scale turbines for power generation). Fuel cells are finally becoming economic and reliable. Various hybrid combinations of internal combustion and electric generation are also filling some of these niches early in this transition.

Over the next few decades, most structures—including the average home—will use electricity produced in their basements the way heat and air conditioning are produced today. Over a similar period, the automobile's internal combustion engine will gradually give way to various forms of electric drive. Building systems, governed by the pace of construction and replacement, will change more slowly. By 2010, half the cars in a showroom are likely to be electrics. They're greener, cleaner, quieter—and quick and fun to drive.

The environmental impact of energy production is also a major shaper of the future. Concerns about climate change and local pollution have increased pressures to improve efficiency and radically reduce the amount of CO_2 emitted during the production and use of energy. Fortunately, the new technologies will gradually improve the situation. Ultimately, the movement toward electricity that is locally produced by using hydrogen in fuel cells will mean a deep-green energy system. The fundamental uncertainty is how we will produce that hydrogen. Initially, it will come from various hydrocarbons, including natural gas, gasoline, and methanol. Later, we may produce hydrogen directly from water using a combination of renewable and nuclear electricity.

Deregulation and privatization are opening up new forms of competition. In electricity, the business of its generation has become highly competitive and will remain so. The privatization of state oil companies has created new and dominant competitors in the oil and gas industries. These competitive forces are, of course, accelerating the rate of innovation.

Furthermore, we Americans tend to have a strong bias in favor of technologies that give us greater control: we choose PCs over mainframes, the Internet over the centrally switched network, VCRs over broadcast, and automobiles over mass transit, all of which are examples of our choosing control over efficiency or power or shared goods. Distributed electricity just gives us control over one more aspect of our lives—technologies that give us more control have a tendency to win.

A number of companies are poised to gain from these transformations. Alameda, California–based Silicon Energy is providing software and services to manage energy systems using the Web. Nth Power Technologies is the venture capital fund behind Silicon Energy and is busy exploring other energy ventures as well. Investing in Nth Power and Silicon Energy is ABB, the giant, global high-tech energy and control systems company. There's plenty of room for startups, venture funds, and old giants to play. In another playground, that of fuel cells, Ballard Power Systems and Plug Power are the most visible players. And Enron continues to reinvent itself in order to

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exploit the new energy and information networks.

The dominant incumbents in energy, due to their strength, capital base, and access to talent, may continue to win and keep the game basically the same. Companies like Pacific Gas & Electric and the Southern Company in electricity supply, Shell, Texaco, and BP Amoco in oil and gas, and Siemens and General Electric in electric hardware supply have endured for so long that they may keep the old game going to protect their dominance.

The new technology, on the other hand, may take off more rapidly than most people expect and lead to radical changes in the energy industry. Economics, ecology, and convenience may drive us toward an all-electric, hydrogen-powered fuel-cell economy with distributed power. The key assumption here is that there will be a steady improvement in all aspects of the technology. If that turns out to be a good assumption, then this scenario may be almost inevitable.

Although energy systems are slow to change, the combination of new technology, competition, and ecological pressures makes the persistence of the current system unlikely. In the absence of a major breakthrough in science, something like the distributed power scenario may already be under way.

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