No.

Summary of Final Report

The Master Plan Study on Pollution Risk Mitigation Program for Sustainable Coal Development in East Kalimantan Province in the Republic of Indonesia

February 2007

Japan International Cooperation Agency
Economic Development Department

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Content

The outline of the study

1. Background of the study

The Republic of Indonesia is the world's leading producer of coal and is rapidly increasing production in line with present energy demand. Production in 2005 reached about 150 million tons, an increase of some 1.7 times within the recent five-year period. The majority comes from coal mines in Kalimantan and in particular East Kalimantan, which accounts for more than half the coal production and coal export from Indonesia.

Given this situation, the environmental impacts associated with the rapid increase in activity of coal mines have been a common concern. As many coal mines are located along the Mahakam river in central East Kalimantan, these concerns include the inflow and discharge of non-marketable fine coal from coal washeries to the river leading to detrimental impacts on living conditions and the total reliance of the approximately one million inhabitants in the river basin on this economic activity in recent years.

A pollution risk mitigation program for sustainable coal mine development is therefore required in Indonesia and a program based on environmental pollution control measures is viewed as an immediate priority within the Ministry of Energy and Mineral Resources of the Indonesian Government.

Within this context, a study was initially proposed in 2004 by the Indonesian Government and agreed with Mineral Research & Development of the Ministry of Energy and Mineral Resources. This was followed by a preliminary review in July 2005.

2. Purpose of this study

This study aims to carry out an assessment of effective countermeasures to mitigate environmental impacts associated with coal mine production, especially in view of the importance of coal development and its contribution to the Indonesian economy and its position as a major energy resource. A further aim is to design a master plan based on a pollution risk mitigation program relating to implementation of environmental monitoring and effective utilization of non-marketable fine coal.

The primary factors, which are aimed at contributing to economic development in Indonesia while keeping in mind “Sustainable development” and “Building of a self-sustainable technology transfer”, include:

①Preparing a plan to mitigate pollution risk caused by the coal mining industry.

②Proposing management measures to mitigate against environmental deterioration, focusing on an environmental monitoring plan.

③Preparing a plan of effective utilization of low quality coal such as nonmarketable fine coal.
④Supporting capacity development of those people involved in the study.

The survey content included in the JICA service assignment is as follows:
① Review and collection of existing data and information
② Survey of present status of coal wash process, wastewater treatment and environmental monitoring
③ Survey of non-marketable fine coal utilization technology, non-marketable fine coal-based power generation system and socio-environmental issues
④ Master Plan preparation

3. Area of the Study

The area covered by the field survey extends over a coal producing area in East Kalimantan in Indonesia, and specifically includes Samarinda City and the Central and East Kutai Prefectures. **Figure 1** and **Figure 2** show surveyed area..

Figure 1. The Republic of Indonesia and main area of the study

Figure 2. Samarinda City and Mahakam River

4. Scope of the Study

The content of the study, time schedule, and so on was in accordance with the Scope of Work agreed and signed in December 2005.

5. Counterparts of the Study

The chief of the counterparts is nominated as tekMIRA, Mineral and Coal Technology Research Center, the Ministry of Energy and Mineral Resources, assisted by the State Government of East Kalimantan. In order to carry out the study in an efficient manner, it was proposed that a Steering Committee and Advisory Board be organized as part of the support to be provided by the Indonesian Government.

(1) Steering Committee

Base	Jakarta
Chair	Head of ARDEMR
Committee Member	Directorate General Mineral Coal & Geothermal Directorate Electricity & Energy Utility Head of Mineral and Coal Technology Research Center (tekMIRA)
Meeting Date	1st Meeting: Time of Inception Report Presentation and Discussion 2nd Meeting: Time of 1st workshop in Samarinda 3rd Meeting: Time of 2nd Workshop in Jakarta
Purpose and Duty	Periodic progress reporting and discussion Provision of feedback to the Central Government for policy-making, coal development and environmental protection plan

(2) Advisory Board

Base	Samarinda
Chair	Head of Dinas Pertambangan, East Kalimantan State
Committee Member	BAPEDALDA, East Kalimantan State Bureau of Construction, etc. of East Kalimantan State Mulawarman University Coal Mine companies around Mahakam River PLN in East Kalimantan State Representatives from industries Representative of NGOs
Meeting Date	1st Meeting: Time of the Inception Report Presentation and Discussion 2nd Meeting and after: Meetings arranged on as required basis. One such occasion is the time of 1st workshop in Samarinda
Purpose and Duty	Periodic progress reporting and discussion Hearing and understanding of local voices on local situation, direction, problems, and capabilities

6. Team Members and Task Assignments

Six professionals are nominated for the Study. The names of the personnel and relevant task assignments are shown below.

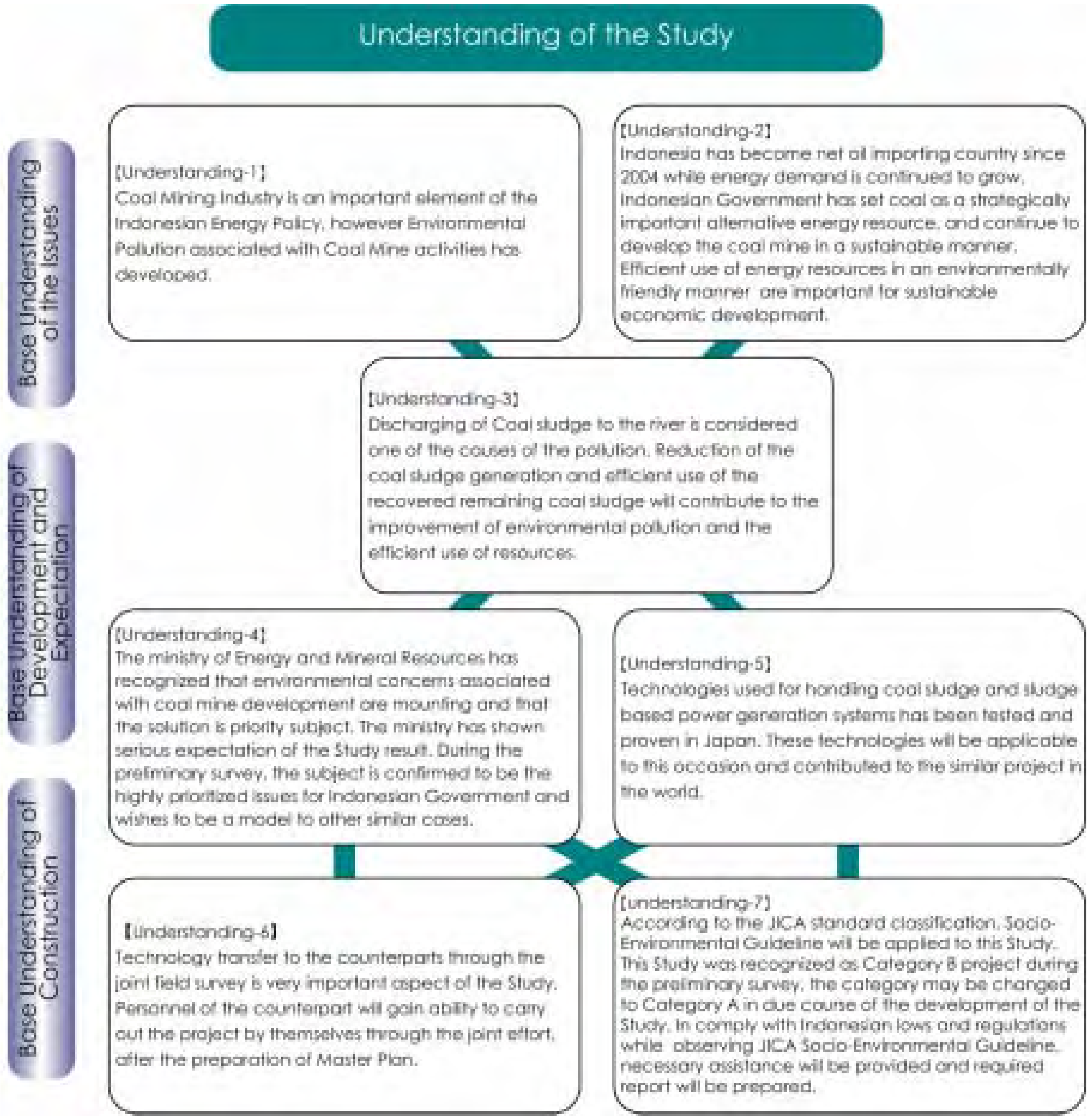
No.	Name	Role in Charge
1	Hajime ENDO	Team Leader, Coal Policy, Waste Water Treatment
2	Nobuhiro KOYANAGI	Coal Washing Process
3	Ryozo OHNO	Environmental Monitoring/Analysis
4	Masaaki EBINA	Effective Utilization of Non-marketable fine coal and Power Generating by Non-marketable fine coal
5	Masaaki TSUTSUI (Eiichiro MAKINO)	Energy Policy/Organization/Economics
6	Satoru KUSHIDA	Socio-Environmental Concern

