

# 16

## Harmonising the coal industry with the environment

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Coal contributes greatly to social and economic development. It triggered the industrial revolution and has driven industrialisation in the past several centuries. At present, many developing countries are still heavily dependent on energy-intensive industries, such as metals and manufacturing. While the World Coal Institute (WCI 2001) says that the coalmining industry employs seven million workers globally, five million of whom are in China, it has elsewhere been estimated that China alone has about six million coalminers (China Coal 2002). Due to the abundance of town and village-owned coalmines in China, particularly illegal mines not registered in any statistics, such figures are far lower than the reality. The coal industry plays a special role in alleviating poverty. For example, most coalmines are in rural or remote areas where they are usually the largest employers, the largest providers of welfare for poor communities and the sole producers of affordable energy.

The coal industry is, however, also problematic. Occupational health and safety in mines are old but prominent issues; fatal accidents happen frequently, and mostly in developing countries. Occupational diseases also often cause slower, but larger numbers of deaths. World Combined Services (2003) observed that black lung, a lung disease caused by breathing coal dust, killed 55,000 miners between 1968 and 1990 and continues to kill 1,000 miners a year.

Environmental issues have been emerging to shift the focus from those traditional problems. Coal is one of the primary environmental polluters. Its production and consumption have local, regional and international negative impacts on the environment. Local environmental impacts are predominantly those caused by

mining activities and can include land subsidence, water pollution and mine waste. Regional and international environmental impacts are derived from emissions from coal combustion, such as particulate pollution and the emission of nitrogen oxides, carbon dioxide and sulphur dioxide. Since the 1972 Stockholm Conference, environmental issues have become more prominent worldwide. The number of international conventions for protecting the environment has increased considerably (United Nations 2002). In general, environmental regulations affect the coal industry in terms of production, transportation and consumption.

Even though sulphur dioxide, nitrogen oxides, and particulate pollution have received attention, carbon dioxide emissions and climate change have gradually become primary concerns because of their global impacts. This chapter studies the regional and global issues raised regarding emissions from coal use. Environmental regulations are defined as international treaties, agreements, guidelines, directives and national laws that are related to regional and global issues (for example, air pollution and climate change), such as regulations on emissions of sulphur dioxide, nitrogen oxides, particulates and carbon dioxide. Among these, regulations governing carbon dioxide emissions are of the most concern because of the unpredictable and adverse impact on the global coal industry.

Due to the additional costs involved in making coal more environmentally acceptable, environmental regulations have negatively affected the coal industry. Arguably, these regulations will change the ability of coal to compete with other fuels; for example, higher carbon dioxide emission taxes give petroleum compounds an advantage against coal. Since environmental concerns have priority over the future of the coal industry, it is easy to conclude that the industry's future is bleak. In China, the view that the coal industry is *XiYang Gongye* (the Setting Sun, that is, hopeless) is widely held. But, on the contrary, many Chinese scholars have argued that there is a promising future for the coal industry (Shang 2001; Li 2003; China News 2001). However, these arguments are not convincing as they cannot answer the key questions: how can the coal industry overcome the adverse impact of environmental regulations? How should the decline of the coal industry in Western Europe be interpreted? Could alternatives replace coal? They also omit the beneficial effects of environmental regulations and thus fail to consider the possibility that protection of the environment could be harmonised with coal production and consumption.

This chapter argues that growth of the coal industry can be harmonised with environmental objectives. Through case studies and the comparative analyses of economic, technical and theoretical issues, it argues that in the long term, environmental regulations will probably not lead to the decline of the coal industry

globally. On the contrary, the enforcement of the environmental regulations can help the coal industry to maximise its contribution to society, assisting the industry to achieve sustainable development. Historical experience has demonstrated that the coal industry was able to continue parallel development with stonger environmental regulations.

### **Environmental regulations and the coal industry: historical experiences**

Despite many uncertainties surrounding the relationship between greenhouse gases and climate change, many global activities are being initiated to control greenhouse gas emissions. A key example is the controversial Kyoto Protocol, under which industrial countries agreed to reduce their greenhouse gas emissions by at least 5 per cent below 1990 levels in the commitment period 2008–12. Although the United States—the world's largest emitter of carbon dioxide—has refused to ratify the Kyoto Protocol, it nonetheless became effective on 16 February 2005. Even though carbon dioxide is one of the most significant greenhouse gases by volume, its global effects vary compared with those of other greenhouse gases (Birnie and Boyle 2002:501). Regardless, the Kyoto protocol will place great pressure on countries to minimise carbon dioxide emissions.

The main international environmental regulations relating to coal are the 1979 United Nations' Convention on Long-Range Transboundary Air Pollution, the 1985 Sulphur Protocol, the 1992 UN Framework Convention on Climate Change (UNFCCC), the 1997 Kyoto Protocol to the UNFCCC (the Kyoto Protocol) and the 1998 Nitrogen Oxides Protocol. There are many other guidelines, including those from sources such as non-governmental organisations (for example, the World Bank Environmental Guidelines). Regulations on pollutants such as sulphur dioxide and nitrogen oxides affect the coal industry greatly because they directly restrict coal use, alter coal consumption and change the coal industry's structure or its markets. Since these kinds of controls have been in place in many parts of world for some time now, their effects are obvious. However, the control of carbon dioxide seems to have the most serious impact on the coal industry as coal combustion produces the largest amount of carbon dioxide per unit of energy. Since controls on carbon dioxide emissions have been introduced only recently and the targets have been contracted, the outcomes are unclear. Therefore, compared with other environmental regulations, the UNFCCC and the Kyoto Protocol will affect the coal industry in unpredictable ways.

