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The Bottomless Well: The Twilight of Fuel, the Virtue of Waste, and Why We Will Never Run Out of Energy, by Peter W. Huber & Mark P. Mills

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Arguably the weakest section of the book is that dealing with law (Chapter 7). The brush used to touch on important legal topics is simply too broad to leave the reader reasonably well informed. The discussion of riparian and prior appropriation doctrines is just too simplistic; the reader would benefit from at least some small amount of analysis as to strengths and weakness of the systems and contemporary problems and issues arising from those weaknesses. Surely methods for resolving interstate conflicts over water is an important topic. This topic gets four pages of discussions concerning interstate compacts, but neither equitable apportionment (surely a familiar topic to a Nebraskan) nor congressional apportionment is given mention.

The book's strongest, most attractive facet is the author's enthusiasm for the topic. This enthusiasm comes through to the reader on almost every page. Thus, one wants to forgive the author for spotty coverage of topics. This is surely justifiable given the many topics covered in the book—perhaps too many. But one would expect that the author would at least advise the reader of where "abbreviated" coverage occurs and would provide citations for sources that the interested reader could consult for greater depth. The lack of this kind of guidance is perhaps the book's most unforgivable fault.

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The Bottomless Well: The Twilight of Fuel, the Virtue of Waste, and Why We Will Never Run Out of Energy. By Peter W. Huber & Mark P. Mills. Basic Books, 2005. Pp. 214. $26.00 hardcover.

The authors first challenge what they call "the conventional wisdom" that improved energy efficiency diminishes the demand for energy. They argue, sometimes with the help of simple charts, that the opposite is true. Second, they reason, less convincingly, by examining past trends and looking forward to an extraordinary future that now beckons, that we will never run out of energy. Unfortunately, the book contains a mishmash of stories about the wonders of technologies from James Watt and on.

Their first story begins in 1765, the year James Watt invented the steam engine; eleven years later Nikolaus Otto invented the internal combustion engine, and fourteen years later Thomas Edison patented his light bulb. The bulk of the first ten chapters is devoted to showing that increasingly more efficient cars, engines, steam turbines, light bulbs, radios, jets, microprocessors, robots, and whatnots have become available to consumers over time. For example, the energy cost of transportation (fuel gallons/100 vehicle miles) fell sharply from 1973 to

1993, and moderately from 1993 to 2003. From 1973 to 2003, total fuel use in transportation has been rising steadily. From 1900 to 2000 the cost of transmitting information (cents/1000 words) has been dropping drastically while, during the same period, total energy use (quads) has been rising almost continuously. This process of ever rising efficiency is summarized in Figure 7.2, where the authors show that the energy cost of the U.S. economy, measured by thousand Btu/$GDP has been falling from 1950 to 2003: The U.S. economy is twice as energy-efficient today as it was in 1950. From roughly 20,000 Btu/$GDP the rate has dropped to 10,000 Btu/$GDP.

Supposedly, the authors develop contrarian challenges to the conventional wisdom that improved energy efficiency intensifies energy demand instead of curbing it. I disagree. Conventional wisdom, if it derives from solid economic analysis, shows that if, say, the amount of electricity that it takes to produce one additional hour of light decreases 10 percent, the marginal cost of producing light must fall, and consequently the consumption of light must increase. Whether the use of electricity would increase or decrease depends, in this example, on whether illumination would increase more than 10 percent or less than 10 percent. Theoretically, either result is possible, depending on the elasticity of supply and demand for light. (Elasticity measures the sensitivity of consumers and producers to price changes.) Empirically, as demonstrated by the authors, the use of light, and other energy-driven goods, has increased over time faster than the decline of energy use per unit. Just consider a 10 percent reduction in electricity per one hour of illumination leading to 20 percent growth in total illumination. The result would be 8 percent growth in electricity use. As I mentioned before, the authors show that the energy cost of the U.S. economy has been falling from 1950 to date, and the U.S. economy is twice as energy-efficient today as it was in 1950. But, they claim, total energy consumption has almost tripled. Using this statistic is an exaggeration; from 1950 to 2000 population grew 86 percent, and, together with capital accumulation, it accounted for half of the total increase in energy consumption. To further illustrate this point, suppose technology froze in 1950. Then, just due to population growth, from 1950 to 2000 the use of electricity would have increased 86 percent.

The first ten chapters, dealing with the improved energy efficiency and its impact on the demand for energy, furnish a confusing mishmash of topics. The authors devote a lot of space to the pyramids of "virtuous waste"—the massive amounts of low-grade energy that are required to deliver relatively tiny amounts of high-grade power, say, for lasers. I do not find this phenomenon more amazing than the massive amount of irrigation water used in the process of producing a single watermelon. Does the water used for irrigation less the water content of the watermelon constitute a "virtuous waste"? And what about the water content of the rind?

Huber and Mills cover topics such as the first and second laws of thermodynamics. For physicists and engineers this is dull staff. For the rest of us, thermodynamics laws are irrelevant. The same is true about lengthy technical discourses on fueling radios, jets, surgical instruments, silicon cars, and endless other modern gadgets. They could not even leave the Luddites and George Orwell out of their book. The gangs of "Luddites" early in the nineteenth century destroyed machinery that replaced handicraftsmen in the English textile industry. In 1947, George Orwell prophesied that machines will end up in the hands of a few bureaucrats leading to dictatorships with "big brothers" watching us from cracks in the walls and ceilings inside our homes. Most machines use energy in the process of production, but Luddites and "big brothers" hardly help us understand why the well is bottomless.