7. Study Principle and Direction

Non-marketable fine coal is considered to be one of the major pollutants and contributing to industrial waste in the area. The Study will investigate the situation of non-marketable fine coal generation and review of sludge discharge to the environment at the coal washing plants in 5 coal mine companies. These will include PT Tanito Harum, PT Kitadin, PT Fajar Bumi Sakti, PT Multi Harapan and PT Bukit Baiduri, located along the Mahakam River in East Kalimantan State.

The investigation, to be undertaken in conjunction with the assigned counterparts, covers the review of the coal washing process, waste water treatment system and monitoring of the environment. The Master Plan for establishment of an effective and efficient monitoring system and application of utilization technology will be prepared in the Study.

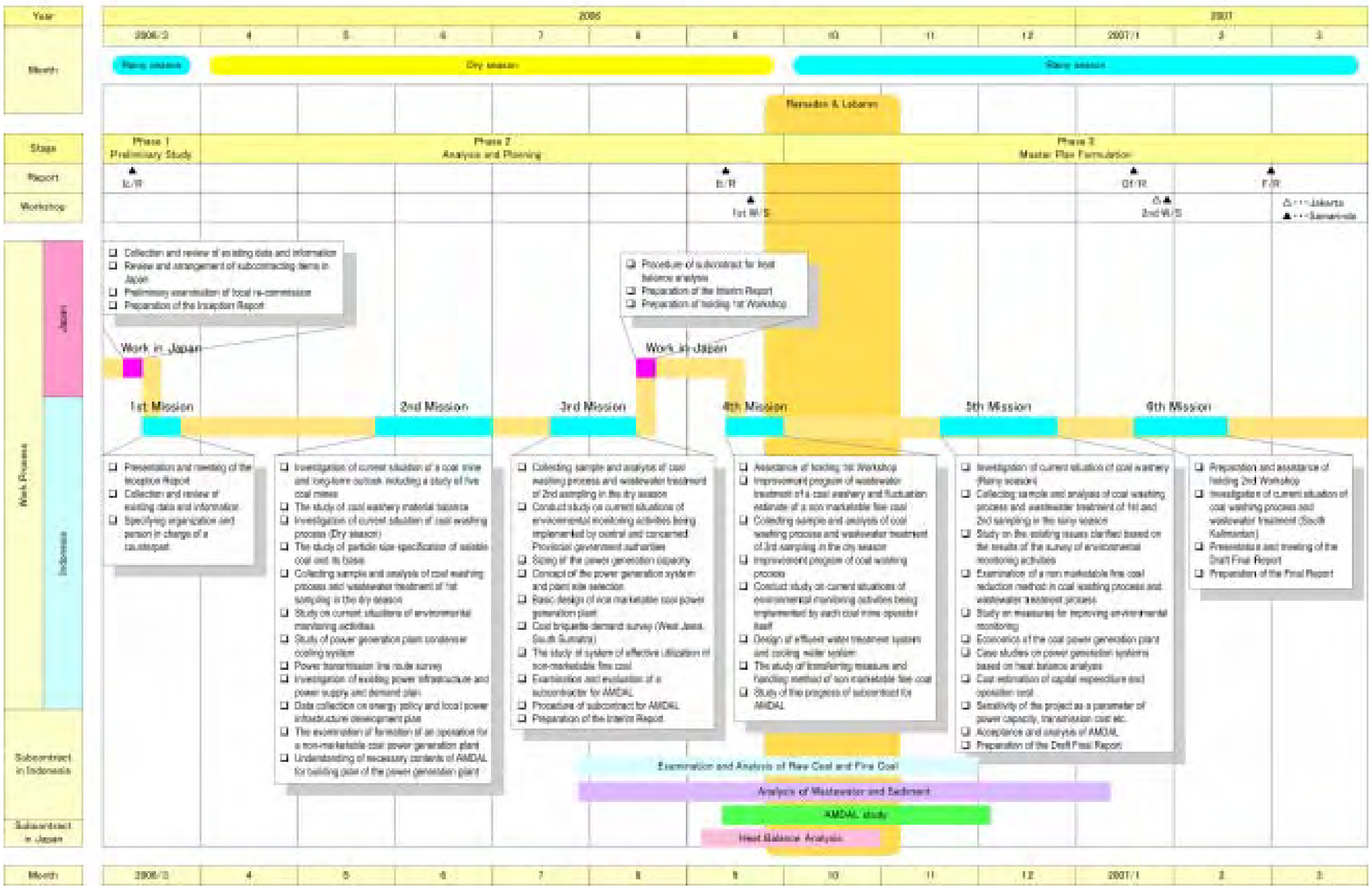
Understanding and direction of the Study for the joint Japanese and Indonesian team is as follows:



8. Study Commencement

The Study is commencing in March 2006 and will be completed in February 2007, a total period of 13 months. The work flow of the JICA study is shown next illustration.

Work Flow of the JICA Study



Chapter 1: An Overview of the Energy Situation in Indonesia

- Indonesia became a net oil importer in 2004 as the nation's existing major natural gas fields began to be depleted. Changes in the energy situation in Indonesia have a tremendous impact, not only on the nation itself but on other Southeast Asian countries including Japan as well. During the period from 2005 to 2025, Indonesia's medium- and long-term primary energy supplies are projected to increase at the annual rate of 6.2%. Coal demand is particularly large and is expected to increase at the annual rate of 11% during the same period. As shown in **Figure 3**, primary energy supplies are expected to increase to 50% in 2025 from the current 20%. Under these circumstances, coal will play a much more important role as Indonesia's energy source and export resource.

