Optimal Projects for China's Coal Mine Methane Mitigation

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1. Foreword

Coal is the dominant energy in China. The exploitation of coal causes the emission of coalbed methane. Coal mine methane (with main composition of CH_4) is not only one of the major disasters for China's coal mines but also a significant greenhouse gas with its greenhouse effect 21 times (100 years) than that of CO_2. At present, the exploitation of coal in China is concentrated in the depth shallower than 1000m. Based on the forecasting result of China coalbed methane resources, coalbed methane reserve in the burial depth of 300m – 1000m is 9.14 x $10^{12}m^3$. The coalbed methane will be discharged to the atmosphere if it's not recovered and utilized. Therefore, one of the priority objectives for methane mitigation is to cut down coal mine methane emission and to recover and utilize coal mine methane.

2. The emission amount of China's coal mine methane

There are lots of coalfields in China with varied exploitation depth and gas content (0-30m^3/t). Based on quantities measured data, coalbed methane content in low gas concentration coal mines is generally less than 5 m^3/t, but the maximum coalbed methane content in high gas concentration coal mines is as high as 20-30 m^3/t. Coal mine methane can be graded by relative gas emission amount (gas emission amount from per ton of coal production) and gas emission forms. Those coal mines with gas content higher than 10 m^3/t is graded as high gas concentration mines. Investigation to the key state owned coal mines was made respectively in 1994 and 2000 and result is shown in table 1.

Investigation results in 2000 showed that the proportion of China's key state owned coal mines with high gas content and the outburst mines was 50.5%. Coal production from those mines accounted for 47.2% of the total but methane emission amount was as high as 86.3%. Those coal mines with high gas concentration are the main sources of methane emission and also the priority areas in future methane mitigation.

Table 1 Investigation Result of Methane Emission Amount in Key State Owned Coal Mines

	1994		2000	
	Gas Emission Amount (Mm^3)	Percentage (%)	Gas Emission Amount (Mm^3)	Percentage (%)
Low Methane Concentration Mines	647.71	14.1	664.8	13.7
High Methane Concentration Mines	1895.73	41.3	2099.13	43.3
Methane Outburst Mines	2050.49	44.6	2050.49	43

95% of China's annual coal production is produced by coal mine exploitation and large amount

of coalbed methane have been discharged to the atmosphere by gas ventilation. It's estimated that the amount of methane emission by China's coal mines in 2000 reached 9.625 billion m^3 (pure CH_4) which accounted for 60% of the total in the world and was equivalent to the emission of 1.38 tons of CO_2. It's predicated that total amount of coal mine methane emission will be further increased with the increase of China's coal production. The statistic s of methane emission amount by year in China's coal mines is shown in table 2.

Table 2 Statistics of Methane Discharge Amount in China by Year

Year	1987	1992	1993	1994	1995	1996	2000
Methane Discharge Amount ($10^8 m^3$)	64.5	83.2	85.5	89.5	89.0	92.8	96.3
Coal Production (10^8 tons)	9.3	11.1	11.5	12.3	12.9	13.7	10

3. Underground coalbed methane drainage in coal mines

China started to test underground coalbed methane drainage from the early 1950's. It started up firstly the test in the coal mining administrations of Fushun, Yangquan, Tianfu and Beipiao with annual drainage amount of 60 x $10^6 m^3$. According to the statistics, totally 196 coal mines had conducted underground coalbed methane drainage throughout China by the year 2002 with total drainage amount of 1.15 billion m^3 (pure CH_4), but less than 50% of the methane extracted had been utilized and the discharge amount was as high as 600 million m^3. Based on the development tendency, future coalbed methane drainage amount in China will be gradually increased, thus the key issue will be to strengthen the recovery and utilization.

Coal mine methane drainage in China is now focused in the key state owned coal mines. Coal mine methane drainage amount in key coal mines in China by year is shown in table 3. It has the largest underground drainage amount in Fushun mining area, Yangquan mining area and Songzao mining area of the country. It has the highest drainage rate in Tianfu mining area, Fushun mining area and Songzao mining area. It has the maximum drainage amount per ton of coal in Zhongliangshan mining area, Tianfu mining area and Fushun mining area. The average coal mine methane drainage concentration in 2000 in China was 32.26% with the drainage rate of 25.8% (in the key mining areas). Detailed information is shown in table 4.

