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Industry as a partner for sustainable development

Coal

World Coal Institute (WCI)

World Coal Institute

Developed through a multi-stakeholder process facilitated by:

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Industry as a partner for sustainable development

Coal

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Disclaimer

In a multi-stakeholder consultation facilitated by the United Nations Environment Programme, a number of groups (including representatives from non-governmental organisations, labour unions, research institutes and national governments) provided comments on a preliminary draft of this report prepared by The World Coal Institute (WCI). The report was then revised, benefiting from stakeholder perspectives and input. The views expressed in the report remain those of the authors, and do not necessarily reflect the views of the United Nations Environment Programme or the individuals and organisations that participated in the consultation.

Contents

Foreword

The World Coal Institute (WCI) has prepared this report on behalf of the coal industry* for the United Nations Environment Programme (UNEP). The document does not represent a position or view of the WCI, except where expressly identified as such.

The purpose of the report is to provide policy-makers, NGOs and coal industry members with information on the progress of the coal industry in implementing sustainable development principles for preparation of the World Summit on Sustainable Development in Johannesburg in August/September 2002. To achieve this goal, the report includes a general overview of coal markets and the structure of the coal mining sector (Part 1).

This report does not seek to measure the overall level of coal industry performance in meeting sustainable development. Instead it recognises, under each of the pillars of sustainable development – economic, social and environmental – how coal use and production contribute (in some cases negatively) to sustainable development (Part 2) and what measures are in place to promote sustainable development (Part 3). Measures for performance improvement (Part 4) are not generally targeted at individual environmental, social and economic issues, but are addressed on the basis of seeking advancement on a broad range of issues across the three pillars of sustainability.

The conclusions in this report are for the industry as a whole and are based on available information – responses to the WCI questionnaire, company health and safety reports and WCI member comments, as well as generally available publications. The WCI questionnaire was based on the UNEP 'Guidelines for Industry Sector Reports' and was distributed to all WCI members, non-member coal companies and other coal mining industry organisations.

WCI is a non-profit, non-governmental association of coal producers and coal consumers. Membership is open to coal producers and coal consumers; WCI is the only international body that represents the coal industry worldwide. Current membership is mainly transnational coal mining companies, with representatives from six continents. For more information regarding the WCI and the coal industry, visit the WCI Web site http://www.wci-coal.com/.

Report drafts have been widely distributed to coal producer organisations and members of WCI. WCI would like to thank all those who contributed comments.

* The coal industry includes coal users as well as coal producers and this is how the term is generally used in this report. However, the report focuses mainly on coal production, since UNEP will be receiving separate reports covering aspects of coal use, including power generation.

Executive summary

The tenth anniversary of the Rio Earth Summit has provided the coal industry (coal producers and coal users) with an opportunity to review its performance in promoting sustainable development. In reviewing the performance of the coal industry, it is pertinent to recognise how coal use and production contribute to sustainable development, identify areas in which the industry has been successful in improving its performance and establish priorities for further action over the next ten years.

Coal plays a crucial role in sustainable development. It is the most widely used energy source in electricity generation and an essential input to most steel production. Coal reserves are abundant and widely distributed around the world, providing an accessible and affordable energy source. All authoritative studies, such as the International Energy Agency's World Energy Outlook show that coal use is set to increase over the next 20 years as the world meets its growing energy needs.

For many developing countries, affordable energy from coal is vital for building internationally competitive industries, and providing basic household services such as lighting, cooking and refrigeration. Unlike oil and gas, coal is easily obtained from a large range of suppliers operating in a competitive market.

The production of coal plays an integral role in the economic and social development of many countries. Coal is an important export commodity for countries such as Colombia, Australia and South Africa. Coal mining is a major source of direct and indirect employment, especially in developing countries where it is essential for alleviating high levels of rural unemployment and poverty. Large scale coal mines are often the biggest source of income for rural communities – in the form of wages and expenditure on locally sourced goods and services – and taxes and royalties on these mines are an important source of government revenue. They often contribute to the provision of economic and social infrastructure – transport, water, education and communications – in their local communities.

Over the last ten years, the coal industry's performance against sustainability objectives has improved significantly in many areas. Most notable among these advances are:

- the development and deployment of higher combustion efficiency technologies that reduce emissions;
- greater involvement in addressing local community development issues, mostly through voluntary agreements;
- broader and more complete integration of environmental considerations into mine management;
- improved transparency and company accountability.

That said, many of the major challenges facing the coal industry at the Rio Summit still exist today. These include climate change and acid rain and the need to transfer best health, safety and environmental management practices to many developing countries.

The extent of, and emphasis on, actions to enhance sustainability have varied between developed and developing countries, reflecting their different circumstances and development priorities. Within the OECD, much more progress has been achieved in improving the social and environmental performance of coal production and use. In non-OECD countries and economies in transition, the main emphasis has been on enhancing the utilisation of local coal resources mainly through government initiatives aimed at closing

inefficient mines and gradually modernising economically viable mines with the help of increased private investment.

The consolidation of the coal mining industry over the past decade, together with the growth in coal trade, has increased the proportion of world coal demand met by transnational mining companies. The mines developed and operated by these companies are large, capital intensive and efficient, and apply the best mining practices available worldwide to minimise the environmental impacts and health and safety risks of their operations. There is an increasing reliance on these companies, through the transfer of good mining practice, to provide global stewardship for the implementation by the coal industry of the principles of Agenda 21.

For the coming decade, there are seven key areas for improvement that the coal industry should address (see box 1). Of these, perhaps the most pressing need is to increase the breadth and depth of understanding of sustainability issues throughout the coal industry and, from this basis, develop leadership within the industry for identifying and achieving necessary change.

Box 1: Key areas for improvement in the coal industry in the next decade (to 2012)

1. Increase the understanding of the principles of sustainable development within the industry and among local mining communities.
2. Build strong leadership within the industry to implement the principles of sustainable development worldwide and foster greater co-operation with multi-stakeholders.
3. Improve the health and safety performance of coal mining, especially in developing countries.
4. Reduce the environmental impacts of coal production and use, especially in developing countries.
5. Further the development and deployment of cleaner coal and carbon capture and sequestration technologies worldwide.
6. Improve the collection, collation and distribution of information regarding environmental, health and safety impacts – with enhanced transparency and recognition of exemplary performance.
7. Demonstrate the effectiveness of voluntary agreements in achieving progress on sustainable development in order to enhance their credibility.

There is also a requirement for greater awareness and concern about sustainability issues at the local coal mining community level. Community education programmes should be extended to encompass sustainable development principles and the effects of consumption choices on sustainability.

Very large gaps exist between the poor coal mining and utilisation practices prevalent in many developing countries, and the best practice standards of health, safety and environmental performance in developed countries (applied in developing countries by transnational companies). The unregulated operation of illegal small-scale mines and the burning of coal in unventilated home fires have serious health and environmental impacts in a number of developing countries. Programmes to bring illegal mines into the formal mining sector and affordable electricity to poor rural households are required.

Promoting cleaner coal technologies (CCTs), including CO_2 disposal, is essential to a balanced, cost effective climate change response (especially in developing countries, where coal combustion efficiencies are low but alternatives to coal-based generation are severely limited). However the inability of deregulated energy prices to reflect energy security considerations, and the failure to take account of life cycle rather than 'burner tip' emissions, are areas of market failure which militate against CCTs and warrant government intervention. Government assistance for research and development (R&D) into CCTs, and their deployment to developing countries, is needed in place of existing fossil fuels subsidies that distort consumption and investment decisions and perpetuate inefficiencies.

The present disparate nature of coal company reporting of health, safety, environment and community (HSEC) performance is a barrier to transparency and accountability and the recognition of good performance by markets, governments and civil society. Large transnational mining companies should lead the way (possibly through the United Nations Global Reporting Initiative) towards an internationally consistent reporting format and the preparation of a triennial global coal industry sustainability performance evaluation.

The members of the World Coal Institute (WCI) recognise the critical importance of adopting and implementing a comprehensive sustainability agenda, in partnership with all stakeholders. To this end, WCI has developed ten objectives/principles to provide a framework for industry initiatives and guide individual action by member companies (see box 2 overleaf).

Box 2: Key principles and objectives of member companies of the World Coal Institute in addressing sustainable development:

1. In addressing the challenges of sustainable development, three basic and inter-related objectives must be met: economic security and prosperity; social development and advancement; and, environmental sustainability.
2. Minerals-based industrial materials and the provision of adequate, reliable and affordable energy are fundamental to achieving these objectives – and for meeting the needs and aspirations of people in both developed and developing countries. Access to energy remains a critical development need, particularly for the one-third of the world's population without electricity.
3. Meeting the sustainable energy challenge on a global scale in the face of rapidly growing energy demand will require innovation and acceleration of technological change across all energy sectors, including coal and other fossil fuels.
4. Coal is the world's most abundant and widely distributed fossil fuel resource, emphasised by the role coal has played in underpinning world economic and social progress. Given the projected strong growth in global demand and the importance of supply security, coal will continue to be an essential part of the world's energy and industrial materials in the foreseeable future.
5. The industry recognises the need to address issues that challenge the role of coal in the transition to a more sustainable society. These include health impacts from the domestic use of coal; environmental impacts from emissions associated with the use of coal; environmental impacts associated with coal production; and economic and social contributions during, and at the conclusion of, mining activities.
6. In addressing these issues and to give practical effect to sustainable development, the coal industry has identified five key actions:

   - minimise coal production impacts on the biosphere (land, water) and on local communities;
   - improve the technical and economic efficiency of energy conversion, thereby minimising resource use;
   - significantly reduce 'per unit' emissions from the production and use of coal;
   - contribute to the efficient and beneficial transfer of new and advanced cleaner coal technologies to enhance their global uptake and to assist in meeting the needs of developing countries (recognising their legitimate development aspirations and the low energy efficiency of existing thermal plant);
   - support by individual coal companies for community development initiatives to address local sustainability issues, providing enhanced economic and social opportunities relevant to the location and scale of their operations.

7. Continuing reductions in emissions through accelerated technology improvement and transfer are the key to effective, least cost solutions to sustainability and climate change issues, and is the industry's major priority for the future. Past improvements – including significant increases in thermal efficiency and reductions in sulphur and nitrogen oxides (SOx, NOx) and particulate emissions – need to be more broadly adopted and enhanced. Coal also has a valuable role in improving the efficiency of other energy sources (including renewables) through synergies from combined activities, which need to be understood and applied.

8. Life Cycle Analysis (LCA) provides greater transparency and understanding of the full environmental performance of energy and materials alternatives – and illustrates that differences in GHG emissions between coal and its alternatives are significantly less than conventional burner tip analysis has indicated. A number of new research initiatives hold great promise to significantly reduce GHG emissions from coal use, while options such as production of hydrogen from coal to provide a cleaner energy source, and emissions capture, are longer-term prospects.
9. The particular needs of developing countries must be addressed through practical programmes for the transfer of the most up-to-date commercial technologies, electrification, and modern combustion systems for domestic household use of coal as a transition to broader distributed and reticulated grid energy systems. Priority must be given to overcoming existing unsafe domestic use of non-commercial forms of energy, which pose adverse environmental impacts and health risks.
10. Policy responses must be flexible and recognise that there is no one single solution to the sustainability challenge. Effective, least cost outcomes will need markets to operate with minimum distortion, and to encourage innovation and eco-efficiency in creating enhanced economic value with reduced environmental impacts.

Part 1: The coal market and coal mining industry structure

Coal has been used as an energy source for hundreds of years; there was international trade in coal as long ago as the Roman Empire. Coal not only provided the energy that fuelled the industrial revolution of the 19th century, but it also launched the electric era of the 20th century.

The process of forming coal has taken many millions of years. Coal is buried prehistoric vegetation that has been subjected to elevated temperatures and pressures, which has caused physical and chemical changes. Initially peat, the precursor of coal, was converted to lignite or brown coal – coal types with low organic 'maturity'. Over many more millions of years, the continued changes transformed lignite to sub-bituminous coals. This process continues to produce hard coals (bituminous) and anthracite.

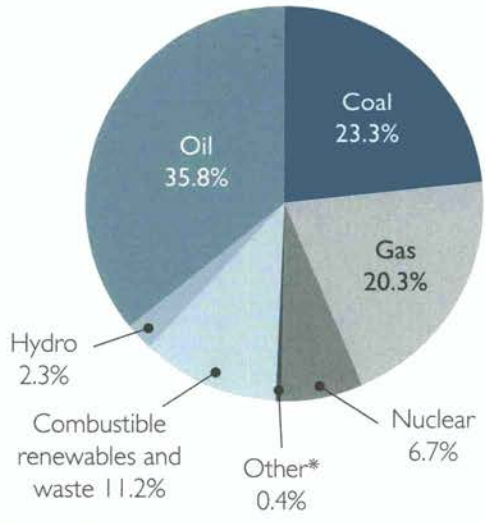
The degree of 'metamorphism' or coalification undergone by coal, has an important bearing on the physical and chemical properties of coal and is referred to as the 'rank' of coal. Low rank coals, such as lignite and sub-bituminous coals, are typically friable materials with a dull, earthy appearance; they are characterised by high moisture levels and a low carbon content. Higher rank coals are typically harder and stronger and have a higher energy and carbon content and lower moisture levels than low rank coals.

1a The coal market

1a (i) Coal consumption

Coal supplies 23% of world primary energy (figure 1) and around 60% of coal use globally is for electricity production (IEA 2000a). Coal is the most important fuel for electricity generation worldwide – 38% of global

Figure 1: Total world primary energy consumption, commercial and non-commercial sources, 1998



* Includes solar, wind, heat, geothermal etc.
Source: IEA 2000a

electricity generation – and also plays a vital industrial role as a reductant in steelmaking – 70% of global steel production. Many countries rely heavily on coal in electricity generation (table 1); for example, coal fired electricity comprises more than 80% of total electricity generation in Australia, China, Poland and South Africa.

Coal use in steel production (around 10% of total coal consumption) is becoming less important to total coal demand and this trend is likely to continue in the future. In OECD countries for example, coking coal production (coal used primarily for steel making) as a share of total coal production has fallen from around 14% in 1980 to around 11% in 2000 (IEA 2001a).

The falling dependence of steel production on coal is due mainly to increased rates of steel recycling (that does not require coal), efficiency improvements in blast furnace technology – gains in economies of scale, greater use of pulverised coal technologies and more effective use of exhaust heat. For example, in Germany coal consumption per tonne of steel produced has fallen from 795kg/tonne of hot metal to 501kg since 1960 (WCI, 2000). In the future, the deployment of new technologies that by-pass the blast furnace altogether – direct reduction of the ore – are likely to reduce the reliance on coal further (IEA 2001a).

Worldwide consumption of coal breaks down as follows: OECD economies 51%, transition economies 9% and developing economies 40% of total hard coal consumption (table 2). The largest consumers of coal are the United States, China, EU15, India and Russia, which together comprise around 70% of total coal consumption. On the whole, coal demand is mainly met through the consumption of domestically produced coal, although Japan and South Korea, two large consumers of coal, rely almost entirely on imports.

Coal consumption has fallen by around 0.4% a year on average between 1990 and 2000. This reduction is driven mainly by a more than 5% reduction in coal consumption in the former USSR and eastern Europe, due primarily to economic restructuring, and a fall of around

Table 1: Coal fired electricity as a share of total electricity generated in selected countries, 2000

Country	%
Poland	96
Czech Republic	71
Greece	64
Denmark	52
Germany	51
The Netherlands	42
EU15*	25
United States	56
Australia	84
India	66
China	80
South Africa	90

*1999 data
Sources: IEA 2001b, BP 2001 and Simpson, Spence and Young 2001

Table 2: Global coal consumption*				
	1990	2000	Average annual growth rate 1990 to 2000	Share of world consumption 2000
	Mtce**	Mtce	%	%
OECD				
United States	689	806	1.6	25.8
EU15	421	299	-3.4	9.6
Poland	115	82	-3.3	2.6
Australia	56	67	1.7	2.1
Japan	109	141	2.7	4.5
South Korea	35	61	5.8	2.0
Other	131	125	-0.5	4.0
Total	**1,555**	**1,581**	**0.2**	**50.6**
Former USSR and eastern Europe				
Russia	258	158	-4.8	5.1
Ukraine	107	55	-6.4	1.8
Kazakhstan	57	33	-5.3	1.1
Other	57	32	-5.7	1.0
Total	479	278	-5.3	8.9
Developing countries				
South Africa	102	117	1.4	3.7
China	762	686	-1.1	22.0
India	152	233	4.4	7.5
Other	193	228	1.7	7.3
Total	**1,209**	**1,264**	**0.4**	**40.5**
Total world	**3,243**	**3,123**	**-0.4**	**100.0**

* Includes hard coal and low-rank coals. ** Million tonnes of coal equivalent.
Source: BP Statistics 2000

20% in consumption in China since 1998, which has been ascribed principally to the upgrading of coal-fired power plant. Coal consumption in the OECD and developing countries has risen by 0.2% and 0.4% respectively.

Generally, the greater growth in coal consumption in developing countries is a result of higher rates of economic growth, increasing rates of electrification, and a substitution of gas for coal in electricity generation in developed economies (especially within EU15 countries).

Global energy needs are projected to continue to grow at an average annual rate of 2% to 2020 (IEA 2000b). Much of the increase in global energy use is expected to occur in developing countries due to a high energy intensity of output coupled with strong economic growth and increased rates of electrification. Coal is projected to play an important role in meeting this growth in energy demand, with demand increasing by around 1.7% a year (IEA 2000b).

The IEA (2000b) projects that 70% of the increase in coal demand to 2020 will come from non-OECD countries, mainly from China and India for power generation. Coal demand from OECD countries is projected to rise by only 0.3% a year, because of intensified competition from gas fired electricity and the retiring of old coal fired power plants in Europe.

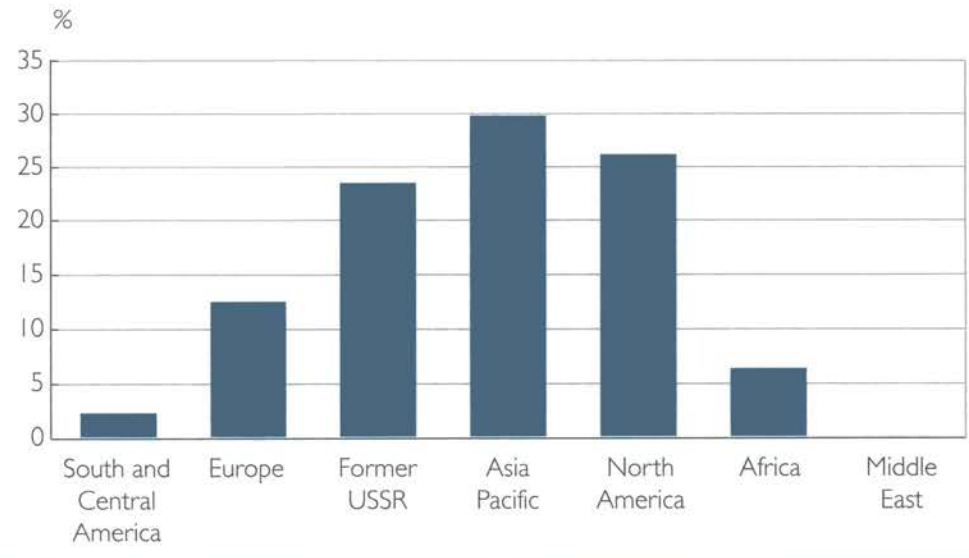
1a (ii) Coal production, trade and prices

A key feature of coal is that its abundant reserves are widely distributed (figure 2), with no concentration of reserves in any one region – unlike oil in the Middle East and gas in Russia. Coal reserves are shared roughly equally between Asia Pacific, North America and the former USSR (around 23% to 30% of global reserves) and commercial production takes place in over 50 countries around the world. At current production and proven reserve levels, coal supplies would last around 200 years – four times and six times as long as gas and oil supplies respectively (figure 3).