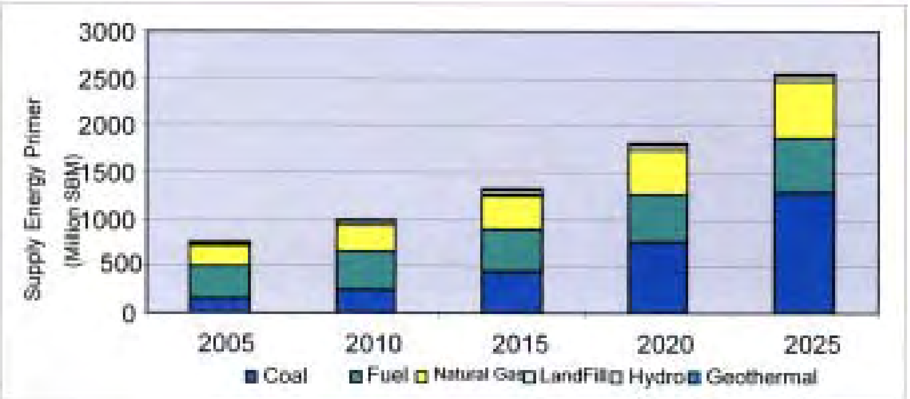


Figure 3. Projection of Primary Energy Supply

Source: Ministry of Energy and Mineral Resources

- Indonesian coal, which holds the third place among coal imports into Japan, continues to perform an important part in securing Japan's stable coal supplies. The largest importer of Indonesian coal is Japan, which, as shown in **Figure 4**, accounts for 21% (19 million tons/year) of the total coal exports, followed by Taiwan (17%) and India (8%). In 2005, coal exports accounted for 72% of the total coal output of 153 million tons. This ratio is predicted to go down to 66% by 2010 and further down to a lower level by 2020 (see **Table 1**). This is because rising nationalism over resources as seen among oil and gas producers is expected to have an impact on coal.

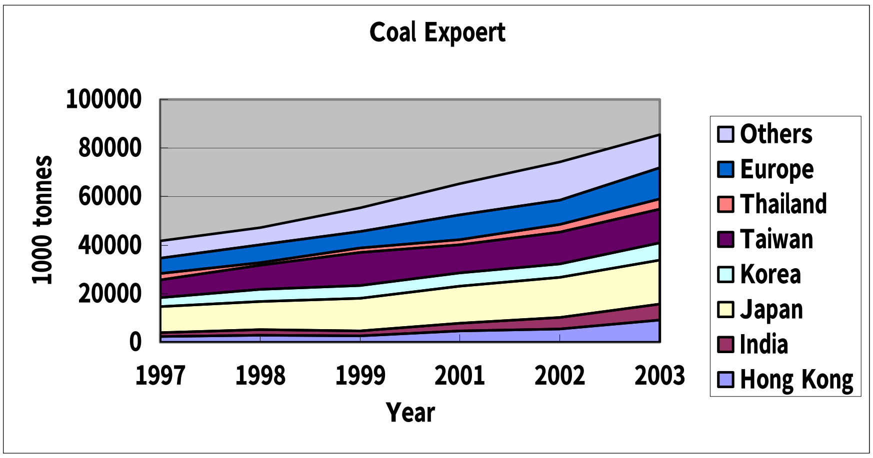


Figure4. Coal Exports by Importing Countries

Source: Ministry of Energy and Mineral Resources

Table 1. Actual and Projected Volumes of Coal Sales

(1,000t)

	Result			Prospect							
	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025
Expore Domestic	85,680 30,657	93,759 36,081	110,790 41,351	126,516 42,899	131,629 43,844	136,670 44,916	136,178 44,896	141,000 75,000	141,000 106,000	105,000 150,000	105,000 195,000
Total	116,337	129,840	152,141	169,415	175,473	181,586	181,074	216,000	247,000	255,000	300,000

Notes

(1) The source of actual values until 2005 are based on the Ministry of Energy and Mineral Resources' 2004 Mineral and Coal Statistics and 2005 Mineral, Coal and Geothermal Statistics.

(2) The prospect during the period from 2006 to 2009 represent the quantities based on the 2005 production plan (RKAB PKP2B 2005) prepared for gaining regulatory approval and other quantities.

(3) The prospect for 2010, 2015 and 2020 are based on the KBN 2004-2020.

(4) Coal consumption for 2025 is based on the BPEN (International Energy Management Blueprint), which predicts that coal-mix energy will reach 32.7% by 2025.

- Indonesia's electric power infrastructure is so vulnerable that there is room for reconsideration of refurbishment plans including power generation, transmission and distribution infrastructures. In the meantime, coal-fired thermal power plant construction plans as represented by Crash Programs have been increasing but the plans tend to be delayed while power failures occur frequently in rural areas.

Chapter 2: A Profile of the East Kalimantan Province

- The East Kalimantan Province has an expanse as large as the main island of Japan and has a population of 2.70 million. The provincial capital is Samarinda.

- The principal resources being produced now in the East Kalimantan Province include timber, coal, LNG and oil, which together account for nearly 25% of Indonesia's resources exports. All these resources are being exported into Japan, so that the province provides a very important source of resources supplies for Japan.

- The East Kalimantan Province accounts for around 57% of Indonesia's total coal production of 153 million tons (in 2005) and nearly 62% of the nation's exports of 111 million tons (in 2005). (See **Table 2.)** The coal mines near the Mahakam River, the survey district, and which use this river for a transport route, are producing approximately 25,000,000 tons of coal annually, of which about 70% are exported.

Table 2. Volumes of Production and Sales in the Area

Location	Production		Sales			
			Domestic		Export	
	2004	2005	2004	2005	2004	2005
E. Kalimantan	68,396	87,351	13,993	17,881	55,766	68,889
S. Kalimantan	54,541	55,045	14,666	15,614	34,499	37,949
C. Kalimantan		824			295	788
S. Sumatra	8,637	8,559	7,117	7,151	2,713	2,492
W. Sumatra	254	251	286	273		
Riau	93	1,073	18	383	76	382
Bengkulu	429	362	1	49	410	290
Total	132,350	153,465	36,081	41,351	93,759	110,790

Source:Mineral, Coal and Geothermal Statics2006, Ministry of Energy and Mineral Resourdec,

- The current situation in the East Kalimantan Province is that energy demand is brisk, while frequent power failures occur due to a steep rise in oil prices and a natural gas shortage. None of the coal-fired thermal power plants is in operation.

Chapter 3: The Current State of the Environment in the Mahakam River Basin

- The effects of production activities in the coal mines on the water quality of the Mahakam River were examined on the basis of data that the Regional Environmental Impact Control Agency (BAPEDALDA) gained from a water quality survey of this river that it conducted for many years in the East Kalimantan Province. **Figure 5** shows the sampling points where the agency conducted surveys. In this figure, the shade area represents the coal mining area where the survey was carried out and the red color shows its location.

