

NO.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DEPARTMENT OF MINERAL RESOURCES
MINISTRY OF INDUSTRY
THE KINGDOM OF THAILAND (DMR)

**FEASIBILITY STUDY (PHASE I)
ON
COMPREHENSIVE DEVELOPMENT OF THE NGAO COAL BASIN
IN
THE KINGDOM OF THAILAND**

FINAL REPORT

JANUARY 2002

**MITSUBISHI MATERIALS NATURAL RESOURCES DEVELOPMENT CORP.
MITSUI MINING ENGINEERING COMPANY LIMITED**

JAPAN

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PREFACE

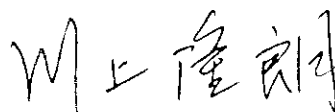
In response to the request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct “the Feasibility Study (Phase I) on Comprehensive Development of the Ngao Coal Basin in the Kingdom of Thailand”. The study was implemented by the Japan International Cooperation Agency (JICA).

JICA dispatched a study team led by Mr. Minoru Matsumura of Mitsubishi Materials Natural Resources Development Corporation to the Kingdom of Thailand four times from August 2000 to November 2001.

The team held discussions with the officials concerned of the Government of the Kingdom of Thailand, and conducted related field surveys. After returning to Japan, the team conducted further studies and compiled the final results in this report.

I hope that this report will contribute to the optimum planning for “Comprehensive Development of the Ngao Coal Basin in the Kingdom of Thailand”, and to the enhancement of friendship between our two countries.

I express my sincere appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation through the Study.



Takao Kawakami

President

Japan International Cooperation Agency

January 2002

Mr. Takao Kawakami
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Kawakami

Letter of Transmittal

We are pleased to submit to you the Final Report on “the Feasibility Study (Phase I) on Comprehensive Development of the Ngao Coal Basin in the Kingdom of Thailand”. The Study was conducted during 16-month from August 2000, under the contract with your organization.

With due consideration of the current condition of energy and coal in Thailand, the Feasibility Study has been carried out to make an optimum plan on “Comprehensive Development of the Ngao Coal Basin” from the technical, environmental and economical points of views. In addition, the technical transfer was carried out to DMR’s officers by means of on-the-job training.

In this report, compiled are the results of exploration, geological evaluation, upgrading test, comprehensive development plan, environmental assessment and preliminary economical evaluation on Ngao Coal basin, and also reflected are the opinions of the counterparts through the discussions held in Thailand during the study period.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Ministry of Economy, Trade and Industry. We also wish to express our deepest gratitude to the Department of Mineral Resources, Ministry of Industry, other authorities concerned of the Government of the Kingdom of Thailand, the Embassy of Japan in Thailand and the JICA Thai office for the close cooperation and assistance extended to us during the period.

Very truly yours,

Minoru Matsumura
Team Leader

松村 稔

The Feasibility Study (Phase I) on Comprehensive
Development of the Ngao Coal Basin in the Kingdom
of Thailand

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I . INTRODUCTION

In response to the request of the Government of Kingdom of Thailand (hereinafter referred to as “Thailand”), the Government of Japan decided to conduct Feasibility Study (Phase I) on comprehensive Development of NGAO Coal Basin (hereinafter referred to as “the Study”), in accordance with the laws and regulations in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as “JICA”), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study in close cooperation with Department of Mineral Resources, Ministry of Industry (hereinafter referred to as “DMR”), the authorities concerned of Thailand.

JICA assigned a joint study team (hereinafter referred to as “the Study Team”), composed of Mitsubishi Materials Natural Resources Development Corporation and Mitsui Mining Engineering Co., Ltd. to carry out the Study in accordance with the agreement between DMR and JICA on December 21, 1999.

The study has been started on August 2000 and carried out successfully following procedure and schedule which were described in the Inception Report.

This Draft Final Report is the summary of progress and result of the Study.

1. Objectives

The main objectives of the Study are as follows.

- (1) Comprehensive analysis of the coal seam condition and estimation of the minable coal reserves at the Study Site.

- (2) Conceptual planning of coal mine development applying the upgrading technology of coal quality in consideration of environmental influence.
- (3) Technology transfer on coal mine development procedure (exploration, evaluation, mining, environment and quality upgrading etc.) to DMR staff through the Study.

2. Study Site

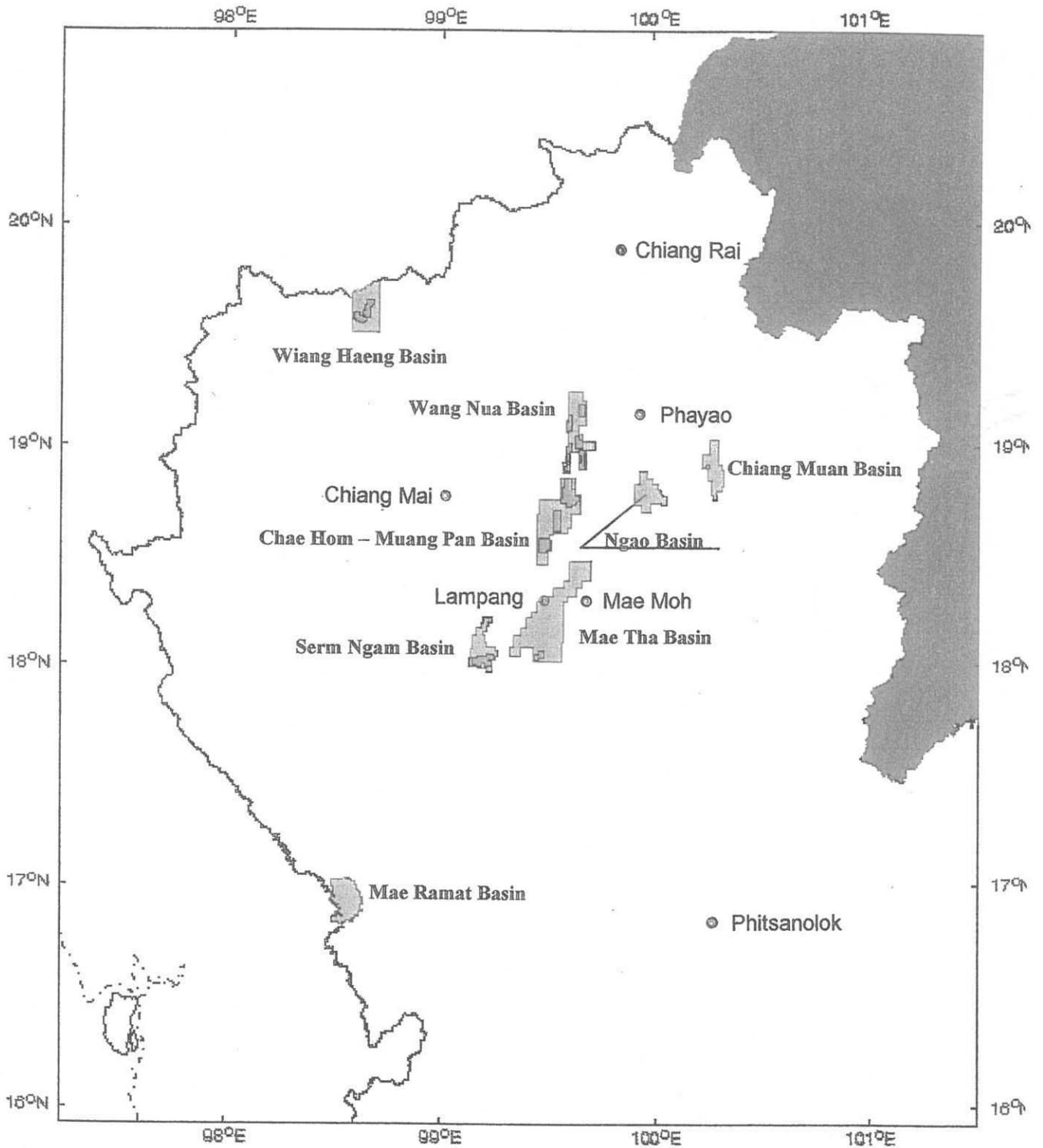
The Study Site is in a part of NGAO Coal Basin which is located 80 km northeast of LAMPANG city, the main city in the northern territory of Thailand. The coal basin covers about 200 k m², but the Study Site is limited to 63 k m² in area supposed to be prospective. The location of NGAO Coal Basin is shown in Figure 2-1.