Because coal production mainly services domestic demand, the largest producers of coal are countries with ample domestic supplies, in highly populated countries where coal is used widely in electricity generation, such as in China and the United States (table 3 on page 18). Production of coal between OECD and developing countries is roughly equal (47% versus 44%) with the remainder from the former USSR and eastern Europe. Between 1990 and 2000, the greatest increases in production have occurred in Australia, Indonesia and Colombia due largely to increased exports.

Because of the expense of transportation, most traded coal is hard coal, which has higher value and energy content. Coal trade, especially seaborne trade in hard coal, has on average risen by around 4% a year since 1970, with the growth dominated by the trade in steaming coal (used mainly for electricity generation). The initial growth in coal trade during the 1970s was due to strong growth in steam coal demand as coal widely replaced oil in electricity generation as a result of oil price rises (IEA 1997).

Figure 2: Coal reserves by region as a share of global reserves (2000)

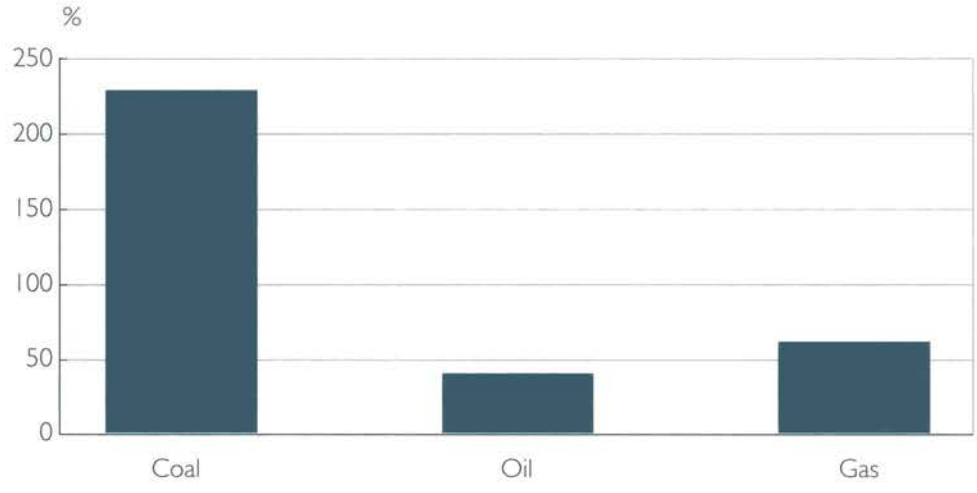


Source: BP Statistics 2001

More recently, the growth in steam coal trade has been driven by greater imports from Japan, developing Asia and Latin America where there are inadequate domestic reserves to meet growing demand. The largest coal exporters are Australia, South Africa, Indonesia, the United States, China and Colombia.

Coal trade growth, buoyed by strong growth in Asia and the United States, is likely to continue over the medium and long-term. To 2020, thermal coal trade is projected to rise by around 50% (DRI WEFA 2001), with approximately 80% of this growth coming from increased imports from Asia. Despite China's recent increase in thermal coal exports, it is expected that Australia will remain the dominant exporter to Asia and will fill much of the increased import demand from Asia in the medium and long-term. A key market development expected over the medium and long-term is the emergence of Colombia and Venezuela as growing exporters to the United States and Europe, providing greater competition for traditional exports from South Africa into these markets (DRI WEFA 2001).

Figure 3: Reserves to production ratio, in years (2000)



Source: BP Statistics 2001

Table 3: Global coal production*				
	1990	2000	Average annual growth rate 1990 to 2000	Share of world production 2000
	Mtce	Mtce	%	%
OECD				
United States	802	815	0.2	26.7
EU15	298	139	-7.3	4.6
Poland	135	97	-3.2	3.2
Czech Republic	52	33	-4.4	1.1
Turkey	25	35	3.5	1.2
Australia	152	222	3.9	7.3
Other	93	77	-1.9	2.5
Total	**1,558**	**1,419**	**-0.9**	**46.5**
Former USSR and eastern Europe				
Russia	252	165	-4.1	5.4
Ukraine	120	60	-6.7	2.0
Kazakhstan	97	55	-5.5	1.8
Other	24	16	-4.1	0.5
Total	**492**	**296**	**-5.0**	**9.7**
Developing countries				
Colombia	21	39	6.4	1.3
South Africa	132	170	2.5	5.6
China	775	711	-0.8	23.3
India	148	220	4.1	7.2
Indonesia	9	68	21.8	2.2
Other	141	130	-0.8	4.2
Total	**1,226**	**1,338**	**0.9**	**43.8**
Total world	**3,276**	**3,053**	**-0.7**	**100.0**

* Includes hard coal and low-rank coals.
Source: BP Statistics 2000

Coal's abundance, wide distribution and ease of transportation ensure that the price of coal is determined in a competitive market. Over the last ten years, despite growth in coal demand, average annual increases in mine productivity of around 9% (IEA 2001a) from improved technology and economies of scale have driven market prices steadily downward (figure 4). The competitive and stable supply conditions in the coal market over the last ten years have shown coal to be a relatively low cost and risk free energy source compared with oil and gas.

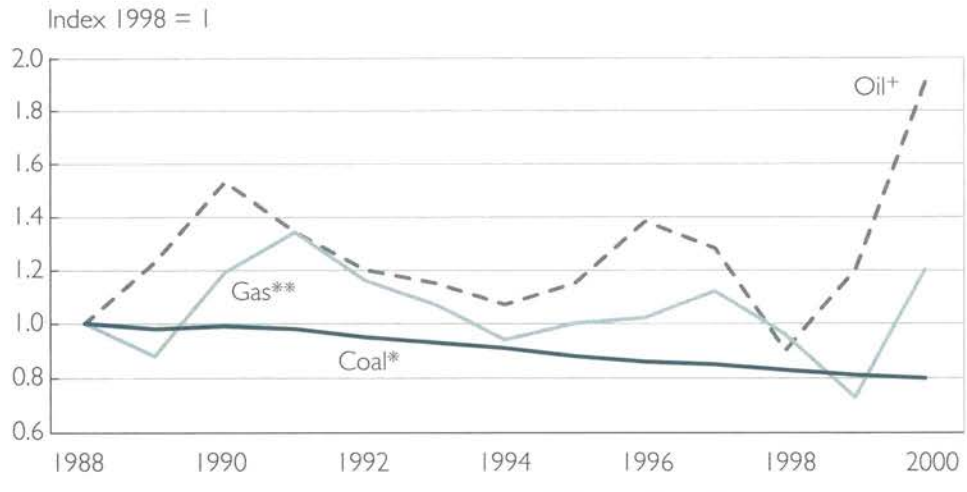
Falling coal prices from 1996 to 1999 (6% to 8% a year in real terms) have created a tight coal market as new mining projects were put on hold and high cost capacity was closed. This, together with strong thermal coal demand in electricity generation, due to high gas prices, is projected to increase prices in the short-term (Maurer 2001). However, strong competition and further productivity improvements will contribute to a continuation of the long-term downward trend in prices (Maurer 2001).

1b Structure of the coal mining industry

The structure of the coal mining industry can be broadly divided into large scale mining operations and medium to small scale operations. There are no data available to quantify the contribution of coal production from medium to small scale mines. However, the contribution of this type of mining to total coal production is minor – probably less than 15%, taking account of overall production levels in the countries in which this type of mining occurs and the closure of inefficient small and medium scale mines as part of recent coal mining industry adjustments.

Large scale mining can be defined as capital intensive mining that is conducted mainly by large multinational mining companies. Large scale mining operations generally operate in developed countries to meet export and domestic demand or in developing economies for export to developed economies. Such large scale mining is generally subject to intensive competition (from imports, in the export sector and/or against other energy sources).

Figure 4: Prices of coal, oil and gas



* Prices based on receipts from United States electricity utilities for steaming coal. ** EU cif prices.
+ West Texas intermediate prices.
Source: BP 2001

Small to medium scale mining is more difficult to define. A small scale mine generally employs less than 100 people, with limited capital or sometimes only rudimentary equipment and produces no more than 250,000 tonnes (ILO 1999). Medium scale coal mines are generally somewhat protected from competition (government protection and or natural protection because of the high transport costs of imports), frequently government owned, with low productivity, high labour intensity (compared with large scale mining) and outdated technology.

For an overview of the mining sector in key coal producing countries, refer to the country briefs in section 1b(iii).

1b (i) Large scale mining

A number of changes to the coal market over the last ten years have dramatically increased the price competition faced by the coal mining sector. Typically, the increased competition has come from:

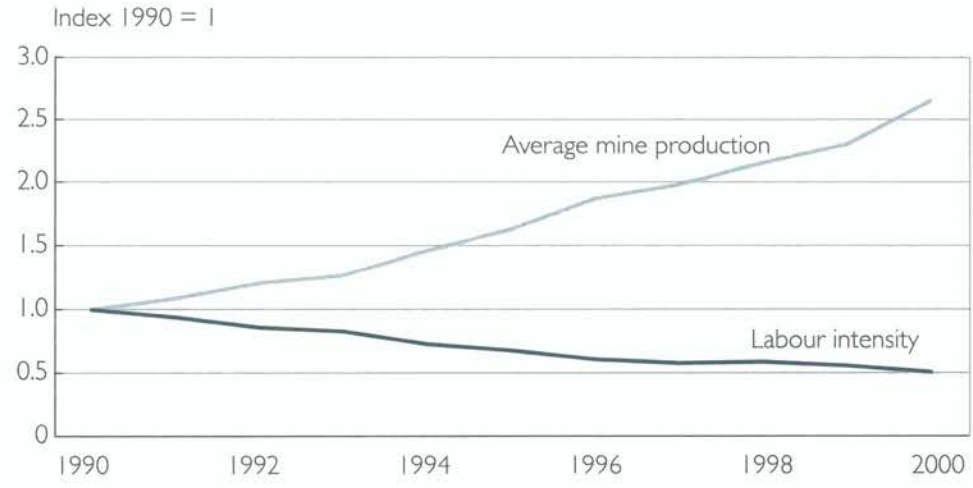
- greater international coal trade, especially from the emergence of new exporters such as Indonesia and China;
- reduced shipping costs;
- increased availability and competitiveness of alternative energy sources such as gas;
- liberalisation of electricity markets and international trade;
- development of coal spot market trading.

Increased price competition in energy markets in developed economies has driven the push towards lower production costs and larger scale mines with high capital costs to take advantage of economies of scale in mining. Figure 5 shows the reduction in labour intensity and average mine productivity in the United States over the last ten years.

1b (ii) Small and medium scale mining

Small to medium scale mining generally occurs in developing countries and transition economies, where price competition and access to capital are limited. In many large coal producing countries, such as China, India, Russia and Poland, the government still plays a large role in mining operations, often setting long-term production goals and prices and underwriting losses. However, increasingly, coal

Figure 5: Average United States coal mine production and labour intensity



Source: IEA 2001a

mines from these regions are being opened up to competition and governments are in the process of reducing or removing production subsidies, closing high cost mines and encouraging private involvement in expanding and modernising viable medium scale mines. For regions where coal mining is an important source of employment, such as Poland and Russia, private involvement and deregulation is being met with resistance.

In impoverished rural areas, small scale mining persists at a subsistence level, and will continue to persist, where there are few avenues for local employment, despite reductions in support for legal mines and increased competition from imported coal. Small scale coal mining takes place in areas where labour costs are extremely low and where coal provides the only source of energy. Often these small scale mines are illegal and operate with no regard for health and safety or the environment (refer to section 2b (i) and 2c (i) regarding health, safety and environment impacts from small mining). Workers in these mines generally use rudimentary equipment, are poorly educated with few skills and are often children or women.

On a global scale, addressing poor performance in small scale mines is akin to addressing accidents and deaths in amateur fishing. Fish captured by amateurs and coal from small scale mines comprise only a small share of the global catch and production respectively. Yet the incidence of accidents and deaths from amateur fishing and small scale mines far outweighs the incidence from large scale professional fishing and mining. In both cases, behaviour in these small scale operations is difficult to regulate because monitoring compliance with regulations is costly – they are widespread and often intermittent. More effort is required to improve both awareness and performance, particularly by national and local authorities, where these practices are prevalent.

In many cases, governments have tried to bring illegal small scale coal mines within the reach of domestic mining laws or have attempted to close them. However, lack of resources to inspect and police small mines, especially in remote areas has meant that these efforts have had little success in improving conditions. In some cases, there is a lack of political will to regulate small illegal mines because they provide an important source of employment for rural communities.

Ib (iii) Coal mining in key countries

China

China is the second-largest producer and consumer of coal in the world behind the United States. There are three types of coal mines in China – state-owned mines, town- and village-owned and operated mines, and provincial government mines. State-owned mines account for around 57% of total coal output – up from 40% in 1998 (China Web 2001). These are typically large mines that have historically supplied local electricity and state-owned industrial enterprises. Operation of these mines shifted in 1998 from the central government's Ministry of Coal to the provincial, regional or municipal governments. The central government, as of 30 June 2001 has ordered that all small state-owned mines are to close, in order to reduce the frequency of mine accidents.

Town and village enterprises are generally small scale mines that often have no legal status and have poor health and safety standards (see section 2b (i) for more details). These mines are generally below ground with little or no safety equipment. In 1998 around 40% of total coal production was from small scale mining and over 70% of the production was from the 51,000 illegal mines (ILO 1999). Coal from these mines has been responsible for over two-thirds of coal production growth in China between 1985 and 1996 (Schneider et al. 1999). Poor environmental health and safety performance of these mines and over supply in the domestic market prompted the

central government to earmark 23,000 of these mines for closure in 1999. Together with the closure of 14 bankrupt state-owned mines, small mine closures reduced production in China by 17% in 1999 relative to 1998.

As of 30 June 2001, the Chinese government has ordered that all illegal town and village small scale coal mines are to close and that all small scale enterprises that hold mining permits are to close until they meet government safety standards. The programme has seen 5,117 small scale mines close this year, but despite increased raids on illegal mining operations, many small scale illegal mines continue to operate (Times Asia, 2001).

In many remote and desolate provinces, such as Guizhou, small scale enterprises are secretly kept open because the mines offer the only source of income for miners. The increased prices being reaped in the domestic coal market (due to lower domestic supply associated with lower production and shifting coal to the export market) is likely to entice many illegal mines to remain open despite government efforts.

Production from local government mines makes up the remainder of coal production, in 1996 it was estimated to comprise around 16% of total production.

The Chinese government is also undertaking reform to improve the performance of domestic coal mines. This has included reducing the level of subsidies underwriting loss-making state-owned firms and increasing foreign investment in the coal mining industry. Foreign investment has been funnelled into the upgrading of existing large scale state-owned mines and into the development of new mines. These developments will help to facilitate China's growing coal exports that have risen from 32mt in 1997 to 55mt in 2000 (IEA 2001a).

The China National Coal Import and Export Corporation is the primary Chinese partner for foreign investors in the coal sector. Areas of interest for foreign investors have so far concentrated on new technologies (only recently introduced in China) or projects with environmental benefits – coal liquefaction, coal bed methane production, and slurry pipeline transportation projects. Over the longer term, China plans to aggregate the large state coal mines into seven corporations by the end of 2005. Such firms might then seek to pursue foreign capital through international stock offerings.

Indonesia

Indonesia exports around 77% of its coal production (mainly steaming coal). Of total exports, around 70% is from four large scale mines, three of them operated by foreign-owned companies (McMahon et al. 2000) that commenced mining after the reform of mining legislation in the mid-1980s. The largest of these mines is the Kaltim Prima open pit mine (Kalimantan region), jointly owned by Rio Tinto and British Petroleum (BP). In 1999 this mine produced 14mt of thermal coal for the export market (over 30% of total Indonesian exports).

Production of medium scale mining accounts for around 30% of total production. The bulk of the coal from medium scale mines is from two state-owned mines (PT Tambang Batubara Bukit Asam) which is mainly used for domestic electricity generation; the rest (two million tonnes in 1998) is for export. Authorised medium scale, domestically-owned and run mining companies contribute around 6% of total Indonesian coal production. There are more than 100 of these authorised companies, most however, are not active, but could provide significant potential for future growth in production if coal prices were to rise in the future.

It is difficult to estimate the contribution of small scale mining to national production, however, it has been estimated that

production from this sector was around 9% of the total value of coal produced in Indonesia in 1999 (McMahon 2000). The number of small scale mines has increased since the Asian economic crisis. People have moved into small scale coal mining, often illegally, to improve their incomes through increased returns to coal production associated with the devalued rupiah. This trend has been enhanced by the availability of equipment, at low rents, from the moribund construction sector in Kalimantan (McMahon 2000). To date, there has been little action to prevent illegal mining due to the general sympathy of the government towards people trying to survive the post-crisis period.

Indonesia is currently amending existing mining regulations that will, among other things, give local governments greater responsibility for regulating mining and will inevitably change the attractiveness of mining investment across regions within Indonesia.

India

India is the third-largest producer of hard coal in the world. The Indian government controls almost all coal production (around 90%) under a holding company, Coal India Ltd (CIL) which has seven main subsidiaries. Among these subsidiaries, the largest is the South East Coal Fields India (SECL), with around 23% of total production. CIL, the largest coal company in the world, was formed in 1972/1973 to nationalise the coal mining industry, in response to poor environmental and safety records of privately run mines and to develop coal mining for industrialisation and economic growth.

At present, private mines are only allowed to operate if they exist specifically to supply a particular end use, for example a coal fired power plant. The government, under its Integrated Coal Policy, is hoping to allow new private investment (Indian companies only) in new coal fields without the constraint of selling to a captive market in the near future. CIL is responsible for forming corporate objectives, approving and monitoring performance of subsidiary companies in the fields of long-term planning (production goal setting), conservation, research and development, sales, pricing finances, recruitment, training, safety, industrial relations, wages, material management, etc.

Although there are over twice as many underground mines as open cast mines, over 80% of coal production in India is from opencast mines, generally in the central south and east of the country. There are 561 coal mines in India, with only a few of these mines being large scale operations (with over 10mt in production). Underground mining methods are limited to conventional board and pillar, with limited use of modern longwall techniques.

India relies heavily on coal to meet its domestic electricity generation requirements (around 70%) and because of the abundance of coal in India and limited infrastructure to support import capacity, future demand for coal is likely to be met mostly from increased domestic production. However, to meet growing domestic demand, India requires urgent capital investment to increase mining capacity and to improve the productivity of existing mines. Part of the capital requirements will be met through a USD1,060 million loan from the World Bank and JEXIM Bank.

