Sectoral and Geographic Analysis of the Decline in China's National Energy Consumption in the Late 1990s

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ABSTRACT

In the process of industrializing, countries typically increase energy consumption during periods of rapid economic growth. China has been no exception, until recently. According to official statistics, China's energy consumption rose at an average annual rate of 6% between 1990 and 1996, flattened in 1997, and then suddenly dropped by more than 9% over the next two years before beginning to rebound in 2000. This paper is a preliminary examination of the causes of this decline, examining the energy forms, economic sectors, and localities for which the decline was most pronounced. It attributes the decline in energy consumption solely to a decline in coal end-use, primarily in the industrial sector. Between 1996 and 2000, GDP continued to increase—both at the national aggregate level as well as in the industrial sectors of the provinces that experienced the largest magnitudes of decline in industrial energy use: Hunan, Liaoning, Jilin, Sichuan, Shaanxi, and Jiangsu. This paper also identifies the subsectors of industry where the decline was most pronounced, including textiles, chemicals, ferrous and nonferrous metals production, building materials, and coal extraction, where state control allowed for greater intervention. The paper concludes that government industrial policy was a primary factor in the energy decline, supported by ongoing programs to increase energy efficiency. Implications of this decline for international climate change efforts are offered.

Introduction

China is the world's second-largest emitter of carbon dioxide and second-largest consumer of energy, after the United States. Energy use in China had been increasing very rapidly since the late 1960s, until 1997, when this trend reversed and consumption fell. This decline, which continued for three years, was unexpected and has remained largely unexplained. Understanding the sources of this apparent transformation is important to determining whether it indicates a permanent change in patterns of energy use and to assessing China's future path of carbon emissions.

Compared to the United States, China is at a very different level of economic and social development. Both countries are large continental economies with extensive industrial bases, but China is at a stage of development more like the US prior to World War II with dominant heavy industry, a high reliance on coal, relative energy self-sufficiency and extensive coal-based power generation.

If China's success in reducing energy consumption during a period of economic growth could serve as a model for other developing countries, such a model would be significant. This paper therefore examines the source of China's sharp decline in energy through a close study of energy statistics from 1996-1999.

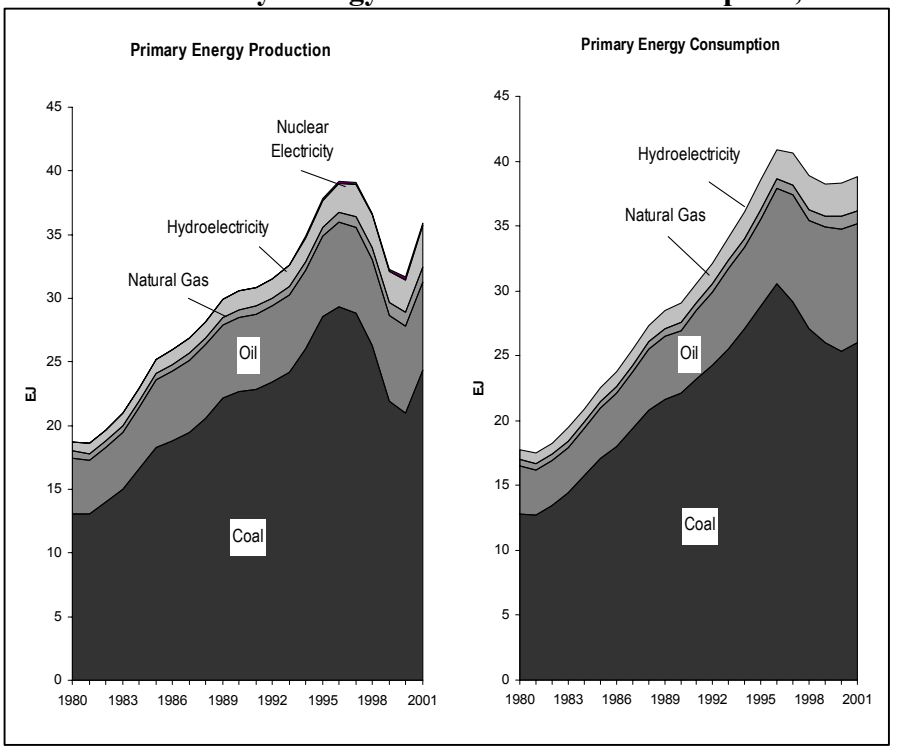
National Data Analysis

National Energy Consumption Trends

National energy data provides a macro view of China's energy development in the last 20 years (Figure 1). Energy consumption grew at an annual average rate of 5% between 1980 and 1996, but fell by 2.6 EJ from 1997 to 1999 (NBS 1997, 2001). Recent energy statistics indicate that energy consumption began to rise again starting in 2000 (NBS 2002).

