BOOK REVIEWS

Beyond the Age of Oil: The Myths, Realities and Future of Fossil Fuels and Their Alternatives by LEONARDO MAUGERI (Santa Barbara: ABC-CLIO, 2010) 260 pages, ISBN 978-0-313-38171-3 hardback

Originally published in Italian in 2008, followed by the English version in 2010, Maugeri's sequel to his earlier book, *The Age of Oil*, takes a hard look at the role of fossil fuels and their alternatives over the next 20 years. The author, an ENI employee, considers himself a "rational environmentalist" and is convinced that current energy-consumption patterns are not sustainable, as carbon-dioxide levels will inexorably rise and contribute to growing and unacceptable environmental consequences. He makes no mention, however, of the "Climate-gate" scandal that erupted in late 2009, or the absence of statistically significant world warming for over a decade. He argues that cheap energy is not good for the planet's health, has discouraged energy efficiency, and has curtailed investments in alternative and cleaner energy technologies.

He concludes, as have others, that fossil fuels will dominate world energy consumption for many years to come despite the progress in renewable-energy technologies and their adoption. On the policy front, he recommends in addition to more research on all energies, actions to make the perceived "cheap" fossil fuels more costly through the implementation of a carbon tax, a cap-and-trade system, a carbon tariff on goods imported from countries with what the West considers lax environmental standards, and what he terms a "mobile excise tax" on final products derived from petroleum, with the tax activated when oil prices fall to relatively low levels of about $60 per barrel. While Maugeri does not see himself as a "catastrophist" on climate change, his recommendations to address it are hugely controversial and likely to be very costly to economies around the world.

This book offers a sound discussion of fossil fuels and the array of possible future alternatives to them. Most readers will agree with his descriptions and assessments of oil, coal and natural gas, or his discussions of carbon dioxide (capture and storage), nuclear, hydropower, biofuels, solar, wind, geothermal, or hydrogen. But I expect them to have many issues with his policy recommendations, all of which he advances to address the problems he sees of climate change—whether they exist or not, the need to increase energy efficiency, and to make fossil fuels more costly and thus less attractive in the market place. He is convinced that his recommendations will not harm economic growth, but offers no evidence why that should be the case. Rather, he believes that cheap energy and energy innovation cannot coexist, and that the higher prices resulting from

adoption of his recommendations will stimulate the innovation he views as necessary to move away from fossil fuel consumption. He is a strong proponent of increasing funding on energy research (independent of the level of fossil fuel prices), both public and private, although he sees public funding as the preferred sustained source. He sees greater energy efficiency as the best means of both reducing energy consumption across the board and of reducing greenhouse-gas emissions; in this regard, he offers little new as writers for years have recognized that greater efficiency in energy use serves to stretch existing supplies and reduce the need for new capacity. Even if climate-change science remains far from settled, Maugeri wants his recommended policies to steer or nudge the world toward a future low-carbon economy.

Oil is the current king of the suite of fossil fuels. That role is earned due to oil's exceptional energy density, its flexibility in producing other forms of energy products, its availability and price that are lower than that of alternatives, and its ease of sale, transport, and storage. He recognizes that oil will not be displaced for decades given its flexible characteristics. Maugeri concurs with other writers that the concept of "peak oil" is flawed, for it ignores technological advance and the role of prices. He offers a nice explanation of the boom and bust cycles that have characterized oil (and gas) markets for much of the last 40 years. He notes the underinvestment in capacity when prices are low, altering expectations of future prices, that then spurs higher prices as demand rises. The industry has long-lived investments which increase capacity with a lagged response to higher prices, but higher prices certainly lead to more investment and output over time. He uses the measure of worldwide spare capacity as indicative of how prices can be expected to move. In his view, spare capacity of less than 4 percent of world demand can inspire a dramatic increase in prices. On the other hand, spare capacity between 5 and 6 percent generally indicates that prices will remain stable, while spare capacity in excess of 6 percent points to the likelihood of declining prices.

In an ideal world, Maugeri favors oil prices high enough to encourage alternative energy development, new technology, and energy efficiency, but not so high as to stunt economic growth. He estimates that price at from $50-60 per barrel over the long term, but notes that no individual or group can impose or maintain an ideal price range. Since we are already well above a price of $60 per barrel in the neighborhood of $80 per barrel, the issue is whether that price will be sustained long enough to change patterns of oil use. Maugeri seems not to trust the market-price solution, given his view of the negative externalities of oil use and calls for policies that make motor transport more efficient, restrictions on automotive use in central cities (only small engines and low-emission vehicles), and much more public research and technological innovation on oil's emissions and pollutants.

