

Mongolia

Ministry of Mining

Mongolia

Master Plan Study on the Development and Utilization of Coal

Executive Summary

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Chapter.1 Introduction

1.1 Purpose of the study

This study aims at formulating development and utilization master plan of Mongolia, which is targeted for the year 2025. Particularly, the coal supply and demand assumption in Northeast Asia (potential export market of Mongolia, which includes Southeast Asia focusing on Japan, China, South Korea, and Russia), which gazed at export diversification of coal, is considered. After examining the possible use of existing arranged and analyzed information on coal utilization technology, particularly clean coal technology related to Mongolian coal development, a coal exploitation master plan is drawn up.

After examining the possible use of arrangement and analysis of the existing information, coal utilization technology of the clean coal technology related to Mongolian coal development, a coal exploitation master plan is drawn up. The report of the master plan will be submitted to Director of Strategic Policy and Planning Department, Ministry of Mining.

1.2 Counterpart

A counterpart team that appoints business managers focusing on the counterpart JCC member sector was established as shown in Fig. 1-1. An inception report, progress report, interim report, and draft final report were submitted and discussion of the individual contents at the JCC meeting was held each time. In addition, three workshops with third-sector participation were held.

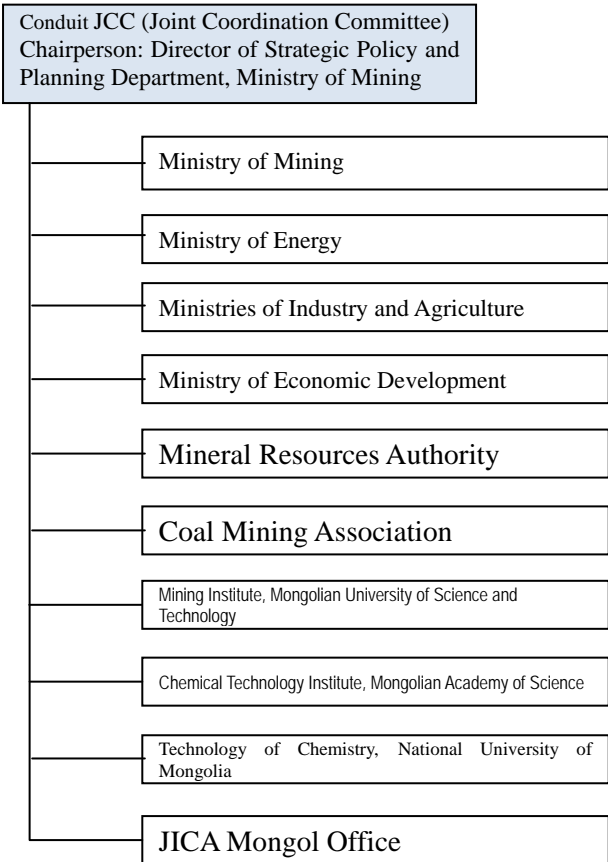


Fig. 1-1 JCC members

1.3 Study schedule

Fig. 1-2 shows the overall research plan in this study

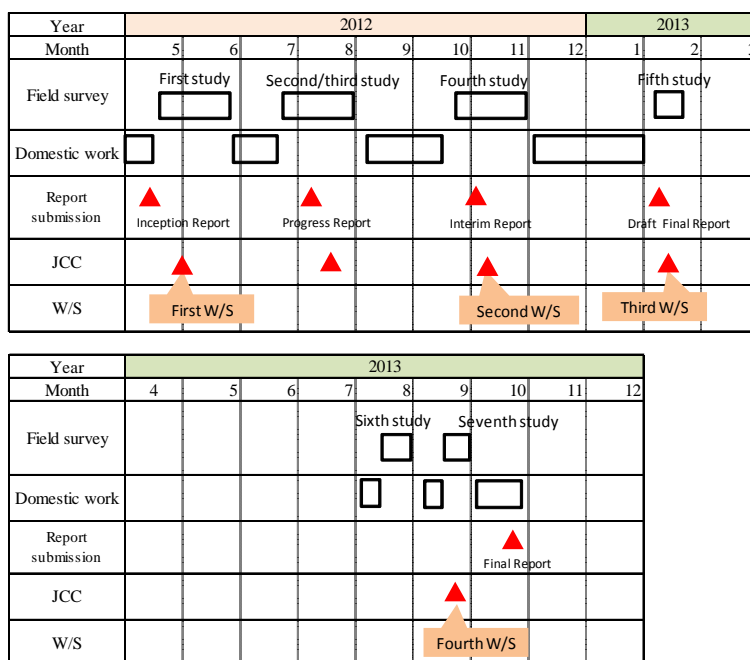
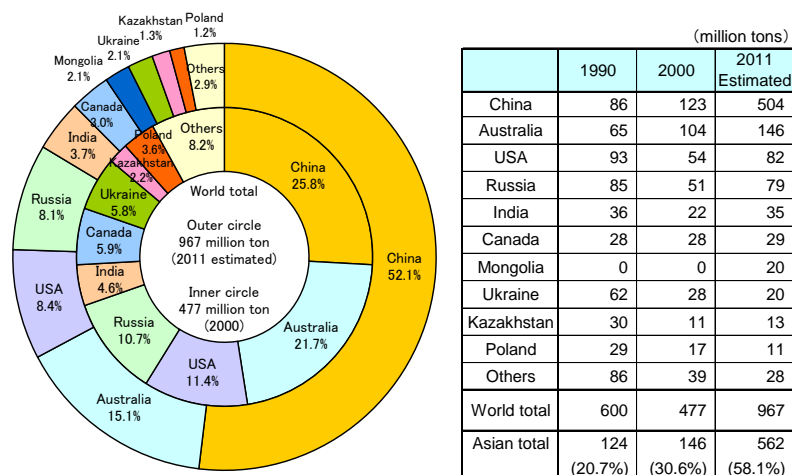


Fig. 1-2 Study plan

Chapter.2 Coal Supply-demand Forecasts for Northeast Asia etc. and Coal demand of Mongolia

2.1 Global coking coal production

Coking coal production in 2011 is 967 million tons. As shown in Fig. 2-1, China is the largest producer of steam coal, accounting for half or more of coking coal production, followed by Australia, the United States, Russia, India, and Canada in that order. Two countries, China and Australia, alone cover 67.2% of production. Coking coal production in Asia in 2011 is 562 million tons, accounting for 58.1% of world coking coal production, up 25.8 percentage points from 2000.

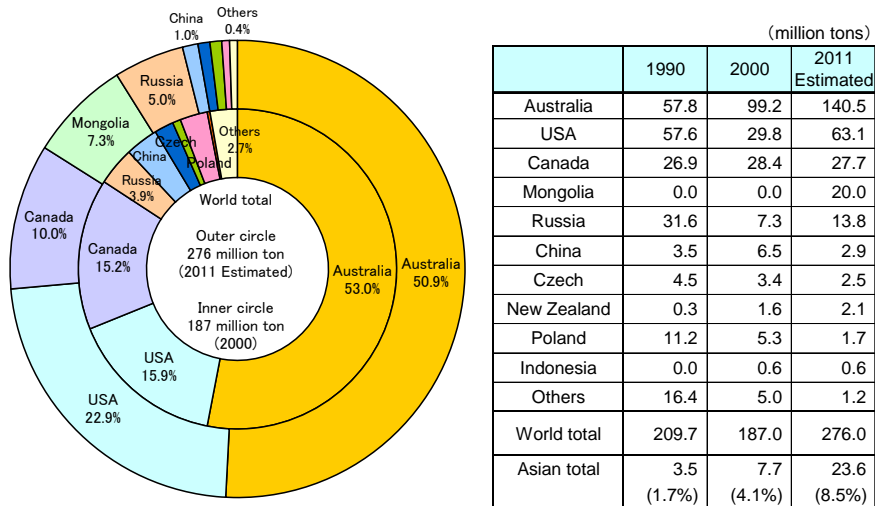


Source: Prepared by JICA study team based on the "Coal Information 2012" of IEA

Fig. 2-1 Top 10 Coking Coal Producing Countries

2.2 Coal export

World steam coal (including anthracite) and coking coal export volumes in 2011 are 861 million tons of the former and 276 million tons of the latter. As for coking coal export volume, Australia was ranked the first, accounting for 50.9%, followed by the United States, Canada, and Mongolia in that order with 22.9%, 10.0%, and 7.3%, respectively (Fig. 2-2).