With the emergence of more environmental regulations, many observers think that the future for the coal industry is unpromising (Keay 2003). This view can be

traced back to the 1960s and 1970s in the United States, when the government was considering regulating coal pollution. The coal industry and its supporters in government worried that such regulation would limit coal's ability to compete with other fuels (McGinley 1992:261).

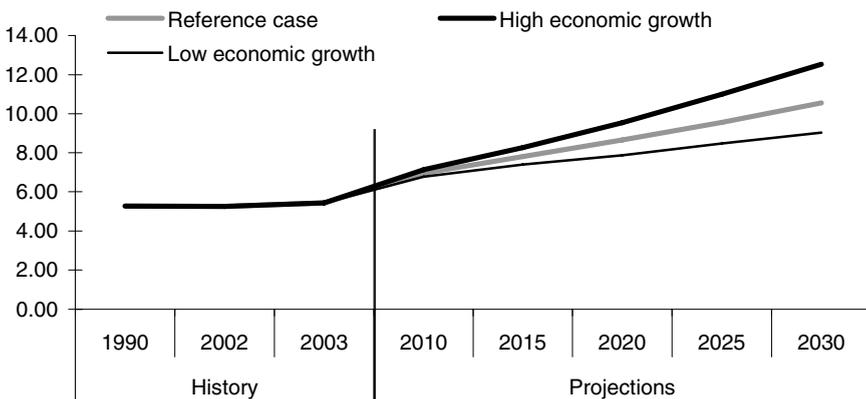
The reality, however, is that even with an increasing number of environmental regulations on coal in the past three decades, global demand for coal has increased by more than 60 per cent since 1970 (Figure 16.1). In 1999, world coal consumption was 4.7 billion short tonnes and was projected to increase in the United States, Japan and developing countries in Asia. It should be pointed out, however, that this forecast does not consider the effects of environmental regulations such as the Kyoto Protocol (EIA 2001).

BP (2005) demonstrates that, in the past decade, global production and consumption have increased despite environmental pressures, particularly in Asia and the Pacific. The decline of coal in Europe and Eurasia is probably due to the economic breakdown in the former Soviet states.

### Clarification of the relationship between environmental regulations and the coal industry in Western Europe

The experience of Western Europe is an interesting case, the recent and dramatic decline of its coal industry is often cited as proof of a general global trend. This

Figure 16.1 World coal consumption, 1990–2030 (billion short tonnes)



Source: Energy Information Agency, 2004. *International Energy Outlook 2004*:75.

view ascribes the decline to tightening environmental regulations and predicts that the coal industry in other parts of the world will also decline as more environmental regulations are implemented.

The European Community did not have an environmental policy until 1972, when the first Action Program on the Environment was formulated. More recently, more than 200 regulations have been agreed as part of the European Commission policy (Bell and McGillivray 2000:123). The first European Commission-wide air-quality standard was the 1980 Air Quality Directive (Smoke and Sulphur Dioxide). Further standards encompassing nitrogen oxides were established in 1985 (Haigh 1990:182, 195). Other environmental regulations that might affect the coal industry are the 1988 European Commission Large Combustion Directive, the European Union Climate Change Strategy and the UNFCCC. The European Union agreed to an 8 per cent reduction in emissions, of which the United Kingdom's share was 12.5 per cent (UNFCCC 2004). The European Commission (including the United Kingdom) signed the Kyoto Protocol on 29 April 1998 and ratified it on 31 May 2002 (UNFCCC 2006).

The European Union's 1992 proposal to tax carbon dioxide emissions and energy was supposed to raise the price of anthracite by 58 per cent, natural gas by 14 per cent and petrol by 6 per cent, if the entire tax were to be passed on to the consumer (Johnson and Corcelle 1997:176). At the end of 2001, eight member states had implemented this tax, although, to date, no such tax exists at the European Union level (further details are available in European Environment Agency 2000).

The annual coal output in Western Europe declined from approximately 600 million tonnes in the early 1960s to 86 million tonnes in 2000. In Western Europe, only Germany, the United Kingdom and Spain are still producing coal. Coal consumption in Western Europe decreased 36 per cent from 894 million tonnes in 1990 to 573 million tonnes in 2002 (EIA 2005a).

Germany, France, Spain and the UK granted substantial subsidies for coalmining, totalling 6.3 billion euro in 2001 (Commission of the European Communities 2002:24). In these countries, domestic production costs are much higher than the price of imported coal; for example, in Germany, Spain and France, domestic production costs are three to five times more than imported coal prices (Table 16.1). When these countries phase out subsidies and liberalise their coal trade, domestic coal production will inevitably decline because more coal will be imported. In 2004, Germany imported an estimated 39 million short tonnes of coal (EIA 2005b).

The decline of the coal industry in Western Europe has not resulted from changed environmental regulations. The huge gap between production costs and prices for imported coal implies that the decline of coal production is due to domestic producers losing competitiveness with cheaper imported coal. If environmental

**Table 16.1 Western European coal industry subsidies, production and import prices, 2000**

	Subsidies (US\$ 2,000 million)	Hard coal production (million tonnes) (US\$ 2,000)	Average subsidy per tonne of coal produced (US\$ 2,000)	Average price per tonne of coal imported
Germany	4,245	40.4	105	32
Spain	1,035	16.4	63	32
France	933	4.9	192	36
United Kingdom	132	35.3	4	38

**Source:** Energy Information Agency, 2002. *International Energy Outlook 2002:77*.

regulations were the main reason for the decline, coal consumption should have decreased earlier and to a greater extent than production because environmental regulations would have affected coal use first. The reality is that production has decreased more than consumption. Those claiming that the Western European case indicates a trend assume a spurious relationship between changed environmental regulation and the decline of the coal industry.

