A generation of renewable energy technologies, now coupled with market mechanisms that make them viable alternatives to oil, has come of age in the past decade. At the same time, the politics of energy has returned to the center of the international stage. We have seen experiments with the deregulation of energy markets, as well as the California energy crisis, the Enron energy debacle, and massive grid failure and power outages in the northeast United States, Scandinavia, and Italy. Amidst these changes came the Gulf Wars and the 11 September 2001 attacks—events that highlighted the energy-security linkages that stem from American fossil fuel energy entanglements around the world. The costs of wind- and solar-generated electricity have fallen dramatically, high-efficiency hybrid vehicles are now making significant market inroads, and the use of fuel cells in vehicles and stationary power plants is now a very real possibility. A backdrop to these transformations has been the growing scientific awareness and now near-universal recognition of the reality of human-induced changes to global climate, largely as a result of fossil fuel combustion.

Into this fray steps Vaclav Smil, a prolific researcher and commentator on regional energy systems and the global energy economy. *Energy at the Crossroads*, his 18th book, is an informative and often personal account of our collective energy history, which draws on Smil’s experience to put many of the trends in energy production and economics into perspective.

Smil starts by examining trends in both the supply mix and energy consumption over the last century. He provides a captivating account of the growth of the hydrocarbon economy and foreshadows his main theme of the need, yet difficulty, of altering this carbon-rich energy diet. He surveys coal, oil, and gas supplies as well as the reserves of hydrocarbon resources that are currently (although perhaps only temporarily) seen as “noneconomic.” The very large reserves of these nonconventional resources suggest that changes in our basic ideas about resource entitlements, the “good life,” and our relation to the biosphere will be needed to motivate efforts to value and use our fossil fuel resources more wisely, in ways that do not degrade the planet.

Smil offers only a brief discussion of carbon sequestration, which its proponents claim could dramatically reduce the environmental impacts of fossil fuel use. Although I am wary about plans to sequester carbon underground or undersea (largely because cleaner energy options appear technically and economically more attractive), it is curious that a book about energy paths and choices neglects a topic that has received so much recent attention.

The sections on renewable energy options (biomass, wind, solar, hydropower, and geothermal energy) provide clear snapshots of these industries. Smil nicely highlights the question of technology takeoff. Although the global wind-energy industry has grown explosively at an annual rate of over 30% for almost a decade, wind power still plays only a small role in the global energy economy. In parts of northern Germany and Scandinavia, however, it now provides 25% of the electricity (and in selected months, up to 50%). The European Union hopes to obtain 10% of its electricity from wind by 2010. This dramatic rise—based on technological and economic innovations—is a striking example of rapid change in a seemingly staid energy industry. Smil rightly asks whether this growth is a harbinger of a transformed energy system or merely a minor sideshow to the hydrocarbon economy.

Other recent books present more detailed examinations of global hydrocarbon resources and their potential exhaustion (1) and the policies that have enabled the growth of renewable energy industries (2, 3).
minded with kites, tested designs in their homemade wind tunnel, and practiced piloting skills and their “wing-warping” banking technique with gliders. After spending an additional two years perfecting their design, they sought patent protection and buyers for their inventions. In 1908, they finally began to fly in public (ending skepticism about their success) and repeatedly broke records for distance, time aloft, and altitude. The following years saw the Wrights’ engineering and flying activities eclipsed by business matters and patent litigation. Wilbur died in 1912; his brother survived as an elder statesman and honored pioneer of aviation until 1948. The authors conclude their book with an account of Orville’s long-running feud with the Smithsonian Institution over the latter’s declaration that the 1903 Great Aerodrome of Samuel Langley (a former head of the institution) was “capable” of flight. The disagreement led Orville to loan the 1903 Flyer to the Science Museum in London, where it remained until his death.

Instead of focusing on the Wright brothers, Taking Flight presents the invention of the airplane as the culmination of centuries of dreams and efforts. Richard Hallion, a founding curator at the NASM and formerly the U.S. Air Force historian, places the technological developments within the cultural, scientific, political, and military contexts of their times. His comprehensive and balanced account includes extensive citations to the records left by aviation pioneers as well as to previous histories. Hallion divides his narrative into seven historical phases. The earliest, dominated by myths and desires, included the invention of kites, rockets, and helicopter toys. Balloons and airships were the center of attention from the late 18th century to about 1900. Over the same interval, George Cayley’s foundational aeronautics research was followed by a series of fruitless attempts at heavier-than-air flight. Four figures who stressed the importance of flight research with piloted gliders—the German Otto Lilienthal, the American Octave Chanute, and the Wright brothers—stood out in the 15-year period that saw the successful development of a practical airplane by 1905. Hallion devotes the second half of his book to covering the subsequent phases: the resurgence of European aeronautics, the maturation of flying and its acceptance by the military, and the important roles played by airplanes in the First World War.

In his introduction, Hallion presents six aspects of “common knowledge” about early flight that he believes false and summarizes alternative interpretations that are further developed within the book: Efforts to build the first airplane form only one strand of the quest for flight, and Europeans made important advances toward flight before the Scientific Revolution. The Wright brothers did not invent the airplane in isolation, nor did their foreign tours teach Europe’s aviators how to fly. A highly unstable tail-first biplane, their Flyer highlighted the importance of controllability but did not inspire the planes that soon came to dominate world aviation. By the time of Wilbur’s death, European innovations had already made the Wright company’s designs hopelessly outdated. The European powers did not ignore the military potential of airships and airplanes during the arms race before the First World War, and in the war’s first month aerial reconnaissance played a key role in the crucial battles of Tannenberg and the Marne.

Both of these books confirm the Wright brothers’ preeminence among the pioneers of flight. But Hallion’s account also offers convincing support for his conclusion “that had the Wrights never lived, the airplane would have been invented in Europe, in all likelihood France, by the year 1910.” It seems probable that many other technological breakthroughs are similarly characterized by a limited scope of contingency—an aspect worth remembering during celebrations of their anniversaries.

—SHERMAN J. SUTER

References


Smil devotes a chapter to the ongoing fascination, importance, and perils of fore-
When learning futures options, on the other hand, traders new to any particular market (bonds, gold, soybeans, coffee or the S&Ps) need to get familiar not only with the option specifications but also with the product specifications of the underlying futures contract. These, however, are insignificant obstacles in today's environment, which offers so much information just a click away.