An examination of the fuels composing China's energy consumption mix makes it apparent that the entire decline in energy consumption over this period was due to a fall in coal use. In just four years, from 1996 to 2000, reported coal consumption fell by 200 million tonnes, (from 1447 Mt to 1245 Mt), while reported production fell by 400 million tonnes (from 1397 Mt to 998 Mt). While coal accounted for 75% of national primary energy consumption in 1996, its share dropped to 66% in 2000—the lowest level since the founding of the People's Republic of China in 1949. Again, recent statistics indicate that the decline has been reversed, and both coal production and consumption have risen in 2001 and 2002 (NBS 2001, 2002).

Figure 1. Total Primary Energy Production and Consumption, 1980-2001



Source: NBS 2001, 2002.

National Coal Sector Trends

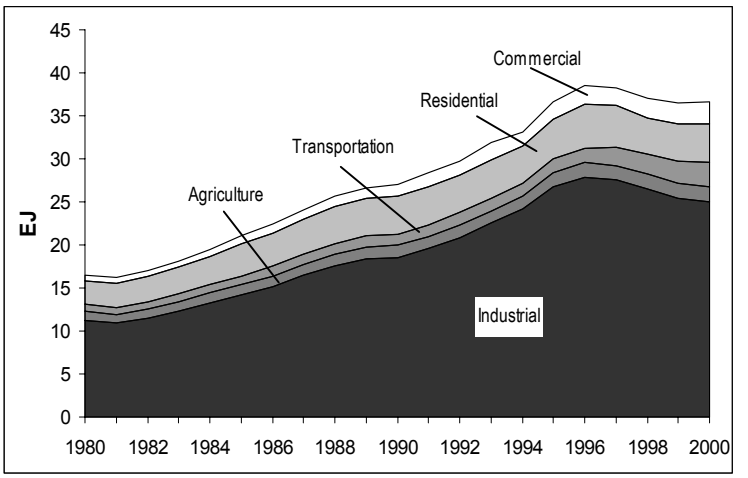
China's economy has undergone a dramatic change since reforms started in 1980. Steady growth in private, collective, and foreign ownership has reduced the contribution of state-owned enterprises to GDP. Nonetheless, the state maintains a significant ownership

share in a number of major industrial sectors, including most heavy industry and the energy sector. In the 1990s, many of these sectors experienced huge deficits as they were unable to compete with non-state firms due to high levels of staffing, high production costs, low economies of scale, and outdated product lines (Fridley, Sinton & Lewis 2003).

One of the largest loss-makers was the state-owned coal sector, which by 1993 was receiving nearly 6 billion yuan in state subsidies and employed over 3.4 million workers (Thomson 2002). China is the largest coal producer (and consumer) in the world, but China's coal industry has lagged behind international best practices and technologies. There has been a structural reshuffling and strict curbing on the aggregate coal output in recent years, and an increase in the mechanization of coal mining (SCMP 2003). State coal enterprise profitability was affected by the proliferation of local and private small mines around the country, which by 1995 were producing 63% of national coal output (Thomson 2002). The small coal mines were loosely regulated, accounted for a growing number of miner deaths, damaged the integrity of some coal fields, and in some cases produced low-quality, highly polluting coal—including some of the highest sulfur coal in China. In addition, a growing surplus of coal from low-cost small mines competed with production from state-owned mines, leading to even higher losses and a growing stockpile of unsold coal (Thompson 2002). In order to make the state coal sector profitable and to address some of the problems created by the proliferation of small mines, in 1997 the government issued a directive to shut down the operation of many of the 82,000 small coal mines then operating in China.

Local dependence on small coal mine employment led to many being reopened illegally, production from which contributed to uncertainty in total coal production statistics during this period. The official production data most certainly excludes some output from small mines that have unofficially reopened, and has likely led to an over-statement of the magnitude of the production decline. However, undercounting of illegal coal production is less relevant to the official coal consumption data which are collected from a smaller quantity of consumers (primarily coal companies and major end-users).