As the largest coal producer in the European Union, the United Kingdom's case is compelling evidence that disproves this conclusion, because in the United Kingdom the decline of coal has not coincided with the introduction of environmental regulations. The environmental regulations that potentially affect the United Kingdom coal industry have been in place for a long time and include the *Clean Air Acts* of 1956 and 1968, the *Control of Pollution Act 1974* and the *Pollution Control and Local Government (Northern Ireland) Order 1978*. It was, however, not until the early 1980s that coal production fell sharply. Coal production in 2004 was less than one-fifth of that in 1980 and about one-quarter of the 1990 level. Imports grew steadily to reach 20 million tonnes a year in the 1990s, then expanded rapidly to overtake domestic production. Except for a slight decrease in 2002, imports exceeded domestic production in 2003 and 2004, reaching a new record of 36 million tonnes (Figure 16.2). This demonstrates that there is little logical relationship between the decline of the domestic coal industry and the implementation of new environmental regulations.

In fact, the decline in coal consumption in the United Kingdom resulted mainly from the privatisation of the electricity industry, which led to a rapid increase in natural gas-fired electricity generation at the expense of the use of coal (EIA 2002). Because of its plentiful reserves of natural gas, the British government has

a long tradition of encouraging the use of natural gas as a substitute for coal and oil in industry and for power generation (EIA 2006a). Whatever role changed environmental regulations played in the general decline of the coal industry, they are not considered to be the main cause.

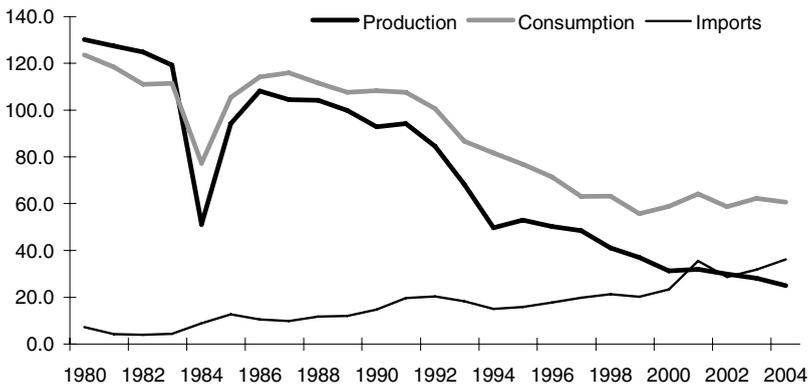
The decline in the United Kingdom's coal production was also due to high domestic production costs. Before 2000, consumers were compelled to buy subsidised domestic coal, enabling the domestic industry to survive. After the removal of such restrictions in 2004 and with the increased importation of cheaper coal from other countries, United Kingdom prices for coal purchased by major power producers decreased by 33 per cent when compared with the price in 1994 (Figure 16.3).

Notably, compared with oil and gas prices, the price of coal has remained stable (Figure 16.3). In the future, this will help coal to become more competitive. The International Energy Agency (IEA) forecasts that, although Europe's local output continues to fall, future consumption will be stable. In its latest *World Energy Outlook*, the IEA predicts that European coal consumption will fall by only 0.4 per cent in the next 30 years (cited in Keay 2003).

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Figure 16.2 **Coal production and consumption in the United Kingdom, 1980–2004**

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**Source:** Department of Trade and Industry (DTI), 2005. *Energy statistics: coal*, URN No. 05/87a10. Available from <http://www.dti.gov.uk/energy/statistics/source/coal/page18529.html> (accessed 21 June 2006).

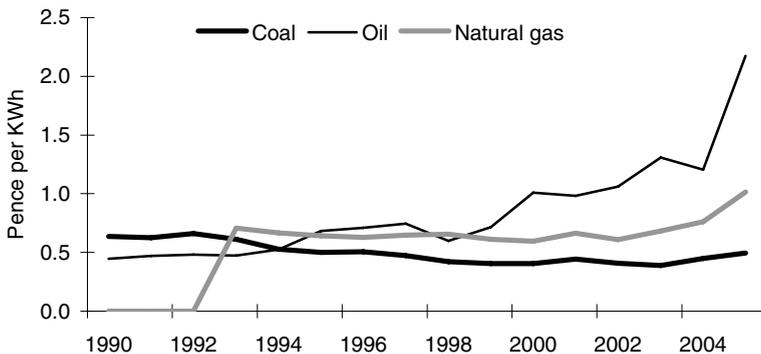
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## The joint development of environmental regulations and the coal industry in the United States

United States has a unique combination of a large coal industry and strict environmental regulations, providing evidence of the real effects such regulations have on the coal industry.

In the United States, the first important coal-related regulation was the *Clean Air Act*, passed in 1963. In 1970, the United States Congress passed the first amendment to the act, setting in motion a nationwide effort to improve the country's air quality. Since then, additional laws and regulations have been added. In particular, the 1977 amendment to the *Clean Air Act* established for the first time 'ceilings' for different air pollutants, including particulate matter, carbon monoxide, sulphur dioxide and nitrogen oxides. The *Clean Air Act* also manages many standards at a federal and state level, forming the air pollution control system. Since environmental regulations began to affect the coal industry in 1977, this chapter will focus its analysis on the industry from this time until the present.

Figure 16.3 Average prices of fuels purchased by major United Kingdom power producers, 1990–2006



**Source:** Department of Trade and Industry (DTI), 2006. *Quarterly Energy Price Tables*, URN No. 6/276b/tab:Table 3.2.1. Available from <http://www.dti.gov.uk/energy/statistics/publications/prices/> (accessed 28 June 2006).

