empires themselves. Lastly, their relentless drive for expansion supplied much of the impetus for those ever-enlarging systems of interaction and exchange that eventuated in what we now know as globalization, with all its attractions and drawbacks.

Dane K. Kennedy

See also Imperialism

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> *In the eyes of empire builders men are not men but instruments.* • NAPOLEON BONAPARTE (1769–1821)

Energy

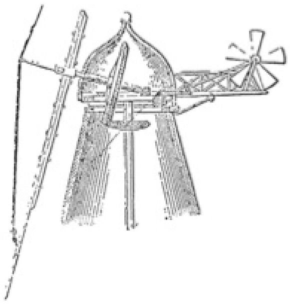
When seen from the most fundamental physical point of view, all processes—natural or social, geological or historical, gradual or sudden—are just conversions of energy that must conform to the laws of thermodynamics as such conversions increase the overall entropy (the degree of disorder or uncertainty) of the universe. This perspective would make the possession and mastery of energy resources and their ingenious use the critical factor shaping human affairs. Also, given the progressively higher use of energy in major civilizations, this perspective would lead logically to a notion of linear advances with history reduced to a quest for increased complexity that is made possible by higher energy flows. People who could command—and societies and civilizations who could use large or high-quality energy resources with superior intensities or efficiencies—would be obvious thermodynamic winners; those converting less with lower efficiencies would be fundamentally disadvantaged.

Such a deterministic interpretation of energy's role in world history may be a flawless proposition in terms of fundamental physics, but it amounts to a historically untenable reductionism (explanation of complex life-science processes and phenomena in terms of the laws of physics and chemistry) of vastly more complex realities. Energy sources and their conversions do not determine a society's aspirations, its ethos (distinguishing character, sentiment, moral nature, or guiding beliefs) and cohesion, its fundamental cultural accomplishments, its long-term resilience or fragility.

Nicholas Georgescu-Roegen, a pioneer of thermodynamic studies of economy and the environment, made a similar point in 1980 by emphasizing that such physical fundamentals are akin to geometric constraints on the size of the diagonals in a square—but they do not determine its color and tell us nothing whatsoever about how that color came about. Analogically, all societies have their overall scope of action, their technical and economic capacities, and their social achievements constrained by the kinds of energy sources and by varieties and efficiencies of prime movers that they rely on—but these constraints cannot explain such critical cultural factors as creative brilliance or religious fervor, and they offer little predictive guidance regarding a society's form and efficiency of governance or its dedication to the welfare of its citizens. The best explanation of energy's role in history thus calls for a difficult task of balancing these two realities, of striving for explanations that take account of these opposites.

Periodization based on the dominant uses of primary energy cleaves world history into just two highly asymmetrical spans: the renewable fuel era and the nonrenewable fuel era. All premodern societies relied exclusively, or overwhelmingly, on solar, that is, perpetually (when measured on civilizational time scales) renewable energies. They derived their heat and light from biomass (the amount of living matter) that is produced by photosynthetic conversion of sunlight and harvested mostly as wood and crop residues, above all straws and stalks; plant and animal fats were also used in lighting. Their kinetic energy came from human and animal metabolism (energized, obviously, by eating the biomass) and, to a much lesser extent, from wind and flowing water, the two forms of converted solar radiation (after it is absorbed by the earth's biosphere) that power the global water cycle and atmospheric circulation.

Fossil fuels, too, had their origin in photosynthesis, but the constituent biomass was subsequently transformed over a period of between 1 million and 100 million years by high temperatures and pressures in the uppermost layers of the earth's crust into qualitatively new materials. Consequently, fossil fuels—ranging, in the ascending order of quality, from peats through various coals (lignites to anthracites) to hydrocarbons (crude oils and natural gases)—are not renewable on historic time scales. This means that premodern, solar societies had an energy basis whose potential longevity coincided with the remaining duration of the biosphere (the part of the world in which life can exist) itself (i.e., still hundreds of millions of years to go). On the other hand, modern societies will have to change their energy base if they are to survive for more than a few hundred years.



The windmill is the major mechanical means used to harnass wind energy on the ground. This diagram shows the primary mechanical parts of the upper portion of a windmill.

