Working out the Kinks: Understanding the Fall and Rise of Energy Use in China[1]

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At 67%, the share of coal in China's primary energy consumption is at its lowest level since the founding of the People's Republic in 1949. In just four years, from 1996 to 2000, reported output of coal fell by nearly 400 million metric tons [Mt] (from 1397 Mt to 998 Mt), while consumption fell by over 200 Mt, (from 1447 Mt to 1245 Mt). During the same period, the economy reportedly expanded by 8% per year. In 2001, both production and consumption of coal rebounded and rose further through 2002.

This is a remarkable change of fortune for a sector that has traditionally been the backbone of China's energy economy. Since coal dominates the energy structure, the sharp fall in coal use resulted in an overall decline in Chinese energy consumption as well as in CO_2 emissions. The fall was so large it caused global CO_2 emissions to shrink in both 1998 and 1999.

As most of the developed world implements the Kyoto Protocol to reduce CO_2 emissions, China's experience in the late 1990s raises questions regarding policies, processes and programs to mitigate emissions, for both developed and developing countries. China is not bound by Kyoto targets, but as the largest developing country and the second largest energy consumer, China's emissions path has global implications.

The causes of China's energy decline have been difficult to analyze because of deficiencies in China's energy statistical system. Energy demand data lag by several years, and the outdated statistical system has difficulty characterizing the expanding non-state sector. Restructuring of the coal sector—discussed further below—also led to uncertainty in the accuracy of production and consumption data.

It is clear from energy statistics and surveys that the decline in energy consumption between 1996 and 2000 stemmed entirely from a precipitous decline in end-use of coal. Demand for other energy forms—petroleum, natural gas, hydroelectricity and nuclear power—all grew, in some cases rapidly. Indeed, even demand for coal for power generation and heat production, about 40% of total coal use, expanded during this period.

Households and industry accounted for nearly all the change in demand. By 2000, 400 million households consumed 66 Mt less coal than in 1996, having substituted it

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with cleaner, more efficient fuels such as LPG, town gas, natural gas, and electricity. Coal use fell even faster than consumption of biofuels, which most rural households use for part or all of their fuel needs. While sales of household appliances and consumer electronics continued to grow at a double-digit pace throughout the late 1990s, total household energy use was no higher in 2000 than in 1995. This phenomenon is rarely seen internationally today, and derives from China's high dependence on coal in the residential sector.

Unlike household trends, the developments in industry may be more relevant internationally. In industry, not all subsectors nor all provinces contributed to the drop in end-use demand for coal. In general, economic and energy demand growth were strong in the advanced coastal provinces (moderated in the first years of the "Asian Flu" after 1997), while certain inland and western provinces experienced industrial decline. Large sectors such as refining, steel making, and cement, though subject to restructuring, continued to expand. The sectors that contributed most to the drop in coal demand closely match those that became the focus of intense state-led restructuring in the late 1990s in anticipation of joining the WTO. These include textiles, chemicals, building materials, ferrous and non-ferrous metals, and coal extraction, where a high degree of state ownership allowed direct state intervention.

These sectors had numerous small producers, redundant capacity, and low productivity, were protected by import tariffs, and were generally unprepared for international competition. To turn the situation around, the state closed thousands of plants, slashed employment by millions, favored larger-scale plants, and banned new small plants. Even before WTO entry, the government slashed tariffs by two-thirds compared to the 1980s, and quotas and licenses restricting imports were nearly eliminated. Such massive restructuring resulted in major unintended impacts on energy. Between 1996 and 1999, coal use in industry fell by nearly 100 Mt, and in the restructured sectors mentioned above, coal consumption declined by 79 Mt.

The geographical distribution of the declines was uneven. Coal use fell in 13 of 31 provinces from 1996 to 1999; all but four were poorer inland and western provinces . In the four coastal provinces—Jiangsu, Zhejiang, Tianjin, and Guangdong—total energy consumption grew considerably despite the fall in coal use.

