

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

S U M M A R Y

JANUARY 2002

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

JAPAN

MPN
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January 2002

PREFACE

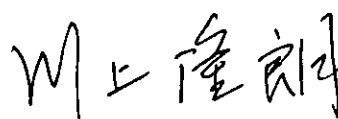
In response to the request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct “the Feasibility Study (Phase I) on Comprehensive Development of the Ngao Coal Basin in the Kingdom of Thailand”. The study was implemented by the Japan International Cooperation Agency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

CONTENTS

	Page
I . INTRODUCTION	1
1. Objectives	1
2. Study Site	2
3. Members of Study Team and Counterpart Team	2
4. Performed Procedures of the Study	5
II . RESULT OF THE STUDY	6
1. Situation of Energy and Coal in Thailand	6
1.1 Public Agencies related to Energy Issues	6
1.2 Demand and Supply of Primary Energy	6
1.3 Demand and Supply of Coal	9
2. Geological Investigation	24
2.1 Previous Exploration Works	24
2.2 Method of Geological Investigation	25
2.3 Regional Geology	33
2.4 Coal Beds in Ngao Basin	36
2.5 Coal Resources and Reserves	45
3. Coal Quality	57
3.1 Tests on Bulk Sample	57
3.2 Coal Analysis and Tests on Drill Core Samples	58
3.3 Coal Quality	59
4. Tests for Coal Preparation and Upgrading	75
4.1 Test for Coal Preparation	75

4.2 Upgrading Test by Drying Method	77
4.3 Upgrading Test by Low Temperature Dry Distillation Process	82
4.4 Upgrading Test by Low-Temperature Liquid Phase Cracking Process	87
4.5 Overall Examination and Evaluation	90
5. Conceptual Planning of Mine Development	93
5.1 Mining Area	93
5.2 Production and Depth of Final Floor	97
5.3 Rock Strength	97
5.4 Water Control and Dewatering Plan	98
5.5 Operational Criteria	99
5.6 Coal Production Cost	100
5.7 Quality and Use of Products	102
6. Environmental Surveys	104
6.1 National Policy for Mining Industry and Environment Preservation	104
6.2 Present Condition of Amphoe Ngao(Ngao city)	107
6.3 Present Condition around the Proposed Mining Area	108
7. Conclusion	119
7.1 Feasibility for Development in Ngao Coal Basin	119
7.2 Remained Works	121
7.3 Conclusion and Recommendation	122

III. TECHNOLOGY TRANSFER	123
1. Training during the Study in Thailand	123
2. Counterpart Training	123
2.1 Members and Teams	123
2.2 Contents	124

APPENDIX

- Photograph : Ph 1 ~12

List of Table

	Page
Table 1-1	Demand and Supply of Primary Commercial Energy 8
Table 1-2	Outlook of Demand and Supply of Primary Commercial Energy 9
Table 1-3	Remaining Reserves in Developed Area 13
Table 1-4	Coal Reserves in Undeveloped Area 13
Table 1-5	Coal Production by Basin 14
Table 1-6	Outlook of Coal Production 15
Table 1-7	Coal Consumption by Use 15
Table 1-8	Outlook of Coal Demand for Power Generation 16
Table 1-9	Outlook of Coal Demand for Cement Industry 16
Table 1-10	Coal Import by Origin 17
Table 1-11	Summary of Coal Demand and Supply 18
Table 1-12	Comparison of Coal Price 23
Table 2-1	Previous Exploration Works 24
Table 2-2	Characteristics of Generalized Types of Peat-forming Environments .. 39
Table 2-3	UN International Framework Classification for Reserves/Resources .. 45
Table 2-4	Coal resources 47
Table 2-5	Coal Reserves for Mining 53
Table 3-1	Previous data on Coal Quality 61
Table 3-2	Coal Analysis Results 63
Table 3-3	Proximate analysis of Zone I and Zone II 71
Table 4-1	Form of Sulfur of the Solid Product 85
Table 4-2	Material Balance and Product Quality 86
Table 4-3	Result of Form of Sulfur 90
Table 5-1	Key figures of Area A, B and C 93
Table 5-2	Quality of Raw Coal and Products 103