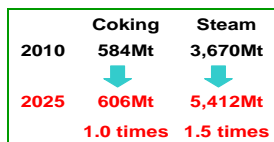
Source: Prepared by JICA study team based on the “Coal Information 2012” of IEA

Fig. 2-2 Top 10 Coking Coal Exporting Countries

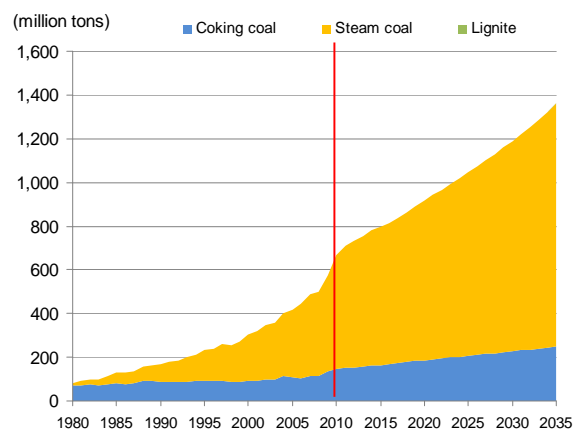
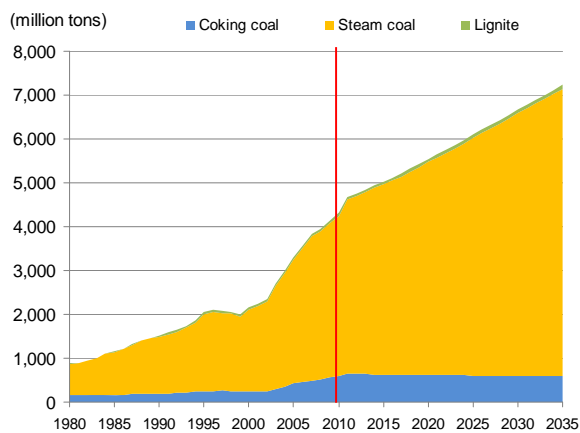
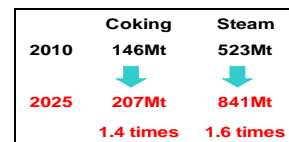
2.3 Outlook for coal demand and coal import in Asia

The prediction result of coal demand and imports in Asia including Northeast Asia (total of 11 countries covered by this survey) is as follows (Fig. 2-3):

< Coal Demand >



< Coal Imports (Coal Market) >



Source: JICA study team

Fig. 2-3 Outlook for Coal Demand and Coal Import in Asia (11 countries covered by this study)

2.4 Projections for Mongolia's export potential

Due to its current economic infrastructure, it is unavoidable that China is the main recipient of Mongolian coal exports. The methodology to examine Mongolia's export potential is as follows.

(a) Coking coal demand in China

Forecasting the demand of coking coal in China, the production of crude steel is a key factor and the following three cases of forecasted production of crude steel are assumed for an analysis of coking coal demand in China. The outlook for coking coal demand and coking coal import in China is shown in Table 2-1

Case 1: The production of crude steel will decrease after peaking in 2011.

Case 2: The production of crude steel will remain flat in and after 2011.

Case 3: The production of crude steel will decrease in and after 2021.

Table 2-1 Outlook for Coking Coal Demand and Coking Coal Import in China

	2006	2010	2011	2015	2020	2025	2030	2035
Crude steel production								
Case 1	422,660	626,959	689,655	673,921	640,892	579,315	510,432	473,281
Case 2	422,660	626,959	689,655	689,655	689,655	689,655	689,655	689,655
Case 3	422,660	626,959	689,655	746,288	776,514	738,457	702,266	667,848
Coking coal demand								
Case 1	408,130	527,100	583,930	565,913	534,663	483,795	429,648	398,889
Case 2	408,130	527,100	583,930	577,481	569,808	561,724	553,632	545,442
Case 3	408,130	527,100	583,930	651,812	701,692	660,754	622,497	586,669
Coking coal import								
Case 1	4,662	47,269	44,658	56,591	53,466	45,961	38,668	31,911
Case 2	4,662	47,269	44,658	57,748	56,981	56,172	55,363	54,544
Case 3	4,662	47,269	44,658	67,788	76,484	69,379	62,872	56,907

Note: Actual data of demand and imports for coking coal is based on the data provided by a Chinese consultant

Source: JICA study team

(b) Ratio of Chinese coking coal import

Table 2-2 shows the ratio of import projects based on the coking coal demand indicated in Table 2-1. As actual data from 2009 through 2011 was limited, it is difficult to predict imported coal volume in relation to coking coal demand, but estimates were made using the ratio shown in Table 2-2. The details are as follows.

- Case 1: The ratio lowered from 2011 due to a decline in coking coal demand, which would cause China to consider maintaining current coal ore production volumes.
- Case 2: The ratio is set at 10% because domestic demand will virtually stagnate from 2015 onward.
- Case 3: Domestic demand will increase through 2020, and much of this increased demand will be addressed through imports so the ratio increases initially and then decreases to reflect the eventual decline in demand after 2021.

Table 2-2 Ratio of imported coking coal reflected in Chinese coking coal demand

	2011	2015	2020	2025	2030	2035
Case 1	7.6%	10.0%	10.0%	9.5%	9.0%	8.0%
Case 2	7.6%	10.0%	10.0%	10.0%	10.0%	10.0%
Case 3	7.6%	10.0%	10.9%	10.5%	10.1%	9.7%

Source: JICA survey team

(c) Mongolian potential for export to China

Table 2-3 shows projected export volume and distribution ratios for Mongolia. In coking coal import, the ratio that Mongolia occupied is assumed 70-80% in 2025 from 32% in 2010. The export volume has a relationship with coal price but is predicted from demand quantity of China here. In addition, the amount using here shows all quantity of clean coal after washing ROM. The quantity of coal becomes approximately 130% when ROM will be exported.

Table 2-3 Mongolia's Potential for Exports to China based on each Case(1000t/year)

		2010	2011	2012	2013	2014	2015	2020	2025
Case 1	Total of Import Coking Coal of China	47,269	44,658	47,700	50,800	53,700	57,000	53,500	46,000
	Mongolian Potential of Export Coking Coal	15,048	20,039	20,000	24,400	29,000	34,000	37,400	36,800
	% of Mongolian Coal in the Total	32%	45%	42%	48%	54%	60%	70%	80%
Case 2	Total of Import Coking Coal of China	47,269	44,658	47,700	51,100	54,400	57,700	57,000	56,200
	Mongolian Potential of Export Coking Coal	15,048	20,039	20,100	24,500	29,400	34,600	39,900	44,900
	% of Mongolian Coal in the Total	32%	45%	42%	48%	54%	70%	70%	80%
Case 3	Total of Import Coking Coal of China	47,269	44,658	48,300	54,600	61,200	67,800	76,500	69,400
	Mongolian Potential of Export Coking Coal	15,048	20,039	20,300	26,200	33,100	40,700	53,500	48,600
	% of Mongolian Coal in the Total	32%	45%	42%	48%	54%	60%	70%	70%

Source: JICA survey team

2.5 Demand for domestic use in Mongolia

The forecast of demand for domestic use was examined by following Case 1, Case 1.5 and Case 2. Existing forecasted data is also shown in Table 2-4.

Table 2-4 Domestic Coal demand volume for 2025 (1,000t)

	Case 1	Case 1.5: 2.5%	Case 2: 4.9%	Reference		MRAM data
				2005-2011 Result	Rate of increase: 4.9%	
2011	6,815	6,815	6,815			
2012	7,000	7,000	7,200			
2015	7,500	7,800	8,300	8,000	8,600	13,700
2020	8,600	9,100	10,900	9,300	11,600	15,700
2025	9,600	10,700	14,400	10,800	15,600	18,100

Note: Case 1: Energy demand projections based on straight-line approximations using actual figures for 2005 - 2011

Case 1.5: 2005 - 2011 coal usage volume actual figures projected using straight-line approximation

Case 2: Energy demand projections are based on per capita growth rate of 4.9% and energy elasticity value of 0.62

Source: JICA survey team

2.6 Total coal demand until 2025 in Mongolia

In Fig. 2-4, (1) shows the forecasted result for “2.5 Demand for domestic use in Mongolia,” (2) shows the forecasted result of coking coal export for “2.4 Projections for Mongolia’s export potential” mentioned above, and (3) shows the total of (1) and (2).