South Africa

South African coal reserves are concentrated in three coal fields – Waterberg, Witbank and Highveld (around 70%) – and are mainly bituminous, with relatively high ash content and low sulphur content. Around 60% of coal production takes place in underground mines; the bulk – just under 50% of coal production (South African Chamber of Mines 1996) – using mainly board and pillar mining techniques. The share of coal from underground mines is likely to increase in the future as easily accessible reserves become depleted, especially in Witbank, the country's largest coal producing area (48% of total production).

Around a third of production is exported, mainly to Europe. Exports rose at around 4% a year during the 1990s, due mainly to a large depreciation in the rand. This is unsustainable in the long-term as mine input costs rise and/or there is an appreciation of the rand against the domestic currencies of export competitors. The rand depreciation has increased the costs of imported mine inputs such as diesel and mining equipment (especially in open cast mines) and despite productivity improvements, mine costs have risen between 6% and 8% in 1998 and 1999 (South African Chamber of Mines 2000).

Coal production is dominated by four companies, Anglo American (Anglo Coal), BHP Billiton (Ingwe), Glencore (Duiker) and Sasol – with 87% of total production (IEA 2001b). In accordance with South Africa's Energy White paper, Anglo Coal and Ingwe have made room, through the sale of assets, for black owned companies, known as 'black empowerment' companies. Eyesizwe (previously known as New Coal) – a joint initiative between these two companies, with Anglo retaining a 11% holding and Ingwe 9% – is a black empowerment company and is now one of the largest coal companies in South Africa.

South Africa has seen considerable consolidation and globalisation of its coal mining operations over the last five years. This trend has continued, with Glencore buying out Duiker Mining, giving the ABG consortium control over 80% of South Africa's coal exports (IEA 2001a). The ABG consortium also owns 85% of the Richards Bay terminal, through which almost all of South Africa's coal exports are shipped (IEA 2001a).

Colombia

Most of Colombia's coal reserves are high quality bituminous coals that are relatively clean burning, with a sulphur content of less than 1%. Coal mining in Colombia is made up of two sectors, modern large scale open cast mining operations in the north (La Guajira and Cesar) and traditional small to medium-sized block caving mines in the Andes Mountains. Approximately 90% of Colombian coal production is from the north and is almost solely destined for export markets in Europe and the United States. The northern mines are located close to shipping terminals and produce high quality coal, making coal from this area highly attractive to export markets.

Outside the north, small scale mines, which make up the majority of coal mines (and coal miner employment) in Colombia, service domestic demand, mainly power generation. Of these around 1,000 mines (or around a third) are illegal (Bula 2000) and are generally underground operations that use explosives and manual implements.

Currently mining titles in Colombia allow individuals or companies the right to explore or exploit mineral resources. A third title 'Aporte' gives state-owned enterprises the right to directly explore or exploit mineral resources or can grant contracts to third parties. Since 1992, the Colombian government formed a policy of disengagement from direct participation in mining activities. Much of the investment that funded the growth in coal exports over the last ten years came from foreign-owned mining companies.

One of the largest coal mining operations in Latin America, the Cerrejon Norte project, is now owned 50/50 by ExxonMobil's Intercor and a consortium of coal producers known as Carbones del Cerrejon (Anglo American, BHP Billiton and Glencore) which purchased the former state-owned Carbocol. Cerrejon Norte hosts one of the largest open pit mines in the world and produces over half of Colombia's total coal production. The large projected increase in coal exports and production over the medium-term will require increases in foreign private sector investment.

Poland

Most coal produced in Poland is hard coal (83%) mainly from underground mines in the Upper Silesian Basin (96% of hard coal production). Coal from this region is produced by six state-controlled companies that operate 38 mines. Around a third is exported to Europe and the former USSR (IEA 2001a). The remainder is for domestic electricity, heat and steel production. Poland is highly dependent on coal fired electricity which accounts for 95% of total electricity production (IEA 2001b) and the coal mining sector contributes almost 4% of GDP (World Bank 2001a). A difficulty facing coal extraction in Poland is the volume of groundwater that must be removed (refer to section 2c (i) for a discussion on environmental impacts of mine water discharge).

Coal production in Poland has historically been characterised by loss-making mines that were underwritten by subsidies and long-term agreements with domestic customers. Despite reform in the early-1990s that included the removal of subsidies and mine closures, many high cost mines remained.

In 1998 the government announced the commencement of more stringent reforms in the coal sector that includes closing up to 30 of Poland's 53 hard coal mines by 2002 and privatisation of the most profitable coal mines. By the completion of the programme, it is estimated that as many as 30 of Poland's 53 hard coal mines will be closed with a 26mt reduction in production capacity (World Bank 2001a). Since 1998, rationalisation has led to a small reduction in coal production and a rise in productivity (measured as output per worker) of 28% (IEA 2001a).

Reform has met strong resistance, because of the importance of coal mining to employment in Poland and the strength of the coal mining unions. To assist in the adjustment process, the World Bank initially provided a USD30 million loan in 1999 (World Bank 2001a) which has been extended to USD100 million in 2001. Much of this loan will go towards re-employment schemes for miners from closed mines. At present, the Polish government has nominated two coal mining companies for privatisation but privatisation remains a controversial issue.

Russia

Russia produces both hard and low rank coal, with reserves split roughly 50/50. At the beginning of 2000, there were 220 widely dispersed coal mines operating in Russia, around half of these were open cast mines. The main coal producing area in Russia is the Kuzbass in West Siberia (approximately 44% of total production), where both hard coal and low rank coal are produced in open cast and underground mines. The other main producing areas are Kansk-Achinsk in central Siberia (15% of production) and East Siberia (14% of production). Coal reserves in Russia are generally far from major population centres or export terminals. As a result, transport of coal to consumers is costly (IEA 2001a) and exports comprise only around 15% of total production (IEA 2001a).

The severe reduction in coal consumption in Russia following the break-up of the former USSR, poor mine management and increased transportation costs, forced government subsidies to unacceptably high levels in the early-1990s – over 1% of GDP (World Bank 1994). This prompted the government, supported by the World Bank loans for adjustment, to undertake two waves of reform in the Russian coal mining sector. The first wave began in 1996 with large scale closing of uneconomic mines that led to reduced coal production.

The second phase, currently under way, is striving to attract private investment to modernise existing mines and develop new mines that can be competitive in the international market. The World Bank has guaranteed investors in the Russian coal mining industry against government actions

that would negatively affect returns on investment up to USD10 million per transaction.

Restructuring is producing results, today almost half of the country's coal comes from privately-owned mines and the sector's productivity between 1994 and 1999 increased by 77% (World Bank 2000).

Australia

Australia is the world's largest coal exporter. Around 70% of Australian coal production is hard coal (with a roughly equal share of coking and thermal coal) for the export market (IEA 2001a). Australian hard coal production for export and domestic use is concentrated in the states of New South Wales and Queensland, two thirds of which is from underground mines. Brown coal is produced in Victoria from open cast mines (around 10% of total coal production in Australia) and is used mainly for electricity generation.

Coal mines in Australia are predominantly owned by large mining companies (around 90% of total capacity) and include mining companies such as BHP Billiton, Anglo Coal, Glencore, and Rio Tinto. The largest is BHP Billiton, a recent merger between the Australian BHP and United Kingdom's Billiton, produces around a quarter of all Australian hard coal production. Ownership of Australian coal mines has undergone some consolidation in the last few years. In 2000, 12 firms controlled 90% of coal production capacity, down from 14 the previous year (IEA 2001a). It is likely that two additional large firms will complete their exit in the course of this year (IEA 2001a).

The competitiveness of Australian coal exports has increased over the last ten years due to improvements in mine productivity. Australian coal mine productivity is the highest in the world measured in output per employee hour (IEA 2001a). Improved mine competitiveness, together with the recent depreciation of the Australian dollar and growth in demand from Asia (especially in South Korea and Japan) have resulted in a 6% a year increase in exports on average since 1990. There are plans under way to increase export mine capacity and port facilities to cater for the 1.7% a year average increase in exports projected to 2020 (IEA 2001a).

United States

The United States is the largest producer and consumer of coal in the world and it has the largest reserves of coal of any country (around a quarter of total global reserves). Around 90% of coal mined in the United States is sold to local electricity power plants. Hard coal accounts for around 95% of total coal production (IEA 2001a). Over the last ten years, production in the west of the Mississippi, mainly in open cast mines, has grown at a faster pace than in the east, overtaking the east in 1998. Restrictions on sulphur emissions from coal combustion have favoured relatively low ash, low sulphur coal from the west, while liberalisation of rail transport, which has reduced intra-national freight costs, has led to further substitution, again towards relatively low cost coal from the west at the expense of coal from the east.

The largest coal producing areas are the Powder River Basin in the west, Central and Southern Appalachia and Northern Appalachia in the east (around 80% of total production). The open cast mines in the Powder River Basin are among the largest in the world. Around 93% of the production from this area comes from mines controlled by five large mining companies – Rio Tinto, Peabody, Arch Coal, RAG and Vulcan Partners. In the Central and Southern Appalachian mines, 59% of production is from underground mines, although there is a trend towards more surface mining.

There is also a high concentration of ownership of mines in Central and Southern Appalachia, with the top six companies

controlling around 51% of production – A.T Massey, AEI Resources, Arch Coal, CONSOL, James River Coal and Peabody (IEA 2001a). In Northern Appalachia, the third largest producing region, underground mining accounted for around 75% of production. Underground mining is on the increase in Northern Appalachia due to the depletion of surface reserves. In 2000 over 50% of production was from three mining companies – CONSOL, RAG and Robert Murray.

Due to strong competition from Australia, South Africa and Colombia in the international market, coal mines in the United States primarily serve domestic demand. However, flexible capacity in many mines with port access, especially in Central and Southern Appalachia, allows producers to increase production to service the export market during times of high prices. Low international prices for coal in the late-1990s and increased competition have reduced coal exports since 1995.

United States exports are projected to remain stagnant for the next 20 years (IEA 2001a). However, concerns over national energy security combined with the low cost of coal fired electricity are projected to maintain coal's dominant position in United States electricity generation over the next 20 years. In response to concerns of global warming, President Bush has committed USD2 billion in R&D for cleaner coal technologies.

1c Conclusions

Coal is by far the most abundant fossil fuel and its reserves are distributed widely making coal a highly available energy source. Unlike oil and gas, the international market for coal is characterised by many exporters, ensuring a secure supply of coal at competitive and stable prices. Improvements in mine productivity have reduced the price of coal over the last ten years and continual improvements will reduce the price further in the long-term.

Over the last ten years there has been a large increase in the competitive pressures facing coal mining, due mainly to greater international coal trade, energy market liberalisation, the development of gas resources and the development of the coal spot market. As a result, there has been, and still is, industry adjustment towards larger capital intensive mines to take advantage of economies of scale.

In developed countries such as Australia and the United States where there has been little protection from market forces, this process is mature and large-scale mining operations dominate. For economies in transition and developing economies, this process is in full swing (but to varying degrees) and there is a great deal of adjustment under way. In some developing countries, such as South Africa and Colombia, industry reform, combined with suitable economic conditions for export, has attracted foreign investment and hence large scale mining dominates production.

Part 2: Coal and sustainable development

2a Economic development

The coal industry's contribution to economic development has two dimensions, one associated with coal mining, the other with coal use. Electricity generation and iron and steel, both highly dependent on coal, are vital for economic development. Coal mining activities provide export earnings for domestic economies and, at the same time, generate employment – in mining and dependent services – for local communities.

The terms economic development and economic growth are often interchanged. For this report, economic development is used to describe continued economic growth.

2 a (i) Coal mining

Employment

Despite dramatic improvements in labour productivity over the last 20 years, coal mining is still a labour intensive exercise. In all, coal is estimated to employ over seven million people worldwide, around 90% of these are employed in developing countries and five million in China[1]. In a given region, the intensity in which labour is employed generally depends on the extent of small and medium scale mining and the capital intensity of mines.

For example, China has the highest labour intensity – 5,000 workers per million tonne of coal mined – because of the significant contribution of small and medium scale mines to total coal production. Australia, a country with extensive large scale mining and a high capital intensity, has the lowest labour intensity – 76 workers per million tonne (table 4).

Coal mining generally takes place in rural areas where unemployment is high compared with urban areas. In these areas, coal mining and

Table 4: Employment statistics* in key coal producing regions

Country	Employment (thousands)	Employment per Mtce of output
Australia	17.7**	76
United States	77.0**	96
Canada	6.6**	118
United Kingdom	7.7**	241
South Africa	53.8**	298
Indonesia	54.5**	861
Russia	197.0**	1,195
Poland	158.0**	1,561
Colombia	40.0+	1,333
India	456.0++	2,171
China	5,000.0^	5,501

* The statistics are the latest available, generally they are for 2000, but in some cases they are for 1999

** IEA 2001a

+ Straight Goods 2001

++ Ministry of Labour India 2001

^ China Labour Bulletin 2001a

(1) Due to the large numbers of coal miners employed outside the official mining sector, it is difficult to estimate the exact number employed in Chinese coal mines.

associated industries are generally one of (if not the) largest employers in the district and, in commercial mining enterprises, often offer the highest wages. Small scale mining in developing countries provides income for many poorly educated and unskilled people in remote and impoverished areas. Work from small scale coal mining can provide a reliable source of employment during times of drought, flood or economic hardships (such as the Asian economic crisis) in these remote areas.

Not only does coal mining directly employ millions worldwide, but it generates income and employment in other regional industries that are dependent on coal mining. These industries provide inputs into coal mining, such as providers of fuel, electricity, equipment, freight and handling, or are dependent on expenditure from employees of coal mines. In small scale coal mining, there is minimal expenditure on these inputs because production is highly labour intensive (as opposed to capital intensive) and coal is generally sold through middlemen (larger coal producers or coal traders) who utilise their own distribution networks.

Expenditure of large scale coal mines in the form of wages, community programmes and inputs into production in the local economy is often a very large source of local community income. For example, Coal and Allied Limited (a Rio Tinto company) in the upper Hunter Valley in New South Wales, Australia spends around USD10 million in the local community for every million tonnes of coal produced and employ over 700 local people. In 2000, Coal and Allied spent USD138 million in the local economy on wages and local goods and services (table 5). This is around 40 times the expenditure of the local Muswellbrook Council (local government) on maintaining and providing local facilities (water, drainage, roads, bridges, parks, sporting facilities etc) where the Coal and Allied mines operate.

Export earnings

Export earnings represent a source of national income that expands the consumption possibilities for an economy. This income is re-circulated around the economy in the form of payments to mine workers and other factors of production and returns to investors. Some of these earnings are redirected overseas in the form of payments to overseas investors and expenditure on foreign goods.

Table 5: Contribution of Coal and Allied coal mining to the Hunter Valley, New South Wales, Australia, 2000

Production, mt	12.8
Employment	766.0
Number of regional businesses providing goods and services	575.0
Earnings, USD million	357.5
Profit, USD million	71.9
Regional goods and services purchased, USD million	90.8
Wages, USD million	44.4
Taxation, USD million	40.2

Source: Coal and Allied 2001

On a global basis, coal is produced mainly for domestic consumption, with only around 15% of hard coal production destined for the traded coal market. In countries where coal is widely produced by large scale mining for export markets, such as in Colombia, Australia and South Africa – constituting around 93%, 70% and 30% of total production respectively – exports from coal are an important source of export earnings. Earnings from coal exports are equal to 13%, 11% and 6% of the value of total merchandise exports in Colombia, Australia and South Africa respectively (figure 6). Coal is Colombia's third-largest export earner behind oil and coffee. Although Indonesia is the third-largest coal exporter in volume terms, in value terms, coal is only a small contributor to total Indonesian exports (2.5%).

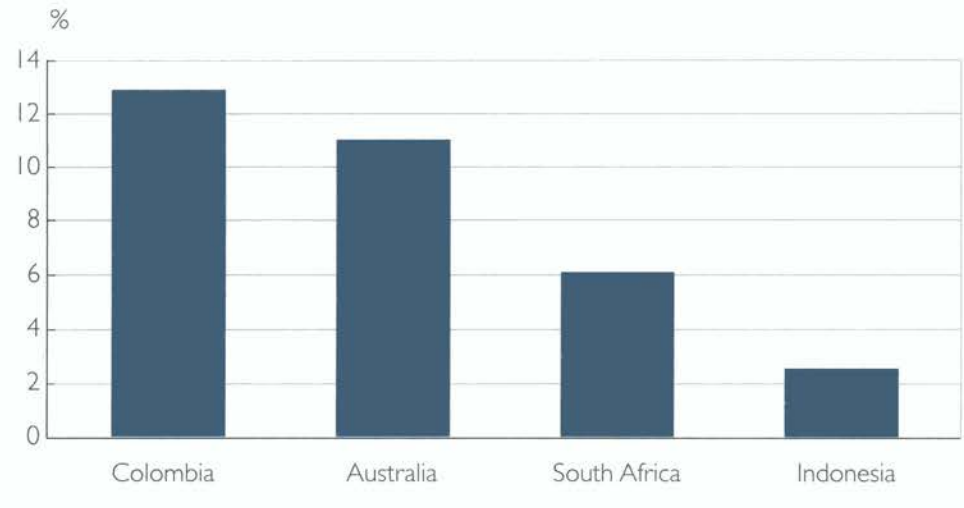
Government revenue from royalties and taxes

There are generally two forms of government revenue that are obtained from mining – royalties and company taxes. Royalties extract a share of the resource rents that accrue to the owners of mines as a result of the grant of access to a scarce public non-renewable resource. They are generally applied either as a price per unit of coal produced or applied as a percentage of earnings from coal mining. For example, in Indonesia, government royalties represent 13.5% of total income from coal mining. In terms of sustainable development, resource rents should be fair compensation to the resource owners (the public) for depletion of their natural resource base.

Tax revenue from mining companies also contributes to government earnings (in, for example, company profits, land taxes, payroll taxes, fringe benefit tax, land tax, local government rates). Government earnings collected from coal mining operations can be an important source of government revenue for developing countries. These funds can in turn be used to finance programmes to further economic growth, social development and alleviate poverty. In Colombia, taxes from coal production in large scale mines are used to help fund adjustment programmes for communities affected by coal mine closure and to train small scale mine operators (see section 3e (ii) for more details).

Government revenue generated from coal mining is skewed heavily towards large scale mining companies. For privately-owned mines,

Figure 6: Coal export earnings as a share of total export value (fob)



economies of scale combined with a highly competitive coal market, restrict the profitability of small and medium scale mines and hence there is not the same opportunities for extracting royalties and tax revenue as with large scale mines. State-owned mines, such as in India, China and eastern Europe, generally are not profit motivated, so that there is no avenue for collecting resource rents. Further support paid to these mines diverts public spending from projects that could provide a greater benefit to the economy. Illegal small scale mining represents lost potential government earnings and there is a significant incentive for governments to try to move these enterprises into the formal sector.