List of Figure

	Page
Figure 2-1	Location of NGAO Coal Basin 3
Figure 1-1	Coal Basins in Thailand 11
Figure 1-2	Representative Transportation Routes of Coal 21
Figure 2-1	Location of Drilling and Trenching 27
Figure 2-2	Sections of Preliminary Boreholes and Trench 29
Figure 2-3	Sections of Exploration Boreholes 31
Figure 2-4	Geological Map 34
Figure 2-5	Stratigraphic Section 35
Figure 2-6	Structure Contour Map (Roof of Zone I) 37
Figure 2-7	Correlation Chart 41
Figure 2-8	Structure Contour Map (Bottom of Zone I) 43
Figure 2-9	Geological Cross Sections 44
Figure 2-10	Calculation Map of Coal Resources 49
Figure 2-11	Iso-thickness Contour Map on Mining Section 51
Figure 2-12	Iso-thickness Contour Map on Accumulated Coal Thickness 52
Figure 2-13	Calculation Map on Coal Reserves for Mining 55
Figure 3-1	Iso-value Contour Map on Ash Content (dry) 65
Figure 3-2	Iso-value Contour Map on Heating Value (dry) 67
Figure 3-3	Iso-value Contour Map on Total Sulfur Content (dry) 69
Figure 3-4	Calorific Value vs Ash Relationship 72
Figure 4-1	Christopher Diagram 75
Figure 4-2	Comparison of Hold Temperature 79
Figure 4-3	Comparison of Heating Rate 79
Figure 4-4	Drying Test Apparatus 81
Figure 4-5	Burning Profile (Thermogravimetric Analysis) 83
Figure 4-6	Dry Distillation Apparatus 83

Figure 4-7	Autoclave Apparatus	88
Figure 5-1	Mining candidate areas	95
Figure 6-1	Drainage System in the Ngao Basin.....	111
Figure 6-2	Drainage System in the Ban Haeng District	113
Figure 6-3	Watershed Classification	115
Figure 6-4	Forest Preservation	117

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 followings.

