

“11th Five-Year Plan ” for Development and Utilization of Coalbed Methane and Coal Mine Methane

1.Principles for development

- (1) Combined surface and underground gas recovery;
- (2) Combined independent development and foreign cooperation;
- (3) Combined local utilization of gas with transport of surplus gas to other cities
- (4) Combined household utilization with industrial utilization
- (5) Combined enterprise development with state support.

2.Targets

In 2010 the national output of CBM (CMM) will reach 10 billion m³. Of which, quantity of CBM to be drained from surface will be 5 billion m³ with a utilization rate of 100%, and CMM to be drained underground will reach 5 billion m³ with a utilization rate of over 60%. The quantity of the newly increased proven CBM geological reserves will be 300 billion m³. An industrial system for development and utilization of CBM/CMM will be gradually built up.

3.Overall Arrangement and Major Tasks of the Plan

3.1 CBM prospecting

Efforts will concentrate on CBM exploration in Shanxi, Shaanxi, Xinjiang, Inner Mongolia provinces or prefectures, on the basis of CBM prospecting projects in Qinnan & Sanjiao in Shanxi, Hancheng in Shaanxi, Changji & Dajing in Xinjiang, and Erlian basin in Inner Mongolian. By 2010, the newly increased cumulative proven geological reserves will reach 300 billion m³ (Table 1).

Table 1 Plan for Newly Increased Proven CBM Reserves in the “11th Five-Year Plan”

(Unit: Billion m³)

Province (Prefecture)	2007		2008		2009		2010	
		Cumulative Reserves		Cumulative Reserves		Cumulative Reserves		Cumulative Reserves
Shanxi	85	85	40	125	25	150	60	210
Shaanxi	10	10	0	10	0	10	20	30
Xinjiang							40	40
Inner Mongolia							20	20
Total	95	95	40	135	25	160	140	300

3.2 Surface CBM Exploitation

By 2010 the productive capacity of CBM will reach 7 billion m³ and production will reach 5 billion m³ (Table 2).

Table 2 CBM Surface Development Plan in the “11th Five Year Plan”

Unit: million m³

Province (Prefecture)	2006		2007		2008		2009		2010	
	Capacity	Output	Capacity	Output	Capacity	Output	Capacity	Output	Capacity	Output
Shanxi	330	230	1 230	830	2 460	1 820	3 880	2 910	5 350	3 950
Liaoning	10	10	20	20	50	30	90	40	100	50
Heilongjiang					20	10	30	20	50	20
Anhui					20	10	70	30	100	30
Henan					20	10	70	20	100	30
Chongqing			10	10	20	20	30	30	50	50
Sichuan							10	10	20	20
Guizhou					30	20	50	30	100	50
Yunnan					10	10	30	20	50	20
Shaanxi	10	10	40	40	70	70	250	200	400	200
Xinjiang					100	50	300	200	500	400
Others					100	50	100	100	200	200
Total	350	250	1 300	900	2 900	2 100	4 910	3 610	7 020	5 020

Efforts will focus on construction of two CBM commercial bases in Qinshui and the eastern fringe of Ordos Basins.

(1) CBM commercial production base in Qinshui basin

Conditions of CBM resources in Qinshui basin are good due to moderate burial depth of coal seams (300-1,000m), great thickness and high methane content (19-26m³/t). Occurrence of strata is flat with a few faults. Joints in coal seams are well developed (530-580 joints per meter). Permeability of coal seam is high (0.5-1.0 md). The geological conditions are good for CBM development. It aims to build a base with a productive capacity of 3.95 billion m³, an output of 3.05 billion m³ and with newly increased proven geological reserves of 150 billion m³ in 2010. The major projects in the plan include those in Qinnan, Fanzhuang, Jincheng mine area, Shizhuang, Shouyang, Panzhuang, Daning and Duanshi.

● Qinnan State High-Tec Commercial Demonstration Project.

Establishment of this project was approved by the State in 2004. Nine hundred wells were designed which would be completed in three stages. One hundred and fifty wells were completed in the first stage in 2006 with a productive capacity of 100 million m³. Four hundred wells with a capacity 400 million m³/year will be built in the second stage. Three hundred and fifty wells with a capacity of 700 million m³ per annum will be constructed in the third stage. A CBM surface vertical well demonstration project will be completed in the

“11th Five Year Period” in China.

