

**ELECTRICITY PRODUCTION IN CHINA:  
PROSPECTS AND GLOBAL ENVIRONMENTAL EFFECTS**

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**INTRODUCTION**

The Chinese economy is booming. It has achieved an average annual growth rate of 10% since 1990 and, according to the World Bank, is now the fourth largest economy in the world. Indisputably, China is an industrial power to be reckoned with.<sup>(1)</sup> Economic growth – the primary objective of the country’s central government – depends almost entirely on coal. An abundant, affordable, but also an especially polluting source of energy, coal currently represents 69% of primary energy consumption in China, compared with 11% in Canada.<sup>(2)</sup>

China uses its vast coal resources chiefly to produce cheap electricity, and this production more than tripled between 1990 and 2004; 78% of electricity generated in China in 2004 came from coal-fired power plants, compared with 17% in Canada.<sup>(3)</sup>

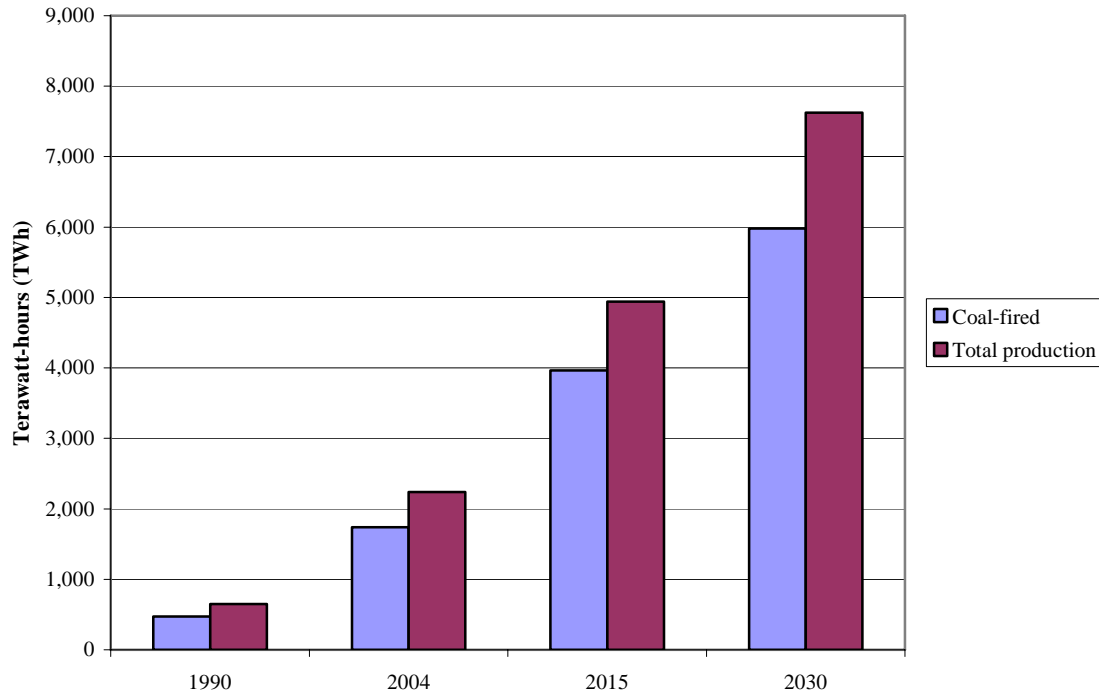
**FUTURE PROSPECTS**

A recent study published by the Massachusetts Institute of Technology (MIT) shows that annual per capita electricity consumption in China, at around 1,700 kilowatt-hours (kWh), remains relatively low: the rate of consumption in rich industrialized nations is on average five times greater.<sup>(4)</sup> It is therefore reasonable to expect that electricity consumption will increase in China as the country grows wealthier and its middle class expands.