- (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

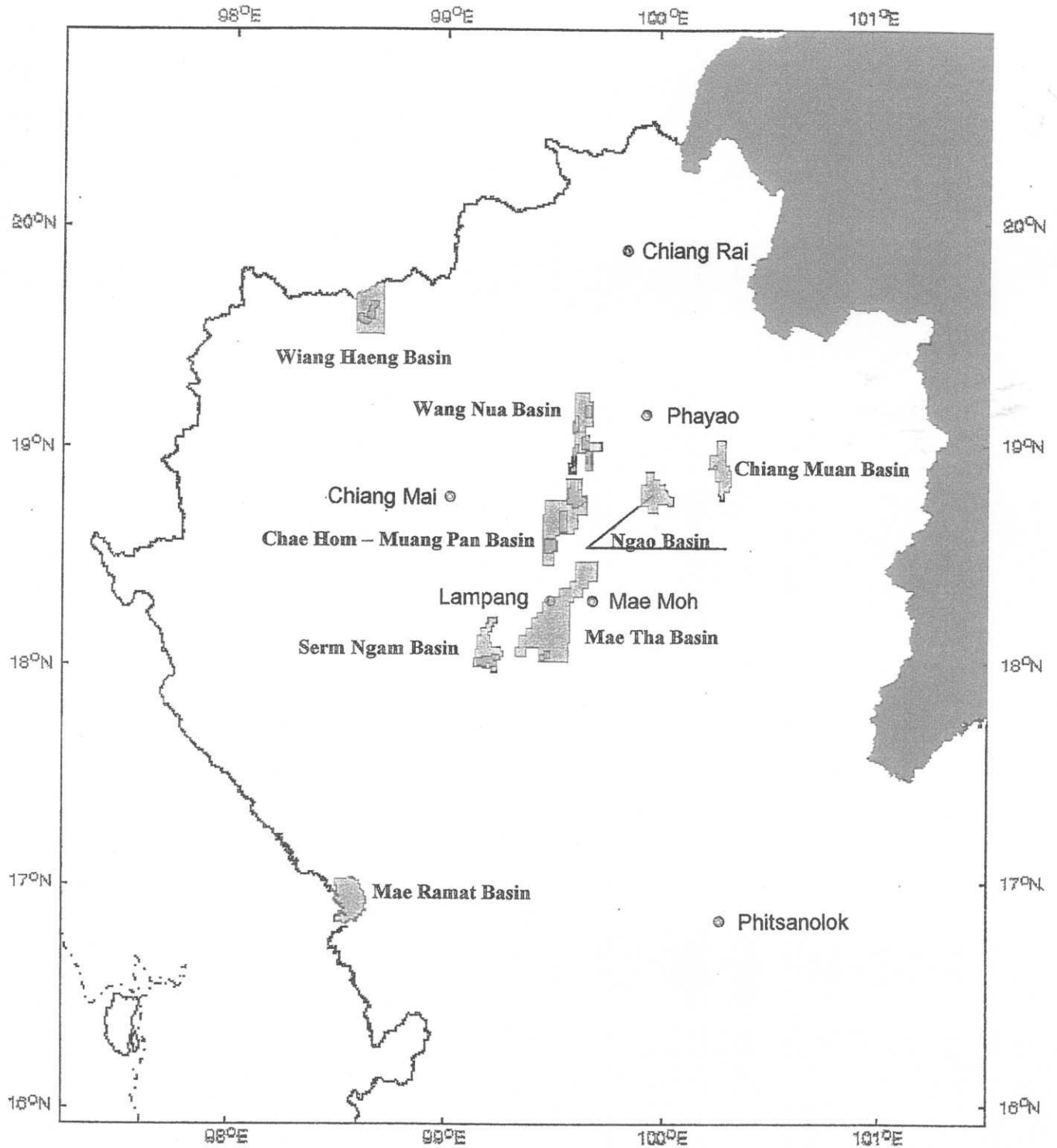
The Study Site is in a part of NGAO Coal Basin where is located 80 km northeast of LAMPANG city, which is the main city in the northern territory of Thailand. The coal basin covers about 200 k m², but the Study Site is limited to 63 k m² in area supposed to be prospective. The location of NGAO Coal Basin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

The Study in Thailand was conducted four times during August 21, 2000 to November 17, 2001.

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 following three ministers of the Government of Thailand.

(1) Office of the Prime Minister

National Energy Policy Office (NEPO) is responsible mainly for formulation of policy, management and development of plans and measures related to energy. Electricity Generating Authority of Thailand (EGAT) is a state enterprise under the Office.

(2) Ministry of Industry

Department of Mineral Resources (DMR) is the counterpart agency for the present study and responsible for exploration and assessment of underground resources, management of prospecting and mining license, mining technology, etc.

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

Department of Energy Development and Promotion (DEDP) is 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". The target and strategies for energy development during the Eighth Plan (1997-2001), particularly in relation to coal, are indicated as follows.

(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 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 of additional coal resources for future use.
- Improve and rules and regulation to enable a more efficient development of coal resources.
- Immediate consideration should be given to concession granting to the private sector.
- Application of modern technology for coal utilization, so as to cause minimal environmental impacts.
- Speed up energy procurement from foreign sources including coal to ensure sufficient supply to satisfy the domestic demand.
- Encourage Thai energy companies to enter into joint development of energy abroad.

1.2.2 Present Situation of Energy Demand and Supply

As shown in Table 1-1, 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. The dependence on imported energy was below 60 % in 1998-1999, but as a recovery from economic recession, it has increased again to 62.5 % in 2000. Consumption of oil was more than 60 % of total energy till 1996, but it has decreased every year to 50 % in 2000. Gas production is

increasing every year and reached more than 30 % of total energy consumption in 2000. Total consumption of coal, both domestic and imported, is about 14 % of total energy.