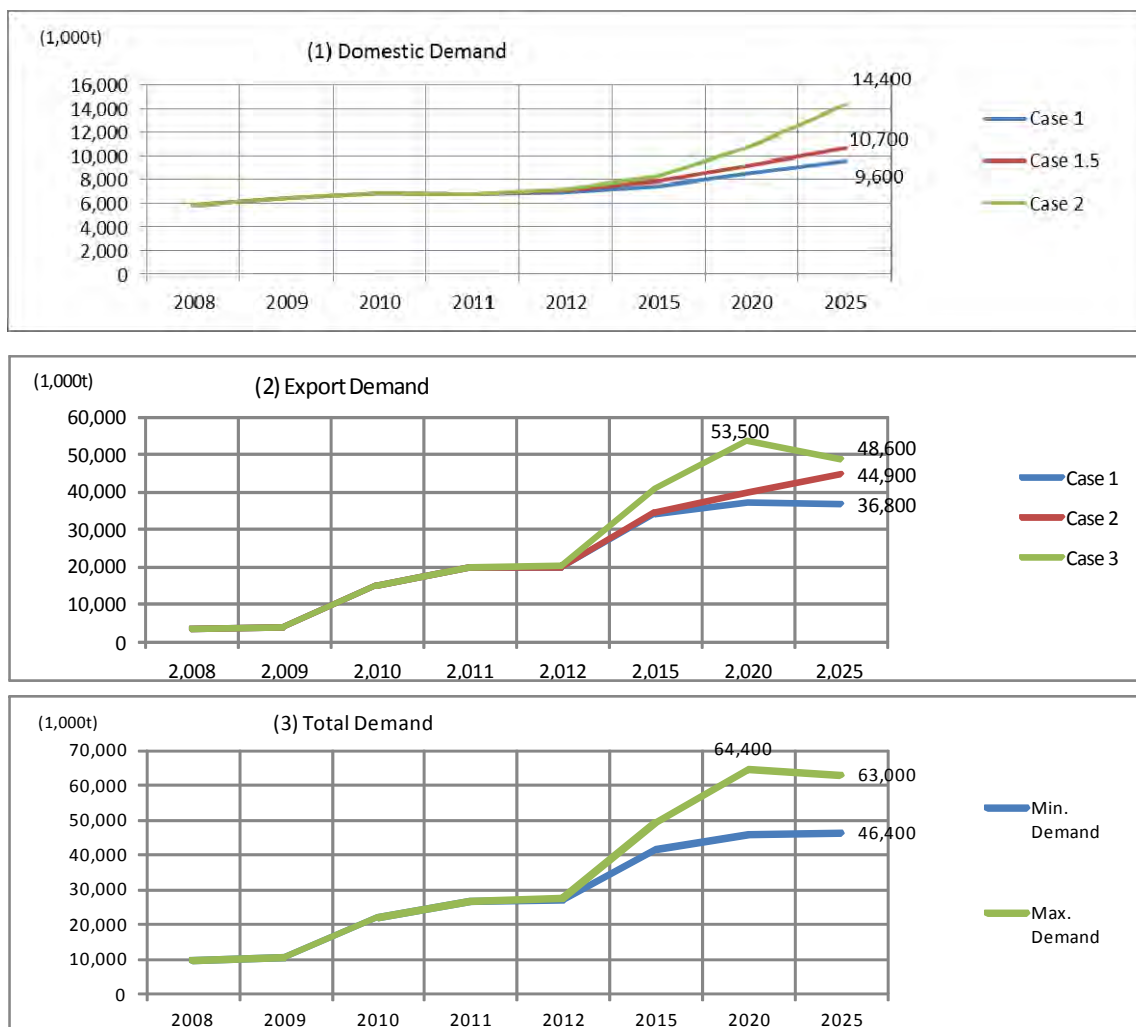


Fig. 2-4 Total demand for domestic and export coal

After investigation of the production plan for domestic coal mines to total demand in Fig. 2-4(1), the supply is considered to be sufficient. Since the total demand forecast for the Chinese market is clean coal¹ based, the 44.9 million tons of Case 2(2) in Fig. 2-4 will be sufficient for export as shown in Table 3-1. Moreover, when the amount of export increases to max, 53.5 million tons, the balance will be covered by ROM.² Therefore, there is no problem with supplying Chinese demand.

Chapter.3 Coal Development Analysis and Future Development Program

3.1 Production schedule of the coal mine for export

Table 3-1 shows the expected productive capacity of coal mines for export. It is predicted in Chapter 2 that export coal will remain at 40-50 million tons of clean coal after washing because of stagnation of the economy by 2025 even if Chinese coal import shows an increasing tendency. Therefore, when a new coal mine produces coal for export, over-production and

¹ Clean coal means coal after coal preparation processes.

² ROM (run-of-mine) means raw coal produced at a mine site.

stockpiling of unsalable coal will occur. It is necessary to push forward coal mine development for export considering China's demand.

Table 3-1 Forecast of Production of Coal Mine for Export

Mine Name	Forecast of production in 2025 (1,000 t)		Remarks
	ROM	Clean Coal	
Erdenes Tavan Tolgoi (East Tsankhi)	20,000	14,000	Under planning of CHP
UHG (Ukhaa Khudag)	15,000	11,000	5Mt x 3Units CHP
MAK Naryn Sukhait	14,000	5,000	Under planning of CHP (7Mt)
Ovoot Tolgoi	8,000		Dry separation by B.F.B
Baruun Naran	7,000		
Tavan Tolgoi (West Tsankhi)	20,000	14,000	Presumed plan of CHP
Tasnt Uul PJ	2,000		
Soumber Coal PJ	5,000		
Khushuut	5,000		Presumed dry CHP
Maanit	2,000		
Huren Gol	3,000		
Total	101,000	44,000	

Source: JICA study team

3.2 Production plan of a coal mine for domestic power plants

Table 3-2 shows production plan of coal mine for domestic power plants.

Table 3-2 Coal Production Forecast of Coal Mine for Domestic Power Plant

No.	Licence Owner	Coal Production Forecast/thous.t/y (ave.)		
		2013-2015	2016-2020	2021-2025
1	Baganuur JSC	4,667	5,200	5,600
2	Shivee Ovoo JSC	1,800	3,739	4,480
3	Sharyn gol JSC	300-1,000	1,000-1,500	1,500-1,000
4	Aduunchuluun JSC	817	1,000	200
5	Red hill Mongolia LLC	340	1,224	1,224
Total		7,924-8,624	12,163-12,663	12,504-13,004

Source: Data created by Mongolian National Coal Association created.

3.3 Production plan of a coal mine for general consumers

Table 3-3 shows commercial coal demand forecasting by 2025. If this is seen, commercial coal demand will result in about 4 million tons in 2025. From the planning of coal mines for commercial use in Table 3-4, when 2014 is removed, it turns out that it is likely that the amount of coal that covers the amount demanded by 2025 will be produced. However, if commercial coal production is set to 2025, an amount far exceeding that demanded is predicted. It is necessary to plan production, considering future demand trends to be important.

Table 3-3 Coal Demand Estimation for General Consumers (1,000t)

1,000 ton/year	2013	2014	2015	2020	2025
Central area	279	3,578	2,091	1,380	3,306
Local area	822	830	838	878	900
Total	1,101	4,408	2,929	2,258	4,206

Source: MRAM data edited by a JICA investigating commission.

Table 3-4 Coal Production Plan of the Coal Mine for General Consumers

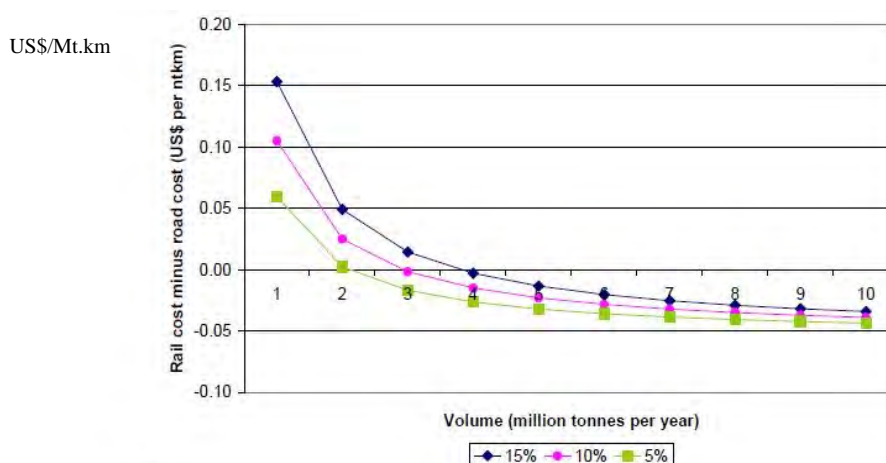
No.	Licence Owner	Coal Production Forecast/thous.t/y (ave.)		
		2013-2015	2016-2020	2021-2025
1	Khangad exploration LLC	333-1,000	600-1,000	1,000-2,000
2	Gobi coal and energy	1,117	90	5,130
3	Buman olz	333	333	-
4	Bold Fo Ar Da	766	920	500
5	Chingisiin khar alt LLC	767	85	85
6	Khar tarvagatai JSC	70-100	100-200	200-1,000
Total		3,386-4,083	2,128-2,628	6,915-8,715

Source: Data created the Mongolian National Coal Association edited by a JICA investigating commission

3.4 Economic infrastructure development plan

(1) Economy comparison between railroad and road

The World Bank made an economy comparison between railroad and road. The outcome of turning point analysis is shown in Fig. 3-1. Accordingly, it is supposed that rail traffic is more economical in the case where each year 2–4 million tons or more coal is transported. However, it will be necessary to further study individual construction costs considering a railroad laying plan and highway construction results in Mongolia.