- **Duanshi CBM Strategic Block Demonstration Project.**

This project plans to construct five multi-lateral horizontal wells and seventeen single-lateral horizontal wells. The annual production capacity will be 100 million m³ when the project is finished. Currently, the first well is finished. A demonstration project of drilling CBM surface multi-lateral horizontal wells will be completed in the “11th Five Year Plan” period in China.

- **Daning Demonstration Project of Gas Drainage Prior to Coal Mining.**

The project was the first multilateral horizontal well ever built successfully in China. Currently, it keeps a stable daily production of 20,000 m³. It will be a demonstration project for extraction of gas prior to coal mining by boring 2-5 multilateral horizontal wells in the “11th Five-Year Plan” period.

(2) Commercial CBM Base in East Fringe of Ordus Basin

Coal seams in east fringe of Ordus basin have moderate burial depth, varying from 500-1,500m. Permeability of virgin coal seams is high, generally, reaching 1 md. The coal seams are thick. (Thickness of a single coal seam is 3-8m, the cumulative thickness of seams, 8-13m.) Methane content is high, 12-23 m³/t. Ranks of coal are mainly fat and coking coal, with small amount of lean coal and meager coal. The geological conditions are excellent for CBM development. A base with a productive capacity of 1.6 billion m³ and with an annual output of 1.1 billion m³ will be built and the cumulative newly increased proven geological reserves will be 90 billion m³ in the 11th Five Year Plan period.

3.3 Drainage and Utilization of CMM

In the period of the 11th Five-Year Plan” stress will lay on gas extraction aiming at ensuring mine safety, establishment and improvement of a complete legislation and standard system for gas drainage, tackling key scientific and technological problems, construction of demonstration projects and gradual increase of gas drainage and utilization rates. In 2010, the national gas drainage quantity will reach over 5 billion m³, and the drainage rate, over 40%; the quantity of gas to be utilized will reach over 3 billion m³, the utilization rate, over 60%; and large scale gas drainage will be carried out in Shanxi, Liaoning, Anhui, Henan, Chongqing, Sichuan, Guizhou, Shaanxi, Ningxia provinces (or prefectures, or cities) according to the plan (Table 3).

The following key demonstration projects will be built for control and utilization of CMM in the period of the “11th Five-Year Plan:

- **Demonstration project for CMM control and utilization in mines where a group of coal seams are extracted under highly gaseous, high temperature and high ground pressure conditions.**

A mine area, which mines a group of coal seams with serious proneness of outburst, will be selected for demonstration of comprehensive gas control and utilization technology to ensure safety in high productivity mine. Comprehensive CMM extraction and utilization

technology will be developed. Gas drainage rate will reach over 60% and gas drainage quantity will reach over 500 million m³. The gas utilization quantity will be 450 million m³. The installed capacity of power generating sets will reach over 100,000 kW. The risks of gas will be basically controlled, and the face output will be over 3 million tons of raw coal.

Table 3 Quantities of Gas To be Drained and Utilized in the 11th “Five Year Plan”

Unit: Mt m³

Province	2006		2007		2008		2009		2010	
	Drainage	Use	Drainage	Use	Drainage	Use	Drainage	Use	Drainage	Use
Hebei	42.19	23.10	49.61	28.60	55.11	35.20	59.51	40.70	60.61	41.80
Shanxi	598.20	345.62	1048.80	717.48	1079.95	762.04	1278.40	801.12	1515.70	1201.11
Inner Mongolia	28.27	12.00	31.35	12.00	33.00	15.00	34.10	15.00	34.10	15.00
Liaoning	244.97	135.10	325.17	248.78	311.33	261.71	318.46	263.84	377.70	273.39
Jilin	17.05	3.30	21.84	8.45	22.94	8.80	26.79	13.86	31.19	15.84
Heilongjiang	63.56	26.42	80.56	38.30	93.46	44.49	106.76	51.32	109.86	52.67
Jiangsu	2.73	1.50	2.73	1.50	2.73	1.50	2.20	1.50	2.20	1.50
Anhui	294.80	103.98	358.60	153.64	413.60	191.20	455.40	251.86	495.00	266.82
Jiangxi	26.40	3.96	31.66	4.75	39.60	5.94	51.46	7.72	69.46	10.42
Henan	110.00	23.87	150.00	127.18	220.00	272.98	300.00	393.65	350.00	486.70
Hunan	30.00	10.00	35.00	20.00	45.00	30.00	60.00	45.00	80.00	60.00
Chongqing	206.32	35.36	224.92	40.97	245.51	46.45	268.56	55.60	296.01	67.04
Sichuan	59.26	37.92	75.86	56.56	150.55	104.01	212.37	158.22	227.74	170.54
Guizhou	686.18	145.20	784.08	167.86	872.72	202.68	932.38	199.18	1049.56	213.84
Shaanxi	90.31	13.00	113.18	29.47	116.48	72.60	267.54	81.62	326.92	112.64
Gansu	26.07	11.00	28.60	15.00	36.08	31.90	42.90	39.60	42.90	38.50
Ningxia	90.20	72.16	103.95	88.35	132.00	118.80	165.00	156.75	215.00	173.00
Total	2616.51	1003.49	3465.91	1758.89	3870.06	2205.30	4581.83	2576.54	5283.95	3200.81