Infrastructure

The availability and accessibility of a natural resource is not the only condition to operate a mine; mining requires considerable support infrastructure. Necessary infrastructure includes:

- transport infrastructure (roads, shipping terminals, rail links and airports to transport miners);
- mining equipment;
- communications facilities (cables for Internet and telecommunications and post offices);
- reliable water and energy utilities (for mine and community use);
- facilities for the community that will depend on mining (housing, recreation, health, medical and waste management).

Coal mining activity takes place in rural communities where access to infrastructure in some countries is poor and depending on the location, mining companies directly provide these facilities. This can occur in both developed and developing countries. However, the extent of expenditure on infrastructure depends on the scale of mining operations. Generally it varies from potentially extensive expenditure where large scale mining takes place to almost no expenditure in small scale mining. Small scale mines do not require extensive infrastructure, but generally they rely on existing transportation networks such as river systems or road networks and draw mainly on local labour and primitive technologies that do not require the development of additional facilities such as water resources, electricity and housing etc.

2a (ii) Coal use

Energy use and economic development

Access to affordable energy is a driving force behind economic development. For developing economies that have a relatively high dependency on energy intensive production – such as metals and manufacturing – economic growth is more closely linked to energy consumption than in developed countries (table 6). However, to prevent the exhaustion of finite energy resources and meet environmental expectations – requirements for sustainable development, economic growth must become less reliant on energy consumption.

Table 6: Average annual change in energy consumption and economic growth, 1973 to 1997

	Primary energy consumption %	GDP %
OECD	1.3	2.6
Non-OECD	3.1	3.7
Global	1.9	2.8

Source: Energy Data Modelling Centre 2000

There are two ways in which economic growth can be de-coupled from energy consumption – structural economic shifts and technological improvements. Over time as economies develop, their energy intensity (energy consumed per unit of GDP) falls as production shifts from relatively energy intensive activities, such as metals production, to less energy intensive operations such as services. The notion that economic development can reduce the energy intensity of an economy and lead to improved environmental performance is known as the 'environmental Kuznets curve' (Stern et al. 1996). The development and application of new technologies that reduce energy consumed per unit of output must be accessible (affordable). This is especially true for developing countries where energy intensity is relatively high.

Improving access to energy for the world's poorest countries is essential to promote economic and social development in these countries. Despite improvements over the last decade, around two billion people still do not have access to commercial (reticulated) energy, such as electricity (UNDP, 2000). Accessing modern energy would allow these people to move away from the combustion of fuels (such as biomass and coal) in household fires (often without flues), and increases economic development in four major ways:

- labour that would otherwise be spent collecting fuel (such as biomass and coal) is freed for more productive use such as in agricultural and manufacturing industries. This increases household income, labour supply and the productive capacity of developing economies;
- the intensive collection of biomass for fuel for household consumption in many cases degrades the productivity of agricultural land – through desertification (by removing trees) or through depriving the soil of nutrients (collecting animal waste);
- inefficient combustion of unconventional fuels, especially in households without flues, creates health complications. Moving households away from these energy sources to modern energy sources (such as electricity) improves the productivity of household labour;
- the provision of household electricity provides for the use of modern appliances (such as washing machines) and lighting which acts to improve the productivity of home labour, further freeing labour for more productive use - such as gaining employment.

The role of coal

Coal contributes to economic development primarily through its wide use in electricity generation and steel production. The pervasive use of electricity in many different economic activities, makes it the most important energy source for economic development. Electricity:

- fuels the use of a broad range of equipment and appliances that improve the productivity of labour (such as high technology and manufacturing equipment),
- is used during electrolysis to form chemical changes (for example transforming bauxite into alumina),
- is used to generate heat (as in steel production),
- provides lighting to expand economic activity beyond daylight hours.

Coal fired electricity does and will continue to play an important role in economic development because it is affordable and available. Accessibility and availability are two of the requirements identified by the World Energy Council (2000) for meeting the challenge of providing sustainable energy. The third, acceptability – social and environmental – is a topic of discussion in sections 2b and 2c.

Accessibility

Accessibility refers to the ability of households and businesses to use energy as required. For modern energy, such as electricity, to be

accessible, it must be available at prices which are both affordable and sustainable (reflect the real costs of energy production, transmission and distribution to support the financial ability of companies to maintain and develop their energy services). Modern energy is inaccessible to the poorest two billion people in the world, because they cannot afford it, and/or because there is inadequate distribution infrastructure.

Coal fired power is a competitive electricity technology, due mainly to the relatively low cost of coal. The abundance of coal, ample prospects for mine productivity improvements and the competitive nature of the traded coal market ensures that coal fired electricity will remain a competitive option. However, the affordability of coal in the future will depend on policies designed to internalise both positive and negative externalities such as environmental impacts, energy security and energy safety. In the short to medium-term, despite improvements in technology, alternative energy technologies will, in many circumstances, not be competitive with existing conventional technologies such as those for coal, making the reliance of electricity from these sources limited.

Availability

Availability relates to long-term continuity of energy supply as well as to short term quality of service. The effects of recent electricity supply disruptions on economic growth in California have brought energy security into sharp focus. Outside California, recently liberalised domestic energy markets (especially in Europe) are experiencing an increased reliance on imported energy, often from politically unreliable sources, increasing the threat of future supply disruptions and unexpected price rises. Coal fired power in a country's energy mix reduces its exposure to the potentially serious effects of supply disruptions and unexpected price rises.

The international coal market, unlike oil and gas, is competitive and prices have maintained a steadily declining trend over the last ten years (figure 4 on page 19) and should continue to do so. In liberalised electricity markets, the presence of ample coal fired capacity allows switching from gas to coal during times of high gas prices, dampening the effect of gas price shocks on electricity costs and inflation. This has been observed in liberalised OECD electricity markets over the last 18 months. For example, in the United Kingdom, recent high gas prices led to a 32% increase in the use of coal in electricity generation in the first half of 2001 compared with the figure for the same period in 1999. Unlike oil and gas, coal is an energy source that is not threatened by major geopolitical risks or uncertainty associated with weather conditions (hydro, solar, wind).

The role of coal as a 'shock absorber' in liberalised electricity markets, especially in Europe, is threatened by ageing coal fired capacity and an investment environment that favours new gas fired electricity plants. In a liberalised energy market, it is the project developers that shape the energy mix. For replacement of retiring coal capacity, investment in gas fired plants is favoured because of its low establishment costs relative to other technologies – short construction time and low capital costs – and the investor preference for quick returns (as opposed to returns in the future).

At present in liberalised electricity markets, there is no mechanism to entice developers to consider long-term energy security issues when investing in new capacity. Without a framework to bring energy security (and environmental) concerns into energy choice decisions, there is a threat that liberalised electricity markets will lead to future energy security problems.

As a widely distributed fuel (commercially mined in over 50 countries), coal, unlike oil and gas, is a fuel that is widely available, including in developing countries. Sourcing

energy from domestic markets, instead of relying on fuel imports can reduce a country's exposure to exchange rate, price and supply risks. For some developing countries, relying on domestic coal supplies instead of imported energy reduces the outflow of limited foreign currency earnings. Also, coal is easily and safely transported, allowing coal to be used in remote locations in small scale dual fired generators with renewable sources such as bagasse.

Coal in steel production

Steel is a building block for economic development. Steel is a strong, adaptable, hygienic and affordable material that is used widely in machinery and infrastructure that help to facilitate economic development. Some of the applications for steel include:

- construction material to strengthen concrete, reinforce foundations and to provide a frame for buildings, such as schools, factories, offices or residences;
- primary input in the production of transport vehicle components chassis and bodies, engine parts etc.,
- packaging product for food, beverages, solvents, grease, paint, etc.;
- input in producing electronic components used in computers and telecommunication systems.

Around 70% of global iron and steel is dependent on coal as an input into production. Blast furnace technologies relies on coal – mainly as an energy source and reductant to produce new steel, as opposed to electric arc furnace that mainly recycles scrap steel. Blast furnace efficiency improvements, the deployment of direct reduction technologies (that bypass the blast furnace) and increased rates of recycling (although there are limits on the availability of scrap) will reduce the dependency of iron and steel production on coal in the future.

2b Social development

The contribution of coal to social development can be divided into issues related to coal production and coal use in electricity production. Coal mining is both land and labour intensive and hence there are a number of issues that affect the welfare of local communities (employment, conflicting land uses, health and safety etc). The main contribution of coal to social development is through its use in electricity generation, an important energy source for improving standards of living.

Given the different coal production methods employed and varying coal uses across countries, the performance of coal in meeting the goals of sustainable development differ across regions. Typically, the contribution of coal production and use to sustainable development in a country reflects the performance of industry as a whole in promoting the principles of sustainable development.

The regions where inappropriate coal use and production has the worst social impacts are inevitably poor. This section, in outlining the role of coal in social development, highlights the different contributions across regions. Details regarding programmes for promoting sustainable development is the topic of discussion in Part 3.

2b (i) Coal mining

Mine safety

The varied performance of the coal mining industry on social issues can be clearly demonstrated by analysing performance on safety issues. Mine deaths are the most widely available statistics related to mine health and safety reporting and are used here as a proxy for mine safety.

Coal mining death statistics can be used to demonstrate differences in health and safety performances (table 7), but a degree of caution should be exercised when analysing differences in these statistics. Firstly, the differences among fatality rates reflect not only the differences in mine management, but to some extent, differences in the accessibility of coal. Coal mining deep underground, as in Poland, entails a higher risk of fatalities than coal mined in open cast pits, as in Australia. Secondly, fatalities unrelated to mine accidents, but related to working conditions, such as possible deaths from exposure to high levels of coal dust, are not recorded in mine fatalities.

Finally, mine fatalities, especially in small scale mining are often unreported by mine operators due to fear of mine closure; this is true in China where some sources estimate that up to 20,000 fatalities occur a year (China Labour Bulletin 2000a).

Limitations of the data aside, a few conclusions can be drawn. The overwhelming majority of coal mine fatalities occur in China and the fatality rate is over 300 times worse than in Australia, which has the lowest fatality rate. The majority of these deaths are in small scale town and village mines. Mining techniques in these mines are labour intensive (often women and children) with rudimentary equipment and poor health and safety conditions. It is shown in figure 7 that the death rate from these mines is around 34 times the rate from large scale state-owned mines.

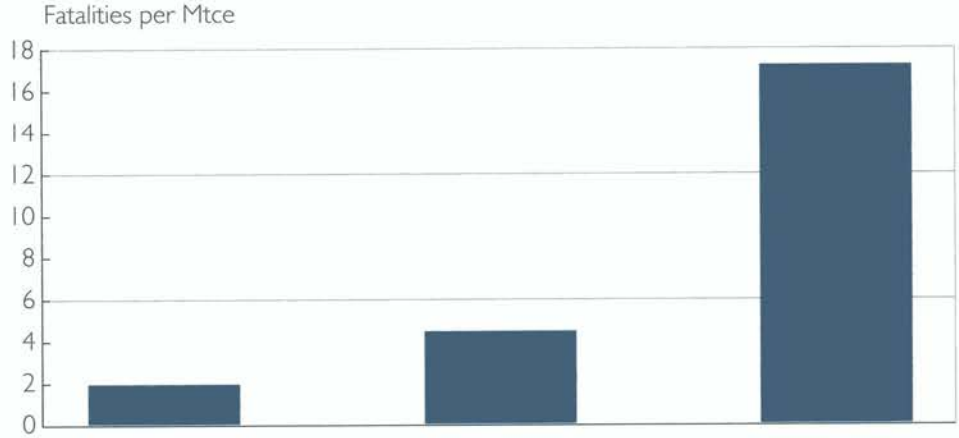
According to the Chinese Labour Bulletin (2001a), 50% of the deaths in coal mining in China occur due to methane gas (mainly explosions) where there is poor (or no) ventilation and gas monitoring facilities. The Chinese government is aware of this problem and it is this poor performance that is providing the impetus for government small scale mine closures (refer to section 3e(ii)).

Table 7: Coal mining fatality statistics per annum, 2000*

	Deaths	Fatality rate (Fatalities per Mtce)
Australia	4	0.02
United States	38	0.05
United Kingdom	4	0.05
Poland	28	0.28
Russia	137	0.83
China	5,786	6.36
India	100	0.48
South Africa	30	0.17

*The statistics are for the year 2000, except for Russia and India (1999 data) and the United Kingdom which is an average since 1970.

Figure 7: Fatality rates in Chinese coal mines



Source: Chinese Labour Bulletin 2001a

The lowest fatality rates occur in countries where there is a strong commitment to health and safety standards across all industries and where large scale modern operations dominate production, such as in Australia, the United Kingdom and the United States. In these countries, health and safety standards are governed by legislation (which is tightly enforced) and in the event of a mining fatality, there is a rigorous investigation into the cause of the accident.

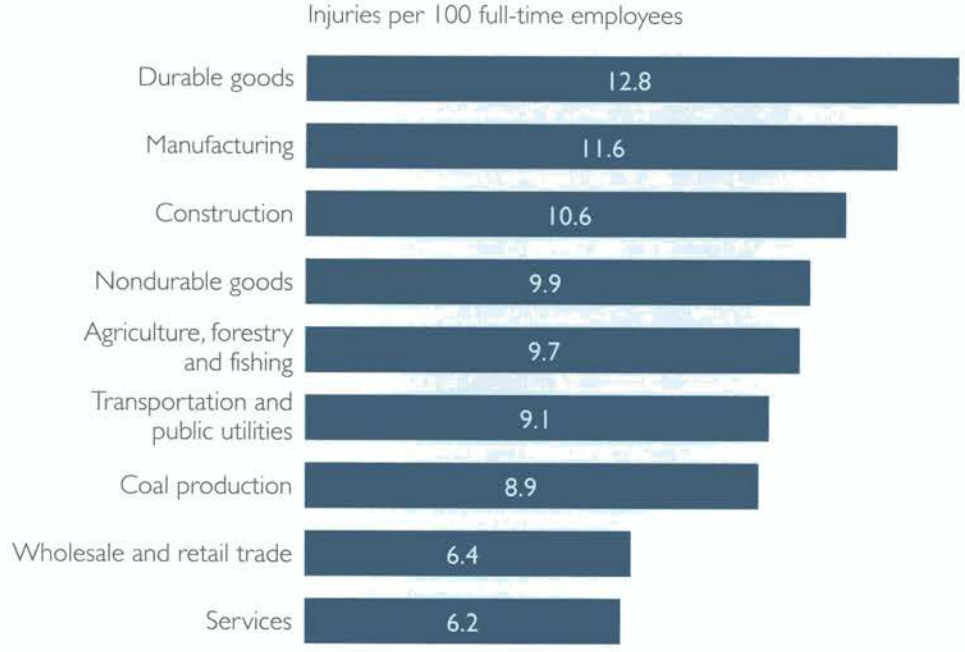
If the investigation finds a duty of care is breached, the mine operators face severe penalties including significant fines and possible criminal action. There is also a more widespread commitment to mine health and safety evaluation and reporting. Mining in these countries (mainly large scale) is highly mechanised with a low labour intensity (table 4 on page 29) and uses modern safety systems and equipment such as hard hats, mine ventilators, methane gas extractors and air filtered helmets.

Compared with the poor health and safety record of the past, especially in Europe, modern coal mines are safe. For example, in 1900, around five deaths occurred in the United Kingdom for every million tonnes of coal equivalent produced. Since 1970, this number is equal to 0.05, a 100 times improvement in performance. In countries where modern large scale mining dominates, the incidence of injuries from coal production is comparable to the rates of injury from other industries. For example, in the US, nine injuries were reported per 100 workers in 1995, only wholesale and retail trade and services reported a lower injury rate (figure 8 overleaf).

Health

Mining-related diseases, such as pneumoconiosis (respiratory disease) and hearing impairments are a serious concern to all mining industries, including the coal mining industry. Pneumoconiosis from coal mining (coal workers' pneumoconiosis or CWP is also known as black lung) is the most serious of these diseases, causing breathing difficulties that hinder the ability of miners to work, diminishes their standard of living and life expectancy. Miners working for long periods of time in poorly ventilated underground coal mines are

Figure 8: Injury rates in selected United States industries, 1995



Source: All industry rates except coal are from the United States National Mining Association 1999. Coal injury incidence rates are from the United States Department of Labour Mine Safety and Health Administration 2001.

the most susceptible to pneumoconiosis. The incidence of CWP varies between regions, depending on the degree to which mining takes place underground, the use of ventilation equipment and measures implemented to prevent CWP. Statistics on the incidence of CWP are patchy, reflecting the low rates of miner health examinations especially in developing countries. However, from the reports available, the incidence of CWP seems to be falling with increased awareness of the disease and the implementation of legislation to limit coal mine dust. On the whole, the disease is more prevalent in countries with traditionally poor health and safety records.

In China, according to national surveys, there were around 5,000 new cases of pneumoconiosis in 1996, of which approximately 40% (or 2,000) are reported to come from coal mining (ILO 1997). These numbers represent half the reported cases in 1990; the reduction has come about due to the implementation of mine dust restrictions. However, it is likely that these numbers are a vast underestimate of the actual incidence of pneumoconiosis because of under-reporting in small scale mines. In contrast, tight regulation and mandatory health examinations in Australia have virtually eliminated CWP from Australian coal mines, so much so that the Joint Coal Board no longer separates data on CWP from other respiratory diseases.

In the United States, regulations to control coal mine dust and prevent CWP were not introduced until 1969, 26 years after Australia

first introduced regulations. As a result, the incidence of CWP among coal workers is still high relative to Australia. It is estimated by a report by the United States Department of Health and Human Services (1999) that 1,400 coal miners died in 1996 from CWP (30% lower than in 1990), although 95% were over the age of 64. In total, this has led to USD16 billion in compensation payments between 1987 and 1996.

Of the greatest concern, the report also pointed out that of the 7,000 miners examined between 1992 and 1996 who had been in the industry between ten and 20 years (after the introduction of legislation governing coal mine dust), 2.4% proved positive to CWP (category 1/0+). Although this is a large drop since 1970 (around 10%) it is relatively unchanged compared with results from 1982 to 1986. The reasons behind the persistence of CWP in coal mines in the United States are unclear, but it has been suggested that poor mine dust inspection and in some cases, difficulty (economic) complying with regulations may be responsible (Courier Mail 1998).

Loss of hearing acuity due to prolonged exposure to hazardous noise (noise induced hearing loss or NIHL) occurs slowly and often without notice until hearing is damaged significantly. NIHL is a hazard for all types of activities that involves loud noise, especially explosions. In the coal mining industry, NIHL is a threat to all workers in all countries, although relative to other sectors, the incidents of NIHL from mining is minor.

For example, in the United States it is estimated that around 70% of people diagnosed with NIHL are from manufacturing, construction and transportation industries and less than 5% are from mining (United States Department of Health and Human Services 2000). Nonetheless, NIHL is a serious health risk among coal miners, for example, it is estimated that around 65% of coal miners are, to some degree, affected by NIHL by the time they reach retirement in the United States (United States National Institute for Occupational Safety and Health 2001). The incidence of NIHL worldwide is difficult to ascertain because of the lack of available data.

Community service and community relationships

Coal mines, especially large scale coal mines, are a major source of employment and income to local communities and can play an important role in the development of local communities in the countries where they operate. Large scale coal mining can contribute to the social welfare of a community by developing basic facilities and services, such as drinking water, health, sanitation, housing and transport, and providing (or stimulating the provision of) services such as health, education and recreation.