Table 3 Coal Mine Methane Drainage Amount in Key Coal Mines in China by Year

Coal Mines	Annual Gas Drainage Amount (x 10^4 m^3)								
	1980	1985	1990*	1993	1995	1996	1998	2000	2002
Liaoning Fushun	9988	10212	10863	11336	12231	11362	12685	12856	12761
Shanxi Yangquan	8578	8952	7691	9053	9268	10095	11514	11726	19985
Chongqing Songzao	1070	3409	5923	7631	5642	6522	6953	7635	9270
Chongqing Tianfu	544	1291	2259	2510	2739	2710	2646	7716	1712
Chongqing Nantong	170	718	2200	2027	2066	2093	2833	2273	1460
Chongqing Zhongliangshan	1857	1883	2150	2207	2084	2198	2363	2396	2415
Sichuan Furong	57	124	1243	1410	2703	2708	2892	2468	3796
Guizhou Liuzhi	194	466	1100	1841	2047	2011	1939	817	746
Henan Jiaozuo	227	386	1026	1227	1353	1347	01198	1045	1139

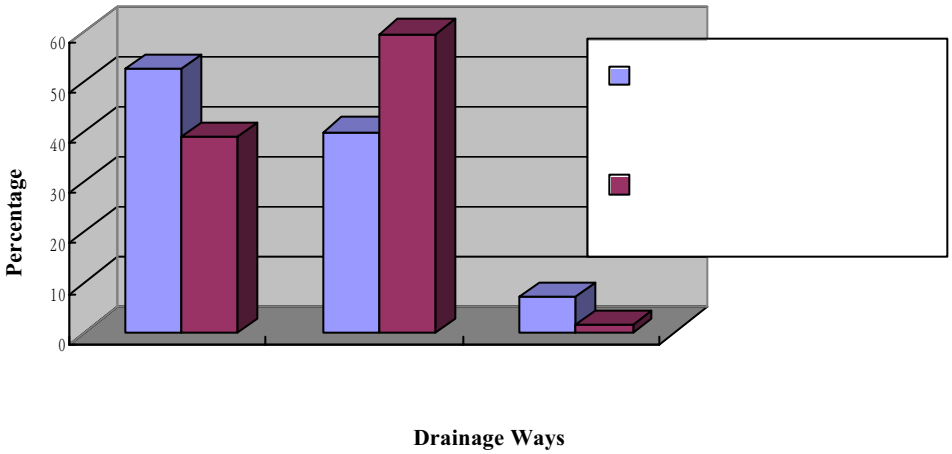
Liaoning Tiefa	252	180	1017	1626	2211	2352	3599	4448	6352
Hebei Kailuan	308	444	835	807	851	850	1601	912	882
Jiangxi Fengcheng	977	467	801	827	904	1032	577	981	297
Hebei Fengfeng	449	625	762	989	1357	1315	1409	1148	1461
Henan Hebi	521	691	712	648	950	908	1058	1238	1242
Liaoning Beipiao	359	209	593	657	393	471	515	302	
Guizhou Panjiang	—	0.84	564	1500	2058	1829	3634	10236	7112
Helongjiang Jixi	247	734	542	337	151	159	5	—	66
Guizhou Shuicheng	193	164	535	1275	1947	2023	1206	2621	5948
Inner Mogolia Baotou	1844	420	466	0	0	0	223	493	393
Anhui Huainan	247	474	406	420	500	660	2262	4939	11163
Helongjiang Hegang	322	110	395	988	635	1255	383	1050	1159
Shanxi Guzhuang	—	128	368	375	320	335	—	—	—
Shanxi Yinying	348	116	354	370	410	199	62	—	—
Anhui Huaibei	169	425	316	466	453	504	790	1801	4281
Shanxi Xishan	86	—	150	147	595	421	331	276	899
Hunan Lianshao	31	160	140	167	179	251	332	308	260
Jiangxi Pingxiang	—	89	44	128	140	155	386	282	180
Jilin Liaoyuan	239	125	37	0	408	405	777	1198	524
Liaoning Shenyang	—	4	17	22	174	187	514	950	2588
Ningxia Shitanjing	—	—	6	1104	1466	2162	2836	4380	-
Jiangxi Yinggangling	—	20	4	13	18	42	88	48	58.5
Hunan Beisha	25	—	—	-	0	22	102	90	110
Sichuan Guangwang	—	—	—	370	135	218	238	251	110
Sichuan Yongrong	—	—	—	144	238	281	328	330	461
Ningxia Shizuishan	—	—	—	2	118	165	156	583	
Shaanxi Tongchuan	—	—	—	505	590	780	655	416	683
Shaanxi Hangcheng	—	—	—	109	118	110	309	428	302
Gangshu Jingyuan	—	—	—	200	384	441	540	504	700
Gansu Yaojie	—	—	—	20	0	15	46	62	142
Henan Pingdingshan	—	—	—	65	330	579	2449	2586	2750
Shanxi Nanzhuang	—	—	—	783	1153	536	72	—	
Guangdong Meitian	—	—	—	65	160	155	—	—	
Others	—	—	—	-	—		—	—	
Total in China	29341	330127	43434	54304	60036	63383	74242	91793	114610