Turning next to coal, Maugeri not surprisingly finds it dirty and polluting. Coal's advantage is that it is widely available and cheap. "Clean coal" technologies have improved over time, but at present no technical way exists for

cleaning up the whole life cycle of coal's production and use. With the U.S. and China accounting for over half of world coal consumption, Maugeri suggests that these two countries have "the major responsibility of addressing the problem of curbing CO_2 emissions" from burning coal. Coal is his most telling example of the incompatibility of cheap energy and limiting climate change.

Maugeri's chapter on natural gas is a good historical summary of the development of the gas industry throughout the world, how international competition between pipeline gas, liquefied natural gas, and new supplies of shale gas are altering the competitive picture particularly in Europe, and the fact that the transport and storage costs of gas have typically been far higher than for oil. Gas has half the CO_2 of coal, and its use has grown rapidly in power generation, as plants can be built more quickly and more cheaply than those running on coal or nuclear. He touches on whether a natural-gas cartel, akin to OPEC, could develop with the purpose of restricting output and driving up prices. He thinks it could, particularly in Europe, in a period of low gas prices and a departure from gas contract prices linked to oil prices. Most commentators on this topic, however, give the idea far less credence, since there are so many different sources of gas production from countries with vastly different economic and national interests. From a mobility and lower-pollution perspective, natural gas as a transportation fuel offers much hope. Cars can run on compressed natural gas or on liquefied natural gas, but the downsides include more space occupied in the trunks for the fuel cylinders, and the absence of CNG or LNG fuel-distribution facilities. Maugeri sees a big role for natural gas in the future, particularly as old nuclear and coal plants reach the end of their lives. He also expects, in a political climate where curbing pollution and greenhouse gases is emphasized, that natural gas will eventually displace oil as the king of fossil energies.

Having looked at oil, coal and natural gas, all of which emit carbon dioxide upon combustion, Maugeri turns next to issues and problems of carbon capture and storage (CCS). He sees the three major challenges as cost, fear of CO_2 escaping, and fear or risk of a geological disaster at the storage site. Capture is expensive, even from concentrated sources, and storage sites are frequently far from the points of origin, making transport costly as well. The technology is not yet advanced enough to make CCS viable, but since the world will be using fossil fuels for decades, more public research has to be directed to making CCS effective and affordable. Internationally, China and India are and will continue to be big producers of CO_2, and for them as well as for developed countries a technological solution is a must, in his view.

The rest of the book is devoted to non-fossil fuels, commencing with a discussion of nuclear power, followed by a chapter on hydropower. Neither of these methods of generating electricity produces harmful emissions. Maugeri traces the former's development since the 1950s, but notes that its contribution as a percent of world power generation is declining. Despite nuclear power's zero emissions, Maugeri is doubtful that a nuclear renaissance is in the offing. He believes that the issues surrounding waste disposal, the general fear of nuclear

power after Three Mile Island and Chernobyl, and the absence of nuclear-fusion technology (which does not produce radioactive waste) will dampen the future share of nuclear in the world energy mix. Construction costs, including permitting and regulatory costs, are high, and decommissioning costs are frequently overlooked and can be substantial. Maugeri sees natural gas replacing not only retired coal plants but nuclear ones as well.

Like nuclear, hydropower is another alternative to fossil fuels in power generation. It is clean, renewable and for the most part reliable, although droughts can affect it. In many parts of the world, it is unlikely to increase, given countries' interests in their lakes and rivers for recreational uses, and the frequent requirement to move large numbers of people out of the way of the water reservoir behind the dam. While large new dams could be built in Africa and Latin America, the demand centers are far from the water resource, requiring costly investment in transmission systems. If the shares of nuclear power and hydropower decline as he expects, Maugeri notes the problem of trying to produce more energy from fossil fuels while at the same time reducing greenhouse-gas emissions and pollutants.

Maugeri's next three chapters address biofuels along with wind and solar power. He points out that the power density from wind and sun is low, so that it takes vast expanses of land to generate energy-crop yields as well as electrons from wind and sun. The last two not only suffer from high costs but also from locations often far from demand centers, as well as problems of intermittency, and must be connected to grids that can handle the ramping up and down of power. Neither has shown that it can produce sufficient power to be cost effective for large amounts of produced power. The burning of biofuels can result in direct pollution and human-health hazards, but it is the bioethanol and biodiesel, which added to gasoline can stretch that fuel's supply, which Maugeri addresses. He notes that 30 percent of U.S. corn output is used for ethanol production, but even if the whole crop were turned into biofuels, it would replace only about 5 percent of U.S. oil demand. Crops of this type, whether corn or sugarcane, tend to have low or modest energy content. Additional problems with biofuels involve costs (it is subsidized and U.S. tariffs against foreign supplies exist), environmental damage often linked to deforestation, use of large amounts of water, and competition with or disruption to food supplies as land is converted to biofuels uses. Nonetheless, all three sources of energy have a role to play.