3. Members of Study Team and Counterpart Team

J I C A Study Team

MATSUMURA Minoru	General Leader / Coal Development Plan
SHIMA Takehiko	Energy & Coal Circumstances / Sub Leader
KAWAGUCHI Yuzo	Geology
YOKOYAMA Takayuki	Drilling
TATSUMOTO Katsunobu	Coal Quality Upgrading
TAKAHASHI Takeshi	Mining
YAMAZAKI Kenichi	Environment

Fig2-1 Location of NGAO Coal Basin



Coal Area Map in The North of Thailand under Minerals Act B.E. 2510 (Section 6 bis.)

DMR Counterpart Team

Nares Sattayarak	Energy / Chief
Somchai Poom-im	Geological Group / Chief
Sunton Srikulawong	Geological Group / Sub Chief
Apichart Jeenagool	Geological Group
Tinnakorn Sunee	Geological Group
Wuttipong Kongphetsak	Geological Group
Pornchai Pongsakorn	Geological Group
Surachai Krobbuaban	Geophysics Group / Chief
Rungson Charusirisawad	Geophysics Group / Sub Chief
Kriangkrai Pomin	Geophysics Group
Wijaiyut Prapawit	Geophysics Group
Apinun Punyamae	Geophysics Group
Bundit Chaisilboon	Evaluation Group / Chief
Pakpoom Sriyarak	Evaluation Group

4. Performed Procedures of the Study

4.1 Preparatory Study in Japan (Aug. 1~9,2000)

Preparation of Inception Report and Site Study

4.2 First Stage Study in Thailand (Aug. 21~Oct. 18, 2000)

(1) Explanation and Discussion on Inception Report

(2) Collection of Data and Information

- Previous exploration data
- Mining law, Standard of coal reserves calculation, Environmental law and

regulations, etc.

- Energy and coal development circumstance

(3) Check and Reinforcement of Geological Database

(4) Geological Analysis and Interpretation

(5) Reconnaissance Field Survey

Implementation of reconnaissance field survey, Selection of location for exploratory boreholes and planning of geological field survey

(6) Preparation and Implementation of Contract Work

- Implementation of preparatory drilling and preparation of bulk sampling
Preparatory drilling (PH1,2,3) : 3holes × 10m=30m
- Preparation of exploratory drilling
- Preparation of coal analysis and rock test
- Preparation of float and sink test

(7) Preliminary Environment Study

4.3 First Stage Study in Japan (Sep. 7, 2000~Nov. 17, 2000)

(1) Analysis and Arrangement of Obtained Information

- Complement of database on previous drilling data
- Analysis and interpretation of geological data
- Making of geological structure map, structure contour map of main coal seams and geological section

(2) Determination of Contractor in Thailand and Japan

Determination of contractor for drilling, coal analysis and test, rock test, quality upgrading test in Thailand and Japan.

4.4 Second Stage Study in Thailand (Nov. 23, 2000~Feb. 10, 2001)

(1) Collection of New Data and Information

(2) Bulk Sampling, Sample Preparation and Float-Sink Test

(3) Exploratory Drilling and Geophysical Logging

- Implementation of exploratory drilling and geophysical logging

5 holes (NGJ1/43~NGJ5/43),total length of boreholes:1,052m.

- Preparation of database, columnar sections of boreholes and coal seams

- Core sampling, coal analysis and rock test

Coal sample (float-sink test, coal analysis and test), rock sample (rock test)

- Geological Field Survey

The boundary between the soil and basement rocks was mainly surveyed because this region is mostly covered by thick soil.

- Investigation of Coal Mine Condition

The actual conditions of the following mines were investigated.

Mae Moh Mine, Lampang Mine 2(Mae Than), Ban Pu Mine(Li Mine), Ban Pa Kha Mine, Chiang Muan Mine

4.5 Second Stage Study in Japan (Dec. 11, 2000~Mar. 8, 2001)

(1) Analysis and Arrangement of Obtained Information

- Energy and coal circumstance in Thailand

- Geological evaluation of coal resources

(2) Examination and Evaluation of Coal Preparation and Upgrading

(3) Conceptual Planning of Mine Development

Based on the evaluation of coal resources, conceptual development plan of coal mine was studied in consideration of environmental restriction

(4) Preparation of Interim Report

4.6 Third Stage Study in Thailand (May. 21, 2001 ~ Jun. 8, 2001)

(1) Explanation and Discussion on Interim Report

(2) Preliminary Market Research

Preliminary market research was carried out in consideration of the salable coal quality based on the result of drilling core analysis and upgrading tests.

