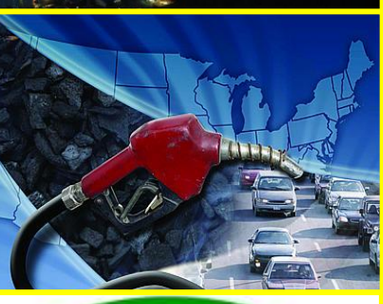









Investment Opportunity of Investment Prospect Toward The Development and Utilization of Liquid Coal in East Kalimantan

AGENCY FOR LYCENSING AND REGIONAL INVESTMENT (BPPMD) OF EAST KALIMANTAN PROVINCE

Jl Basuki Rahmat No 56 Samarinda Kalimantan Timur 75117.
Telp. 62-0541-743235 – 742487 Fax : 0541-736446
E-mail : Humas@bppmd.kaltimprov.go.id
Website : http://www.bppmd.kaltimprov.go.id

PREFACE

Coal as one of natural resource that can't be renewable, can be processed become new energy resources. East Borneo with the coal reserve that is relatively big, it is possible to produce fuel oil substitute (alternative energy source) by using coal liquefaction technology to become fuel oil.

This report study is purposed to give description about coal potency in East Borneo that can be processed into liquid coal. With this description, it is hoped that it can be used by investors or interested parties to develop it.

With this report, it is hoped that interested parties can get comprehensive information about potency and investment opportunity in East Borneo.

We say thank you to all parties that include in this making report.

Samarinda, July 2013
Head of the Licensing Agency and Regional Investment
(BPPMD) East Borneo Province

Diddy Rusdiansyah AD.,SE.,MM
NIP. 19640627 199003 1 oo6

CONTENT

TABLE LIST

FIGURE LIST

CHART LIST

CHAPTER I
INTRODUCTION

1.1. Background

World energy consumption is getting bigger in line with the increasing of human need in doing their activities. While the energy sources needed now is dwindling. Exploitation and exploration of natural resources to get energy is getting uncontrolled. The need-exploitation-profit cycle is rapidly rotate. Natural resources exploitation that are having limit (non renewable) are getting incentive. It causes the availability is getting dwindling and simultaneously causing bad effect to human life itself. This thing becomes global matters and needed globally solution either.

Indonesia that is known well as rich country on natural resources, also have a role in exploiting this natural resources. However, Indonesia is geographically also endowed with the diversity of natural resources, either with the limited sources (non renewable) or infinite resources (renewable). During this, Indonesia is rely on limited natural resources in getting energy and even to get national income. Oil and gas sectors also coal become the sector that is most exploited either for domestic or international needs. Recorded that in 2012, realization estimation on raw oil production as big as 860 thousands barrel per day (bpd) or 92% on target that is 930 bpd. While for coal, Indonesia produce as many as 725 million ton per year with the composition is 26,3% for domestic needs or approximately 70-80 millions ton per year and the remaining is for export needs. During year 2012, coal production reach 386 million ton or as big as 109% from the production in 2011 that reach 353 million ton. From the year 2012 production, as big as 82 million ton are used for domestic needs

and 304 million ton for export. In year 2013, production is estimated reach 391 million ton with the DMO allocation as big as 74,32 millions ton. It is increase if compared to DMO 2012 that is 67,3 millions ton. Domestic needs are generally used for powerhouse (generator). With those production number, estimated that Indonesia coal reserve number remain 20 years.

While New Energy and Renewable Portion (EBTK) in mix energy is also increasing that is in year 2012 become 0,52%. This New Energy and Renewable including liquid coal.

World energy needs including Indonesia are getting bigger, while the energy sources are getting dwindling. This thing is certainly become the serious thought to face that condition in the future.

It needed the paradigm change about energy management especially that concerning limited natural resources exploitation or non renewable. It's time to dig renewable natural resources potency or processing natural resources into new energy sources. This new energy sources can be obtained by processing natural resources either with the renewable resources or non renewable resources.

