Coal Mining Task Force

Action Plan

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Introduction

The six countries of the Asia-Pacific Partnership on Clean Development and Climate—Australia, China, India, Japan, the Republic of Korea, and the United States of America—are cooperating to meet both their increased energy needs and associated challenges, including those related to air pollution, energy security, and greenhouse gas intensities.

The Partnership has established public-private Task Forces in eight key sectors: (1) cleaner fossil energy; (2) renewable energy and distributed generation; (3) power generation and transmission; (4) steel; (5) aluminium; (6) cement; (7) coal mining; and (8) buildings and appliances. The Task Forces are designed to meet Partnership goals through international cooperation to facilitate the development, diffusion, deployment, and transfer of existing, emerging and longer term cost-effective, cleaner, more efficient technologies and practices among the Partners through concrete and substantial cooperation so as to achieve practical results.

As a product of its first stage of collaboration, each Task Force has created an Action Plan which has been endorsed by the Policy and Implementation Committee. The Action Plans contain an initial set of priority activities for implementation. Some projects contained within the Action Plans may need to be refined or elaborated. Financial resources are needed for the implementation of the Action Plans. Some initial funding from some government and industry sources has already been identified for the implementation of projects. Partner countries will continue to work to mobilize further funding from both public and private sectors in order to bring about full implementation of the practical projects identified in the Action Plans and will continually develop new projects and add them to this set of activities.

Sector Review

Coal is the world's most abundant and widely distributed fossil fuel. It is a global industry that makes a significant economic contribution to the global economy. Coal is mined commercially in more than 50 countries and used in more than 70. Annual world coal consumption is about 5,800 million short tons, of which about 75% is used for electricity production. This consumption is projected to nearly double by the year 2030 to meet the challenge of sustainable development and a growing demand for energy.

Production

Although coal deposits are widely distributed, more than 58% of the world's recoverable reserves are located in four Partners: the United States (27%), China (13%), India (10%) and Australia (8.7%). By rank, anthracite and bituminous coal account for 53% of the estimated recoverable coal reserves (on a tonnage basis), sub-bituminous coal accounts for 30%, and lignite accounts for 17%. In 2004, these four countries, taken together, accounted for about 64% of total world coal production. Partners consume about 65% of the total world production with Japan (183Mt) and South Korea (79Mt) being the world's two largest coal importers for electricity generation and steel production. Coal produces 40% of the world's electricity, which is double the share of its nearest competitors (gas and hydro) and coal is an essential element in over 65% of the world's steel production. These proportions are expected to remain at similar levels over the next 30 years.

Increasing Demand

During the past two years, coal consumption has grown at a faster rate than any other fuel, rising by almost 5% in 2005. Demand for coal in China grew by 11% in 2005, in Japan by 5%, and in the United States by 2%. Lignite, also used in power generation, will grow by 1% per year and demand for coking coal used in iron and steel production will likely increase by 0.9% per year over this period. As the most important fuel for electricity generation, cement manufacturing and paper making and a vital input into steel production, coal will have a major role to play in meeting future energy needs.

The International Energy Agency (IEA) predicts that world energy demand will grow around 60% over the next 30 years, most of it in developing countries. China and India are very large countries in terms of both population and land mass, and both have substantial quantities of coal reserves. Together, they account for 70% of the projected increase in world coal consumption. Strong economic growth is projected for both countries (averaging 6% per year in China and 5.4% per year in India from 2003 to 2030), and much of the increase in their demand for energy, particularly in the industrial and electricity sectors, is expected to be met by coal.

Sustainability

Sustainable economic and social development is unimaginable without access to adequate supplies of electricity. It lights houses, buildings, streets, provides domestic and industrial heat, and powers most equipment used in homes, offices and machinery in factories. Electricity is one of the most effective and environmentally responsible ways of delivering the energy needed for sustainable development. Access to modern energy services not only contributes to economic growth and household incomes but also to the improved quality of life that comes with better education and health services. These are key factors in alleviating poverty.

Coal provides an affordable, safe and increasingly clean fuel for power generation, and can enable widespread access to electricity in a reasonable timeframe. But coal plays other roles in social development. Coal companies are involved in the local communities in which they operate and where their workforces live. Education and skill development programs are an essential component of major coal operations, and the health and welfare of workers is a priority. The development of mine reclamation and closure plans, in consultation with the local community, enables the local society to adapt and respond and ensures a sustainable community even after the mine has closed.

Energy Security

Increases in energy demand means energy security concerns become more important. Energy must be readily available, affordable and able to provide a reliable source of power without vulnerability to long- or short-term disruptions in order to provide solid economic growth and maintain levels of economic performance. A diverse mix of energy sources, each having different advantages, provides security to an energy system by allowing flexibility in meeting each country's needs. Coal has a dominant role to play in meeting the demand for a secure energy supply because it is affordable and, in most circumstances, cheaper per unit of energy than other fuels in the Asia-Pacific Partner countries. Coal prices have also been more stable than oil and gas prices. For example, the delivered cost of coal at U.S. electric utilities in 2005 was $1.53/MMbtu while the average cost of natural gas was $8/MMbtu. The benefits to consumers through lower costs of power generation have been enormous.

Even as demand grows, society expects cleaner energy with less pollution and an increasing emphasis on environmental sustainability. The coal industry recognizes it must meet the challenge of environmental sustainability; in particular it must reduce its greenhouse gas emissions if it is to remain a part of a sustainable energy future. The Asia-Pacific Partner countries are all also members of the Methane to Markets Partnership, which is working to find cost-effective opportunities to reduce methane in the coal industry that can lead to improved mine safety, greater mine productivity, and increased revenues.

Coal has positive impacts in important areas such as energy security by being reliable and affordable, thus enabling economies to develop and quality of life to improve. Coal also makes a significant direct contribution to economic development at the local level, particularly in the poorer parts of the world. Mining is often the biggest source of income for rural communities, providing the economic basis for local infrastructure such as roads, schools, and transportation, water and health facilities as well as above average wages in many localities.

Greenhouse

All forms of energy have their impacts—negative as well as positive. Coal, like all other sources of energy, has a number of environmental impacts, from both mining and combustion. Although modern power plants utilize a variety of techniques to reduce the emission of their waste products and improve combustion efficiency, these techniques are not widely implemented in all countries because they add to the cost of electricity.

Active and abandoned coal mines also emit methane, a more potent greenhouse gas and another cause of global warming. For years, methane in mines was viewed as a nuisance and a safety hazard that had little intrinsic value. Recent projects have shown that the opposite is true: coal mine methane (CMM) is an energy product and a commodity that, when captured, can provide many benefits to the mine, the local, regional, and national communities, and the global environment. Methane from coal mines can be captured rather than released to the atmosphere and used for many purposes, including natural gas pipeline feedstock or power generation. Globally, CMM accounts for 8% of total anthropogenic methane emissions. In 2000, worldwide CMM emissions totaled 120 million metric tons of carbon equivalents (MMTCE). By 2020, the world's coal mines are expected to produce annual emissions of 153 MMTCE. China and the United States, the world's largest producers of hard coal, are also the leading emitters of CMM. Other countries with significant CMM emissions include Australia and India.

Alternative methodologies to capture the energy content of coal, such as underground coal gasification, have the potential to eliminate greenhouse gas emissions. Underground coal gasification, combined with separation and re-injection of the CO_2 produced by the process, is one strategy that can disconnect rising electricity demand from rising greenhouse gas contributions, while at the same time minimizing or eliminating the cost of coal mining, transportation, ash disposal, and land reclamation from mining activity. These are all subjects of the Coal Mine Task Force action plan.

Other sources of greenhouse gas emissions come from the hundreds of coal seam fires burning around the world. Those burning underground can be difficult to locate and many cannot be extinguished. Fires can cause the ground above to subside; in addition, combustion gases are dangerous to life, and fires breaking out to the surface can initiate surface wildfires. Coal seams can be set on fire by contact with a mine fire or surface fire and sometimes by spontaneous combustion. China reports that its coal fires burn 10-15 million tons of coal a year.

Technologies are presently available that are capable of eliminating most local and regional pollutants from coal-fired power generation (particulates, oxides of nitrogen, and sulfur dioxide) but they need to be used more widely around the world. New, more efficient coal-fired power plants reduce emissions of carbon dioxide. There has been an eightfold improvement in thermal efficiencies in plants producing electricity during the 20th century. Coal cleaning technologies are also available to further improve power plant efficiencies, and reduce air emissions, coal transportation costs, and power plant maintenance costs.

Future Outlook

According to IEA, by 2030, coal-based power generation is projected to more than triple. Despite competition from natural gas, coal is likely to provide 33% of global electricity generation. Attaining this anticipated growth will be increasingly dependent on coal's capability to accommodate growing global concerns: economic growth, environmental protection, mitigation of climate change, improved labor safety and health standards, and community development in a coordinated and effective manner. In the absence of a positive response, these concerns could become limiting factors to coal's growth.

Enabling a prospering coal industry requires continued efforts on the part of governments, industry and the international community with regard to:

- *Technology transfer*: financing technology transfer to developing countries faces enormous challenges unless the macro-economic and policy frameworks encourage investors and protect intellectual property rights. Cumulative investment needs of developing countries for coal mining and shipping during 2001–2030 amounts to $261 billion. IEA notes that the risk of a shortfall of foreign investments is greatest in developing countries, where ownership remains in government hands. Neither domestic capital markets nor government budgets have been or will be able to provide such funding. International financial assistance in demonstration projects have proven their value if coupled with a legal regime attracting investors. The number of these projects (mining, liquefaction, underground gasification, coal washeries, methane recovery, waste handling, other advanced coal utilization technologies and coal slurry pipelines) needs to be multiplied until the costs of modern technologies have been brought down.

- *Restructuring*: recent policies of developing countries aim at a greater degree of private sector involvement in mining and power generation, including privatization. At the basis of success are a reduced role of governments in operations, the gradual phase-out of price controls, import tariffs and subsidies, and the removal of restrictions such as on the use of coal production in captive power plants.

- *Management*: the transfer of efficient management practices, through internationally operating companies or otherwise, enables significant productivity gains. The tools are company-supported education, training and community relations.

- *Standards*: in developing countries, the setting of health, safety, environmental or quality standards has to obey the triple objectives of economic, social and ecological development. This demands a fine-tuned move to appropriate standards tailored to individual country situations rather than the direct adoption of standards from developed countries. International financial institutions should recognize such a step-wise strategy as valid when determining the conditions for loans.

Technological advances have made coal mining today more productive than it has ever been. To keep up with technology and to extract coal efficiently with the least environmental impact possible, modern mining personnel must be highly skilled and well trained in the use of complex, state-of-the art instruments and equipment. Future coal miners have to be highly educated and many jobs require four-year college degrees. Computer knowledge has also become greatly valued within the industry as most of the machines and safety monitors are computerized. Presently there is a shortage of qualified mining personnel with the skills needed to operate a modern mine. This task force will conduct a workforce assessment and training needs analysis to provide Asia-Pacific Partners with access to opportunities to collaborate in education, training, research and employment in the coal industry.

Historically, coal mining has been a dangerous activity, but most of these risks have been greatly reduced in modern mines, and multiple fatality incidents are now rare in the developed world. According to the Bureau of Labor Statistics, coal mining is not even among the top 10 most dangerous occupations in the United States per capita. Pilots, truck and taxi drivers, loggers, fishermen, roofers and other occupations face greater on the job risks than coal miners. Unfortunately, in lesser developed countries, thousands continue to die annually in coal mines. This task force has the goal to achieve zero harm by promoting leading health and safety practices in Partner countries. When adopted, these will significantly reduce the number of accidents per year.

Coal fires are emerging as a threat with significant economic, social and ecological impacts. Globally, thousands of coal fires are burning, especially in China and India. Rural Chinese in coal-bearing regions often dig coal for household use, abandoning the pits when they become unworkably deep, leaving highly combustible coal dust exposed to the air. This exposed dust and fine coal are susceptible to spontaneous combustion thus starting a new coal fires. Mapping China's coal fires from satellite photography discovered many previously unknown fires.

Methane is another component of coal. Methane in coal can be dangerous, as it can cause explosions in underground mines. It has, however, become a valuable resource in some coal mines and is being captured and sold to natural gas providers. One of this task force's goals is to protect and rehabilitate (reclaim or restore) the natural environment. By exchanging leading practices on coal fire management and coal mine methane capture and recovery, Partner countries will have new opportunities to reduce emissions and preserve coal resources currently being lost to fires.

Low ash, sulfur, and carbonate coals are prized for power generation because they do not produce much boiler slag and they do not require as much effort to scrub the flue gases to remove particulate matter. Carbonates stick to the boiler apparatus and increase maintenance expenses. Coal preparation (or beneficiation) is the process of preparing coal for the intended end use by removing or reducing impurities that interfere with clean combustion. Coal can be processed or cleaned to remove contaminants such as ash, moisture, and pyritic sulfur, thus improving the heat value of the coal and increasing its sales price. Removing sulfur, ash, and moisture eliminates the weight of non combustible material from the coal which lowers transport costs. Coal preparation provides a means of insuring that coal can be matched to most industrial applications by improving the quality of the coal after mining to a level that satisfies end-user requirements. The coal mining task force will facilitate technology transfer among Partner countries to improve coal quality, increase recovery and reduce costs.

Low coal prices and high oil prices have renewed interest in coal liquefaction and underground coal gasification (UCG). In China, the construction of a coal liquefaction plant has begun in Majiata, Inner Mongolia. In the United States, the Gilberton coal-to-power-and-clean-fuel demonstration plant is at its final stage, and will be the nation's first plant to convert coal into diesel fuel. In India, Nvyveli Corporation intends to develop and exploit UCG technology for vast lignite deposits in order to diversify its energy resource base for power generation. Australia plans to pursue the next phase of its UCG project at Chinchilla and install and open a demonstration plant based on UCG syngas. This task force plans to accelerate commercial deployment of UCG and other advanced mining technologies through information sharing and demonstration projects.

Proven technologies exist to reduce the emission of dust, CO_2, SO_2, and NO_x from coal-based power generation, to clean coal, to conduct underground coal gasification, to recycle toxic effluents and by-products, to utilize coal bed methane, to mitigate subsidence or to reclaim surface and underground mining operations. The issue is one of the worldwide deployments of leading practices.

Australia

Australia is the world's largest exporter of coal and the fourth largest producer of coal behind China, the United States and India. In general, Australia produces high-quality coking and steaming coals that are high in energy content, and low in sulfur, ash and other contaminants. Coal plays a central role in the Australian economy, currently accounting for 16% of total merchandise export income and approximately 80% of electricity supply.

Australian black coal production is expanding and is expected to reach 320 Mtpa in 2006–07. In 2005–06 total production is forecast to be around 309 Mt, of which 239 Mt or 77% was exported. Australia's top five export destinations in 2005 were: Japan (45% of export market share), Korea (13%), European Union (11%), Taiwan (9%), and India (8%).

Australia has the world's sixth largest resource base, with large deposits of both brown and black coals, located predominantly on the east coast in the states of Queensland, New South Wales and Victoria (brown coal). Economic demonstrated reserves are sufficient to sustain current production rates of black coal for 200 years and several centuries for brown coal.

The Australian coal mining industry is highly mechanized and is moving increasingly towards the development and implementation of automated systems. For instance, Australia has developed computerized systems for guiding dragline operations and is undertaking world leading research into the development of fully automated longwall mining systems. A joint project with JCoal is automating underground roadway tunneling and roof bolting.

All Australian coal producers contribute to a fund that supports generic coal industry research covering productivity and performance, occupational health and safety, the environment and coal utilization. This research program has made a major contribution to improving all aspects of the economic, environmental and safety performance of the Australian coal industry. The successful development of technologies to capture and utilize methane drainage gases and ventilation air methane illustrates the value of this program with over 445 million cubic meters of methane emission mitigated annually.

Table 1 Australian Coal Production, Consumption and Exports

	2003–04	2004–05	2005–06[e]	2006–07[f]
Saleable production (Mt)	285.9	300.7	308.8	320.1
Domestic consumption (Mt)	67.5	69.4	70.2	71.3
Total exports (Mt)	218.4	231.3	238.6	248.8
of which:- metallurgical (Mt)	111.7	124.9	127.5	135.1
thermal (Mt)	106.7	106.4	111.1	113.7
Export value (A$ billion)	10.9	17.1	25.0	23.9

[e] ABARE estimate.
[f] ABARE forecast.

Table 2 Mine Statistics for Saleable Coal—Australia

	2001–02[e]	2002–03[f]	2003–04	2004–05
Open cut				
Production (Mt)	196	207	218.9	234.8
Mines (number at year end)	60	63	64	61
Employment (average no. CY2002–05)	13,382	13,687	15,722	19,180
Output per employee (tonnes CY2002–05)	14,940	15,240	14,510	11,835
Underground				
Production (Mt)	76.4	67.7	64.9	70.2
Mines (number at year end)	44	40	40	41
Employment (average no. CY2002–05)	8,212	7,756	8,092	9,236
Output per employee (tonnes CY2002–05)	8,790	8,480	8,050	7,260

China

Coal use in China's electricity sector is projected to increase from 16.3 quadrillion Btu in 2003 to 50.1 quadrillion Btu in 2030, at an average rate of 4.2% per year. In comparison, coal consumption in the U.S. power sector grows by 1.6% annually, from 20.2 quadrillion Btu in 2003 to 30.7 quadrillion Btu in 2030. At the end of 2003, China had an estimated 239 gigawatts of coal-fired capacity in operation. To meet the demand for electricity that is expected to accompany its rapid economic growth, an additional 546 gigawatts of coal-fired capacity (net of retirements) is projected to be brought on line in China by 2030, requiring large financial investments in new coal-fired power plants and associated transmission and distribution systems.