Assumptions:

- Rail construction costs \$2 million per kilometer; a similar road costs \$500,000/km.
- Operating costs (excluding infrastructure, but including the capital costs of rolling stock) are 3 cents per tonne-kilometer for rail, and 8.5 cents for road.
- Infrastructure costs are covered with equal nominal charges spread over a 20 year project life, and present value of these charges calculated using discount rates of 5, 10, and 15%.

Source: Southern Mongolian Infrastructure Strategy, World Bank, 2011

Fig. 3-1 Comparison of Rail and Road

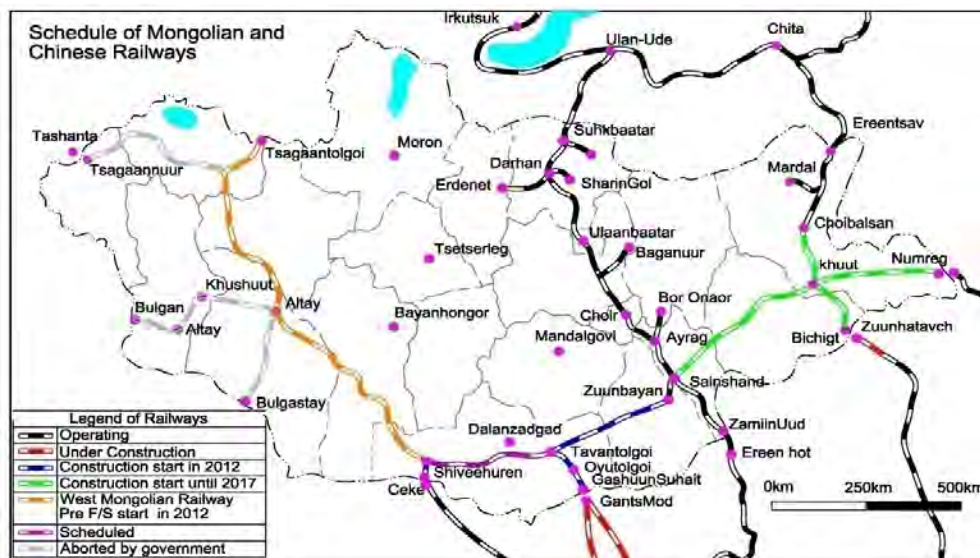
(2) Railway plan

On the basis of the railway plan decided by the country’s parliament in June 2010, the state-owned Mongolian Railway company (henceforth referred to as “MTZ”) divided the railway network with a total distance of 1,800 km into the stages of Phase I – Phase III. Among these, the railway planned in Phase I and Phase II is of high importance and is to be built by 2015. The new railway construction plan by Phase II is shown in Table 3-5 and the railway construction plan by the stages of Phase I – Phase III is shown Fig. 3-2. Originally, build-operate-transfer (B.O.T.) was planned, but, in November 2012, this B.O.T. was abolished and the financing policy will return to the conventional method.

Table 3-5 Mongolian Railway Construction Plan (2010)

Route		Distance km	Annual transportation amount (Million Ton)	Note
Phase I	Tavantolgoi-Sainshand	468	24.7	(1)
	Sainshand-Khuut	450	15.7	
	Khuut-Choibalsan	155	0.5	
Phase II	Khuut-Numrag	380	15.2	(2)
	Sainshand-Zamiin-Uud		1.0	
	Sainshand-Skhvaatar		8.0	
	Tavantolgoi-Gashuun Sukhait	267	18.1	
	Nariinsukhait-Shiveekhuren	46	23.2	
Total		1,766	66.0	(1)+(2)+(3)

Source: Railway Authority of Mongolia



Source: A JICA investigating commission edits the information from RAM.

Fig. 3-2 Schedule of Mongolian and Chinese Railways (2011)

(3) Road plan

(a) Current State of the Road

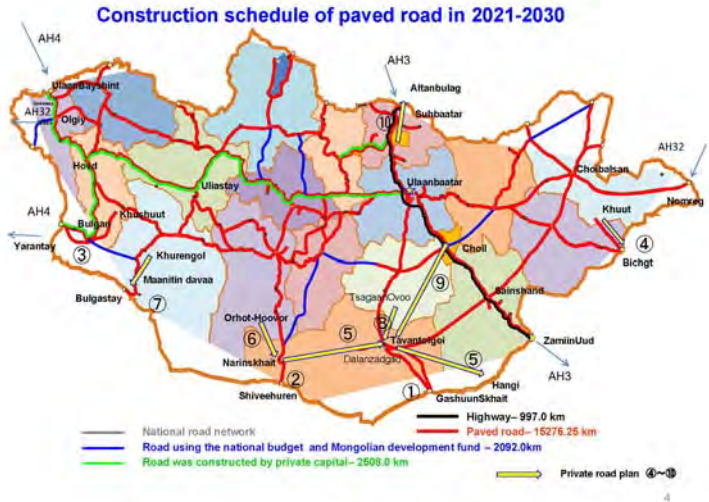
Fig. 3-3 shows a map of paved roads in 2011 and Fig. 3-4 shows a map of paved roads from 2011 through 2030 in total. Although many unpaved roads still exist as of 2011, a national highway is

scheduled to be paved in its entire length by 2020 (DOR information). In recent years, the amount of road construction by the B.O.T. system is increasing over the country. Taking a look at Fig. 3-3 and Fig. 3-4, the roads marked ① and ③ in Fig. 3-3 that were privately constructed in 2011 will become national highways in 2021 and later as shown in Fig. 3-4. These were constructed by the B.O.T. system for coal transportation, and they will then be national highways after 10 years from construction. From now on, roads will be constructed on the premise of the B.O.T. system.



Source: DOR

Fig. 3-3 Construction schedule for paved roads in 2011



Source: DOR

Fig. 3-4 Construction schedule for paved roads in 2021–2030

(4) Coal export to a third country

A case study was carried out to estimate the total cost of exporting coal to Northeast Asia by five routes regarding transportation costs and some fees. When FOR (free-on-rail, price of coal at the pit mouth) was assumed to be US \$ 125, the total of these costs was US \$ 59 - US \$ 92 from Mongolia to

Chinese ports and was US \$ 120 from Mongolia to Russian ports. In addition, there were some experimental examples of private corporations. The results indicate that that there is an export possibility to a third country at US \$ 125-150 for thermal coal and US \$ 200-250 for coking coal at international price.