Coal, as one of the natural resources that non renewable can be process into new energy sources. Based on its content, coal can be process into new energy sources through gasification process or liquefaction process. Gasification process is a process to converse carbon in coal into gas (syngas) with gasification media (gasification agent), while the liquefaction process is catalytic hydrogenation process or coal liquefaction with coal hydrogenation in hydrogen donor solvent with the help of ferro-oxide catalyst at the pressure between 35-275 atmosphere and temperature approximately 375-450^0 C. High pressure and temperature are used to crack coal into reactive fragments that is called with free radicals. One of coal gasification process result is

Coal Bed Methane (CBM). CBM right now is commonly used by industry, household and even has developed into fuel for power plants. While for the resulting product from coal liquefaction is fuel oil. From the several researches show that fuel oil quality that is produces from liquid coal is higher and has friendly characteristic on environment and also efficient. Therefore, this liquid coal can be the alternative energy source that has bright prospect in the future.

East Kalimantan with the coal reserve that relatively big, it is possible to produce fuel oil substitute (alternative energy source) by using the coal liquefaction technology to become fuel oil. Data year 2005 (source: Geological Resource Center, 2006) show that medium coal calorie reserve (5100 – 6100 cal/gr.abd) in East Kalimantan as big as 941,62 millions ton, for high calorie (6100 – 7100 cal/gr.adb), the reserve is 1.064,82 millions ton. While for the highest calorie (> 7000 cal/gr.adb), the reserve is 65,24 millions ton. With those potency, expected that the utilization of coal in East Kalimantan can be the one of source regional income.

1.2. Aims and Objectives

This study is intended to give description about coal potency in East Kalimantan that can be process into liquid coal. With this description, it is hoped that its potency can be used by the investors or concerned parties to develop it.

Specifically, the objectives of this study as follows:

a. To get description about coal potency based on natural resources aspect, human resources, and infrastructures.
b. To get description about the properness of liquid coal potency development from marker, technical, financial aspects, also benefit/ impact to regional economic.

c. To arrange potency profile of liquid coal investment project from properness aspect such as market, technical, and financial also potential to be offered to investors.

1.3. Usefulness

This study report in the form of document which is hoped that can be used for:

a. East Kalimantan province government. This study report will become information source in setting regional policies to develop local resources through superior commodity investment programme to investors.
b. Investors. This study result will give clear and accurate information about investment opportunity also as a decision-making to do investment in East Kalimantan.

1.4. Work of Scope

This study has done in regency/ city in East Kalimantan especially in East Kutai regency. East Kutai regency has abundant coal reserve and some of mining company has been operated such as Kaltim Prima Coal Company (KPC) Sangatta. This study is related to technical, market, and financial aspects of coal liquefaction business.

CHAPTER II
PROSPECT, POTENCY, AND DEVELOPMENT DIRECTION AND LIQUID COAL UTILIZATION

2.1. Liquid coal Development Prospect

Indonesian economic right now is still sustained by oil and gas export although reserve coal is getting dwindling. There is stagnant inclination on oil and gas production in a long term. This is because of some factors such as oil and gas wells which operated now is already old, new well discovery is very slightly, process over technology in oil and gas sector doesn't work well, geopolitics situation that unstable, etc.

On the other side, Indonesian primary energy consume has been increase 50% in the last one decade. As many as 30% from Indonesian total primary energy consume is still come from oil, this make Indonesia become an oil importing country.

In second quarterly report year 2013, estimated that oil and gas reserve is on decline trend in the upcoming decade. Oil reserve is estimated decrease from the estimation 3,9 billion barrel (bbl) in last 2012 become 3,5 billion bbl in 2017, decrease again into 3,3 billion bbl in 2022. For gas, reserve is estimated flat remain at approximately 3,9 trillion meter cubic (TCM) until 2018, down slightly to 3,8 TCM except drilling activity rate is increase.