Figure 2. National Energy Consumption by Sector, 1980-2000



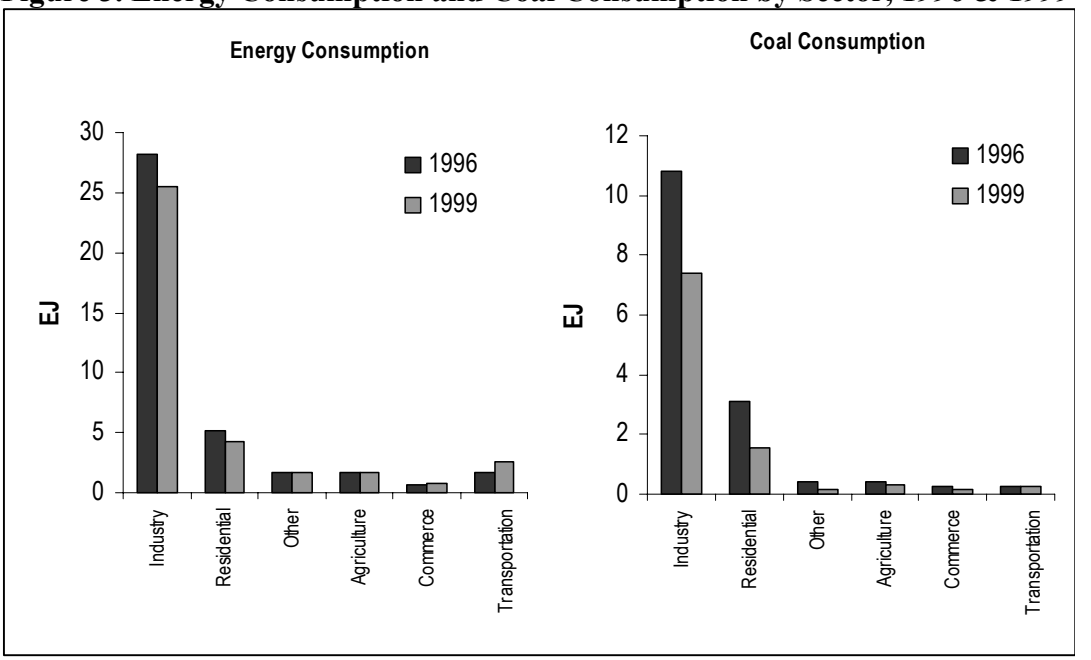
Source: NBS 1997, 2001, and 2002.

Sectoral Analysis of Energy Consumption

Industry is the largest energy-consuming sector in China, and has been for the past two decades (Figure 2). During the period of China's energy consumption decline from 1996 to 1999, industry maintained a relatively stable share of total national energy consumption, changing only slightly from 72% to 70% (NBS 1997, 2001).

The majority of the decline in national energy consumption took place in the industrial sector. Figure 3 displays energy consumption and coal consumption in 1996 and 1999 in the major economic sectors, including industry, residential, agriculture, commercial, transportation and other.[1] The industry sector experienced the largest magnitude of decline in both energy consumption and coal consumption during this time period (NBS 1997, 2001).

Figure 3. Energy Consumption and Coal Consumption by Sector, 1996 & 1999



Source: NBS 1997, 2001.

The residential sector also experienced a notable decline in both total energy use and in coal, but this reflects a very different set of development trends for this sector. Since the 1980s, the government has encouraged fuel switching in households as well as "electrification" to support the widespread ownership of household appliances and consumer electronics. In 2000 Chinese households consumed 66 million tonnes less coal than in 1996, having substituted it with cleaner and more efficient fuel forms including LPG, town gas, natural gas, and electricity (Fridley, Sinton & Lewis 2003). At 90% of household energy consumption in 1980, coal accounted for only 36% of residential consumption in 2000 (NBS 2001).

An absolute decline in energy use is remarkable, particularly since over this period the sale of household appliances and consumer electronics proceeded at double-digit rates annually. This substitution effect, constraining energy demand and emissions growth, is not likely a trend that will be experienced in other developing countries. Residential energy use

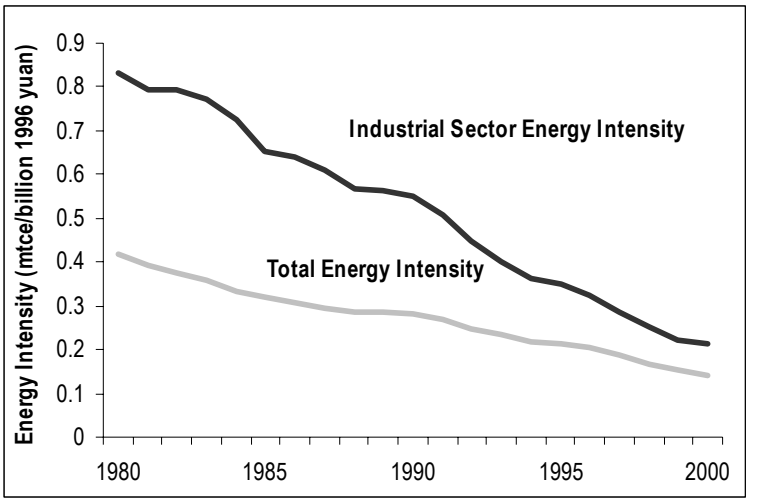
[1] "Other" refers to public sector energy consumption (e.g. government buildings, schools and hospitals).