Nearly one-half (45%) of China's coal use in 2003 was in the non-electricity sectors, primarily in the industrial sector. China was the world's leading producer of both steel and pig iron in 2003. Over the projection period, coal demand in China's non-electricity sectors is expected nearly to triple, increasing by 26.1 quadrillion Btu. Despite such substantial growth, however, the non-electricity share of total coal demand remains close to the 2003 level. Coal remains the primary source of energy in China's industrial sector, primarily because the country has only limited reserves of oil and natural gas.

With a substantial portion of the increase in China's demand for both oil and natural gas projected to be met by imports, the Chinese government is actively promoting the development of a large coal-to-liquids industry. Initial production of coal-based synthetic liquids in China is scheduled to commence in mid-2007 with the completion of the country's first coal-to-liquids plant, located in the Inner Mongolia Autonomous Region. It is being built by the Shenhua Coal Liquefaction Corporation and will have an initial capacity of approximately 60,000 barrels per day. In another development, China's Shenhua and Ningxia Coal Groups have initiated a feasibility study regarding the construction of two 80,000 barrel per day plants to be sited in the Ningxia Autonomous Region and the Shaanxi Province.

India

In India coal plays a dominant role as the primary source of energy, with a 59% share in total electricity generation capacity. In the last 30 years coal-based electricity generation has increased six fold in the country. Domestic coal production has increased from the level of 30 million tonnes at the time of independence to 407 MT in 2005–06. Today, India ranks third in the world both in terms of coal consumption (around 425 million tonnes) and coal production (407 million tonnes). Raw coal production has been growing close to 6% annually in the past few years. The share of coking coal in total coal production has, however, gone down from 14% to 7.7% in the past three years.

The total coal resource of India as estimated on 1 January 2006 stands at 253 billion tonnes with 96 billion tonnes of proven reserves representing roughly 9.3% of the world's proven reserves. However, India has relatively smaller proven reserves of prime and medium coking coal (17%).

At present India's coal industry is dominated by Government owned companies. Coal India Ltd, a Central Government company, is the biggest producer of coal (84.4%) followed by Singareni Colliery Company Ltd. (8.9%), a joint venture company of Central and State Governments. Some other smaller public undertakings exist for meeting their captive requirement. In the private sector, TISCO and Jindal Power and Steel (JSPL) are major players. The present statutory and regulatory provisions allow captive mining in the private sector for approved end users like power, iron, steel and cement. A large number of coal blocks have already been allocated under this dispensation. These allocatees may form a subsidiary or joint venture company to carry out mining activities subject to certain conditions. For captive consumption and washeries, 100% foreign direct investment (FDI) is permissible in coal mining. The captive mines are expected to add substantially to coal production of the country.

Imports of coal to India have increased substantially over the past few years because of demand for low ash content coking coal from the steel sector and non-coking coal from the power and cement sectors. In the last 10 years, imports have increased three times (39.4million tonnes during 2005–06). India also exports about 1.5 million tonnes of coal to neighboring countries such as Bangladesh and Nepal. Coal is under Open General License (OGL) and any person can import it freely. Customs duty of 5% is applicable on coking coal having ash content above 12% and non-coking coal.

The power sector in India is the largest consumer of coal. Total coal supplied to the power utilities in 2005–06 was 317 million tonnes; the steel and cement sectors are second and third largest consumers respectively. A large spectrum of industrial consumers uses coal as processing input. In India, the sale of coal is through linkages so as to ensure planned production and assured supply to the core sectors. For the non-core sectors and others needing additional coal, it is available through e-marketing and other consumer centric mechanisms.

With the growing demand for electricity, coal production is estimated to increase to 676 million tonnes in 2011–12 and to 828 million tonnes in 2016–17. Due to its geology, India depends primarily on open cast mining (85%) to meet growing demand. Mass production technologies like draglines, electric and hydraulic shovels, and large capacity dump trucks are being used. In underground mines, continuous miners and longwalls are beginning to be adopted. New mining technology initiatives are needed to address coalfields that lie in remote areas and occur in hillside tracts (steep seam mining) to achieve improved production performance and extraction percentage.

Indian coal has high ash content but is relatively low on sulfur. Coking coal has been classified into six categories on the basis of ash content whereas non-coking coal has seven categories based on its useful heat value (UHV). Issues relating to environmental degradation and climate change are being addressed by adopting better mining and coal cleaning technologies. Coal beneficiation capacities are being increased and efficient coal beneficiation technologies are being planned to help conserve environment.

New initiatives are being adopted for capturing and utilizing green house gases like coal bed methane (CBM), coal mine methane (CMM) and ventilation air methane (VAM). Reclamation of abandoned mines is also getting attention. India has taken major strides in CBM exploitation and is actively pursuing underground coal gasification as an economical and environmentally friendly technology to exploit deep coal reserves. Potential of coal liquefaction and over ground coal gasification are also being explored.

India has also entered into bilateral cooperation in the coal sector with China, the United States, Australia, the European Union, the United Kingdom, France, Russia and Canada. India is also actively involved in the U.S. FutureGen Project and the international Methane to Markets Partnership.

Table 3 Trends of Production, Import and Export of Coal in India (figures in million tonnes)

	2003–04	**2004–05**	**2005–06**
Domestic coal production			
Open cast	298.5	320.3	345.7
Underground	62.7	62.3	61.3
Total	360.2	382.6	407.0
Coal import			
Coking	13.0	16.9	17.1
Non-coking	8.7	12.0	19.7
Coke	1.9	2.8	2.6
Total	23.6	31.7	39.4
Coal export			
Coking	0.16	0.11	0.00
Non-coking	1.50	1.18	1.33
Coke	0.20	0.15	0.00
Total	1.86	1.44	1.33

Japan

An Overview of the Industry

With the two oil crises of the 1970s, coal began to be reconsidered as an energy source around the world and there was agreement even from the IEA to promote the production and wider use of coal. In Japan, to improve the fragile energy supply and demand structure, coal has been positioned as an important pillar of alternative energy, resulting in the promotion of the increased use of coal.

The Current State of the Industry

Coal deposits are plentiful and are distributed over a wide area, particularly in developed countries, making supply highly stable and also very economically efficient. In 2000, coal accounted for 17.9% of Japan's supply of primary energy. On the other hand, the ratio of domestic coal in the supply of Japan's domestic primary energy remained at about 1.9% and accounted for only 0.3% in the total supply of domestic primary energy.

Figure 1 Japan's Total Primary Energy Supply and Coal's Share in the Supply

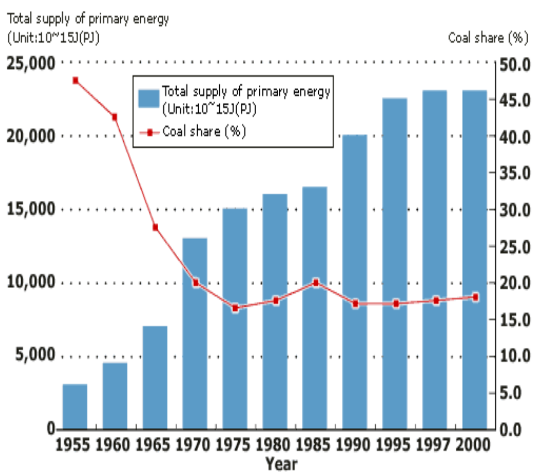
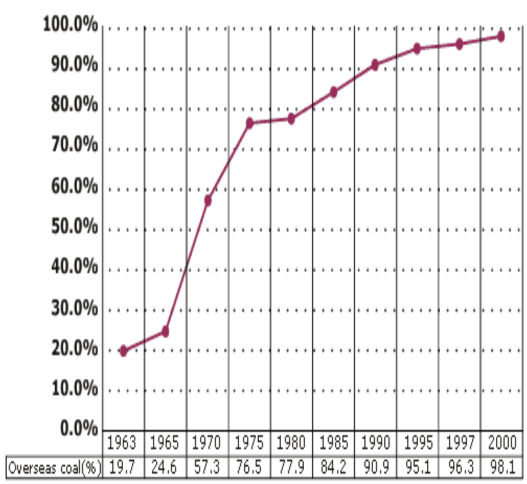


Figure 2 Overseas Coal in Japan's Domestic Coal Supply



However, the July 2001 Long-Term Energy Supply/Demand Outlook predicts that in 2010, coal will account for approximately 19% of domestic primary energy supply and it will continue to be an important energy source.

Table 4 Forecast for Primary Energy Supply—Japan

Forecast for Primary Energy Supply

(Unit: Million KL in crude oil equivalent)

Year / Item	1990		1999		2010			
					Standard case		Target case	
Primary energy supply	526		593		622		602	
Classification	Actual figure	%	Actual figure	%	Actual figure	%	Actual figure	%
Oil	307	58.3	308	52	280	45	271	45
Coal	87	16.6	103	17.4	136	21.9	114	19
Natural gas	53	10.1	75	12.7	82	13.2	83	14
Nuclear power	49	9.4	77	13	93	15	93	15
Hydroelectric power	22	4.2	21	3.6	20	3.2	20	3
Gepthermal power	1	0.1	1	0.2	1	0.2	1	0.2
New/Alternative energy, etc.	7	1.3	7	1.6	10	1.6	20	3
Renewable energy	29	5.6	29	4.8	30	4.8	40	7

Note: Renewable energy includes alternative energy, hydroelectric power,and geothermal power.

Source: The report "Energy Policies: Looking Ahead", Coordination Subcommittee, Energy Supply and Demand Subcommittee the Advisory Committee for Natural Resources and Energy, July 2001

The Current State of the Coal Mining Industry in Japan

Japan’s coal mines have become increasingly deeper and more remote making domestic coal three times as expensive as coal from other countries. At present, Japan has coal mines in cooperation with Kushiro Coal Mine, located in Kushiro, Hokkaido, and other several small surface mines. Total production in 2004 was 1,327,946 tons.

Table 5 Coal Imports 2005 by Origin—Japan

Japan Coal Imports 2005 by Origin (Unit: tonnes)

Country	Steam Coal	Coking Coal	Anthracite	Total	
Australia	59,329,477	43,888,278	435,154	103,652,909	57.35%
Indonesia	7,791,062	21,619,110		29,410,172	16.27%
China	16,318,575	5,678,918	1,967,994	23,965,487	13.26%
Russia	6,593,929	3,281,731	819,271	10,694,931	5.92%
Canada	730,200	6,644,553		7,374,753	4.08%
Vietnam			2,350,601	2,350,601	1.30%
United States		2,062,543		2,062,543	1.14%
New Zealand		706,150		706,150	0.39%
North Korea			277,017	277,017	0.15%
South Africa	142,675			142,675	0.08%
Malaysia		55,433		55,433	0.03%
Ukraine			21,021	21,021	0.01%
Venezuela			14,931	14,931	0.01%
South Korea			2,600	2,600	0.00%
Taiwan			911	911	0.00%
Total	90,905,918	83,936,716	5,889,500	180,732,134	100.00%

Source: Trade Statistics, Trade Statistics, Ministry of Finances

Figure 3 Coal Production and Number of Coal Mines—Japan (1980–2003)

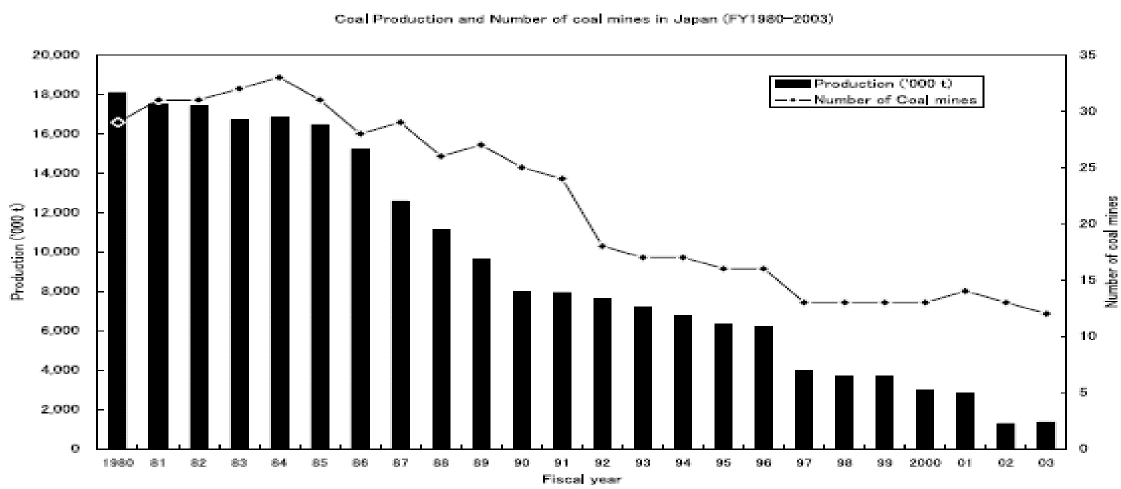


Table 6 Coal Mine Safety Statistics—Japan (2000–04)

Japan Coal Mine Safety Statistics 2000-2004

Year	2000	2001	2002	2003	2004
Number of Mines	14	15	14	14	14
Average Employees	2,966	2,659	864	901	892
Cumulative Employees	784,150	739,621	237,842	231,364	228,435
Cumulative Employee hours worked	6,693,169	6,314,970	2,039,410	1,957,386	1,940,296
Production (tonnes)	3,147,347	3,208,394	1,379,861	1,341,799	1,327,946
Number of Accident	34	40	2	1	3
Fatalities (men)	2	0	0	0	0
Injuries (men)	29	37	2	1	3
Accident Rate (men/ per million men)	39.53	50.03	8.41	4.32	13.13
Accident Rate (men/ per million hours worked)	4.63	5.86	0.98	0.51	1.55
Accident Rate (men/ per million tonnes)	9.85	11.53	1.45	0.75	2.26

Source: Mine Safety Statistics, Ministry of Economics, Trade and Industry

Korea

Korea relies on imports for 97% of its energy needs because of its own severely limited mineral resources (Green Energy Expo, 2004). Coal supplies about 21% of the country's total energy, amounting to an estimated coal consumption of 72.6 million tonnes in 2002. Only about 3.82 million tonnes were produced domestically in 2001. More than 95% of Korea's coal requirements are supplied mainly by China and Australia, and to a smaller extent by the United States. Korea's indigenous coal reserves were estimated at 78 million tonnes in 2002, comprising primarily low-quality anthracite used in home heating and small boilers. Many coal mines are closing and overall coal production is declining. The Korean government is encouraging investments in foreign coal mining ventures as a measure to secure its future energy needs. Korea's state power company, KEPCO, has made several such equity investments, totaling 19 overseas projects in 2003 with several of these in Australian coal mines (EIA, 2005a; WTO). Korea's relationship with coal is unique in that it plans to increase its dependence on coal for electricity needs while moving toward a reduced domestic supply of coal stabilized at 2.7 million tonnes. As of 2002, IEA estimated Korea's reserve-to-production ratio to be 19 years (IEA, 2002). Coal reserve and production data are summarized in Table 7.

Table 7 Korea's Coal Reserves and Production

Indicator	Anthracite and bituminous (million tonnes)	Sub-bituminous and lignite (million tonnes)	Total (million tonnes)	Global rank (no. and %)
Estimated proved coal reserves (2003)*	0	80	80	50 (0.01%)
Annual coal production (2003)**	3.3	0	3.3	37 (0.7%)

Sources: *EIA (2005b); **EIA (2005c)

Korea's coal is concentrated in four of its nine provinces: North and South Chungcheong, Gangwon (location of Samcheok, the largest coalfield in Korea), and to a small extent in South Jeolla (NationMaster).

Table 8 Korea's Coal Mining and Production Statistics

Type of mine	Production (million tonnes)	Number of mines
Underground (active) mines—total	3.3	9
Abandoned underground mines—total	N/A	337 mines closed since 1983 (5 KOCOAL-owned and 332 private)

Source: KEEI (2003)

Status of Coal and the Coal-Mining Industry

The state-owned Korea Coal Corporation (KOCOAL) is responsible for about 40% of the total coal produced by the country, with main facilities at Changsung, Dogae, and Hwasoon (USGS, 2003). The remaining coal production in Korea is from six privately owned mines (KEEI, 2003) with Kyongdon Company in Samcheok City as the largest operation. Korea produces only anthracite, importing all its bituminous requirements. According to the statistics from Korea Energy Economics Institute (KEEI) production of anthracite has dropped by over 70% from 1992 to 2003. Fast depletion of coal reserves and high production costs continue the declining trend as the Korean government plans to close several coal mines in 2005 (USGS, 2003). Information on gassy mines was not found. However, the reported fatalities from methane explosions in Samcheok indicate presence of the gas in the coalfield there (KOSHA, 2003).