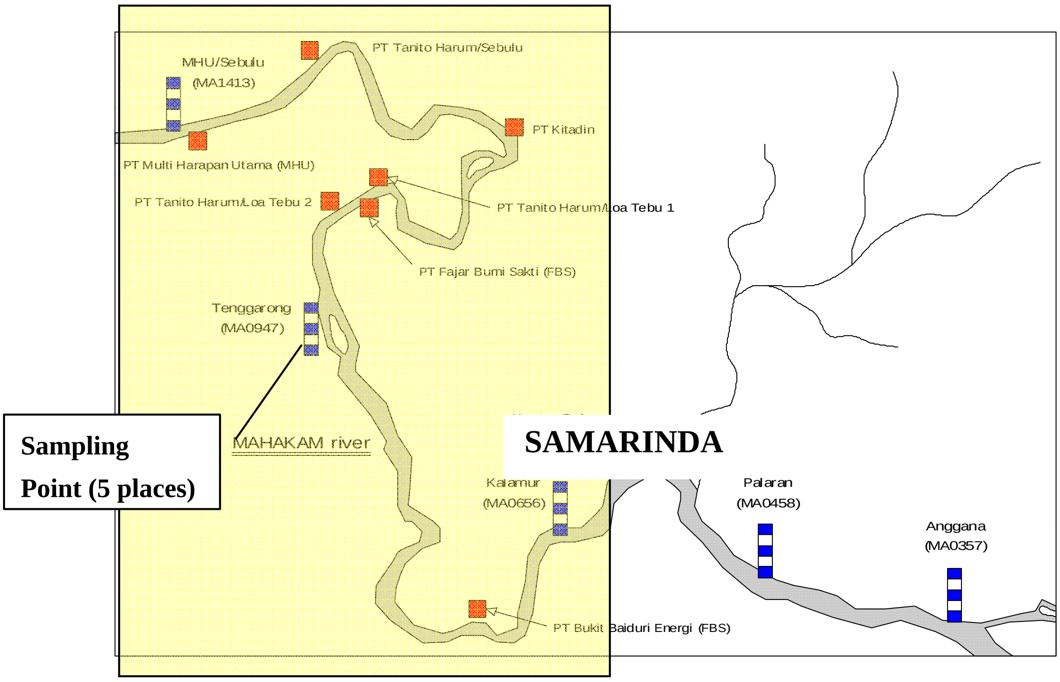


Figure 5. Sampling Points in the Mahakam River by the BAPEDALDA

- Some environmental parameters of some coalmines are exceeding the environmental limit of water quality, especially TSS value (the amount of solid matter). However the survey found that data measured by BAPEDALDA show that discharged water by a coal preparation plant located along the Mahakam River do not affect water pollution significantly.

Chapter 4: Analysis of the Current Environmental Pollution Problem Due to the Coal Mines in the Mahakam River Basin

- In the Mahakam River Basin, there are 15 productive coal mines that produced nearly 25,000,000 tons of coal in 2005. These coal mines in the river basin account for 15-16% of Indonesia's total coal production, domestic sales volume, and coal exports. These coal mines use the Mahakam River as a transport route. Currently there are nine contractors and numerous KP-type coal mines. **Table 3** shows the coal production and sales volume of the coal mines near the Mahakam River. In this table, the shadow line indicates the surveyed coal mines. The coal production will be supposed to increase rapidly and a few coal mine in Table 3 have doubling plan. Moreover new coal mine will increase.

Note:KP stands for Kuasa Pertambangan and is one of the four forms of coal production prevailing in Indonesia. It is a mining authorization. Simply put, it is a private business enterprise mainly established by the Indonesian domestic company. Besides this enterprise, there are a state-owned coal company called PTBA, coal business contracting companies or contractors, which are classified into first-generation, second-generation, third-generation and fourth-generation contractors, and cooperative units called KUDs.

Table 3. Coal Production and Sales Volume of the Coal Mines near the Mahakam River

(1,000t)

No	Company	Licence	Production		Sales			
					Domestic		Export	
			2004	2005	2004	2005	2004	2005
1	Anugrah Bara Kaltim, PT	KP	3,413	3,395	3		1,479	1,502
2	Bina Mitra Sumberarta, PT	KP		169				
3	Bukit Baiduri Energi, PT	KP	1,430	1,690	1,690	32	1,225	1,626
4	Fajar Bumi Sakti, PT	KP	2,113	328	78	188	864	120
5	Gunung Bayan Pratama Coal, PT	PKP2B, 2nd Generation	3,360	4,330	3,343	2,594	2	1,324
6	Jembayan Muarabara	KP		1,050				1,050
7	Kartika Selabumi Mining, PT	PKP2B, 2nd Generation	736	1,035	837	1,007		
8	Kimco Armindo, PT	KP		963				
9	Kitadin Corporation			1,604	78	571	864	1057
10	Lanna Harita Idonesia, PT	PKP2B, 3rd Generation	1,700	1,887	57		1,480	1,733
11	Mahakam Sumber Jaya, PT	PKP2B, 3rd Generation		2,304		1,006		1266
12	Mandiri Intiperkasa, PT	PKP2B, 2nd Generation	602	1,082	16		352	1,021
13	Multi Harapan Utama, PT	PKP2B, 1st Generation	1,521	897	299	242	1,002	648
14	Tanito Harum, PT	PKP2B, 1st Generation	2,256	2,403		9	3,217	4,984
15	Trubaindo Coal Mining, PT	PKP2B, 1st Generation		1,610		1,171		389
		Total	17,131	24,747	6,401	6,820	10,485	16,720
		Total in Indenesia	129,835	153,465	37125	41351	93759	107332
		Shear (%)	13.2	16.1	17.2	16.5	11.2	15.6

Mineral, Coal and Geothermal Statics 2006, by Ministry of Energy and Mineral Resources

- Environmental pollution sources generated by production activities in the coal mines are:
  - (a) Contaminating the rivers into which the coal mines are discharging effluent (containing TSS or total suspended solids) in concentrations higher than the standard value because waste water is incompletely treated at the coal preparation plants.
  - (b) Non-marketable fine coal produced from the treatment of waste water is incompletely disposed of and, consequently, is discharged outside, particularly in the rainy season.
  - (c) Sand and gravel generated from open cut mining are discharged
  - (d) High-sulfur content dirty coal dumped in abandoned mine sites is producing acid water, impeding the afforestation of abandoned mine sites and causing a decline in the pH value of rivers.

- **Figure 6** shows an outline of the washing process and source of non-marketable fine coal and dirty coal, while **photos 1 and 2** indicate non-marketable fine coal and **photos 3 and 4** show dirty coal.

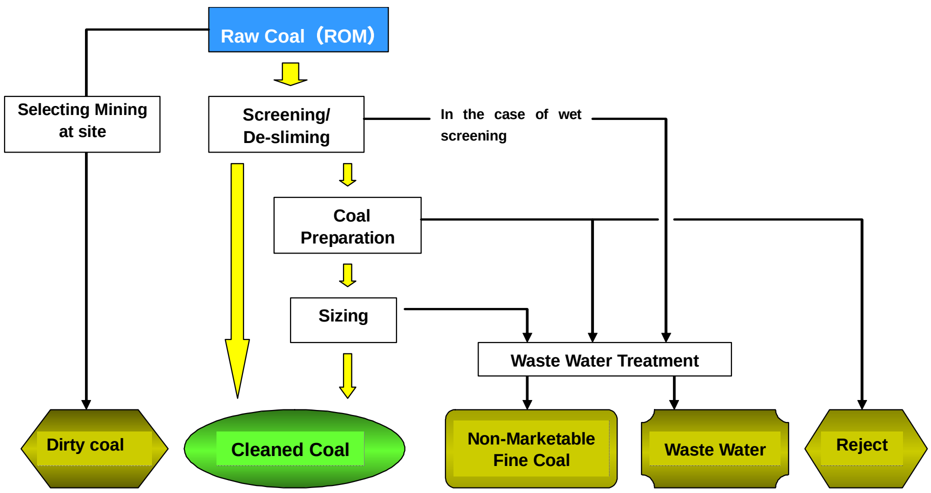


Figure 6. An Outline of the Washing Process

Photo 1. Non-marketable fine coal piled up out in the open in a

Photo 2. Non-marketable fine coal being recovered from a settling pond

Photo 3. Dirty coal removed during work for cleaning of the upper coal layer

Photo 4. A boundary with the coal layer is shown. Dirty coal occurs in the 5-10 cm upper layer.