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

1.2.3 Outlook of Energy Demand and Supply

The outlook in Table 1-2 is based on the assumption that GDP growth rate will be in a range of 4.5 to 4.8 % until 2011. The total energy demand is expected to 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.

Consumption of oil will increase further in the future, but its share in total energy demand will maintain the present level of 50% until 2011. Because domestic production of natural gas and coal will be insufficient for growing demand, the import volume of both will increase remarkably. 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

1.3.1 Coal Resources in Thailand

Coal resources in Thailand are mostly lignite of Tertiary in geologic age and the majority of coalfields are situated in the northwestern part of the country as shown in Figure 1-1. Coal reserves have been estimated by DMR based on the results of coal exploration since 1987 for both developed and undeveloped areas as shown in Table 1-3 and 1-4 respectively.

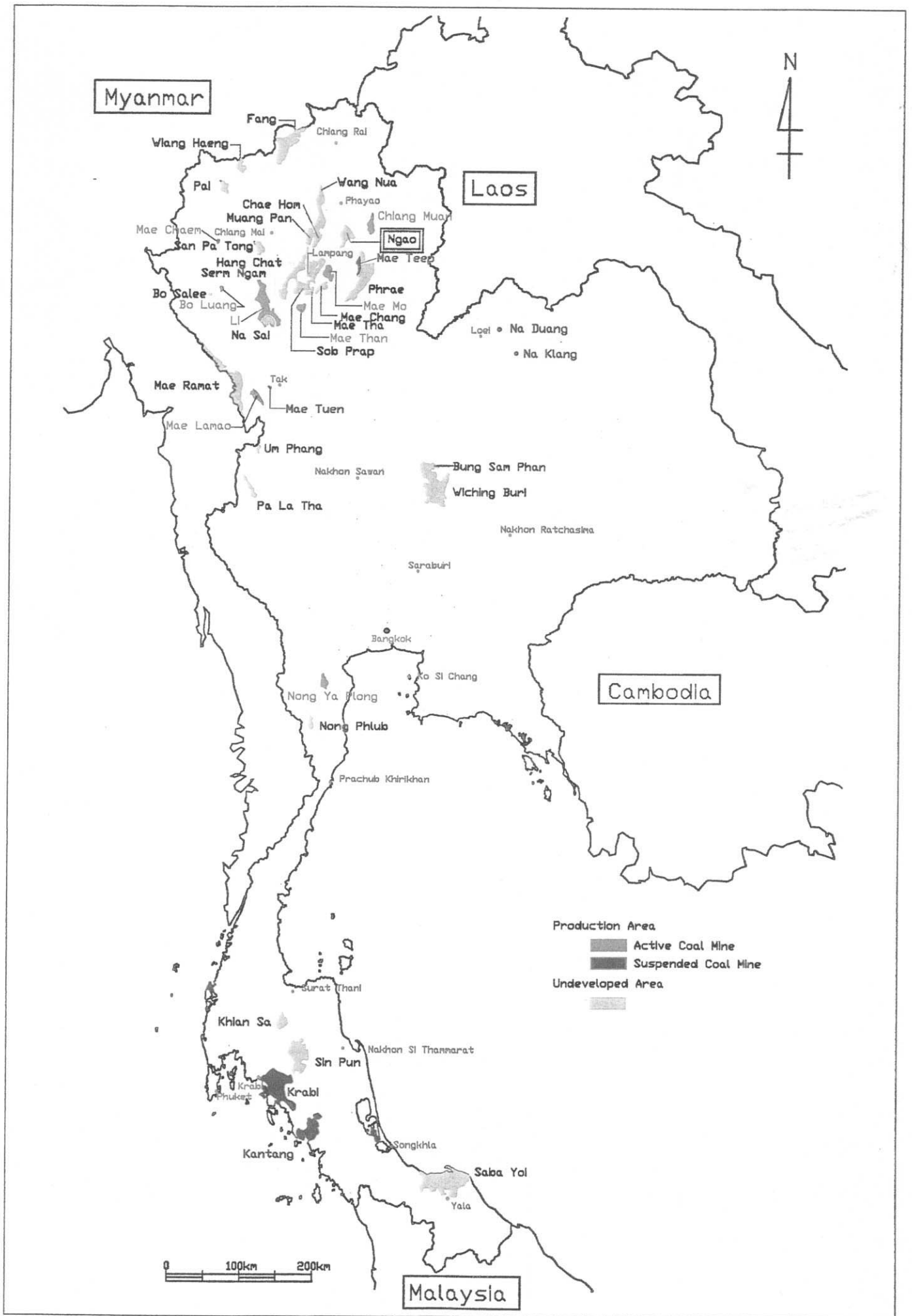


Figure1 - 1 Coal Basins in Thailand

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

1.3.2 Domestic Coal Production

(1) Present Situation

At present, total annual production is 17-18 million tons, of which 70% is produced at Mae Moh mine. Table 1-5 shows the coal production by coal basins.

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 33 million tons is the remaining reserves in the areas developed by private companies. 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. 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

1.3.3 Coal Demand

(1) Present Situation

Table 1-7 shows coal consumption by use. About 70% of total consumption is used for power generation and about 20% is used in cement industry. 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 : NFPO, May 2000, etc.

(2) Outlook of Coal Demand

Power Generation

Table 1-8 shows the outlook of coal consumption for power generation. Mae Moh power plant will consume 13-15 million tons of domestic coal annually until 2011. Coal demand for IPP will increase from initial 3 million tons in 2003 to 11.6 million tons in 2011. Total coal demand for power generation will be 1.4 times in 2006 and 1.8 times in 2011.

Table 1-8 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