- **Gas control and utilization demonstration project for mines which extract coal seams with serious proneness of outburst without mining a protective seam.**

A mine area with serious proneness of outburst will be chosen for demonstration, where no protective seam is mined. Comprehensive prevention and control technology against coal and gas outburst and technologies for CMM drainage, household use and power generation will be developed. By 2010, the risk of coal and gas outburst will be effectively controlled, and a complete technical and management system will be established for comprehensive control and utilization of gas without mining a protective seam. The drainage quantity of the demonstration mine area will reach 150 million m³ and the utilization rate of power generation and domestic purpose will be over 80%.

- **Gas drainage and utilization demonstration project for highly gaseous mine with serious proneness of spontaneous combustion.**

A highly gaseous mine area, which mines thick coal seam with serious proneness of spontaneous ignition, will be selected for demonstration. Technologies will be developed for drilling in-seam long borehole for gas drainage and effective control of spontaneous combustion in the mined-out area and for domestic use and power generation. Quantity of gas to be drained will be over 150 million m³, the drainage rate being over 60%. The gas utilization rate will be over 80%. The spontaneous combustion in the gob will be basically controlled.

- **Demonstration project for combined surface and underground CMM drainage and utilization.**

A mine area which extracts medium-thick coal seams with high gas content will be selected to demonstrate the technology for capture of gas prior to mining, combined surface and underground gas drainage technology, and technology for utilization of midstream and upstream products, like CMM collection and transportation, chemicals, etc. The annual output of a work face will reach over 3 Mt of raw coal. The gas accidents will be effectively controlled. The annual CBM productive capacity will be 1 billion m³. The installed capacity of generating sets of the gas power plant will reach 120 MW.

- **Demonstration project for R&D of gas extraction and utilization technology and for equipment manufacturing.**

First class domestic enterprises capable to undertake R&D of CMM drainage and utilization technology and equipment manufacture will be chosen for demonstration. Efforts will focus on key technology for drainage and control of gas in weak and soft coal seams with potential risk of outburst, key techniques of a system giving pre-warning of gas accident in high production faces, key and effective techniques & equipment for CMM drainage, which will reach the world advanced level.

3.4 Comprehensive gas control in mine areas with proneness of coal and gas outbursts

Active mines and mines under construction within the mine areas with serious proneness of coal and gas outburst need to establish and improve the gas drainage system, and the surface CBM extraction needs to combine with underground gas drainage. Measures for prevention of coal and gas outbursts should be strengthened in accordance with “Detailed Rules and Regulations for Prevention and Control of Coal and Gas Outburst”. Mines shall not be put into production until the gas pressure reduces to less than 0.74 Mpa and all the indices reach those of seams with no outburst risks. The “Guidance Catalogue for Restructuring of Industry” should be strictly implemented. It is strictly forbidden to build any new small mines in areas prone to coal and gas outburst. The existing small mines without necessary production conditions should be sorted and consolidated to increase their capability against mine hazards by integration of resources and combined transformation with large coal enterprises, which have experiences of gas control and technical and management foundation, or by entrusting the large enterprise to manage the small mines.

3.5. Key technologies and equipment to be popularized and applied

(1) Surface drainage.

They are mainly multilateral horizontal well drilling technology, under balanced drilling technology, surface vertical well fracturing technology to increase permeability of coal seam and expanding the extent of highly permeable area; dewatering and gas recovery technology, technology for monitoring fractures produced by fracturing in CBM well. CBM logging technology, CBM wire-line coring technology, etc.