Biomass Fuels

Biomass fuels had two inherent disadvantages: low power density (expressed in watts per square meter—W/m^2) and low energy density (expressed in joules per kilogram—J/kg). Even in rich forests biomass was harvested with densities not surpassing 1 W/m^2, but most people did not have tools to cut mature tree trunks and had to rely on smaller trees, branches, and leaves gathered with much lower density. Similarly, the collection of crop residues, needed also as feed and as a raw material, rarely yielded more than 0.1 W/m^2. Consequently, extensive forested areas were needed in order to supply the energy needs of larger settlements. A large preindustrial city in a temperate climate would have required at least 20 to 30 W per square meter of its built-up area for heating, cooking, and manufacturing, and, depending on the kind fuel it used, it would have needed a nearby area of up to three hundred times its size to supply its fuel. The constraint is clear: No temperate-climate megacities of 10 million people or more could have existed during the era when wood was the main source of energy.

These power density limitations became even more acute after charcoal became used on a relatively large scale. Conversion from wood to charcoal was done to increase wood's low energy density: In its air-dried form (about 20 percent moisture) the fuel had about 18 MJ/kg, whereas charcoal rates about 60 percent higher at 29 MJ/kg. The obvious advantages of the better fuel include smaller mass to be transported and stored, smaller furnaces (or braziers), less frequent stoking, and less air pollution. However, traditional charcoaling was inefficient,

TABLE 1.
Energy Densities of Common Fuels (based on Smil 1991)

Fuel	Density (MJ/kg)
Dried dung	10–12
Air-dried straw	14–16
Air-dried wood	15–17
Charcoal	28–29
Lignites	10–20
Bituminous coals	20–26
Anthracites	27–30
Crude oil	41–42
Gasoline	44–45
Natural gas	33–37 (cubic meters)

wasting about 80 percent of the initially used wood in the process. This waste would put a great strain on wood resources even if charcoal's use was limited to space heating and cooking, but its expanded use in various manufactures and in metallurgy made it an acutely limiting factor. For example, in 1810 the metallurgical charcoal needs of the United States prorated annually to a forested area of roughly 50 by 50 kilometers, and a century later they would have amounted to an area of 170,000 square kilometers, equal to a square whose side is the distance between Philadelphia and Boston. The constraint is clear: No global steel-dominated civilization based on charcoal could exist, and coal-derived coke took over.

Human and Animal Muscles

Similarly, the limited power of human and animal muscles constrained productive capacities as well as aggressive forays of all traditional societies. Healthy adults can sustain work at 40–50 percent of their maximum aerobic capacity, and for men (assuming muscle efficiencies of 20 percent) this translates to 70–100 W of useful work. Small bovines (cattle and water buffalo) can sustain about 300 W, lighter horses around 500 W, and heavier animals 800–900 W (one horsepower is equal to 745 W). These rates give common equivalences of at least four men for an ox and eight to ten men for a horse. No less importantly, heavier draft animals can develop briefly maximum power well in excess of 3 kW and can thus perform tasks unattainable by men (plowing heavy soils, pulling out tree stumps). Larger numbers of stronger draft animals thus greatly improved the productivity of traditional farming: Even slow plowing was three to five times faster than hoeing.

However, these gains had to be paid for by devoting more time to caring for these animals and devoting increasing amounts of land to their feeding. For example, feeding the peak number of U.S. farm horses and mules in 1919 (21 million) required about 20 percent of the country's farmland. Obviously, only countries endowed with extensive farmland could afford this burden: The option was foreclosed for Japan, China, or India. Heavier draft animals and better implements eventually cut the time that was spent in producing staple crops. For example, all field work on a hectare of wheat required 180 hours in medieval England, 120 hours in early nineteenth-century Holland, and 60 hours on the U.S. Great Plains in 1900. However, in any society where food production was energized solely by human and animal muscles most of the labor force had to be employed in agriculture. The rates ranged from more than 90 percent in imperial China to more than 66 percent in the post-Civil War United States, and in all traditional agricultures adults were also commonly helped by children.