Most authors conclude their review of renewable energies after they consider wind, solar, and biofuels. Maugeri adds chapters on geothermal power and hydrogen, concluding that their joint or sole contribution to supplying the world's energy needs is minor. Even if the geothermal resource is plentiful in a specific location, Maugeri notes that there often is not a market nearby, which adds to costs of delivering electricity from this source. Hydrogen received a lot of play in President George Bush's 2003 State of the Union Address, but by the 2007 Address, hydrogen had been dropped, perhaps in recognition of the technical and cost realities. Hydrogen has to be "made" from other sources and this process

uses a lot of energy. Maugeri points out that the costs of producing and transporting hydrogen from natural gas with the same energy content as gasoline are triple those of gasoline. The hope for hydrogen has long been for fuel cells to replace the internal-combustion engine, and in doing so generate no emissions other than water. Costs for fuel cells remain far higher than those for internal-combustion engines. Moreover, there is a distribution problem, since refill locations are not readily available. Clearly, the hydrogen economy is a distant dream.

In his final two chapters, Maugeri examines the gains from greater energy efficiency, and the policy tools governments could use to steer or nudge societies toward greater efficiency, lower use of fossil fuels, and a lower carbon future. He concludes that price is key, and no economist would disagree. Incentives to replace old electric motors or old appliances with new, more efficient ones will go a long way to increasing energy efficiency. Drawbacks arise because, for example, more efficient vehicles are usually driven more (the Jevons paradox) and thus consume more gasoline; more efficient air conditioners turn a luxury into a commodity with resultant greater energy use; consumers are frequently unwilling to consider higher up-front appliance costs even if subsequent running costs are far lower than those of the cheaper item; and electric-utility regulatory policy sometimes introduces perverse incentives. In Maugeri's view, the most important of all is energy price, for if energy is viewed as nearly a free good, it is almost impossible to get consumers to adjust their consumption or to look for ways of increasing their energy efficiency.

Maugeri's policy recommendation of a carbon tax and a cap-and-trade regime is unusual, in that normally the two are considered alternatives. He advances the carbon tax as a means of achieving results quickly, where results are defined as lower consumption of fossil fuels and diminished emissions. He is prepared to drop the carbon tax once a cap-and-trade regime is running properly, which in his view will take a longer time to show results. However, these tools will have minor impacts if they are not implemented internationally, and emerging economies have a host of arguments against both of these proposals. Given the political difficulties experienced to date in the U.S. in trying to implement similar proposals, neither seems likely by one country, let alone by many countries collaborating internationally.

Maugeri also promotes a carbon tariff on goods from countries that have lower environmental standards than does the importing country, although he ignores the view that such a tariff could easily take on a protectionist guise. This proposal in effect judges others' environmental policies and is unacceptable on every level; it may have been advanced as a low-cost beggar-thy-neighbor alternative to either of the first two, were they to fail to be implemented. Finally, he suggests a variable excise tax to prop up the price of oil when it tends to be in one of its "bust" periods; his price where this tax would kick in is if oil prices fell to about $60 per barrel.

What distinguishes this book is the thoroughness with which the author considers energy alternatives and their consequences, and the urgency he con-

veys—whether you agree with him or not—about taking steps now to address his acute climate concerns by diminishing fossil-fuel use. It remains troubling, however, that he devoted little attention to the lack of convergence in the debate on climate-science studies and outcomes. Despite the array of policy proposals advanced, this reviewer doubts the likelihood of their implementation in the U.S. or elsewhere, largely due to questions about climate science and anticipated substantial economic costs. Both economically and politically, nevertheless, Maugeri has expanded readers' understanding and set out a large challenge to policymakers worldwide.

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Natural Gas in Asia: The Challenges of Growth in China, India, Japan, and Korea 2nd Edition, Edited by JONATHAN STERN. (Oxford: Oxford University Press 2008) Hardbound 409 pages ISBN-2008 978-0-19-954141-6

The Asian financial crisis inspired this update of a book published in 1997. With timely updates and necessary corrections, this book covers energy-related situations of two major energy producers-consumers (China and India) and two major energy consumers in Asia (Japan and Korea). This book thoroughly reviews both the four countries and the status of natural gas and LNG supply capacity from Russia, Southeast Asia, Australia, and the Middle East. The second edition well reflects new economic (including financial) and energy developments. It also provides future perspectives in natural-gas markets as well as other competing fuel sources such as nuclear. Altogether these fit well with the title of the book.