Cement Industry

Domestic demand for cement products is forecasted to increase on the assumption that annual growth rate of GDP will be about 4.5% after 2000. Table 1-9 shows the outlook of cement production and corresponding coal demand.

Table 1-9 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	5.56	5.79	6.92	7.99

Unit : million tonnes

Source : NEPO, May 2000

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.

1.3.4 Coal Import

(1) Present Situation

After decreasing once due to economic recession, coal import turned to rise again to 4 million tons in 2000. The main consumer of imported coal is cement industry and remainder is used in SPP power plant and in small industrial boilers. Table 1-10 shows coal import by export countries.

Table 1-10 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

(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. 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.

1.3.5 Summary of Coal Demand and Supply

Table 1-11 summarizes coal demand and supply in Thailand.

Table 1–11 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, May 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. Coal demand for power generation will increase sharply in 2003 with the start of IPP and reach 28 million tons in 2011. Coal demand for cement industry will also increase with the growth of GDP in the future and will be 8 million tons in 2011.
- (3) As a result, total coal demand in Thailand is forecasted to increase to 32 million tons in 2006 and 39 million tons or 1.7 times of present level in 2011.
- (4) To meet the growing coal demand, 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.

1.3.6 Others

(1) Transportation of Coal

Figure 1-2 shows the representative transportation routes of coal for main consumers' sites. Domestic coal is transported by truck. The distance from coal producing area in the northern region to the cement factories in Saraburi is 500 to 600 km and transportation charge is about 0.65 Bahts/t·km.

At present, there is no port in Thailand with unloading facilities for coal. Therefore, imported coal is transported by a combination of ship – barge – truck. The main transfer point to barge is near Ko Si Chang. In other cases, coal is unloaded at the east of Bangkok or southern part of the peninsula depending on the place of consumers.