(2) Underground drainage.

They are mainly in-seam long borehole drilling in virgin coal seams, technology for controlled pre-splitting blasting with long boreholes to increase permeability of coal seams; pre-drainage of coal seam gas by using crosscut to intersect coal seam, all hydraulic drill rig and powerful movable pump, etc; technology for gas drainage from worked and pressure released areas; technology for regional control of gas by working a protective seam; technology for gas drainage from worked out areas (gob) and technology for drilling horizontal borehole in rock.

(3) Gas utilization. They are mainly technologies and appliances for domestic gas burning; technologies and equipment for supply of gas and hot water at medium and low pressure, and application of steam gas boilers; technologies and equipment for power generation with gas generating sets, etc.

3.6 Construction of long distance CBM transport pipe network

Overall plan for construction of CBM pipelines and natural gas pipe network will be made. Ten major CBM transport pipelines will be built, totaling 1,441 km long, in the “11th Five Year Plan”. The total designed transport capacity will be 6.5 billion m³ (Table 4).

4. Measures to be taken

(1) Strengthen supervision and management of CBM (CMM) extraction and utilization

The supervision and management system for development and utilization of CBM (CMM) should be set up and improved. The duties of all the relevant departments of the government should be made clear. Legislation shall be improved and the relevant policies shall be formulated. The access standards for enterprises involved in exploration and development of CBM should be stringent in aspects of technology, capital, management and personnel. The macro control and management should be strengthened in project approval, price, quality, safety, environmental protection, information, standards and public interests, etc. Principles of unified planning and overall development by the state and steady progress in development and utilization of CBM should be insisted on. Efforts shall be made to avoid simultaneous establishment of too many projects and to prevent waste of resources and capital.

(2) Promote development of CBM industry by classes and in steps

It is necessary to strengthen exploration and development of CBM, and to undertake forecast and comprehensive evaluation of CBM resources. In regions, where resources conditions permit, surface recovery of CMB should be carried out prior to mining as soon as possible. Priority is given to surface capture of CBM in regions with proneness of coal

and gas outburst, in mine safety production replacement regions, and in CBM enrichment regions with favorable conditions. Standards for controlling CBM gas content within the safety limits shall be worked out. The trade standards for prevention and control of CMM, mainly determination of mine output by quantity of gas drained, and determination of mine output by quantity of ventilation air, and the specific stipulations regarding integration of coal mining and gas recovery should be perfected. In setting up gas drainage systems, priority shall be given to 45 key enterprises where gas is monitored and controlled. Efforts will be concentrated on supporting renovations of gas drainage systems with drainage rate less than 40%. Adequate support will be given to newly built or reconstructed gas drainage systems to guarantee safety in mines and promote healthy development of CBM industry.

(3) Improve supporting policies for better development of CBM (CMM) industry

- In order to promote development of CBM industry and development & utilization of CMM, the relevant policies will be issued.
- The construction land necessary for CBM development and CMM recovery and utilization projects will be arranged in priority according to state's related stipulations.
- Enterprises involved in reconnaissance and extraction of CBM (CMM) directly from the surface can apply for reduction and exemption of exploration right use fee and mining right use fee according to the related state's stipulations before 2020.
- The CBM (CMM) recovery and utilization technical transformation projects can enjoy import tariffs preferential policies when importing necessary equipment, instruments, spare parts and components as well as special tools.
- Depreciation of equipment for recovery of CBM (CMM) can be accelerated on the basis of baseline year and the depreciation capital can be included in enterprise cost.
- The VAT of products, using recovered CBM (CMM) as the main material, will be reimbursed as soon as it is levied up to 2020.
- The products, using recovered CMM as the main material, will be exempted from income tax for five years starting from the year getting profits. The enterprises are allowed to deduct 150% of expenditures for technical development actually occurred in that year from taxable income of that year.
- The electricity generated by coal enterprises from CMM can be used by the enterprises themselves. The surplus electricity, which needs to enter the grid, will be arranged and given priority by the grid enterprise to sell it through grid. The price of electricity fed to the grid is fixed according to that approved by the State, or according to the mark post price of electricity generated by local generating sets with desulfurization cleanup device in thermal power plant.