Domestic coal production is supported by several government measures, such as subsidies, low-interest loans to coal producers, tariffs on coal imports of 1% and 5%, and a 10% VAT on imported coal and price ceilings. These subsidies have been on the rise, effecting high production costs for the government. As part of streamlining the country's coal supply, the government has been closing its mines (WTO). Coal production in Korea is expected to stabilize at 2.7 million tonnes per year (IEA, 2002).

Korea practices at least two key occupational safety and health laws in mining operations: The Industrial Safety and Health Act and the Act Relating to Prevention of Pneumoconiosis and Protection of Pneumoconiosis Workers. The former act provides for occupational safety of both employers and the employees. The latter act concerns prevention of pneumoconiosis and provisions for the affected workers (MSHA).

The government provides a 5% tax credit for implementing energy-efficient or renewable energy technologies. Additionally, 5.5–7.5% low-interest loans are offered for investment in these facilities. Also, a reference price system has been deployed in 2002 that subsidizes excess costs of power generated from alternative sources (WTO). CMM recovery is justifiably a key element of energy conservancy and is environmentally crucial. Therefore, although CMM projects have yet to develop in South Korea, it is possible that the Korean government would contribute by providing incentives and tax breaks to encourage CMM use and ease its entry into the energy market.

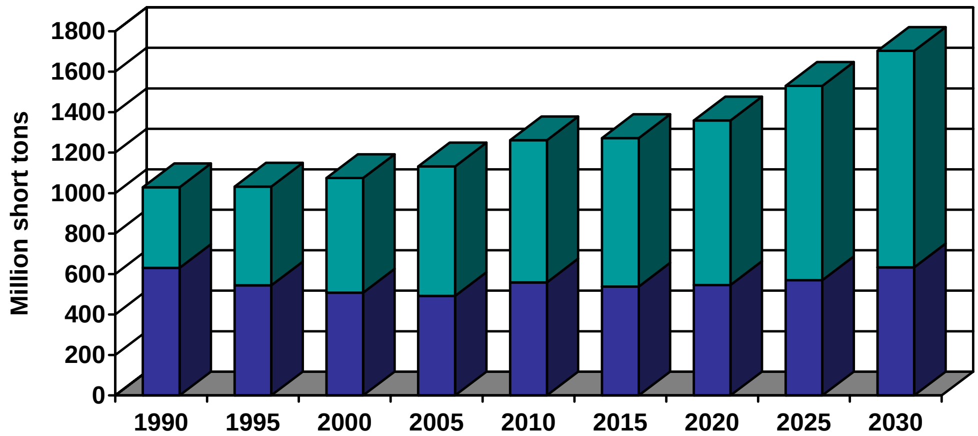
United States

Coal is one of the true measures of the energy strength of the United States. One quarter of the world's coal reserves are found within the United States and the energy content of those reserves exceed that of all the world's known recoverable oil. Coal is also the workhorse of the nation's electric power industry, supplying more than half the electricity consumed by Americans. Coal-fired electric generating plants are the cornerstone of America's central power system.

Coal production in the United States reached a record level in 2005, ending the year at 1,133.3 million short tons according to preliminary data from the Energy Information Administration (Table 9). Production in 2005 was 21.2 million short tons higher than the 2004 level of 1,112.1 million short tons, and surpassed the prior record set in 2001 by 5.6 million short tons. Although total U.S. coal consumption rose in 2005, not all coal-consuming sectors had increased consumption for the year. Coal consumption increased in the electric power sector by 2.2% and declined in the other industrial sector, while coking coal consumption decreased slightly. U.S. coal exports rose for a third consecutive year in 2005, while coal imports again reached a record level.

Production is expected to grow at least 1–2% annually, and EIA expects that by the year 2030 the United States will likely be producing and consuming over 50% more coal per year than today.

Figure 4 Coal Production, Actual and Projected—United States (1990–2030)



Thirty-three percent of all energy produced in the United States is from coal. Approximately 89% of the coal is used for electricity; and produces 51% of all electricity in the United States. There are about 200 coal companies operating in the United States but nearly 70% of production comes from the 10 largest producing companies. All coal companies in the United States are privately owned or owned by stockholders. The government does not own or operate any coal company. In the eastern part of the country most of the coal reserves are privately owned. However, the federal government does own much of the land in the west where coal deposits are located. Coal companies operating on federal lands lease the right to mine the reserves from the government. Although the 1,400 coal mines range from very small to the largest in the world, 60% of production comes from the top 60 mines, 38 of which are located in the western part of the country and 22 in the east.

Just over one-third of U.S. coal production is produced in underground mines. Sixty-eight per cent of underground production is in the Appalachian coalfields. More than 50% of underground production comes from mines using the longwall mining method. The remainder is produced using continuous mining machinery. More than 40,000 miners (57% of the workforce) work in underground mines. The underground mines produce primarily bituminous coal used for electricity and steel. Nearly two-thirds of U.S. coal is produced at surface mines. Nearly 70% of surface mined coal comes from western states. Over 30,000 miners (43% of the workforce) work in surface mines. These surface mines produce bituminous, sub-bituminous and lignite coal used primarily for the generation of electricity.

Table 9 U.S. Coal Supply, Disposition, and Prices, 2001–2005 (million short tons and nominal dollars per short ton)

Item	2001	2002	2003	2004	2005
Production by region					
Appalachia	431.2	396.2	376.1	389.9	396.4
Interior	146.9	146.6	146.0	146.0	149.2
Western	547.9	550.4	548.7	575.2	587.0
Refuse recovery	1.8	1.0	1.0	1.0	0.7
Total	1,127.7	1,094.3	1,071.8	1,112.1	1,133.3
Consumption by sector					
Electric power	964.4	977.5	1,005.1	1,016.3	1,039.0
Coke plants	26.1	23.7	24.2	23.7	23.4
Other industrial plants	65.3	60.7	61.3	62.2	60.8
Combined heat and power (CHP)	25.8	26.2	24.8	26.6	20.6
Non—CHP	39.5	34.5	36.4	35.6	40.2
Residential/commercial users	4.4	4.4	4.2	5.1	5.1
Residential	0.5	0.5	0.5	0.6	0.6
Commercial	3.9	4.0	3.8	4.6	4.6
Total	1,060.1	1,066.4	1,094.9	1,107.3	1,128.3

Coal consumption in the electric power sector increased 22.7 million short tons in 2005. Preliminary data show that total generation in the electric power sector (electric utilities and independent power producers) in the United States increased by 2.0% in 2005, while coal-based generation increased by 1.8%. Primarily as a result of a larger proportion of lower Btu coal being used in 2005, coal generation did not rise as much as coal consumption measured in short tons. Coal use in the non-electricity sector declined slightly by 1.9% to a level of 89.2 million short tons.

Coal consumption in the non-electric power sector declined in 2005 although a new coke plant (the first one in seven years) began production early in the year. Coal consumption at coke plants still decreased slightly in 2005 (0.2 million short tons) to end the year at 23.4 million short tons. Even with the slight decline in U.S. coke production in 2005, concerns about the availability and price of coke in the international market resulted in decisions to:

1) expand the capacity at the newest coke plant (construct an additional 100 coke ovens); 2) build another new coke plant; and 3) refurbish a previously closed coke plant.

The United States leads the world in coal mine methane capture and utilization at active mines. In 2003, 70% of all drained gas was used, primarily injected into the natural gas grid. The environmental and ancillary benefits derived from CMM recovery are many, and are proving to be quite profitable for the U.S. companies active in the market. While the market penetration for drained gas is very good, there remain many opportunities for additional CMM projects. In addition to the 16Bcf (500 million m3) of drained gas available, installation of degasification systems at existing mines and several new mines will likely add to the amount of gas available. Improvements in drilling technologies could further increase the available volumes of drained gas. Abandoned mines represent a new and growing coal mine methane resource. With the advent of technologies that can make use of the low concentration of methane, much of the U.S. focus will be directed at encouraging ventilation air methane (VAM) project development.

In the international markets in 2005, both U.S. coal exports and imports increased, with U.S. coal exports totaling 49.9 million short tons, an increase of 1.9 million short tons over 2004, and U.S. coal imports reaching another record level, ending the year at 30.5 million short tons, 3.2 million short tons higher than in 2004. Metallurgical coal exports in 2005 totaled 28.7 million short tons, an increase of 6.8% over the 2004 level, and accounted for almost 94% of the increase in total U.S. coal exports for the year. As the increasing worldwide demand for steel continued in 2005, metallurgical coal demand followed even in the face of increasing prices.

Productivity at U.S. coal mines is the highest in the industry's history although the rate of increase has slowed from that experienced over the last decade. There are about 75,000 miners and 55% of them work in mines that produce more than 1 million tons. These miners are some of the highest-paid industrial workers in the United States and their numbers are increasing. The industry's safety record continues to improve as the injury rate has decreased by 51% since 1990 and the number of fatalities has declined by nearly 70%. In 2004, 56% of all mines operating in the United States had no injuries. This is not enough, however, as the industry goal is a zero injury and fatality rate.

The recurring problems (weather, environmental, legal challenges, and global economics) that the coal industry typically deals with had varying impacts on coal production in 2005. The overriding issue for the U.S. coal industry in 2005 was transportation of coal from mines to consumers.

Goals and Objectives

The objectives set for the Coal Mining Task Force are:

- Accelerate the deployment of appropriate technologies and practices that can improve the economics and efficiencies of coal mining and processing while continuing to improve mine safety and reduce environmental impacts.

- Building on existing programs and research, establish, as appropriate, efficiencies and emission reductions and mine reclamation objectives based on each nation's circumstances.

- Identify current mining and reclamation activities in each country, as appropriate, and exchange leading practices information on maximizing resource recovery, including coal mine methane, and reclamation of surface mined lands.

Table 10 Summary of Coal Mining Task Force Themes, Goals, Project Areas and Activities and Partnership Value-adding

Themes	Goals	Project areas	Projects and activities	Partnership value adding
Health and safety	To achieve zero harm		Coal mine health and safety	Promotion of leading health and safety practices to significantly reduce the number of accidents per year
Environmental impacts	Protect and rehabilitate (reclaim or restore) the natural environment		Leading practices for sustainable development	Promotion of leading coal mining and reclamation practices
			Coalfield fires	International collaboration for deployment of advanced technologies
			Reclamation of legacy mines	Sharing information on regulatory and programmatic approaches and leading practices
		Coal mine methane	Increasing recovery and use	Create economic opportunities to drive the capture and use of coal mine methane
			Training, study tours, workshops on methane drainage and drilling in advance of or during mining	
			Integrated coal and methane extraction	
Economic resource recovery	Maximizing resource recovery through more cost- effective and efficient extraction technologies	Coal beneficiation	Economic modeling	Facilitate technology transfer to improve coal quality and recovery and reduce costs
			Information sharing on coal drying	
			Fine coal beneficiation	
			Information sharing on coal processing	
			Waste coal management	
		Mining technologies	Thick seams	To accelerate commercial deployment through information sharing and demonstration
			UCG	
			Steep seams	
			Overburden dump stability	
Workforce planning and skills development	To ensure an adequate competent workforce		Workforce assessment and training needs	Provide access to APP countries for opportunities to collaborate in education, training, research and employment in the coal industry

Appendix A: Individual Project Plans

The projects identified in the table below indicate the task force's initial actions, all at different stages in their funding. This task force recognizes that additional projects will be identified and undertaken as the work of the task force progresses. The task force may establish working groups to provide guidance and advice and to support the implementation of activities and projects.

Table 11 Individual Project Plans

Project title	2006	2007	2008	2009
CLM-06-01 Information Sharing on Coal Processing Technologies	Organize a workshop/seminar for an inter-Partner flow of information on leading practices in coal preparation technologies especially for near gravity separation in India by end 2006.	Identify possibilities of bilateral/multilateral cooperation for adoption of leading practices with a view to reducing cost of coal preparation.	Demonstrate the results of cooperation with field trials.	
CLM-06-02 Coal Beneficiation: Economic Modeling, Analysis and Case Studies	Phase 1 Review existing regulations and practices for coal beneficiation considering the technical and economic feasibility of achieving various levels of percent ash reduction. Employ computer simulation program based on the coal characteristics to identify optimum operating conditions that maximize clean coal recovery. Develop recommendations for optimum percent ash and sulfur reduction in washed coal taking into consideration factors including: reduced air emissions, reduced coal transportation costs, improved power plant efficiencies, reduced power plant maintenance costs and outages, decreased ash disposal costs, effective utilization of coal rejects, etc. A computerized model backed up with case studies for a quick decision for the level of beneficiation for a particular coal for a particular use.	Phase 2 Develop a simulation package for the design and operation of coal beneficiation plants Workshop with representatives from APP coal sector to focus on technical, environmental, regulatory, and financial viability of coal beneficiation, and to employ the results of Phase 1.	Phase 3 Establish procedures as well as guidelines to systematically adopt the optimal level of beneficiation into coal mining and coal processing practices considering economic and technical aspects of coal washing, utilization of washery rejects, operation of power plants and environmental impacts. A computerized model validated with case studies for decisions on the economically optimum level of beneficiation for a particular coal for a particular use. Review of funding mechanisms available to systematically integrate coal beneficiation in the coal cycle as well as regular use of clean coal technology. Workshops and technical transfer of regulatory, funding and coal beneficiation best practices.	
CLM-06-03 Fine Coal Beneficiation—Joint Venture Project	Organize inter-Partner workshop on leading practices in fine coal beneficiation technologies in India by end 2006.	Identify possibilities of bilateral/multi lateral co-operation for adoption of leading practices with a view to reducing cost of fine coal beneficiation.	Demonstrate the results of co-operation with field trials under a Joint Venture Project at one of the coking coal beneficiation plant in India.	
CLM-06-04 Information Sharing on Coal Drying	Australia to facilitate demonstration of the coal drying technology developed in-house to the Partner countries.	Assess the economic viability of the technology. Initiate the possibility of technology transfer to an Indian coking coal beneficiation plant under bilateral cooperation.	Demonstrate the results of co-operation with field trials.	

Project title	2006	2007	2008	2009
CLM-06-05 Joint Venture Project on Waste Coal Management	Organize Inter-Partner workshop on leading practices in waste coal management technologies in India by end 2006.	Initiate the possibility of technology transfer to an Indian non-coking coal beneficiation plant under bilateral/multi lateral cooperation.	Demonstrate the results of cooperation with field trials under a joint venture project.	
CLM-06-06 Extraction of Steep Seam Coal	Phase 1. Evaluation of the application of other mining methods to the unique characteristics of the coal bearing strata of the North East Region. *Deliverables*: Identification, evaluation, ranking and prioritization of alternative mining techniques will be presented in an Evaluation Report, complete with graphics, numerical analyses, financial forecasts, and risk assessment. Recommendation Report for next stages of development. Workshop and technical transfer on technical, financial and regulatory practices and recommendation.	Phase 2. Subject to a successful execution of the preceding activity, application of one or more of the evaluated techniques to field-evaluation of those methods. Execution of the suggested retrofits and modifications to the mining method(s) to achieve the desired production, coal quality, operating safety, and financial results.		Phase 3. Subject to the successful execution of the preceding activity, transfer one or more of the proven mining methods to a pre-selected underground mine with difficult ground conditions. Execution of the suggested retrofits and modifications to the mining methods in order to achieve the desired coal production, coal quality, operating safety, and financial results
CLM-06-07 Leading Practice Sustainable Development Program for the Mining Industry	Development of Stage 2 booklets (Working with Indigenous Communities, Biodiversity Management, Tailings Management, and Managing Sulfidic Materials, Acid Drainage and Metal Leaching) will commence in June 2006 with production completed by the end of the 2006 calendar year.	Development of Stage 3 handbooks (Monitoring, Auditing and Performance, Particulate, Noise and Blast Management, Water Management, Hazardous Materials Management, Risk Assessment and Management, Cyanide Management). Phase 2: Prepare and conduct workshops (late 2006)	Finalization of Stage 3 handbooks Phase 2: Conduct workshops	Development of future titles and workshops (if required). The themes listed in Stages 1 to 3 of the program do not limit the scope of the program, which will evolve to address leading practice management issues as they arise.
CLM-06-08 Overburden Slope Stability	Visit surface mines in Wyoming (US) or other sites similar to deep open cast mines in India.	Training of Indian mine planners in USA, collection and evaluation of best practices for engineering and mining operations and observation of execution of short and long term mine planning.	Identified opencast projects for international assistance: Jayant OCP, NCL Bina OCP, NCL Umrer and Gondegaon OCPs, WCL	