The mix and focus of community activities chosen by large scale coal mine operators varies according to the location of the mine and the development needs of the community. Small scale mining is not as profitable as large scale mining and cannot afford to provide the same support to local communities. Nonetheless, small scale mines are an important source of employment and can help to alleviate areas of rural poverty.

There are potentially negative social impacts on local communities from the opening of a large scale coal mine. The most common impact is changes to land use, especially changes from traditional uses (mainly agriculture and hunting) and cultural disturbance. The degradation of spiritual and historical values of traditional land, when converted to mining land, can create a sense of dislocation among indigenous communities. Relocating indigenous people from their traditional land often requires them to be reintegrated into alternative communities that can cause conflict. Also, cultural conflicts can be caused when miners are brought into the local community to seek work.

At the same time, establishing a large scale coal mine increases demand for labour from the local community which affects traditional sectors such as farming that lose employees and in some cases face higher production costs through increased wages to maintain employees. When large scale coal mines are closed (for economic reasons) coal mine workers become unemployed and without retraining and local alternative employment options, they may be forced to move from their community to seek employment.

On the whole, large scale coal mine operations are sensitive to potentially negative social impacts from mining and through largely voluntary programmes seek to minimise these impacts (see section 3a (i) for more details of these initiatives).

2b (ii) Coal use

The primary contribution of coal to social development is as an abundant, low cost source of energy for electricity generation. In developed countries, labour saving devices (freeing more time for leisure) such as electric ovens, washing machines, driers, vacuum cleaners, dishwashers and computers are dependent on electricity. Devices that provide recreation and comfort, such as lighting, heaters, stereos, computers, televisions and videos, are also powered by electricity. As household income levels continue to rise, a growing number of labour saving and leisure devices will be demanded in the future, increasing the reliance on electricity to provide improvements in standards of living. Electricity is also a major source of energy required for vital services such as education, health and water.

To help proliferate the use of the above devices and services in order to close the gap in living standards between developed and developing countries and to give two billion people access to basic services, it is important that electricity be affordable and reliable in developing countries. Coal is often the best fuel to provide affordable, safe and reliable electricity in these regions because coal is widely available, can be easily and safely transported (compared with oil or gas) and is and will continue to be a relatively low cost energy supply.

Where there is no access to conventional energy sources such as electricity, coal, where available, can play an important role in alleviating energy poverty, especially in countries with severe winters such as Russia, Ukraine, Mongolia and Kazakhstan (World Bank 2001b). Coal seams that are close to the surface can provide a readily accessible energy source for energy-poor households and alleviate the pressures of deforestation caused by household consumption of biomass.

However, if burnt in an open stove with no flue, coal (like biomass) can cause serious health problems. The United States Geological Survey (1998) estimates that around one billion people worldwide use coal indoors in unvented fires for heating and cooking. The health problems from inappropriate coal use can be exacerbated if the coal used is poor quality with high levels of toxic elements.

Perhaps the worst example of inappropriate coal use, combined with the use of poor quality coal, is in Guizhou Province and surrounding areas in China, as highlighted in a study by the United States Geological Survey (Finkelman, Belkin and Zheng 1999). In this area at least 3,000 people are suffering from severe arsenic poisoning from the consumption of chillies dried over fires burning high arsenic coal. At the same time, the consumption of corn dried over fires fuelled by coal briquettes – containing high levels of fluorine from coal and clay binders – is estimated to cause dental and skeletal fluorosis in more than ten million people in China. These health problems, besides the potential loss of life, reduce the standard of living and earning capacity of sufferers, in turn increasing rural poverty.

2c Environmental impacts of coal

The coal industry is striving to minimise its environmental footprint. The key environmental challenges facing the coal industry are related to both coal mining – particle emissions and disturbance of land – and the use of coal – greenhouse gas, acid rain, ground level ozone and waste disposal.

The coal industry is concerned about all of these impacts. However, like many of the social issues, the severity of the impacts from coal varies across regions. Major differences between regions are not due to intrinsic differences in the coal reserves themselves, but more because of differences in mining practices and combustion technologies that reflect various levels of development.

2c (i) Coal mining

Land disturbance and acid mine drainage

Large scale coal mining, especially surface mining, requires large tracts of land to be disturbed. This disturbance includes removing vegetation, moving overburden (waste rock and soil), removal of coal, relocating overburden to backfill and in some cases the introduction of foreign waste (such as combusted coal waste) in backfill. The main environmental problems associated with land disturbance include erosion of the soil, dust pollution and losses to natural vegetation.

Today, minimising these impacts and rehabilitating land to a condition that is consistent with the conditions before mining began are legal requirements in most countries, including developing countries. However, the degree of compliance with national legislation varies according to the type of mining operation. Large scale coal mining operations generally adhere to national mining regulations. Despite being genuinely concerned with minimising the impacts of their operations, good environmental performance among these organisations (even above national standards) is essential to maintaining the economic viability of their mining operations.

Large scale mines are easily identifiable in the public eye and as such are monitored frequently. Failure to perform well can lead to financial ruin from fines, government enforced closure or falling share prices from adverse public opinion. Among small scale mines, there is often poor adherence to the national laws because of the lack of financial resources, ignorance of the law, poor mine management and low levels of expertise.

In addition, small scale mines are generally infrequently inspected because they are in remote areas where they are hidden from public scrutiny and often there is not a high commitment by authorities to enforce reclamation legislation in these cases. This is particularly true in China and India where fires from spontaneous combustion of coal, and water contamination from disused mines are reducing the capacity of agricultural land and damaging local habitats.

There is a much higher commitment to mine reclamation among large scale coal mining companies. Transnational companies generally apply advanced reclamation techniques adopted to meet strict regulations in developed countries to their operations in developing countries, often to a level beyond what is required in these countries. These companies, reinforced by their commitment to shareholders and public accountability, place mine environmental performance high on their company goals.

Acid mine drainage (AMD) is an environmental problem that can come from waste material dumps, including coal mines and less frequently, rehabilitated underground and surface mines. AMD is metal-rich water formed from the chemical reaction between water and rocks containing sulphur-bearing minerals. This acid run-off from mine sites

dissolves heavy metals such as copper, lead and mercury into ground and surface water (EPA 2001a). The environmental effects of AMD include contamination of drinking water, disrupted growth and reproduction of aquatic plants and animals and corrosion of bridges.

2c (ii) Coal use

Greenhouse gas emissions

Greenhouse gases come from natural sources – especially water vapour, the largest greenhouse gas – and anthropogenic sources. Globally, the largest source of anthropogenic greenhouse gas emissions is carbon dioxide (CO_2) from the combustion of fossil fuels – around 75% of total greenhouse gas emissions covered under the Kyoto Protocol (table 9). Among fossil fuels, CO_2 emissions from coal combustion worldwide are approximately the same as emissions from the combustion of oil (mainly in transportation and household heating).

In OECD economies, emissions from coal combustion account for much less than emissions from the combustion of petroleum products, while in non-OECD countries emissions from coal combustion are around the same as emissions from agriculture. For the coal sector, fugitive methane (CH_4) emissions are also a source of greenhouse gases.

The possible threat to social, economic and ecological systems from climate change places the control of greenhouse gas emissions from coal mining and use at the forefront of environmental challenges facing the industry. However, as the comparisons in table 9 imply, it is important in addressing climate change that comprehensive measures are used to limit emissions from a wide range of sources, including petrol use and fugitive emissions.

It is worth remembering in this context that a number of other greenhouse gases have a higher global warming effect per unit emitted than CO_2 (as reflected in the table below); also that a number of factors offset the apparent greenhouse impact of coal use. For instance:

- full Life Cycle Analysis (LCA) shows that electricity generation from other fuels such as gas may have similar or even higher GHG emissions than coal-based generation,
- emerging clean coal technologies will significantly reduce the difference in GHG emissions between best coal and gas technologies at the point of combustion,
- synergies between coal, biomass and solar thermal can significantly increase the efficiency of these renewable energy technologies and may be the most cost-effective way to increase the use of renewable energy;

Table 9: Emissions of the three major greenhouse gases

	Carbon dioxide from combustion			Other carbon dioxide*	Nitrous oxide**	Methane+
	Coal	Oil	Gas			
	%	%	%	%	%	%
Non-OECD	25.0	16.2	9.6	14.2	11.8	23.3
OECD	26.4	35.2	15.5	2.6	8.4	11.9
Global	25.6	24.4	12.2	9.1	10.3	18.3

* Mainly fugitive emissions and industrial processes. ** Mainly from agriculture, industrial processes and transport. + Mainly agricultural, fugitive and waste emissions.
Source: IEA 2001c. Note: the sum of the rows do not equal 100% because of rounding errors.

- by-products from coal-based generation can be used to lower lifecycle greenhouse gas emissions,
- utilising coal seam methane is a relatively easy way to reduce total greenhouse gas emissions from the coal cycle.

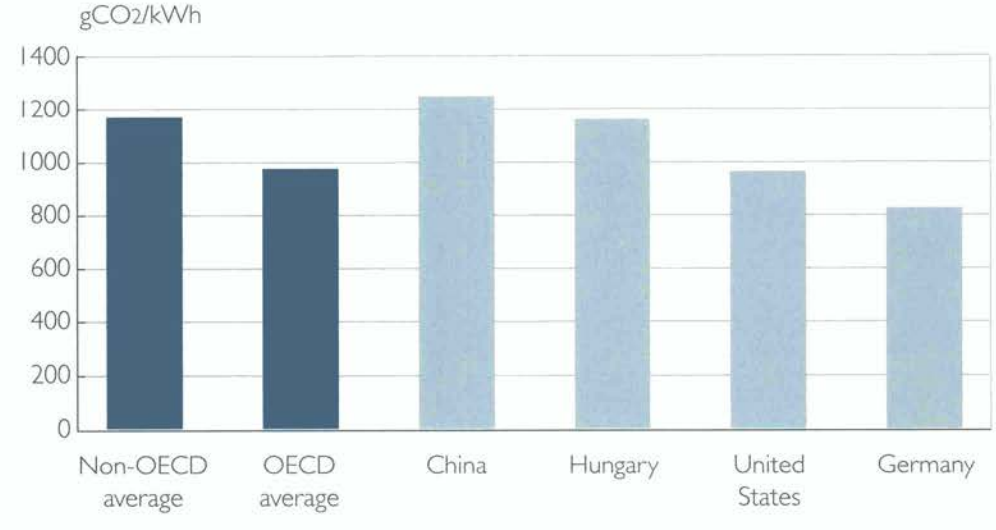
There are also large variations in emission intensity of coal fired electricity between countries (figure 9). The emission intensity of coal fired power plants in OECD countries is on average 17% lower than in non-OECD countries. This is mainly because on average power plants in non-OECD countries operate at lower operational efficiency levels, are more often outdated technologies and use poorer quality coal. For example, the emission intensity of coal fired electricity in China is relatively high because around 40% of coal fired power plants are over twenty years old (Xiong T 1997) and they mostly use low quality coal.

On the other hand, Germany has a relatively low emission intensity because many inefficient coal fired plants were closed after re-unification and a number of new highly efficient plants have been developed and deployed. Information, on a national level, regarding the emission intensities of coal fired plants is difficult to obtain.

Acid rain and ground level ozone

The combustion of fossil fuels, including coal, produces gaseous emissions of sulphur dioxide (SO_2) and nitrous oxides (NOx) that are responsible for the production of 'acid rain' and 'ground level ozone'. Acid rain refers to the deposition of acid from the atmosphere and can take the form of dry deposition – gases and particles – or wet deposition – rain, fog or snow. Acid rain occurs when SO_2 and NOx gases react in the atmosphere with water, oxygen, and other chemicals to form acidic compounds. Ground level ozone (O_3) is mainly responsible for smog that forms a brown haze over cities. Ground level ozone is formed when NOx gases react with other chemicals in the atmosphere and is enhanced by strong sunlight.

Figure 9: Emission intensity of coal fired electricity



Sources: Hungary, United States and Germany are from the IEA 2001c. Non-OECD, OECD and China estimates are based on estimates of thermal efficiency from IEA 1999a.

Emissions of SO_2 and NOx are commonly termed transboundary air pollution because the environmental impacts from the production of these gases are not restricted by geographical boundaries. Acid rain causes acidification of waterways and slows growth or kills trees, resulting in a cascade of ecological effects that decrease biodiversity (EPA 2001b). Ground level ozone can create breathing difficulties in some people and severely reduce visibility.

The incidence and damage of acid rain varies greatly between countries, especially between developed and developing countries. Technical, management decisions and policy choices can all determine the effectiveness of solutions to acid rain. The development of modern emission control technologies and the greater use of low sulphur coal have greatly reduced acid rain in developed countries, especially in Europe and the United States. For example, in the United States, despite continued growth in coal fired electricity production, emissions of SO_2 from utilities have fallen by around 3% a year since 1980 (EPA 1999).

In China, the continued use of high sulphur domestic coal (80% of which is unwashed), the inefficient use of coal in households, the slow uptake of emission control technologies and inefficient coal fired power stations continues to cause acid rain related damage to agricultural production and the ecology. This highlights the preference for developing countries to place economic development needs above environmental and social objectives.

Waste and waste disposal

Waste is generated as a result of coal combustion at electricity power plants – utility coal combustion waste (UCCW) – and waste that is produced by activities not directly related to coal combustion – low volume waste (LVW). The main source of UCCW is uncombusted – naturally occurring – mineral matter. It is either carried out of the boiler along with flue gases (fly ash), does not melt and settles to the bottom of the boiler (bottom ash) or remains in molten state and is drained from the bottom of the boiler (boiler slag). The residual from desulphurisation of flue gas (mainly gypsum) after combustion is generally reused to replace mined gypsum, in the manufacturing of wall boards.

This residual is not considered a source of waste in this report. Sources of LVW include waste from cooling towers, on site coal cleaning, periodic cleaning of ion exchange beds and heat exchange surfaces and precipitation run-off from piles of stored coal. Today, UCCW and LVW waste for disposal can be minimised through the use of high efficiency coal combustion technologies – such as cleaner coal combustion technologies, through coal washing and reprocessing waste into construction materials (these technologies and their use are discussed in section 3b).

2d Conclusions

Coal mining and coal use contribute to economic development. Commercial coal mining takes place in over 50 countries in often remote and poor areas, providing an important source of rural employment, government income, exports and infrastructure. Coal is the most abundant fossil fuel and is widely available at a low cost, making it the world's most important fuel for electricity generation (38.1% of all electricity is generated from coal) and an important input into primary steel production.

The international market for coal has many geopolitically stable exporters ensuring that supplies of coal are secure and prices are competitive. In a diverse energy mix, coal can act as a 'shock absorber', dampening the effects of gas price rises on electricity costs and maintaining economic development. This was illustrated in the United Kingdom where the effect of recent gas price rises on electricity prices was largely diffused by a

switch to increased coal fired electricity (increasing coal consumption in electricity by around 32%) at the expense of gas fired electricity. However, the contribution of coal to future energy market security is threatened in many countries by ageing coal capacity (in many countries, especially in Europe) and liberated electricity markets that favours new capacity developments with low establishment costs (namely gas fired capacity).

For social and environmental development, coal mining and coal use have both positive and negative impacts. On the positive side, coal is a widely available low cost energy source and provides electricity at an affordable price to households in developing countries that otherwise would not be able to access electricity. For the two billion people who do not have access to commercial energy, coal – collected from local reserves – is often available for use by households and can alleviate energy poverty. At the same time, utilising local coal reserves in replace of biomass, helps reduce the negative impacts on soil fertility, desertification and food production associated with biomass collection.

For the coal industry, the negative impacts that are of most concern are:

- emissions from coal combustion – especially greenhouse gas emissions and NOx and SO_2,
- health and safety issues in coal mines,
- health impacts from low efficiency coal use in households,
- coal combustion waste management,
- impacts of mining on local communities,
- acid mine run-off.

However, the magnitude of these impacts is generally greater in developing countries where the priority for development is on economic development. For some issues, such as health complications from low efficiency use of coal in households and the poor performance of small scale mining, rural poverty in developing countries is the main cause of these problems.

A shortcoming of the analysis in this chapter is the poor availability of data – global and country level – on the performance of coal mining and coal use. This should be addressed in the future and is a topic of discussion in Part 4.

Part 3: Effectiveness of measures to promote sustainability

The aim of this section is not to review all of the measures undertaken by the coal industry to promote the principles of sustainable development. Rather, the primary aim of this section is to provide an overview of the types of actions taken to promote the principles of sustainable development in the coal industry. Also, this section evaluates the success of each programme and identifies areas for future development.

The main types or measures deployed to move the coal industry towards a path to sustainable development are:

- voluntary initiatives,
- education and skill development,
- research and development (R&D) and technology transfer,
- information management,
- government initiatives and legislation.

The coal mining industry is made up of a wide variety of mining operations (from illegal small scale mines – although they only comprise a small share of total coal production – to large scale mines operated by transnational companies) and takes place in over 50 countries all over the world. The wide availability of coal – from domestic sources and from the international market – means that it is also widely used around the world. Therefore, the extent and types of measures deployed to improve the performance of coal mining and coal use vary greatly, but mainly reflect different levels of economic development.

For developing countries, implementing principles of sustainable development generally means implementing policies that will enable these countries to achieve economic development and alleviate poverty. In the context of the coal industry, this means, implementing policies to better utilise their coal resources (including opening up resources to foreign investment).

This is reflected in the introduction of the Chinese Government's White Paper on Agenda 21. 'Because China is a developing country, the goals of increasing social productivity, enhancing overall national strength and improving people's quality of life can not be realised without giving primacy to the development of the national economy and having all work focused on building the economy.' (http://www.acca21.edu.cn/chnwp2.html).

Economic development is seen as crucial to generating resources for programmes to improve the environmental and social components of sustainable development. Programmes in these economies are often limited to regulation (but often without the capacity or the will to enforce regulation) and access to World Bank adjustment loans.

On the whole, the greatest action to implement the principles of sustainable development over the last ten years have been undertaken by mining companies from developed countries that operate in both developed and developing countries. Most of the initiatives discussed in this section relate to initiatives undertaken by large scale coal mining companies. Often, 'best practice' mine management (such as rehabilitation, minimum water contamination and workplace safety) adopted in domestic mines (in developed economies) are transplanted to mines operated in developing and transition economies.

3a Voluntary initiatives

Global coal demand is being met increasingly by large scale coal mines operated mainly by transnational companies. Without international legislation to govern the health, safety and environmental performance of companies globally, voluntary initiatives (widely used by transnationals) play an important role in stimulating the adoption of sustainable development principles worldwide. Voluntary initiatives strengthen the role of companies in society (in accordance with requirements established in section 3, principle 30 of Agenda 21).

There are two main ways that transnational mining companies have been involved in voluntary initiatives: as parties to voluntary national initiatives organised by government or industry groups; and, by adopting their own programmes in response to local development needs. Generally, voluntary mining initiatives are important where there is insufficient regulation (or independent monitoring is poor), where it is difficult to regulate (for example social issues such as education and health) or where there is a threat of future regulation (as in emission reduction restrictions).