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- (1) World Bank, “Total GDP 2006,” World Development Indicator database, Geneva, July 2007. Follow Quick Reference Table link at: <http://go.worldbank.org/B5PYF93QF0>.
  - (2) US Department of Energy, Energy Information Administration, *Country Analysis Briefs: China*, August 2006, <http://www.eia.doe.gov/emeu/cabs/China/Coal.html>; Natural Resources Canada, *Important Facts on Canada’s Natural Resources*, 2006, <http://www.nrcan.gc.ca/statistics/energy/default.html>.
  - (3) US Department of Energy, 2006; Natural Resources Canada, 2006. World-wide, 40% of electricity is generated by coal-fired power plants. See David Talbot, “The Dirty Secret,” *Technology Review*, July/August 2006.
  - (4) J. Katzer et al., *The Future of Coal: Options for a Carbon-Constrained World*, Massachusetts Institute of Technology, Cambridge, Mass., 2007, p. 64.

According to the reference scenario of the International Energy Agency (IEA), China's electricity production will more than double in the next 10 years and coal-fired power plants will continue to dominate the market (Figure 1).<sup>(5)</sup>

**Figure 1 – Electricity Production in China, 1990-2030**



Source: Data obtained from the International Energy Agency, *World Energy Outlook 2006*. Figure prepared by Frédéric Beauregard-Tellier, Parliamentary Information and Research Service, Library of Parliament.

Coal-fired power plants represent 70% of total generating capacity in China, which was around 508 gigawatts electrical (GWe) in 2005.<sup>(6)</sup> According to the MIT study, China is building the equivalent of two new coal-fired 500-MWe power plants every week.<sup>(7)</sup> The IEA reports that China may have added between 50,000 and 70,000 MWe of capacity to its

(5) Revised yearly, the IEA's reference scenario projects supply and demand for oil, gas, coal, renewable energy, nuclear power, electricity, and related carbon dioxide emissions to the year 2030 for 21 regions and the world as a whole. See: <http://www.worldenergyoutlook.org/ref.asp>.

(6) J. Katzer et al., *The Future of Coal*, p. 74.

(7) *Ibid.*, p. ix.

electricity network in 2005, mainly through the construction of coal-fired plants. The IEA reference scenario postulates that China will add 700 gigawatts electrical (GWe) of coal-fired capacity to its electricity network by 2030 and will be responsible for more than half of the increase in the world's coal-fired electricity generation.<sup>(8)</sup> All experts agree that coal-fired plants will continue to dominate the Chinese electricity sector for several decades to come.<sup>(9)</sup>

The predominant use of coal in China is easy to explain. First, the abundance of coal supplies guarantees a reliable source of energy: China has the third largest coal reserves in the world, after the United States and Russia, with an estimated 114 billion metric tonnes.<sup>(10)</sup> By far the planet's biggest producer and consumer of coal, China was responsible for more than one third of global coal production and consumption in 2005.<sup>(11)</sup> Chinese coal consumption increased by 62% between 2000 and 2005.<sup>(12)</sup> According to the IEA reference scenario, China and India will account for 57% of the world's coal consumption by 2030.<sup>(13)</sup>

Second, coal is much cheaper per unit of energy produced than natural gas or petroleum. Moreover, the dominant pulverized coal combustion technology has been in existence for about a century, making the typical coal-fired plant easy to build and operate.

## **GLOBAL ENVIRONMENTAL EFFECTS**

The prodigious abundance of coal and its low price make it the fuel of choice for electricity generation in China. However, its use could have important global environmental consequences if new technologies are not deployed to minimize emissions.

Coal is by far the most polluting fossil fuel. Burning it releases large quantities of sulphur oxides, nitrogen oxides, particulate matter, carbon dioxide (CO<sub>2</sub>) and other pollutants. The electricity sector is the source of 80% of nitrogen oxide emissions and 44% of sulphur

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(8) International Energy Agency, *World Energy Outlook 2006*, Paris, 2006.

(9) International Energy Agency, *China's Power Sector Reforms*, Paris, 2006.