Project title	**2006**	**2007**	**2008**	**2009**
CLM-06-09 Coal Mine Health and Safety	Work together to identify the major hazards and core risks associated with coal mining such as fires and explosions, methane accumulation, roof falls and other major causes of accidents and fatalities. Identify and collate the health and safety legislative frameworks, regulatory capacity, skills, education, and training requirements for each Partner country. Enumerate best practices in each country and identify and collate leading technologies and the current indicators used to measure performance in each country	Using the data base and information developed in task 1, develop a series of workshops for exchange of information on procedures, equipment and practices that can reduce accidents and thus reduce the number of fatalities and injuries associated with coal mining. Exchange information and assist in developing emergency response procedures. This information exchange can include training in many areas including but not limited to: inspection techniques; techniques of risk management; surveillance and auditing techniques; accident investigation and analysis; room and pillar mining; ground control plans; mine fire, water, gas, and explosion hazards and analysis; and slope and dump stability in open-cast mines.	Establish demonstration projects aimed at improving the health and safety conditions of mines by identifying/providing appropriate training and safety equipment. A pilot site will be selected and the following activities pursued: The selected mine will undergo a health and safety assessment in order to identify health and safety equipment needs of workers. Workers and supervisors will receive training on accident/injury prevention methods and emergency response. A plan of action that details the specific needs of the selected mine to improve its health and safety conditions for workers will be developed. Best practices information targeted at improving health and safety performance will be identified and disseminate to employers, workers, and government officials	A more detailed analysis of statutory and regulatory requirements established in each of the Partner countries will be completed and made available to all Partner countries. Where feasible, a system will be established to allow ongoing electronic access to these data bases. Assist countries in developing the necessary skills, competencies, and capacity of regulatory staff to enforce statutory and regulatory requirements.
CLM-06-10 Reclamation of Legacy Coal Mines to Abate Hazards	Regulatory review to determine gaps	Collection and evaluation of best practices for environmental management of mining operations. Review of funding mechanisms available to systematically reclaim legacy mines. Workshops and technical transfer of regulatory program strategies, funding strategies and land reclamation best practices		

Project title	**2006**	**2007**	**2008**	**2009**
CLM-06-11 Increasing Recovery and Use of Coal Mine Methane	Conduct assessment of information needs to develop a catalogue of CMM technologies that have been tried or used in specific countries, coal-basin specific characteristics, and most promising potential sites to investigate pilot projects Based on this assessment, identify information gaps and determine need and feasibility to develop a comprehensive assessment of technologies. Draft information needs assessment and recommendation developed by end of 4th quarter 2006.	Establish plan for workshops and site visits (Q1 2007). Initiate planning to establish one pilot CMM drainage and recovery program (2nd quarter 2007).		
CLM-06-12 Integrated Coal and Methane Extraction	Select a project site and conduct site investigation including data collection, site characterization and carry out preliminary mine measurements and monitoring.	Conduct COSFLOW modeling to predict mining conditions and forecast CMM, develop and optimize integrated coal and methane production plan, design real time strata and gas monitoring systems.	Develop, purchase and/or manufacture hardware and software, install the designed system at the project site and conduct real time monitoring.	Continue real-time mine monitoring, complete project result assessment, conduct workshop to demonstrate the project outputs, and complete a final project report.
CLM-06-13 Thick Coal Seam Extraction	Select a project site and conduct site investigation including data collection, site characterization, and carry out preliminary mine measurements and monitoring.	Field monitoring in mines and extensive modeling investigations to evaluate the effect of various extraction systems and designs.	Develop and trial the optimum extraction method/design at the selected field site in the SCCL coalfield. It also involves extensive field monitoring and fine-tuning of the mining systems/designs.	Continue performance monitoring of the adopted extraction system and conduct workshop to demonstrate the project outputs, and complete a final project report.
CLM-06-14 Underground Coal Gasification in India	Collect and evaluate current status and best practices for underground coal gasification, and convene a workshop in India to address the two main issues cited above. The main goal of the workshop would be to identify and discuss the major factors related to UCG that are unique to India. Participation will be from both Indian and U.S. scientists and engineers knowledgeable in coal geology, hydrology and mining. The workshop will also discuss the lessons that have been learned from current and past UCG experiments, and the advances that have been made in a number of supporting technologies, such as directional drilling, sensing, and process control.	Organize technical visits to operating and pilot UCG sites, and potential sites with Indian and U.S. technical experts to address operational and regulator issues associated with underground coal gasification. Visits would include sites in Wyoming and western India, and would include workshops around local data sets, cores and infrastructure. Identify potential commercial UCG plant sites and develop recommendations for engineering design including the design of an environmental monitoring program to be run prior to, during and after UCG plant startup.	Form project consortium of coal owners, technology providers, end users and financiers and initiate a UCG demonstration project showing the consistent and reliable supply of UCG syngas.	Graduate the UCG demonstration to commercial scale with construction of the selected syngas utilization plant, which could be electrical power, transport synfuels or chemicals as determined by feasibility studies.
CLM-06-15 Workforce Assessment and Training Needs	Each Partner will collect information on existing activities in their country for addressing skills shortages and disseminate to the Partners as an information-sharing tool.	Once the information is compiled in a central location, there will be scope to identify particular models that could be pursued by the Partner countries.		

Project title	2006	2007	2008	2009
CLM-06-16 Technical Improvement for Control of Coalfield Firing	I. To increase detective and explorative accuracy Oct. 2006—Workshop, project task force, field trip for study Nov 2006—Project designing documentation Dec 2006—Project financing	Jan–May 2007—Introduction of instruments and equipments Jun–Oct 2007—Pilot exploration, training	2008–09: Extension in other regions and countries like India. Report	
	II. To establish coalfield fire monitoring system Oct 2006—Workshop, project task force, field trip for study Nov 2006—Project designing documentation Dec 2006—Project financing	Jan–Aug 2007—System development Aug–Dec 2007—System debugging	Jan–Dec 2008—Data acquisition, system operation	2009-Extension. Report
	III. New technology and materials for fire extinguishing Oct 2006—Workshop, project task force, field trip for study Nov 2006—Project designing documentation Dec. 2006—Project financing	Jan–Dec 2007—Technical transfer, equipments installation	Jan-Dec. 2008—Staff training, pilot production, application of the new materials	2009-Wrap-up report, Extension of new technology

CLM-06-01: Information Sharing on Coal Processing Technologies

Project

There are wide variations in pre-combustion coal treatment concepts and in the technologies used in different countries. These differences can lead to suboptimal coal preparation technologies being used in some countries. Poor coal preparation efficiency, increases waste coal generation and increases cost. In order to streamline suboptimal systems of coal preparation it is essential to share the experience gained in other Partner countries.

Generally, there are five coal preparation scenarios presently being utilized with variations in equipment size. These include:

- Crushing and screening only.
- Cleaning of coarse coal (–75mm to +13mm size) in a Jig, Barrel or Heavy Media Bath with the remaining fraction of raw coal directly being mixed with the clean coal.
- Coarse coal treated either in a Jig or Heavy Media Bath and coals (-13mm to +0.5mm) treated with Heavy Media Cyclone and fine coal (–0.5mm) directly mixed with clean coal.
- Cleaning of coarse coal and small coal fractions, along with cleaning of fine coal (-.5mm) using mostly flotation technique or water-only cyclones/Hydro cyclones, with closed circuit water recovery.
- Cleaning of all sizes of coal, in multiple stages of sizing and crushing and producing two or more clean coal products, with closed water recovery circuits.

Lack of information on the technologies available in other Partner countries hinders some Partner countries from optimizing the performance of their coal preparation techniques. Information sharing on technologies available in respect to coal preparation would probably lead to increases in efficiency of operations and offer beneficiation process cost savings.

Goals and Objectives

Initiate an inter-Partner flow of information on best practices in coal preparation technologies, especially for near gravity separation.

Possibilities of bilateral/multi lateral co-operation for adoption of best practices.

Reduction in the cost of coal preparation, which is of great interest to some Partner countries.

Obstacles and Challenges

Until now individual countries needed to pursue bilateral system of cooperation for adoption of best practices due to lack of any Partnership forum. APP provides an opportunity to share the best practices of one country with the others.

Location

Any country that may be decided by the CMTF.

Deliverables

Workshop/Seminar/Plant visits

Schedules

6 months

Resources needed to complete action item

To be decided by the hosting countries for such workshop/seminar.

Prepared by India

June 8, 2006

CLM-06-02: Coal Beneficiation: Economic Modeling, Analysis, and Case Studies

Project

India has significant coal reserves and is among the largest coal producing countries in the world. Coal production in India is projected to double or triple within the next decade, the majority of which will be used for thermal power generation. Significant portions of the coal reserves are characterized by contaminants including high ash contents (resulting in low-calorific value) or high sulfur content (resulting in unacceptable emissions and impacts on human health). Consistent with the goals of the Partnership, efforts should be pursued to deploy coal cleaning technologies and practices that can improve the economics and efficiencies of coal processing and contribute to energy security, reduce pollution, improve the quality of life, and address the challenge of climate change.

Most coal power plants burn coal without any prior cleaning. However, production of environment-friendly and affordable electricity with high-ash coal or sulfur content necessitates coal beneficiation (CB) prior to its utilization as an energy resource. Moreover, CB reduces the load on overburdened rail systems and reduces the need to import higher-quality coals. The need for more CB facilities—to improve health and safety, to mitigate environmental degradation, to enhance power plant equipment lifespan, and to conform to regulatory requirements—is now well accepted and has been practiced in most coal consuming countries. More and more power plants and CB facilities are being planned and implemented in India and China. However, there is a tremendous need to implement high efficiency CB plants using modern technology, and to better characterize not only the costs, but the benefits of employing cleaner coal. Typically, the true costs of using dirty coal and its impact on human health, transportation costs, power plant efficiency and maintenance, etc. are being ignored thereby posing a problem for greater market penetration of these coal cleaning technologies.

Goals and Objectives

The pre-combustion cleaning of coal and the integrated use of clean coal technology is a desirable and achievable goal. This can be achieved by:

- Establishing a nationwide programs to protect society and the environment by assuring that the coal supply essential to a Partner country's energy requirements and to its economic and social well-being is provided while striking a balance between protection of the environment and the Partner country's need for coal as an essential source of energy.

- Promoting the use of washed coal and coal rejects as fuels and the utilization of clean coal technology in the power generation cycle to substantially improve the quality of the environment, to ensure the beneficial use of land or water resources, and to avoid endangerment of the health and safety of the public.

- Establishing nationwide programs to introduce efficient and economic coal cleaning technologies and practices.

A coal cost model needs to be developed which should take the quality of raw coal, the purpose and technology of its end use and the beneficiation technology to be adopted as inputs to arrive at the level of desired ash percent in the clean coal and the technology of beneficiation for optimum cost of beneficiation so that the cost of the end product is optimized.

The model should be developed on the basis of a number of case studies for the major end uses of coal like power generation, steel making, cement production and sponge iron production.

The model should also be able to indicate the savings in GHG generation at different levels of ash reduction in the beneficiated coal vis-à-vis raw coal use.

Obstacle and Challenges

Comprehensive management programs for employing coal cleaning technologies and utilizing coal rejects have not been developed and implemented. Without this, coal producers are unable to consistently achieve the appropriate level of coal beneficiation, and consumers are unaware of the economic benefits of using beneficiated coal.

There is no cost model for beneficiating near gravity coal. Without it, the producer is unable to decide how near gravity coal can be economically beneficiated and the consumer is unaware of the economic benefits of using the beneficiated coal. Even though the cost of mining coal in India is one of the lowest in the world, the cost of beneficiation becomes prohibitive for the consumers to accept beneficiated coal. Recent understandings of the impacts of GHG emissions have prompted the interest in developing this model.

Project Location

India

Deliverables

Phase 1.

- Review existing regulations and practices for coal beneficiation considering the technical and economic feasibility of achieving various levels of percent ash reduction.
- Employ computer simulation program based on the coal characteristics to identify optimum operating conditions that maximize clean coal recovery.
- Develop recommendations for optimum percent ash and sulfur reduction in washed coal taking into consideration factors including: reduced air emissions, reduced coal transportation costs, improved power plant efficiencies, reduced power plant maintenance costs and outages, decreased ash disposal costs, effective utilization of coal rejects, etc.
- A computerized model backed up with case studies for a quick decision for the level of beneficiation for a particular coal for a particular use.
- Schedule: 2006

Phase 2.

- Develop a simulation package for the design and operation of CB plants

- Workshop with representatives from APP coal sector to focus on technical, environmental, regulatory, and financial viability of coal beneficiation, and to employ the results of Phase 1.
- Schedule: 2007

Phase 3.

- Establish procedures as well as guidelines to systematically adopt the optimal level of beneficiation into coal mining and coal processing practices considering economic and technical aspects of coal washing, utilization of washery rejects, operation of power plants and environmental impacts.
- A computerized model back up with case studies for decisions on the level of beneficiation for a particular coal for a particular use.
- Review of funding mechanisms available to systematically integrate coal beneficiation in the coal cycle as well as regular use of clean coal technology.
- Workshops and technical transfer of regulatory, funding and coal beneficiation best practices.
- Schedule: 2007

Resources Needed

To be determined.

Prepared by the United States and India

Attachment 1 Economic Modeling and Analysis for Coal Beneficiation

Statement of the Problem

India has significant coal reserves and is among the largest coal producing countries in the world. Coal production in India is projected to double or triple within the next decade, the majority of which will be used for thermal power generation. Significant portions of the coal reserves are characterized by contaminants including high ash contents (resulting in low-calorific value) or high sulfur content (resulting in unacceptable emissions and impacts on human health). Consistent with the goals of the Partnership, efforts should be pursued to deploy coal cleaning technologies and practices that can improve the economics and efficiencies of coal processing and contribute to energy security, reduce pollution, improve the quality of life, and address the challenge of climate change.

Most coal power plants burn coal without any prior cleaning. However, production of environment-friendly and affordable electricity with high-ash coal or sulfur content necessitates coal beneficiation (CB) prior to its utilization as an energy resource. Moreover, CB reduces the load on overburdened rail systems and reduces the need to import higher-quality coals. The need for more CB facilities—to improve health and safety, to mitigate environmental degradation, to enhance power plant equipment lifespan, and to conform to regulatory requirements—is now well accepted and has been practiced in most coal consuming countries. More and more power plants and CB facilities are being planned and implemented in India and China. However, there is a tremendous need to implement high efficiency CB plants using modern technology, and to better characterize not only the costs, but the benefits of employing cleaner coal. Typically, the true costs of using dirty coal and its impact on human health, transportation costs, power plant efficiency and maintenance, etc. are being ignored thereby posing a problem for greater market penetration of these coal cleaning technologies.

Goals and Objectives

The pre-combustion cleaning of coal and the integrated use of clean coal technology is a desirable and achievable goal. This can be achieved by:

Establishing a nationwide programs to protect society and the environment by assuring that the coal supply essential to a Partner country's energy requirements and to its economic and social well-being is provided while striking a balance between protection of the environment and the Partner country's need for coal as an essential source of energy.

Promoting the use of washed coal and coal rejects as fuels and the utilization of clean coal technology in the power generation cycle to substantially improve the quality of the environment, to ensure the beneficial use of land or water resources, and to avoid endangerment of the health and safety of the public.

Establishing nationwide programs to introduce efficient and economic coal cleaning technologies and practices.

Obstacles and Challenges

Comprehensive management programs for employing coal cleaning technologies and utilizing coal rejects have not been developed and implemented. Without this, coal producers are unable to consistently achieve the appropriate level of coal beneficiation, and consumers are unaware of the economic benefits of using beneficiated coal.

Project Location
India and China

Deliverables
Phase 1.

- Review existing regulations and practices for coal beneficiation considering the technical and economic feasibility of achieving various levels of percent ash reduction.
- Employ computer simulation program based on the coal characteristics to identify optimum operating conditions that maximize clean coal recovery.
- Develop recommendations for optimum percent ash and sulfur reduction in washed coal taking into consideration factors including: reduced air emissions, reduced coal transportation costs, improved power plant efficiencies, reduced power plant maintenance costs and outages, decreased ash disposal costs, effective utilization of coal rejects, etc.
- Schedule: Summer/Fall 2006

Phase 2.

- Develop a simulation package for the design and operation of CB plants
- Workshop with representatives from APP coal sector to focus on technical, environmental, regulatory, and financial viability of coal beneficiation, and to employ the results of Phase 1.
- Schedule: Fall 2006

Phase 3.

- Establish procedures as well as guidelines to systematically adopt the optimal level of beneficiation into coal mining and coal processing practices considering economic and technical aspects of coal washing, utilization of washery rejects, operation of power plants and environmental impacts.
- A computerized model back up with case studies for decisions on the level of beneficiation for a particular coal for a particular use.
- Review of funding mechanisms available to systematically integrate coal beneficiation in the coal cycle as well as regular use of clean coal technology.
- Workshops and technical transfer of regulatory, funding and coal beneficiation best practices.
- Schedule: Spring 2007

Resources Needed
- Phase 1. $95K
- Phase 2. $150K

- Phase 3. $225K
- Total = $470K

Prepared by the United States and India

Attachment 2 Coal Washing Cost Model-Case Study

Statement of the Problem

Coal in the Indian subcontinent generally has a high percentage (>35%) of inert material intimately mixed with the carbon content. These are known as near gravity coals. Separation of inert material from near gravity coal requires extensive crushing prior to beneficiation which increases costs and generates large amounts of fine coal. Washing near gravity coal (fine coal) is technically challenging, more costly, and buyers are not prepared to bear this cost. Consumers generally prefer to burn coal without beneficiation, leading to higher ash generation and higher GHG emissions. There is a need to develop a computerized model through which decisions could be taken as to which coal should be beneficiated to what level for optimum cost of the end product.