For the coal industry, there are advantages associated with undertaking early voluntary action. These include improving public perception of the industry, developing new business opportunities for companies (such as trading emission permits, developing new technologies and skills within the organisation) and helping companies to integrate social and environmental factors into management decisions (in accordance with section 1, principle 8 of Agenda 21).

The flexibility of voluntary initiatives that make them popular with mining companies often generates suspicion among policy-makers and members of the public. This is mainly because market pressures often restrict the extent of action, the effectiveness of voluntary initiatives are generally not measured and penalties for failure to meet voluntarily imposed targets are not enforceable (Plahe and van der Gaag 2000). Market pressures often restrict action because of the threat of lost competitiveness against companies not covered by a voluntary initiative. Also, without strong company verification of compliance with the initiative, it is difficult for the market to recognise and reward good performance, eroding the possible benefits from company action.

3a (i) Company initiatives

Company voluntary initiatives are most frequently used to promote social development within local communities. Regulation in this area is light; tighter regulation would reduce the flexibility of voluntary initiatives in meeting localised social needs. Shaping initiatives that best meet the social needs of local communities requires an open and engaging relationship between the local community and mine operators. For transnational coal mining companies, increased engagement in the local community, from project preparation to mine rehabilitation, has been a major area of progress over the last ten years. Increased involvement has flowed into a heightened community and industry awareness of the environmental and social impacts of mining.

The focus of multinational coal mining companies in local communities differs across communities. In developing countries, coal mining companies have been especially active in helping to improve local standards of living and alleviating poverty (in accordance with section 1, principle 3 of Agenda 21). In South Africa, multinational coal mining companies (such as BHP Billiton and Anglo American), along with other industry partners, formed the Powerbelt HIV/AIDS project (launched by the vice president of South Africa), aimed at reducing the spread of HIV/AIDS and improving the conditions of people suffering with the disease.

For its work in preventing the spread of HIV/AIDS, Anglo American was awarded the 1999 Global Business Council HIV/AIDS award. The success of this programme is due mainly to the multifaceted approach adopted. Measures have included targeting community prevention and education, providing counselling to sufferers and families of sufferers and conducting research into the effectiveness of programmes. All measures have been conducted with extensive co-operation between companies and between companies and local community groups.

Voluntary initiatives in developed communities are most often aimed at providing community services and housing to local rural communities to ensure that they are not disadvantaged by their remote location. The initiatives most often involve direct payments to develop or retain services such as medical services, sporting facilities, enhanced schooling opportunities etc. The contribution of funds to support community services and facilities is a more effective way of helping the community rather than the company providing these services directly.

On environmental issues, although there is generally legislation in place setting minimal standards for environmental performance, in many cases, large scale coal mining companies undertake voluntary action to achieve a standard of performance beyond what is required. For example, Anglo Coal is establishing targets (beyond legal requirements) and 'business as usual baselines' for key environmental areas, such as water use, energy consumption and land use.

On the whole, most large scale mining companies seek to minimise their impacts without setting targets. Although there is often no penalty imposed directly on the company for not reaching the target, setting targets helps the collection of information regarding company performance, integrates environmental considerations into company planning, improves transparency and reduces the likelihood of penalties from non-compliance with legislation.

3a (ii) Mining industry organisations

Generally, coal mining industry organisation initiatives focus on issues outside local mining communities that require joint action. Voluntary initiatives undertaken by industry organisations potentially commit a large number of coal producers to take action. This is important because it somewhat defuses the concerns by individual companies that unilateral action to implement principles of sustainable development can affect their competitiveness. Industry body codes of practice are often widely accepted among industry group members and therefore provide an avenue for information sharing, industry-wide data collection and company and industry performance assessment.

Voluntary programmes organised by industry groups generally focus on improving the performance of members within the geographic boundaries in which the industry group operates, because most industry groups are national or sub-national, as is the coverage of voluntary programmes. Multilateral voluntary programmes are more difficult to design and implement because of the wide ranging priorities for action among coal mine operators. However, due to the rise of transnational companies, increased global coal trade and the emergence of transborder pollution issues, there has become an increasing requirement for international co-operation to complement regional and local initiatives.

On a global scale, WCI, the only body that represents the coal industry globally, has developed a set of principles and objectives to help steer company action in promoting sustainable development among member companies (box 2 on pages 10 and 11). These principles and objectives cover a broad range of issues, from support for addressing local

community development issues to furthering the transfer of cleaner coal technologies. National industry initiatives often include a code of 'best practice' for members to minimise the health, safety and environmental impacts from mining. Generally, they are not designed as prescriptive rules, but are principles to be adopted that allow companies to form their own strategies. A comprehensive code of practice is the Minerals Council of Australia's Code for Environmental Management (http://www.minerals.org.au/files/environment/Code2000.pdf) which sets out seven principles that signatories commit to implement progressively.

There are rules for verification associated with this code. Signatories must produce for public distribution an annual environmental report within two years of signing and complete an annual survey to assess compliance with the code (that must be accredited by an auditor at least once every three years). The requirement to produce a survey to verify compliance with the code is a new initiative (2000) and at present there are no results available from the surveys.

A limitation of industry organisations in promoting sustainable development is that they are designed to serve the interests of their members and actions are generally focused on areas of priority for most (or most influential) members. For example, WCI membership outside the large multilateral coal mining companies is limited, and as such, attention has been focused on areas of greatest interest to transnational coal mining companies, such as climate change. A future challenge for any global industrial organisation, including WCI, is how to engage members on sustainable development issues where rewards are often not readily realised by the donors, such as helping locally operated mines in developing countries to develop health, safety and environment reports.

3b Research and development (R&D) and technology transfer

Given that coal is abundant, affordable and widely used, efforts to reduce the environmental impacts of coal, especially coal use, can potentially move the world's energy supply base towards meeting the criteria of sustainable development.

3b (i) Cleaner coal technologies

State-of-the-art developments in coal fired electricity have the capacity to significantly reduce the emissions to air from coal combustion and reduce the environmental impacts from waste disposal. There are many technological options that have been developed to reduce emissions from combustion, many of which have been deployed and are proving highly economic. Efficiency enhancing technologies, such as supercritical pulverised bed combustion, fluidised bed combustion, integrated coal gasification combined cycle systems, cogeneration and hybrid combined cycle technologies, reduce the volume of coal consumed and emissions (CO_2, NOx, SOx and particulates) produced per unit of energy generated and minimise waste residuals.

Further R&D is being undertaken worldwide to improve the environmental and economic performance of coal, in particular coal use. Generally, the research is funded jointly by industry and government, with government grants focused mainly on large scale projects. The United States is the largest contributor to cleaner coal development projects, including methane and CO_2 capture and sequestration, pledging USD2 billion over the next ten years. There is significant co-ordination and information sharing of technological research at an international level through bodies such as the International Committee on Coal Research (ICCR) (refer to http://www.iccr2000.co.za/abouticcr.htm for

more information regarding the activities of the ICCR).

At the 'tail-pipe', carbon capture and sequestration provides the potential to significantly reduce emissions to the atmosphere from coal combustion sources. At present the high cost of carbon capture and storage (estimated to be between USD150 to USD220 per tonne of carbon) renders this option uneconomic. However, given the extensive potential of sequestration in the power generation sector, there has been a large increase in funding for these projects with the aim of improving its economic viability.

For example, the United States Department of Energy (USDOE) has increased its funding for these projects from USD6 million last financial year to USD19 million this year with the aim of reducing the cost of carbon avoided to USD10 per tonne or less by 2015 (refer to http://www.fe.doe.gov/coal_power/sequestration/index.shtml for more information regarding USDOE carbon sequestration projects for coal combustion).

Potential emission abatement from the deployment of these technologies is great. For example, if developing countries were to update existing coal fired technologies with the commercially available cleaner coal combustion technologies, it is estimated that emissions per unit of electricity would be reduced by around 36% per unit of electricity produced (IEA 1999a). For more detailed information regarding cleaner coal technologies, refer to the 'Clean Coal Technologies' link on the WCI Web site (http://www.wci-coal.com).

Adoption of cleaner coal technologies

The rate of adoption of higher efficiency technologies worldwide is ongoing, but there are a number of issues that limit the deployment of these technologies: investment in new capacity, fuel choice and technology choice. Energy market reform over the last ten years, especially in OECD countries, has increased competition in energy markets and in turn has delivered efficiency improvements and lower electricity prices. In many cases, such as in the United Kingdom and Australia, competition between generators has been particularly intense, driven in part by over-capacity. Prior to energy reform, decisions regarding capacity and fuel choices were based on political considerations, and in many cases, past government investment decisions have led to over capitalisation (Short et al. 2001). On the whole, low electricity prices in newly reformed energy markets have acted as a barrier to investment in new capacity.

In terms of selecting between energy sources in electricity generation, there have been a number of developments that have hindered investment in coal fired generation. These include:

- unresolved issues relating to the Kyoto Protocol (such as access to flexibility mechanisms) have created uncertainty over the future cost of using fossil fuels relative to alternative energy sources;
- the large reductions in NOx and SOx emissions from coal fired power plants, in meeting increasingly stringent environmental expectations, has increased the cost of using coal relative to other energy sources;
- increased trade in gas, albeit from a few sources, coupled with the relatively low establishment costs of gas plants (short development time and low capital costs), and an investor preference for immediate returns (as opposed to uncertain returns in the future), have increased investment in gas fired plants at the expense of coal. However, this trend could be reversed if recent fluctuations in gas prices continue, especially in the face of ongoing productivity improvements in coal production.

Not withstanding the limitations described above, coal fired technologies remain an economically viable source of electricity generation today and will continue to be in the future (subject to the design of future policies). Investment in coal fired capacity is ongoing, especially in developing countries where energy demand is growing strongly. However, the technologies of choice are not always the most efficient cleaner coal technologies. Cleaner coal technologies require specialist implementation and management skills and there is limited 'hands on' experience available in many countries.

First adopters of new technologies generally suffer from high set-up and management costs associated with higher capital costs – from design problems, improper installation and lack of plant management expertise. Utilities, especially when faced with high establishment costs and uncertain prices from a competitive electricity market, are unwilling to accept the cost of establishing new technologies. Further, in competitive electricity markets where new technology coal plants are in operation, information regarding production costs is guarded by utilities, creating a barrier to the adoption of cleaner coal technologies (IEA 1996).

Although cleaner coal technologies have been more widely adopted in developed countries, such as in Europe and Japan, there is growing momentum for greater adoption in developing countries (section IV, principle 34 of Agenda 21). Coal fired technologies in these countries are often old and inefficient (figure 9 on page 43) and given the high projected growth in coal use in these countries, it is important to encourage replacement with state of the art technologies to reduce CO_2 emissions.

The programmes under way to increase the rate of cleaner coal technology transfer are generally co-operative initiatives, where demonstration plants are established in developing countries with the support of foreign capital. For developed countries, providing assistance for demonstration projects (either given by governments or by companies) helps to build relationships between local utility companies and government officials and encourages the further deployment (exports) of technological equipment and expertise overseas. An example is the United States Export-Import Bank initiative that provides favourable finance terms for cleaner coal projects that promote the sale of United States goods internationally. It was responsible for financing the first IGCC demonstration plant to be built in a developing country (India).

The development and application of cleaner coal technologies is a priority under China's tenth five-year plan and is made law under Article 36 of the 1996 Coal Law. There are currently two cleaner coal technology demonstration projects in China, a pressurised fluidised bed combined cycle plant (for more information visit http://www.acca21.edu.cn/indexe8.html), and an integrated coal gasification combined cycle plant (for more information visit http://www.acca21.edu.cn/pp4-1.html).

The funding for these projects is from foreign utility companies, foreign governments – through low interest loans – and by the Chinese government. These demonstration projects have helped build international technical co-operation, information sharing on issues of cleaner coal plant development, improved technical expertise in China and developed relationships between foreign companies and Chinese.

There is also scope in the future for investors from developed countries to gain further benefits under the Kyoto Protocol Clean Development Mechanism (CDM). Investment in cleaner coal and sequestration activities in developing countries reduce greenhouse gas emissions to atmosphere relative to a 'business as usual' scenario. These reductions (referred

to as certified emission reduction units – CERs) can be traded on an international permit market and the benefits shared between the host and investor on a case by case basis. However, the benefits from investing in CDM projects are likely to be dependent on the rules (yet to be decided) governing the calculation of baseline emission levels and the cost of abatement from other sources (such as abatement within developed countries).

Without the United States participation in the Kyoto Protocol, the demand and price for internationally traded permits is likely to be low, causing additional returns provided by the CDM to be minimal in the first commitment period. This is a potential barrier to further technology transfer of cleaner coal technologies in the medium-term.

3b (ii) Waste minimisation and waste management technologies

Effective regulation regarding waste disposal in developed countries has led to the development of technologies that reduce environmental impacts from waste disposal, either by minimising the production of waste, or by managing waste at the tail-pipe (in accordance with section II, principle 21 of Agenda 21).

Coal cleaning is the best and most widely used technology to reduce the production of UCCW. It lowers the ash content of coal by as much as 50% to 70% (Stultz and Kito, 1992) and reduces the sulphur content of coal. Coal washing of high ash content coal is widespread in developed countries and is being increasingly adopted in developing countries (especially in China and India where much of the local coal has high ash and sulphur levels), although there is scope for further improvement. In China around 22% of total coal production is washed and there are plans to extend coal washing capacity further; however access to water is a serious constraint to further development (IEA 1999b).

In India, the government has introduced regulation for all coal fired power plants built after 2000 to wash coal from local mines. A further barrier to the development of coal washing plants, especially in China and India, is the high capital cost required in establishing washeries. This is an especially pertinent consideration when compared with the alternative of replacing the production of domestic coal with imports of washed low ash, low sulphur coal from a number of import sources such as Indonesia and Australia.

Reprocessing UCCW into building materials is an effective and economic way of reducing the environmental impact of waste disposal. In 1999, the European Union (EU) used around 50% of the fly ash and bottom ash produced (in construction materials), 87% of gypsum from flue gas desulphurisation waste and 100% of boiler slag (ECOBA 2001). The use of UCCW in building and construction to replace other manufactured products (such as cement), saves resources (like sand and fossil fuels) and reduces emissions in the manufacturing of these products.

3c Education and skill development

Educational and skill development programmes for large scale mining companies vary according to the education level of workers and the community development needs. In developing countries, programmes are tailored at assisting the basic education levels of workers and the general community. For example, Anglo Coal and BHP Billiton make basic adult education and training available for all workers at their South African operations (and in Anglo's case their dependants as well). Improving the education level of workers helps improve the safety and environmental performance of mines.

BHP Billiton and Anglo Coal are also involved in programmes to develop the skill levels of local businesses and schools in South African

mining communities. Often local businesses provide services to the mines or mine workers directly and it is in the best interests of the mine operators to improve the performance of these businesses. In addition, management programmes are frequently designed to help local school administrators and the cost of school buildings and equipment is often met, at least partly, through contributions from local mines. Improving the education and skill levels of the local community helps to attract investment to regional communities – essential to sustaining the community after mine closure.

Programmes aimed at improving the awareness of environmental, health and safety issues have been instrumental in reducing mine accidents and reducing the environmental impacts of coal mining. Many large scale coal mining operations are acting to empower all mine workers, through education, to become responsible for the consequences of their own (and their team's) actions. Greater awareness, continual discussion and sharing of information on potential health and safety risks (and methods to reduce risks) among all levels of workers has been an important factor underlying Australia's leading health and safety performance in coal mines.

So far, education programmes to promote the principles of sustainable development have focused on the development of mine site and local community education. This generally has not included education on how the local community members can apply the principles of sustainable development to their own consumption and production patterns (outside the mine).

3d Information management

Information management, in this report, refers to the collection, presentation, distribution, validation and use of company information (within and outside of the company) on the performance of the three pillars of sustainable development (measures to improve coal user information management is beyond this report). Since the Rio Earth Summit, large scale coal mining companies, together with companies in other sections of the mining industry, have made large strides towards improving the transparency of their operations. They have achieved this by increasing accessibility to information regarding mining operations and through improving their relationship with local communities.

3d (i) Health, safety and environment (HSE) reporting

The extent of health, safety and environment reporting varies across regions. It is generally not a legal requirement of companies to produce an HSE report, although it is compulsory to produce an environment report in Australia (for guidelines on producing environmental reports in New South Wales visit http://www.minerals.nsw.gov.au/enviro/policy/edg05.htm). Most transnational coal mining companies produce health, environment and safety reports because they have a commitment to public transparency (and to shareholders) and/or they are signatories to a voluntary agreement that requires them to produce a HSE report.

For many locally operated medium and small scale mines in developing countries, there is almost no social and environment reporting beyond reporting coal mine accidents and deaths, and most information regarding performance is only made available through the media, usually highlighting social or environmental catastrophes.

For mine operators that do not produce reports, barriers to reporting include the perception of uncertain benefits coupled with certain costs, lack of expertise on how to measure performance and historical dependence, in some countries, on governments to force action on environment and social matters. Often there is also a

general reluctance to divulge company information for fear of competitive (and or public) reprisals or government regulation.

In the absence of standard guidelines for health, safety and environment reporting, the type of data collected and presented varies greatly. A common difficulty is measuring how the operations of the mine affect the social well-being of the community. Some companies measure their contribution in terms of the financial contribution to the community, while others use a qualitative approach to describe how the company has assisted or hindered the community.

The level at which the company performance is reviewed varies across companies. Some companies evaluate their performance on a company-wide basis, including other areas of their activity that are unrelated to coal mining, while some evaluate their coal activity separately, even down to individual mine evaluations. This makes evaluating the performance of the global coal mining industry on sustainable development difficult.

Despite some shortcomings in comparing company HSE reports, many companies are going through a learning phase and are producing reports for the first time. At the other end of the spectrum, some companies are producing detailed HSE reports and are establishing both short-term and long-term targets for environmental, health and safety performance.

3d (ii) Consultation with local communities

Consultation with local communities and addressing their concerns is a requirement in most developed countries and South Africa prior to mine development. On top of meeting local legal requirements, many coal mining companies have made large strides towards engaging local communities in addressing the local impacts of mining (section 3, principle 26 of Agenda 21). The benefits of engaging local communities include improved worker morale and productivity, increased ability of the company to attract employees from the local community, a greater awareness of public perception and public concerns (allowing companies to take preventative action) and the early identification of unexpected social and environmental impacts.

There are many schemes that companies employ to help build trust in local communities. These include 'open mine' policies which give stakeholders from the community the opportunity to tour the mine. Some companies have established a community telephone access facility for the public (often manned 24 hours) to discuss issues regarding the mine – such as dust levels, noise, disturbance of property from vibration etc. Another measure to enhance community information and understanding is the development of databases for the listing of mine and community contacts to provide an avenue for the discussion/resolution of issues relating to the impacts of mines on local communities (refer to box 3 overleaf).

3e Government initiatives and regulation

Government involvement in the coal mining industry varies across countries. In regions such as eastern Europe and Russia, China and India, there has been a long history of government involvement in coal mining. In countries such as Australia, the United States and South Africa, government involvement in the (modern) coal mining industry has been minimal with most mine development undertaken by private investors. The recent development of major coal export activities in Indonesia and Colombia has also been undertaken by the private sector, with significant foreign investment.