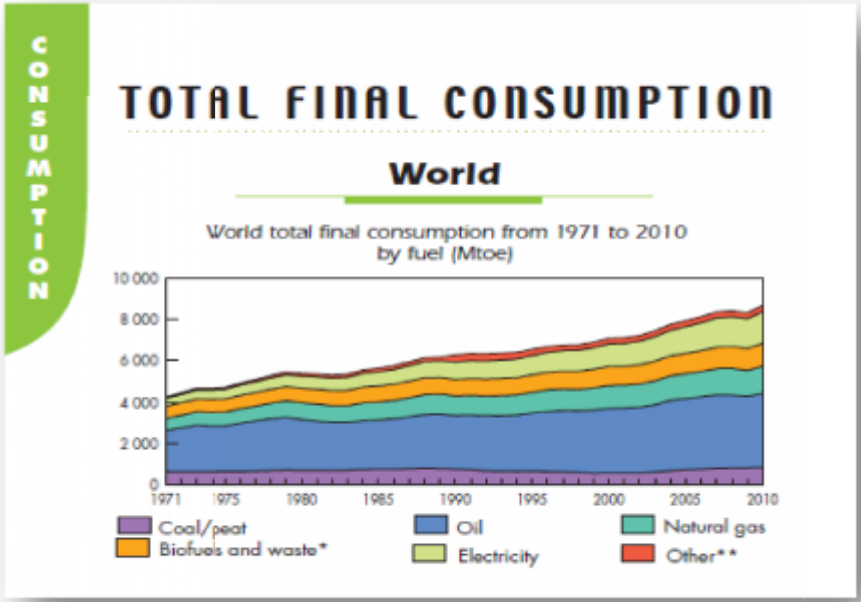
Looking that above condition, there is imbalance between demand side and supply side. Energy needs are getting increase while on the other side energy sources production is getting decrease. Therefore, it needs pro active and systematic actions to anticipate this imbalance by reducing dependence on oil and gas, and soon change over to alternative energy sources, either from new energy or renewable energy.

Liquid coal is one of new energy source that has promising enough potency and has some surplus if compare to other energy

source. Liquid coal is obtainable from coal liquefaction process (hydrogenation) which then producing synthetic fuel material. Fuel material from this liquid coal can substitute the fuel material that is obtained from non renewable energy source (fossil) that this reserve current tends to be decrease.

Seeing the abundant coal potency in Indonesia, especially in Kalimantan island and Sumatera island (in other region can be seen coal even in small number, like in West Java, Central Java, Papua, and Sulawesi), should this abundant number is being used also to process this coal into liquid coal which then can be use into fuel.

Chart 1
World Final Energy Consumption
(1971 until 2010)



Beside the abundant resource number, liquid coal market segment as a fuel is also very prospective in the future. From the record of International Energy Agency (IEA) year 2012, show that world energy consumption always increasing every year and getting extravagant, although in some country like in Indonesia being

intensive in setting energy saving programmed. Energy consumption from year 1971 until 2010 is shown on Chart 1. While the fuel type proportion is shown on Chart 2.