Based on the results of these, the possibility of the development in NGAO coal Basin was studied.

(3) Research Relevant to Mining

- Support system for machine and equipment
- Land space for surface facilities and installations
- Environmental impact to residents

(4) Cost Study on Coal Mine Development

Standard cost study was carried out for mine development planning in these mines (Mae Moh Mine, Ban Pu / Li Mine, Ban Pa Kha Mine, Chiang Muan Mine).

(5) Preliminary Cost Research on Coal Preparation

Coal preparation cost was researched in those mines.

4.7 Third Stage Study in Japan (Jun.11, 2001~Oct.26, 2001)

(1) Analysis and Arrangement of Obtained Information

(2) Determination of Method and Cost Estimation on Coal Preparation and Upgrading

Coal preparation cost was estimated from the data of those mines.

Upgrading cost was very roughly estimated from the information of SGI process in USA.

(3) Conceptual Planning and Cost Calculation of Coal Mine Development

(4) Preliminary Evaluation and Recommendation on NGAO Coal Basin

Based on the result of the Study, economic and financial evaluation for the mine development in the Study Site was done.

The possibility of mine development in the Study Site was comprehensively studied, considering not only economics of the project, but also contributions to the local economics and environmental impacts to the region.

(5) Preparation of Draft Final Report

(6) Preparation of the Seminar on the Study Result

4.8 Fourth Stage Study in Thailand (Oct.31, 2001~Nov.17, 2001)

(1) Explanation and Discussion on Draft Final Report

(2) Holding of The Seminar

(3) Decision of the Policy for Phase II Study

It was decided that Phase II Study was not implemented.

(4) Preparation of Final Report

II. Result of the Study

1. Situation of Energy and Coal in Thailand

1.1 Public Agencies related to Energy Issues

The public agencies related to energy issues are under the three ministers of the Government of Thailand; namely, Office of the Prime Minister, Ministry of Industry and Ministry of Science, Technology and Environment. The name of these agencies and their roles are as follows. The agencies responsible for environmental issues are described separately in the section of “Environmental Surveys”.

(1) Office of the Prime Minister

National Energy Policy Office (NEPO)

Responsible for formulation of policy, management and development of plans and measures related to energy, petroleum pricing, tariff structure, energy research, etc. and collection and processing of energy-related information and statistics.

National Energy Policy Council (NEPC) is the supreme organization managing energy-related matters, which consists of the prime minister as the chairman and ministers of related ministries as the members. NEPO acts as the secretariat of the Council.

Electricity Generating Authority of Thailand (EGAT) is a state enterprise under the Office of the Prime Minister.

(2) Ministry of Industry

Department of Mineral Resources (DMR)

Responsible for exploration and assessment of petroleum, coal, minerals and water

resources, management of prospecting and mining license, mining technology, environment on mine development, etc.

Mineral Fuels Division, one of the Divisions of DMR and the counterpart for the present study, is divided into 5 units.

- Energy Resources Policy and Planning Unit
- Energy Resources Assessment and Development Unit
- Petroleum Concession Right and Revenue Unit
- Petroleum Operations Supervision Unit
- Energy Resources Information and Data Unit

Petroleum Authority of Thailand (PTT) is a state enterprise under the Ministry of Industry.

(3) Ministry of Science, Technology and Environment (MOSTE)

Department of Energy Development and Promotion (DEDP)

Responsible for research, develop, supervise, monitor and operate on production and utilization of energy.

1.2 Demand and Supply of Primary Energy

1.2.1 Energy Policy

Energy policy in Thailand is determined every five years in accordance with “the National Economic and Social Development Plan (NESDP)” and the targets and the strategies of energy development during that five years plan are established. Present is the final year of the Eighth NESDP (1997-2001) and the following targets in relation to coal are shown in “Strategies for Energy Development during 8th NESD Plan” by NEPO.

(1) Targets for Energy Development

- Increase commercial primary energy production at an annual growth rate of 5.0 %.
- Maintain the growth rate of the domestic primary energy consumption at a similar level to that of GDP.
- Maintain the level of energy import dependence at below 75 % by the year 2001.
- Target for domestic production of coal in 2001 is 14.4 million tons for electricity generation and 7.5 million tons for industry use.

(2) Strategies for Efficient Achievement of the Targets

- Speed up exploration for additional coal resources to ensure adequate energy reserves for future use.
- Improve and amend rules and regulation which hinder coal development, to enable a more efficient and systematic development of coal resources.
- Immediate consideration should be given to concession granting to the private sector to develop coal mines initially explored by DMR.
- The application of modern technology for coal utilization in electricity generation and in industrial sector, so as to cause minimal impacts towards the environment.
- Speed up energy procurement from foreign sources, in particular that of LNG, orimulsion and coal, to ensure sufficient supply to satisfy the domestic demand.
- Encourage the Thai energy companies to enter into joint ventures on energy development abroad,

1.2.2 Present Situation of Energy Demand and Supply

Owing to a serious economic crisis in 1997, GDP growth rate fell down to minus in 1997 and 10.2 % in 1998. However, economy in Thailand turned gradually to upward trend in 1999 and GDP growth rate was recovered to 4.2 % in 1999 and 4.4 % in 2000.

Table 1-1 Demand and Supply of Primary Commercial Energy

	1996	1997	1998	1999	2000	(%)
Production	450.1	523.4	524.1	549.3	590.3	(100.0)
Crude Oil	26.4	27.5	29.4	34.1	58.1	(9.8)
Condensate	32.4	40.8	42.2	45.1	47.7	(8.1)
Natural Gas	227.6	281.0	305.0	335.7	351.1	(59.5)
Lignite	131.7	142.7	124.9	119.3	107.3	(18.2)
Hydro	31.9	31.4	22.6	15.1	26.2	(4.4)
Import (Export)	737.8	709.4	621.8	657.6	722.2	(100.0)
Crude Oil	633.2	728.8	679.7	698.9	675.0	(93.4)
Petroleum Product	76.4	(40.4)	(65.1)	(75.0)	(43.5)	(-6.0)
Condensate	(21.9)	(21.4)	(16.4)	(11.7)	(4.4)	(-0.6)
Natural Gas	0.0	0.0	0.4	0.5	38.5	(5.3)
Coal	48.7	41.1	20.4	41.0	52.2	(7.2)
Electricity	1.4	1.3	2.8	3.9	4.5	(0.6)
Consumption	1,120.7	1,175.7	1,089.5	1,125.1	1,155.3	(100.0)
Crude Oil & Pet. Product	685.2	681.3	610.9	611.2	580.4	(50.2)
Natural Gas	227.6	281.0	305.4	336.2	389.5	(33.7)
Lignite	125.9	139.4	127.5	117.6	102.6	(8.9)
Imported Coal	48.7	41.1	20.4	41.0	52.2	(4.5)
Hydro & Imported Elec.	33.4	32.8	25.4	19.0	30.6	(2.6)
Import/Consumption (%)	65.8	60.3	57.1	58.4	62.5	
GDP Growth Rate (%)	5.9	-1.4	-10.2	4.2	4.4	