Limits were also obvious in warfare because even trained muscles could impart relatively restrained destructive force to the tools of war, a reality made clear by comparing kinetic energies of common preindustrial weapons. The kinetic energy of a single stone ball shot from a medieval cannon equaled that of five hundred arrows discharged from heavy crossbows or one thousand thrusts delivered with heavy swords. Pregunpowder battles thus consisted of limited expenditures of muscular energy, a reality that explains frequent preference for either sieges or stealthy maneuvers. Wars became much more destructive only with the introduction of gunpowder—in China during the tenth century and in Europe at the beginning of the fourteenth century.

Speed of travel was another obvious constraint imposed by animate metabolism and by inefficient conversion of wind. Speedy running and horse riding were used only for urgent messaging, and impressive distances could be covered in a single day: The maximum on

TABLE 2.

Sustained Power of Mobile Prime Movers (assembled from data in Smil 1994 and 2003)

Prime Mover	Sustained Power (W)
Working child	30
Small woman	60
Strong man	100
Donkey	150
Small ox	300
Typical horse	600
Heavy horse	800
Early small tractor *(1920)*	10,000
Ford's Model T *(1908)*	15,000
Typical tractor *(1950)*	30,000
Honda Civic *(2000)*	79,000
Large tractor *(2000)*	225,000
Large diesel engine *(1917)*	400,000
Large marine diesel engine *(1960)*	30,000,000
Four gas turbines of Boeing 747 *(1970)*	60,000,000

Roman roads was up to 380 kilometers. However, speeds of normal travel were restricted to 10–15 kilometers a day for men with wheelbarrows (a common means of transport in imperial China), not much more for wagons drawn by oxen, 30–40 kilometers for wagons pulled by heavy horses, and 50–70 kilometers for passenger horse carts on relatively good roads. The prohibitive costs of animate land transport are perfectly illustrated by prices noted in the Roman emperor Diocletian's famous *edictum de pretiis* (price edict): In 301 CE moving grain just 120 kilometers by road cost more than shipping it from Egypt to Ostia, Rome's harbor.

Preindustrial Inanimate Prime Movers

Most preindustrial Old World societies eventually introduced simple mechanical devices to convert two indirect solar energy flows—flowing water and wind—to rotary power, and they also used sails to propel their ships. The evolution of sails shows slow progress from inefficient square sails of ancient Egypt and classical Mediterranean cultures to triangular sails of the Muslim world, batten sails of medieval China, and finally complex rigging (flying jibs, fore, main, mizzen, topgallant, and spanker sails) of large ships that early modern Europe sent on its global conquests during the eighteenth and nineteenth centuries. Although seaborne transport was by far the cheapest alternative, it was both unpredictable and unreliable.

The best sailing ships—British and U.S. China clippers of the second half of the nineteenth century—could average more than 30 kilometers per hour for hours and came close to 20 kilometers per hour for entire intercontinental journeys, whereas the best Roman cargo vessels could not surpass 10 kilometers per hour. However, all sailing ships could be becalmed by lack of winds or had to resort to extensive tacking when sailing into the wind. Consequently, grain ships sailing between Ostia and Egypt could take as little as a week or as long as three months or more, and two thousand years later homeward-bound English ships had to wait sometimes up to three months for the right wind to take them into Plymouth Sound.

The origins of waterwheels remain uncertain, but, notwithstanding such impressive examples as a cascade of Roman watermills in Barbegal in southern France, they were of limited importance in all classical societies where slave labor provided cheap energy for grain milling and manufacturing tasks. Waterwheels did become particularly important in some medieval societies where their power was used above all for food processing, wood sawing, and metallurgical processing. However, eight hundred years passed before the capacities of the largest wheels increased tenfold, and by the beginning of the eighteenth century, when they were the largest available prime movers, their European ratings averaged less than 4 kW, an equivalent of just five heavy horses. Windmills appeared only toward the end of the first millennium CE and, much as waterwheels, became eventually important in some Middle Eastern and Mediterranean countries and in parts of the coastal Atlantic Europe. However, again, even the relatively advanced Dutch machines averaged less than 5 kW during the eighteenth century.

As a result, societies that derived their kinetic energy almost exclusively or overwhelmingly from animate

TABLE 3.