Table 4 Coal Mine Methane Drainage Amount in 2000

Actual Drainage Amount 10^4 m^3	Drainage Concentration, %	Drainage Rate%		Actual Footage, 10^4m/year	Rate of Methane Utilization, %	Amount of Methane Utilization 10^4 m^3	Borehole Footage Per Ton of Coal, M
		Actual Percentage in Drained Area	Actual Percentage in Coal Mines				
91793	32.26	31.79	25.8	293	49.9	31839.4	0.36

Drainage methods in common use in China's coal mines are gas drainage from the original coal

seam, from adjacent coal seams, from gob wells as well as the comprehensive drainage method. Based on the investigations to 110 coal mines that have conducted methane drainage business throughout China, 58 coal mines adopted the method of gas drainage from the original coal seam and the drainage amount accounted for 39% of the total; 44 coal mines adopted the method of gas drainage from the adjacent coal seams and the drainage amount accounted for 59.5% of the total. The other coal mines adopted the method of gob well drainage and surrounding coalbed methane drainage, the drainage amount accounted for 1.5% of the total (Shown in picture 1). The result of adjacent coal seams drainage is better than that of the original coal seam drainage.



Picture 1 The Proportion of Underground Drainage Methods in China's Coal Mines

4. The potential for China's coal mine methane mitigation

Climate change is the hot topic globally concerned and also one of the great challenges facing the whole world. All the states in the world are positively dedicated to slowing down the growth rate of global green house gas emission. The United Nations Framework Convention on Climate Change was produced and approved in the United Nations Conference on Environment and Development in Rio De Janeiro, Brazil in May 1992. The signatory parties to the Convention formulated Kyoto Protocol in the 3rd session in December 1997. The Chinese government reviewed and approved Kyoto Protocol on August 30, 2002. Climate Change Office of China State Development and Reform Commission supports coal mine methane mitigation projects that is the important component of the announcement of national green house gas mitigation information. Coal mine methane development and utilization has been listed as one of the three main sectors to be assisted by UNDP assistance project of " The Implementation of CDM Mechanism Capacity Construction in China". Considering the strong green house effect and huge emission amount by coal mine methane, the mitigation of China's coal mine methane will make great contributions to the global environment. The important measure to mitigate coal mine methane is to enhance methane recovery and utilization and to improve the economic value of coalbed methane utilization.