Unit : 1000 bbl/day crude oil equivalent

As shown in Table 1-1, demand and supply of energy is closely related to a change of economic situation. Total consumption of primary energy in 1998 fell down by 7.3 % compared with previous year, and then it has gradually increased to the level before the economic crisis. A similar trend is found in import of energy. As a result, dependence on imported energy was below 60 % in 1997-1998 but as a recovery from economic recession, it has increased again to 62.5 % in 2000.

Oil, natural gas and coal are the main source of energy. Consumption of oil was more than 60 % of total energy consumption till 1996, but it has decreased every year to 50 % in 2000, of which 95 % was imported. Most of the consumed natural gas is domestic product, of which more than 90 % is produced from offshore gas fields in the Gulf of Thailand. Gas production is increasing every year and reached more than 30 % of total energy consumption.

With regard to coal, domestic production has decreased and imported coal has increased. Total consumption of coal, both domestic and imported, is about 14 % of total energy consumption.

1.2.3 Outlook of Energy Demand and Supply

As mentioned before, energy policy in Thailand is determined in accordance with “The National Economic and Social Development Plan” which is enacted every five years. Present is the final year of the Eighth Plan (1997-2001). Because the Eighth Plan was formulated before the economic crisis, target or forecast of energy related matters has been updated and revised as required. Table 1-2 was prepared by NEPO based on the actual results till 1998. The Ninth Plan (2002-2006) is scheduled to be promulgated in October 2001 and it is believed that there is no big change in basic energy policy.

The outlook in the table is based on “Moderate economic recovery (MER)”, which is one of the three scenarios by Thailand Development Research Institute (TDRI). In this case, GDP growth rate is expected at – 0.2 % in 1999, 3.6 % in 2000 and afterward in a range of 4.5 to 4.8 % until 2011.

Although the total energy demand decreased in the first half of the Eighth Plan period, it is expected that, by subsequent gradual recovery from the economic recession, the demand will increase annually at an average rate of about 5% until 2011. Consequently, an amount of energy demand will be 1.3 times in 2006 and 1.7 times in 2011 compared with that in 2000.

Main source of energy in the future will be still petroleum and its amount will increase.

However, its share in total energy demand has lowered gradually from 56 % in 1996 to 50 % in 2000 and will maintain this level until 2011. Domestic production of natural gas and coal, which are the main alternative source to petroleum, will be insufficient for growing demand. As a result, the import volume of both will increase remarkably and the dependence on foreign source, which lowered down to 57% in 1998, will rise again to 68 % in 2006 and 76 % in 2011.

Table 1-2 Outlook of Demand and Supply of Primary Commercial Energy

	2001	2006	2011	Share (%)		
				2001	2006	2011
Production	520.7	587.1	514.3	100.0	100.0	100.0
Crude Oil	31.4	24.6	19.2	6.0	4.2	3.7
Condensate	51.3	61.0	43.1	9.9	10.4	8.4
Natural Gas	299.2	340.3	315.9	57.5	58.0	61.4
Lignite	121.4	137.2	109.7	23.3	23.4	21.3
Hydro	17.4	23.9	26.5	3.3	4.1	5.2
Import (Export)	772.3	1,043.2	1,481.5	100.0	100.0	100.0
Crude Oil	868.4	998.5	1,038.6	112.4	95.7	70.1
Petroleum Product	(211.5)	(177.2)	20.1	-27.4	-17.0	1.4
Condensate	(43.6)	(53.3)	(35.4)	-5.6	-5.1	-2.4
Natural Gas	116.3	147.2	178.1	15.1	14.1	12.0
Coal	37.8	118.0	244.2	4.9	11.3	16.5
Electricity	4.9	4.9	30.3	0.6	0.5	2.0
Consumption	1,199.0	1,534.1	1,950.3	100.0	100.0	100.0
Crude Oil & Pet. Product	613.1	763.5	964.1	51.1	49.8	49.4
Natural Gas	404.5	486.6	575.6	33.7	31.7	29.5
Coal/Lignite	159.1	255.2	353.9	13.3	16.6	18.1
Hydro & Imported Elec.	22.3	28.8	56.8	1.9	1.9	2.9
Import/Consumption (%)	64.4	68.0	76.0			

Unit : 1000 bbl/day crude oil equivalent

Source : NEPO, May 1999

1.3 Demand and Supply of Coal

The forecast of coal demand and supply in this report is based on the latest available report by NEPO entitled “Estimated Coal Demand in 2001-2011 (in Thai), May 2000”.

1.3.1 Coal Resources in Thailand

Coal resources in Thailand are mostly lignite with minor sub-bituminous of Tertiary in geologic age. As shown in Figure 1-1, the majority of coalfields are situated in the northwestern