The decline in coal demand also set the stage for another unintended consequence of restructuring: improvement in the average quality of coal on the market. In China, less than one quarter of the 1 billion tonnes of coal mined is washed, so heat content of delivered coal can vary widely. As demand fell and the market went into surplus, buyers were able to purchase higher quality coal for similar prices, reducing the volume of coal needed to deliver the same amount of heat. The surplus market also allowed the government to shut tens of thousands of small private and locally run coal mines, redirecting resources to the large state mines. In addition to reducing the coal surplus, the closures helped increase productivity, end chronic deficits, eliminate production of some of the highest sulfur coal, and prevent some mining deaths and suboptimal resource extraction. Nonetheless, some small mines reopened illegally, and their production remained absent from national statistics until 2002, when adjustments to official figures were made.

During the 1990s, other factors reinforcing a decline in industrial energy intensity were at work as well. Since major reforms started in 1980, national programs of investment, subsidized loans, outreach, and regulation promoted increased efficiency. This supported a reduction in energy intensity (energy used per unit of economic output) of over 4% per year between 1980 and 1995. By the mid-1990s, fuel prices had risen significantly, in most cases to world levels, providing firms price signals encouraging efficiency. In the 1990s as well, the state encouraged larger scales of production in energy-intensive industries, leading to lower per-unit energy consumption. Similarly, new production equipment was more efficient than older units, some of which had remained in use since the 1940s. These developments slowed growth in energy use in the face of higher production, although taken alone they cannot account for the dramatic drop in consumption in the late 1990s.

It is clearer now that the events of the late 1990s reflected a mixture of one-time events and ongoing forces that, together, resulted in a dramatic drop in energy consumption while maintaining GDP growth. It was not, as some observers have claimed, a directed transformation of energy use in China to support climate-change prevention. Nor is it, as others have suggested, merely an illusion created by untrustworthy statistics. Industry remains the leading sector of the economy, accounting for 45% of GDP in 2001 compared to 44% in 1996, and it is still the largest energy consumer, at 67% of the total. Coal, though reduced in importance, remains the dominant fuel, and is likely to remain in this role for several decades.

If China's specific circumstances in the late 1990s find little parallel in other developing nations, are there still useful lessons that might be derived? Part of the answer lies in the policies China has adopted and is planning to adopt to maintain a low ratio of energy to GDP growth, to increase efficiency of industrial energy use, and to limit use of coal. Stronger environmental policy enforcement will support fuel switching and diversification. A new policy to aggressively promote natural gas will displace coal in many power plants and maintain the pace of fuel-switching in homes. Gas supplies are currently quite limited (only 3% of energy consumption), but imported LNG and eventually imported pipeline gas will increase its share.

For the first time, China is considering adopting "voluntary agreements" between industry and the government to accelerate improvement in industrial efficiency. Modeled after the successful Dutch experience, a pilot program in the iron and steel sector is expected to begin in 2003. If it succeeds, it may be extended to other sectors. China is also developing efficiency guidelines for industrial equipment and systems. Though rarely seen internationally, this approach parallels China's successful development of a standards and certification program for appliances and industrial equipment such as small motors. Substantial international support for such programs has come from the Global Environment Facility.

The government is also requiring larger scale in new plants in some sectors. Ten years ago, the average ethylene plant was 150,000 tonnes; new ones will be built in the 800,000-1 Mt range. New power plants under 600 MW have been discouraged. As "scaling up" leads to continued efficiency gains. industrial restructuring will promote consolidation and closure of smaller, older firms.

While production in heavy industry is likely to continue to grow, higher-value-added industry and service sectors are poised to expand even faster, supporting a lower rate of energy demand growth. These sectors will mainly use coal indirectly, in the form of electricity. The power plants that supply these sectors will likely be using better coal, since production will be concentrated in large-scale mines and coal washing will be expanded. Compared to the US, China can still improve by about 15% the average heat content of a ton of coal.

Still, the evolution of national energy systems is slow, changing over many decades. China's oil imports are rising quickly, natural gas use will take off from its current small base, and electricity from dams, non-hydro renewables, and nuclear power plants will be more important in 20 years than they are now. Without some unforseen shock to the system or binding international restrictions on carbon emissions, however, coal will remain the single most important fuel in China's energy system.