

## Coal in India: current status and outlook

The world cannot do without coal. This energy source covers more than one-quarter (28.4% in 2006) of all primary energy consumption and is used to generate nearly 40% of all electricity consumed worldwide. All scenarios and forecasts agree that coal consumption will be growing substantially, driven mostly by China and India. According to the IEA reference scenario (World Energy Outlook 2007), these two countries are expected to account for 82% of the increase in global coal demand by 2030. The outlook for India gives cause for concern: despite a strong domestic coal industry, it could eventually become a major importer. If so, what will the economic, industrial and environmental consequences be?

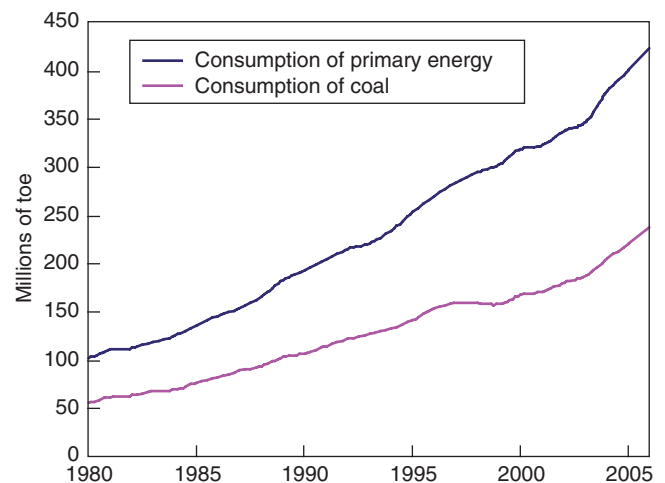
India ranks Number Six in the world for the consumption of primary energy (432 Mtoe in 2006). Its appetite for energy is growing extremely rapidly: it averaged 6.7% a year between 2003 and 2006<sup>1</sup>. Given the demographics, consumption per capita is one of the lowest in the world (512 kgep per capita in 2003), but this figure is steadily increasing.

### Consumption rising fast

#### Coal continues to dominate India's energy portfolio

Reporting a figure of 238 Mtoe for 2006, India was the Number Three coal consuming country in the world. It represented 7.7% of the coal consumed worldwide (versus 2.4% in 1966). Coal covers more than half (56.2% in 2006) of domestic demand for commercial primary energy<sup>2</sup>. Moreover, since 2002, it has become steadily more dominant: its share of the national market now stands at about the same level as in the early 1990s<sup>3</sup>.

Fig. 1 - Trends in the consumption of commercial primary energy and coal in India



Source: BP Statistical Review 2007

Demand for coal in India is growing at a particularly fast rate. For decades, it has been running much higher than the world average. Between 1976 and 2006, domestic coal consumption rose by 5.3% a year, versus 2% for the world. In recent years, average annual growth has accelerated sharply, exceeding 8% a year since 2003.

[1] For the purpose of comparison, the population of India and its economy are growing at average annual rates of 1.6% and 8.4% (2005).

[2] Conventional energies still represent the bulk of the domestic market. Coal accounts for about one-third of total domestic energy demand (including for conventional energies).

[3] Between 1998 and 2002, coal saw its market share decline to nearly 52%. This downsizing coincided with a sharp rise in oil and gas usage.

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Table 1  
Coal consumption: average annual growth rates

	1986-1996	1996-2006	2005-2006
India	6.4%	4.4%	7.1%
World	1.1%	2.8%	4.5%

Source: BP Statistical Review 2007

### The challenge facing the electricity sector

The power sector alone represents more than 75% of domestic consumption of coal, used to generate more than 69% of India's electricity. In recent years, coal has strengthened its position in this sector: in 1990, it only accounted for 65% of total output.

With installed capacity totaling 137,552 MW in 2005 (about 4% of world output), India has seen its electricity sector expand substantially. Electricity consumption rose 64% during the previous decade, placing India in the sixth position worldwide.

The rate of electrification has not reached 45% of the population: over 580 million Indians still do not have access to electricity. The Indian government aims to connect all villages to the power network by 2010. Reaching this especially ambitious goal will require the mobilization of the entire industry as well as large-scale investments.

As a result, most forecasts estimate that the power sector will grow by 8 to 10% a year between now and 2020, one of the highest growth rates in the world. For base production alone, about 68,500 MW in extra capacity will have to be added. In light of existing domestic economic conditions and resources, it is expected that coal-fired thermal power plants will cover most of this increase in capacity. The five-year XI Plan calls for the construction of several "ultra mega power projects", i.e. giant units designed to exploit economies of scale and series. Each will represent 4,000 MW (5 × 800 MW) in capacity. It is thought that five of these plants will be located near the coast to help cope with increased demand for imports (70 Mt a year).