(10) British Petroleum, *BP Statistical Review of World Energy 2006*, Coal Reserves, <http://www.bp.com/sectiongenericarticle.do?categoryId=9017917&contentId=7033433>.

(11) Ibid.

(12) Ibid.

(13) International Energy Agency, *World Energy Outlook 2006*.

dioxide emissions in China,<sup>(14)</sup> and China and its neighbours suffer the direct consequences. China is grappling with serious environmental problems, including poor air quality and increasingly acid rain; China is home to seven of the world's ten most polluted cities.<sup>(15)</sup>

Pollution arising in China also affects Canada. A scientific study released in March 2007 showed that storms over the Pacific Ocean – the water mass that influences the climate on the West Coast – are becoming more violent because of sulphur dioxide and particulate emissions from the large industrial polluters in the region, notably China and India.<sup>(16)</sup>

In addition, up to 50% of the mercury found in the Arctic may be windborne from Asia.<sup>(17)</sup> Mercury enters the food chain, posing a threat to human health and to the wildlife of the Far North.

Lastly, it is important to note that China, largely because of its dependence on electricity generated by coal-fired power plants, will become the biggest emitter of CO<sub>2</sub> in the world by 2010, surpassing the United States.<sup>(18)</sup> CO<sub>2</sub> emissions attributable to coal-fired plants in China are increasing at an alarming rate and have now reached over 2,200 megatonnes (Mt) per year (Figure 2).

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(14) International Energy Agency, *China's Power Sector Reforms*, 2006.

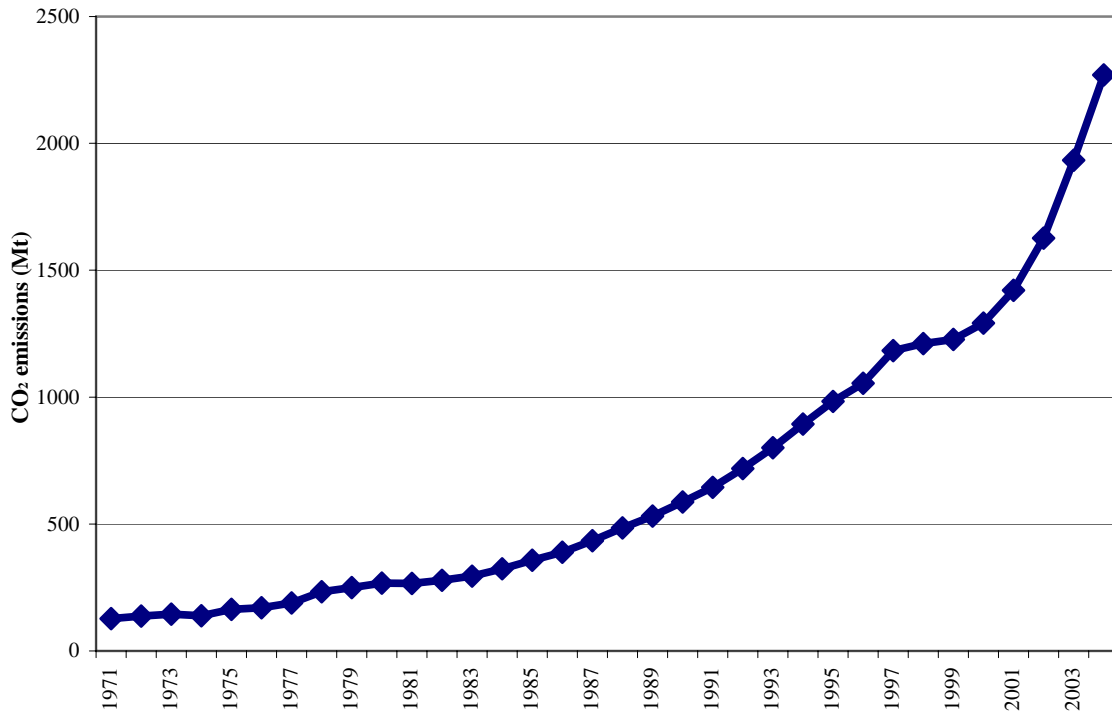
(15) See the US Department of Energy's Energy Information Administration site, <http://www.eia.doe.gov/emeu/cabs/chinaenv.html>.