David Fridley of Lawrence Berkeley National Laboratory presents a well-documented, informative, and comprehensive description of natural gas in China. The key and valid message of this chapter is that Chinese dependence on coal will increase. Sunjoy Joshi, Senior Fellow, Observer Research Foundation and Najeeb Jung of the Oxford Institute for Energy Studies (OEIS) find that natural-gas demand in India is still weak, but a substantial increase of relatively cheap domestic-gas production will drive the gas market to new heights. The review also presents comprehensive descriptions on LNG and gas pricing in India. There is also a balanced description of Iran-Pakistan-India (IPI) gas pipeline.

The chapter on natural gas in Japan by Akira Miyamoto examines long-term market potential and covers issues essential for further development and provides useful data tables. Miyamoto shows that increases in natural-gas consumption are mainly caused by unscheduled nuclear-power-plant shutdowns. The chapter provides details of nuclear-power-plant operations such as load factor and suggests that nuclear power plants are unsuited for middle- or peak-load capacity.

On page 131, the tone reverses; previously the market was termed competitive, but here it suddenly becomes "uncompetitive." Japanese concern about the security aspects of importing gas from Russia is seen as the major deterrent to international pipeline projects. Miyamoto notes that the key determinants of future natural-gas demand in Japan are price competitiveness and the future development of nuclear-power. Projections of price competitiveness prove valuable.

As do most chapters, the treatment of natural gas in Korea by Keun Wook Paik of OIES, well describes market development, status, and prospects. Paik treats energy demand and supply and the natural-gas industry and provides valuable statistics. Coverage includes the government's long-term supply and demand projections, market and infrastructure expansion, gas-supply issues, supply shortages, prices, and overseas gas development and partnership. Gas–industry privatization, restructuring, and liberalization are also examined. Privatization and restructuring have started, but liberalization has stalled. Paik believes that the rationale for merging KNOC and Kogas into a worldscale company capable of competing with other NOCs is questionable. He notes that there is strong opposition to gas for power and direct LNG imports.

Paik also treats efforts to arrange pipeline connections between Russia and the Korean peninsula. He provides plausible projections of development of gas pipelines to the Korean peninsula but expects no breakthrough in Russian exports to Asia possibly until 2015. He shows that the problem of North Korean cooperation predictably proved insuperable.

Michael Bradshaw of the University of Leicester and Jonathan Stern start with an overview of gas developments during the Soviet Era 1965-91. This review is essential for understanding the gas industry in Russia and Central Asian countries. After this period, political and commercial issues were resolved, and large-scale gas trade began.

The descriptions of Western Siberia are brief but precise. Pipeline gas from this region may not flow into Asia or east until 2020. The chapter discusses various projects in Eastern Siberia and the Far East. For the Sakhalin Projects, the chapter gives a balanced description on the gas-development projects that shows the commercial and political difficulties and complexities that need to be resolved to bring this gas to market from a region that could be the major source of gas for Asia over the next several decades.

The chapter also reviews the nature, prospects, and regional benefits of the gasification program. It covers the role of government and Gazprom, pipeline export markets, and the foreign-investment climate. The latest developments in constructing export pipelines are noted. As for Russian gas exports to Europe, it cites much important, credible information from speeches, reports, and records and compares it to Asia. As for the foreign investment climate, it notes dispute over the terms and conditions over Sakhalin-2 projects and presents fair reflections of risks involved in developing the projects. It has brief but precise descriptions on the situation in Central Asia—Turkmenistan, Kazakhstan, and Uzbekistan. In sum, for Russian gas exports to Asia, it provides sound opinions and

projections of the gas imports to 2020 from Russia and Central Asia to China, Japan, and Korea.

The Russian, Japanese, and Korean chapters have detailed endnotes that provide useful, comprehensive background information.

Consultant David Ledesma presents a thorough, well-documented description regional LNG/gas market in Southeast Asia and Australia covering ASEAN cross-border linkages of gas-pipeline and trade development in the region. He covers the factors affecting current energy-policy frameworks. He presents data on the volume and location of gas reserves, environmental considerations, pressures to favor domestic markets over exports, resource nationalization, and need for export earnings. Ledesma also examines regional LNG availability involving "trust" and long-term relationships.

Ledesma briefly treats the key unresolved issues with completing the Trans-ASEAN Gas Pipelines (TAGP) by 2020. These include cross-border charges and operations and the logistics of transporting power between countries. Ledesma carefully argues that the TAGP may not materialize because of the lack of available additional gas for export in the region, as well as high construction costs. The development of the power grid will depend on how hydroelectric, rather than gas-fired, power develops.