### A surge in industrial growth

Close to 20.5% of domestic coal is consumed by industry, especially two sectors:

- Steel and related industries (coking) use nearly 12% of domestic coal. Ranked seventh in the world, the Indian steel industry is growing fast: since 2004, production has increased at a rate of almost 10% a year.

- Coal is also used by the cement industry, which, according to the X Plan for 2002-2006, is growing at a rate of 6-8% a year. Sustained by a dynamic construction sector, cement production accounts for 3% of Indian consumption.

### The impact on supply

India possesses abundant coal resources (nearly 253 Gt). With nearly 96 Gt in proved resources (more than 10% of the world total), India ranks fourth in the world behind the United States, Russia and China. At the current rate of extraction, these reserves represent more than 200 years of production.

Table 2  
India's coal reserves as of 1st January 2006 (in Gt)

	Proved resources	Indicated resources	Inferred resources	Total
Total	95.9	119.8	37.7	253.3
<i>including coking coal</i>	16.5	13.5	2.1	32.1

Source: Government of India, Ministry of Coal

The domestic reserves are composed almost entirely of bituminous coal, with 27 large accumulations in the east and the central part of the country. The lignite formations in the south only represent 2.6% of reserves. Although bituminous coal accounts for more than 97% of domestic reserves (versus 53% for the world), one should keep in mind that Indian coal is of mediocre quality. It is low-sulfur but contains a very high percentage of ash (between 30 and 55%), which gives rise to major logistics problems. Coking coal only represents 17.3% of proved reserves and less than 13% of total estimated resources.

Apparently, India possesses sufficient reserves, but will it be able to bring them into production fast enough to keep up with rising demand?

### Overambitious production targets?

India is the world's third largest producing country, with output standing roughly at 210 Mtoe. Since the coal industry was nationalized in the 1970s, large-scale investment and modernization programs have been carried out to boost production. In 30 years, average annual output has increased from about 70 Mt to nearly 432 Mt a year for FY2006-2007.

There are 565 known mines in India. Most are open-pit mines and some are very large (> 10 Mt/year). Closed mining only represents 19% of national production.

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### A partially open market

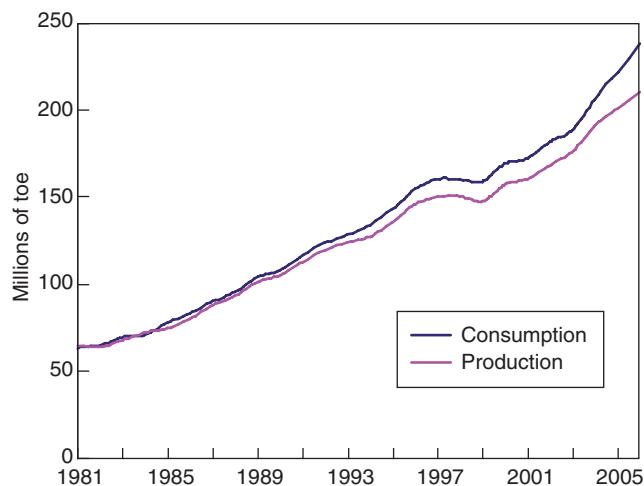
The Indian coal industry continues to be dominated by state-controlled companies. Coal India and its subsidiaries lead world coal production with 2006 output of 343 Mt. With a workforce of nearly 470,000 and 390 mines, Coal India is responsible for 88% of the coal extracted in India every year. Singareni Collieries, a public-sector company in the state of Andhra Pradesh, ranks second with about 35 Mt/year.

India had trouble reaching the production targets specified in the five-year plan, so the government opened up the market to the private sector, but only partially. For now, only the so-called captive mines are affected by this change, i.e. mines that supply an electric power plant, a steel mill or a fertilizer plant located at the pithead.

### The end of self-sufficiency

For many years, domestic production satisfied the bulk of domestic demand. In the last few years, however, production has had difficulty keeping up with the big increase in demand. In five years, coal imports have doubled, rising from 20 Mt to 41 Mt for FY2005-2006. Recent statistics show an even steeper uptrend, with imports reaching 61 Mt for FY2006-2007.

Fig. 2 - Coal in India: growing reliance on imports



Source: BP Statistical Review 2007

### A structural coking coal deficit

India is looking at a structural coking coal deficit. Its reserves are limited in size, therefore the country cannot increase production fast enough to keep up with the high growth of its steel industry. Inevitably, India must rely on imports, purchasing substantial quantities

of coke and coking coal, particularly from Australia. These imports totaled close to 25.8 Mt for FY2006-2007.