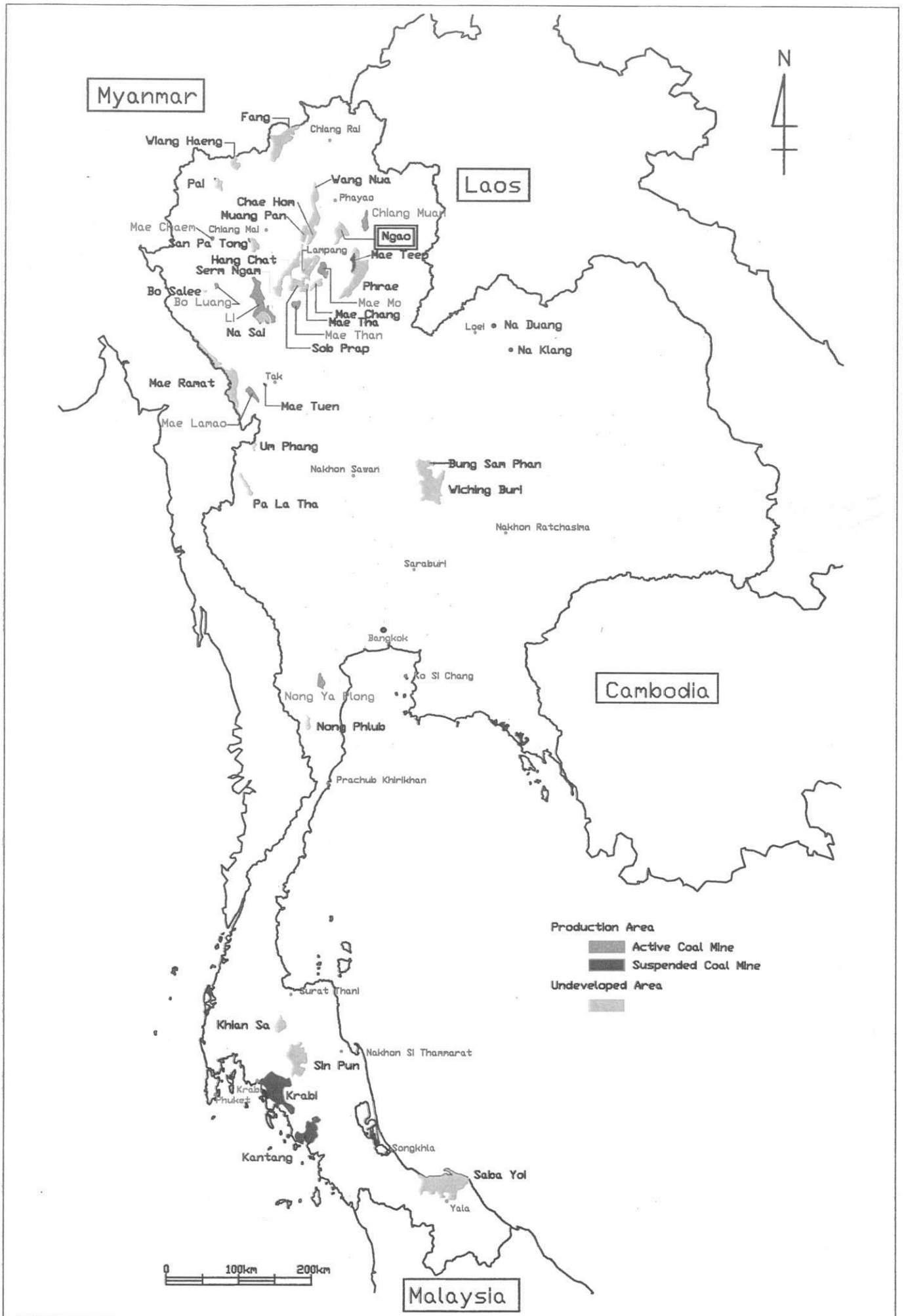


Figure1-1 Coal Basins in Thailand
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part of the country and several of them are in the peninsula. Coal basins have been formed separately in intermontane basins or subsided places with relatively small size.

Coal Exploration and Assessment Project (CEP) has been carried out by DMR since 1987 in more than 70 Tertiary basins. Based on the results of CEP, 27 basins are identified as coal potential areas. Coal resources (in-situ geological reserves) in those potential areas and remaining reserves in 14 developed areas have been estimated by DMR as shown in Table 1-3 and 1-4 respectively.

In the developed areas, total remaining reserves at the end of 2000 have been estimated at 1,372 million tons, of which 1,227 million tons or 90 % are those of EGAT's Mae Moh mine. In undeveloped areas, total reserves of 27 basins have been estimated at 1540 million tons, of which 785 million tons are measured reserves and 755 million tons are indicated reserves.

1.3.2 Domestic Coal Production

(1) Present Situation

Table 1-5 shows the coal production by coal basins. The first coal production in Thailand was 22 thousand tons in 1955 at Mae Moh mine. Since then, production has increased gradually and exceeded one million tons in 1979 and 10 million tons in 1996. Reduction of production in these few years is due to the economic recession and operation control at Mae Moh power plant to reduce SO₂ emission.

At present, fourteen coal mines in nine basins are producing coal with open cut method. Total production is 17-18 million tons, of which 70% is produced at Mae Moh mine and remainder is from private mines leading by Banpu and Lanna Lignite. Coal basins with relatively large production are Mae Moh, Li and Mae Than. All of them are situated in Lampang Province in the northern region of the country.

Table 1-3 Remaining Reserves in Developed Areas

Basin	Province	Reserves		Status
		Produced	Remaining	
Mae Moh	Lampang	178.862	1,226.748	Active
Li	Lamphung	34.315	1.037	Active
Mae Than	Lampang	15.451	20.398	Active
Chiang Muan	Phayao	1.872	N.A.	Active
Na Hong	Chiang Mai	2.487	N.A.	Active
Bo Luang	Chiang Mai	1.378	N.A.	Active
Mae Lamao	Tak	1.053	0.576	Active
Mae Teep	Lampang	0.885	10.115	Suspended
Mae Tun	Tak	0.320	0.900	Suspended
Nong Ya Plong	Phetchaburi	1.091	0.630	Active
Krabi	Krabi	7.961	112.038	Suspended
Kantang	Trang	0.010	N.A.	Suspended
Na Duang	Loei	0.154	N.A.	Suspended
Na Klang	Udon Thani	0.006	N.A.	Suspended
Total		245.836	1,372.048	

Table 1-4 Coal Reserves in Undeveloped Areas

Basin	Province	Reserves		
		Measured	Indicated	Total
Wiang Haeng	Chiang Mai	93.02	34.12	127.14
Fang	Chiang Mai	1.12	NA	1.12
San Pa Tong	Chiang Mai	0.50	NA	0.50
Bo Salee	Chiang Mai	0.43	0.67	
Pai	Mae Hong Son	0.17	0.37	0.54
Chae Hom	Lampang	16.19	41.04	57.23
Hang Chat	Lampang	10.32	28.26	38.58
Mae Tha	Lampang	22.49	55.07	77.56
Ngao	Lampang	48.40	50.70	99.10
Serm Ngam	Lampang	6.19	13.21	19.40
Wang Nua	Lampang	9.01	21.16	30.17
Mae Chang	Lampang	2.01	5.01	7.02
Chiang Muan	Phayao	25.28	17.98	43.26
Na Sai	Lamphun	1.31	5.27	6.58
Phrae	Phrae	1.61	0.40	2.01
Mae Lamao	Tak	15.58	46.37	61.95
Mae Ramat	Tak	37.54	72.17	109.71
Phob Phra	Tak	2.33	7.04	9.37
Umphang	Tak	8.05	19.24	27.29
Buang Sam Phun	Phetchabun	6.85	0.00	6.85
Wichian Buri	Phetchabun	1.65	2.62	4.27
Nong Ya Plong	Phetchaburi	4.45	12.26	16.71
Nong Phlab	Prachuab Khirikan	10.52	2.79	746.36
Sin Pun	Nakhon Si Tham.	91.06	16.42	107.48
Khian Sa	Surat Thani	15.41	40.02	55.43
Saba Yoi	Songkhla	349.86	254.89	604.75
Kantang	Trang	3.42	10.26	13.68
Total		784.77	755.10	1,539.87

