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China's oil use, 1990–2008

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ABSTRACT

Over the past two decades, China's oil demand has risen steeply. In 1990, it was only about 25% higher than that of 1978, the year economic reform was introduced. By 2008, it had reached 396.0 million tons, roughly four times the 1978 level, making China the second largest oil user worldwide. The country became a net oil importer in 1993, and between 1993 and 2008, its net import dependency—a yardstick for energy security—soared from 7.5% to 50.0%. China's increased demand for oil has made the country a global energy player of critical importance. Although the literature on the global implications of China's oil use has proliferated, relatively few studies have attempted to examine "how China uses oil." Hence, this study covers every oil-consuming facility and sector in China, exploring the patterns of, and factors involved in, oil demand by power plants, oil refineries, heat plants and, gas-works, and industrial, transport, agricultural, household and commercial sectors. It concludes that in virtually all sectors in China, oil demand will grow, with transport and industry leading the way.

1. Introduction

The international price of oil (NYMEX crude) climbed from about $25/barrel in March 2003 to a record high of $147/barrel in July 2008 (EIA, 2009b). Many attributed the price increase to China's oil demand, as this country accounted for 37.1% of the increase in world oil consumption between 2003 and 2007, even though it represented 38.2% of the growth in world oil demand from 2000 to 2003 (BP, 2009, p. 12). Although some forecasted that the price would rise to $200/barrel, it suddenly plunged to below $50 in mid-November 2008 and fluctuated between $35 and $75 from December 2008 to September 2009 (EIA, 2009b).

The drop in oil price mainly resulted from a financial tsunami, which reduced oil demand. World oil demand is expected to fall in 2009 (Kwiatkowski, 2009), while Chinese oil consumption in 2009 is forecasted to be 0.4 % lower than that in 2008 (IEA 2009b, p. 13).

However, China's leaders believe that in the long run domestic oil demand growth will accelerate. They are making judicious use of the current situation to protect the country's future energy security. With US$2 trillion in foreign currency reserves, they have recently signed multi-billion-dollar cash-for-oil agreements with a number of oil-producing countries that have run short of money for investment,[1] including Russia, Kazakhstan, Brazil, Venezuela and Angola (Cala, 2009). In June 2009, China's national oil companies appeared to secure access to substantial oil and gas reserves in Iran and Iraq (Andrews-Speed, 2009). Clearly, China will continue to be a major player in the world oil market.

Although the role of China in the world oil industry has attracted increased research attention in recent years, comprehensive studies of "how China uses oil" are relatively few (Leung, 2009). Therefore, this study explores the patterns of, and factors involved in, oil demand by every oil-consuming facility and sector, including power plants, oil refineries, heat plants, and gas-works, and industrial, transport, agricultural, household and commercial sectors, to shed light on future oil demand.[2]

This paper consists of five parts. Next, we provide an overview of China's oil economy. Then, we analyze transformation consumption of oil and end-use consumption of oil, respectively. Lastly, we discuss the major findings and their implications.

2. China's oil economy

The People's Republic of China, a large country, has a territory of 9.6 million km^2 and had a population of 1.328 billion at the end of 2008 (NBS, 2009, p. 1, 38). Since economic reform began in late 1978, China's real gross domestic product (GDP) has grown rapidly, with an average annual growth rate of 9.8% during 1978–2008 (CEIC Data, 2009). China's nominal GDP reached US$4401.6

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[1] The sudden plunge in oil prices should spell major trouble to oil-producing countries. Russia's 2009 budget was designed based on oil at $95/b, and Venezuela's and India's at $60/b (Escobar, 2009, p. 49).

[2] For sectoral analysis of energy in developing countries, see ESCAP (1991) and IEA (1994).

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billion at the end of 2008, making it the world's third largest economy (IMF, 2009).

A country's demand for energy tends to mirror the size of its economy. Hence, the total primary energy consumption (PEC) of China has also increased rapidly, with an average annual growth rate of 5.6 % during 1978–2008 (CEIC Data, 2009). China's PEC amounted to 2850.0 million tons of coal equivalent (Mtce) in 2008, second only to that of the United States (NBS, 2009, p. 145).

Table 1
China's primary energy consumption and its composition[a], 1990–2008.
Source: China Statistical Yearbook 2008, CD-ROM.

	Total	Coal	Oil	Natural gas	Primary electricity[b]
	Mtce	%	%	%	%
1990	987.0	76.2	16.6	2.1	5.1
1991	1037.8	76.1	17.1	2.0	4.8
1992	1091.7	75.7	17.5	1.9	4.9
1993	1159.9	74.7	18.2	1.9	5.2
1994	1227.4	75.0	17.4	1.9	5.7
1995	1311.8	74.6	17.5	1.8	6.1
1996	1389.5	74.7	18.0	1.8	5.5
1997	1378.0	71.7	20.4	1.7	6.2
1998	1322.1	69.6	21.5	2.2	6.7
1999	1338.3	69.1	22.6	2.1	6.2
2000	1385.5	67.8	23.2	2.4	6.7
2001	1432.0	66.7	22.9	2.6	7.9
2002	1518.0	66.3	23.4	2.6	7.7
2003	1749.9	68.4	22.2	2.6	6.8
2004	2032.3	68.0	22.3	2.6	7.1
2005	2233.2	69.1	21.0	2.8	7.1
2006	2462.7	69.4	20.4	3.0	7.2
2007	2654.8	69.5	19.7	3.5	7.3
2008	2850.0	68.7	18.7	3.8	8.9

China Statistical Abstract 2009, p. 145.