- Five coal mines that have coal preparation plants were surveyed and, in addition, several other coal mines were surveyed in order to look into the situation of dirty coal. In the present survey, TSS, pH, Fe and Mn contained in waste water discharged from the coal mines were measured in the dry season and in the rainy season and the actual situation was identified based on much data. **Table 4** shows an outline of the coal preparation plants surveyed.

Table 4. An Outline of the Coal Preparation Plants Surveyed

	Washery	Capacity	Separation	Washing Process	Washing/Wastewater Process Turning Poin	Wastewater Process	Water
1	PT. Kitadin	60t/h+120t/h	Separation	Jig	Settling Pit	Settling Pond	Partial Recycle
2	PT. Fajar Bumi Sakti (FBS)	100t/h	Separation	Jig	De-slime Screen	Settling Pond	Entire Recycle
3	PT. Tanito Harum / Sebulu	125t/h	(De-slime)	(Jig※1)	Settling Pit	Settling Pond	
4	PT. Tanito Harum / Loa Tebu 1	70t/h	De-slime	Drum-Washer	Cyclone Classifier	Settling Pond	
5	PT. Malti Harapan Utama (MHU)	400t/h	De-slime	Screen	Cyclone Classifier	Settling Pond	
6	PT. Bukit Baiduri Energi (BBE)	250t/h	De-slime	Screen	Cyclone Classifier	Settling Pond	Under Construction

- Three of the five surveyed coal mines are open cut mines and the other two are open cut and underground mining collieries. In open cut mining, the selective mining approach that discards raw coal near the upper and lower formations is adopted in order to minimize the amount of rocks mixed in. Accordingly, open cut mining produces a smaller amount of minerals to be carried to the coal preparation plant than the underground mining method does. Argillaceous minerals that occur in the present area have the property of absorbing water and becoming muddy. At the three open cut mines, therefore, small amounts of muddy argillaceous minerals are removed from coal with de-sliming facilities. The other two underground mining coal mines, on the other hand, remove large quantities of rocks, including argillaceous minerals, from coal with specific-gravity separators.

- De-sliming and specific-gravity preparation both are the wet processes that use water, so that they produce muddy argillaceous minerals and pulverized coal-containing muddy water with a 3-8% concentration. This muddy water is separated into solids and liquid in a settling pond in the wastewater treatment process. This resultant deposit becomes non-marketable fine coal and an overflow product is discharged as waste water flowing into the Mahakam River.

- Some coal mines are found in dry season to discharge waste water with concentration of TSS substantially higher than the regulatory standard (400 mg/l or about 0.04%) into the Mahakam River. There is concern that the amount of solids discharged into the Mahakam River will increase sharply as the ratio of underground mining operations will increase and, backed by firm coal demand both domestic and abroad, the coal preparation plants will increase in number.

- Meanwhile, non-marketable fine coal, a deposit produced in the waste water treatment process, is piled up out in the open and disposed off without being used for any purpose. The around-the-clock continuous monitoring revealed that at some coal mines, this pile of non-marketable fine coal was washed away by the heavy rains in the rainy season into the Mahakam River as waste water with a concentration nearly two to four times as high as the normal level (see **Figures 7-1 and 7-2**). Open-air piles of non-marketable fine coal, to say nothing of waste water, are a major source of environmental pollution during rainfall. The importance of continuous monitoring is recognized anew.

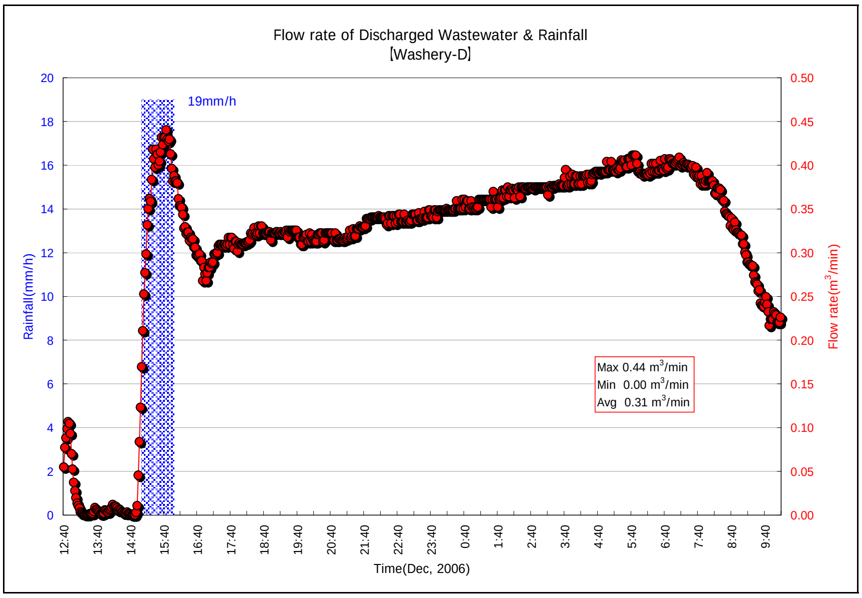


Fig.7-1, 24hr measurement of flow rate at D-Washery

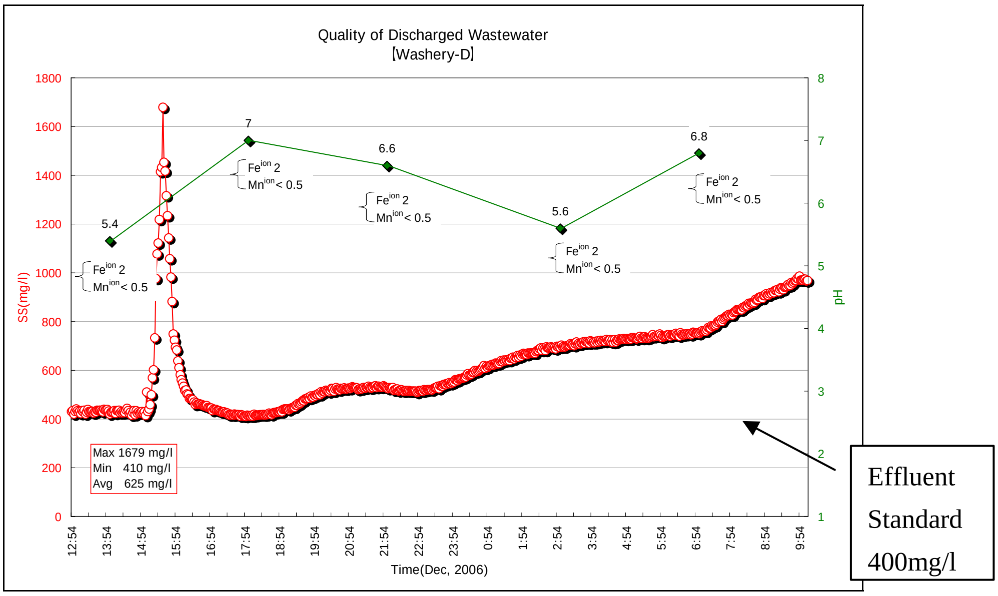


Fig. 7-2, 24hr measurement of water quality at D-Washery

- A fundamental solution to the non-marketable fine coal-caused environmental pollution problem cannot be gained unless piling up non-marketable fine coal out in the open or disposing of it on the site is eliminated. Developing technology to use non-marketable fine coal is crucial. Such technology must be established promptly because it will provide an incentive for the coal mines to treat waste water securely.