(16) Renji Zhang et al., Intensification of Pacific storm track linked to Asian pollution, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 104, No. 13, 27 March 2007, pp. 5295-9.

(17) Senate, Standing Committee on Energy, the Environment and Natural Resources, Proceedings – Issue No. 8, 1<sup>st</sup> Session, 39<sup>th</sup> Parliament, 2 November 2006, [http://www.parl.gc.ca/39/1/parlbus/commbus/senate/com-f/eng-f/08evb-f.htm?Language=F&Parl=39&Ses=1&comm\\_id=5](http://www.parl.gc.ca/39/1/parlbus/commbus/senate/com-f/eng-f/08evb-f.htm?Language=F&Parl=39&Ses=1&comm_id=5).

(18) International Energy Agency, *World Energy Outlook 2006*.

**Figure 2 – CO<sub>2</sub> Emissions From Coal-generated  
Electrical and Thermal Energy in China,  
1971-2004**



Source: Data obtained from the International Energy Agency. Figure prepared by Frédéric Beaugard-Tellier, Parliamentary Information and Research Service, Library of Parliament.

According to the IEA reference scenario, China will account for 39% of increased global CO<sub>2</sub> emissions between 2004 and 2030 as emissions from its coal-fired plants rise from 2,269 Mt in 2004 to 5,450 Mt in 2030. For purposes of comparison, Canadian greenhouse gas emissions in 2004 totalled 758 Mt.<sup>(19)</sup> Some analysts maintain that if China and other emerging industrial economies do not succeed in controlling their greenhouse gas emissions, catastrophic climate change will become inevitable.<sup>(20)</sup>

(19) See Environment Canada, *Canada's 2004 Greenhouse Gas Inventory – A Summary of Trends*, [http://www.ec.gc.ca/pdb/ghg/inventory\\_report/2004/2004summary\\_e.cfm](http://www.ec.gc.ca/pdb/ghg/inventory_report/2004/2004summary_e.cfm).

(20) John Podesta, John Deutch and Peter Ogden, "China's Energy Challenge," in *China's March on the 21<sup>st</sup> Century*, ed. Kurt M. Campbell and Willow Darsie, The Aspen Institute, Washington DC, 2007.



## A TRANSITION TOWARD CLEAN COAL TECHNOLOGIES?

For all these reasons, it is urgent that China at the very least begin a shift toward technologies that make it possible to reduce the environmental impact of burning coal in electrical power plants.

Although clean coal technologies (such as gasification and supercritical boilers, which increase the efficiency of coal-based electrical production and decrease emissions) are promising from an environmental standpoint, various experts consider it highly unlikely that they will be deployed on a large scale in China in the immediate future. They are expensive and, in the case of gasification combined with CO<sub>2</sub> capture and storage, not commercially viable in the absence of clear guidelines that put limits, and hence a price tag, on greenhouse gas emissions.

The Chinese government already has a great deal to do in order to improve the performance of existing power plants and enforce compliance with environmental standards, which are all too often ignored. Some commentators have concluded that China will not be able to deploy clean coal technologies on any general scale much before 2020.<sup>(21)</sup>

In addition, China, which gives priority to economic growth, does not seem prepared to set an absolute ceiling on its emissions. The government's most recent five-year plan instead aims for a 20% reduction in the economy's energy intensity. It should be noted that China, as a developing country, has no greenhouse gas reduction targets under the Kyoto Protocol.

It is therefore vital that the international community work closely with China – and with other emerging industrial economies – so that clean coal technologies can be deployed as rapidly as possible and on a scale that will allow the maximum possible reduction in the environmental effects of coal combustion.

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(21) P. Fairley, "China's Coal Future," *Technology Review*, January/February 2007.