Goals and Objectives

A coal cost model needs to be developed which should take the quality of raw coal, the purpose and technology of its end use and the beneficiation technology to be adopted as inputs to arrive at the level of desired ash percent in the clean coal and the technology of beneficiation for optimum cost of beneficiation so that the cost of the end product is optimized.

The model should be developed on the basis of a number of case studies for the major end uses of coal like power generation, steel making, cement production and sponge iron production.

The model should also be able to indicate the savings in GHG generation at different levels of ash reduction in the beneficiated coal vis-à-vis raw coal use.

Obstacles and Challenges

There is no cost model for beneficiating near gravity coal. Without it, the producer is unable to decide how near gravity coal can be economically beneficiated and the consumer is unaware of the economic benefits of using the beneficiated coal. Even though the cost of mining coal in India is one of the lowest in the world, the cost of beneficiation becomes prohibitive for the consumers to accept beneficiated coal. Recent understandings of the impacts of GHG emissions have prompted the interest in developing this model.

Location

A number of coal washeries both coking coal washeries and non-coking coal washeries along with some of the end use plants where such washed coal could be used.

Deliverables

A computerized model backed up with case studies for a quick decision for the level of beneficiation for a particular coal for a particular use.

Schedules

2 years

Resources needed to complete action item

To be indicated by the Partner to undertake such study.

Prepared by India
June 8, 2006

CLM-06-03: Fine Coal Beneficiation—Joint Venture Project

Project

Coal beneficiation requires crushing of coals to some optimum size depending on the beneficiation technology employed. During the crushing process, a lot of fines are generated, which are very difficult to beneficiate/wash. This problem is particularly faced in India where due to higher ash content the fine coals contain substantial amount of ultra-fines which are difficult to separate from the inert material. Washing of coking coal fines is being practiced in India mostly employing either water-only cyclones or Froth Flotation techniques. The water-only cyclone is a cheap but less efficient method, which gives approx. only 2 to 3% reductions in ash content.

Fine coal processing by froth flotation is associated with difficulties in froth handling, product dewatering, low throughput, and inefficient separation especially with oxidized coal which is a typical characteristic of Indian coking coal. Though, Froth flotation is an efficient technology for fine coal beneficiation, it is not very effective in India, basically due to high consumption of reagents, high cost of reagents and the process being sensitive to the surface property of the particles.

The fine coals which are not separated from the inerts find their way to rejects causing substantial degradation of environment. Its maximum recovery is essential in order to harness and efficiently utilize the available energy resource.

The problem of fine coal washing is by and large faced by most of the coal producing countries. As such, there is need for developing a suitable process for up-gradation of fine coal to recover maximum clean coal, preferably without application of costly reagents by adopting improved/enhanced gravity separation technologies.

Goals and Objectives

Fine coal beneficiation may be targeted for coking coal in the first instance due to its more specific requirements of low ash content for the metallurgical use. The beneficiated fine coal is used in India as a sweetener in coke making. The desired ash content in the beneficiated fine coal is around 15%. Its recovery percent should be maximized to reduce the loss of ultra-fines.

Obstacles and Challenges

The raw coal supplies to the coking coal washeries in India is mostly from different varying sources with coals of different characteristics. Adjustment of variables, viz. reagent doses, feed concentration, feed rate etc. to their optimum levels with feed variation is not practicable. Moreover, the available technologies in themselves have not been very effective in separating the near gravity fine coals from the inert.

Project Location

A Coking coal washery in India

Deliverables

The project can be taken up by organizing a workshop between the Partner countries followed by technology transfer through a Joint Venture Project between the interested countries.

Schedules
2 years

Resources Needed
Resource requirement may be assessed after the first workshop is held on the topic.

Prepared by India

June 8, 2006

CLM-06-04: Information Sharing on Coal Drying

Project

Thermal drying is generally not part of coal beneficiation at the washery nor is it practiced at the bulk consumer's facility. The moisture level of run-of-mine coal is between 1 to 6%. The moisture content of washed coal can increase to 15% from full-scale washing of coking coal and to 11% in blended thermal coals. The high moisture levels in washed coal often reduce the benefits gained from reducing the ash content. This is obviously not desired by either the producer or the consumer. High moisture coal from the beneficiation plants gives rise to reduction in available heat content for the end use purpose as a lot of heat is consumed in heating the associated moisture and as such requires more coal to be burnt for requirement of the same heat content. Reduction of surface moisture on beneficiated/washed coal is a problem area for coal preparation plants that eventually will lead to reduced GHG emission.

Goals and Objectives

Alternative but economic coal drying technology would be a welcome concept if the cost of coal drying remains within economical range and does not overburden the consumers. Australia has conducted some coal drying studies and obtained reduced GHG emissions. Partner countries would like to have a technology exchange on coal drying to realize the benefits achieved by the Australian studies.

Obstacles and Challenges

It has not been possible to completely eliminate the surface moisture with established coal drying technologies.

Project Location

A coking coal washery in the Jharia Coalfield in India

Deliverables

Technology Transfer

Schedules

1 year

Resources Needed

To be indicated by the Partner for technology transfer.

Prepared by India

June 8, 2006

CLM-06-05: Joint Venture Project on Waste Coal Management

Project

Coal Beneficiation Plants produce enormous amount of unusable coals (rejects) depending upon the purpose for which these beneficiate coals. The amount of reject generation in the case of coking coal beneficiation plants in India is around 10–15% of raw coal feed whereas that in the case of non-coking/thermal coals is 15–20% of the feed. These rejects contain substantial amount of carbon which when disposed in the mined out areas in the hot and humid countries create lot of environmental problems due to self oxidation of coal rejects. Apart from this there is substantial loss of potential energy source as these rejects contain around 15–20% carbon.

In Partner countries with high inherent ash content in coal, particularly in India, the volume of rejects generation every year is very high. Disposal of such rejects with their gainful utilization is of common interest to all the Partner countries.

The future coal requirement in Partner countries is envisaged to be very high owing to their dependence on coal for the energy resource. As such the volume of waste coal generation is also expected to be substantial. Waste coal management, thus, gathers important significance for future. One of the methods of such waste coal management is generation of power through burning of such coals under Fluidized Bed Combustion (FBC) technology. However, waste coal management through this technology has not been very successful in some countries due to very high ash content in such waste coals. Existing power plants with FBC technology are of low capacity, generally 10MW capacity. Such Plants with high ash content of 55–72% in waste coal often face operational problems leading to frequent stoppages of the plant.

Goals and Objectives

As the existing utilization of waste coal is very meager, more capacity addition is required to stop the drainage of energy in washery rejects. As such, effective rejects utilization has been considered a thrust-area with the following emphasis:

- To establish an efficient, cost-effective technique for power generation from washery rejects
- Ash generated from the power plant will be disposed as a back-fill material in the Opencast Mines.
- The Power Plants to envisage post combustion emission control technologies e.g. CO_2 control etc.

Obstacles and Challenges

Waste coal management is a problem world over. Attempts have been made in the past to produce power from such coal but in a limited way. Large volumes of waste coal generation require more efforts on this account and hence a Joint venture project with the above listed objectives would be helpful in gainful utilization of waste coal for harnessing energy from such coal.

Project Location

A Non-coking coal washery in India

Deliverables

The project can be taken up by organizing a workshop between the Partners followed by technology transfer through a Joint Venture Project between the interested countries.

Schedules

3 years

Resources Needed

Resource requirement may be assessed after the first workshop in held on the topic.

CLM-06-06: Extraction of Steep Seam Coal

Project

The North Eastern Region of India is comprised of seven states, namely: Arunachal Pradesh, Assam, Maghalaya, Mizoram, Manipur, Nagaland, and Tripura. North Eastern Coalfield (NEC) is a unit of Coal India Limited, a Government of India undertaking, engaged in carrying out coal mining operations in this region. Coal is produced by both open cast and underground mining methods from coal bearing strata that has been tectonically folded with the coal seams dipping from 30–60 degrees. The coal reserves to a depth of 600 meters (proved, indicated and inferred) aggregate to some 945 million tonnes. The coals occurring in this region are tertiary coal, unique in character by virtue of their low ash content, and thus of high value.

Three underground mines (all in the Makum coalfields of the State of Assam) are currently operating in mineable reserves aggregating approximately 30 million tonnes. The coals produced from this area are used for power generation, cement making, brick kilns, and other industries requiring heat. Increasing energy demands in this region combined with low coal mining productivity from the steep seam coalfields may result in the increased need to transport coal from other regions of India thereby resulting in increased energy costs.

The coalfields lie in remote areas and occur in hillside tracts. The seam structure is inconsistent and the coal beds not only pitch severely but are highly gassy and often mechanically weak. The seams are subject to high lateral pressure and are known for their spontaneous combustion potential.

Different underground mining methods, locally described as the Bhaska, Tipong, Descending Shield, Flexible Roofing, and Hydraulic mining, have not proven to be remarkably successful or demand more start up capital than can be justified given the perceived mining risks.

The North East Region therefore desires a comprehensive assessment of the mining techniques in other countries that could be compatible for use in the North East Region.

Goals and Objectives

The overall objective of this work is to achieve improved production performance and extraction percentage of the steep seam higher value coal by utilizing improved mining technology. This will be accomplished through evaluation of the application of alternative mining methods used in the United States to the unique characteristics of the coal bearing strata of the North East Region.

Obstacles and Challenges

Lack of comprehensive technical and environmental development/management programs as well as lack of expertise and funding has impeded the desired development. The development of mining methods for use in steep seam mining operations have not been a priority for most productive countries since economics force private coal companies to mine the best mining reserve conditions first, which are not as severe as the geologic conditions encountered in these coalfields in India. Mining industry collaboration and modeling are needed to solve these mining condition issues.

Project Location

India (Northeast coalfields, Ledo Colliery)

Deliverables

- Phase 1. Evaluation of the application of other mining methods to the unique characteristics of the coal bearing strata of the North East Region.

  Time frame: One Year resources permitting

  Deliverables:

  - Identification, evaluation, ranking and prioritization of alternative mining techniques will be presented in an Evaluation Report, complete with graphics, numerical analyses, financial forecasts, and risk assessment.

  - Recommendation Report for next stages of development.

  - Workshop and technical transfer on technical, financial and regulatory practices and recommendation.

- Phase 2. Subject to a successful execution of the preceding activity, application of one or more of the evaluated techniques to field-evaluation of those methods. Execution of the suggested retrofits and modifications to the mining method(s) to achieve the desired production, coal quality, operating safety, and financial results.

  Time Frame: Two Years resources permitting

  Deliverables: Status reports complete with graphics, numerical analyses, financial forecasts, and risk assessment.

- Phase 3. Subject to the successful execution of the preceding activity, transfer one or more of the proven mining methods to a pre-selected underground mine with difficult ground conditions. Execution of the suggested retrofits and modifications to the mining methods in order to achieve the desired coal production, coal quality, operating safety, and financial results.

  Time Frame: One year resources permitting

  Deliverables: Report complete with graphics, numerical analyses, financial forecasts, and risk assessment.

Budget

- Phase 1: $150K

- Phase 2: $400K

- Phase 3: $500K

- Total: $1,050K

Prepared by the United States and India

CLM-06-07: Leading Practice Sustainable Development Program for the Mining Industry

Project

As agreed at the Asia-Pacific Partnership meeting held in Berkeley USA in April 2006, Australia has proposed a project to provide leading practice guidance and support for the sustainable development of the minerals industry. The Leading Practice Sustainable Development Program for the Mining Industry is directly relevant to the coal industry and will support two of the objectives of the Coal Mining Task Force, to:

- Facilitate technologies and practices that can improve the economics and efficiencies of mining and processing and continue to improve safety and reduce environmental impacts.

- Identify current reclamation activities in each country, as appropriate, and exchange best practice information in reclamation of surface mined lands with a focus on enhanced surface reclamation practices that improve the opportunities for carbon sequestration.

The Leading Practice Program recognizes that countries at different stages of economic development may not have the same capacity and expertise to regulate the sustainable development of the mining industry operating in their jurisdictions. The growth in demand for minerals in recent years has led to the opening of new mines and increased production capacity at existing mines. The ability of mining agencies to develop an effective regulatory framework for mining industry investment and mine operation decisions will be enhanced through a commitment to leading practice guidance. At the same time, the mining industry should operate at recognized and acceptable standards within the community to maintain its social license to operate. The Leading Practice Program will provide this guidance to industry and government, and information on specific issues for the community in general.

Goals and Objectives

The Leading Practice Program is being developed in consultation with mining regulating agencies, the mining industry, research organizations and community groups to provide guidance for sound mining practices based on a triple bottom line approach to sustainable development—the relationships between economic, social and environmental development. The Program recognizes community expectations of the mining industry and is consistent with industry standards for sustainable development, including the *Ten Principles for Sustainable Development Performance* released by the International Council on Mining and Metals in 2003.

Obstacles and Challenges

The themes addressed by the Leading Practice program are relevant to issues facing coal producers and mining communities in all Asia-Pacific Partnership countries. The guidance and information provided by the Program can be used by mining operations in each country. Task force members may be familiar with the former *Best Practice Environmental Management* booklets produced by the Australian Department of the Environment and Heritage. The Leading Practice Program replaces and extends these booklets with a broader sustainable development focus that can be applied to mining operations in all situations.

The booklets will provide guidance on leading practices, standards and information necessary to maintain the mining industry's social license to operate through a commitment to sustainable development. Further to that, the environmental, social and economic issues are addressed on a "whole of life" basis so that resource producers and consumers can implement leading practices to reflect broad sustainable development principles.

Deliverables

The following themes have been identified as priorities for action under the Program:

- Community Engagement and Development.
- Mine Rehabilitation.
- Mine Closure.
- Stewardship.
- Working with Indigenous Communities.
- Biodiversity Management.
- Tailings Management.
- Managing Sulfidic Materials, Acid Drainage and Metal Leaching.
- Cyanide Management.
- Monitoring, Auditing and Performance.
- Particulate, Noise and Blast Management.
- Water Management.
- Hazardous Materials Management.
- Risk Assessment and Management.

These themes do not limit the scope of the Program, which will evolve to address leading practice management issues as they arise.

Coal Mining Taskforce members can contribute to the development of the booklets through participating in the stakeholder consultation process. Member countries will also be invited to participate in workshops based on these publications, planned to be held as part of the APEC Ministers Responsible for Mining meeting in Australia in February 2007.

The first four booklets in the Program addressing Community Engagement and Development, Mine Rehabilitation, Mine Closure and Stewardship will be released in the second half of 2006. Development of Stage 2 booklets (Working with Indigenous Communities, Biodiversity Management, Tailings Management, and Managing Sulfidic Materials, Acid Drainage and Metal Leaching) will commence in June 2006 with production completed by the end of the 2006 calendar year.

Resources Needed

Financial and in-kind support, including provision of information and review of draft booklets in the public consultation phase, will be required for the production of the Leading Practice booklets.

Prepared by Australia

CLM-06-08: Overburden Slope Stability

Project

Opencast mining contributes about 85% of the total production of Coal India Limited (CIL), which is the principle coal producer in India. Opencast mining will continue to remain as a dominant mining technology in CIL for at least the next two decades, with the depths of opencast mines projected to increase in the future. Opencast mines have already been planned with a maximum depth of about 300 m, and the removed material (overburden) must be placed elsewhere in a manner that is safe and minimizes ground space. While very low and flat dumps would be ideal from a stability point of view, this approach would occupy more ground space and prove expensive. Hence a balance must be struck between minimizing ground space and ensuring that the dumped overburden does not slide and cause accidents and operational shutdowns. The stability of over burden dumps, poses a problem for current and future opencast mines. The problem is already acute in some of the CIL mines like Jayant and Bina.

Goals and Objectives

To design and develop engineered mine planning that integrates proper removal and placement of overburden, install complex pumping systems, monitoring of overburden piles and the successful drilling of deep overburden piles for the deployment of sensors to detect slope failures.

- Assessment of pheratic surface in the internal overburden dump without installation of peizometers.
- Monitoring of internal overburden dump slope to verify deviation from the planned dump slope.
- To measure the rate of slope movement in internal dump and to predict failure of dump.
- To collaborate with a drilling technology company to efficiently and cost effectively complete a drill hole penetrating the deep overburden pile for installing sensor monitoring.
- Technology transfer in the areas of application of laser based surveying technology for measurement of dump slopes, measurement of dump slopes movement and methods of prediction of failure of internal dump slope are therefore considered necessary.

Obstacles and Challenges

The short-term challenge is to acquire drilling technology to be able to complete long drill holes through thick stacked overburden to house sensors capable of predicting slope failures that injure miners and destroy equipment. Also, training and developing engineers and operation managers to execute the mine plan knowing the given severe and adverse geologic mining conditions that the Indian coal mining industry faces.

Project Location

Visit Surface Mines in Wyoming or other sites similar to the steep seam characteristics in India.

