BOOK REVIEW

THE HYDROGEN ECONOMY by Jeremy Rifkin (Penguin Putman Inc., 2002)

Reviewed by
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This book is a thoughtful and readable presentation about how the hydrogen-based energy era will in the near future replace the fossil fuel energy era that began over a century ago. The author, who has written fifteen other non-fiction books dealing with the economic impact of a variety of scientific and technology changes, is a member of the faculty at the Wharton School of Business at the University of Pennsylvania and is Chairman of the Washington-based Foundation on Economic Trends.

Three propositions supply the framework of Rifkin's analysis of the coming major energy "regime change" on which this book is written. The first is that the fossil fuel energy era will undergo a phase-out process in the near future when the global fossil fuel production peak is reached and the resource bas of these fuels begins to decline. As this phase-out process unfolds, the Middle East countries will control the largest share of remaining fossil fuel reserves and will therefore exert increased influence upon both international policies and the global economy. Second, the energy source destined to replace fossil fuels is hydrogen, to be separated from water and consumed in fuel cells to create electricity on a decentralized, distributed energy bases. The worldwide production of electricity from hydrogen-powered fuel cells promises to become a low cost, abundant energy source which could last indefinitely and would result in the restructuring of many industries, including both transportation and electric power industries. Finally, this book demonstrates that the major challenge confronting the world and the energy industry involves the timely recognition of (a) the need to prepare for the orderly phase-out of the fossil fuel economy and (b) the need to establish the infrastructure and framework within which a "hydrogen energy web" can realize its potential for supporting a strong, expanding global economy with improved living standards worldwide, including those in third world countries.

I. THE FOSSIL FUEL ERA PHASES OUT

The enormity of the task of "phasing out" the fossil fuel era is well stated by Rifkin in these terms:

> Remove fossil fuels from the human equation and modern industrial civilization would cease to exist. We heat our homes and business from fossil fuels, run our factories with fossil fuels, power our transportation with fossil fuels, light our cities and communicate over distances with electricity derived from fossil fuels, grow our food with the help of fossil fuels, construct our buildings with materials made from

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> fossil fuels, . . . store our surpluses with plastic containers and packaging made from fossil fuels, and produce our clothes and home appliances with petrochemicals. Virtually every aspect of modern existence is made from, powered with, of affected by fossil fuels (p. 64).

Apart from the heavy dependence of today's civilization on fossil fuels, Rifkin points to three other factors that will impair society's ability to implement an orderly end to the fossil fuel era. These include (a) the dominant presence of centralized, hierarchical command and control business organizations within the energy industry, organizations which are generally less flexible in coping with new challenges, (b) the rise of Islamic fundamentalism in the Middle East and around the world and (c) the threat of increased warming of the Earth's climate from fossil fuel combustion. Each of these points receives a thoughtful review as the source of problems to be met in the fossil fuel phase-out process.

Rifkin uses the "bell curve" metaphor to explain the issues on the timing or commencement of the fossil fuel phase-out process. Beginning with the initial discovery of crude oil in 1859 (by Col. Drake at Titusville, Pa.), the annual production of fossil fuels on a global basis has steadily increased for more the 140 consecutive years. This trend has been supported, of course, by the successful efforts to explore and discover new crude oil reserves and has created an upward production curve, which is the front half of the bell curve on global oil production. This curve will reach its peak when the volume of world oil reserves available no longer support an annual increase in oil production. A study published by two prominent geologists in the March 1998 *Scientific American* forecasts that global oil production will fail to meet global demand in 2010 and that supply will steadily decline at 3% per year thereafter. Although there are many other such studies cited, Rifkin concludes the fossil fuel phase-out timing discussion by noting the experts on the subject are divided into two camps: those who believe oil production will peak in twenty-eight to thirty-eight years and those who think it is likely to peak much sooner, within eight to eighteen years. He also notes that the ten to thirty years difference between these forecasts is "a very small time window in history" (p. 29)

The other significant point made about fossil fuel production peak issues concerns world population growth. According to a BP-Amoco study, world oil production per capita peaked in 1979 and has been declining ever since. In other words, the increase in the world oil production has not kept pace with the growth in world population for the past twenty-three years. Where per capita energy production is concerned, (and this is arguable the best way to evaluate the adequacy of supply) the world is well on its way down the backside of the fossil fuel production bell curve.