To date, the United States has not ratified the protocol. However the government has accepted the intention of Kyoto and has expressed a commitment to controlling carbon dioxide emissions.

After the implementation of the 1977 *Clean Air Act* amendments, the coal industry did not lose competitiveness, defying the expectations of many observers. Conversely, coal production continued to increase, while its price continued to decline (see Figures 16.4 and 16.5).

The EIA forecasts that coal production in the United States will continue to grow in the next 25 years and the coal prices will continue to decline largely because of an increase in mining productivity. The average mine-mouth price of coal declined with the annual ratio of 4.9 per cent (EIA 2006a:99). The global reality is that the coal industry continues to grow despite the continual implementation of environmental regulations, and, such regulations were not the main cause of the decline of the coal industry in Western Europe. The case of Western Europe should not be used to suggest that the future of the coal industry is unpromising.

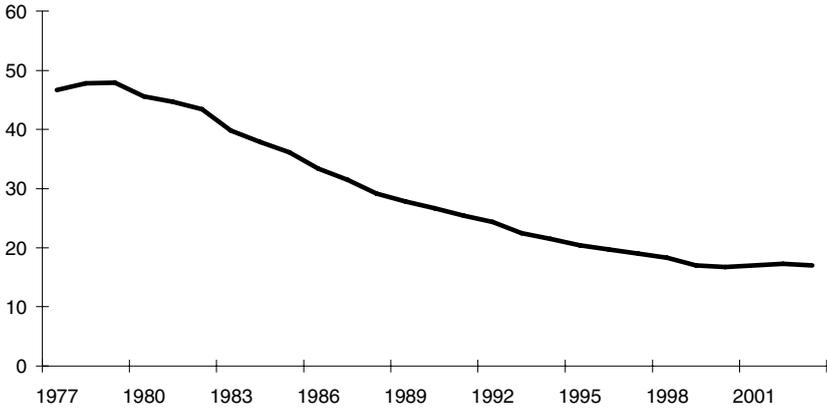
The United States' case clearly demonstrates that, in the long term, environmental regulations do not harm the coal industry; in fact, they can help the industry become more competitive. McFarland, Herzog and Jacoby (2004:6) studied the future of coal consumption under different scenarios of changing carbon prices, gas prices and clean coal technological costs and found that in the United States and among European Union countries, coal would continue to be viable. It is possible that the coal industry will not only overcome the adverse impact of environmental regulations, but will continue to grow. This can be demonstrated by the continuing growth of coal consumption, alongside a decline in prices. Technological advances play an important role in the case of harmonising the coal industry with environmental regulations.

### **The economic logic of environmental regulations**

Coal is a non-renewable and therefore scarce resource. This means that any one extra (marginal) unit of use will have higher costs and lower benefits than the former unit. That is, there is an increasing marginal social cost (MSC) and a decreasing marginal benefit. In Figure 16.6 at point  $Q_1$ , the marginal social benefit (MSB) equals the MSC, where coal is used most effectively. One additional unit will bring a net loss to society.

Unfortunately, without environmental regulation, more than the optimum quantity of coal will be used because some costs will be externalised and will not be paid by consumers. Therefore, the consumers' marginal private cost (MPC) curve would

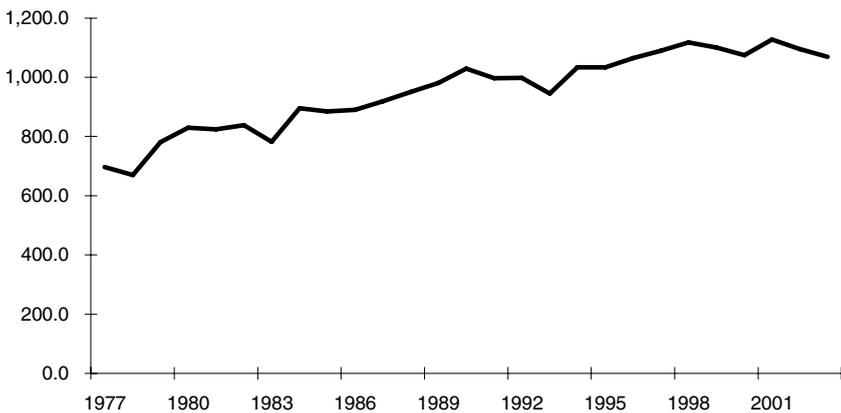
Figure 16.4 **United States' coal real price, 1977–2003** (dollars per short tonne)



**Note:** The price is chained in US dollars (2000 as the base year price), calculated by using GDP implicit price deflators.

**Source:** Energy Information Agency, 1949–2004. *Coal Prices*. Available from <http://www.eia.doe.gov/emeu/aer/txt/stb0708.xls> (accessed 28 June 2006).

Figure 16.5 **United States' coal production, 1977–2003** (million short tonnes)



**Source:** Energy Information Agency, 1949–2004. *Coal Production*. Available from <http://www.eia.doe.gov/emeu/aer/txt/ptb0702.html> (accessed 28 June 2006).

lie below the MSC curve, except at the original point where they meet. Simultaneously, the MSB curve, whether it pertains to the whole society or individual average, would remain the same.

For the individual, the private optimum quantity will be at  $Q_r$ , which is higher than  $Q_1$ . At this point, the whole society will suffer a marginal net loss to  $MSC_r - MSB_r$ . The greater the externalities, the higher the  $Q_r$ , and, thus, the higher the marginal social net loss.