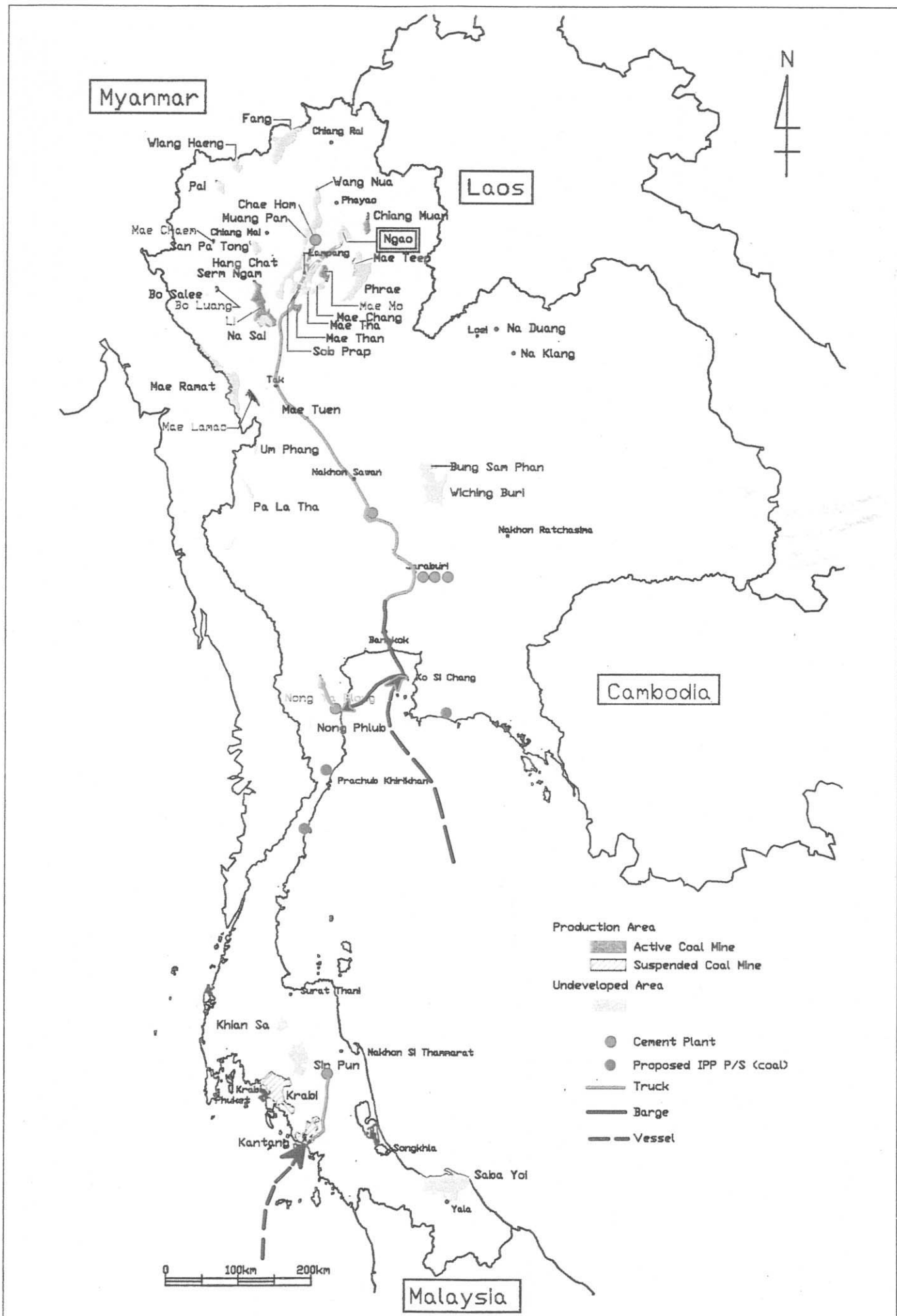


Figure 1-2 Representative Transportation Routes of Coal

(2) Coal Price

Table 1-12 shows the average coal price in the value of Thai Baht.

Table 1-12 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

There is no big change in domestic coal price for these several years, while the price of imported coal shows a rising trend due to a low exchange rate of Thai baht since 1997. Because the international market price this year has recovered from the bottom price in 2000, the imported coal price in Thailand is expected to rise further after this year.