Deliverables

In the United States, the larger share of production comes from large surface mine using mega equipment to move and store vast quantities of overburden from the mining operation.

All types of equipment and mine conditions exist in the United States which can be observed and studied including engineering and operational processes that accomplish the goal of minimizing and eliminating slope failures.

Collection and evaluation of best practices for engineering and operations of mining operations, including but not limited to approaches for installation of peizometers to assess pheratic surface, monitoring dump slope movement, and installation of senor monitoring.

Review and observe the execution of short and long term mining planning.

Schedules

Late 2006–2007 resources permitting

Resources Needed

$400,000 for salary, travel, communications, collection of best practices and workshop/technical transfer.

CLM-06-09: Coal Mine Health and Safety

Project

Occupational health and safety issues associated with coal mining must be managed appropriately to reduce the number of fatalities and injuries associated with the industry to levels as low as possible. While the current situation in each country differs as mining conditions, workforce training, legislation and regulations which govern health and safety and enforcement policies are not the same, all agree the ultimate goal for each Partner is to have a world class mining industry achieving a zero fatality and injury rate. All Partner coal producing countries (China, India, Australia and the United States) also agree that as coal production is expected to increase significantly in the future the goal of reducing the injury and fatality rate to zero will become an increasingly greater challenge.

Interest has been expressed on the part of all Partner countries to work together to advance coal mining health and safety in a number of areas including application of advanced rescue equipment and associated services; procedures and techniques for locating and rescuing trapped miners; procedures for rescue mobilization, and in other areas. The Partner countries believe that their respective experiences and problems in each of these areas can be shared to common advantage.

It is important to establish emergency response and rescue procedures for use once an accident has occurred. However, prevention of accidents must take equal priority and both areas must be addressed simultaneously. All fatalities and injuries should be preventable and although there are many causes, a significant number are the results of fire and explosions from gas releases, inrush and rock falls. These health and safety risks can be controlled by developing and implementing new technologies, education and training, sharing leading practice procedures and through the development and implementation of sound legislative, regulatory and enforcement frameworks.

The project will involve all three key areas necessary for a sound occupational health and safety program for mining: people, equipment and systems. These areas can address all major hazards and risks for health and safety in conjunction with effective and efficient legislative and regulatory systems. All branches of government in the Partner countries concerned with mine health and safety will be part of the project.

Goals and Objectives

Develop a strategic approach to risk management to move toward the goal of zero fatalities and injuries in the coal mining industry. Initial information exchanges will assist in identifying areas and countries where work can productively proceed. In addition to information exchanges it is envisioned that the project will include work in automation, enhancement of rescue operations, improved communication and regulation capabilities, and monitoring procedures. The project will increase awareness amongst all Partner countries and their workforces of mine safety standards and accident prevention and will work, as appropriate, toward strengthening the capacity of governments to promote mine health and safety.

The project will work to provide suggestions for an overarching legislative framework for health, safety and risk management, identify leading practices to control health and safety risks, identify expertise and resources within the Partner countries in the health and safety areas and, funding permitting, conduct one or more demonstration projects in an area that will be selected by the task force.

Improvements in health and safety and a reduction in fatalities and injuries will improve the economics of coal mining both through an improvement in productivity and a reduction in mining costs.

The ultimate goal of the project will be to improve coal mine health and safety throughout the region and to provide an example for coal and mining industries world wide.

Obstacles and Challenges

This project, of necessity, must involve a long-term strategy. Many factors contribute to poor safety performance with factors differing in each region. These factors can include:

- Lack of safety equipment and expertise with regard to prevention of workplace accidents.
- Limited technical resources to conduct proper safety training and inspections.
- Limited technical knowledge regarding accident detection and prevention methods and rescue techniques.
- A poorly educated and/or trained workforce.
- A legislative, regulatory and enforcement framework that is not comprehensive or may not be suited to promotion of improved safety measures.

The challenge will be to address each of these factors in a holistic manner by identifying and sharing areas of leading practice and by adopting them, as appropriate, in a step-by-step process. Good health and safety practice is achieved by putting in place the appropriate legislative, regulatory and enforcement frameworks and supporting industry practices that encourage better safety outcomes. Changes in people, equipment, procedures and legislative, regulatory and enforcement systems take time, and must be accomplished in each country recognizing their differing industrial and governmental structures and financial capabilities. However, these changes will ultimately lead to a higher worldwide standard in mine health and safety.

Deliverables

Task 1. (Short-term—Within One Year)
Work together to identify the major hazards and core risks associated with coal mining such as fires and explosions, methane accumulation, roof falls and other major causes of accidents and fatalities. An example of such an analysis as it relates to fires and explosions is attached.

Identify and collate the health and safety legislative frameworks, regulatory capacity, skills, education, and training requirements for each Partner. Enumerate best practices in each country and identify and collate leading technologies and the current indicators used to measure performance in each country.

Task 2. (Short to Medium Term—One to Two Years)
Using the data base and information developed in task 1, develop a series of workshops for exchange of information on procedures, equipment and practices that can reduce accidents and thus reduce the number of fatalities and injuries associated with coal mining. Exchange information and assist in developing emergency response procedures. This information exchange can include training in many areas including but not limited to: inspection techniques; techniques of risk management; surveillance and auditing techniques; accident

investigation and analysis; room and pillar mining; ground control plans; mine fire, water, gas, and explosion hazards and analysis; and slope and dump stability in open-cast mines.

Task 3. (Longer Term to be Accomplished Within a Five Year Time Period)
A more detailed analysis of statutory and regulatory requirements established in each of the Partner countries will be completed and made available to all Partner countries. Where feasible, a system will be established to allow ongoing electronic access to these databases. Assist countries in developing the necessary skills, competencies, and capacity of regulatory staff to enforce statutory and regulatory requirements.

Task 4. (Medium to Longer Term)
Establish demonstration projects aimed at improving the health and safety conditions of mines by identifying/providing appropriate training and safety equipment. A pilot site will be selected and the following activities pursued:

- The selected mine will undergo a health and safety assessment in order to identify health and safety equipment needs of workers.
- Workers and supervisors will receive training on accident/injury prevention methods and emergency response.
- A plan of action that details the specific needs of the selected mine to improve its health and safety conditions for workers will be developed.
- Best Practices information targeted at improving health and safety performance will be identified and disseminate to employers, workers, and Government officials.

Resources Needed

Both cash and in-kind support will be required for various activities and will be determined on the basis of the work plan and schedule agreed.

Prepared by the United States incorporating Australia’s draft paper.

Example Template— Fires and Explosions

Elements	Identified Sub elements	Controls	Resource	Service Providers
People	For example: • Gas Management • Dust management • Spontaneous Combustion detection and management • Fire hazard recognition • Culture • Hazard awareness • Literacy • Induction • Contraband	For example • Training and certification • Legislation framework to include: inspections and enforcement	For example • Ventilation Officer's Course • Stonedust sampling certificate • Fire officer course • Gas detection course • Mines Rescue course • Leadership Skills course • Trades qualifications • Best Practice regulatory frameworks	
Equipment	For example • Design	For example • legislative framework: best practice equipment and systems, requirement for plans, monitoring and enforcement • Explosion proof equipment • Electrical reticulation standards • Mechanical standards	For example • Technical specifications • Flameproof enclosures • Intrinsically safe equipment	
	• Use	• Procedures for use	Best practice company procedures	
	• Maintenance	• Standards	Best practice company procedures	
	• Fire fighting equipment	• Fire depots • Extinguishers • Water supply etc	Best practice company procedures	
	• Ventilation equipment	• Fans • Ducting • Brattice • Scrubbers • Ventilation structures and appliances	Best practice company procedures	
	• Explosion suppression	• Water barriers • Stonedust barriers • Stonedusting	Standards for dust Best practice company procedures for application requirements and equipment	
	• Disposal	• Procedures	Best practice company procedures	
Environment	For example	For example • legislative framework: best practice equipment and systems and requirement for plans, monitoring and enforcement		

Elements	Identified Sub elements	Controls	Resource	Service Providers
	• Explosive Gases	• Ventilation • Gas detection and monitoring • Gas drainage • Frictional ignition controls • Gas utilization	Best practice company procedures	
	• Dust	• Ventilation • Dust monitoring • Dust suppression	Best practice association and industry guidance material	
	• Spontaneous combustion	• Ventilation • Detection • Prevention	Methods and systems of mining	
Systems	For example • Industry regulation	For example • legislative framework: best practice equipment and systems and plans, monitoring and enforcement	Best Practice regulatory frameworks	
	• Inspection system	• Internal • External	Best Practice regulatory frameworks	
	• Mining methods	• Mine design	Best practice association and industry guidance material	
	• Underground Environment management	• Gas monitoring • Ventilation monitoring • Dust monitoring • Power reticulation • People location • Communications	Best practice regulatory frameworks and association and industry guidance material	
	• Education and certification	• Competency based • Formal accreditation	Best practice regulatory frameworks and association and industry guidance material	
	• Supervision	• Leadership • Skills • Compliance • Enforcement	Best practice association and industry guidance material	
	• Maintenance management	• Structured/computerized • Condition monitoring • Inspections • Compliance standards • Overhaul periods • Life cycle management	Best practice regulatory frameworks and association and industry guidance material	
	• Emergency Response	• Fire fighting • Self Escape • Mines Rescue • Simulation exercises	Best practice regulatory frameworks and association and industry guidance material	

Elements	Identified Sub elements	Controls	Resource	Service Providers
	• Reporting	• Non compliance • Fires and explosions • Events and incidents	Best practice regulatory frameworks and association and industry guidance material	
	• Information Technology	• Web based information services • Research providers		

CLM-06-10: Reclamation of Legacy Coal Mines to Abate Hazards

Project

Coal mining operations can result in disturbances to the land surface that burden or adversely affect commerce and the public welfare by destroying or diminishing the utility of land for commercial, industrial, residential, recreational, agricultural, and forestry purposes, by causing erosion and landslides, by contributing to floods, by polluting the water, by destroying fish and wildlife habitats, by impairing natural beauty, by damaging the property of citizens, by creating hazards dangerous to life and property, by degrading the quality of life in local communities, and by counteracting governmental programs and efforts to conserve soil, water, and other natural resources. The predicted expansion of coal mining to meet the world's growing energy needs makes it even more urgent to establish appropriate standards to minimize additional damage to the environment and to productivity of the soil and to protect the health and safety of the public. At the same time it is important to develop programs with associated funding mechanisms to restore the utility of land damaged by past mining.

For example, China has reported it has about 13.3 million acres "derelict" lands of which four million of those acres were caused by past coal mining. This adversely impacts nearly 1/10th of China's total agricultural acreage. Although mining reclamation began in the early 1960s in China, it has not been consistently implemented and about 40,000 new hectares are presently being disturbed by coal mining activities each year. In India more than 80,000 people have to be shifted to safer places as they are residing in areas which are now considered unstable due to past unscientific mining and the coal mine fires endangering such areas. Large tracts of mined out/subsided areas of the past also require reclamation apart from dealing with fires in some of the old coalfields.

Goals and Objectives

Mining becomes a temporary land use through programs of environmental management and land reclamation.

- Establish a nationwide program to protect society and the environment from the adverse effects of coal mining operations.
- Assure that the coal supply essential to a Partner country's energy requirements and to its economic and social well-being is provided and strike a balance between protection of the environment and agricultural productivity and the Partner country's need for coal as an essential source of energy.
- Promote reclamation of mined areas left without adequate reclamation and which continue, in their unreclaimed condition, to substantially degrade the quality of the environment, prevent or damage the beneficial use of land or water resources, or endanger the health or safety of the public.

Obstacles and Challenges

Comprehensive environmental management programs for coal mining operations and funding mechanisms for reclamation of legacy mines has not been developed and implemented.

Project Location

To be determined

Deliverables

Regulatory review to determine gaps.

Collection and evaluation of best practices for environmental management of mining operations.

Review of funding mechanisms available to systematically reclaim legacy mines.

Workshops and technical transfer of regulatory program strategies, funding strategies and land reclamation best practices.

Schedules

Late 2006-mid 2007 resources permitting

Resources Needed

$500,000 for salary, travel, communications, collection of best practices and workshop/technical transfer.

Prepared by the United States

June 8, 2006

CLM-06-11: Increasing Recovery and Use of Coal Mine Methane

Project

Methane, a potent greenhouse gas, is contained in coal seams and associated strata but is released into the atmosphere during coal mining activities. Coal mine methane contributes about 8% of all human-related emissions of methane. Globally, China has the largest coal mine methane emissions, followed by the United States. In 2000, Australia ranked 5th and India ranked 9th in global coal mine methane emissions.

Methane must be removed from underground coal mines before and/or during mining to ensure mine safety. Most methane is removed by mine ventilation systems, which provide a breathable work environment and control methane concentrations to safe levels. Ventilation may be supplemented by degasification in advance of or during mining, or after mining has occurred. Degasification systems, also commonly referred to as drainage systems, employ vertical or horizontal wells to remove methane from the coal and associated geologic strata. The concentration of ventilation air methane (VAM) in ventilation air must be kept very low[1] to ensure that it does to reach explosive levels. Depending on site characteristics and techniques used, methane recovered from pre- or post-mining drainage ranges from pipeline-quality to medium or low-quality.

The United States leads the world in recovery and utilization of coal mine methane for use as a clean-burning energy source. The U.S. coal industry has accumulated vast experience with drainage practices to access gassy coal seams, draining the gas to reduce in-mine methane concentrations primarily for health and safety purposes. Australia is also a key innovator in recovering and utilizing coal mine methane, including some experience with utilizing dilute ventilation air methane.

Goals and Objectives

Improve mine safety and increase coal mine methane/coalbed methane production and utilization in the APP countries, primarily in China and India, by promoting use of more effective drilling and mine drainage technologies and techniques in advance of mining, and the recovery or use of low-grade CMM sources, such as VAM.

Obstacles and Challenges

Lack of widespread deployment of current technology (for drilling or effectively draining methane from coal seams, or for end-use such as gas processing for pipelines or power generation), as well as lack of training to operate such technology.

Lack of demonstrated, economically attractive technology for recovery or use of low-grade CMM, such as VAM.

Lack of appropriate infrastructure for processing, transmission and utilization (e.g., gas pipelines for pipeline quality and off-spec gas).

Inadequate characterization of potential CMM resources.

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[1] For example, mining regulations in the United States limit methane concentration in air at the mine face to less than 1%, and actual concentrations typically are much lower in practice.

Regulatory and legal barriers that impede project development (such as lack of clarity about ownership of the gas, or lack of clarity or certainty in the permitting process).

Lack of investment capital for high-capital projects.

Project location

India and China

Deliverables

Note: The efforts of this task force are intended to be complementary to efforts to promote coal mine methane project development under the Methane to Markets (M2M) Partnership, an international initiative that includes all six Partner countries. M2M is focused specifically on overcoming impediments to project development, including informational, regulatory, and policy barriers; and pre-feasibility studies to evaluate use of end-use technologies under site-specific circumstances. The activities of this Task force may tap into the project-based activities of the M2M Coal Subcommittee where relevant and appropriate to ensure that there is no duplication of effort.

- Conduct resource and market assessments to identify needs, opportunities, and barriers in target Partner countries to deploy technologies for coal mine methane utilization, including degasification ahead of, during, and after mining. This effort may include:
    - Identification and assessment of advance degasification and CMM utilization technologies that have been used or tried in these areas.
    - Identification of country- or coal-basin specific characteristics and limitations for specific CMM drainage, recovery, and utilization technologies.
    - Identification of the most promising sites or regions in each country for available CMM utilization techniques using pre-feasibility assessments. This effort may include referencing work already being accomplished under the M2M Coal Subcommittee, or supplementing that work as appropriate.
- Implement pilot programs to demonstrate the applicability of advance drilling and CMM recovery technologies under site-specific conditions.
- Conduct outreach and assistance activities to deploy advance degasification and CMM recovery techniques and facilitate technology transfer and provide capacity building. These workshops should complement training and technology transfer activities conducted under the aegis of M2Mconcerning methane recovery and utilization technologies.
    - Conduct a series of regional workshops targeted primarily on Chinese and Indian participants on best practices for pre-mine methane drainage and CMM utilization. U.S. and Australia industry specialists will be invited to provide portions of the training.
    - Site visits in the United States for relevant Chinese and Indian participants to see current best practices for advance degasification and CMM utilization in the United States or Australia.

- Exchange information and identify R&D objectives for a research program to develop advanced CMM utilization technologies, particularly for VAM

Schedules

Conduct assessment of information needs to develop a catalogue of CMM technologies that have been tried or used in specific countries, coal-basin specific characteristics, and most promising potential sites to investigate pilot projects Based on this assessment, identify information gaps and determine need and feasibility to develop a comprehensive assessment of technologies. Draft information needs assessment and recommendation developed by end of 4th quarter 2006.

Initiate planning to establish one pilot CMM drainage and recovery program (2nd quarter 2007).

Establish plan for workshops and site visits (1st quarter 2007).