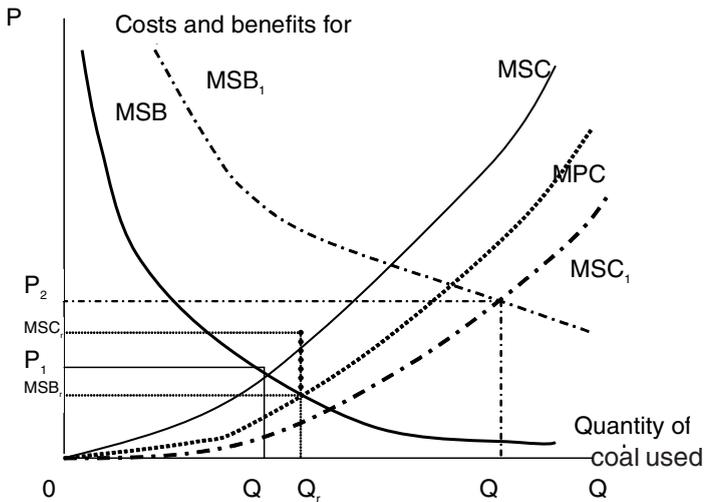
Environmental regulations will internalise costs of coal utilisation and thus drive MPC close to MSC. This will cause coal to be used in a socially efficient way, even based on individual decisions, which would make coal more attractive to society. Warhurst (1994:133) states that enforcing environmental regulations on mining operations does not always cause detriment to its economy. Rather, it might bring economic advantage. In this case, it is easy to see that some low-grade coal resources, quantity at  $Q_r - Q_1$ , are reserved. When new technologies (for example, sulphur emission controls) cut costs or when marginal society benefits rise (that is, when the MSB and the MSC move to  $MSB_1$  and  $MSC_1$  respectively), those previously saved marginal resources could be used without a negative contribution to society.

This mechanism is the economic basis for coal to harmonise with environmental regulations. This has been proved in the United States case. In 1997, the US Environmental Protection Agency studied the benefits resulting from the *Clean Air Act* between 1970 and 1990 and showed that the net present value (NPV), with a 5 per cent discount rate, was US\$21.7 trillion.<sup>1</sup>

### **Technological improvement and the declining trend of unit coal emissions**

Setting a ceiling for carbon dioxide emissions does not necessarily lead to a decline in coal production and consumption. Environmental regulations can encourage the use of clean-coal technologies, which separate and seize carbon dioxide instead of discharging it, reducing emissions per unit of coal. For example, an integrated gasification combined cycle (IGCC) technology (most likely to be in commercial use soon) could increase generating efficiencies by 20 to 30 per cent and reduce emission levels (especially of carbon dioxide and sulphur dioxide) more effectively than present pollution-control technologies (EIA 2001). Figure 16.7 displays the relationship between coal use and carbon dioxide emissions. If the relationship was line I, when environmental regulations demand reducing carbon dioxide emissions from P to  $P_1$ , a dramatic decline of coal consumption from Q to

Figure 16.6 Economic logic of environmental regulations

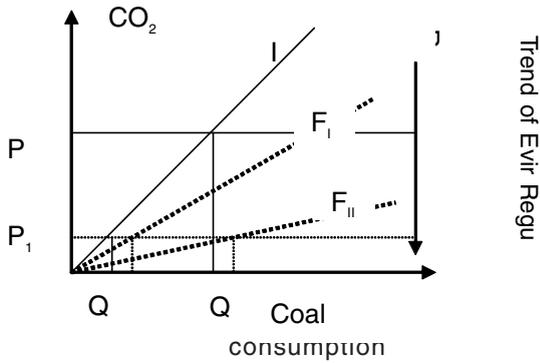


$Q_1$  will occur. However, if new technologies change the relationship between coal and carbon dioxide emissions to line  $F_I$ , the coal decline from the same reduction will not be as great as the former. If the relationship were line  $F_{II}$ , a small increase in coal consumption would occur.

A study in the United Kingdom shows that even a simple replacement of one or two coal-fired power stations with modern supercritical and ultra-supercritical plants can do more to reduce carbon dioxide emissions than the entire United Kingdom renewable programs have done thus far (Keay 2003). The study indicated that new technologies, such as IGCC, combined with carbon sequestration, could achieve a zero discharge.

The United States Department of Energy states that it is possible for a coal plant to emit no pollution. It points out that, besides IGCC, integration of gasification with a fuel cell (IGFC) has the potential to achieve near-zero emissions. The Bush Administration has launched a public-private partnership to develop a coal-fired electricity-generating facility with near-zero emissions (Shimkus 2005). If carbon sequestration can reach reasonable cost targets, carbon fuel might achieve a price comparable with or even cheaper than carbon alternatives (Keay 2003). Therefore, it cannot be concluded whether environmental regulations would dramatically change the energy consumption structure.

Figure 16.7 Different emissions per unit of coal consumption



### Benefits of environmental regulations to the coal industry

Care should be taken when talking about benefits, as this does not mean that the cost side is not important, however, there are some benefits to the coal industry from environmental regulations.

First, environmental regulations can promote the upgrading of enterprises and the optimisation of industry structures. Regulations can help to provide a level playing field for competition through the internalisation of costs. Warhurst (1994:133) shows that strict environmental regulations can make enterprises achieve better technological standards. That is, new technology with lower production costs and causing less environmental harm could, more or less, offset environmental costs. Those companies that are unable to upgrade in accordance with new environmental standards will be forced into bankruptcy. This will improve the coal industry as a whole.