4.1 History and status of coal mine methane utilization

The utilization of coal mine methane in China started in the end of 1970's. The State brought coal mine methane utilization project into line with national plan of energy saving basic construction

investment in 1982. By the end of 1993, over 50 methane utilization projects have been set up. The utilization amount of coalbed methane resources in 1999 exceeded 400 million m^3. Along with the gradual deregulation of gas price and the further understanding to methane as a kind of resources in recent years, methane commercial development projects have been conducted in lots of mining areas. But the amount of gas utilization in 2000 was only 5.6% of the total gas emission amount and the drainage amount accounted for only 8.9% of the total emission amount. Even methane emission amount has increased year by year but the percentage of gas utilization has decreased. Thus it can be seen that it has enormous space for the mitigation of China's coal mine methane.

4.2 The effective measures to improve the mitigation capacity of China's coal mine methane

(1) **To improve drainage rate**. Coal mine methane drainage rate in China currently is fairly low. Majorities of methane have been discharged to the atmosphere by gas ventilation. To improve methane drainage rate is the effective measure for gas mitigation. At present, total numbers of coal mines with high gas concentration and methane outburst mines were approximately 280 (by the statistics in 2000), but there were only 196 coal mines undertaking methane drainage business (in 2002). The drainage rate in the key state owned mines is only 25.8% and the average drainage rate in the country is less than 10%. Therefore, it needs to improve the drainage rate in the existing coal mines extracting methane and to realize drainage at an earlier date in the remaining coal mines that have not yet conducted drainage business but with high methane concentration as well as in the mines with gas outburst. It will have a big increase in China's coal mine methane drainage rate.

(2) **To improve the commercial utilization value of methane drainage**. Methane drainage concentration in China now is on the low side. The average annual drainage concentration in 2000 was 32.2%. Quantities of the extracted methane have to be discharged to the air for the concentration can not reach that of commercial utilization. This is one of the major reasons of methane utilization at a lower level in China. Thus, it needs to improve drainage technologies and the supporting technologies, to increase methane drainage concentration and to improve its commercial utilization value.

(3) **To enhance research and import the program and technology for the utilization of low concentration methane resources**. It needs to improve the utilization level of low concentration methane resources. The technologies of low concentration methane purification and enhancement are also very important that can improve significantly the utilization value and scope of coalbed methane resources.

(4) **To improve the utilization level of the extracted coalbed methane**. The extracted coalbed methane in China now is mainly used as household gas with low gas price and fluctuating gas consumption demand that has been heavily influenced by local consumer numbers and the pipeline network. Meanwhile, coal at low price in the mining area has restricted to household utilization of coalbed methane resources. Most of the mining areas are located in the countryside that is far away from the urban city, the scale of civil projects is limited also. Therefore, to improve the industrial utilization level of coalbed methane resources can greatly increase coalbed methane consumption and decrease its emission.

(5) **To enhance the research and economic evaluation on the recovery and utilization technology of ventilating methane**. There is no precedent and related research to follow on

the utilization of ventilating methane resources in China now. It needs to speed up the pace of both research and technology import in the aspect. Methane emission can be enormously reduced by the recovery and utilization of ventilating methane.

5. Optimal projects for China's coal mine methane mitigation

During the visit to the United States by President Zhu Rongji in April 1999, ten letters of intent were signed with the US host among which included the project of "Coal Mine Methane Market Development" assisted by the US Environmental Protection Agency to China Coalbed Methane Clearinghouse. The project was started up on October 1, 1999. It selected coalbed methane development projects in eight key mining areas of Jincheng, Yanquan, Huainan, Huaibei, Panjiang, Pingdingshan, Jiaozuo and Fushun. It carried out project analysis and evaluation in the aspects of technology, market, economy and environmental protection, and the results showed eight mining areas could be selected as the optimal areas for coal mine methane mitigation due to the abundant coalbed methane resources and most favorable development conditions. Project inventories and the status of the mining areas are shown in table 5 and 6.