Chart 2
The Percentage of Each Fuel Type that Supply World Energy

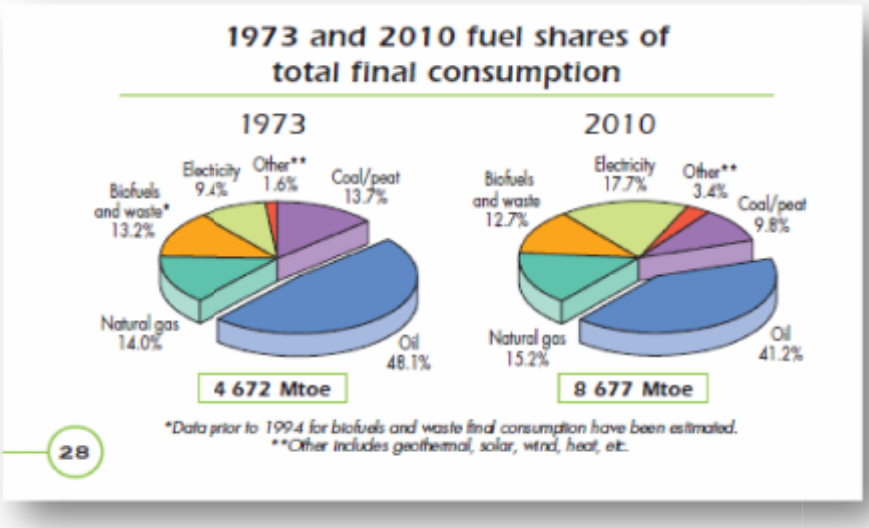
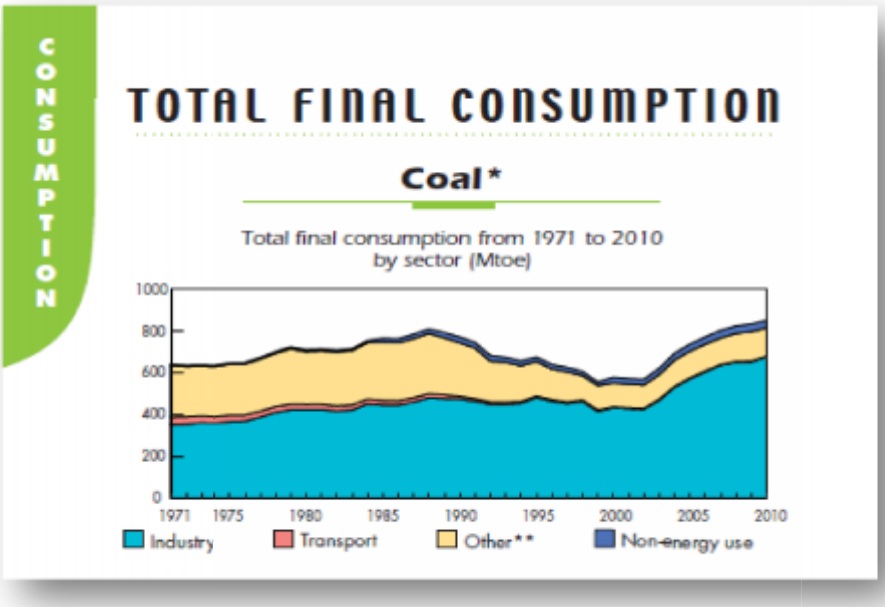


Chart 3.
Final Energy Consumer that Come From Coal



Coal role as world energy contributors has reduced its role from year 1973 until 2010. That increase significantly is other sources which includes new energy source and renewable.

For energy consumer from coal, until year 2010 was dominated by industry including powerhouse. Consumption by user from 1971 until 2012 relatively increases. For more detail it can be shown on Chart 3.

The advantages owned by liquid coal cause this commodity need to be developed immediately to anticipate the rises of world energy consumption in the future.

2.2. Coal Processing Technology

According to Muchjidin (2005), "Coal is sediment rock that chemically and physically is heterogenic and contains of carbon, hydrogen and oxygen elements as a main element and sulphur also nitrogen as an additional element. Other substance, that is framer organic compound "ash" spread as mineral substance particle and separate in whole coal compound. Physically, coal tends to solid and black. Coal can be changed into another form such as gas and liquid to produce new product which can be used again to several needs. The conversion of coal can be done with two ways that are by gas manufacturing or gasification (coal gasification). While changing the physic form of coal from solid to liquid or abbreviated coal liquefaction enable coal to be used as an alternative of fuel.

There are two different methods to change coal into liquid fuel:

1. **Direct Liquefaction**

   Direct Liquefaction is done by dissolving coal in a solvent at high temperature and pressure. This process is very efficient, but the liquid product that is produced needs further purification to reach world class fuel characteristic.