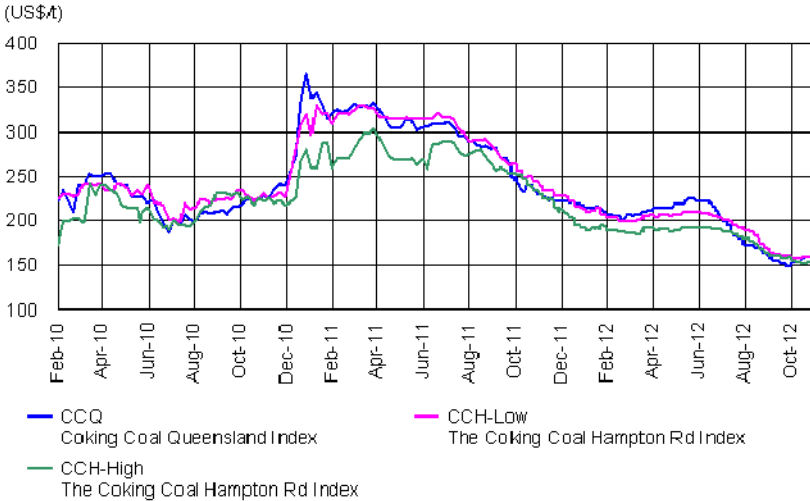


Fig. 3-5 Energy Publishing's FOB Coking Coal Price Indices

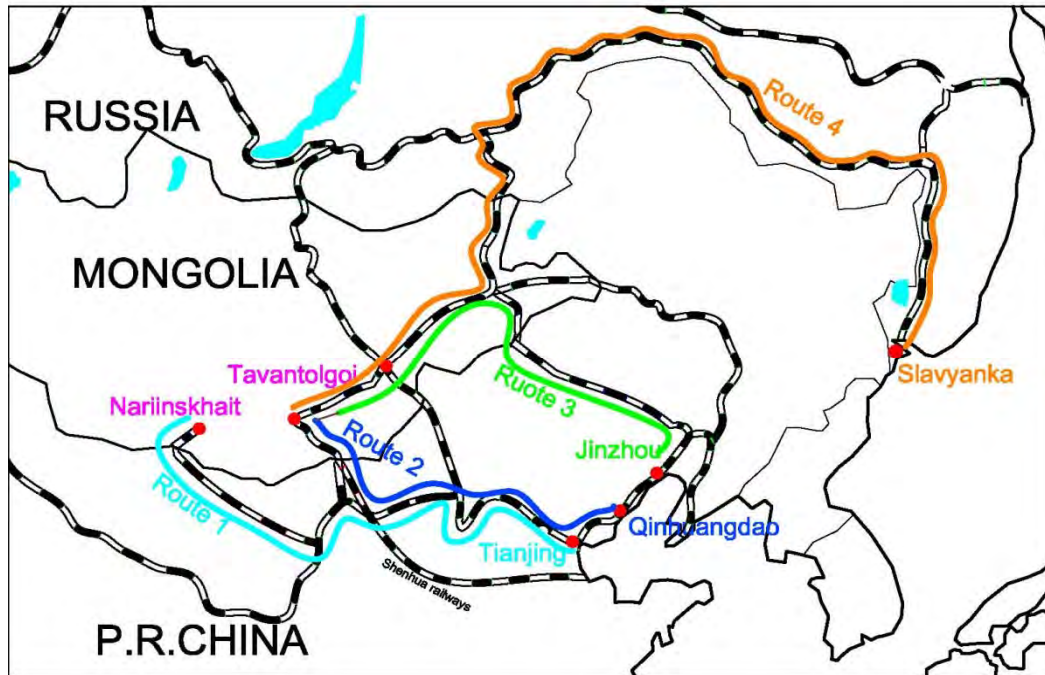
(5) Case study concerning coal export to the third country

The following five routes were examined concerning the transportation costs.

- Route 1 Nariinskhai → Shiveehuren → Huang hua
- Route 2 Tavantolgoi → Gashuunsukhait → Tianjin
- Route 3 Tavantolgoi → Gashuunsukhait → Qinhuangdao
- Route 4 Tavantolgoi → Bichgt → Jinzhou
- Route 5 Tavantolgoi → Sukhbaatar → Slavyanka

The five routes and port positions are indicated in Fig. 3-6 and transport expenses based on an evaluation of each export route are shown in Table 3-6. It is assumed that the use of railway is the cheapest method of transport. Concerning the Chinese route from the South Gobi region to China's Ceke, Ganqimaoto is to be used and no transshipment will take place.

- The Chinese side will extend the railway to Shiveekhuren, Gashuunsukhait.
- Through the Chinese route, 10 M tons of coal is to be exported annually while 9 M tons of coal per annum is to be exported through the Russian route, taking into account the transport capacity of each railway.



Source: JCOAL document

Fig. 3-6 Coal Export Routes China And Russia

Table 3-6 List of Transport Costs by Route

Route 1			Route 2			Route 3		
Action	Action Place	USD/t	Action	Action Place	USD/t	Action	Action Place	USD/t
FOR	Nariin	125.00	FOR	Tavantolgoi	125.00	FOR	Tavantolgoi	125.00
Railway 45km	Sukhait	1.66	Railway 267km	Gashuun	9.61	Railway 267km	Gashuun	9.61
	Shiveehuren			Sukhait			Sukhait	
Transport Cargo to Cargo	Shiveehuren	0.00	Transport Cargo to Cargo	Gashuun Sukhait	0.00	Transport Cargo to Cargo	Gashuun Sukhait	0.00
Export Commission		2.41	Export Commission		2.41	Export Commission		2.41
Import Commission		0.94	Import Commission		0.94	Import Commission		0.94
Railway 2,011km	Shiveehuren	19.82	Railway 1,355km	Gashuun Sukhait	13.93	Railway 1,539km	Gashuun Sukhait	15.58
Port Charge	Huanghua	33.75		Port Charge			Tianjin	
FOB Total USD/t		183.58	FOB Total USD/t		185.64	FOB Total USD/t		187.29
Route 4			Route 5			SS=Sainshan:KH=Khuut *=Not Authorizad		
Action	Action Place	USD/t	Action	Action Place	USD/t			
FOR	Tavantolgoi	125.00	FOR	Tavantolgoi	125.00			
Railway 1,118km	Bichigt (SS+KH)	40.25	Railway 1,310km*	Sukhbaatar	47.16			
	Transport Cargo to Cargo			3.00				
Export Commission	Bichigt (SS+KH)	2.41	Rent Cargo	Sukhbaatar	8.50			
Import Commission		0.94						
Railway 1,070km	Bichigt	11.37	Railway 4,180km*	Sukhbaatar	41.95			
Port Charge	Jinzhou			33.75				
FOB Total USD/ton		216.72	FOB Total USD/ton		245.61			

Source: NEDO2012 Report, WB2011 Report, JCOAL Document

3.5 Master plan of the coal development

3.5.1 Master plan

Although Mongolia is a resource producing country with a wide variety of abundant natural resources, the country has promoted economic development with the export of resources because of a small domestic demand. With regard to coal resources, Mongolia has huge amount of high-quality coking coal reserve. An increase in export is expected in the future and thus coal development projects have increased sharply.

In developing a master plan for the coal development, we first projected the possible amount of coal export and the amount of domestic demand of Mongolia, focusing on the coal demand trend in Northeast Asia. From the result, we estimated that the total amounts of domestic demand and export demand collectively are 46.4 million tons at the minimum and 64.4 million tons at the maximum for the prospect to 2025. To achieve these figures, we created a master plan for coal development summarizing recommendations and items of the action plan with the focus on coal management, coal environment and coal export policy, targeting a coal development program that enables Mongolian people to enjoy the benefit of resource development and minimize environmental problems.

The master plan of the coal development is drawn up including proposal and the item of action plan and schedule after we investigated and examined the Mongolian coal development status and economic infrastructure situation and arranged issues including a prediction in the future,

Master Plan of Coal Development

Target: Coal development aims at obtaining a coal supply and demand of max. 64.4million t by 2025, to allow the Mongolian people to enjoy the benefit of such coal development and minimize the environmental impact

The Coal management policies

- Tax system issues related to coal production and sales
 - Review of coal tax system by export agency
 - Establishment of a representative organization for private mining companies that can negotiate with the government
 - Gain the understanding of the public through public relations and edification activities.
- Establishment of local communities for mine workers
 - Include residential environment development conditions in the mining development approval process
 - Establish and implement urban planning
- Coal engineer development, employment security, and guarantee of status
 - Establishment of coal engineering accreditation system and specialty schools
- Mines for domestic demand

Create government organization to serve as central administrative organization for coal operations in order to achieve quick evaluation and implementation of measures.

Coal environmental policies

- Organization of laws and policies related to environmental preservation
 - Improvement for environmental conservation-related legislation, policy connection, the transparency
- Issues concerning nomads
 - To pave the transportation road and the maintenance of laws and review of the existing system for the coexistence of coal mine development and nomads

Coal export policies

- Mongolian investment climate
 - The stability of the investment climate for foreign country
- Problem of export coal prices
 - Establishment of "Coal Export Price Survey Council" (provisional name),
 - Establishment of "3rd Country Coal Export Evaluation Council" (provisional name),
 - Reevaluation of coal tax system and evaluate fees, etc.

Economic infrastructure development plan

- Tax revision related to transport for large and small business of coal mine
- Incorporate water recycling technology

3.5.2 Recommendations and the item of the action plan and schedule

(1) Coal management policies

(a) Tax system issues related to coal production and sales

1) There is a need to reevaluate the taxes currently being paid by mining companies and to create a more efficient tax system. To achieve this, the opinions of mining companies should be evaluated by an overseas auditing firm and opportunities for exchanges of opinion between the government and private companies should be established.