(4) 4. Set up and improve Technical supporting systems for CBM industry

A technical system suitable for exploration, development, drainage and utilization of CBM should be established and improved gradually in China, with the enterprise

being the main part of the system, orientated to the market, and by combining the production unit with universities and research institutes. The enterprise technical center approved by the state should be strengthened. Technical innovation for development and utilization of CBM (CMM) shall be promoted in the enterprises by applying incentive policies and incentive mechanism for independent innovations in order to tackle key technical problems. The construction shall be expedited of State Engineering Research Center for Control of CMM, and the State Engineering Research Center for Development and Utilization of CBM, which will carry out plans for CMM control and utilization engineering laboratory, and form a new network system and an integrated system for independent innovations. The centers will insist on the principles of combining introduction of foreign advanced technology with independent development, and will enhance digestion, absorption and re-innovation of the introduced technology.

(5) Intensify restructuring of system and mechanism for development and utilization of CBM

The state-ownership of resources should be stressed. The systems and mechanisms for CBM development should be reformed in order to attract all kinds of investors to take part in development and utilization of CBM, to make use to maximum the manpower, financial and material resources and to promote development of CBM industry. The mechanism for coordination of the profits obtained from CBM development and utilization should be established in order to mobilize the initiatives of local governments. Large enterprises are encouraged to participate in exploration, development and utilization of CBM. The competitive mechanism will be adequately introduced. The foreign investors are encouraged to take part in projects, like risk exploration of CBM resources, recovery and utilization of CMM, CBM technical cooperation and infrastructure construction. Measures for supervision and management of foreign cooperation shall be drawn. The withdrawal mechanism should be implemented strictly. Contracts with insufficient investment should be terminated in time.

(6) Set up personnel training and technical exchange base for CBM development and utilization

It is encouraged to combine R&D in the colleges and universities with R&D bases at State level on the basis of joint investment from the state and enterprises. It will be a base for cultivating high level researchers, for continued education and for technical exchange, which will provide talent personnel to promote development of CBM industry.

(7) Plan the natural gas and CBM (CMM) pipe network construction as a whole

The construction of CBM and natural gas pipe network should be planned as a whole according to distribution of resources and market demand. It should take into consideration pipeline transport requirements to two kinds of resources and the future requirements for exporting regional resources. The State will formulate CBM quality standards to encourage injection of CBM into the natural gas pipe network in order to expand the extent of CBM consumption. The government will support the local

governments and the enterprises in speeding up construction of special CBM pipe networks in the principle of using CBM in the local market and exporting the surplus gas to other provinces.

(8) Enhance coordinated development of CBM and coal resources

Integration of coal extraction with CBM recovery should be insisted on. The problems with crossing of coal mining right and CBM mining right should be sorted and resolved properly in accordance with laws. In setting up a new exploration right, the resources of coal and CBM should be explored and evaluated as a whole, and the reserves should be identified. For CBM resources with gas content higher than the figure specified by the national standard, and conditions suitable for surface exploitation, a unified scheme for development and utilization of coal and CBM should be worked out. Priority will be given to resources suitable for surface extraction of CBM to promote coordinated development of CBM and coal resources.

Table 4 Plan for Construction of Long-distance CBM Pipelines

No.	Planned Pipelines (starting point and terminal)	Dia. Of pipe (mm)	Length (Km)	Pressure (MP)	Transport Capacity (Million m ³)	Investment (Million Yuan)	Construction Time
1	Qinshui-Jincheng	508	51	4	800	140	2006
2	Duanshi-Jincheng-Bo'ai (connecting with Yu-bei branch)	426	120	6	1 000	288	2006
3	Duanshi-Changzhi- Linzhou-Anyang- Handan	426	245	6	1 000	588	*
4	Songzao-chongqing	400	175	1.47	230	210	2006
5	Hancheng-Houma-Linfen	325	180	4	500	396	*
6	Daning-Jixian-Linfen-Huozhou	325	240	4	500	528	*
7	Ningwu-Yuanping-Dayu-Taiyuan -Shouyang-Yangquang	325	300	4	500	660	*
8	Sanjiao-Shaanjing line 2	219	70	11	500	140	2007
9	Duanshi-Bajiakou (connecting with West-East Pipeline)	426	40	15	1 000	96	2008
10	Baode-Shaanjing line	325	20	7	500	44	2008
Total			1 441		6 530	3 090	

*: Awaiting for further discussion depending on development and utilization of CBM