Sustained Power of Stationary Prime Movers (assembled from data in Smil 1994 and 2003)

Prime Mover	Sustained Power (W)
Large Roman waterwheel *(200 CE)*	2,000
Typical European waterwheel *(1700)*	4,000
Large Dutch windmill *(1720)*	5,000
Newcomen's steam engine *(1730)*	10,000
Watt's largest steam engine *(1800)*	100,000
Large steam engine *(1850)*	250,000
Parsons's steam turbine *(1900)*	1,000,000
Largest steam engine *(1900)*	3,500,000
Typical steam turbine *(1950)*	100,000,000
Largest steam turbine *(2000)*	1,500,000,000

power that was supplemented locally and regionally by small waterwheels and windmills could not guarantee either an adequate food supply or a modicum of material comforts for most of their inhabitants. Nutrition remained barely sufficient even after good harvests (yields remained static for centuries), famines were recurrent, small-scale artisanal manufactures (except for a limited luxury trade) were inefficient and limited to a narrow range of crude products, typical personal possessions were meager, illiteracy was the norm, and leisure and travel were uncommon.

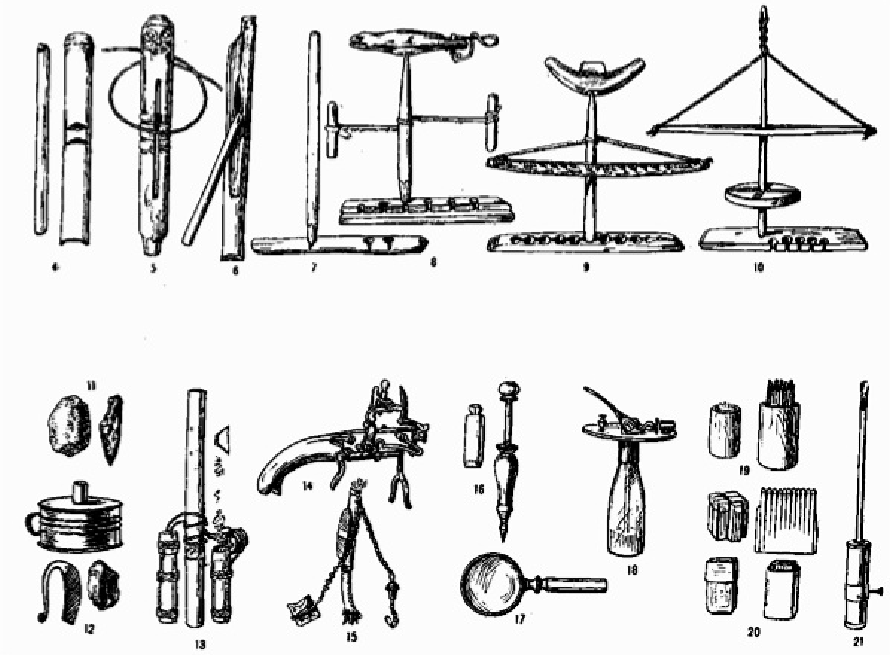
Fossil Fuels, Mechanical Prime Movers, & Electricity

All of those circumstances changed with the introduction of fossil fuels. Although people had used coal in parts of Europe and Asia in limited ways for centuries, the Western transition from biomass to coal took place (obviously with the exception of England) only during the nineteenth century (for example, in the United States wood supplied more than half of all primary energy until the early 1880s), and in the most populous Asian countries the transition was accomplished only during the second half of the twentieth century. The oldest fossil fuels (anthracites) go back 100 million years, the youngest ones (peats) go back just 1,000 years. Both solid fuels (different kinds of coal) and hydrocarbons (crude oils and natural gases) are found in often highly concentrated deposits from which they can be extracted with extraordinarily high-power densities: Coal mines with multiple seams and rich oil and gas fields can produce between 1,000 and 10,000 W/m^2 (watts per square meter), densities 10,000–100,000 higher than those for biomass fuels.

Moreover, fossil fuels, with the exception of marginal kinds such as low-quality lignites and peat, also have much higher energy densities: Steam coal, now used largely for electricity generation, rates 22–26 MJ/kg, and crude oil and refined products rate 42–44 MJ/kg. Extraction and distribution of fossil fuels thus create energy systems that are the opposite of biomass-based societies: High-energy-density fuels are produced from a limited number of highly concentrated deposits and then distributed not just regionally or nationally but increasingly also globally. The distribution task is particularly easy with liquid hydrocarbons that are shipped by large tankers or sent through large-diameter pipelines. Not surprisingly, liquid fuels became the world's leading energy sources during the latter half of the twentieth century.