2) Currently, export coal mining operations are taxed at over 40% in relation to coal exploration and the country's private companies have voiced their dissatisfaction and the public is not seeing the benefits of coal exports. To resolve these problems, private mining companies should form a "representative organization" that can negotiate officially with the government.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Review of coal tax system by export agency	→	→	
(2) Establishment of a representative organization for private mining companies that can negotiate with the government.	→		
(3) Gain the understanding of the public through public relations and edification activities.	→	→	

(b) Establishment of local communities for mine workers

Policies are needed that help establish communities for miners and their families in areas near the mine development site. This would establish a stable environment in which workers could concentrate on mining works. Not only would this ensure the safety of workers, but it would also help establish a technical foundation. To achieve this, immediate work should begin towards the urbanization of large-scale mining development areas that gives consideration to providing a pleasant, long-term living environment for workers' families. This should also contribute to constraining population growth in U/B City.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Inclusion of residential environment development conditions in the mining development approval process.	→		
(2) Establishment and implementation of urban planning	→	→	

(c) Coal engineer development, employment security, and guarantee of status

In Mongolia, there are many young people without work despite holding university degrees in engineering. Among illegal miners are many young people with significant mining experience but they are not settled. From the understanding that engineers are part of a country's assets, public and private organizations must support the creation of specialty schools and the reeducation of workers. This will result in the development of specialist engineers through a license system and help stabilize

employment through guarantees of stable income.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Establishment of a coal engineering accreditation system and specialty schools	→	→	

(d) Mines for domestic demand

1) Regarding the problem of setting coal prices that support stable operation of mines providing coal for power plants, the experience of private companies should be applied to the management of coal mines in order to streamline management. Also, the use of coal upgrading technology to prevent declines in sales prices as well as government support will be vital.

2) Facilities’ investment plans for the purpose of increasing production at coal mines providing coal for power plants involve differing policies between government-run and privatized coal mines but the country needs a centralized organization to manage all coal activities

3) In rural areas, small-scale mines have reached a state of over-exploration and such operations are causing various problems related to environmental preservation and exploration technology (3.2.9). Small-scale rural mines need to be organized and reestablished at medium-sized mining operations producing 100-300 k tons of coal for each region in order to achieve a high level of efficiency. Adequate coal prices should be established and a system that gives consideration to nomads and environmental preservation should be incorporated in order to resolve the problem of fuel supply for surrounding residents.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Creation of government organization to serve as central administrative organization for coal operations in order to achieve quick evaluation and implementation of measures.	→		

(2) Coal environmental policies

(a) Organization of laws and policies related to environmental preservation

1) During our on-site reviews, we saw examples of natural environment standards not being fulfilled. There are cases where a cease of operations order is issued by the National Special Audit Bureau in response to legal violations but the standards for such measures are unclear . As immediate measures are required, appropriate authority should be allocated to local agencies as well. There is a need to achieve increased transparency of standards.

2)Environmental impact assessments are outlined by law but we received many on-site opinions indicating that the assessment procedures are complicated and require a lot of work . The country should reevaluate assessment criteria, reduce the time required for various procedures, and decrease the

required time by consolidating the assessment procedures required by prefectures and villages in addition to the central government in order to create a system that ensures quick and accurate assessments.

3)Based on current laws, the liabilities and obligations that must be fulfilled by a mining rights owner during the decommissioning of a mine are not necessarily clear. Restoration work required after the decommissioning of a mine, including environmental preservation actions, requires significant capital. It would be preferable to have laws requiring the mining rights owner to submit proof of annual reserves to an agency managed by the government in order to ensure that environment restoration funds are secured in advance.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Improvement for environmental conservation-related legislation, policy connection, the transparency	→		

(b) Issues concerning nomads

1)The greatest problem related to mining operations is the use of truck transport via unpaved roads in order to export coal from the South Gobi mine to China. The nomads along this route suffer damage from dust scattering, noise, and extinction of the grass. If truck transport is to be used in new coal exploration plans, at least approval before the start of mining operations should be pursuant to confirmation of paved roads from the mine to the truck transport target site. For small-scale mines, the government could consider developing paved roads and then collecting tolls.

2) There are cases where nomads living within a mining district raise objections to mine exploration and development is not able to progress smoothly . Taxes paid by mining companies could be used to provide nomads in the area surrounding the mining region with a satisfactory living environment in order to gain the understanding of nomads.

3) Massive land is required for mine development and problems related to land used by nomads will continue to occur. In addition to establishing ownership rights, measures need to be implemented to protect the livelihoods of nomads as much as possible.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Establishment of relevant laws by the supervising government bureau	→		
(2) Review existing policies by supervisory agencies so that residents at risk of harm and residents potentially at risk are provided with direct relief.		→	

(3) Coal export policies

(a) Mongolian investment climate

Regulation of foreign capital and the rights and interests acquisition of a country for strategic goods must be enforced, but in the case of investment by a foreign country, the stability of the investment climate is very important. The Mongolian government should avoid a hasty switch of policy and measures that will produce excessive investment risk for the investment side or decrease in investment opportunity due to anxiety. It is necessary to maintain in the long term a stable investment climate. As a result, the development of resources and allied industrial development & promotion will thereby directly lead to Mongolian national interests being satisfied.

(b) Problem of export coal prices

1) In relation to Chinese market prices and adjusting Mongolian sales prices, agencies related to foreign policy must establish an international framework for exports to China and revise pricing. Also the country must reinforce its information management and market trend assessment capabilities in order to evaluate export pricing management.

2) As almost all exports are to China, exports are greatly influenced by the Chinese economy. The country requires a strategy and economic infrastructure to support exports to other countries. If coal prices rise in the future, then possibilities will arise. Also, national support policies to bring down production costs are required.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Establishment of "Coal Export Price Survey Council" (provisional name)	→		
(2) Establishment of "3rd Country Coal Export Evaluation Council" (provisional name)	→		
(3) Reevaluation of the coal tax system, evaluation of fees, etc.	→	→	

(c) Economic infrastructure development plan

1) The Mongolian economy is greatly influenced by the Chinese economy. In order to stabilize and expand the domestic economy, Mongolia must establish multiple export routes . Additionally, not only must they secure domestic export routes, but it is also vital that they secure land transport routes through China and Russia as well as a port for loading and unloading. As such, Mongolia will need to conduct negotiations with governments and private companies in China and Russia.

2) With the elimination of the B.O.T. system for railway construction, there is concern that construction will be delayed but, conversely, general roadway construction will be accelerated by the B.O.T. system. The development and expansion of infrastructure is strongly related to problems of environmental impact and attempts to achieve both sometimes result in opposing cases (3.3.2). In order for the government to achieve development planning in line with funding policies and reduce the

environmental impact, they will need to control the speed of resource development.

3) Concerning the private development of roads, it will prove difficult for small to medium-scale mines to grow if they are levied under the same conditions as large-scale mines . To establish the support of small to medium-scale businesses as a key to future industrial development, the government must make radical revisions to tax systems related to transport for large businesses and small to medium-scale businesses.

4) Securing water resources is vital to resource development. In particular, securing water resources in the Gobi region, where annual rainfall is extremely low, is a critical issue . Measures, including securing water resources through surveys of underground water resources or long-distance transport of necessary volumes, are required. Water recycling technology must also be incorporated.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Incorporation water recycling technology	→	→	

Chapter.4 Coal Utilization Technology Analysis and Future Development Program

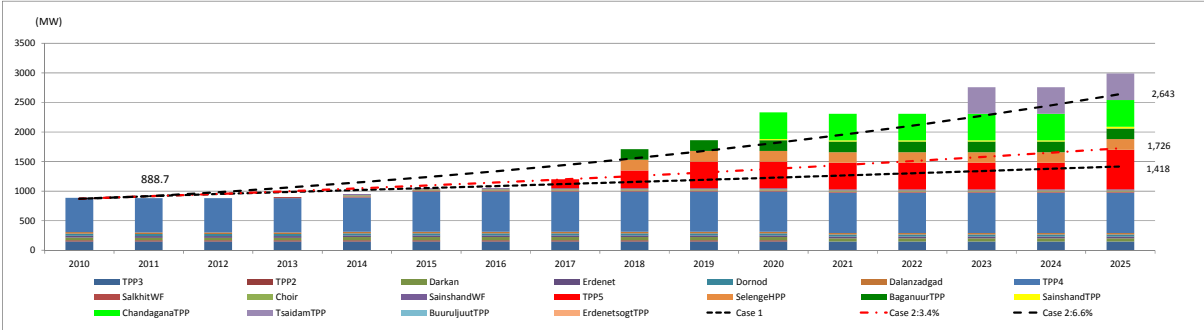
4.1 Current status of coal utilization in Mongolia and Forecast

4.1.1 Forecast of electricity demand and power station construction plan

Table 4-1 shows an electricity demand prediction and the power station plan for each case.