II. THE DAWN OF THE HYDROGEN REGIME

At the onset of Rifkin's discussion about how the hydrogen economy will emerge as the fossil fuel era fades, there are two anecdotes, which speak volumes about the coming of the hydrogen revolution. The first is a reference to an 1874 book by Jules Verne, the popular science fiction writer of the 19th century. Verne's book, *The Mysterious Island* is about the adventures of five Union soldiers who escape from their Confederate captors was made in a hot air

balloon which eventually landed on an island many miles from its take off point. One day, as this group of stranded men were musing about the future of the Union, one of them asked the engineer in the group what might happen if America were to run out of coal. "What will they burn instead of coal?" he asked (p. 176). "Water," exclaimed the engineer, who went on to explain that water decomposed into its elements by electricity could be employed as fuel (p. 176). He went on to say that hydrogen and oxygen constitute water that used separately or together these elements will provide an inexhaustible source of heat and light that is more intense that that from coal. "Water will be the coal of the future," he concluded (p. 177).

The second anecdote concerns an October 2001 (three weeks after 9/11/01) presentation in New York City by Phil Watts, Board Chair of Royal Dutch Shell, to a U.N. group on the future of energy. Mr. Watts' comments began with the advice that his company was preparing for the end of the hydrocarbon age and the claim that, in the 21st century, the fossil fuel era would give way to a revolutionary new regime based on hydrogen. He went on to say that Shell had already committed a billion dollars to making the transition to the new hydrogen economy. I believe these two stories speak for themselves as authenticators of the imminence of the hydrogen energy era.

Rifkin's treatment of the many profound issues presented by the pending conversion to the hydrogen economy is thorough and provocative; it also embraces many of the political and socio-economic values and goals that could be addressed more effectively in this new energy era than in the fossil fuel era. Some of the more intriguing issues he identifies include: (a) how to maximize the social and consumer benefits to be derived from a hydrogen energy system which inherently lends itself to the distributed energy model, (b) does the fact that hydrogen exists almost everywhere and is likely never to become scare make it a public property which must be collectively shared? Is this a situation in which new business practices need to be invented to reflect the public or semi-public nature of the hydrogen energy regime? and (c) Does the hydrogen economy provide the structural basis for international energy-sharing networks that can lift billions of people out of poverty? Shouldn't the goal of this new energy system include the provision of stationary fuel cells for every neighborhood and village in the developing world?

III. THE TIMELY CONVERSION TO THE HYDROGEN ECONOMY

Given the huge uncertainty about when fossil fuel supplies will begin to decline, there is more speculation about how the conversion to the hydrogen era might be structured than there is hard factual information. Against this background, Rifkin nonetheless raises a series of major questions about the hydrogen era transition process that deserve attention as soon as possible, even though they cannot be fully answered today. Two of these issues are explained here.

IV. THE DIRTY FOSSIL FUEL ISSUE

This issue concerns the situation in which the global oil and natural gas production peak has been passed sooner than expected, forcing unprepared

countries and companies to turn to dirtier fossil fuels – coal, heavy oil, tar sand – as substitutes. Given the threat of global warming, the switch to these dirtier fuels could cause devastating effects on the Earth's biosphere. The question presented, therefore, is whether there should be any ground rules or restrictions adopted to protect against such environmental damage during the hydrogen era transition process.

V. IS HYDROGEN THE PEOPLE'S ENERGY?

The argument Rifkin makes in favor of treating hydrogen as public property takes note that hydrogen is the lightest and most ubiquitous element in the universe. When hydrogen becomes fuel, it becomes the "forever fuel" because it will never run out, and its consumption involves no harmful emissions. On the other hand, he also notes the hydrogen cannot be found in isolation; instead it must be extracted from natural sources such as water or natural gas.

Rifkin goes on to say that whether "hydrogen becomes 'the people's energy' depends" on "how it is harnessed in the early stages of development" (p. 10). He also argues that the proper "sharing" of hydrogen will require that public institutions and nonprofit cooperatives "with a collective worldwide membership that exceeds 750 million people" intervene at the outset of the hydrogen energy revolution and "help establish distributed generation associations (DGAs) in every country" (p. 10).

It is not entirely clear what the role of these DGAs would be and how that role relates to the question of whether hydrogen is the people's energy. To the extent that these DGAs are intended to facilitate the maximizing of the economies available from energy swaps between fuel cell operators, the scheme makes good sense, even though it seems not particularly responsive to the "people's energy" question.

VI. CONCLUSION

Those who have a professional state in the energy business need to learn as much as possible, as soon as possible about the energy regime transition issues. A good place to begin that learning is *The Hydrogen Economy*.

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