Ledesma also examines various aspects of Indonesian gas which has been the traditional mainstay of LNG exports in the region. Ledesma gives an overview of Indonesia's economy, its laws for exploiting resources, the beginning of natural gas in Indonesia, and how LNG is supplied and priced. Ledesma collected valuable data on specific LNG export plans. He examines how pressure to increase domestic gas demand has limited LNG exports and questions whether this trend can be reversed.

Malaysian gas supply is treated with concise but comprehensive descriptions of Petronas—a successful national oil company. An informative and a balanced view on the prospects in specific areas is provided.

Australia has become the most important regional LNG exporter. The differences in Australia's gas business from other ASEAN countries—no production-sharing contracts and environmental issues, are well described. The characteristic of domestic market—coal-bed methane and LNG export projects are concisely but comprehensively described with detailed, valuable data. Ledesma gives three reasons why gas development in Australia is slow and expensive—the shortage of human resources, technical complexity, and environmental factors. Ledesma presents short but helpful data and information on Brunei, Myanmar, Papua New Guinea, and Vietnam

On the Middle East, consultant Andy Flower first raises questions on whether proven natural-gas reserve figures are valid—over-stated due to political reasons or under-stated due to lack of interest in natural gas. Valuable data are provided on gas production and consumption. He also shows why and how LNG exports developed to countries in both the Pacific (Japan, Korea, Taiwan) and the

Atlantic (US, and Europe) basins. He discusses whether this is due to exaggeration of reserves or a desire to preserve resources for domestic use.

Flower extensively covers the Qatar gas sector showing how the country has become the world's largest LNG exporter. This includes a history of the LNG industry the domestic political situation, how LNG market has evolved, capacity, production, sales patterns, and Qatar's export prospects after 2012. He also examines the development of pipeline gas exports through the Dolphin project.

He presents concise but comprehensive descriptions of Oman's LNG capacity, export potential, and the possibility of sufficient gas supply to produce LNG. Flower's evaluations or predictions on future development of gas and LNG in Qatar, Oman and Yemen seem valid.

Flower extensively treats the gas sector in Iran and particularly the Iran-Pakistan-India (IPI) pipeline venture. One critical question is whether Iran's controversial nuclear program will release natural gas for export. Another is limitation of LNG exports due to surging domestic gas demand and gas re-injection in the oil fields.

Flower shows well that heavy domestic use of gas in Saudi Arabia and disappointing reserve discoveries mean that for the foreseeable future, exports are out of the question. Flower provides projections for 2007-2020 of the role of Middle Eastern LNG in meeting Asian gas demand using data on projects that are in operation or proposed.

Many critical issues are soundly covered in Stern's conclusion: energy, gas and LNG markets in the 2000s, short-term LNG supply, continuing globalization of LNG and gas markets, bilateral and multilateral political relations, liberalization, competition, security of supply, and local, regional, and global environmental issues. He shows how politics, along with economics and technology, hinder pipelines and LNG from being developed. He notes the primacy of politics in the concern of states about obtaining secure supplies. He adds that, just as in Europe, gas use in many Asian countries is aimed at reducing urban air pollution and only more recently, in countries such as Japan, has the issue of gas' contribution to carbon-emission reductions become relevant. However, for many regional countries, gas remains less desirable than nuclear power, if the latter proves to be politically acceptable.

He believes that new domestic gas supplies in India will be more competitive than imported gas or LNG, but major expansion of demand may require greater LNG imports, and possibly also pipeline gas, if political problems with regional countries can be resolved. The supply discussion shows that Russia and central Asia could potentially be substantial suppliers to Asia, but their progress, particularly in the case of Russia, has been far slower than expected. The share of Southeast Asia is declining, and new discoveries will be absorbed by domestic demand. Australia and the Middle East, particularly Qatar, will be the major new suppliers of LNG to Asia; and in the longer term (beyond 2020), Russia can play a much larger role as long as political issues can be resolved. Appendixes on cost increases for LNG projects and on LNG pricing in Asia give useful information.

The book then is a must for those who work in the natural gas and LNG sector in the region and the world as well. It gives a balanced view of the past, present, and future of the gas sector in Asia including Russian Far East.

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Energy Myths and Realities: Bringing Science to the Energy Policy Debate by VACLAV SMIL (Washington, DC: AEI Press, 2010) 213 pages, ISBN 978-0-8447-4328-8

When an author claims to bring "science" to a public-policy debate, I normally cringe because the combination mixes epistemological categories. Science is the use of experiments or their reasonable statistical equivalent seeking to establish cause-and-effect relationships among variables, that is, if X occurs then Y follows with empirical regularity. In contrast, public-policy debate is a discussion about whether coercion (the power of the state) should be used to alter outcomes. Such discussions include considerations about costs versus benefits, individual rights, value conflicts among people, and the proper role of the state in human affairs. So science, which tries to tell us what is, is completely distinct from the question of whether public policy can improve social welfare.