Table 4-1 Forecast of power capacity in 2025 by Case 1 to Case 3

Case	Power growth	Power capacity
Case 1	2.7%	1418 MW
Case 2 (GDP growth: 4%)	3.4%	1726MW
Case 3 (GDP growth: 6.6%)	6.6%	2643MW



Source: JICA study team

Fig. 4-1 Forecast of electricity demand and power station construction plan

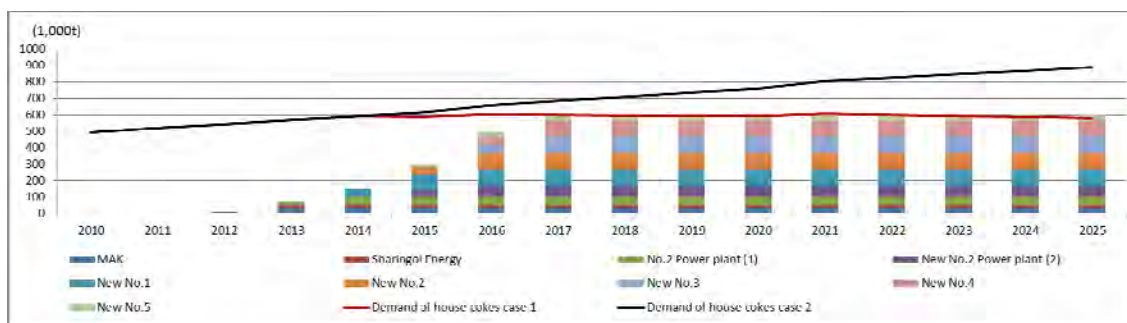
4.1.2 The forecast of householder cokes demand

Table 4-2 shows the forecast of householder coke demand and the construction plan for householder coke plants. The quantity of householder coke is based on Table 4-1 and the construction plan for householder coke plant is based on the JICA study result.

Table 4-2 Ger increase projections and household coke demand

Year	Mongolia		Ulaanbaatar						
	Population (1,000 people)	Increasing number (1,000 people)	Population (1,000 people)	No. of households (1,000 unit)	No. of households of ger & house (1,000 unit)	Case 1			Case 2
						New Apartment (1,000unit)	Remaining No. of households of ger & house (1,000 unit)	House cokes (1,000t)	House cokes (1,000t)
2010	2,761	45	1,152	294	176		176	493	493
2011	2,811	50	1,201	307	186		186	521	521
2015	2,938	36	1,409	361	220	10	210	589	617
2020	3,119	36	1,669	439	271	60	211	592	760
2025	3,301	36	1,886	510	317	110	207	581	889

Source: JICA study team

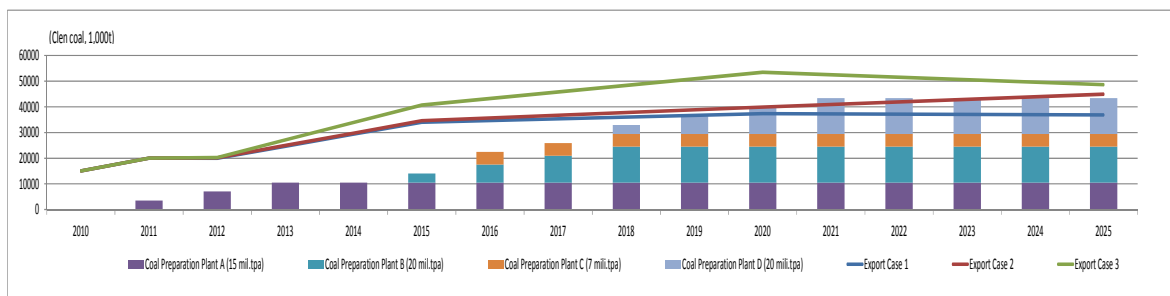


Source: JICA study team

Fig. 4-2 Forecast of householder coke demand and construction plan for householder coke plants

4.1.3 Forecast of construction plan of coal preparation plants

Fig. 4-3 shows the forecast of the construction plan for coal preparation plants and the amount of coal export to China is shown in Table 2-3.




Source: JICA study team

Fig. 4-3 Forecast of construction plan for coal preparation plants

4.1.4 Forecast of the construction plan for coal gasification and liquefaction

Fig. 4-4 shows the construction plan for coal gasification and liquefaction using for 3-4 million tons

of coal by a Mongolian private company after completion of F/S. There are two more companies planning a construction plan of coal gasification.


2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
F/S													
	Technology Selection & preparation				Construction					 Diesel Gasoline DME			
					Staff Training								

Source: JICA study team

Fig. 4-4 The construction plan for coal gasification and liquefaction

4.1.5 Forecast of the construction plan of metallurgical cock

Fig. 4-5 shows the construction plan for 300,000 tons of metallurgical coke by a Mongolian private company. All products will be exported to designated consumers.

2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
		F/S											
				Contract			Construction						

Source: JICA study team

Fig. 4-5 Construction plan for metallurgical coke

4.2 Master plan of coal utilization

4.2.1 Master plan

Not only is coal an energy source, but it can also acquire high added value by coal processing, and Mongolia has a strong interest in new industrial construction using coal. At first, the present situation and forecast of coal utilization in Mongolia was studied in devising the master plan for coal utilization. As a result, looking towards 2025, the target of coal processing of Mongolia is to build a self-sufficient system of coal-based energy early to establish energy security in Mongolia. In addition, the export of coal processing products suggests what they perform in total to a maturity degree of the industrial base by the accumulation of Mongolian coal processing techniques. The master plan for coal utilization shows the proposal, and an action plan and an action schedule are to be achieved.

Master Plan of Coal Utilization

Target: Establishment of the Mongolian energy self-sufficiency system using abundant coal resources and construction of the industrial base for exports of the coal processing product.

Coal policies for introduction of coal utilization

- | | |
|----------------------------------------------------|------------------------------|
| ■ <u>Tax exemptions for imported equipment</u> | ■ <u>Stability agreement</u> |
| ■ <u>Loan guarantees for large scale financing</u> | ■ <u>Staff training</u> |

Power sector

- | | |
|------------------------------------------------------------|------------------------------------------------------------------|
| ■ <u>Improving efficiency of existing CHP</u> | ■ <u>Construction of new power plants linked to power demand</u> |
| ■ <u>Replacement of No. 4 power plant</u> | ■ <u>Exporting electricity</u> |
| ■ <u>Early launch of construction of No. 5 power plant</u> | ■ <u>Establish a training simulator</u> |

Heat production sector

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> ■ <u>CHP plant efficiency improvements and increased HOB efficiency</u> <ul style="list-style-type: none"> ➢ Short-term improvement plans for HOB efficiency improvements, ➢ Large-scale centralization of HOB, ➢ Examination of HOB using blended fuel of municipal waste and coal ■ <u>The reinforcement of household cokes facilities</u> <ul style="list-style-type: none"> ➢ Supply 600k tons for winter in 2018, ➢ Reevaluate grant program, ➢ "Household cokes Production Evaluation Workgroup (provisional name)" | <ul style="list-style-type: none"> ■ <u>Processing of tar and phenol-laced waste water produced by private companies producing household cokes</u> ■ <u>Production of coal-based synthetic liquid fuels</u> <ul style="list-style-type: none"> ➢ Cultivate engineers through a collaborative effort by government, businesses, and universities |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Coal utilization technology sector

- | | |
|------------------------------------|--------------------------------------|
| ■ <u>Coke for steel production</u> | ■ <u>Activated carbon production</u> |
|------------------------------------|--------------------------------------|

Coal preparation technology

- | | |
|-------------------------------------------------|-------------------------------------------------------------------|
| ■ <u>Development coal preparation engineers</u> | ■ <u>Practical application of dry coal preparation technology</u> |
| ■ <u>Use of middling product after washing</u> | |

4.2.2 Recommendations and the item of the action plan & schedule

(1) Coal utilization policies for introduction of coal utilization

(a) Tax exemptions for imported equipment/facilities

As transportation cost to Mongolia is very high, all imported equipment/facilities costs rise and damage the economic viability of capital-intensive projects. From the Mongolian government’s perspective, it is better to tax profitable projects after their start of operation, otherwise a high up-front tax burden will discourage investment into capital-intensive sectors such as coal gasification.