- Reducing the volume of non-marketable fine coal and discharging wastewater within the effluent standard values are possible as long as the coal preparation process and the wastewater treatment process are improved. Proposals for improvements to be adopted at the coal mines have been prepared. The next chapter describes these proposals.

- The environmental pollution problems for which coal mining is responsible are so serious that environmental pollution risk-alleviating measures for sustainable coal development are being sought. In the meantime, as the recent rapid increase in coal demand has stimulated coal development, numerous conflicts between the coal mine operators and local inhabitants have occurred, posing serious social problems in various parts of the country. The coal mine operators are providing various forms of assistance for community development to local inhabitants living near the coal mines but their assistance is so limited that they are unable to achieve community-wide consensus among local inhabitants. Implementing specific measures that should benefit many inhabitants is one of the solutions to their discontent and hence will lead to sustainable coal development.

Chapter 5: Proposal for Environmental Pollution Control Measures

1. Environmental Monitoring

- The documents that the coal mine operators formally submitted to the Regional Environmental Impact Control Agency (BAPEDALDA), a regulatory agency, once a month were surveyed. These official documents contain the results of measurements indicating that some coal mines are discharging waste water with concentration of TSS significantly higher than the regulatory value. It will be hard to say that the sampling data every one month could show whole data in the month and it is realized that continuous monitoring should be carried out.

- The Ministry of the Environment (MOE), under its Proper corporate performance review program, and the BAPEDALDA are rating the coal mines in the area in terms of the quality of waste water from their coal preparation plants once a year. According to the results of this rating, most of the coal mines in the area are rated “red,” meaning that “the quality of waste water is a little higher than the standard value and improvements must be made.”

- Unlike Japan, the Indonesian authorities simply require the coal mining companies to make voluntary improvements if the concentration of waste water exceeds the regulatory value. They do not implement any stringent measures, such as the suspension of mining operations as imposed in Japan.

- The master plan calls for the following improvements:
  (1) The creation of locality-specific environmental monitoring systems;
  (2) The creation of an environmental monitoring database and its operational procedures
  (3) The creation of an environmental monitoring database communications transmission system
  (4) A proposal for the reinforcement of environmental monitoring management at the coal mines and for the alleviation of environmental risks in the Mahakam River Basin.

- Meanwhile, tekMIRA, our counterpart in the present survey in Indonesia, has issued the terms of reference (TOR) for the creation of an environmental monitoring system for environmental pollution sources from coal mining activities.

2. At-source Pollution Reduction Technologies

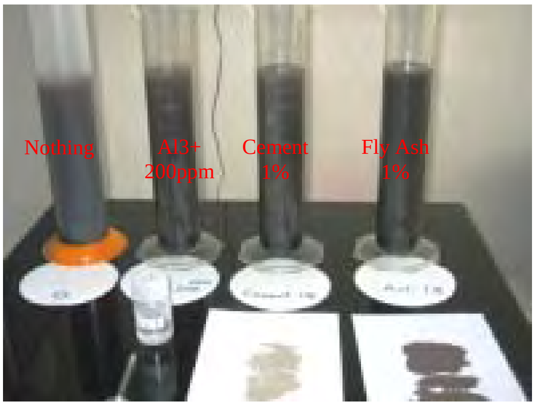
- Ways to implement pollution reduction technologies include improvements on the coal preparation process and the establishment of the waste treatment procedure. Based on the sampling data obtained at the surveyed coal preparation plants, a model case was developed and a proposal for improvements at the coal preparation plants was prepared.

- A fundamental solution to waste water treatment should aim at the circulation of waste water from coal preparation, or aim to create a closed circuit of reusing waste water after treatment. Waste water may be discharged in the rainy season but reusing waste water will naturally lead to the secure management of the TSS concentration of waste water treated.

- The basics of pollution reduction technology in the coal preparation process lie in how many solid particles can be retained within the coal preparation process to prevent them from flowing out into the waste water. In other words, facilities designed to branch the coal preparation process off from the waste water treatment process are crucial. The existing surveyed branching facilities provide a grain size as rough as 300 μm or more. A well-managed sizing cyclone could achieve 150 μm or half the current grain size. All the coal preparation plants should install sizing cyclones manufactured to the appropriate specifications and acquire the appropriate technology to operate them.

- The finer the grain of pulverized coal produced in this area becomes, the higher its ash content becomes. In order to lower the grain size and mix much finer pulverized coal with products, a prerequisite is to produce pulverized coal products that have a stable grade. Facilities capable of controlling the grade or specific-gravity separators (such as jig separators) are only installed at the two underground mining coal mines. Some coal mines are far from operating facilities properly. It is necessary to determine the proper amount of coal stoked, proper amount of air, proper amount of water, and form a proper wave and select jigs with high accuracy.

- All the coal mines have adopted a settling pond in the waste water process. Very fine argillaceous minerals contained in the waste water are all negatively charged, which means that they are repelling each other and consequently are very hard to settle. A method to use the optimum coagulant in waste water is therefore needed. Tests were conducted to use coal ash as an alternative to an inorganic coagulant. It was very interesting that the addition of a 1% coal ash solution to waste water produced tremendous effects. Thus it can be cited as one of the effective uses of coal ash. **Photos 5-1** and **5-2** show how sedimentation tests were carried out on three kinds of coagulant in waste water from coal preparation. The left end shows an untreated sample and the right end indicates the coagulation effect of coal ash in **Photos 5-2**. The dissemination of economical flocculent for wastewater treatment in Indonesia will be essential and one of the ultimate solutions.



Phot.5-1 Sedimentation tests

Phot.5-2 Sedimentation tests after 2hrs

- At some coal mines, coal and muddy water surrounded the coal preparation facilities and there was no place to walk; conditions were so bad that discussion about improvements of facilities or operating skills were out of the question. It is a matter of quality control consciousness. The underlying cause is the existence of non-marketable fine coal piled up out in the open around the facilities.

3. Effective Utilization Technologies

- Important effective utilization technologies are cost-efficient sustainable technologies. Thus a plan to commercialize briquettes (through carbonizing and fabrication) was examined and a dirty coal-fueled power generation plan was shaped.

3.1. A Briquette Plan

- Non-marketable fine coal can be used to make briquettes but as the market for briquettes is small in size, the amount of briquettes used is limited and so the total quantity of non-marketable fine coal generated cannot be used. Because of a sharp rise in oil prices, a private-sector project to commercialize briquettes is in progress. The economic efficiency of this plan was evaluated and possible problems were identified.

- Currently briquettes are produced in eight places. PTBA, one of briquette manufacturers, is operating production plants in three locations – Tanjung Enim, Lampung, and Gresik – and is the largest briquette supplier with a production capacity of 85,000 tons a year, accounting for 85% of the total production capacity. The second largest supplier is tekMIRA's facility in Cirebon, which has a production capacity of 10,000 tons a year. This accounts for 10% of the total production capacity. There are four additional facilities in operation but these facilities are small in size and their combined production capacity accounts for no more than 5% of the total production capacity.

3.2. A Coal-fueled Power Generation Plan

- An examination of the production volume, economic efficiency and sustainability found that using non-marketable fine coal and dirty coal as fuel to generate electricity is the most effective approach and the most feasible option judging from the electricity situation in the area. Dirty coal fueled power generation is carried out in Australia, India, China and countries in East Europe and is already recognized as an effective solution to the environmental pollution problem. If this plan is implemented it will become the first model case in Indonesia. **Figure 8** shows the CIF prices of non-marketable fine coal, dirty coal and standard sub bituminous coal, and **Figure 9** shows the power generating costs of these materials.