in many developing countries is primarily from biomass fuels, which have lower energy contents than coal and less carbon per unit combusted. Therefore as countries develop, they often substitute towards fossil fuels, and total energy consumption will tend to increase. In China's case, substitution away from coal towards gas and electricity, in combination with energy efficiency policies, has had the effect of reducing residential energy use even while demand for electricity has increased at an average of 16% per year (NBS 2002).

A look at sectoral consumption of primary energy identifies sectors that experienced the decline in coal consumption. The share of coal consumed in the industrial sector fell significantly; in 1996 coal fueled 39% of industrial energy consumption, while in 1999 it comprised only 29% (NBS 2000). To understand whether this decline reflects a general fall in industrial activity or is concentrated in a few sectors, a further breakdown of industrial energy use into subsectors is necessary.

Although industry has played the leading role in China's economic development, it retains a number of inefficiencies. Government policies in recent years have aimed to increase efficiency in the industrial sector and have resulted in changes to the structure of China's economy. Attempts at improving China's industrial structure have included the closure of inefficient factories and mines, reducing resource waste and pollution, and improving facilities and technology (CIIC 2002). Many of the inefficiencies present in the industrial sector provide opportunities for continued reductions in energy intensity. Figure 4 illustrates how industrial sector energy intensity has been declining at an even faster rate than national energy intensity.[2]

Figure 4. Energy Intensity: Total and Industrial



Source: NBS 2001, 2002.

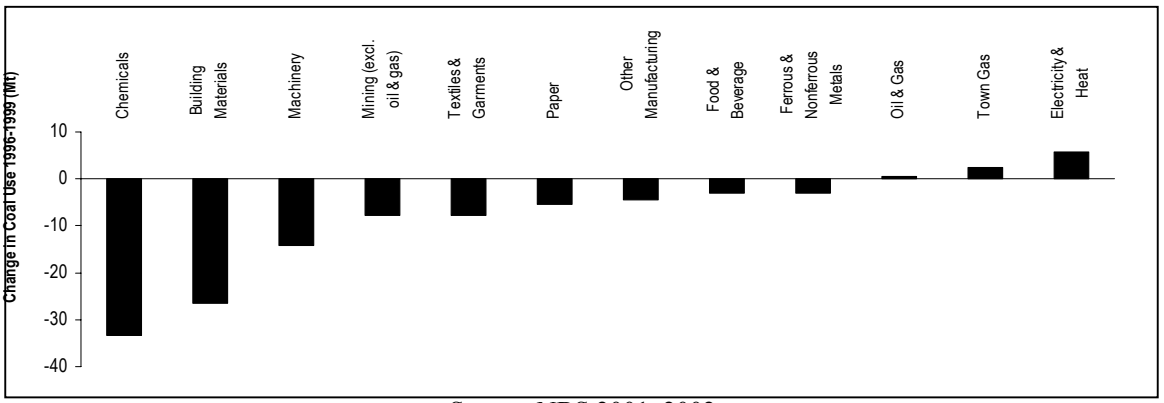
Another factor used to explain decreasing energy intensity in China is the replacement of heavy industry by less energy-intensive high technology and service sectors. Al-

[2] Total energy intensity is a measure of total primary energy consumption divided by total gross domestic product. Industrial energy intensity is a measure of industrial sector primary energy consumption divided by industrial sector gross domestic product. The energy unit used, million tons coal equivalent (mtce), is a standardized unit allowing for comparisons across fuels.

though these latter sectors have indeed grown, heavy industry has continued to expand in China, including the industrial subsectors of chemicals, chemical fertilizer, steel, and cement production (Sinton & Fridley 2000). This growth, along with an increase in power generation, has been the main driver behind trends in coal use (Sinton & Fridley 2000). Real economic output and physical output in these industries has grown rapidly, at rates similar to those for "newer" high value added light industrial sectors. Services have expanded gradually to account for about one third of value added, mainly at the expense of agriculture. At the broad sectoral level, then, the structure of the economy has not actually "lightened."