Unit : Million tonnes

Source : DMR Annual Report, 2000

Table 1-5 Coal Production by Basin

Basin	Province	1996	1997	1998	1999	2000
Mae Chaem	Chiang Mai	143	290	214	210	98
Bo Luang	Chiang Mai	170	237	210	199	108
Chiang Muan	Phayao	183	469	453	583	187
Mae Moh	Lampang	16,262	16,489	14,419	12,026	13,622
Mae Than	Lampang	1,763	2,047	2,009	2,539	1,632
Mae Teep	Lampang	0	31	0	0	6
Li	Lamphun	2,940	2,600	2,472	2,260	1,845
Nong Ya Plong	Petchaburi	23	85	160	167	93
Mae Lamao	Tak	75	56	97	94	83
Krabi	Krabi	0	0	0	0	40
Total		21,562	22,134	20,157	18,218	17,714

Unit : 1000 tonnes

Source : DMR

(2) Outlook of Coal Production

As seen in Table 1-3, majority of the remaining reserves in the developed areas exist in the properties held by EGAT; namely, 89% is in Mae Moh and 8% is in Krabi. Therefore, only a few percent or 33 million tons is the remaining reserves in the areas developed by private companies. When compared simply this amount with annual production scale of private mines (approximately 5 million tons), the reserves will be exhausted within 6 – 7 years. Actually, it is believed that most of the existing private mines will be closed by 2007.

At present, there is no definite plan to open a new coal mine in a specific area. However, there is possibility to facilitate new coal mine development, because coal price of domestic lignite has become cheaper compared with imported coal in the value of Thai baht since introduction of floating exchange rate system in 1997. Besides, DMR intends to open some selected areas for bidding this year, which have been explored and held by DMR for special purposes under the Mineral Act.

The report by NEPO forecasts that, based on the coal reserves in undeveloped areas

estimated by DMR, coal production from new potential areas will commence in 2002 and production will increase to 4 million tons in 2006 and 6 million tons in and after 2008. Outlook of domestic coal production based on the above assumption is shown in Table 1-6.

Table 1-6 Outlook of Coal Production

Mines	1999	2000	2001	2006	2011
Mae Moh	12.03	13.62	13.21	15.00	14.77
Private Mines	6.19	4.09	6.77	3.37	0.61
New Potential	0.00	0.00	0.00	4.05	6.04
Total	18.22	17.71	19.98	22.42	21.42

Unit : million tonnes
Source : NEPO, May 2000

According to this table, production from Mae Moh mine will be in a range of 13 to 15 million tons after 2001, while production from private mines will be in a narrow range, because decrease in production from existing mines and production from new area will offset each other. As a result, the total production is forecasted to be slightly less than 20 million tons until 2004 and 20-21 million tons after 2005. NEPO has also examined an alternative case without production from new area, but description of this report is based on the former case, expecting 6 million tons of production from new potential areas.

1.3.3 Coal Demand

(1) Present Situation

Table 1-7 shows coal consumption by use. Two main coal consumers in Thailand are power generation and cement industry; namely, about 70% of total consumption is used in the former and about 20% is used in the latter. Remainder is used in other small industries, such as paper/pulp, tobacco curing, fiber, food, lime, etc.

Table 1-7 Coal Consumption by Use

	1998	1999	2000	Share (%)		
				1998	1999	2000
Electricity	16,090	15,440	15,850	71.9	69.4	68.9
EGAT	15,390	13,890	14,120	68.8	62.4	61.4
SPP	700	1,550	1,730	3.1	7.0	7.5
Industry	6,280	6,810	7,150	28.1	30.6	31.1
Cement	4,420	4,720	5,130	19.8	21.2	22.3
Others	1,860	2,090	2,020	8.3	9.4	8.8
Total	22,370	22,250	23,000	100.0	100.0	100.0

Unit : 1000 tonnes

Source : NEPO. Mav 2000. etc.

Table 1-8 shows power generation by energy source used in EGAT. Natural gas is the largest energy source in power generation with 50% share of total GWH, then coal and petroleum fuel follow next. EGAT uses only domestic coal as a fuel for coal fired power plant and “others” in the table mean the purchase of electricity from Laos and SPP (Small Power Producer). Coal fired power generation by IPP (Independent Power Producer) is behind schedule due to low demand of electricity by economic recession.

Table 1-8 Power Generation by Energy Source

	1998	1999	2000	Share (%)		
				1998	1999	2000
Hydro	5,088	3,410	5,981	5.6	3.7	6.0
Coal/Lignite	16,475	15,419	15,852	18.1	16.7	16.1
Fuel Oil	17,534	15,429	9,611	19.2	16.7	9.8
Diesel	989	457	108	1.1	0.5	0.1
Natural Gas	46,238	47,111	53,855	50.7	50.9	54.6
Others	4,836	10,646	13,151	5.3	11.5	13.5
Total	91,160	92,472	98,469	100.0	100.0	100.0

Unit : GWH

Source : NEPO

Because coal is mostly used as a fuel for cement manufacturing in Thailand, coal demand in cement industry is closely related to cement production. Although cement production increased

at an annual growth rate of more than 10% until 1996, it turned to decrease after economic crisis, particularly in 1998. As the economic recession is being recovered, cement demand is also increasing and about 5 million tons of coal was used in cement industry in 2000.