2. **Indirect Liquefaction**

   Indirect liquefaction is done by coal gasification to form "syngas" (mixture of hydrogen and carbon monoxide). This

syngas then compacted with a catalyst to produce quality high ultra-clean product. One of this coal liquefaction types is 'Fischer-Tropsch process.

For the liquefaction technology, there are 3 (three) kinds of coal liquefaction that can be used, that are:

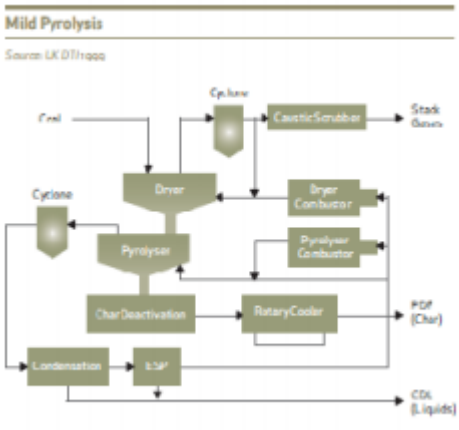
1. Carbonization and Pyrolisis

Carbonization with high temperature is an oldest coal liquefaction process. Coal was heated until 950° in a container- where on the inside occurs decomposition process and free radicals were push outside. This is the thaw of kokas manufacturing process, and liquid hydrocarbon (coal tar = tar charcoal) is a dominant product on this process.

This carbonization process is using high relative cost with the very poor result. Therefore, the resulting coal tar isn't economic if it used for general fuel transportation. This coal tar is used widely for producing roof, waterproofing and insulating compound and as a raw material for dye, medicine and paint.

Mild pyrolysis is carbonization process on lower temperature or decomposition process. Coal is heated on the temperature between 450°C and 650°C, release substances that easily blow (volatile matter) and forming other mix substances through thermal decomposition process.

Figure 1
Carbonization and Pyrolisis Process



Fluid raw material that is produced has higher quality if compare to carbonization process at high temperature but maximum is only until 20%. The main result is charcoal. This process has been used in United States to

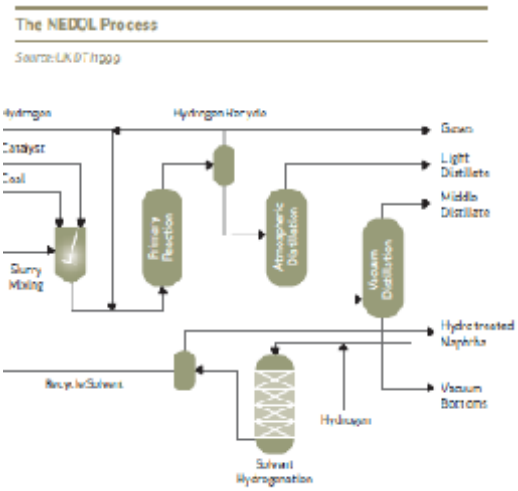
raise the calorie value of low-rank sub-bituminous coal and also to reduce the sulphur content. To accelerate pyrolisis process is done by inserting coal in container with the temperature approximately 1200°C, but only in a few seconds only. This aim process is only to produce mix chemical substance, not to produce liquid fuel. Carbonization and pyrolisis producing liquid fuel in small proportion from the whole production and still needed further treatment to produce fuel. Pilot processing station has been built in United States (operated in year 1992 until 1997) to up-grade calorie value.

2. Direct Liquefaction

This process is done with refining the grain size of coal. Then slurry (coal powder) made with mixing this coal with a solvent. Slurry is inserting into high pressure reactor together with hydrogen by using pump. Then slurry is given pressure 100-300 atm in a reactor then heated until the temperature reach 400-480°C.