- Because the details of this power generation plan are described in the attachment, this section outlines this plan.

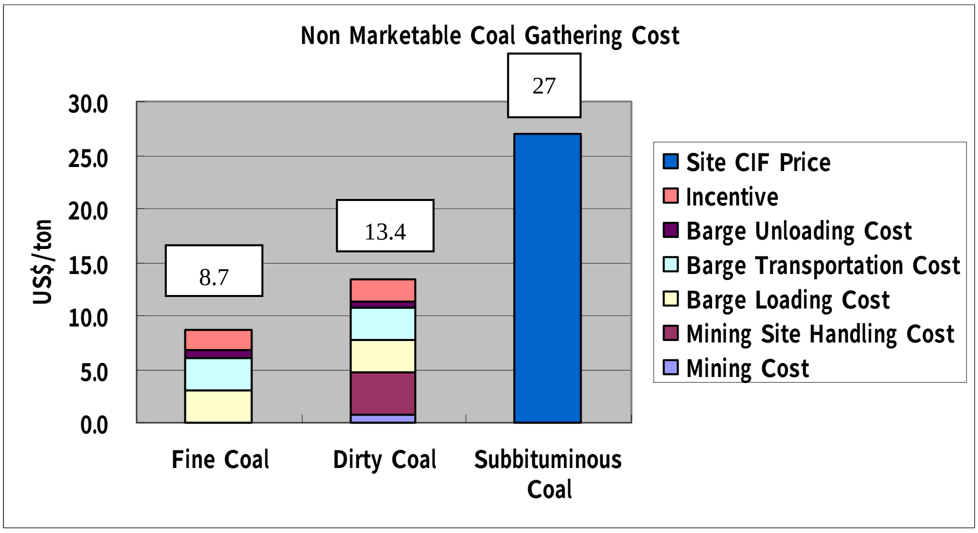


Figure 8. The CIF Prices of Non-marketable fine coal, Dirty Coal, and Standard Sub-bituminous Coal

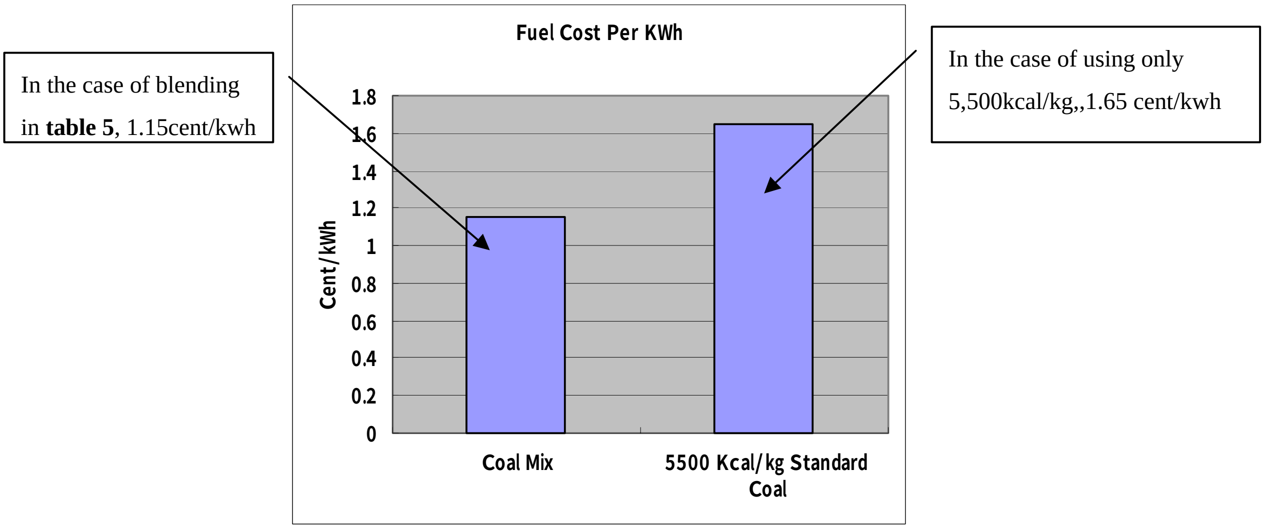


Figure 9. Comparison of Power Generating Costs

- In order to enhance the feasibility of this plan, a site was selected, economic efficiency was evaluated, and an implementation organization was arranged in cooperation with related organizations, such as PLN, the government of East Kalimantan Province, and Samarinda City. The volume of dirty coal produced, a power generation plan and a transmission line plan were examined and this examination allowed us to conclude that a suitable site for constructing a power station comprising two 50MW units would be an area near the coal storage yard of the Bukid Baidrey Energy coal mine, one of the coal mines surveyed in the recent survey, near Samarinda City. This area is shown in **Photo 6**.

Photo 6 Candidate site of A Coal-fueled Power Generation

- Because non-marketable fine coal and dirty coal with high moisture content, ash content and high sulfur content are to be used as fuel, the desired boiler type is a circulating fluidized bed boiler. In addition, because there is a large variation in ash content and moisture content among fuels, low-grade coal with 5,000 kcal/kg or so will be needed as supplementary fuel to stabilize the power output.

- A survey has confirmed that non-marketable fine coal and dirty coal will be made available in quantities sufficient to meet the power output needs. The percentages of fuels to the annual consumption of 467,000 tons will be 21% for non-marketable fine coal, 38% for dirty coal, and around 41% for low-grade coal. Because the volume of non-marketable fine coal produced is unstable, the annual consumption has been provisionally estimated at 100,000 tons at minimum, which corresponds to one-third of the estimated volume. To adjust the percentage composition of fuels, non-marketable fine coal will be regarded as a main fuel and if the volume increases, the amount of dirty coal will be adjusted. In this case, the power generating cost will be lowered further. The percentage composition of fuels to use is shown in **Table 5**.

Table 5. Ratios of Fuels to Use

Coal Mix	Kcal/kg	$/ton	Ton/year	wt%
Non Marketable Fine Coal	2,920	8.7	100,000	21.4
Non Marketable Dirty Coal	3,840	13.4	177,000	37.9
Supplement Low Rank Coal	5,000	27	190,000	40.7
Average	4,198	17.4	-	-

- A public corporation of the government of East Kalimantan Province will be in charge of supply of these coals to the power station. Important areas of consideration include quality control, securing a sufficient amount of coal supply, and stabilizing coal prices.

- In our economic study, power tariff using soft loan is 2.92 US¢ shown in **Table 6** and the **Table 7** shows E-IRR in the case of IPP using cheaper power tariff than our calculation result of IPP. Seeing about recent purchased power price, it may be difficult for the private sector to build and operate the same project using non-marketable coal having an environmental impact as a fuel.

Table 6 Power Tariff Calculation

	US¢/kWh
Capacity Charge	0.81
Fuel Charge	1.15
Operation & Maintenance	0.96
Total	2.91

Note	
Operation Factor :	85%
Capacity Charge :	Annual Loan Payment
Fuel Charge :	Coal Mix Price @ Plant Site
Operation & Maintenance:	4 % of Project Cost

Table 7 E-IRR of IPP

	E-IRR 6 US ¢/kWh	E-IRR 5 US ¢/kWh
10 Year (%)	7.86%	2.40%
20 Year (%)	13.01%	8.81%
30 Year (%)	13.86%	10.10%

- The environmental assessment standards were established to protect the social environment in the power station plan, public hearings with local inhabitants were held in two areas (refer **to Photo 7 and Photo 8**), and strong public support was gained for this plan. On the other hand, because coal for use in the proposed power station has a high ash content, how to treat ashes generated by the combustion of this coal has posed a problem. Thus adequate environmental protection measures must be carried out, drawing on Japan's experience with ash treatment technology and the reuse of ashes.