(2) Outlook of Coal Demand

Power Generation

Outlook of electricity demand has revised downward taking recent economic situation into account. Table 1-9 shows the outlook of coal consumption for power generation made in May, 2000. According to this table, Mae Moh power plant will consume 13-15 million tons of domestic coal annually until 2011. IPP project by imported coal is behind schedule and expected to start operation in 2003 in this report. Coal demand for IPP will increase from initial 3 million tons to 5.3 million tons in 2006 and 11.6 million tons in 2011. Coal consumption by SPP will be constant at 2.15 million tons per year after 2000. To sum up the above, coal demand for power generation will be 1.4 times in 2006 and 1.8 times in 2011 compared with that in 2000.

Table 1-9 Outlook of Coal Demand for Power Generation

	1999	2000	2001	2006	2011
EGAT	13.89	14.12	13.21	15.00	14.77
IPP	0.00	0.00	0.00	5.28	11.55
SPP	1.55	1.73	2.15	2.15	2.15
Total	15.44	15.85	15.36	22.43	28.47

Unit : million tonnes

Source : NEPO, May 2000

Cement Industry

Table 1-10 shows the outlook of cement production and corresponding coal demand. Domestic demand for cement is forecasted to increase on the assumption that annual growth rate of GDP will be about 4.5% after 2000. Because the production capacity of cement factories

exceeds the domestic demand, 9.5 million tons of clinker cement is expected to be exported after 2000. Based on the above assumptions, coal demand for cement industry is forecasted to increase from 5.1 million tons in 2000 to 6.9 million tons in 2006 and 8 million tons in 2011.

Other Industries

Constant volume of 80 thousand tons of coal is allocated to tobacco curing and coal demand for other industrial boilers is forecasted to be 2,13 million tons in 2001 and 3% increase annually afterward.

Table 1-10 Outlook of Coal Demand for Cement Industry

	2000	2001	2006	2011
CEMENT- Production	32.47	33.73	41.47	51.17
- Consumption	22.97	24.23	31.97	41.67
- Export	9.50	9.50	9.50	9.50
COAL - Demand	5.13	5.79	6.92	7.99

Unit : million tonnes

Source : NEPO, May 2000

1.3.4 Coal Import

(1) Present Situation

Coal has been imported in the past at a level of several hundred thousand tons per year. Imported amount has increased steadily since 1993 and 3.8 million tons was recorded in 1996. After decreasing once due to economic recession, it turned to rise again to 4 million tons in 2000. The main consumer of imported coal is cement industry, which uses it for improving heating value of feed coal. Remainder is used in SPP power plant and in small industrial boilers.

Table 1-11 shows coal import by export countries. Although more than 90% was imported from

Indonesia till a few years ago, its share has decreased recently to 64% in 2000. On the other hand, import from neighboring countries, such as Vietnam, Laos and Myanmar, is increasing, indicating diversification of source.

(2) Outlook of Coal Import

As mentioned in previous section, domestic coal production will not increase significantly in the future, even if the coal resources of new potential areas will be developed. Because the coal demand is forecasted to increase at a high growth rate on the other hand, a considerable amount of imported coal will be required to meet growing demand.

Table 1-11 Coal Import by Origin

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Australia	84	299	68	0	0	0	0	0	136
China	74	164	165	167	172	39	55	127	68
Vietnam	2	24	11	16	56	8	67	470	705
Indonesia	304	372	1,117	2,123	3,523	3,070	1,320	2,273	2,629
Laos	0	0	0	14	44	80	54	174	147
Myanmar	0	24	54	0	0	0	0	66	411
Others	6	81	2	2	47	3	49	32	2
Total	470	964	1,417	2,322	3,842	3,200	1,545	3,142	4,098

Unit : 1000 tonnes

Coal : includes anthracite, bituminous, lignite & other coal, excluding coke & briquette

Source : Customs Department

Imported coal will be used for power generation by IPP and SPP in major part and also consumed in other industries, mainly in cement manufacture. Imported amount will sharply increase to 7.4 million tons in 2003 when coal fired power generation by IPP will start. As continually increasing afterward, coal import is forecasted to reach 9.5 million tons in 2006 and 17.8 million tons in 2011.

Recently, leading mining companies of Thailand, Banpu and Lanna Lignite, have participated in coal mining business in Indonesia. Two mines have already started operation and some of produced coal were imported to Thailand.

1.3.5 Summary of Coal Demand and Supply

Table 1-12 summarized coal demand and supply in Thailand.

Table 1-12 Summary of Coal Demand and Supply

	1999	2000	2001	2006	2011
DEMAND					
<u>Electricity</u>	15.44	15.85	15.36	22.43	28.46
EGAT	13.89	14.12	13.21	15.00	14.77
IPP	0.00	0.00	0.00	5.28	11.55
SPP	1.55	1.73	2.15	2.15	2.15
<u>Industry</u>	6.81	7.15	8.00	9.47	10.94
Cement	4.72	5.13	5.78	6.92	7.99
Others	2.09	2.02	2.21	2.55	2.95
TOTAL DEMAND	22.25	23.00	23.36	31.90	39.40
SUPPLY					
<u>Domestic</u>	18.26	17.79	19.98	22.42	21.42
for Electricity	13.89	14.12	13.21	15.00	14.77
for Industry	4.37	3.67	6.77	7.42	6.65
<u>Import</u>	3.28	4.10	3.38	9.48	17.79
for Electricity	1.55	1.73	2.15	7.43	13.70
for Industry	1.73	2.37	1.23	2.05	4.29
TOTAL SUPPLY	21.54	21.89	23.36	31.90	39.40

Unit : million tonnes

Source : Forecast – NEPO. Mav 2000. Actual – Estimate from Info. of NEPO. DMR & Others.

The characteristic points are as follows.

- (1) Most of the existing coal mines, except Mae Moh mine, will be closed by 2007 due to

exhaustion of remaining reserves. Even if some new coal mines will be developed in place of them, production will be similar to the present level. Consequently, total production of domestic coal, including Mae Moh, will maintain a level of 20 to 22 million tons in the future.

- (2) Main uses of coal are power generation and cement manufacture. Regarding power generation, Mae Moh power station will use the similar amount of domestic coal to the present in the future. In order to satisfy the growing demand of electricity in the future, IPP by imported coal is planned to operate around 2003 and total coal demand for power generation will be 28 million tons in 2011. Coal demand for cement industry will also increase as the growth of GDP in the future and will be 8 million tons in 2011, compared with 5 million tons in 2000.
- (3) As a result, total coal demand including for power generation, cement manufacture and other industries is forecasted to increase from 23 million tons in 2000 to 32 million tons in 2006 and 39 million tons or 1.7 times of present level in 2011.
- (4) Since coal demand will grow at a high rate and domestic production will keep the similar level to the present, imported coal will increase remarkably in the future. Imported coal is forecasted to be 9.5 million tons in 2006 and 17.8 million tons in 2011, compared with 4 million tons in 2000. Main uses of imported coal are power generation by IPP and cement manufacture and high heating value of 6,000 kcal/kg or more will be desired for both uses.