As a minimum, government initiatives establish laws of resource ownership and utilisation with minimum health, safety and environmental

Box 3: Engaging the community – a case study in South Africa

A joint programme between non-government organisations (NGOs), community-based organisations (CBOs), mining companies and the South African Chamber of Mines, is a good example of the strong commitment of the mining industry to building trust in local communities. The programme's main output is a database of mine and community group contacts (NGOs and CBOs) that members of local communities can use to discuss and/or resolve issues regarding the impacts of the mine. For locals and the mining companies, identifying local community groups gives them points of reference to discuss mine developments and impacts, impact minimisation strategies and community development programmes.

The database is published on the Internet and is accompanied by step-by-step instructions on how the public should use the database to discuss an issue with a mining company (http://www.cominfo.org.za/mcc/intro.htm). Where an issue is not resolved satisfactorily, the Chamber of Mines will seek resolution of the issue on behalf of the community. In the future, the programme hopes to publish examples of good mine management practices in South Africa. The success of the programme has been hindered by the poor Internet access in rural communities. To counter this problem, hard copies of the database have been made available to local NGOs and CBOs.

requirements that are accompanied with penalties for breaches. These requirements and penalties act to protect investors, workers, the environment and the public. However, legislation that sets minimum standards generally does not reward producers and consumers of coal that perform above these standards.

In some developing countries, coal mining legislation does not set out specific requirements, but establishes broad goals or principles. For example, in China, there are few specific environmental requirements and although an environmental impact assessment (EIA) is required before mining commencement, there are no detailed EIA implementation requirements in mining regulations (ERM China 2001). Also, legislation is often only effective in regulating the consequences of mining that can be easily measured, such as mine water run-off, emissions and work place injuries. It is more difficult to apply effective regulations to social indicators such as the effects of mining on local culture.

In a competitive and global coal market, the risk of lost international competitiveness from implementing national regulations can act as impediments to regulation in coal use and coal production. For coal producers that face international competition, there is little scope for passing increased costs associated with complying with national legislation onto coal users and thus they must bear the cost. For some producers, this translates into smaller margins; however, for relatively high cost mines with slim margins, this may result in mine closure and increased regional unemployment. Regulations that threaten mine closure or reduced employment levels are avoided, especially in regions with high rural unemployment and/or a highly unionised workforce.

3e (i) Market mechanisms

To endeavour to protect the environment, governments are increasingly looking towards market mechanisms that can achieve environmental standards at a lower cost, rather than 'command and control' methods to regulate company behaviour. The most common market mechanisms that encourage good behaviour or discourage unsustainable behaviour are taxes, subsidies and permit trading.

The problem with using taxes and subsidies is that there is no control on the overall level of environmental performance that will be obtained from the tax or subsidy, requiring constant revision of the tax or subsidy to reach a target level of performance, creating uncertainty for market participants. However, taxes remain attractive to governments, often for revenue reasons and because they are easy to implement and administer relative to permit trading.

If a specific level of environmental performance is required, permit trading allows the target to be met at least cost (assuming the market is competitive and the cost of administration and permit trading is zero). Permit trading typically allows the government to set the acceptable level of environmental performance as a whole and enables industry participants to decide through the market how to meet the performance targets. There is extensive literature on the benefits and limitations of different market mechanisms and reviewing this literature is beyond the scope of this report (see for example Hinchy et al. 1998 and Fisher et al. 1996).

Market mechanisms have been used effectively to meet strict environmental standards and at the same time minimise economic impacts, maintaining employment levels and thus contributing to social sustainability. The best example is the United States Environmental Protection Agency's SO_2 and NOx emissions trading scheme that has reduced emissions of NOx and SO_2 significantly, while minimising the cost on the economy.

Under this scheme each utility is afforded the opportunity to minimise the cost of compliance by choosing between emissions reductions – switching to low sulphur coals, installing emission control equipment - and purchasing permits to meet their target. To ensure compliance, each utility is fitted with a constant monitoring unit that measures emission levels of NOx and SO_2. The success of the scheme has led to an additional 76 utilities volunteering to join (at June 2001) over and above the original 110 utilities who came under the scheme in 1995.

Market mechanisms are currently being (and will continue to be) deployed as a key tool for controlling greenhouse gas emissions. However, the choice and design of market mechanisms will be crucial to the future of the coal industry. If governments 'pick and choose' the sources of GHG emissions that should be discouraged, for example by exempting certain sources from a national trading scheme – such as non-CO_2 emissions from natural gas extraction and distribution, transport or agriculture – the cost of compliance will not be minimised.

Instead, low cost abatement options will be foregone and the burden of abatement action will fall on the sources that government selects. For the coal industry, any narrowing of possible emission reduction sources, especially in relation to gas production, will increase the early (and costly) retirement of coal fired power plants. This has serious implications for energy security, especially in regions, such as the EU, where nuclear and hydro expansion is restricted (due to political and capacity constraints) and an increasing proportion of gas demand must be met from an insecure and volatile international gas market.

3e (ii) Health and safety and small scale mining

Although small scale mining only comprises a portion of total coal production worldwide, the poor health, safety and environmental performance of this sub-sector (which does not reflect the performance of the industry as a whole) requires special attention. Actions to improve the performance of this sub-sector must be based on an understanding of the causes of small scale mining. To demonstrate different government approaches to small scale mining and to analyse their effectiveness in promoting sustainable development, two

cases are examined and evaluated, one in Colombia and the other in China.

Since 1993, the government in Colombia has implemented a programme to bring small scale illegal mines under national legislation. Central to this programme was the Legislation Social Programme (LSP) which gave current small scale mines that operate outside the law six months to apply for a mining licence. To attract illegal miners to co-operate, Ecocarbon (a state-owned company responsible for coal mining activities) offered legal assistance and training for the legislative process and advertised the programme widely. Further, miners whose applications were approved gained access to low cost loans to fund investment in mining and safety equipment, and training programmes (provided by Ecocarbon and other private mining companies).

In all, 841 applications were received and assessed (by Ecocarbon and consultants) according to their economic and environmental viability. Successful applications were granted a mining licence for two years with the option of extending the licence to ten years if, after training and mine development, it was considered that they could become part of the formal mining sector. Unsuccessful miners were re-trained with the view of re-employment in other industries and finance was provided to local businesses to develop new business activities. The programme has shown immediate benefits with a reduction in reported mine accidents of around 40% since 1993 (Bula 2000). The keys to success of this programme have been:

- the clear identification of the distinct reasons – economic, social and technical – why some mines operate outside the law, together with an understanding of their constraints;
- providing incentives to miners to legalise their operations rather than punishing them for non-compliance and providing them with legal assistance to become compliant;
- administration by a single agency (to avoid administrative tangle) that is well staffed with technical expertise, is well recognised and trusted within the mining community;
- ample funds to facilitate the programme (in this case from royalties collected from coal production in medium and large scale mines);
- actions to address the long-run sustainability of mining have attempted to minimise the social costs of readjustment through training and development of alternative local businesses.

For China, small scale mining is not treated separately from other forms of coal mining and therefore efforts to improve the health, safety and environmental performance of small scale mines are the same as applied to larger state owned mines. Legislation has been the main policy tool and includes the Coal Mine Safety Law (1992), general Coal Law (1996) and the establishment of the State Bureau for Supervising Coal Mine Safety (2000) to raise awareness of the law and empower inspectors to close (or suspend) mines where they see fit. The layers of regulations governing coal mines, often overlapping makes compliance complicated, especially for small scale mine operators who are often poorly trained and educated.

The effectiveness of tightening legislation has had little effect on the performance of small scale mines. In 1995, 72% of coal mine fatalities occurred in small scale mines, 30% of these mines operated without a permit and 70% failed to meet minimum health and safety standards (IEA 1999b). Poor compliance with government health and safety regulations among small scale mines in China is usually the result of a lack of capital, education or skill level. Inadequate mine inspection is also a problem because of shortages of trained staff to inspect the large number of small scale

mines. The Chinese government estimates a requirement of 500,000 mine inspectors, but at present it only has a few thousand inspectors to monitor 200,000 mines.

Nonetheless, increased mine inspection since 1995 has led to the closure of at least 60,000 small mines, including both government owned and illegal operations, leaving only 23,000 registered small scale mines (down from 82,000 in 1997). In response to the 2,378 reported coal mine accidents (and 4,500 deaths) for the first ten months of 2001, the government ordered all small scale mines to stop production for further safety inspections.

The repercussions for small scale miners are more mine closures and increased punishment for those held responsible for accidents. However, closure of these mines extinguishes an important (sometimes only) source of local employment. It is likely that without further training or funding of projects to promote local business development, many miners from these closed operations will be forced to commence or recommence illegal mining. Action to reduce the negative impacts of small scale mining (legal or illegal) must be made within a framework to addresses rural poverty.

For China's major coal mines, the government recently announced a programme to upgrade mine safety equipment and allocated USD65 million to improve safety in 81 mines.

3e (iii) Coal mining industry adjustment

With the globalisation of the coal market, coal mining is becoming more competitive; smaller inefficient mines are being forced to close and potentially economic mine sites are being forced to upgrade capital equipment. In countries that have traditionally protected coal mining activities from international market forces, such as China, Russia, India, Poland and the Czech Republic, there is widespread mine closure, and where potentially economic mine sites still exist, there is urgent need for capital investment to maintain the viability of these mines.

In general, government response to increased capital requirements in coal mines has been to look to the private sector by allowing private investment in existing state and locally owned mines and/or by allowing direct investment to commence new mines. However, in some cases, such as in India, there are constraints on the extent of private investment from foreign sources.

There are a number of issues that hinder investment in coal mining in developing and eastern European countries. These include political and economic instability in these countries, corruption (within organisations controlling mining) and mine equipment theft, restrictions on foreign investment, poor historical environmental and social performance, poor transportation networks to access export markets, government coal price controls and high levels of bureaucratic overlap.

Nonetheless, increased investment is essential to help these countries maintain a viable coal mining industry, and in the case of countries such as China and India, to help them improve their health, safety and environmental performance (China Labour Bulletin 2001b). Helping developing countries to attract foreign investment requires a better understanding of the impediments to investment in these countries.

Without alternative sources of rural employment, mine closure has increased unemployment and intensified rural poverty and in some cases illegal mining. Government efforts to alleviate the social impacts from coal mine readjustment are often hampered by lack of funds. This is where the World Bank has made a large contribution, mainly through the provision of loans, especially in eastern Europe. In Russia, the World Bank has granted the government USD1.2 billion in loans to support

its coal mining industry readjustment programme. The programme includes actions to improve the efficiency of economically viable plants and measures to minimise the social impacts from the dislocation of miners (visit the Web site http://www.worldbank.org.ru/eng/news/announcements/announ4.htm for more information).

3f Conclusions

There is a wide range of programmes adopted to help move the coal industry onto a path of sustainable development. However, the extent of the initiatives, especially among coal mining operators is far greater in developed countries (where large scale mines predominate) and in developing countries where transnational mining companies operate.

Over the last ten years, consolidation of the coal mining industry, together with the growth in world coal trade, has increased the proportion of the world coal demand met by transnational mining companies. These companies' mines are technologically advanced, highly capital intensive and achieve the highest environmental, health and safety standards globally. There is an increasing reliance on these companies, through the transfer of good mining practice, to provide stewardship for the implementation of the principles of Agenda 21 globally.

Among large scale coal mining companies (national and transnational), the key programmes in implementing the principles of sustainable development are voluntary initiatives, education and skill development, research and development and technology transfer, information management and government initiatives. The greatest advances that these companies have made is in improving their transparency and public accountability, building relationships with local communities based on trust and becoming engaged in local community programmes and bringing environmental impacts into the forefront of mine management. Recently there has been an encouraging development of greater collaboration between these companies and coal users on research and development programmes.

For developing countries and economies in transition, the emphasis of sustainable development initiatives (mostly from government) has been on economic development and enhancing the utilisation of local coal resources. The main measure to achieve this goal has been to close inefficient mines and modernise economically viable mines with the help of increased private investment. Nonetheless, there are programmes under way to improve the safety performance of coal mines and reduce the environmental damage from coal use in these countries.

The impediments to the effectiveness of these programmes include, rural poverty, a lack of understanding of the causes of small scale mining, education and skill deficiencies and access to funds for investment in capital equipment that will improve environmental and safety performance.

Long-term, the greatest challenge facing the future of the global coal industry is to reduce emissions of greenhouse gases. The coal industry recognises the significant contribution that it can make to reduce the risk of human-induced global warming though the development and deployment of low cost technological solutions. The coal industry also recognises that government policies designed to reduce greenhouse gas emissions must allow abatement from a wide range of sources using flexible market mechanisms (such as permit trading) otherwise the burden of adjustment will be unnecessarily high in the coal industry.

A key problem for the coal industry in addressing climate change, and other issues related to coal use, is that there is little

co-operation between coal producers and coal users in programmes to develop the economic viability of cleaner coal technologies. However, recent evidence suggests that this shortcoming is now recognised by leading industry players and steps are being taken to increase co-operation between the two parts of the industry.

Although the industry has made great strides in improving transparency, there are still steps that the industry could take to further this process. A first step would be to improve the standards of health, safety and environmental reporting and seek to increase the rate of reporting. Greater vigour applied to measuring performance across the industry will enable the effectiveness of voluntary initiatives to be evaluated globally, enable good performing companies to be recognised and rewarded (through the markets) and allow civil society to verify performance.

Part 4: Moving forward

The tenth anniversary of the Earth Summit provides the coal industry with an opportunity to review its performance in promoting sustainable development, to recognise where it has been successful and where further action is required. In Part 3, the key areas for further action were recognised. The purpose of this chapter is to consider a set of goals that the global coal industry as a whole should aim for over the next ten years and to explore the mechanisms that may be adopted by the coal industry to meet these objectives.

4a Key areas of improvement

There are seven key areas that the coal industry should address in the next ten years to move it further along the path to sustainable development. These areas are listed in box 4.

Improving the health, safety and environmental performance of coal mining, and minimising the environmental impacts of coal use globally, is essential to move the coal industry onto the path of sustainable development. In terms of the key areas of improvement (in box 4), special attention is given to addressing the impacts of coal mining and coal use in developing countries, especially impacts related to poverty – low efficiency use of coal in households and small scale coal mining. Issues relating to developing countries require urgent action because of the magnitude of the problems and because they do not have the capacity to address these problems unilaterally. The key areas of improvement in box 4 are not ranked according to urgency of action required.

4b Instigating change

To be effective in initiating improvement in key areas, the measures discussed below in many cases need to be implemented together because the successful adoption of one measure is dependent on the successful adoption of other measures. For example, implementing measures that improve the availability of industry-wide information are vital to identifying areas that need improvement in developing countries.

Box 4: Key areas of improvement in the coal mining industry for 2012

1. Increase the understanding of the principles of sustainable development within the industry and among local mining communities.
2. Build strong leadership within the industry to help implement the principles of sustainable development worldwide and foster greater co-operation with multi-stakeholders.
3. Improve the health and safety performance of coal mining, especially in developing countries.
4. Reduce the environmental impacts of coal production and use, especially in developing countries.
5. Further the development and deployment of cleaner coal technologies and carbon capture and sequestration technologies worldwide.
6. Improve the collection, collation and distribution of information regarding environmental, health and safety impacts – with enhanced transparency and recognition of exemplary performance.
7. Demonstrate the effectiveness of voluntary agreements in achieving progress on sustainable development in order to enhance their credibility.

4b (i) Developing strong leadership and co-operation

Goals for 2012:

- empower a coal industry body to encourage the implementation of the principles of sustainable development,
- develop closer working relationships among coal producers, coal users, government and civil society.

Given the diverse nature of the worldwide coal industry, achieving these goals will require a great deal of co-operation within and outside the industry (governments and civil society groups). Historically, the extent and types of company and government initiatives have varied widely according to regional and local priorities, which is understandable and appropriate. However, there have been a number of developments over the last ten years that have increased both the need and capacity for greater global co-operation to effectively implement principles of sustainable development. These include:

- the increasing role of transnational coal producers;
- an enhanced sense of corporate accountability and responsibility;
- increased availability of information and greater public awareness of health, safety and environment issues;
- increased trade in coal;
- action to mitigate transboundary pollution problems from coal use – SOx, NOx and CO_2.

Taking coal production and use to a higher level of sustainability will require international industry leadership in promoting the principles of sustainable development and facilitating their implementation worldwide. This is a major challenge for the coal industry.

A step along this path has been taken by the members of WCI in developing the sustainability principles outlined in Part 3. WCI plans to conduct a series of regional stakeholder workshops (the first to be in south-east Asia in April 2002) to help to give effect to the principles by exploring the factors for, and impediments to, clean coal technology transfer.

This development of leadership within the coal industry needs to be accompanied by greater participation in and with civil society to benefit from their expertise and explore co-operative ways to improve the standing of coal industry programmes. Educational institutions, NGOs and other national and international organisations are increasingly willing to work with industry and represent an important information source to help coal companies develop and deliver credible social and environmental programmes outcomes at affordable cost.

A first step to greater engagement with civil society should be for coal industry organisations to encourage members to develop stronger and more involved relationships with these organisations. A formal way of achieving this is to encourage members to join the 'Global Compact'. The Global Compact (first proposed by the United Nations Secretary-General Kofi Annan in 1999) encourages participants to adopt a value-based platform in their business activities that is designed to promote institutional learning and encourages transparency and dialogue between government, business and NGOs. For more information regarding the Global Compact, visit the Web site http://www.unglobalcompact.org/.

4b (ii) Cleaner coal technologies

Goals for 2012:

- carbon capture and sequestration to be economically viable,
- all new investment in coal-fired plant capacity (worldwide) to be cleaner coal technologies,

- continued development of cleaner coal technologies.

Co-operation among stakeholders on the further development and deployment of technologies to significantly reduce, and ultimately eliminate, CO_2 emissions from coal combustion is essential if coal is to have a secure future as a low cost, sustainable energy source and industrial input.

Energy market reform – a role for government

As mentioned in section 3b, there are a number of barriers to the adoption of cleaner coal technologies and sequestration technologies – electricity market liberalisation, high set-up costs for coal fired plants, information gaps and information protection. Increasing the resources available for the development and deployment of new technologies that reduce emissions of greenhouse gases should be a focus of attention for government.

Governments can contribute to the development and deployment of cleaner coal technologies by funding research and development projects in cleaner coal technologies on an equal footing with the funding of other emission-reducing technologies, such as renewables. These projects endeavour to reduce the cost and information barriers to adopting new technologies and to improve their environmental performance.

One alternative is for governments to redirect resources currently made available for the subsidisation of fossil fuel industries, including coal, to the development and deployment of emission-reducing technologies, including cleaner coal and carbon sequestration. Removing subsidies on fossil fuels will also reduce emissions by helping to establish energy prices that reflect the true cost of production, in turn enhancing more efficient energy use.

Providing access to affordable energy should be achieved through more widespread market reform to enhance competition and efficiency gains in energy production and distribution. Actions to reduce energy poverty should focus on providing targeted assistance to the poor, rather than subsidising inappropriate and inefficient energy practices by all.