The aforementioned projects concentrate coal mine methane utilization on residential use, power generation, chemical industry, methane fueled vehicles and so on. It's to describe respectively the utilization as follows:

(1) CMM residential use project

Coal mine methane is a clean gas fuel. The concentration of coal mine methane extracted underground is generally 30%~60% that is qualified for residential use in the mining areas. In China, coal mines extracting methane have generally established regional pipeline system to supply gas for households in the mining areas and for surrounding cities and towns. The basic technical conditions for residential use methane include the follows: over 30% of methane concentration, sufficient gas resources, over 2000 Pa of stable pressure, no toxic impurities in gas and perfect facilities for gas storage and transportation. At present, coalbed methane is mainly used as residential gas in China. In 1994, residential use methane accounted for 74% of the total consumption. It is predicted that in 2020 gas utilization rate will reach 85~90% in the large and medium-sized cities covering 350 million populations and gas utilization rate will reach 45% in towns covering 380 million populations. Gas demand for residential use and urban commercial use will be 63.0~71.3 billion m^3. Therefore, to combine coal mine methane mitigation with the increasing demand to residential gas and commercial gas will bring vast market space and mitigation potential. Actually, most mining areas extracting methane such as Fushun, Panjiang, Huaibei, Huainan and Jiaozuo are developing projects for civil use. Of those, the civil use project in Fushun is a typical representative. In addition, residential use coalbed methane project in Jiaozuo mining area shows a broad prospect for its adjacency to the city of Jiaozuo.

CMM residential use project in Fushun

With a very short distance to Shenyang, the capital city of Liaoning Province and to the surrounding cities as well as 30 kilometers away from Shenyang gas pipeline network, Fushun mining area enjoys great advantages geographically. Meantime, as the first mining area that performed coal mine drainage test in China, Fushun has perfect drainage system, surface pipeline

network and matured drainage experience. Fushun ranks the first all over China in methane drainage amount and drainage rate, its total annual drainage amount is 126 million m^3 with the drainage rate of 78%. The first stage of the project by Fushun Mining Group Co. Ltd. utilizing methane extracted mainly from underground of Laohutai mine has been established. It is supplying 58.80 million m^3 of gas annually to Shenyang and makes good profits.

The second stage of the project to supply gas to Shenyang by Fushun mining area is firstly to mix high concentration coalbed methane exploited by surface drilling with coalbed methane by underground extraction and to meet the quality requirement by Shenyang. The supplying scale of mixed gas is 61.84 million m^3/a (pure CH4). Total investment of the project will be ￥155.587 million RMB yuan with internal rate of return of 23%, investment payback period of 7 years and annual methane drainage amount of 15Mm^3. The project will produce obvious economic benefits and social benefits.

The project has been listed as the sub-project of "Environmental Improvement Project of Liaoning Province" supported by Asian Development Bank. Project evaluation has been made by experts from home and abroad invited by Asian Development Bank. It's expected to get loan from Asian Development Bank next year.

CMM residential use project in Jiaozuo

Jiaozuo mining area is rich in coalbed methane resources and has favorable reservoir conditions. A total resource in the area is 157. 4 billion m^3. The household use market is fairly big. Even if the drainage rate will be increased to 100%, it can only meet 50% of gas demand in Jiaozuo in 2010. Total investment of the project will be ￥53 million RMB yuan (US$ 6.39 million). The internal rate of return is 23% , investment payback period is 7 years and the annual methane drainage amount will be 20 million m^3.

(2) Coalbed Methane Power Generation

Power generation is the most important field for the industrial utilization of coalbed methane mitigation and has been widely practiced abroad. In China, there was a precedent of the practice. As early as in 1989, the first coalbed methane fired power plant with capacity of 1500KW was built in Laohutai coal mine of Fushun. Natural gas power generation is environmentally friend, economical and highly efficient. It is predicted that 5.6%~7.1% of the total electricity in China will be generated by natural gas in 2020. But the proportion of natural gas fired power generation accounts for less than 2% currently in China. Therefore, one of the important measures for future coal mine methane mitigation is to make full use of the extracted coal mine methane and to have power generation by ventilating methane. At present, all the large mining areas, such as Jincheng, Yangquan, Panjiang, Huainan, Huaibei and Pingdingshan are planning to invest into the construction of coalbed methane fired power plants. Of them, the 120MW project of Jincheng is a most typical representative. Meanwhile, Huainan mining area promises a broad prospect in coalbed methane power generation.