Even though science can resolve few, if any, policy disputes, it is invoked frequently by political talking heads as an arbiter. Why? The jargon and mathematics of science are not understood by many people, and science has been the source of progress for several hundred years. Moreover, unlike religion, which has many versions, the laws of physics, chemistry, and biology are universal and neutral. So political partisans invoke science as a policy rationale because of its neutral cultural reputation; scientists go along because it gives them authority, and the public defers because it is not equipped to understand. This equilibrium is bad for both science and public policy, but we appear to be stuck despite the efforts of some to chart a different path (Pielke 2006; Tierney 2009).

While the science and public policy wars have taken place almost exclusively in the environmental-policy arena, Vaclav Smil has written a book that invokes science in its title as an arbiter in energy-policy disputes. However, his invocation of science is charmingly ignorant of the "science" wars involving environmental, health, and safety regulation since 1970 or at least there is no discussion of the controversy in the book. Instead the book is an attempt by a smart person to apply some arithmetic, engineering and scientific knowledge, and common sense to past and present energy-policy proposals and fads including electric cars, nuclear power, "soft" energy, peak oil, CO_2 sequestration, biofuels, and wind power.

Electric cars have been the answer ever since cars were invented. Smil tells us that Edison was a strong believer in electric cars and many early cars

were electric. But the mass-produced affordable Model T in 1908, the electric starter in 1913, and tetraethyl lead in 1924 all shifted the market towards gasoline and away from batteries as a source of power (19–20).

How about now? Many continue to believe that electric cars are the answer to all our problems. But Smil pours cold water on such dreams with arithmetic. Three megawatt hours of electricity would be required to travel 12,000 miles a year (26). With transmission and other losses, 11 megawatt hours of generation would be required to get the 4 megawatt hours to the car. This works out to 38 miles per gallon equivalent (27). This is the same efficiency offered by advanced gasoline, diesel, and hybrid engines. And there would not be carbon-emission advantages unless all the new electricity used for cars were renewable. Thus, the electric car is not the answer to all our problems.

In addition to false beliefs about electric cars, bogus concerns about running out of oil ("peak oil") also have been a constant in energy-policy discussions. Smil recounts the history and then closely examines M. King Hubbert's predictions and compares them with reality because so many casually assert that Hubbert was correct about U.S. oil-production history and, therefore, will be for the world as well. In fact, Hubbert was right about neither the U.S. peak nor cumulative production (62–67). The fundamental problem with the peak-oil crowd, according to Smil, is its lack of thinking about price, a point obvious to readers of this journal (71–72). Smil argues that the peak-oil crowd is correct about one thing: the considerable uncertainty that surrounds oil-reserve data. "To know ultimate reserves, we must first have ultimate knowledge. But nobody has this knowledge and nobody should pretend to" (67).

In his discussion of the transition from the fossil fuel present to the renewable-energy futures sketched by Al Gore and T. Boone Pickens, among others, Smil tells us that "it is nothing but a grand delusion to think that in ten years the United States can achieve wind and solar generation whose equivalent in thermal power plants took nearly sixty years, while incurring write offs and building costs on the order of $4 trillion . . . ." (143) " . . . During the next decade, none of the new energy sources and prime movers will make a major difference by capturing 20–25 percent of its market, either world wide or in the Unites States." (149)

For economists, the key weak point of the book is the introduction. In the first few pages, Smil makes assertions that are at best controversial positions and at worst wrong. He simply makes them without elaboration or citation as if they were equivalent to statements about the earth revolving around the sun, not worthy of discussion in polite company for the last several centuries. Smil argues the 1973–74 oil-price increase was "deliberately engineered by the leading oil exporters . . . . (1)" Such language does not reflect the more complicated arguments offered by Adelman (1995) and Kalt (1981) that describe no net change in supply (Adelman 110) but changes in price expectations, inventory increases, and the peculiar effects of President Nixon's price-control regime on vertically integrated oil companies' incentives to import.

Smil also criticizes the failure to increase Corporate Average Fuel Economy (CAFE) standards between 1975 and 2008 (2). Again this perspective ignores the standard criticisms found in the economics literature by Crandall and Graham (1989), Kleit (2002), and Godek (2006). Smil also asserts that oil imports weaken the currency and the nation's security (2) and oil prices rose in 2009 from their 2008 lows because of the falling value of the dollar (4).