Photo 7 Public hearings at Loa Duri Ulu

Photo 8 Public hearings at Sungai Kunjang

- The attached power generation plan summarizes the details such as the selection of a proposed site, power generating capacity, system interconnection, an outline of a power station, and verification of economic efficiency. A further examination of the details calls for the following activities:
  (1) Geological survey by a field boring at candidate site
  (2) Coal sample combustion tests
  (3) Verification of the properties of sample ashes
  (4) Calculation of construction costs
  (5) Preparation of a detailed construction schedule

Chapter 6: Transfer of Technologies

The following technologies have been transferred to counter parts and coal mines:

(1) Environmental monitoring-related technology
(2) Water pollution control technology
(3) Water quality measuring technology
(4) Coal separator performance evaluation method

Chapter 7: Conclusions and Recommendations

1. Conclusions

1.1 Affection of environmental contamination to Mahakam River

The environmental limits for some water quality parameters are being exceeded at some coalmines, especially TSS (total suspended solids). However, data measured by BAPEDALDA show that water discharged by coal preparation plants of coal mines located along the Mahakam River does not affect water pollution significantly.

1.2 Environmental pollution sources generated by production activities in the coal mines are as follows:

(a) A potential impact on rivers is that the coal mines are discharging effluent containing TSS in concentrations higher than prescribed standards because the waste water is incompletely treated at the coal preparation plants.

(b) Non-marketable fine coal produced from the waste water treatment is incompletely disposed of and, consequently, is discharged outside the mining area, particularly, in the rainy season.

(c) Sand and gravel generated from open cut mining are discharged to rivers.
(d) High-sulfur content dirty coal dumped in abandoned mine sites is producing acid water, inhibiting the afforestation of abandoned mine sites and lowering the pH value of rivers.

1.3 Counter measures

(a) Establish continuous monitoring systems
(b) Improve the coal washing process and wastewater treatment methods
(c) Enhance environmental management systems
(d) Effectively utilize non-marketable coal

2. Recommendations toward improved measures to be taken in future

2.1 The Urgent (short term) Items to be Implemented

(1) Establish model continuous monitoring systems for pH and TSS of wastewater effluent from a coal washing plant
(2) Reduce the amount of Non-marketable Fine Coal by improving the wastewater treatment process
(3) Increase the wastewater effluent quality by reducing pollutant levels below the appropriate quality criteria by means of improving wastewater treatment process and other measures
(4) Enhance the neutralization treatment process for acid wastewater to be discharged from coal mines
(5) Undertake human resources development, personnel education and training for technology transfer of the above items (1) to (4)
(6) Remove Non-marketable Fine Coal, both current stockpiles and that to be generated in the future, and reduce the amount of Dirty Coal for disposal and thereby materialize the environment friendly reject-fired power plant to reduce environmental risk load

2.2 The Mid-term Items to be Implemented

(7) Disseminate the system of continuous monitoring of environmental pollution sources from coal mining activity to all coal mining areas in Indonesia
(8) Enhance and implement the measures needed for governmental organizations to establish sustainable environmental monitoring systems
(9) Enhance environmental management systems, set effective wastewater effluent criteria, and put in place a strong system for penalties
(10) Develop effective uses of coal ash that will be generated by coal utilization and establish measures to avoid or mitigate the relevant environmental pollution risk

(11) Human resources, personnel education and training for technology transfer of the above items (7) to (10)

3. Recommended Concrete Implementation Plan

In parallel with conducting additional studies of the measures listed in Items 2.1 and 2.2 above and through effective combination of these measures, the following two concrete steps are proposed:

I. Establish a " Technology Transfer Center for Environmental Pollution Control in Coal Production Activity (preliminary title)"

II. Construct a Non-marketable Coal Fired Power Plant

4. Effectiveness of Implementing the Recommended Improvement Measures

I. Establishment of " Technology Transfer Center for Environmental Pollution Control in Coal Production Activity (preliminary title) "

This measure is to transfer technology from Japan to enhance the environmental regulation compliance systems within government organizations and the coal mine industry and to establish sustainable environmental risk mitigation measures through personal training by technology transfer These measures will be effective in the mitigation of environmental risk to be generated by the increase of coal mining activity and coal utilization in Indonesia.

II. Construction of Non-marketable Coal Fired Power Plant

A Coal Fired Power Plant is an environmental measure that effectively utilizes Non-marketable Fine Coal and Dirty Coal for fuel and creates a driver for the positive implementation of wastewater treatment in coal mines. The people of Samarinda City and its surrounding areas will receive stable electric power supply from the coal mining industry, which in turn will improve people’s perceptions of the industry in Indonesia.

5. The program schedule

Table 7 lists the program schedule and details for the implementation of recommendations.

Table 7 Recommendations toward implementing improved measures to be taken in future

	Contents		Short term (2007-2009)	Medium term (2010-2012)	Long term (20013-2015)
1. " Technology Transfer Center for Environmental Pollution Control in Coal Production Activity (preliminary title)"					
Purpose: Technology transfer					
Coal mine	1) Environmental Monitoring				
		(i) Establishment of a model case of online monitoring system for pH and TSS of wastewater from coal preparation plant	→		
		(ii) Dissemination of the system of online monitoring of environmental pollution sources from coal mining activity to the whole coal mines in Indonesia		→	→
	2) Technology transfer for reduction of the amount of Non-marketable fine coal through improvements of wastewater treatment process (including OJT)	(i) General education through class room lectures (ii) OJT at a coal washing plant	→		
	3) Reduce the wastewater effluent quality values down below concerned effluent quality criteria by means of improving wastewater treatment process and others	(i) General education through class room lecture (ii) OJT at each coal washing plant	→		
	4) Enhancement of neutralization treatment process for acid wastewater to be discharged	(i) General education through class room lectures (ii) OJT at a coal washing plant	→		
	5) Coal washing and quality management	(i) General education through class room lectures (ii) OJT at a coal washing plant	→		
	6) Enhancement of environmental management system	(i) Enhancement of environmental management technology in a coal mine and technology transfer for enhancement of environmental management organization (ii)Use of unified formats by electronic media for recording monitored data and related documents, of which the formats will be common to all coal mines (iii) Establishment of wastewater quality analysis laboratory in a coal mine with	→	→	
CCT	1) Effective uses of coal ash to be generated by coal utilization and establishment of measures to avoid and mitigate the relevant environmental pollution risk 2) Emission and air quality			→	→
Govern-mental Administ-ration	1) Enhancement and implementation of the measures to be needed for governmental organizations for the purpose of establishing the sustainable environmental monitoring			→	
	2) Enhancement of environmental management system, effective wastewater effluent criteria 3) Establishment of community-based environmental monitoring system for having local 4) Enhancement of environmental monitoring database telecom system 5) Combination with the wide area environmental monitoring of Mahakam River Basin			→	→
2. Construction of "Non-marketable Coal Fired Power Plant"					
Purpose: Removing existing Non-marketable fine coal and those to be generated from now on,					
	(1)Establishment of implementation structure		→		
	(2)EIA		→		
	(3) F/S		→		
	(4)Detailed design		→		
	(5) Construction			→	
	(6) Commencement of commercial operation				→

Attachment: "An Environmentally Sound Dirty Coal-fueled Power Generation Plant"

Attachment: "Social Environment"