The contribution of coal fired electricity (and cleaner coal technologies), especially in a competitive electricity market, will depend to some degree on the design of government policy. In newly deregulated electricity markets, where there generally has been over capacity, there has been no framework to internalise externalities related to energy security, which in many cases (such as in the EU) has concentrated recent investment on gas fired plants. This has increased reliance on gas imports, often from unstable sources (refer to IEA 2001d for a discussion on externalities relating to energy choices).

Another major failure of liberalised energy/carbon markets is their inability to factor the true life cycle emissions of alternative fuel sources into prices. Energy prices and emission penalties applying at the point of generation/combustion will not reflect the actual incidence of greenhouse gas emissions occurring at all stages in the production, transportation, use and disposal of a fuel source – and, therefore, will not send the right signals to energy producers and consumers about modifying their investment and consumption choices to minimise emissions.

These fundamental market failures bias the development of electricity generation away from coal and clean coal technology, and provide the justification for government intervention. Government assistance for research and development into CCTs, and their deployment to developing countries, is needed in place of existing fossil fuel subsidies that distort consumption and investment decisions and perpetuate inefficiencies.

Flexibility mechanisms

Where governments seek to reduce emissions, policies should be designed to meet long-term emission abatement targets at minimum cost to the global economy to allow sustainable economic development. In fact, minimising the economic impacts of emission abatement actions on developing countries (that may arise due to trade and investment impacts, such as reduced exports of coal to developed countries) is a requirement of Article 4.8 of the Kyoto Protocol (for a description of the economic impacts of the Kyoto Protocol on developing countries, refer to Polidano et al. 2000).

To achieve this goal, governments should not limit abatement to a few sources, but instead allow abatement from a wide range of verifiable sources (such as fugitive emissions from fossil fuel extraction, agriculture and transport). At the same time, governments should minimise the barriers to the use of flexibility mechanisms – emissions trading, CDM, Joint Implementation (JI) and bubble arrangements. For illustrative purposes only, it is estimated (Polidano et al. 2000) that allowing developed (Annexe B) countries access to international emissions trading (under the Kyoto Protocol with United States participation) reduces lost coal export earnings in developing countries (from lower global coal demand) by at least USD515 million (1995 terms).

Assisting in the development of these as yet formative mechanisms would be one way for the coal industry to enhance co-operation within its own ranks and with other stakeholders, and demonstrate leadership on climate change. In particular, the project-based nature of CDM and JI mean they are suited to collaboration focused on clean coal technology, and the experiences from projects already underway (for example there are two cleaner coal projects of this type in China) could provide a basis on which to build a project-facilitation programme encompassing information exchange/shared experience and joint investigation of the impediments to/requirements of successful projects.

Information dispersal

Utility manufacturers and operators that have invested time, money and expertise in building and operating cleaner coal technologies protect information regarding the economic cost (especially capital cost) of their utilities because it has strategic and market value (IEA 1996). As cleaner coal and sequestration technologies become more cost competitive in a larger number of locations, there will be an increasing need to make information regarding the performance of these technologies more widely available. It is important that information is made available in an easily comparable form to encourage investment in new capacity and to ensure an efficient allocation of investment funds among technologies.

Up until now, there has been little consideration of how the protection of information affects investment decisions in electricity generation in deregulated markets. This is mainly because there is still over-capacity in many of these markets – a hangover from investment decisions prior to deregulation. The threat of future capacity shortages (as occurred in California) should prompt research to address this question.

Industry organisations can play an important role in dispersing information by working together to produce an Internet accessible database that compares the performance of different types of plants in different locations. Industry organisations and NGOs (with an interest in the deployment of emission-reducing technologies) and governments should encourage utilities to contribute information regarding plant performance for the development of such a database. Also, information regarding the environmental impacts of operating technologies could be obtained if utility companies improved the

standards of their HSE reporting (outlined below in section 4b (iii)).

4b (iii) Improve the collection, collation and distribution of information

Goals for 2012:

- coal industry-wide HSE reporting using a standardised system of reporting,
- produce a triennial report that identifies key areas of improvement and areas for further development in implementing the principles of sustainable development in the coal industry.

Evaluating the progress of the coal industry on sustainability grounds is made more difficult by the lack of information on coal mine health, safety and environmental performance and of data measuring the environmental and social impacts of coal use (at a company and national level). This is likely to remain a problem for many years to come; it is unrealistic to expect that the goals outlined above will be achieved on a fully comprehensive basis. Outside large transnational companies, there is a low rate of environmental, health and safety reporting in the industry, particularly in many developing countries.

Of the companies that produce HSE reports, most measure only some of the impacts of their coal mines and there is no standard way of reporting, making comparisons of performance at a national and global level problematic. Overall, this affects the transparency of the industry and makes public accountability difficult. In the future, enhanced HSE reporting will be required to help direct decisions and resources – especially in capital markets – towards practices of sustainable development, and it is crucial that the coal industry takes early action to meet these expectations.

Consistent HSE reporting

To meet the growing demand (from governments, NGOs and investors) for transparency, the coal industry should establish a code for measuring the performance of companies within the industry worldwide. This would:

- benchmark coal companies' performance and improve transparency for investors and buyers of coal,
- simplify HSE reporting and verification,
- help support company management systems and performance targets.

Without the help of international law, the implementation of a standard HSE reporting code, such as the Global Reporting Initiative (GRI), will be largely voluntary. Large transnational mining companies that already produce HSE reports should take the lead in adopting such a code and encourage other coal producers to do the same through the GRI network.

The vision of the GRI (mainly funded by the UN) is 'to make sustainable reporting as routine and as credible as financial reporting in terms of comparability, rigor and verifiability' (refer to http://www.globalreporting.org/ for more information). At present, the guidelines are available only in draft form and are being tested by a range of companies. It is expected that by 2002 the GRI will be permanent; it could be an appropriate vehicle for the coal industry to improve HSE reporting.

Triennial coal performance report

Participating in efforts to standardise and improve reporting on business sustainable development performance worldwide should be accompanied with appropriate data collection and analysis to evaluate the performance of the global industry. The two main sources of information for this report could be the HSE reports (from mining companies and coal users) and the database of environmental and economic performance

suggested in section 2b (ii). This report would benefit the industry by enabling the effectiveness of voluntary industry initiatives to be easily verified by civil society, enable good performing companies to be identified and rewarded (through capital and end product markets) and counter the often held misconception that the industry is not addressing poor performance.

4b (iv) Improving health, safety and environmental performance in developing countries

Goals for 2012:

- work with governments to eliminate low efficiency use of coal in households;
- bring illegal small scale coal mining into the formal mining sector;
- lift environmental, health and safety management standards worldwide closer to 'best practice'.

To reduce the HSE impacts of coal use and coal production in developing countries, there needs to be two areas of focus. Firstly, addressing rural poverty and the related impacts on community health, safety and environment and secondly, bridging the gap between health, safety and environmental standards in developed countries and developing countries.

Reducing impacts from low efficiency coal use and small scale mining

Low efficiency coal use

The use of coal in unvented household open fires – which causes serious health complications – is due mainly to the low affordability and availability of modern energy such as electricity. For many, this is a general result of rural poverty. Beyond this, solutions should identify ways to minimise the impacts of low efficiency coal use in households and at the same time recognise how alternative energy sources can become more accessible to replace unventilated coal use in households in the longer-term.

Short-term solutions should include providing households with external flues to minimise the exposure to fumes in confined living spaces, educating households and manufacturers of briquettes about the health risks associated with burning poor quality coal and identifying low cost methods to test the safety of the coal before it is burnt.

To eliminate household coal use, governments should aim to improve household access to commercial energy such as electricity, especially where coal use in households is creating serious health threats. Expanding access to electricity for poor communities would also enhance economic and social development (refer to sections 2a (ii) and 2b (ii)) and reduce the environmental impacts associated with inefficient coal combustion.

The focus for achieving this goal should be energy reform. In many developing countries, the provision of household energy (in the form of gas, oil and electricity) is heavily subsidised and lack of competition among producers and distributors creates inefficiencies. Priority for governments should be to remove subsidies and re-channel these funds towards extending energy grids (such as an electricity grid), subsidising household connection costs, and in remote areas, fund the provision of alternative energy systems.

Energy subsidies should be made available only to lower-income households, or they should be compensated for the increased energy costs (from the removal of the subsidy) through direct income payments. To deliver efficiency improvements and lower energy prices, governments should move towards increased private ownership in energy provision within a framework that encourages competition.

Small scale mining

Small scale mining, especially when it operates outside the law at a subsistence level, has the worst health, safety and environmental record

within the coal mining industry and should be given special consideration within a broader programme to alleviate local poverty. Experience in Colombia in bringing illegal small scale coal mining into the formal sector has shown great promise in improving safety in small scale mines and in helping to develop alternative employment opportunities for displaced miners.

To facilitate information sharing on the effectiveness of policies to address small scale mining and to form an action plan to combat small scale mining, an action group should be established by international agencies with participation from stakeholders from Colombia and regions where small scale mining is prevalent (such as China and Indonesia).

The causes of illegal, small scale coal mining are not well understood. Research should be undertaken to identify the extent of small scale coal mining in countries where this occurs (especially in light of government coal mining industry reforms), evaluate environmental, health and safety impacts, understand the causes and recognise the potential effects of future reform. Action to address illegal small scale mining should be focused on limiting their impacts in the short-term by bringing all illegal mines into the formal sector.

Miners from viable mines should be provided with assistance to improve mine efficiency and education to improve health, safety, environmental and economic performance of the mines. In parallel with this adjustment process, there should be programmes operating to establish alternative local industries that will provide a sustainable source of employment for displaced miners and reduce local poverty.

Bridging the HSE gap between developed and developing countries

At present, the only data that is easily accessible on coal mine performance worldwide is mine fatalities, which indicate safety standards in coal mines in developing and transition economies lag well behind standards in developed countries such as Australia, the United States and the United Kingdom (table 7 on page 36). Improving HSE reporting will help better identify specific areas where more action is required.

The large mining companies that predominate in developed countries have a relatively sound performance on environmental, health and safety issues. These companies can play an important role, through information sharing, to help improve the performance of poorer performing mines, especially in developing countries. This information may be dispersed on a global scale by developing a 'global code of good mining practice' that outlines verifiable standards of performance to minimise the health, safety and environmental risks associated with mining.

There currently exist many different codes of conduct at a national level, for example the Minerals Council of Australia's Code for Environmental Management (available at http://www.minerals.org.au/files/environment/Code2000.pdf). Others at a global level only cover certain industries or particular issues, for exmaple the ILO Code of Practice on Safety and Health in Non-ferrous Metals Industries (2001). Whether there should be a code of practice for the coal mining industry specifically (as opposed to a general mining code) should be a topic of further discussion. Developing a global code of practice for the mining industry is likely to be a priority for future work for the newly formed International Council for Mining and Minerals (ICMM).

A more 'hands-on' approach that should work alongside the development and adoption of a global mining code is a 'mentor system' that gives poor performing mines access to the expertise and experience from good performing mines. Where such relationships are practicable, they could be valuable in helping locally operated mines in developing countries build the capacity to implement a HSE reporting framework.

For operational purposes, this relationship should be between companies operating in the same region. As transnational coal mining companies increase their involvement in developing countries, especially in China, opportunities for these companies to act as mentors to locally operated mines will increase.

4b (v) Improving the credibility of voluntary agreements

Goals for 2012:

- increase engagement among multi-stakeholders within and outside the coal industry,
- replace regional voluntary codes with a global code that is constantly evaluated – in terms of global adherence to the code and the suitability of the standards in the code.

Voluntary agreements are an important vehicle for engaging transnational mining companies to address sustainable development. They have arisen mainly because of the difficulties associated with obtaining global, legally binding agreements on matters of health, safety and the environment. However, voluntary agreements often do not have a high credibility among civil society. Concerns over the credibility of these arrangements arise because they are non-binding, their effectiveness is generally not measured and verified by civil society and because competitive pressures often restrict the extent of action.

Global voluntary agreements and strong evaluation

Action should be taken to complement regional agreements (or codes of good practice) with a global code of good mining practice (as discussed in section 4b (iv)). Global agreements (one for coal mining and one for coal use), coupled with improved industry wide performance evaluation and verification, will help to defuse the competitive pressures that often work against voluntary action under regional agreements.

The standards of performance prescribed in a code should be easily verifiable and realistic and adherence to codes should be constantly monitored as part of the triennial coal mining industry performance report (described in section 4b(iii)) and barriers to implementation recognised. To reward good performers, the report should identify the companies who have complied with the code. Reviewing the code should also be an ongoing practice involving multi-stakeholders.

Involving civil society groups

Building networks with civil society including academics, trade unions and NGOs, with the view of engaging them in discussions and information sharing, will help build trust with the wider community. Actively engaging these groups in setting standards and verifying performance will help improve the credibility of voluntary arrangements. If voluntary arrangements do not achieve credibility, there will inevitably be a call to governments for tighter regulation and harsher fines for non-compliance with regulations.

4b (vi) Improve the awareness and understanding of sustainable development

Goals for 2012:

- include an education programme on sustainable development principles in all staff and community education programmes,

- make all coal miners aware of the principles of sustainable development.

Awareness and understanding does not guarantee action, but they are prerequisites for effective action. Coal mining companies can play an important role in educating local communities about the social and environmental consequences of their consumption decisions and production activities and how they can minimise these impacts. The initial focus of company efforts to increase public awareness and understanding of sustainable development should be to increase awareness among their own workers.

Actively involving all levels of mine workers in discussions on health and safety issues has been shown to be effective in reducing mine accidents. This approach should be extended to include environment, economic and social issues.

Coal mines play an important role in educating and supporting education programmes in local communities. This is generally through providing funding to local schools, running education programmes for workers and other community members and through sharing management expertise with local businesses. Coal mining companies should develop and integrate with existing programmes, a sustainable development education programme that is suitable for the local community – taking into account local development needs. These programmes should be developed with the help of local NGOs and CBOs.

4c Conclusions

To date, the coal industry (especially coal producers) have not shown a great deal of leadership in addressing issues that relate to the use of coal because there is little vertical integration within the industry. In addressing issues related to coal production, the wide geographic distribution of coal mining, the varied scale of mining operations and the wide range of issues that vary across location has made co-ordination of efforts difficult. It is imperative that the coal industry better co-ordinates its efforts – under an industry body with greater responsibility and adequate resources – and shows stronger leadership and direction on sustainability issues.

Central to developing and implementing programmes to promote sustainable development, in improving the credibility of voluntary initiatives and improving the public perception of the industry, the coal industry should more actively engage civil society. This should be achieved by developing a greater sense of trust between members of the industry and civil society by involving these groups in designing and verifying voluntary programmes. More formally, greater participation by industry members in international initiatives that include civil society groups (such as the Global Compact) will help foster greater trust.

A limitation of this report has been the lack of information available on company and industry-wide performance on social and environmental development, mainly due to the lack of consistent HSEC (health, safety, environment and community) reporting in the industry. In the future, enhanced levels of HSEC reporting will be expected from business to help direct decisions and resources – especially in capital markets – towards sustainable development practices and it is crucial that the coal mining industry takes early action to meet these expectations.

To allow the market to recognise and reward good performers, to improve the credibility of voluntary agreements, to recognise areas of further improvement and areas of success and to improve the public perception of the industry, it is vital that the industry adopts a standard, well recognised HSEC reporting framework.

Contributing to the understanding and education of local communities and employees is a key component of mining company programmes to promote sustainable development. Extending these programmes to include a component on the principles of sustainable development, including a greater understanding of how consumption choices and production processes affect sustainability, will help implement sustainable development principles in the wider coal community.

Annexe 1: References

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UNEP contribution to the World Summit on Sustainable Development

The mission of the United Nations Environment Programme (UNEP) is to provide leadership and encourage partnerships in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations. **The UNEP Division of Technology, Industry and Economics (DTIE)** contributes to the UNEP mission by encouraging decision-makers in government, business, and industry develop and adopt policies, strategies and practices that are cleaner and safer; make efficient use of natural resources, ensure adequate management of chemicals, incorporate environmental costs, and reduce pollution and risks for humans and the environment.

This report is part of a series facilitated by UNEP DTIE as a contribution to the World Summit on Sustainable Development. UNEP DTIE provided a report outline based on Agenda 21 to interested industrial sectors and co-ordinated a consultation process with relevant stakeholders. In turn, participating industry sectors committed themselves to producing an honest account of performance against sustainability goals.

The full set of reports is available from UNEP DTIE's web site (http://www.uneptie.org/wssd/), which gives further details on the process and the organisations that made it possible. The following is a list of related outputs from this process, all of which are available from UNEP both in electronic version and hardcopy:

- industry sectoral reports, including
  - accounting
  - advertising
  - aluminium
  - automotive
  - aviation
  - chemicals
  - coal
  - construction
  - consulting engineering
  - electricity
  - fertilizer
  - finance and insurance
  - food and drink
  - information and communications technology
  - iron and steel
  - oil and gas
  - railways
  - refrigeration
  - road transport
  - tourism
  - waste management
  - water management

- a compilation of executive summaries of the industry sectoral reports above;
- an overview report by UNEP DTIE;
- a CD-ROM including all of the above documents.

UNEP DTIE is also contributing the following additional products:
- a joint WBCSD/WRI/UNEP publication entitled *Tomorrow's Markets: Global Trends and Their Implications for Business*, presenting the imperative for sustainable business practices;
- a joint WB/UNEP report on innovative finance for sustainability, which highlights new and effective financial mechanisms to address pressing environmental, social and developmental issues;
- two extraordinary issues of UNEP DTIE's quarterly *Industry and Environment* review, addressing key regional industry issues and the broader sustainable development agenda.

More generally, UNEP will be contributing to the World Summit on Sustainable Development with various other products, including:
- the Global Environmental Outlook 3 (GEO 3), UNEP's third state of the environment assessment report;
- a special issue of UNEP's *Our Planet* magazine for World Environment Day, with a focus on the International Year of Mountains;
- the UNEP photobook *Focus on Your World*, with the best images from the Third International Photographic Competition on the Environment.

Sustainability profile of the Coal industry

- Achievements
  - The development and deployment of higher combustion efficiency technologies which reduce emissions of polluting gases.
  - Full Life Cycle Analysis shows that electricity generation from other fuels such as gas may have similar or even higher GHG emissions than coal-based generation.
  - Transnational mining companies have made great advances in improving their transparency and public accountability, building relationships with local communities and becoming engaged in local community programmes, and bringing environmental impacts into the forefront of mine management.

- Unfinished business
  - The coal industry is striving to reduce its environmental footprint from the production and use of coal and minimising coal production impacts on the biosphere (land, water) and on local communities.
  - Continuing reductions in emissions through accelerated technology improvement and transfer are the key to effective, least cost solutions to sustainability and climate change issues, and is the industry's major priority for the future.
  - The World Coal Institute has developed a set of sustainability principles to provide a framework for industry initiatives and guide individual action by member companies. WCI will be conducting a series of regional stakeholder workshops to help give effect to the principles.

- Future challenges and possible commitments
  - Furthering the development and deployment of cleaner coal and carbon capture and sequestration technologies worldwide.
  - Improving the standards of health, safety and environmental reporting and increasing the rate of reporting.
  - Increasing the understanding of the principles of sustainable development within the industry and among local communities.

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