There are some methods in direct liquefaction, but the basic process is dissolving coal at high temperature and pressure continued with hydro cracking process (that is by adding hydrogen on a catalyst).

Figure 2
Direct Liquefaction Process

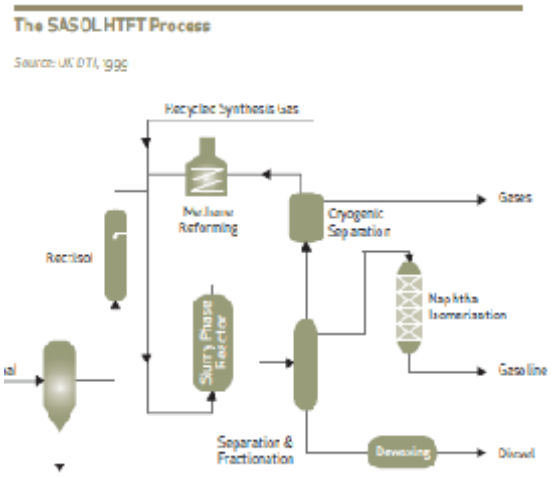


On this direct liquefaction process, fluid result from this process can exceed 70% from the weight dry coal, with the heat efficiency reach approximately 60-70%. While its quality, is higher if compare to pyrolisis

process. Besides that, the result can be use as a fuel mixer substance in a powerhouse or some other needs. Nevertheless, it need further process to produce fuel that designated for the fuel at transportation sector. There are two groups in direct liquefaction process that are:

- Single-stage: producing liquid raw material that have been distilled (distillates) through one main reactor or chain reactor. Mostly, in this process have been changed into two-stage process to increase light oil production.
- Two-stage: producing liquid raw material that have been distilled (distillates) through two reactors or chain reactor. Early reaction process is by dissolving coal either without catalyst or with low activity catalyst, then finally produce weight liquid coal. This is the further treatment in the second reactor, by using hydrogen and high activity catalyst to produce additional distillation.

Figure 3
Kohleoel and NEDOL Process



The number of process at single-stage technology has been developed- including Kohleoel, Nexxon Donor Solvent, SRC< Imhausen and Conoco, but not yet realized commercially.

Kohleoel and NEDOL process are considered to be further developed, and Economic, Trade and Industry Ministry of Japan expecting that this technology being transferred to China towards the end of this decade. Coal and a catalyst based on synthetic iron is a basic

component then mixed with solvent to form coal granule/ powder. Then mixed with hydrogen and heated before inserting to the main reactor, which operated on the temperature 450°C and pressure 170 bars. Product that has been result is cooled, depressurized and distilled to provide a light product. Medium and heavy distillates are produced via the vacuum distillation column, and some used to provide the solvent for the initial slurrying step.

Two-stage process often obtained from single-stage reaction process – The liquefaction process of Catalytic Two-Stage is developed from H-Coal single stage. This technology is one chosen by the Shenhua's Inner Mongolia plant in China, because it is appropriate with HTI Direct Coal Liquefaction Technology. Coal that has been milled is being crash into powder in re-dissolution process, then early being heated, mixed with hydrogen and being inserted into the first reactor, which those reactor is operated on a special condition that is on the temperature 435-460°C and pressure 170 bar. The second reactor which completing the liquefaction process, and those second reactor is operated on the higher temperature. Catalyst reaction for those two process (single and two stage) is on nano scale, iron based, spread in granule/powder (slurry).

3. IndIrect Liquefaction

Indirect liquefaction involves the complete breakdown of the coal structure by gasification with steam. Composition of synthetic gas or 'syngas' is regulated to give balance that is needed between hydrogen and carbon monoxide. Sulphur compound also be taken out in this process to avoid intoxication on reaction catalyst and also to produce fuel transportation with low sulphur content.