Desirable qualities of fossil fuels were greatly augmented by two fundamental technical revolutions: the invention and rapid commercial adoption of new mechanical prime movers and by the creation of an entirely new energy system that produced and distributed electricity. Chronologically, the new inanimate prime movers were steam engines, internal combustion engines, steam turbines, and gas turbines, and their evolution has brought increased overall capacities and higher conversion efficiencies. The English inventor Thomas Newcomen's steam engines (after 1700) were extraordinarily wasteful, converting no more than 0.5 percent of energy in coal into reciprocating motion; the Scottish inventor James Watt's radical redesign (separate condenser) raised the performance to 5 percent by 1800, and his machines averaged about 20 kW, equivalent to two dozen good horses. Before the end of the nineteenth century gradual improvements increased the power of the largest steam engines to the equivalent of four thousand horses and their efficiency to more than 10 percent.

These machines powered the main phase of nineteenth-century industrialization by mechanizing many industrial processes, expanding productive capac-



This series of drawings shows the variety of means used to make fire over time and across cultures: (4) Fire saw from Borneo; (5) Fire thong from Borneo; (6) Fire plow from Polynesia; (7) Fire drill from Native America; (8) Fire drill from Inuit of Alaska; (9) Fire drill from Inuit of Alaska; (10) Fire drill from Iroquois of Canada; (11) Strike-a light from Inuit of Alaska; (12) Strike-a light from England; (13) Strike-a light from Malaysia; (14) Tinder pistol from England; (15) Strike-a light from Spain; (16) Fire syringe from Thailand and Malaysia; (17) Lens from ancient Greece; (18) Hydrogen lamp from Germany; (19) Match light box from Austria; (20) Matches; (21) Electric gas lighter from the United States.

ities, and putting the cost of an increasing range of basic consumer products within the reach of average families. Their impact was particularly critical in coal mining, the iron and steel industry, and machine construction. They also offered unprecedented power for both landborne and waterborne transportation. By 1900 railways offered scheduled services at speeds an order of magnitude faster than those of horse-drawn carriages, and large steamships cut the trans-Atlantic crossing to less than six days, compared to the pre-1830s mean of nearly four weeks.

However, their peak was short-lived: During the last two decades of the nineteenth century small steam engines began to be replaced by internal combustion machines and the large ones by steam turbines. Internal combustion engines of the German engineer Nicolaus Otto's motorcycle (commercialized as stationary machines after 1866 and as wheeled transport by the German engineers Gottlieb Daimler and Karl Benz and Wilhelm Maybach starting in the 1880s) eventually reached efficiencies in excess of 20 percent. Inherently more efficient engines of the German engineer Rudolf Diesel (introduced after 1900) reached more than 30 percent. Inventions of the 1880s, the most innovation-packed decade in history, also laid lasting foundations for the development of the electric industry with the U.S.

> *The release of atom power has changed everything except our way of thinking . . . the solution to this problem lies in the heart of mankind. If only I had known, I should have become a watchmaker.* • ALBERT EINSTEIN (1879–1955)

inventor Thomas Edison's development of an entirely new energy system (a contribution more important than his tenacious work on incandescent light), the U.S. inventor Nikola Tesla's electric motor, and the Irish engineer Charles Parsons's steam turbine.

Electricity provided the superlative form of energy: clean at the point of use, convenient, flexible to use (as light, heat, motion), and amenable to precise control. The latter fact revolutionized industrial production as electric motors (eventually more than 90 percent efficient) replaced unwieldy and wasteful steam-driven shafts and belts. The last of the modern prime movers, the gas turbine, was introduced for aircraft jet propulsion during the 1930s, and later it also became a common choice for generation of electricity. All of these machines were much lighter per unit of installed power than were steam engines—and hence more compact and (with the exception of large steam turbogenerators) suitable for mobile applications.