[a] Only commercial energy is included, but one should bear in mind that non-commercial biomass energy is still widely consumed, particularly in rural China, amounting to 263.0 Mtce in 1990 and 263.0 Mtce in 2007.

[b] Primary electricity includes hydro-, nuclear and wind electricity. Only commercial energy is included.

Oil did not play a major role in China's fuel mix during 1990–2008 (Table 1). In this period, the share of coal decreased from 76.2% to 68.7%, whereas that of oil, primary electricity, and natural gas increased from 16.6% to 18.7%, 5.1–8.9% and 2.1–3.8%, respectively. Coal, a dirty fuel, is being replaced by other cleaner energies, including natural gas and renewable energies. This energy shift is most apparent in industrial, household and commercial sectors. The relation between oil and coal is less linear. Coal now plays a larger role in transformation sector while oil has gained importance in end-use sector. Specifically, coal has gradually replaced oil in power plants, heat supply and gas works whereas oil has progressively replaced coal in transport, agricultural, household and commercial sectors. In industrial sector, there has been a temporary rebound in coal and a decline in oil since 2003, as heavy industry, mainly fuelled by coal, grew more stunningly (Rosen and Houser, 2007).

Moreover, given the constraint of supply, the impact of natural gas on oil is confined to household and commercial sectors, where the competition between natural gas and LPG takes place. Up to the moment, power plants and factories, the traditional big users of natural gas, use relatively little natural gas: this type of hydrocarbon represented 1.1% of total gross fuel inputs to steam power generation and 4.1% of industrial final energy use in 2007, respectively. For industrial feedstock (non-energy use), natural gas grew from 7.2 Mtce in 1991 to 13.3 Mtce in 2007 but oil also increased from 27.8 to 47.6 Mtce (DITS, various years).

Although oil has not traditionally taken up a significant proportion of total energy use, ensuring a reliable and adequate supply of oil in China has become increasingly challenging. Whereas indigenous oil production has increased slowly—climbing from 138.3 million tons (Mt) in 1990 to 197.8 Mt in 2008—China's oil consumption has grown rapidly from 114.9 to 396.0 Mt in the same period, yielding an average annual growth rate of 7.1% (Table 2). China's oil consumption surpassed its oil production in 1993, and as a result, the country became a net importer of oil. Between 1993 and 2008, its net oil import dependency—an important yardstick for energy security—soared from 7.5% to 50.0%.

Oil security and energy security are increasingly the same issue for China's leaders. According to Yergin (1988, p. 112), the

Table 2
China's oil production, consumption and trade, 1990–2008.
Source: China Energy Statistical Yearbook, various issues and pages.

	Oil production	Oil consumption	Oil imports	Exports oil	Net oil imports	Net import dependency[a]
	Mt	Mt	Mt	Mt	Mt	%
1990	138.3	114.9	7.6	31.1	−23.5	−20.5
1991	141.0	123.8	12.5	29.3	−16.8	−13.6
1992	142.1	133.6	21.2	28.6	−7.3	−5.5
1993	145.2	147.2	36.2	25.1	11.1	7.5
1994	146.1	149.5	29.0	23.8	5.2	3.5
1995	150.1	160.6	36.7	24.5	12.2	7.6
1996	157.3	174.3	45.4	27.0	18.4	10.6
1997	160.7	194.1	67.9	28.2	39.7	20.5
1998	161.0	198.2	57.4	23.3	34.1	17.2
1999	160.0	210.7	64.8	16.4	48.4	23.0
2000	163.0	224.4	97.5	21.7	75.8	33.8
2001	164.0	228.4	91.2	20.5	70.7	31.0
2002	167.0	247.9	102.7	21.4	81.3	32.8
2003	169.6	271.3	131.9	25.4	106.5	39.3
2004	175.9	317.0	172.9	22.4	150.5	47.5
2005	181.4	325.3	171.6	28.9	142.8	43.9
2006	184.8	348.8	194.5	26.3	168.3	48.2
2007	186.3	366.5	211.4	26.6	184.8	50.4
2008[b]	197.8	396.0	–	–	197.2	50.0

EIA (2009a), http://tonto.eia.doe.gov/country/country_energy_data.cfm?fips=CH.

[a] Net import dependency stands for the percentage of the amount of net oil imports over the amount of total oil consumption.

[b] Estimates of the EIA (2009a).