1.3.6 Others

(1) Transportation of Coal

Figure 1-2 shows the representative transportation routes of coal for main consumers' sites.

Almost all domestic coal is transported by truck with 13 tons in capacity. The distance from coal producing area in northern region to the cement factories in Saraburi is 500 to 600 km. Transportation charge is about 1 Bahts/t·km in general but in the case of cement plant, it

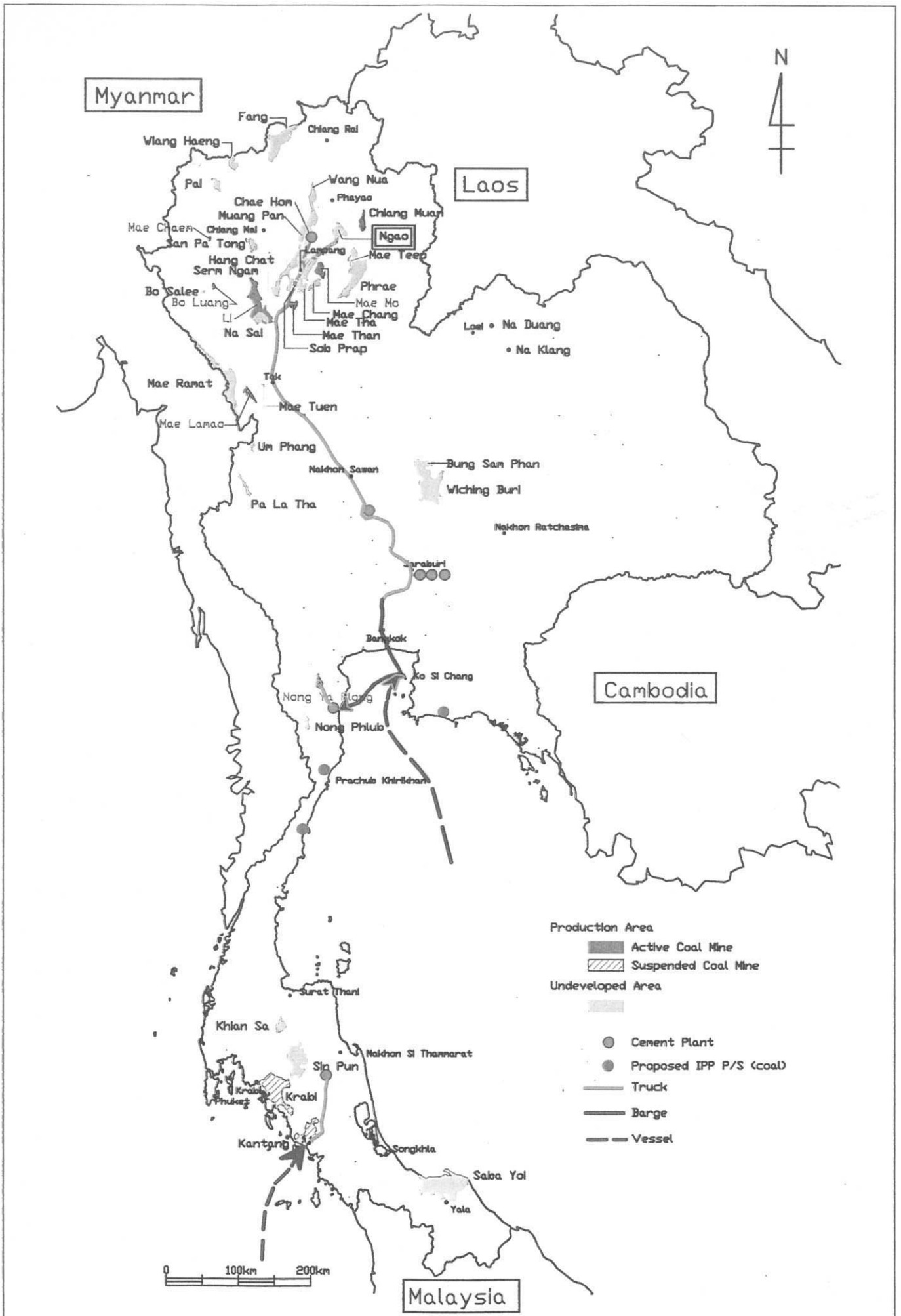


Figure 1-2 Representative Transportation Routes of Coal

becomes cheaper, about 0.65 Bahts/t·km, by carrying other commodities on one way. In Thailand, consumers purchase coal at mine site and transport it by themselves to the consumption sites.

At present, there is no port in Thailand with unloading facilities for coal. Therefore, imported coal is transported to consumers' sites by a combination of ship – barge – truck. In the case for Saraburi, coal is transferred from a ship to a barge near Ko Si Chang and go up the Chao Phraya River to the transfer point at Ban Pa-in and then to the cement plants by truck. Transportation charge between Ko Si Chang and Saraburi is 150 – 200 Bahts. In other cases, coal is unloaded at the east of Bangkok or southern part of the peninsula depending on the place of consumers.

(2) Coal Price

Table 1-13 shows the average coal price in the value of Thai Baht. Basis of the price are FOR at mine site for domestic lignite and CIF at an unloading point from a ship for imported coal.

Table 1-13 Comparison of Coal Price

	1996	1997	1998	1999	2000	(2001)
DOMESTIC	460	472	466	473	NA	NA
IMPORT	942	1,080	1,085	1,139	1,151	(1,273)

(2001) : Average of Jan. – Mar.

Unit : Baht/t, Imported Coal – CIF, Domestic Lignite – ex mine

Source : Customs Department, NEPO

There is no big change in domestic coal price for these several years, while the price of imported coal shows a rising trend. Although coal price in terms of US dollars in the international market has fallen every year, it seems that a low exchange rate of Thai baht since 1977 has affected more on the price in terms of baht. Because the international market price this year seems to recover from the bottom price in 2000, the imported coal price in Thailand is

expected to rise further after this year. Actually, an average price of imported coal from January to March this year was 1,273 bahts or 10% higher than that in 2000.