On the destructive side the Swedish manufacturer Alfred Nobel's invention of dynamite introduced an explosive whose detonation velocity was nearly four times that of gunpowder, and even more powerful compounds followed soon. By 1945 destructiveness was raised to an entirely new level by the development of nuclear-fission weapons, with fusion bombs following just a few years later. By the time the Cold War ended in 1990 with the demise of the USSR, the two superpowers had diverted significant shares of their total energy consumption to the assembly of an incredibly destructive arsenal that amounted to nearly twenty-five thousand strategic nuclear warheads whose aggregate capacity was equivalent to nearly half a million Hiroshima bombs.

Modern Energy Systems

Every component of fossil-fueled energy systems experienced impressive gains in capacity and efficiency, the combination that resulted in large increases in per capita consumption of energy. Although the world's population nearly quadrupled between 1900 and 2000 (from 1.6 billion to 6.1 billion), the average annual per capita supply of commercial energy more than quadrupled, and higher efficiencies meant that in the year 2000 the world had at its disposal about twenty-five times more useful commercial energy than it did in 1900. As a result, today's affluent economies have experienced eightfold to tenfold increases in the per capita supply of useful energy services (heat, light, motion), and the corresponding multiples have exceeded twenty-, or even thirty-fold, in such industrializing countries as China or Brazil: Never before in history had an even remotely comparable gain translated into enormous improvements in the quality of life.

Gains in energy flows that are controlled directly, and casually, by individuals were equally stunning. In 1900 even a well-off U.S. farmer holding the reins of six large horses controlled sustained delivery of no more than 5 kW of animate power; a century later his great-grandson driving a large tractor controlled more than 250 kW from the air-conditioned comfort of his cabin. In 1900 a stoker on a transcontinental train traveling at 100 kilometers per hour worked hard to sustain about 1 megawatt (MW) of steam power; in 2000 a pilot of a Boeing 747 retracing the same route 11 kilometers above the Earth's surface merely supervised computerized discharge of up to 60 MW at a cruising speed of 900 kilometers per hour.

However, the benefits of these spectacular energy flows remained unevenly divided. When measured in metric tons of oil equivalent (toe), annual per capita energy consumption in the year 2000 ranged from about 8 in the United States and Canada to 4 in Germany and Japan, less than 3 in South Africa, 1 in Brazil, about 0.75 in China, and less than 0.25 in many countries of sub-Saharan Africa. Yet, a closer look at the rewards of high energy consumption shows that all of the quality-of-life variables (life expectancy, food supply, personal income, literacy, political freedom) relate to average per capita energy use in a distinctly nonlinear manner: Clear diminishing returns set in for all of these variables as the energy use increases beyond 1–2 toe/capita, and there are hardly any additional gains attached to levels above roughly 2.5 toe. This reality becomes obvious when one asks a simple question: Have the lives of U.S. citizens of the last two generations been twice as good (twice as long, healthy,

TABLE 4.

Energy of Weapons (author's calculations using primary data from a variety of sources)

Projectile	Kinetic Energy of Projectile (J)
Arrow from a bow	20
Arrow from a heavy crossbow	100
Bullet from a Civil War musket	1×10^3
Bullet from an assault rifle *(M16)*	2×10^3
Stone ball from a medieval cannon	50×10^3
Iron ball from an eighteenth-century cannon	300×10^3
Shrapnel shell from World War I artillery gun	1×10^6
High-explosive shell from a heavy World War II antiaircraft gun	6×10^6
Depleted uranium shell from M1A1 Abrams tank	6×10^6
Hijacked Boeing 767 *(11 September 2001)*	4×10^9

Explosives	Energy Discharged (J)
Hand grenade	2×10^6
Suicide bomber	100×10^6
World War II gun shrapnel	600×10^6
Ammonium nitrate-fuel oil (ANO) truck bomb *(500 kilograms)*	2×10^9
Hiroshima bomb *(1945)*	52×10^{12}
U.S. ICBM warhead	1×10^{15}
Tested Novaya Zemlya fusion bomb *(1961)*	240×10^{15}

productive, literate, informed, or free) as those of people in Western Europe or Japan?