Resources Needed

The resources needed for this project approximate U.S. $2 million

Prepared by the United States

CLM-06-12: Integrated Coal and Methane Extraction

Project

China is the biggest coal producer in the world with an annual coal output of 2.3 billion tonnes in 2005. China is also the world's largest coal consumer, with coal accounting for approximately 70% of its total energy consumption. China has an estimated coal resource of 5600 billion tonnes and proved coal reserves of 1000 billion tonnes. The reserve of coal seam methane in China is estimated at around 35 trillion m^3, which is equal to their natural gas reserves.

Coal mine methane (CMM), generated during coal mining, has been the number one cause of major mine safety accidents in China. In addition, coal mines in China emit up to 13 billion m^3 of methane into the atmosphere annually. Only 5% of the methane released from coal mines is used in China. Furthermore, CMM in China is expected to escalate as the mining depth and coal production increases.

Coal mining and methane drainage for mining safety involve two separate processes. To increase coal production, improve coal mining safety, and reduce fugitive mine methane emissions, it is strategically important to integrate the two processes.

The proposed project will apply and demonstrate an advanced approach and technologies to support and promote integrated coal production and methane extraction. This approach is based on two key technologies, both jointly developed between CSIRO Australia and METI/NEDO/JCOAL Japan. The first technology is known as COSFLOW (NEDO/JCOAL/CSIRO)—an integrated coal mine strata, water and gas simulation and modeling tool that provides a completely new and effective approach for predicting and assessing the complex interaction between strata fracture and movement and the water and gas flows during coal mining. The second is NEXSYS™ (METI/JCOAL/CSIRO)—real-time risk management system comprising both software analysis of electronic safety-critical data and internationally certified hazardous area electronic communication devices. CSIRO Australia is a key innovator in coal mining technologies and recovering and utilizing coal mine methane, including experience with utilizing dilute ventilation air methane (VAM).

Goals and Objectives

Improve mine safety and increase coal mine methane/coalbed methane production and utilization in the Partner countries, primarily in China and Australia, by demonstrating and promoting use of:

- Integrated coal production and methane extraction approach.
- Reliable planning and optimization of the joint production processes.
- Effective operational control and risk management technologies.

Obstacles and Challenges

Lack of wide-spread deployment of advanced technologies such as coupled coal mining and gas flow simulation tools, gas capture and utilization technologies and real time mine environmental monitoring and risk management systems (hardware and software).

Inadequate characterization of mine site coal and CMM in-situ conditions.

Lack of understanding of interaction between mining activities and gas emissions.

Lack of reliable prediction of coal mining condition and CMM emissions.

Lack of a close-loop, real-time and ongoing assessment system to effectively manage both simultaneous coal and gas production.

Project Location

China

Deliverables

1. Site investigation and characterization at a mine site in China. This work will cover geological, hydrogeological and coal seam gas conditions, mining methods and conditions, the current status of CMM drainage methods and applications and existing hazard identification and risk management practices.

2. Forecast of coal production and gas conditions and develop integrated coal and methane production plan using COSFLOW. This will involve the design and optimization of both coal production, and underground drainage boreholes and surface goaf holes with a focus on the improvements of both coal production and safety and maximization of methane gas capture. An integrated approach involving applications of several advanced techniques developed by CSIRO will be deployed.

3. Design and implementation of real time strata and gas monitoring, risk management system. This will involve the application of advanced technologies such as NEXSYS™, CSIRO wireless strata, longwall equipment and gas monitoring devices. A robust CMM monitoring system will be an integral part of the system to measure the results of the improved CMM drainage designs.

4. Workshops and final report. Workshops will be conducted to promote integrated coal production and methane extraction approach, advanced technologies and project outputs. A final report will be produced to detail the methodology and technologies, site investigation, site implementation and improvements achieved at the project site during the project.

Schedules

The project is of a four year duration.

- Year 1. Select a project site and conduct site investigation including data collection, site characterization and carry out preliminary mine measurements and monitoring.

- Year 2. Conduct COSFLOW modeling to predict mining conditions and forecast CMM, develop and optimize integrated coal and methane production plan, design real time strata and gas monitoring systems.

- Year 3. Develop, purchase and/or manufacture hardware and software, install the designed system at the project site and conduct real time monitoring.

- Year 4. Continue real time mine monitoring, complete project result assessment, conduct workshop to demonstrate the project outputs, and complete a final project report.

Resources Needed

The resources required for this project—approximately Aus$2.2m for 4 years.

CLM-06-13: Thick Coal Seam Extraction

Project

India and Australia both have huge thick seam coal resources. The coal reserves in thick seams in both countries aggregate to several tens of billion tonnes. The current mining methods and designs for thick coal seams in underground mines are inefficient and result in huge losses of valuable coal resources in both countries. The recovery ratio of thick seams in a number of existing coal mines is below 50% due to the limitations of the traditional mining technologies and complex caving conditions in thick seam environments. It is very difficult to use the traditional Bord and Pillar method in deeper coal reserves, and in addition the application of open pit methods leads to significantly greater costs, surface footprint and fugitive gas emissions. There is an urgent need for comprehensive investigation of various options for thick seam mining and to develop optimum extraction technologies and designs for improving coal recovery in thick seam environments in India and Australia.

Goals and Objectives

The major outcome of this project is optimization of extraction methods and/or designs to substantially improve recovery rates and safety of mining operations in Indian thick seam environments. The other benefit of this project is reduced footprint of mining operations on the surface and a significant reduction in fugitive coal mine methane emissions. The results of these studies would result in significant benefits to all APP countries including India and Australia.

It is proposed to conduct a number of detailed investigations in one of the coalfields of the Singareni Collieries Company Ltd (SCCL) to develop efficient extraction technologies for thick seam mining conditions. The project studies involve extensive field characterization and caving modeling and site monitoring investigations to study the impact of different mining layouts, designs and methods. The project will use an integrated coal mine strata, water and gas modeling tool that provides a completely new and effective approach to fundamental understanding of caving mechanics and prediction and simulation of the complex interaction between strata movement and the water flows during coal mining.

The project will take four years to complete, as it involves substantial field characterization and monitoring studies.

Obstacles and Challenges

Inadequate characterization of mine site conditions, particularly around thick seams and in deep seam mining environments.

Lack of fundamental understanding of caving mechanics in thick seam mines under complex conditions such as those in SCCL mines.

Lack of advanced tools and technologies such as coupled modeling tools and other advanced geophysical methods.

Lack of expertise, experience and funding in India.

Lack of reliable prediction of coal mining conditions with different mining layouts and designs.

Project location

India (Coalfields of Singareni Collieries Company Ltd)

Deliverables

1. Site investigation and characterization at a mine site in India. This phase of work involves detailed characterization of field site conditions, including geological, geotechnical and hydrological parameters. The work also involves a comprehensive assessment of thick seam mining methods used in different APP countries.

2. Field monitoring and integrated caving simulations. This phase of work initially involves field studies to monitor caving conditions, stress changes, ground movement and stability in existing thick seam mines of SCCL. The work then involves extensive simulations to obtain a fundamental understanding of caving mechanics and the effect of various mining and design parameters under different mining conditions.

3. Optimization of extraction systems and designs. This will involve the development of optimum extraction systems and designs based on the results of the project studies and extensive field trials of the developed systems. The studies also include field performance monitoring of the systems and fine tuning of the systems/designs.

4. Technology transfer and final report. Workshops will be conducted to promote advanced technologies and optimum extraction systems/designs developed during the course of the project. A final report will be produced detailing the technologies, site investigation, and improvements achieved at the project site.

Schedules

The project has a four year timeline.

- Year 1. Select a project site and conduct site investigation including data collection, site characterization, and carry out preliminary mine measurements and monitoring.

- Year 2. Field monitoring in mines and extensive modeling investigations to evaluate the effect of various extraction systems and designs.

- Year 3. Develop and trial the optimum extraction method/design at the selected field site in the SCCL coalfield. It also involves extensive field monitoring and fine-tuning of the mining systems/designs.

- Year 4. Continue performance monitoring of the adopted extraction system and conduct workshop to demonstrate the project outputs, and complete a final project report.

Resources Needed

The resources required for this project are approximately Aus$2.0m for 4 years ($1.0m from Australia and $1.0m equivalent support from India to cover the cost of field investigations in India).

Prepared jointly by CSIRO of Australia and SCCL of India

CLM-06-14: Underground Coal Gasification in India

Project

Indian coal reserves generally have high ash content and extend over a wide range of depths. It is economical to mine shallow reserves by opencast mining but poor quality reserves occurring at greater depths cannot be mined by opencast method and must be worked by underground methods or abandoned. India has an estimated 467 billion tonnes (bt) of possible reserves, of which nearly 66% is located at depths considered deep to intermediate and is of low grade.

Underground coal gasification (UCG) is an appropriate technology to access the energy resources in deep and/or unmineable coal seams and to extract these reserves economically through production of synthetic gas (syngas) for power generation, production of synthetic liquid fuels, natural gas, or chemicals. Although India has good potential for underground coal gasification, UGC is an untried technology in India. Coal India and ONGC have recently initiated actions to try this technology on a pilot scale to prove its efficacy in the context of Indian coal. Cooperation with a Russian Institute has been initiated to identify a suitable site(s) for implementing the pilot study.

Use of UGC technology has the potential to eliminate environmental hazards associated with ash, open pit mining and greenhouse gas emissions if it is combined with re-injection of the CO_2 fraction of the produced gas. India's dependence on coal and its projected rapid rise in electricity demand will make it one of the world's largest CO_2 producers in the near future. Underground coal gasification, combined with separation and re-injection of the CO_2 produced by the process, is one strategy that can decouple rising electricity demand from rising greenhouse gas contributions.

Syngas produced by UCG can be used to generate electricity through combined cycle turbines. It can also be shifted chemically to produce synthetic natural gas (e.g., Great Plains Gasification Plant in North Dakota) and it may also serve as a feedstock for methanol, gasoline, or diesel fuel production and even as a hydrogen supply. Currently, this technology could be deployed in both eastern and western India in highly populated areas, thus reducing overall energy demand. Most importantly, the reduced capital costs and need for better surface facilities provide a platform for rapid acceleration of coal-gas-fired electric power and other high value products.

In summary, UCG has several important economic and environmental benefits relevant to India's energy goals:

- It requires no purchase of surface gasifiers, reducing capital expense substantially.
- It requires no ash management, since ash remains in the subsurface.
- It reduces the cost of pollution management and emits few black-carbon particulates.
- It greatly reduces the cost of CO_2 separation for greenhouse gas management, creating the potential for carbon crediting through the Kyoto Clean Development Mechanism.
- It greatly reduces the need to mine and transport coal, since coal is used in-situ.

Goals and Objectives

India would like to get information on this technology from the point of view of technology transfer, the concerned Ministry in the Government dealing with this issue in the Partner countries, regulatory arrangements existing in the Partners practicing this technology, impact of gasification on the ground water, mitigation measures adopted, if any etc. Exchange of information would help the India in actively pursuing with this cutting edge technology.

Obstacles and Challenges

This relatively new area of energy exploitation would require solutions to numerous technical, economical and regulatory issues. At least two technical issues have to be resolved first to ensure that proper site selection provides both the desired conditions for suitable UCG processes and the confidence that the usable groundwater resources are not adversely impacted.

Groundwater/environmental considerations
Even though most UCG operations have not produced any significant environmental consequences, some UCG demonstrations (including two in the United States) resulted in contamination of groundwater resource. A combination of site-selection, operational and monitoring criteria need to be employed to directly address the issue of environmental risk posed to groundwater.

Site/process considerations
Site and process considerations are inter-dependent, one will affect the other. The parameters associated with the relevant process need to be explored to identify, in a quantitative context, which scenarios are most favorable and which are least, for UCG at a particular site. Also, the coal seam should be located in a region where the products of UCG can be used; otherwise an expensive transportation or conversion scenario would develop.

Project Location

India

Deliverables

Phase 1. Collect and evaluate current status and best practices for Underground Coal Gasification, and convene a workshop in India to address the two main issues cited above. The main goal of the workshop would be to identify and discuss the major factors related to UCG that are unique to India. Participation will be from both Indian and U.S. scientists and engineers knowledgeable in coal geology, hydrology and mining. The workshop will also discuss the lessons that have been learned from current and past UCG experiments, and the advances that have been made in a number of supporting technologies, such as directional drilling, sensing, and process control.

The best practices report and workshop would be completed in the short term or within one year, resources permitting.

Phase 2. Organize technical visits to operating and pilot UCG sites, and potential sites with Indian and U.S. technical experts to address operational and regulator issues associated with underground coal gasification. Visits would include sites in Wyoming and western India, and would include workshops around local data sets, cores and infrastructure.

The site visits and workshops would be completed in the short term or within one year, resources permitting.

Phase 3. Identify potential commercial UCG plant sites and develop recommendations for engineering design including the design of an environmental monitoring program to be run prior to, during and after UCG plant startup.

The report on “Potential High Priority UCG Sites and Design would be completed within one year, resources permitting.

Resources Needed

These sums would cover salary, travel, communications, collection of best practices and workshop/technical transfer.

- Phase 1. $95K
- Phase 2. $125K
- Phase 3. $200K
- Total = $420K

Prepared by the United States and India

CLM-06-15: Workforce Assessment and Training Needs

Project

A key issue identified by the Asia-Pacific Partnership Coal Mining Taskforce relates to the global skills shortage in the minerals sector. In the last 10 years the minerals sector has undergone a period of increased production, investment and prices. This has been largely in response to the Asian economic boom and the resulting high demand for energy and resources. As a consequence, the minerals sector has developed a strong demand for professional and non-professional skilled labor.

Goals and Objectives

To develop a strategic approach to address skills shortages in the Partner countries, including the identification of skills shortages and opportunities for training to reduce technology gaps. This will include sharing information on current strategies and practices existing in Partner countries, identifying areas for capacity building and information transfer and developing models to work towards addressing the issue.

Obstacles and Challenges

Inevitably, each Partner will be experiencing the global skills shortage in slightly different ways so it will be important to ensure the activities progressed under the task force have some benefit to all. A collaborative approach undertaken by the task force will equip Partner countries to deploy strategies to deal effectively with the problem in their own country.

Deliverables

Each Partner should identify existing activities that could provide models for further work to be undertaken within the task force. Attachment A includes examples of measures that have been undertaken in Japan. Attachment B includes examples of measures that have been undertaken in Australia.

Each Partner will collect information on existing activities in their country for addressing skills shortages and disseminate to the Partner countries as an information sharing tool.

Once the information is compiled in a central location, there will be scope to identify particular models that could be pursued by Partner countries.

Resources Needed

In-kind for Phase 1.

Attachment A Japan-China Coal Mining Technology Case Study

To attain the purpose to promote ideal coal mines in coal producing countries in the Asia-Pacific region through the technical transfer of coal mining technologies that know-how and skills have been accumulated by coal mines in Japan, New Energy and Industrial Technology Development Organization (NEDO) has started to implement the training project for three countries, China, Indonesia and Vietnam, of the coal producing countries in the Asia-Pacific region since FY 2002 under being supported by the Japanese Government and coal industry.

At present, there is a coal mine and a coal mining technology training center in Japan. NEDO is implementing its training in the two sites in cooperation with governments, coal industry organizations, universities and so on.

The training project is organized into domestic and overseas training projects.

Domestic Training Project

In domestic training project, NEDO gives training and practices to trainees that the counterparts in the whole countries select from many applicants.

Domestic training project is implemented mainly at two coal mines in Hokkaido and Kyushu. Trainees coming from China, Indonesia and Vietnam are classified into training course groups to receive training for 10 to 24 weeks.

The programs of the domestic training project are roughly divided into two disciplines: technical training in coal mining technologies concerned with safety, maintenance, production and management in mines; and professional training in experience.

The domestic training project is divided into two types of courses for senior management course and junior management course.

Senior management courses consist of management engineer course and mine safety and inspection course.

Junior management course has following courses.

- Underground mining course.
- Mine safety course.
- Mine safety technology and management course.
- Machinery course.
- Electrical course.
- Exploration and survey course.
- Roadway development course.

Overseas Training Project

In overseas training project, NEDO dispatches its instructors to overseas coal mines to give lectures and field practices to trainees.

The overseas training project focuses emphasis on the curriculums that are most strongly requested in the consultation with the counterparts in foreign countries.

The overseas training projects, Japanese instructors are dispatched in the field of mine safety and management technology to China, and the instructors give field practice to mine engineers in underground mine in Vietnam and Indonesia.

This training project is successfully carried out in each countries and Japan has a long experience of the training in coal mining technology. This training project receives good evaluation from these countries.

Attachment B Australian Initiatives to Address Skills Shortages

Mining Skills

The Industry Skills Reports for the Resources and Infrastructure Industry Skills Council was completed in May 2005. The report recommended, among other things, that the industry:

- Develop retention plans (e.g., employee-friendly hours of work and rosters) to increase the attractiveness of the industry.
- Up-skill the workers remaining in the industry to cover skills obsolescence.
- Increase the emphasis on multi-tasking existing employees.
- Have recruitment strategies that encourage young people to enter the industry.
- Introduce paid training or subsidized training in or out of work time.
- Develop partnerships with providers (public and private) to ensure that industry needs are better met.
- Provide compulsory training commensurate with industry competencies, particularly for statutory positions.
- Treat contractors as permanent employees for training purposes.

