Energy:
Sun, Wind, and the End of Coal

> We may well call it black diamonds. Every basket is power and civilization. Coal is a portable climate. It carries the heat of the tropics to Labrador and the polar circle; and it is the means of transporting itself whithersoever it is wanted. Watt and Stephenson whispered in the ear of mankind their secret, that a half-ounce of coal will draw two tons a mile, and coal carries coal, by rail and by boat, to make Canada as warm as Calcutta, and with its comfort brings its industrial power.
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> —RALPH WALDO EMERSON

If this was a murder mystery, coal would be the villain hidden in plain sight.

A century ago coal powered the trains and ships that ushered in the modern age. Today, it still plays an outsized role in fueling the electricity plants on a continent whose people are literally coming out of the darkness—out of the enforced darkness of poverty, where streets are dim and students study by a kerosene light—into our electricity-driven age.

Coal is plentiful and cheap: coal-fired electricity powers eight of every ten light bulbs in China, a country that burns almost half the coal used worldwide every year.[1] Coal is an ever-ready servant, abundant and easy to use, and a steady and reliable producer of power.

Coal is also dangerous: it is the single largest cause of the air pollution that prematurely kills more than 1.2 million people each year in China alone, in addition to the more than 1,000 coal miners who perish in accidents in a typical year. Coal is also responsible for worsening climate change, accounting for more than 40 percent of greenhouse gas emissions.[2]

Coal is king in Asia. The continent accounts for almost two thirds of global coal use, up from a quarter in 1980. Coal use in Asia quintupled from 1980 until 2010, even while it fell in the rest of the world; still, coal burning in China is not expected to peak until around 2030. It is just too cheap, too easy, and too efficient at turning its latent caloric energy into the heat that drives the turbines that produce the electricity that Asia so badly needs; coal power is almost irresistible.[3]

The key to solving Asia's energy problems and its environmental nightmare lies in using less coal. China is making progress by adopting cleaner coal technologies. Indeed, a good part of China's attempts to reduce air pollution and slow the growth of carbon emissions will involve more efficient use of coal—building more efficient power stations and eliminating coal in smaller-scale industrial boilers.[4] But the more quickly China and other large, fast-growing countries like India and Indonesia can end their dependence on fossil fuels, especially coal, the faster air quality will improve and the easier it will be to mitigate the effects of climate change.

The end of the coal era will require a mix of solutions. One fuel that is the focus of a good deal of debate in China is natural gas, both conventional and unconventional (shale gas). Although natural gas is certain to play a larger role in meeting China's energy needs, it is unlikely to have the sort of transformative impact that it did in the United States. China has an undeveloped gas pipeline network; it spans only 4,500 kilometers, compared with 360,000 kilometers for the United States. Even China's 2015 target of 56 gigawatts (GW) of gas-fired generating capacity, up from 32 GW at the end of 2013, is substantially less than wind-powered generating capacity was at the end of 2013. China's energy and electricity prices are highly regulated, unlike in the United States, and China's gas prices are high relative to electricity prices. That means many gas-powered utilities must rely on financial subsidies from local governments. Although there is a lot of talk about the importance of developing China's shale gas reserves, these are unlikely to have more than a marginal impact on the country's energy picture. Even if China built out its natural gas pipeline network and increased electricity prices to make natural gas attractive to power plant operators, the need for vast amounts of water in unlocking shale resources makes it an unpalatable fuel for China. Moreover, the singular success of shale in the United States reflects a fragmented industry where small-scale, local wildcat operations have provided entrepreneurial drive. This industry structure is in direct contrast to China's extremely concentrated statist industry.[5]

Another important need is more efficient power grids. Here, as in many other areas, China is embarking on an aggressive expansion program. As noted in the introduction, it spent more in 2013 on emerging smart-grid technologies than the United States did. China now has a plan to build ten ultra-high-voltage power lines at a projected cost of $61 billion to bring power—including wind power—from its remote northern and western regions to its central and coastal cities.

Neither the increased use of conventional natural gas or unconventional shale gas nor the construction of a network of ultra-high-voltage power lines will change China's stark situation: it is a resource-poor, energy-hungry nation that will have to increasingly use energy more efficiently if its economic development is to continue. Even nuclear power, which China plans to grow from 14 to at least 58 GW by 2020, will make up only a small percentage of the country's electricity-generating capacity. That means China must continue to aggressively adopt renewable-energy sources such as solar and wind.

Solar and wind power, the focus of the next two chapters, are the two most dynamic and fast-changing sources of renewable energy. Although Japan is significant as both a manufacturer and a consumer of solar power and South Korea and Taiwan also manufacture solar panels, the dramatic changes that have roiled the global solar and wind industries in recent years are a China story. The Chinese wind and solar power industries have, since the turn of the century, transformed themselves from marginal players into significant global forces—in the case of solar, *the* dominant global force. China took advantage of its status as a technological latecomer to import foreign technology, often improving it, and drive costs down. It was able to do this because its land, labor, and capital are all underpriced for its favored industries.

Wind has an even more promising future in China. Wind power already accounts for a significant part of the country's installed electricity-generating capacity. With a strong political commitment and good policies, researchers at Harvard and Tsinghua believe that wind theoretically could account for all of China's electricity output by 2030 at a price comparable to that of coal.[6]

Still, despite impressive success in winning sales, both solar and wind show some of the problems of China's system. Although solar and wind are environmentally benign sources of power, as ongoing businesses many companies operating in this area are not sustainable. Competition among local governments, in concert with broad national policies, sparked

extraordinary competition among these companies that led to a rapid decline in prices for solar and wind power. This price discounting was unintended—and completely at odds with China's notionally planned economy. It was wasteful, creating large losses that will be borne by ordinary Chinese, who as taxpayers ultimately pay most of the bill for the mistakes of their government and banks. This saga, in short, is not a textbook case of success but a tale of state planning—some of it successful and some not—coupled with the extraordinary, even reckless, ambitions of contemporary China's first generation of entrepreneurs. Unwittingly, however, the China model of a semiplanned industrial policy, buttressed by unnaturally low costs, has succeeded in making renewable energy cost-competitive far more quickly than even the most optimistic analysts would have imagined at the beginning of the 2000s, benefiting not only China but also the world.