(b) Loan guarantees for large-scale financing

Developing countries like Mongolia are regarded as high-risk countries for financing. So financial institutions require a high degree of guarantees that may not be available for domestic companies. This is why the government of Mongolia can step in by providing government guarantees to support viable and important projects.

(c) Stability agreement

Huge up-front capital investment into coal gasification will result in a long-term repay period. So investors receive returns long after their initial investments. In order to encourage investment, the Mongolian government also has to ensure that investors receive their expected returns.

(d) Staff training

Coal utilization such as coal gasification plants will employ many highly skilled engineers, operators. It is good chance to promote employment with sustainable salaries. So educating needed staff at universities, colleges are necessary.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Tax exemptions for imported equipment/facilities	→		
(2) Loan guarantees for large- scale financing	→		
(3)Stability agreement	→		
(4)Staff training	→	→	

(2) Power sector

(a) Improving efficiency of existing CHP

Since 1993, No. 3 and No. 4 power plants in Ulaanbaatar have received continuous renovations in terms of both hardware and software. However, during this survey we found need for further improvements. Continued rehabilitation of these facilities is required in order to ease the power shortages facing Ulaanbaatar.

(b) Replacement of the No. 4 power plant

As noted above, No. 4 power plant has received numerous improvements and renovations since its construction between 1983 and 1991. However, by 2025, the facility will be a deteriorated thermal power plant that is over 40 years old. As such, they will need to replace this facility with a new power

plant. If that happens, the facility should be a 600MW supercritical large-scale facility equipped with both desulphurization and denitration facilities.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Rehabilitation of No. 3 and No. 4 power plants		→	
(2) Replacement of No. 4 power plant			→

(c) Early launch of construction of No. 5 power plant

The power shortages facing Ulaanbaatar have been pointed out for years and thus construction of No. 5 power plant currently under consideration should be accelerated. To meet 2015 demand, they will initially need 450 MW but from 2025 onward, an additional 300 MW will be required. The power plant system can be a subcritical system, with which Mongolia has significant experience, and should be equipped with both desulphurization and denitration facilities.

(d) Construction of new power plants that is linked to power demand

The country needs between five and six units of 300- to 450-MW-class power plants to meet power demand in 2025. If constructing a power plant in Southern Gobi, middling products produced during coal washing can be used as fuel. The construction of these facilities must be linked with demand and progress without fail. As noted above, specifications should include both desulphurization and denitration facilities.

(e) Exporting electricity

When considering export potential, critical issues will be whether a long-term sales agreement needed to recover power plant facilities investments is possible or not and the energy security policies of the target country. The situation of countries with long history of exporting power should be evaluated in order to reduce risks. After having satisfied domestic demand, form to export surplus electric power will be desirable.

(f) A training simulator targeting the latest pulverized coal thermal power plants established.

This will help ensure smooth operation of future thermal power plants.

(3) Heat production sector

(a) CHP plant efficiency improvements and increased HOB efficiency

Air pollution in cities resulting from coal combustion and the growing damage to health are serious problems. Measures to address these problems include the expanded use of household coke and HOB improvements, both discussed below. As a medium-term solution, particularly in relation to the U/B urban planning policies, is the large-scale centralization of HOB as a way to create a hot water provision system based on large-scale coal boilers with CCT requirements. Another vital environmental policy will be the mixed combustion of city trash and coal as a way to improve energy efficiency with HOB centralization.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Short-term improvement plans for HOB efficiency improvements	→		
(2) Large-scale centralization of HOB		→	→
(3) Study of HOB with mixed combustion of municipal solid waste and coal		→	→

(b) Reinforcement of household coke producing facilities

Demand volume does correlate to apartment housing construction plans but during the winter periods of 2017-2018, they should aim to achieve a supply volume of 600 k tons annually. Also, to promote the aggressive and continuous production of household coke by private companies, the system of funding should be reevaluated. Mongolia should also maintain awareness that the production of household coke holds a vital position in the country's plans for the accumulation of technology for a coal processing industry and the development of future engineers.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Supply 600k tons for winter 2018	→	→	
(2) Reevaluation grant program	→		
(3)"Household coke Production Evaluation Workgroup (provisional name)"	→		

(c) Processing of tar and phenol-laced waste water produced by private companies producing household coke

Collaborative evaluation should be conducted by government, businesses, and universities regarding the development of technology for processing methods that suit Mongolia. Evaluations of these processing methods should be incorporated into evaluations of new household coke production facilities.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Measures for processing of tar and phenol-laced waste water produced by private companies	→		

(4) Production of coal-based synthetic liquid fuels

In Mongolia, which has vast coal resources but few other fossil fuel resources on a large scale, the production of coal-based synthetic liquid fuels is both promising and necessary for the country's future. However, as at present the country does not have the required production environment, the technology risks are significant. The problem is how to reduce these risks. Case studies led by private companies and in line with domestic demand should be implemented and the country must align this technology as necessary for the country's future and support its realization. Projects through a collaborative effort by government, businesses, and universities should be implemented in order to provide support and

cultivate engineers. While it would depend on private company trends, operation of the country’s first commercial plant could occur in 2020.

Private-company gasification projects should implement education and training plans for gasification facilities, machinery, safe operation laws, overcoming malfunctions, and maintenance and inspection procedures. This will aid in the smooth launch of facilities and ensure rapid trouble response.

The education/training plan for experiencing gasification facilities, machinery, safety operation method, overcome of failure cases, and maintenance and inspection procedures shall be incorporated into a gasification project implemented by private companies. This is intended to allow a smooth start up of coal gasification facilities as well as quick implementation of countermeasures against failure troubles.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Production of coal-based synthetic liquid fuels			
(2) Cultivate engineers through a collaborative effort by government, businesses, and universities			

(5) Coal utilization technology sector

(a) Coke for steel production

Based on the fundamental plan for self-sufficiency, the production of coke for export purposes when there is no demand for coke for steel production poses large risks in terms of ensuring coke quality and importer demand as well as environmental risks. This is not the case where coke is produced in Mongolia for the purpose of being exported to foreign companies that will use the coke in their own country. In other words, there are cases where it will be economically advantageous to have coke produced in Mongolia, transported to their home country, and then use that coke in their home country.

(b) Activated carbon production

One of the next coal utilizations from a semi-coke production technology is to produce activated carbon. It is imported now, and its consumption will increase as environmental pollution measures will affect materials continuously. Lignite coal is widely used in world markets as the raw material for activated coal. Activated carbon production in Mongolia is promising from a self-sufficiency policy viewpoint. Basic investigations, such as on marketability, grade of its quality required in Mongolia, trial product using Mongolian lignite, and so on, should be carried out.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Basic investigation and F/S			
(2) Construction of commercial plant			

(6) Coal preparation technology

(a) Development coal preparation engineers

Coal preparation plants are facilities that are directly tied to coal sale profits so the country needs to

develop specialists able to evaluate coal preparation technology from a third-party standpoint. It would be ideal to cultivate Mongolians who learn the technology and can serve as plant directors in order to ensure quality management and operational management (4.3.5). The cultivation of coal preparation engineers should involve the development of an educational curriculum that uses local coal preparation plants.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Establish coal preparation engineer development system and create educational curriculum	→		
(2) Conduct coal preparation education		→	→

(b) Use of middling product after washing

Based on coal preparation construction plans, the volume of middling product will be 2.8 million tons in 2015, 8million tons in 2020, and 8.7million tons in 2025. It is vital that they evaluate heat supply facilities and coal thermal power plants that utilize this product as a part of their coal urban city planning. There is potential as energy coal export but there are still problems related to infrastructure and coal prices.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Utilization of the middling	→	→	

(c) Practical application of dry coal preparation technology

As a coal technology in regions with limited water resources and for providing superior options in terms of environmental measures, dry coal preparation technology is vital. At existing facilities, the precision of coal preparation is very low and it will be difficult to achieve levels of coal quality equivalent to coking coal exports. Mongolia already has optimal conditions for implementing this technology. If use of this technology can be made practical, the technology can be also exported to regions with low water resources in other countries.

Action plan	Short term (2015)	Intermediate (2020)	Long term (2025)
(1) Dry coal preparation validation facilities	→		
(2) Construction of commercial plant		→	