National Skills Shortage Strategy

The National Skills Shortages Strategy (NSSS) is a partnership between the Australian Government and key industry groups working to develop solutions to skills needs in critical industries throughout Australia, particularly in the traditional trades. The Strategy takes an industry-led approach to address skill shortages.

On 28 July 2004 the Prime Minister announced the formation of the Australian Mining Industry Skill Shortages Working Group (Chaired by Dr David Smith, Managing Director of Pilbara Iron and Vice President of the WA Chamber of Minerals and Energy) to manage the project.

The Working Group is made up of key stakeholders from companies involved in the exploration, extraction and primary processing of minerals and metals and also includes the Minerals Council of Australia, the Chamber of Minerals and Energy Western Australia and the Departments of Industry, Tourism and Resources and Department of Education, Science and Training.

The Group released a report "*Prospecting for Skills: The Current and Future Skill Needs in the Minerals Sector*" on 31 May 2005. The report found that the sector is experiencing skills shortages but there is a fair level of variability in the extent and impact of them and, that skills shortages are not evident through all of Australia, but appear to be, in part, a 'geographic' phenomenon. Mining operations close to urban concentrations (e.g. Hunter Valley, South-East Queensland, Victoria) report lower levels of skills shortages than those operations in more remote locations.

The Group is currently preparing projects such as:

- *Labor Force Outlook to 2015:* gain an understanding of the people issues in terms of quantum, skills, training infrastructure, industry leakage, shortfalls, types of skills etc against the economic outlook of the minerals sector.

- *Skilled Migration:* Skilled migration—targeted country approach, skills, review immigration process etc.

- *Apprentice and Traineeship Training*: Fast Tracked apprenticeships, employer incentives, and benefits to industry

As part of this process the mining industry has produced:

- Marketing strategies to encourage new entrants to the industry

- An assessment of fly-in/fly-out operations.

Council of Australian Governments (COAG) Skills Working Group

The Council of Australian Governments (CoAG) is the peak intergovernmental forum in Australia, comprising the Prime Minister, State Premiers, Territory Chief Ministers and the President of the Australian Local Government Association (ALGA). CoAG has developed a package of measures designed to underpin a new national approach to apprenticeships, training and skills recognition and alleviate skill shortages currently evident in some parts of the economy. CoAG noted that industry also has a critical role to play in creating solutions.

The commitment to quality training

To ensure and assure the quality of outcomes from the training system, COAG has agreed to accelerate the introduction of a national outcomes-based auditing model and stronger outcomes-based quality standards for registered training organizations in consultation with key parties including employers, regulators and unions. Specific quality assurance measures have also been built into the proposals.

A more mobile workforce to help meet skills needs

COAG has agreed to new measures to enable people with trade qualifications to move more freely around Australia without undergoing additional testing and registration processes. COAG has agreed that governments will work with employers and unions to put in place more effective mutual recognition arrangements across States and Territories by June 2007 and by December 2008 for all licensed occupations where people normally receive certificates and diplomas.

Industry and regulators will be involved, along with other stakeholders, to ensure that a streamlined, nationally-consistent system is achieved without increased regulation, while also meeting the commitment to quality standards, including public and worker safety.

To further assist in meeting skills shortages, COAG has agreed to new arrangements to make it easier for migrants with skills to Australian standards to work as soon as they reach Australia. This does not involve any change to the migration policy.

A more flexible and responsive training system

COAG has also agreed to a set of measures to make sure Australia's training and apprenticeship systems offer more flexible pathways into skills-shortage trades.

By December 2006 all governments will have put in place arrangements that allow apprentices and trainees to work as qualified tradesmen and tradeswomen as soon as they have demonstrated competency to industry standards, without having to wait out a set time period or make special application.

By December 2006 also, legislative, regulatory and educational barriers will be removed so that school-based apprenticeships are nationally available as a pathway for school students where there is industry demand. Industrial barriers will also be removed to enable school-based apprenticeship participation in skills shortage industries where there is industry demand.

To make the most of existing skills in the workforce, COAG has agreed that a better process to recognize the existing skills of all people entering training will be introduced by January 2007, so that workers do not have to repeat or undertake training for skills they have already acquired on the job. New funding to be agreed between the Commonwealth and States and Territories on a bilateral basis will be provided to help training organizations and assessment centers establish or improve recognition processes.

Targeted response to skill shortages in regions

COAG has agreed to establish a new Commonwealth regional program in collaboration with the States and Territories to commence in July 2006 to address the supply of skilled labor to industries and regions. Integrated strategies will be developed for selected regions to identify solutions to labor market needs in regions and industries of strategic importance in the Australian economy.

To support the new national approach, COAG has also agreed that Commonwealth, States and Territories will cooperate more closely in sharing labor market information so as to better understand the extent and location of skills shortages.

Next stages of reform

COAG has agreed that further work on reform is needed to continue to increase the contribution of the vocational education and training system to the productivity of Australia's workforce and has asked for a further report examining:

- The growing need for higher level skills.
- Cultural and workplace change to lift educational participation and attainment.
- Possible reforms to funding and other mechanisms to make the training system more responsive to demand.
- Options to increase Australia 's investment in vocational education and training.
- Enhancing user choice through meaningful and timely performance information.
- More appropriate regulation of education and training providers.
- Building stronger relationships between firms and training providers.

This report is expected to be completed by December 2006.

Commonwealth-State Training Agreement

All States and Territories have agreed to sign the new Commonwealth-State training agreement, which will deliver $5 billion over 2005–2008, and include a range of important reforms. For instance, the agreement will:

- Provide 20,000 additional training places in areas of skill shortages, 10,000 of which are in traditional trades.
- Support a Commonwealth-State Skills Shortage initiative where States will undertake joint projects with the Australian Government and local industry to tackle skills shortages.
- Provide 26,000 extra places for mature age workers.
- Support a national initiative to increase recognition of prior learning so as to allow experienced workers to become formally qualified more rapidly.
- Improve user choice arrangements to offer greater choice of training provider and flexibility in training delivery to employers and their New Apprentices
- Introduce reforms to improve flexibility in the TAFE system, such as offering performance pay and AWAs.

Australian Technical Colleges

Australian Technical Colleges, aimed at increasing the number of New Apprentices in the traditional trades, allow students to secure a Year 12 level education while progressing towards a qualification in the traditional trades. To date the Government has announced 18 Colleges in 17 regions. Twenty-five colleges in 24 regions are planned.

On 10 May 2005 the Minister for Vocational and Technical Education, Gary Hardgrave said the Australian Government would invest $351 million over the next five years from 2004–05 to 2008–09 to assist more young Australians into traditional trades through establishment of twenty four Australian Technical Colleges.

Local industry and community representatives will take a lead role in the governance of each of the Colleges. This will ensure that the Technical Colleges are linked with local industry and will respond to local skill needs.

The Australian Technical Colleges will provide young Australians with the opportunity to commence their training in a traditional trade through a School-Based New Apprenticeship while at the same time completing academic subjects leading to a Year 12 certificate. The Australian Technical Colleges will be established in 24 identified regions. Some of the colleges commenced in the 2006 school year, with all 24 colleges opening their doors by no later than 2008.

Funding agreements have been signed by the Hon Gary Hardgrave MP, Minister for Vocational and Technical Education, for several Australian Technical Colleges throughout regional Australia. Three of these colleges (Northern Tasmania, Gladstone and Townsville) will undertake mining related trade training and industry placements as part of a School Based New Apprenticeship. The apprenticeships offered, or will be in the future, include metals and engineering and mining and plant process operations.

The Queensland Mining and Engineering Academy is a State Initiative which will provide opportunities for several thousand students to gain exposure to the mineral and energy sector through curriculum and industry engagement strategies.

Skilled Migration Program

The Government has increased the skilled migration intake by 20,000 in 2005–06, up to 97,500, up from 24,100 in 1995–96, and has taken a range of measures to skew the intake more strongly to areas of skill shortage. More occupations have been added to the Migration Occupations in Demand List (MODL), which provides a bonus 15–30 points towards the 120 points needed to qualify for entry. The List has been extended to include mining engineers, petroleum engineers, chemical engineers and dental specialists.

On 14 April 2005, the Minister for Immigration and Multicultural and Indigenous Affairs, Senator Amanda Vanstone announced details of the Governments' 2005–06 Migration (Non-Humanitarian) Program. As part of the program, the Skill Stream will increase for the eighth successive year, providing up to 20,000 additional places to help meet Australia's short and long-term labor force needs. This will be within an overall Migration (non-Humanitarian) Program in the range of 130,000 to 140,000 and a Skill Stream of around 97,500. The increase in 2005–06 will complement measures the Government is taking to expand training of Australians, particularly in the traditional trades, and will ensure that the working age portion of our population continues to grow. The primary aim of the program will be to increase the number of skilled migrants entering under the employer sponsored categories, as it is employers who are best placed to identify the skilled migrants to meet industry needs.

The expansion of the program allows for more trades and engineering related occupations identified by the Department of Employment and Workplace Relations as being in ongoing national shortage to be added to the Migration Occupations in Demand List (MODL). These include mining engineers and trades persons such as electricians, metal fabricators and welders. The MODL list is published on the Department of Immigration and Indigenous and Multicultural Affairs' (DIMIA) website.

In December 2005, the Minerals Council of Australia's 2006–07 Pre-Budget Submission recommended to continue an expansion in the immigration program. It also encouraged the continuation of the Government-run international Skills Expos program to assist the industry to identify suitable skilled workers in other countries.

Indian Education Case Study Model

From November 2005, the Department of Industry, Tourism and Resources in partnership with Curtin University, Chamber of Minerals and Energy WA, Department of Education Science and Training and Department of Immigration and Multicultural Affairs has been developing an education pilot project. The project was discussed at the India-Australia Coal and Mining Forum and agreement was reached that Curtin University, BHP Billiton, Rio Tinto and Newcrest Mining would all be involved in advancing this education pilot project. The Chamber of Minerals and Energy WA has received offers from mining companies for 17 places.

The aim of the project is to create a pilot project whereby graduate mining students from India undertake a post graduate course in Australia that includes substantial work experience with a mining company. Upon successful completion of the course, the student would be encouraged to seek full time employment with a mining company and apply for permanent residency in Australia. Curtin University is in the process of developing a course structure for the program.

This project provides a two pronged approach by assisting in alleviating skills shortage in both the short term (work-experience) and long term (permanent job placement). It is envisaged that the pilot project be between Curtin University in Perth, Western Australia, the Indian School of Mines in Dhanbad and the Indian Institute of Technology in Roorkee, Kanpur and Kharagpur. Depending on the success of the pilot project, other universities may consider introducing similar courses.

An expression of interest was issued to the Indian Universities in late March 2006. It is anticipated that a response from the Indians will indicate numbers of students interested in undertaking the program and also give an indication as to when the course is likely to commence.

Australia-China LNG Training Case Study

The Australia-China Natural Gas Technology Partnership Fund is the result of a commitment made by the Prime Minister to the Chinese Government in 2002, in the context of negotiations over the Guangdong LNG contract. The Fund will provide training for Chinese officials, executives and workers and the funding of research studies, scholarships, exchange visits etc of mutual benefit to Australia and China. The initial focus is on training ahead of the first deliveries of LNG from Australia due in mid 2006.

Training in Australia

The first training course in Australia began in May 2005 and is being jointly run by the University of Western Australia and Curtin University. The course is a seven month course, caters for eight trainees and covers:

- Language, cultural and business orientation
- Business management and leadership principles
- Communications skills
- Introduction to LNG and natural gas industry
- NWS LNG operations
- Commercial contract principles
- City gas industry
- Gas power industry
- Gas industry and regulatory environment
- Gas downstream industry
- Industry attachments.

Feedback from the trainees is that they regarded the course as very beneficial.

The training in China consists of four different courses lasting six or seven weeks, caters for forty to fifty trainees per course. The four courses cover:

- Terminal and trunkline projects
- City gas projects
- Gas power plant projects
- Other basic training course

Australia considers that these models could be successfully applied under The Partnership to deal with skills shortages across all Partner countries.

CLM-06-16: Technical Improvement for Control of Coalfield Fires

Project

Coalfield fires are significant not only for wasting natural resources but they also create tremendous environmental problems. Coal fires are mainly distributed in China, India, Indonesia, USA, and Russia but they exist in most countries with coal reserves. In China coalfield fires are most severe in Xinjiang due to its unique geological and geographical conditions.

The depth and dimensions of burning areas can not be accurately determined because of the limitation of currently employed technology and equipment, especially in complex geological conditions where the burning area is greater than100m deep and the temperature is above 500C. Consequently the design standards and effective implementation of fire fighting operations, which normally include a sequence of steps: strip, leveling, drilling, injection water and mud, and recovering, are adversely impacted. The lack of accurate detection of the cavities in the burning areas adds a high safety risk for the fire fighting operation.

Xinjiang is vast and most of the burning areas are dispersed in the remote mountain region. China has no effective monitoring system to plot the trends and forecast a fire's behavior in order to take timely action.

China lacks new technology and materials for fire extinguishing. Fire fighting efforts are made more difficult in some fire areas because no water and soil are available. This excludes the traditional technology and materials used to fight fires. New materials more adapted these situations are urgently needed.

Goals and Objectives

To accurately determine the depth of burning coal seams within a ±1m tolerance, and to be able to visualize the spatial distribution and the underground thermal field.

To establish monitoring systems for timely understanding of the dynamics of the fire area, to setup a database to forecast and manage the fire in order to ultimately stop its destruction and pollution to the atmosphere and environment.

To save water and soil consumption up to 30%, increase fire extinguishing efficiency to approx. 15%, and reduce operational cost to 25%.

Obstacles and Challenges

The internationally advanced technology and equipments have not yet been applied in coalfield fire fighting due to its unique characterization and multiple disciplines involved. International cooperation and exchange in coalfield fire management has not been sufficient, and R&D in this field is under invested. APP provides a good platform for sharing information and technology.

Proposed Action Items for Coal Mining Task Force

To introduce the internationally advanced technology and equipments for improving accuracy and precision in detecting coalfield fires.

To establish a coal fire monitoring system with modern information technology, especially with aviation and satellite remote sensing, GPS, and GIS for locate and map fire dynamics, process analysis, and its impact to the environmental, to help speed-up coal fire fighting operations.

By international cooperation for strengthening R&D on extinguishing technology, especially new extinguishing materials and technology.

Deliverables/Schedules

I. To Increase Detective and Explorative Accuracy	Oct. 2006	Workshop, Project task force, Field trip for study
	Nov. 2006	Project designing documentation
	Dec. 2006	Project financing
	Jan-May 2007	Introduction of instruments and equipments
	Jun-Oct. 2007	Pilot exploration, training
	2008–2009	Extension in other region and country like India. Report
II. To Establish Coalfield Fire Monitoring System	Oct. 2006	Workshop, Project task force, Field trip for study
	Nov. 2006	Project designing documentation
	Jun-Dec. 2006	Project financing
	Jan-Aug. 2007	System development
	Aug-Dec. 2007	System debugging
	Jan-Dec. 2008	Data acquisition, system operation
	2009-	Extension. Report
III. New Technology and Materials for Fire Extinguishing	Oct. 2006	Workshop, Project task force, Field trip for study
	Nov. 2006	Project designing documentation
	Dec. 2006	Project financing
	Jan-Dec. 2007	Technical transfer, equipments installation
	Jan-Dec. 2008	Staff training, pilot production, application of the new materials
	2009-	Wrap-up report, Extension of new technology

Project Location

The project locations are selected in Tielieke Fire Zone and Kueraken Fire Zone in Baicheng County, Yangxia Fire Zone in Luntai County, and Shuixigou Fire Zone in Jimsar County, Xinjiang, China. Among these, Tielieke Fire Zone initiated fire fighting operation since 2004 and will be finished by the end of 2007, the other three fire zones will start operation during 2007–2010.

According to the adjusted coalfield fire control planning in Xinjiang, the Chinese Government will complete the fire fighting programs in Tielieke Fire Zone and Kueraken Fire Zone in Baicheng County, Yangxia Fire Zone in Luntai County, and Shuixigou Fire Zone in Jimsar County, Xinjiang, during 2004–2010. The budget for that operation is estimated for 300 million Yuan, among these 90 million Yuan for Tielieke, and 67 million Yuan has been invested. The selected locations for the cooperative project is right in the burning areas that already have some fire fighting operations, that provide good conditions for the implementation and greatly reduce the cost of the cooperation project.

Resources Needed

It is preliminarily estimated for reaching the project objectives the total fund of US$1.2 million is needed, among these US$700,000 for the instruments and equipment, US$200,000 for the development of monitoring system, and US$300,000 for the others (salary, travel and accommodation, telecommunication, training, and reporting). For the budget for new materials and technology, technical transfer, and procurement of equipment, currently it is not possible to estimate.

For the sources of the project resources, covering that for technical transfer and procurement of the instruments and equipments, funding will be sought from Partner countries.

The Chinese Government will provide strong support to the cooperation project by using its investment for the fire control program, all the necessary cooperation in the implementation, technical staffs, and related data.

Prepared by China