Gas synthetic (syngas) then has been reacted on a catalyst with relative low temperature and pressure. Product result are varied,

depends on reaction condition and its catalyst. Methanol, as a sample, is obtained by using copper as a catalyst (on 260-350°C and 50-70 bars). The only one indirect coal liquefaction process that operated on commercial scale only exists in Sasol, South Africa.

Coal liquefaction in Sasol is based on Fischer-Tropsch (FT) process. Sasol use either FT process with low temperature (fixed bed gasification, slurry-phase FT) or high temperature FT (HTFT) and combine circulating fluidised bed gasification, and Sasol Advanced Synthol Technology. HTFT process is operated on temperature 300-350°C and pressure 20-30 bar, with iron based catalyst, and produce a product with the appropriate lightness level, including high quality clean gasoline, petrochemical, and oxygenated chemicals.

2.3. Market and Competitor

a. Producing country and liquid coal importer.

Coal currently supply approximately 30,3% from whole primary energy that world consumed, and 42% powerhouse is using coal as a fuel (IAE Report, 2012). Indonesia include in 10 countries that produce the biggest coal in the world. Countries that include in the big 10 coal producing (in Mt-2011-e, Million Tonnes-estimation year 2011) are 1. PR China (3.471 Mt), 2. USA (1.004 Mt), 3. India (585 Mt), 4. Australia (414 Mt), 5. Indonesia (376 Mt), 6 Russia (334 Mt), 7. South Africa (253 Mt), 8. Germany (189 Mt), 9. Poland (139 Mt), and 10. Kazakhstan (117 Mt). Beside Indonesia is included in the biggest coal exporter country and noted that in year 2011 Indonesia had importing coal as much as 309 Mt.

Coal export market (coal importer) is 1. PR China (190 Mt), 2. Japan (175 Mt), 3. South Korea (129 Mt), 4. India (105 Mt), 5. Chinese Tapei (66 Mt), 6. Germany (41 Mt), dan 7. UK (33 Mt).

From some biggest coal producing country in the world, generally they have developed coal not only as an export commodity but also had been developed to fulfill domestic needs.

Attention on liquid coal as a fuel transportation is very favored. There are three countries that have abundant coal resources but limited on oil and gas resources that very intense in developing this fuel, that is China, India, and United States. Besides that, Japan as big industrial country has developed this liquid coal technology either for those technology development needs or commercial needs even though still in small scale. Other countries who also interested in developing this commodity such as Australia, Botswana, German, Mongolia, Philippine, England, South Africa, also including Indonesia.

Country was considered successful in developing this liquid coal is South Africa. South Africa had produced fuel that derived from this coal since year 1995 and become the only one liquid coal processing commercial industry activity that operated now. Not only to be used for car and other vehicles, this liquid coal fuel that produced from Sasol energy company, South Africa, also have license to be used in commercial jet. Approximately 30% from gasoline and diesel needs in South Africa is produced from coal. Noted that total capacity from liquid coal processing company reach more than 160.000 bbl/d.

If compare with Indonesia, coal reserve number in South Africa is smaller than in Indonesia. Noted that South Africa produce coal more than 253 Million ton (IEA, 2011 estimate) and contribute almost ¾ from total energy that domestic consumed. Approximately 77% of South Africa energy needs directly obtained from coal and 92% from coal consumption in Africa land is supplied from South Africa.

Beside South Africa, China has also produces liquid coal for fuel. The biggest company in China, Shen Hua Group, cooperate with United States company, Headwaters Technology Innovation (HTI), had produced liquid coal for transportation and basic industry sectors, and using coal supply since year 2007.

Beside South Africa and China, German had also developed liquid coal and even German is the first country who developed the production of synthetic fuel based on coal since year 1900 by using Fischer-Tropsch synthesis process that developed by Franz and Hans Tropsch. In 1930, besides using Fisher-Tropsch synthesis process method began to be developed Bergius process to produce synthetic fuel.