What does a rich energy endowment do for a country? In the United States it has obviously contributed to the country's emergence as an economic, military, and technical superpower—but it could not prevent the collapse of the USSR, which was in 1989 the world's largest producer of fossil fuels. Other prominent examples of the failure to use rich energy resources to build modern, prosperous societies include such different societies as Iran, Nigeria, Sudan, and Indonesia: None of them secured vibrant economies and prosperous lives for its citizens. In contrast, three energy-poor countries of eastern Asia (Japan, South Korea, Taiwan) became the paragons of rapid economic growth and impressive improvements in average quality of life.

Finally, energy use cannot explain the rise and fall of major civilizations and powerful societies. Such notable consolidations and expansions as the rise of Egypt's Old Kingdom, maturation of the Roman republic, unification of Han China (206 BCE–220 CE), the spread of Islam, the Mongolian conquests in Eurasia, and the enormous eastward extension of the Russian empire cannot be linked to any new prime movers or to new, or more efficient, fuel uses. As for the declines, no drastic change of fuel base and delivery (wood, charcoal) or prime movers (slaves, oxen, horses, sailing ships, waterwheels) took place during the long decline of the western Roman empire (the eastern part managed to survive with the identical infrastructure for another millennium), and none of the great breaks of the early modern and modern world—the French Revolution, the collapse of the czarist Russian empire, the fall of Nationalist China, the collapse of the USSR—could be given convincing (or indeed any) energy explanations.

Energy resources and uses are, undeniably, among the critical variables whose specific and unpredictable combinations determine the fortunes of societies. They promote, restrict, or complicate many economic and individual options, and once in place they are critical for setting the tempo of life and the levels of general welfare. Immutable dictates of thermodynamics also mean that higher socio-economic complexity requires higher energy flows. However, this undeniable relationship is not a matter of continuous linear progress but rather one of a relatively early saturation. Moreover, possession of abundant energy sources or their high consumption cannot guarantee well-functioning economies, decent quality of

life, personal happiness, or a nation's security. Energy sources and uses constrain our actions but do not dictate our choices, do not assure economic success, and do not condemn civilizations to failure. In the modern world the only inescapable consequences of higher energy use are greater impacts on the earth's biosphere: The fate of modern civilization may be ultimately decided by our capacity to deal with this challenge.

Vaclav Smil

See also Coal; Natural Gas; Oil; Water Management

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Engines of History

Human beings like to understand what goes on around them; and historians, being human, like to understand what they write about. They do so by finding causes even for the most surprising events. This was true from the start. Herodotus (484–425 BCE), for example, set out to explain how a few small Greek cities had been able to defeat an immense Persian army and navy; while the first historian of China, Sima Qian (d. c. 87 BCE), sought to explain how China's ruling dynasties rose and fell. Herodotus found a twofold explanation: Free men, he said, fought willingly and more bravely than Persian subjects, forced to obey a mighty king; moreover, the king's overweening pride also offended the gods who sent storms to damage his invading fleet. Similarly, Sima Qian invoked both human and supernatural causes. According to him a ruler's virtue allowed him to rule well and therefore attracted the Mandate of Heaven, but when rulers ceased to be virtuous, Heaven withdrew its Mandate and good government broke down until a virtuous new ruler emerged to found another ruling dynasty.

These ideas about what made history happen the way it did proved to be very influential. Until about a hundred years ago China's historians continued to organize their histories around successive dynasties empowered by the Mandate of Heaven. And the idea that freedom made men successful in war (and also in peace) appealed to Romans as well as to Greeks, and reentered European consciousness with the Renaissance.

But in the world as a whole, the Hebrew prophets' idea that Almighty God governed history, punishing peoples and persons for their sins, and rewarding scrupulous obedience to His will, played a more influential role, dominating Jewish, Christian and Muslim societies from the inception of those religions. For believers, Divine Providence remained inscrutable to everyone except specially chosen prophets. Yet ordinary chroniclers and historians took God's will for granted as the decisive force behind everything that happened. Other causes, when they bothered with them, were only subordinate instruments of God's will. Hinduism and Buddhism, on the other hand, treated the visible world as an illusion and paid scant attention to human history. Instead religious speculation about endless cycles of reincarnation reduced everyday events to transient triviality.

The Importance of Animism

Behind and beneath these civilized literary traditions lay a much older interpretation of the world that modern anthropologists call animism. Its basic tenet is that nat-