Why such a dramatic and sudden drop in energy consumption after years of steady production growth? The answer lies within the industrial subsectors. The national energy consumption statistics on industrial subsector coal consumption, presented in Figure 5, allow us to see even more specifically where coal use has declined. Several of the sectors that experienced a significant decline in coal consumption—including chemicals, building materials, mining, textiles, and ferrous and non-ferrous metals extraction and processing—were targeted by government economic restructuring programs.

Figure 5. Net Change in Coal Consumption by Subsector, 1996 to 1999



Source: NBS 2001, 2002.

State-Owned Enterprise Restructuring Policies

It is important to recognize that many sectors that experienced a decline in coal use still exhibit a high degree of state ownership and were specifically targeted for restructuring to reduce losses, reduce the state budget burden, and increase productivity, owing in part to expected WTO accession. In addition, in 1998 the Chinese Government carried out significant reforms and readjustments in their administrative management system. Many government functions were handed down to enterprises, intermediaries and local entities from various State Council departments. Since 1998, over 6,000 profit-oriented enterprises have been handed over to localities. By the end of year 2000, nine state bureaus originally under State Economic & Trade Commission had been eliminated, including internal trade, coal, mechanics, metallurgy, petrochemical, light industry, textile, building materials and non ferrous metals industries, whose functions were then incorporated into State Economic & Trade Commission (CIIC 2002). This reflects consolidation of government industrial policy, and a shift away from the detailed management of industrial activities and towards a more hands-off regulation of economic activities. In the future, China will be less able to rely on direct con-

trol of industrial enterprises, and will be able to affect energy use in the sector primarily through market mechanisms and environmental regulation.[3]

Provincial Data Analysis

Provincial Industrial Sector Energy Consumption Trends

Having identified chemicals, building materials, coal mining, textiles, and metals as the source of nearly 80% of the decline in industrial coal use, it is also instructive to investigate the geographical distribution of the coal decline. Geographic analysis allows for an understanding of whether this decline was widespread, and whether provincial subsector data supports our conclusions based on national subsector data.

An examination of total primary energy consumption in all 31 provinces in China from 1996 to 1999 reveals that there was a net decline during this time period in only five provinces, Hunan, Shaanxi, Jilin, Jiangxi and Guangxi, with the largest provincial decline of 0.33 EJ recorded in Hunan. Over the same period, industrial energy use declined in 15 out of 31 provinces. Of particular interest are the six provinces that experienced the largest magnitude of decline in industrial energy use: Hunan, Liaoning, Jilin, Sichuan, Shaanxi, and Jiangsu. Hunan is in China's eastern interior and has been subject to many mine closures. Jilin and Liaoning in China's northeast are home to China's earliest industrial base, now aging and subject to widespread downsizing, closures, and bankruptcies. In effect, it has become China's own "rust belt." Shaanxi and Sichuan are in western China; the region that has traditionally been the least developed but has become the subject of recent government economic development and investment programs. Jiangsu is a coastal province that has traditionally led the nation in light industrial growth, sharing in the boom economy of the lower Yangtze Delta region.

Provincial-Level Industrial Coal Consumption Trends

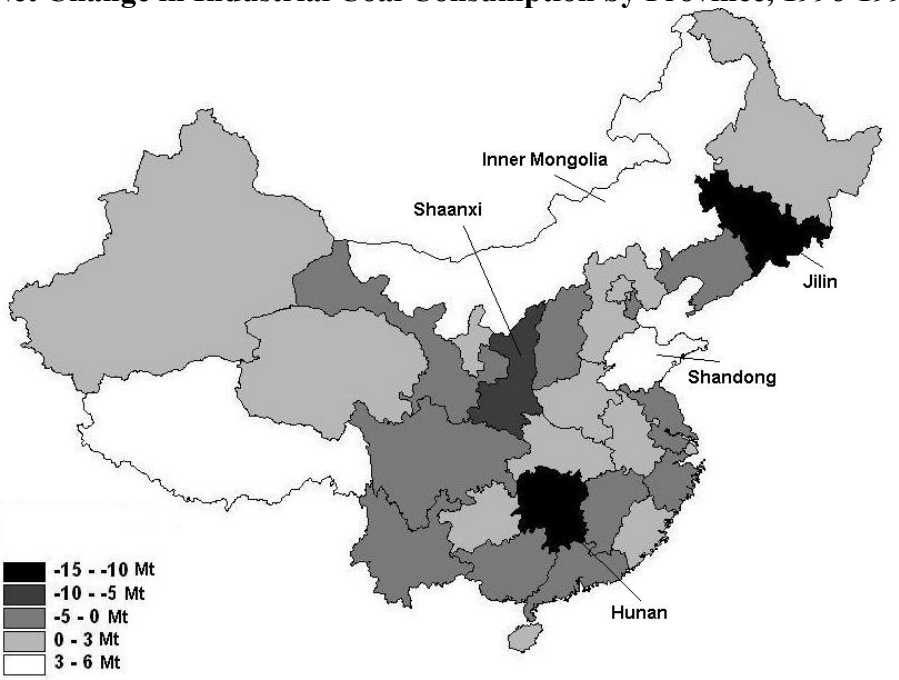
Between 1996 and 1999, industrial coal consumption declined in 14 out of 31 provinces (Figure 6).[4] Most notable is the decline of about 0.41 EJ in Hunan, the decline of about 0.21 EJ in Jilin, and the decline of 0.29 EJ in Shaanxi.