The project of 120MW coalbed methane fired power generation in Jincheng

As one of the major anthracite coal producers in China, Jincheng is rich in coalbed methane resources and its reserve reaches 61.7 billion m^3. In 1995, a coalbed methane fired power plant with the capacity of 240 KW was set up by Jincheng Mining Administration; and a 4×400 KW power station was established near the wellhead of Sihe coal mine in 1997. Later on, a 2×2000 KW co-generation power supply station was built at the cost of ￥13.23 million RMB yuan.

Jincheng Mining Administration is making positive efforts to apply for a loan from Asian Development Bank to build a 120MW power plant which will be so far the biggest coalbed methane fired power plant in China. Entrusted by Asian Development Bank, technical evaluation of the project has be made by China Coalbed Methane Clearinghouse and related foreign experts. The loan is expected to be available next year. The project is promising that will extract 169 Mm^3 of coalbed methane each year and become the project for utilization of coalbed methane at the highest mitigation.

The project of coalbed methane fired power generation in Huainan

It has 592.8 billion m^3 of coalbed methane resources in Huainan mining area. Current drainage rate in the area is 19.2% and the annual drainage amount is 50 million m^3. With years of drainage experience and fairly perfect infrastructure, Huainan will become the energy base in East China, and its geographical position is very close to the economically developed region of East China. Recently, China Huaneng Group Corporation, China Electrical Power Investment Group Corporation and Huainan Mining (Group) Company are making positive preparations to jointly develop a coal and power base in Huainan, striving every possibility to establish a "Three Gorges of Thermal Power " with capacity of 20 million KW by the end of 2020. When the project is completed, Huainan will become the energy base of East China, which will no doubt be favorable to the development and utilization of coalbed methane resources, especially favorable to the coalbed methane power generation.

(3) Chemical industry

Coal mine methane can be used to produce chemical products such as methanol, formaldehyde, carbon black and fertilizer, etc. Some of the coal mines in China have succeeded in producing formaldehyde and carbon black by using extracted coalbed methane. Small scale practice of coalbed methane utilization activities have taken place in Fushun, Huainan, Zhongliangshan, Songzao and Tianfu; and some profits and results have been achieved. According to the forecast by related departments, total demand for fertilizer in China by 2020 will exceed 40Mt, total demand for gas will possibly be more than 32.2 billion m^3 of which 23 billion m^3 for natural gas and the rest for other gas resources. Therefore, it shows broad prospects for coalbed methane resources.

Of the preferential selection projects, the chemical project of Yangquan mining area promises a bright future.

Coalbed methane project in Yangquan

Yangquan mining area is rich in coalbed methane resources and the reservoir conditions are good.

With coalbed methane resources of 868.3 billion m^3, Yangquan mining area ranks the first in total coalbed methane resources among the aforementioned 8 mining areas. The permeability of the coal seams is as high as 4.19md. It has resources advantages for the mitigation and utilization. The drainage volume exceeds 120 million m^3 and the drainage rate reaches 30%. It possesses matured drainage experience and perfect infrastructure in Yangquan mining area. Considering the rich resources and drainage status, the author suggests establishing in the area a utilization project with large scale and long term. At present, a 50,000-ton methanol project in Yangquan mining area with total investment of ￥270 million RMB yuan is under consideration.

(4) Natural Gas fueled vehicles

Natural gas is an ideal clean fuel. Compressed high concentration methane can be used to replace natural gas and gasoline as vehicle fuel. Jiaozuo Mining Administration and Furong Mining Administration have already made helpful practice in the filed. In Furong mining area, all buses are fueled by coal mine methane in place of gasoline and the annual methane consumption is 5.49 million m^3. China now has more than 7 million vehicles and the number keeps increasing at an annual rate of 13%. As a result, fuel consumption will correspondingly grow. As a substitutive fuel, coal mine methane will be well developed as vehicle fuel if the construction of all corresponding infrastructure keeps pace . Jincheng mining area once made plan for such project.