My advice is to ignore the introduction and read a discussion of past and present energy policy proposals guided by arithmetic, engineering and scientific knowledge, and common sense.

References

Adelman, M. A. (1995). *Genie out of the Bottle: World Oil since 1970.* Cambridge: M.I.T. Press.

Crandall, Robert W. and John D. Graham (1989). "The Effect of Fuel Economy Standards on Automobile Safety." *Journal of Law and Economics* 32 (April): 97–118.

Godek, Paul (2006). "Stale CAFE," *Regulation* (Summer): 6–7.

Kalt, Joseph P. (1981). *The Economics and Politics of Oil Price Regulation: Federal Policy in the Post-Embargo Era*. Cambridge: M.I.T. Press.

Kleit, Andrew (2002). "CAFE Changes By the Numbers." *Regulation* (Fall): 32–35.

Pielke, Roger, Jr. (2006). "When Scientists Politicize Science." *Regulation* (Spring): 28–34.

Tierney, John (2009). "Politics in the Guise of Pure Science." *New York Times,* February 24: D1.

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Introduction to the Global Oil & Gas Business by SAMUEL A. VAN VACTOR (Tulsa: PennWell 2010) 176 pages, ISBN 978-1-59370-214-4

At least since the ill-designed Chaney report of 2001, many sources have generated a steady stream of writings vigorously but mindlessly advocating vast changes in the size and composition of world energy use. A lesser but equally forceful effort sought directly to refute these calls for radical transformation. Here a veteran of the energy debates since the 1970s has weighed in with a highly effective alternative approach. This terser-than-average survey centers on the advantages of oil and the deftness with which the extant industry operates. Only at the end, does the author turn to the limitations of the proposed alternatives.

The book is primarily a solid review of the realities of the oil industry. In eight chapters, Van Vactor intelligently goes through an overview, supply and demand, pricing, commodity markets, the industry's current structure, security issues, organizing principles, and alternatives to gasoline. The opening chapter is a brilliant preview of the remainder of the book. In a dozen pages, Van Vactor provides an invaluable overview of the realities of contemporary energy issues given the *deservedly* high role of oil. Since each point is further developed in the ensuing chapters, the discussion here tries to integrate the preliminaries with their

elaboration. Briefly, Van Vactor uses the virtues of oil to undermine concerns about addiction.

The supply-demand discussion remarkably covers the central aspects of the subject. He begins with terse examination of the properties that make oil so attractive a fuel. He reminds us that the oil industry arose in response to depletion-induced rises in whale-oil prices, that the initial stress was on kerosene for lighting, that a key to the dominance of internal combustion in automobiles was that gasoline was previously cheaper than kerosene, and it was not until after World War II that oil surpassed coal as the leading fossil fuel.

However, the bulk of chapter 2 deals with oil-supply prospects. This begins with review of the histories first of reserve development and then of production. He then turns to peak oil. His argument has several aspects. First, the forecasts that peak oil has arrived are questionable even though it may true that the best fields have already been found. Second, cheap oil will someday be depleted. Third, should this happen, numerous higher-cost alternatives, which he discusses, are available. He presents an overlooked virtue of as ethanol as an octane enhancer but notes cheaper sources than U.S. corn exist. He ends with the obvious but critical warning that the available data are inadequate to produce correct forecasts. An interesting but undeveloped subtext concerns the roles of desires to restrict supplies and the takeover by government-owned and managed oil companies in the failure to discover new giant fields. Van Vactor (p. 24) drops a hint by quoting an anonymous geologist who stated a second Saudi Arabia would arise in Saudi Arabia.

Examination of pricing begins with an admirable effort to convey the nature and complexities of the theory of exhaustible resources developed by Hotelling and extended by many others. Van Vactor rightfully concludes that these extensions indicate many possible outcomes. He turns to Adelman's rejection of this approach because simple Hotelling analysis ignores key complications, most notably changes in demands and costs and the uncertainty and endogenous nature of recoverable reserves. Another view is that Adelman is stating the implications of generalizing Hotelling. After tersely explaining why a few specific crude oils serve as indicators of world prices, Van Vactor briefly but neatly conveys the history of OPEC price manipulation and the related unresolved issues. More than half the chapter is devoted to the considerable complexities of oil pricing. What emerges is that government-owned oil companies were less successful than the international majors in maintaining stable prices and present oil pricing relies on information collected by two private services–Platts and Petroleum Argus. Given the transit times involved, the prices at the moment of shipment are based on prices for forward contracts for the date of expected delivery. Van Vactor adds details about differences among major producing and consuming regions.

Then the commodity-market chapter provides a lucid discussion of the value of such markets in oil and elsewhere and well explains the key concepts.