Coal consumption in industry increased in several provinces, most notably in Shandong and Inner Mongolia by about 0.15 EJ in each province between 1996 and 1999. In the provinces of Hebei, Anhui, Guizhou, Hubei and Heilongjiang, industrial coal consumption rose by about 0.06 EJ during this period.

[3] We have not included an analysis of industry ownership data because ownership categories have been redefined with institutional restructuring, leading to inconsistencies in historical data records.

[4] The 14 provinces are Hunan, Jilin, Shaanxi, Sichuan, Jiangsu, Liaoning, Shanxi, Guangdong, Yunnan, Gansu, Zhejiang, Jiangxi, Tianjin, and Guangxi.

Figure 6. Net Change in Industrial Coal Consumption by Province, 1996-1999[5]



Source: NBS 1997, 2001.

Subsector Analysis – Selected Provinces

Of the 14 provinces that recorded a decline in industrial coal use, we selected six provinces to examine in more detail to see whether the national trends in subsectoral energy decline were mirrored at the provincial level. The six include Hunan, Jilin, Shaanxi, Jiangsu, Sichuan and Liaoning. As detailed energy balances by subsector are not available at the provincial level, we examined other indicators of economic activity: primarily subsector value-added and the number of enterprises.

The situation in the industrial subsectors of several provinces supports the trends we found within the national level data.[6] Hunan province, China's "ricebowl," experienced a decline in value-added in textiles, mining, building materials, chemicals, and manufacturing, as well as in other subsectors.[7] This was mirrored by a large percentage decline in the total number of enterprises from 1996 to 1999 in these subsectors as well.[8] These five subsectors accounted for 38% of industrial GDP in Hunan in 1996 (Table 1).

[5] This map excludes Chongqing, originally part of Sichuan, designated a Municipality in 1997. Sichuan values presented in the map do not include Chongqing. No data is available for Tibet.

[6] Food and beverage data has been reorganized in the China statistical yearbooks, and therefore trends may reflect data inconsistencies rather than actual sectoral changes.

[7] The town gas industry was such a small part of the total industrial base in Hunan in 1996 that small increases in production have led to a large percentage change in value added and in the number of industries.

[8] A decline in the number of enterprises within an industrial subsector will not necessarily correspond to the number of factory closures. In addition to outright closures of firms, many firms were merged or consolidated in an effort to increase the scale of production. Data presented in Table 1 therefore may reflect a combination of these occurrences.

Jilin, a major chemical and smelting center in China, experienced a decline in value-added in the metals, chemicals, mining, and textiles subsectors. The metals subsector experienced a decline in the number of enterprises by 91%, and the chemicals subsector by 77%. These two subsectors alone account for 28% of total industrial GDP in Jilin (Table 1).[9] In Shaanxi, the chemicals, building materials, metals and mining subsectors comprise 23% of provincial industrial GDP. These four subsectors also experienced a significant decline in value-added from 1996 to 1999, mirrored by a drop of at least 80% in the number of enterprises (Table 1). Sichuan experienced a decline in value added in the mining, textiles, chemicals, and building materials subsectors, as well as in machinery, manufacturing and paper production. Declines in the total number of enterprises are also observed to have occurred from 1996-1999 in each of these subsectors. Of particular note is the decline within mining and chemicals, since these two subsectors together accounted for 21% of industrial GDP in 1996 (Table 1).