(5) The utilization of coal mine ventilation air methane

Due to its low concentration, coal mine ventilation air methane can be used as part of the mixed fuel for coal-fired boiler and gas turbine. Technology of auxiliary fuel is mainly applied to gas turbine, internal-combustion engine, large-sized boiler and kiln furnace. Meanwhile, applying system using coal mine ventilation air methane as main fuel, such as TFRR, CFRR and gas turbine which use gas in low concentration has already been developed abroad.

Discharged in huge volume, coal mine ventilation air methane promises broad prospect once the economic value of its utilization proves to be feasible. In China, the average concentration of ventilating gas is 0.5%; and the average wind speed at wellhead is 161 m^3/second. According to the foreign experts, it is theoretically estimated that it can generate 1365KW of electricity using the ventilating gas in China. If US $10 million to be invested in each project, US $ 4 billion can be reached in China's equipment markets and the annual sales income will be increased by US $ 430 million. At the same time, some of China's mining areas are showing their great interests in the technology of recovery and utilization of the ventilation air methane. Therefore, it is suggested considering the development and utilization of ventilation air methane if it is economically feasible.

At present, a preliminary agreement has been reached by and between China Coalbed Methane Clearinghouse of China Coal Information Institute and U.S. Environmental Protection Agency to spread the recovery and utilization of coal mine ventilation air methane in China in the coming years. And it's tentatively decided to establish a demonstration project in Huainan.

6. Economic evaluation for coal mine methane mitigation projects

Recently, Economic Evaluation for Coalbed Methane Exploration and Development, a subproject of the 10th Five-year Plan Scientific Research Project completed by China Coal Information Institute has been accepted. The research has determined the economic evaluation methods for coalbed methane development and utilization project in China and has established the economic evaluation models. It has set up for the first time the economic evaluation system for underground coalbed methane drainage projects as well as the comprehensive economic evaluation models for coalbed methane development projects. In the national economy evaluation of CBM projects, improvement of coal mine safety production and protection of environment, indirect benefits brought by coalbed methane projects have been included. Quantitative evaluation has been conducted and sound evaluation models of indirect benefits have been established, which will have significantly importance for the promotion of coal mine methane development and the usage of the assistance from International Environmental Fund.

Under current technological and economical conditions, the internal rate of return of most of methane mitigation projects in the aforementioned 8 mining areas is less than 25% and some even lower than 10% by detailed evaluation to the projects. If the indirect benefits to the national economy including the contributions to the improvement of coal mine safety production conditions, reducing environmental pollution and climate change are taken into consideration, the project internal rate of return will be increased over 10%. Therefore, considering its benefits to the national economy, the project are economically feasible that should be strongly supported by the Chinese government and international society.

7. Conclusions

(1) It has numerous potential in China's coal mine methane mitigation. So far, less than 50% of underground extraction methane annually have been comprehensively utilized. At present, methane drainage level, drainage rate and utilization rate in China are fairly low. Majorities of the methane extracted have been discharged to the air. Total drainage amount and utilization amount of coalbed methane resources can be improved significantly and it will make important contributions to the business of methane mitigation under the premise of improving technology level and enhancing the management.

(2) It has fairly advanced and successful experience in the aspects of coal mine methane drainage and utilization in China currently but the size of drainage and utilization is pretty small. It needs badly capital support to further improve the level and size of methane mitigation and utilization.

(3) The preferential investment regions for coalbed methane mitigation and utilization are the matured mining areas with drainage experience. Currently, Jincheng Mining Area, Fushun Mining Area, Panjiang Mining Area, Jiaozuo Mining Area, Pingdingshan Mining Area, Yangquan Mining Area, Huainai Mining Area and Huaibei Mining area that have favorable conditions are preferentially chosen as the investment regions.

(4) The aforementioned mitigation projects will not only bring significant economic benefits but will also reduce numerous coal mine methane emission. It will bring obvious indirect benefits to the national economy and will make great contributions to the mitigation of global green house

gas. Concerns and energetic investment from the international society will be most welcome.