Second, environmental regulations inspire companies to innovate. Porter and Linda (1995:98) believe firms can even benefit from properly designed environmental regulations because they could lead to unexpected technological innovation, which could reduce pollution and total costs. Examples of such innovative technologies include new combustion processes, such as fluidised bed combustion or low-nitrogen oxides burners, to remove pollutants or prevent their formation; new pollution-control devices, such as advanced scrubbers, which clean pollutants from flue gases before they escape from a plant's smokestack; coal-transfer technologies, which convert coal into fuel forms, such as gas and oil; and carbon capture and storage technologies, which will help achieve zero emissions.

Finally, environmental regulations can help the coal industry attract foreign investment by clearly identifying environmental liabilities. Research shows that states with inadequate environment regulations will have difficulty attracting foreign investment in the mining sector (Otto and Barberis 1994:12), because responsibility for environmental problems is uncertain. For example, in China, many of the old coalmines facing closure have serious environmental problems. At present, it is not clear who is responsible for solving these problems, as current stakeholders, such as governments, coal companies and mining communities, are not able to make the necessary changes. A new investor might be asked to solve these issues which pose a risk and therefore a deterrent to the investment. Regulations can reduce the uncertainty of environmental liability and thus facilitate investment decisions.

### **Coal's alternatives**

Coal is the most abundant fossil fuel and, in the near future, it will retain its advantage over other fossil-fuel energy. At the end of 2004, the world's total recoverable coal reserves were approximately 909 billion tonnes, which, with current exploitation levels, could last for 164 years, while oil and gas could be depleted in 40.5 years and 66.7 years, respectively (BP 2005).

Currently, renewable resources have not matured enough to support world development significantly. The EIA (2001) points out that nuclear energy and hydroelectricity have an uncertain future. For example, some countries plan to restrict and even eliminate nuclear power, which is a frequent target of public protest and opposition. Large-scale hydroelectricity is also becoming increasingly unpopular because of its extensive ecological effects. Hydroelectricity is also problematic because of seasonal fluctuations in water flow. In some places, available resources have already been heavily exploited. Therefore, limited prospects for nuclear and/or hydroelectric capacity in some areas could increase the use of coal for power generation.

A strong supporting view is that distinctions in greenhouse gas emissions between coal and its substitutes are much less than traditional studies have shown. Contrary to popular belief, hydroelectricity can seriously damage the climate because it produces greenhouse gases (methane emitted from turbines and spillways; methane produced from the growth and decomposition of soft green vegetation when water levels fall and rise, and carbon dioxide emissions from above-water decay of standing trees) (Fearnside 2004). Fearnside (2004) also points out that 'any weighting of the emissions impacts for time preference will strongly favour fossil fuel alternatives over hydroelectric generation'.

On the contrary, clean-coal technologies can help coal compete with its alternatives. A new technology that could change the outlook for the coal industry is coal gasification and liquefaction, which will reduce pollutant emissions. There are many coal liquefaction plants in operation or being built in China and southern African.

### **China's coal industry and environmental performance: past evidence and future prospects**

Environmental protection was established as one of China's basic national policies in the 1980s. By 2005, China had introduced nine environmental laws, 15 resource laws, more than 50 state and 200 ministry-level environmental regulations, and more than 2,000 state environmental standards and local environmental legislation (SEPA 2005). Such legislation places many pressures on the coal industry. Meanwhile, China has had double-digit rates of economic growth for much of the past two decades. This has had huge implications for energy consumption and environmental impact.

Although China began its reform in 1978, the transformation procedure for the coal industry began only in 1993, when the central government started to liberalise coal prices and reduced subsidies to the coal industry. Therefore, this chapter will focus on the past 13 years.

#### **The recession period, 1998–2001**

China is rich in coal while short of oil and gas reserves. Therefore, in the past few decades, coal has represented about 70 per cent of China's total primary energy consumption, and more than three-quarters of electricity is generated from coal-fired power plants. Before 1997, China's demand for coal exceeded supply; however, from the end of 1997, the Chinese coal industry suffered a surplus and entered a four-year recession. Prices gradually decreased, output shrank and payments for coal sales remained largely in arrears. China's statistical coal output fell from a peak of 1.397 billion tonnes in 1996 to a low of 998 million tonnes in 2000 (see Table 16.2). With the nominal fall in production, coal producers, especially state-owned mines, have fallen into deficit (Shi 1999:19).

During the recession, state-owned mines laid off a large number of employees, and the remaining workers were not paid on time; new mine construction was postponed; the government suspended matured debts from state-owned mines; and retired workers could not get a pension because the mines could not pay social insurance.

The sudden and large fall in coal production, the large deficits experienced by state-owned mines and the poor living conditions of coalminers during the recession period were the main causes of a pessimistic outlook for the future of the coal industry.<sup>2</sup> Many think the decline of the Chinese coal industry will continue because it inevitably exists in opposition to environmental protection. In 2001, an advertisement on China Central TV claimed that coal was a dirty energy and coal-fired power plants should be closed down. The advertisement triggered a nationwide debate about the future of the coal industry (cited in Feng and Guo 2001). Even today, Greenpeace's Chinese web site (<http://www.greenpeace.org/china/zh/campaigns/stop-climate-change/our-work/asia-clean-energy-revolution-tour/dirty-energy>) still declares that coal is a dirty industry.

However, the reality does not support such a pessimistic view. Table 16.2 demonstrates that from 2001, the production of coal increased dramatically. In 2005, the annual coal production was 2.11 billion tonnes (China Coal News 2006), nearly double that of 2001.