Jiangsu experienced the biggest drop in value-added within the mining and building materials industrial subsectors. The number of enterprises within each of these subsectors also fell dramatically, falling by 65% in mining and by 75% in building materials. These subsectors represent 9% of industrial GDP in Jiangsu. However, Jiangsu's textiles and chemicals subsectors experienced an increase in value added, along with a decline in number of enterprises. These two subsectors together account for 32% of industrial GDP in Jiangsu (Table 1). Jiangsu is a coastal province that has been highly open to foreign investment for some time, particularly in the chemicals subsector; therefore it may have been relatively insulated from state-owned enterprise restructuring. Although the value-added of the textiles subsector increased by 6%, the increase was well below the provincial average increase in value-added of 22% (Table 1). Liaoning experienced a decline in the total number of employees in every industrial subsector except for oil and gas, likely illustrating a combination of factory shutdowns and reorganization and consolidation within the sectors.[10]

[9] The town gas industry was such a small part of the total industrial base in Jilin in 1996 that small increases in production have led to a large percentage change in value added and in the number of industries.

[10] Comparable data on value-added and enterprises was not available for Liaoning Province for the period of this analysis, therefore we used available data on total number of employees per subsector. This index is not directly comparable but likely illustrates the same trends of reorganization and shutdowns that is reflected in the enterprise and value-added data.

Table 1. Selected Subsector Indicators, Six Provinces

HUNAN[11]	1	2	3	JIANGSU[11]	1	2	3
Building Materials	9.4%	-42.1%	-83.4%	Building Materials	5.9%	-19.4%	-74.0%
Chemicals	9.0%	-29.6%	-75.6%	Chemicals	13.9%	35.4%	-43.6%
Electricity & Heat	8.4%	15.0%	-78.9%	Electricity & Heat	5.4%	64.6%	10.5%
Ferrous & Nonferrous Metals	9.4%	4.4%	-75.7%	Ferrous & Nonferrous Metals	8.7%	21.3%	-51.8%
Food & Beverage	5.0%	-40.9%	-75.0%	Food & Beverage	2.5%	40.4%	-49.1%
Machinery	4.0%	-56.5%	-79.8%	Machinery	7.6%	9.0%	-50.9%
Mining (excl. oil & gas)	7.3%	-42.9%	-84.4%	Mining (excl. oil & gas)	2.5%	-22.8%	-65.3%
Oil & Gas	4.2%	0.2%	-76.3%	Oil & Gas	1.6%	53.5%	-34.7%
Other Manufacturing	7.2%	-24.6%	-76.9%	Other Manufacturing	9.4%	4.9%	-49.8%
Paper	2.7%	-48.1%	-81.3%	Paper	1.1%	41.1%	-48.1%
Textiles & Garments	4.8%	-53.2%	-77.5%	Textiles & Garments	17.7%	6.7%	-46.2%
Town Gas	0.0%	-133.3%	-30.0%	Town Gas	0.0%	377.1%	12.5%
Total Industry	100.0%	-17.0%	-80.2%	Total Industry	100.0%	22.0%	-53.2%
JILIN[11]	**1**	**2**	**3**	**SHAANXI[11]**	**1**	**2**	**3**
Building Materials	1.3%	197.5%	-52.2%	Building Materials	4.6%	-19.1%	-86.4%
Chemicals	16.9%	-34.7%	-77.0%	Chemicals	6.5%	-29.3%	-79.7%
Electricity & Heat	7.9%	39.1%	-22.4%	Electricity & Heat	12.2%	3.2%	-67.4%
Ferrous & Nonferrous Metals	10.4%	-49.4%	-90.8%	Ferrous & Nonferrous Metals	5.0%	-14.8%	-82.6%
Food & Beverage	3.8%	26.4%	-66.1%	Food & Beverage	2.4%	-1.0%	-71.2%
Machinery	1.1%	-7.1%	-83.7%	Machinery	3.4%	-19.7%	-82.1%
Mining (excl. oil & gas)	3.3%	-12.8%	-78.9%	Mining (excl. oil & gas)	6.9%	-13.4%	-85.2%
Oil & Gas	9.4%	12.7%	-64.7%	Oil & Gas	5.0%	345.0%	-65.7%
Other Manufacturing	3.4%	839.7%	-74.0%	Other Manufacturing	10.3%	12.3%	-74.5%
Paper	2.3%	-45.6%	-80.2%	Paper	1.7%	-33.4%	-84.6%
Textiles & Garments	2.1%	-11.1%	-82.0%	Textiles & Garments	4.3%	14.3%	-83.2%
Town Gas	0.3%	-82.4%	-13.3%	Town Gas	0.0%	1139.6%	-50.0%
Total Industry	100.0%	8.0%	-78.3%	Total Industry	100.0%	16.0%	-79.9%
SICHUAN[11]	**1**	**2**	**3**	**LIAONING[12]**	**1**	**2**	**3**
Building Materials	6.8%	-10.8%	-83.4%	Building Materials	43.5	18.5	-57.6%
Chemicals	9.6%	-14.4%	-75.1%	Chemicals	58.5	31.5	-46.1%
Electricity & Heat	8.9%	24.1%	-72.1%	Electricity & Heat	10.1	12.9	27.7%
Ferrous & Nonferrous Metals	12.7%	1.0%	-79.7%	Ferrous & Nonferrous Metals	142.4	79.1	-44.5%
Food & Beverage	4.7%	-19.0%	-81.3%	Food & Beverage	11.6	7.5	-35.7%
Machinery	4.1%	-6.9%	-80.4%	Machinery	80.6	35.9	-55.5%
Mining (excl. oil & gas)	10.9%	-64.2%	-87.6%	Mining (excl. oil & gas)	54.7	33.0	-39.7%
Oil & Gas	4.2%	68.1%	-76.8%	Oil & Gas	23.2	15.6	-32.6%
Other Manufacturing	7.0%	-13.2%	-76.8%	Other Manufacturing	-	-	-
Paper	2.3%	-26.5%	-73.6%	Paper	18.5	4.4	-76.5%
Textiles & Garments	3.2%	-19.4%	-79.8%	Textiles & Garments	48.6	21.7	-55.3%
Town Gas	0.1%	185.2%	-22.2%	Town Gas	2.7	2.3	-14.3%
Total Industry	100.0%	4.0%	-86.5%	Total Industry	494.4	262.3	-47.0%