### ... but that's not all

But steel-grade coals are not the only thing that India needs to import. Its huge demand for thermal energy has driven steam coal imports up (to 36 Mt for FY2006-2007) and the pace is expected to accelerate. India needs to install 130 GW in electrical capacity in the next ten years, which is equivalent to 1 GW per month. And coal will continue to dominate the electricity mix in India... and China as well.

### Major logistics problems

Although great effort has gone into the modernization of the logistics chains in India, its entire electricity/coal supply system is coming under increasing pressure.

- In 2004-2005, a major supply shortage forced the largest domestic power generation company, National Thermal Power Corporation, owned by the government of India, to import close to 4 Mt.
- In 2005, the level of stocks at the 25 largest Indian power plants (about 35% of installed thermal capacity) did not exceed seven production days.

Indian coal is mostly extracted in the east of the country and consumed in the north and southwest. Regularly, rail transport problems occur and customers must turn to imports. This situation has prompted key players in the electricity market to secure their supply of imported coal by building up their import activities and announcing the acquisition of holdings in mines located in other countries. Since 2005, the Ministry of Coal has even recommended certain coal imports to prevent probable shortages at power plants located at a great distance from the mines. To handle this increase in imports, India needs to more than double port import capacity within five years. This may well be the next bottleneck!

### Worrisome forecasts already exceeded

Coal imports for thermal power plants were conjunctural but are now becoming structural. The outlook is for a massive increase in imports. By 2025, India may be importing nearly 181 Mt, a figure equivalent to that of Japan, currently the top importer in the world.

Obviously, the fact that India is depending more heavily on the world market will have repercussions on prices. Several signs indicate that India is impacting the international coal business to a greater extent. In this respect, the year 2007 has been instructive: facing a

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domestic coal shortage aggravated by logistics problems, cement manufacturers and electric power producers have increasingly turned to the international market. Today, India buys from the suppliers (South Africa in particular) that have always furnished the Atlantic Basin. This has led to sharp increases in the price of South African coal and helped push the CIF price in Europe higher.

Table 3  
Outlook for Indian coal imports (in Mt)

	2006 - 2007	2011 - 2012	2024 - 2025
<b>DEMAND</b>	<b>474.2</b>	<b>731.1</b>	<b>1267*</b>
<i>including coking coal</i>	<i>43.7</i>	<i>68.5</i>	<i>105</i>
<b>SUPPLY</b>	<b>432.5</b>	<b>680.0</b>	<b>1086</b>
<i>including coking coal</i>	<i>17.9</i>	<i>27.7</i>	<i>49</i>
<b>Remaining demand to be covered</b>	<b>41.7</b>	<b>51.1</b>	<b>181</b>
<i>including coking coal</i>	<i>15.9</i>	<i>10.3</i>	<i>56</i>

\*Scenario based on hypothetical GDP growth of 8% a year.

Source: Government of India, Ministry of Coal, XI Plan & Vision Coal 2025

### Coal and the environment in India

#### Energy efficiency and the Kyoto Protocol

Facing tremendous energy demand, India introduced a policy to promote energy efficiency. In 2001, the Energy Conservation Act was passed. A federal agency, the Bureau of Energy Efficiency, was set up to coordinate actions in this area. Implemented in a booming economy, this policy is now showing the first

encouraging signs of improving the energy intensity of the Indian economy (26 kBtu per dollar of GDP), which is comparable to that of the Czech Republic.

India's CO<sub>2</sub> emissions totaled 1 Gt in 2003. According to the World Bank, they climbed 57% between 1992 and 2002. India ratified the Kyoto Protocol in August 2002. Since then, it has established the National Clean Development Mechanism Authority (NCDMA), which started operating in December 2003.

#### The importance of thermal power plants

At present, power plants in India report low energy efficiencies — about 31% on average (versus 36.7% for OECD plants) — because they use "subcritical" technology. In the medium term, only one supercritical power plant, Seepat (3 × 660 MW), scheduled to start up in 2009, will be able to reach an efficiency exceeding 40%. This being said, it will not long remain isolated because, under the XI Plan (2007-2011) and XII Plan (2012-2016), all new plants will be supercritical. This may help moderate the sharp increase in coal consumption that is expected in the electricity sector.

Experiments with IGCC technology are also underway in India. An initial pilot plant (6.2 MW) is to be followed by a demo-plant (100-125 MW) in the state of Uttar Pradesh.

India also sees CO<sub>2</sub> capture/storage as a priority. It is a member of the Carbon Sequestration Leadership Forum (CSLF) and involved in FutureGen, a US government project to build and operate a near zero-emissions coal-fueled power plant.

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