Indeed, the extremely low production levels from 1998 to 2001 are suspicious, and do not explain why GDP and coal consumption grew while coal production was falling. The average annual growth rate of GDP from 1990 to 2003 was 9.3 per cent and, from 1998 to 2003, 8 per cent (NBS 2004). Electricity, steel and cement industries continued to grow, and parallel the growth of GDP, while the figures indicate that coal production fell (Figure 16.8). What filled the big gap between consumption and production, especially in the three years from 1999 to 2001 (Table 16.2)?

The turning point of the coal market is possibly a result of the Asian financial crisis, however, this nominal decline in demand is enlarged by Chinese coal industry policy. To deal with excess supply, in November 1998, the Chinese State Council initiated a policy 'Closing Up Mines and Restricting the Total Yield', which prepared to cut production by 250 million tonnes by closing 25,800 of 51,200 illegal town and village owned coalmines (Shi 1999:19). Based on the assumption that the problems in the coal industry were caused by oversupply, the government moved to control total output by setting production quotas for each province and threatening punishment for those who exceeded their quota.

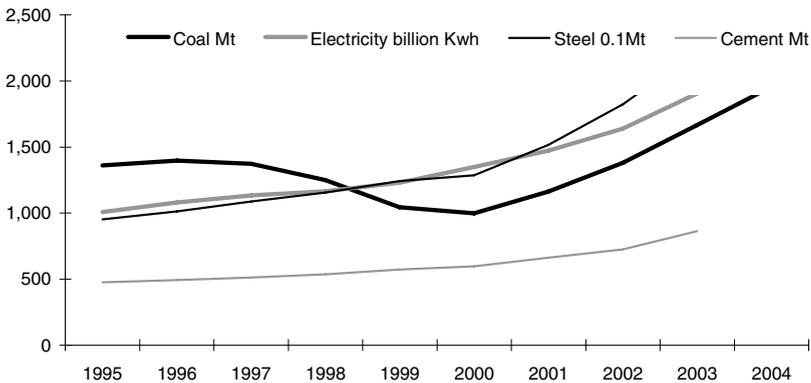
Under this regime, in order to meet the unrealistic output targets, provincial governments and coal companies reported less production. In April 2000, a senior officer of the coal industry bureau in Henan Province complained to the author that the production quota assigned for the province would not allow it to meet its own demand. Strictly obeying the policy would see his province change from

Table 16.2 **China's coal production and consumption, 1995–2004** (million tonnes)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Production	1,361	1,397	1,373	1,250	1,045	998	1,161	1,380	1,667	1,956
Consumption	1,376	1,447	1,392	129	1,263	1,245	1,262	1,366	1,445	1,890

**Source:** National Bureau of Statistics (NBS), 2005. *China Statistics Year Book 1995–2005*, China Statistics Publishing House, Beijing.

Figure 16.8 **Outputs of coal, electricity, cement and steel, 1995–2004**



**Source:** National Bureau of Statistics (NBS), 2004. *China Statistics Year Book 1995–2004*, China Statistics Publishing House, Beijing.

being the second largest coal-exporting province to a importing province, which was ridiculous. The only choice for him was to cheat the central government and try to avoid punishment. Consequently, the statistics registered in the national targets. For example, in 2000, the total production set by the coal industry's state bureau was 980 million tonnes, which exactly matches the final number in the official statistics.

Another possibility is that production from illegal mines was not reported and therefore not included in the official statistics. Illegal town and village-owned mines that were established under previous conditions of strong demand and favourable government policies, and which were supposed to be closed down, continue to operate because their lower production costs make their prices lower than those of the state-owned mines. Since the illegal mines bring many benefits (taxes, fees and illegal income to local government officials, supporting local business), county and town governments have a strong interest in protecting them from closure. Therefore, production was underestimated from 1999 to 2001 when the mine closure policy was emphasised by the central government.

Many researchers believe that coal production in the period from 1997 to 2001 was higher than that registered in the official statistics (Logan 2001; Barlow Jonker 2002a, cited in Ball et al. 2003). They estimated that the unreported coal production amounted to 200 million tonnes. The International Energy Agency (IEA) believes that coal production in 2000 was 1.231 billion tonnes, which was 233 million tonnes more than the official Chinese statistics (IEA 2002, cited in Ball et al. 2003).

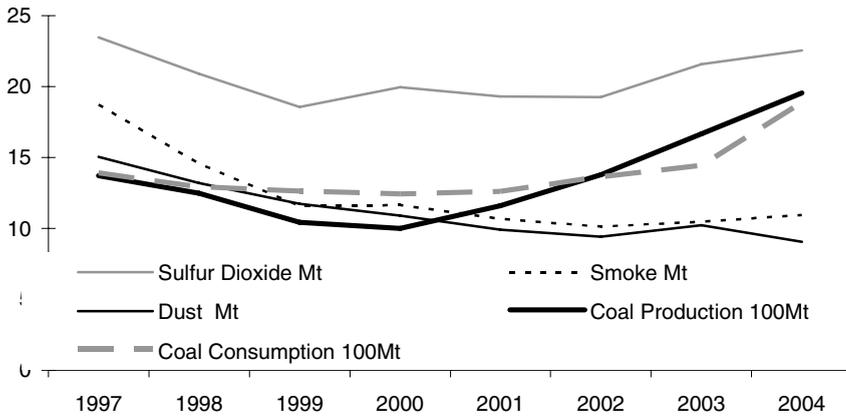
## Environmental performance and the coal industry

The Chinese case shows the co-development of the coal industry with increased environmental protection. As shown in Figure 16.9, coal consumption has increased rapidly since 2000, but emissions of dust and smoke are declining. Even though there is a slight growth in sulphur dioxide emissions, the increase is far lower than the level of coal consumption. Coal consumption increased nearly 50 per cent between 2000 and 2004, yet the emission of sulphur dioxide in that period showed an increase of only 13 per cent (NBS 2004; SEPA 2004). This clearly shows that the coal industry and environmental protection can develop simultaneously.