Source: Provincial Yearbooks for Hunan, Jilin, Shaanxi, Sichuan, Jiangsu and Liaoning 1997-2000.

[11] For Hunan, Jiangsu, Jilin, Shaanxi, Sichuan, column headings are: 1) Value-Added as % of Total Industrial Value, 1996; 2) Value-Added, % Change, 1996 - 99; 3) Number of Enterprises, % Change, 1996 - 99.

[12] For Liaoning, column headings are: 1) Total Employees, 1996; 2) Total Employees, 1999; 3) Employees, % Change, 1996-99.

The trends in industrial GDP in each of these six provinces reflect the national trend in continued economic growth. Of particular interest is the continued growth in industrial GDP from 1996 - 1999, although in most cases at a slower rate than in previous years, despite the decline in industrial value-added in certain major industrial sectors examined here during this period (Table 2). This indicates that the decline in GDP was focused within a few energy-intensive industrial sectors, rather than being a widespread or evenly distributed phenomenon. Other sectors were able to maintain high enough economic growth rates to support an overall continuing rise in industrial sector GDP.

Table 2. Average GDP Growth

	Average GDP Growth 1980-1999	Average GDP Growth 1996-1999
National Total	16%	6.5%
Total Industry	16%	6.5%
Industry: Hunan	11%	11%
Industry: Jiangsu	14%	11%
Industry: Jilin	10%	9%
Industry: Shaanxi	11%	12%
Industry: Sichuan	11%	10%
Industry: Liaoning	8%	9%

Source: NBS 2002 and Provincial Yearbooks 1997-2000.

Conclusions

The main cause of the decline in energy use between 1996 and 1999 in China was a decline in coal consumption, primarily a change in end use, which took place predominantly in the industrial sector. In particular, the decline occurred in the heavy industrial subsectors of building materials, chemicals, ferrous and nonferrous metals production and coal extraction, where a high degree of state control allowed for government intervention in restructuring, as well as in the textiles industry. The decline in coal was most pronounced in the provinces of Hunan, Liaoning, Jilin, Sichuan, Shaanxi and Jiangsu, where these subsectors accounted for significant portions of the industrial sector. During the period of the decline, industrial GDP continued to increase, even in provinces that experienced a decline in value-added in a few energy-intensive industrial sectors. In addition, there was a smaller but notable decline in energy consumption in households.

The industrial restructuring that was undertaken in China with the goal of reducing economic losses, responding to WTO market openings and increasing competitiveness in these sectors resulted in an unintended decline in energy consumption. Due to the unique situations leading to the decline in energy consumption in China, this experience does not necessarily relate to other countries' situations. Because this decline stemmed from the one-time closure of many inefficient factories, this is not likely a phenomenon that can be easily repeated in China.

Future policies that impact China's industrial sector—still 67% of total energy consumption—certainly will be of interest. There are fewer command and control measures available to the government as China's transformation towards a market-based economy advances. China is experimenting with a series of approaches to increase energy efficiency in

industry, including voluntary agreements programs, and still the potential to further reduce energy intensity through future structural shifts in the economy. However, this will likely be a long, complex process that will take more than a single policy initiative to bring about effective efficiency improvements.

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