The discussion surrounding the technology of the "perilously efficient grid" is another bizarre outlier. Apparently electrons in the grid follow laws of physics, not economics. As a result, capital investment in grids is not guided in the marketplace by the laws of supply and demand, and consequently we have a problem. The "perilously efficient grid" discourse also contains a section on "deregulation" of electricity in California that failed because it capped retail prices and ruled out long-term contracts. Gray Davis and Enron paid for their hubris in the political and financial markets, respectively. The grid story is as relevant to the main theme of the book as are the Luddites and George Orwell.

The second main topic of the book is that we will never run out of energy. With regard to the expected changes affecting the automobile in general, and, the internal combustion engine in particular, the authors write: "The best thing U.S. policy makers can do is step out of the way and let the market find its own way to the extraordinary future that now beckons" (p. 76). Amen. Later, Huber and Mills describe how rapidly the fluorescent-light technology has been overtaken by solid-state light, which is dramatically more efficient. Their conclusion is illuminating: "At the end of the day, a burgeoning catalogue of new technologies does not sound like it can provide any kind of useful guide for public policy. But that's the point—no one in 1980 could have foreseen the next two decades of light-bulb evolution, and it is no easier to look more than a few years ahead today" (p. 106). Amen again. But having said that, they rush to save the planet with coal and uranium. I wonder, if it is not possible to look more than a few years ahead, where is the benefit to policy makers who might listen to Huber and Mills, who contradict themselves by picking coal and uranium from the catalogue of new energy technologies that might emerge in a decade or two? It gets worse. The authors correctly claim that coal is here to stay for a long time because it represents the lion's share of the electric-base production in the United States but, should global warming prove to be a confirmed theory, they would favor nuclear power over solar and wind power. I think this contradicts their philosophy, which I share, that governments should "step out of the way and let the market find its own way to the extraordinary future."

To be fair, the concept of a marketplace for energy is not simple. A permanent nuclear-waste facility in the Yucca Mountain should begin serving all nuclear reactors in the United States as soon as possible. Unlimited government insurance for nuclear operators should be privatized. Nuclear energy is green in that it does not release any greenhouse gases, and once nuclear waste, decommissioning, and insurance costs are borne by the private owners of nuclear reactors, nuclear energy should be generated and sold in the marketplace along with all other forms of electric power. Advancing renewable energy through subsidies is a bad idea. Such subsidies, like the 1.5 cents tax credit per kwh generated by wind, lead to political pressure groups that invest time and money in lobbying for higher subsidies. The subsidies to ethanol and similar natural resources survive because the farm bloc has the political power to perpetuate a bad subsidy forever. Let nuclear, wind, and solar energies and biofuels compete on a level field.

Chapter 11 finally gets us to the bottom of the "bottomless well" of energy. Basically, the argument is that past trends give rise to optimism. Prices of retail gasoline and electricity have been falling over time; technologies that find and retrieve crude oil and other similar natural resources have kept their prices stable. The authors illustrate the nature of these technologies as follows: "Oil extracted today from beneath 2 miles of water and 4 miles of vertical rock, with 6 additional miles of horizontal drilling beyond that, costs less than the 60-foot oil Colonel Drake was extracting a century ago and about the same as one-mile oil cost in 1980" (p. 173). These and similar improved technologies coupled to the huge deposits of coal, oil shale, and the like in friendly countries—e.g. Canada—is the reason for Huber and Mills' optimism. However, half way into the most important chapter, they again regress into tedious discourses about James Clerk Maxwell's subtle challenge to the second law, and Richard Feynman's December 1959 lecture to the American Physical Society. Luckily the reader is spared the story of one of two twins who leaves Earth on a fuel-consuming spaceship traveling at the speed of light to a distant star and returns to Earth younger than his brother. Unfortunately, in the last chapter of the book the reader is exposed to yet again another irrelevant discourse—the fable of the sugar, the helix, the DNA and life's progress from chaos to coherence.

If oil fields were spread more evenly all over the world rather than concentrated in a few feudal theocracies, the price of oil (minus its marginal cost of mining) would rise ever so gradually until a "choke-off price" was reached—namely crude oil would be replaced in the marketplace by alternative resources. Fifty dollars per barrel may be in the neighborhood of that "choke-off price." However, because of the political instability in the Middle East, the price of oil may free-fall $25 over a month. The expectation of sharp oil price fluctuations deters private capital investment in both renewable unsubsidized energy or, for that matter, in exhaustible resources like tar-sand refineries in Alberta. Huber and Mills did not address this problem.

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The 2030 Spike: Countdown to Global Catastrophe. By Colin Mason. Earthscan 2003. Pp. 250. $29.95 hardback.

Apocalyptic, yet hopeful, Colin Mason's book, *The 2030 Spike: Countdown to Global Catastrophe* lays it all on the line—the good, the bad and the ugly—and gives its readers a dose of well-researched facts regarding the state of our earth and what will happen if we do not do something immediately to save it. Complete with the usual shocking statistics and sparking interest through the use of clever quotes from celebrities of many disciplines, the book claims to reach out to those with no prior knowledge of the subject and offers "over 100 priorities for immediate action." However, while Mason states his priorities in neat little square boxes at the end of each chapter, he admits that his suggestions are not quite feasible for the common man. Rather, Mason writes to educate, to inspire thought, and to motivate us to come together as a civilization and force our governments and multinational corporations to recognize the threats and to follow a global plan. The author contends that consumers have at their disposal one of the most powerful tools to improve the state of our world—our spending power. Yet, our greed, our ignorance, our denial, and our thoughtlessness remain the earth's worst enemy. The most basic step toward a better world depends on widespread awareness and changes in human behavior based on it.

The book is organized into four sections. Part one, "Crisis Mode," introduces what Mason terms the "six drivers of 2030": depleted fuel supplies, population growth, global climate change, famine caused by water shortages and soil erosion, worldwide divisiveness, and conflict