## The way forward

Improvements in technology provide ways for the coal industry to harmonise with the environment. With the expansion of Chinese coal production, more advanced environmental technologies have been designed and implemented. Besides traditional clean-coal technologies, coal liquefaction provides a cleaner way to

Figure 16.9 Coal production and air pollution emissions, 1997–2004



Source: NBS, 2004. China Statistics Year Book, 1997–2004, China Statistic Publishing House, Beijing.

use coal. Many Chinese companies are working to transform coal into oil, a procedure in which more pollution elements are separated and utilised, minimising emissions. The first direct coal-to-oil plant is being built by Shenhua Group, the largest and safest coal producer in China. The plant wants to discharge no pollution other than carbon dioxide and to research the technology of carbon dioxide seizure and storage. In his recent visit to the plant, Chinese Premier, Wen Jiabao, announced that coal liquefaction was a national strategic project for securing a supply of energy. By 2020 the Shenhua Group plans to transform 100 million tonnes of coal per annum. The Shenhua Group and Southern African Sasol Energy Company are also planning to build several indirect coal liquefaction plants in Shaanxi and Ningxia. Other liquefying technologies are also being tested. Furthermore, coal gasification will reduce a large amount of pollution created by coal combustion. The Shenhua Group has launched the world's first coal-to-olefin plant in Baotou City, Inner Mongolia Autonomous Administration Region.

### New policy initiatives

The current Chinese government is working to change the nation's attitude towards energy development and use, and, if realised, this will provide more favourable conditions for the coordinated development of the coal industry and the economy.

Chinese President, Hu Jintao, advocates a new Science Development Concept to build 'A Saving Society' and 'A Harmonious Society'. Reasonable utilisation of resources and environmental protection are at the top of his agenda, not only as slogans, but as action plans. A good example is the dramatic change in energy and environmental goals for the next five years. On 11 October 2005, the Central Commission of the Chinese Communist Party published a suggestion for the eleventh Five-Year Plan, stating that, in the next five years, energy intensity should be cut by 20 per cent, major pollutants should be reduced by 10 per cent, while the per capita GDP in 2010 should be double that of 2000 (Xinhua Net 2005). It also asks for the formation of a market mechanism for resource allocation and pricing. This suggestion has been incorporated in China's eleventh Five-Year Plan (2006–10) and thus becomes an official goal for the nation (People's Daily 2006).

At the same time, the pricing system is being liberalised and resource prices are increasing. Coal prices have historically been distorted due to explicit and implicit subsidies for coalmining, however, the transition from central planning towards a market economy will begin to alter this. Pricing reforms started in 1993. At the end of 2005, the Chinese central government announced that it would not intervene in the pricing of coal for electricity generation. That indicates that the coal price will be decided solely by the market. Meanwhile, the price is expected to become a tool to inspire saving resources. Therefore, the current government wants to gradually increase the price of non-renewable resources, including coal.

Additionally, in April 2006, the Chinese State Council began testing the sustainable development of the coal industry in Shanxi Province. A key aim of this trial is to internalise such externalities as environmental damage and resource waste (State Council 2006). This indicates that the Chinese government is working towards developing the coal industry in harmony with the environment.

## **Conclusion**

The view that high costs brought about by environmental regulations will harm the coal industry might prove incorrect if the industry can find positive ways to meet regulatory challenges.

Historically, environmental regulations have not hurt the coal industry very much. A detailed study of the coal industry in Western Europe reveals that its decline was not caused directly by environmental regulations and therefore does not indicate a general trend of decline in the coal industry globally. The United States and Chinese cases demonstrate that the development of the coal industry can occur in conjunction with environmental protection.

Theoretical study demonstrates that coal alternatives are not as promising as once thought. In the long run, environmental regulations can assist the coal industry to practise sustainable development by compelling it to achieve a more harmonious relationship with nature and humankind. On one hand, these kinds of environmental pressures can serve as a positive motivation to promote the coal industry. The internalisation of costs will ensure that coal is used in a socially effective way, improving environmental standards will optimise the coal industry's structure, environmental regulation systems will facilitate investment decisions, and so on. On the other hand, coal has a potentially positive relationship with the environment and could keep developing in harmony with environmental regulations. Improvements in productivity, technology and other factors will make coal more competitive with other fuels in terms of clean use and price.

In practice, environmental regulations should be tightened to a point at which almost all externalities in the coal industry have been internalised. This will help humankind make rational economic decisions about utilising coal, and in turn will help coal to maximise its contribution to society.

Currently, China's government is dedicated to formulating a free and conservative coal market and trying to liberalise the coal-pricing system, as well as incorporating external and opportunity costs into the price of coal. Such efforts to create a sustainable and optimal use of coal will drive more socially and environmentally friendly development, favourable for the development of the coal industry and for the environment.

### Acknowledgments

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### Notes

- 1 Here, benefits mean improvement in human health, natural beauty and agricultural production, but it cannot include all the benefits. There are two kinds of costs: 1) the high prices generated, and 2) the cost to implement regulations (Tietenbery 2002:29).
- 2 In April 2000, I was part of a team required by Primer to investigate the situation of local state-owned coalmines. In Henan Province, I visited a mine whose operations had been suspended, where duty workers had only porridge to eat every day and retired workers received no pension for more than a year. Many families affiliated with such mines went into bankruptcy.