The industry-structure chapter in contrast crams in information on varied subjects. It begins with a capsule history of oil-industry organizational changes

from the 1970s onward. Van Vactor then treats the present situation for the four categories of entities that he distinguished–private companies, government-owned companies, what he terms government-sponsored firms (actually ones with heavy government participation with minority shares to private owners), and (very tersely) the service companies. Before discussion of the last, he recalls situations in which government entities performed less well than private ones. He notes the celebrated case of environmental irresponsibility in the Soviet Union. His focus is how, when the Sudan became a pariah state, private firms exited and state-sponsored ones eagerly took over. He briefly notes some of the failed government-sponsored ventures and ends by showing the wide differences in vertical integration by types of firms.

The treatment of security starkly contrasts with the extensive polemics on the issue. Van Vactor disposes of the issue in five pages. He begins with note of the hyperbole that mars discussion. He reviews the World War II oil problems of Germany and Japan, passes quickly over the temptation to capture control of oil resources, notes the contrasting examples of sovereignty assertion by South Africa and OPEC, and the dangers of economic extortion. On the last, he argues that oil is too fungible for threats to work but inordinate fears may influence policy and dangers exist with natural gas. Other observers are more skeptical of a gas cartel.

The organizing-principles chapter is the most ambitious and thus most problematic in the book. The principal and clearly valid argument is that while oil continuously flows from well to customers, the skills needed at each stage are very different and thus, with well-functioning markets at each stage, vertical integration is not necessary. A complex procedure is used to make the case. First, Van Vactor explains what makes flows continuous. Then, he presents and too gently treats Frankel's claim that vertically integrated oligopoly was the natural state of the oil industry and then why changing conditions clearly invalidated Frankel's vision. Van Vactor then turns to the problems of pricing and absorbing crude oil in period from the OPEC countries assertion of power to the emergence of commodity markets. Then the differences in skill needs in crude-oil development and production and in refining are explained.

He pauses tersely to review the theoretic literature on the optimal extent of firms. He starts with Coase's classic statement of why high costs of using the market can lead to assembling resources internally but turns to writings that stress the dangers of using the market. The critics of such fears are more germane to oil. Moreover, as Adelman long ago showed, Frankel was wrong about earlier conditions. Even prior to the 1970s, the degree of vertical integration among just the seven leading international majors differed radically largely because of stark differences in their roles in Middle-Eastern production. Gulf's share in Kuwait made it perpetually producing far more crude oil than it refined; the limited Middle-East role of Shell made it perennially process more crude oil than it produced.

The first half of Van Vactor's section on the transition to commodity-exchange pricing is exemplary, but his review of reported prices may be incom-

plete. He presents one part of the possible causes variations in prices paid at the same time for the same type and origin of crude oil–the cost of ending existing arrangements may exceed the benefits. Public policies probably encouraged inflating tax-accounting valuations. Van Vactor's next several pages are devoted to illustrations of structural arrangements in the oil and natural gas industries. He concludes with brief treatments of asset specificity in oil and government intervention.

In the final chapter, the advantage of Van Vactor over standard reviews of energy prospects is particularly evident. Numerous books are devoted mainly to review of energy alternatives, usually glowing with hope but at times extensively debunking. In one chapter, Van Vactor epitomizes the drawbacks of a rush to new sources. He begins contrasting among three visions of energy transitions–the nuclear-takeover dream of the Eisenhower administration, the collapse foreseen by peak-oil types, and the move to new energy sources advocated by many energy interventionists. He then sketches the reality of prior transitions in energy and why any shift from oil will be similarly protracted. In this discussion, he reviews Jevons' work on the subject and the latter's warning that greater energy efficiency may increase rather than reduce energy use. He then provides an excellent overview of what is needed to replace internal-combustion engines. The rest of the chapter then appraises possible alternatives. He rapidly notes the reasons why synthetic fuels, compressed natural gas, and hydrogen are not promising alternatives. Fuller discussions are given of the promises and problems of hybrid car and a pure electric vehicle. The conclusions are that an electric car may ultimately, but neither rapidly nor predictably, become economic.

Van Vactor here has neatly marched through the minefields of energy economics to produce a lucid, concise, and valid overview of oil in world energy. He properly concentrates on the battle between resource pessimists and their critics among energy economists. The omissions are minor. His automobile-focused treatment of alternatives managed to encompass most possible alternatives except solar and wind. The macroeconomic impacts of oil shocks are ignored; this neglect is sensible given the wide varieties of prevailing views and the uncertainties about which results, if any, are valid. It is typical at this point to recommend a book to whatever audience is perceived. In this case, every literate person in the world should read the book.

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