Meanwhile, Japan also initiative in liquid coal technology development through Sunshine project on year 1974 as an alternative energy development to substitute petroleum. In 1983, (the New Energy Development Organization), organization that focused on development technology to produce new energy also success in developing bituminous coal liquefaction technology by using three process, that are solvolysis system, solvent extraction system and direct hydrogenation to liquefy bituminous coal.

b. Development potency of liquid coal utilization

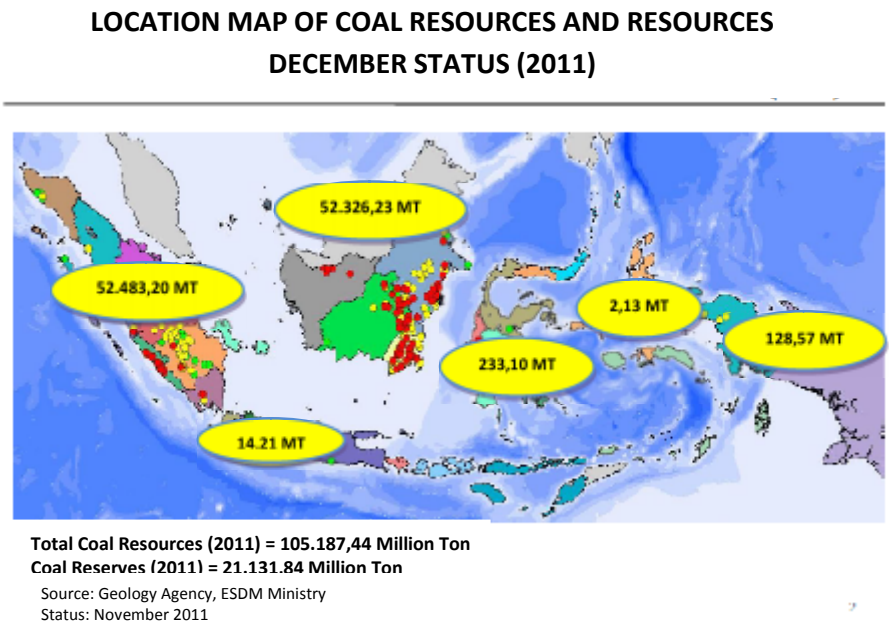
There are two methods that is approved by world in determine world coal reserve number. The first is method that issued by the German Federal Institute for Geosciences and Natural Resources (BGR). This method is used by International Energy Agency (IAE) as a main source in giving information about coal reserve. The second is issued by the World Energy Council (WEC) and used by the BP Statistical Review of World Energy. According to BGR, there is extant 1.004 Billion ton of remaining coal reserve.

In "Indonesian Coal Statistic Year 2012" which issued by Geology Agency of Energy and Mineral Resource Ministry (ESDM), noted

that Indonesian coal reserve number until November 2011 as many as 105.187,44 Million Ton. While the total reserve as many as 21.131, 84 Million Ton. Location Map of Indonesian Coal and Reserve Distribution on December 2011 are shown on Figure 1.

Indonesian coal resources and reserves number in year 2011 according to Geology Resource Center calculation, Mineral Resource and Energy Department as big as 120.338,60 Million ton. Those coal resources are spread in 20 provinces (Hand book of Energy and Economic Statistics of Indonesia, 2012 – on January 2011). See Table 2.

Figure 4
Location Map of Coal and Reserve Distribution
on December 2011



From the total of existing coal resource, the number of coal that had been produced until year 2011 as big as 353.387.341 Ton and already export as big as 272.671.351 Ton. Complete data can be shown on Table 1.

Table 1
Coal Supply (2004 – 2012)

Ton

Year	Production	Export	Import	Domestic
2004	132.352.025	93.758.806	97.183	36.081.734
2005	152.722.438	110.789.700	98.179	41.350.736
2006	193.761.311	143.632.865	110.683	48.995.069
2007	216.946.699	163.000.000	67.534	61.470.000
2008	240.249.968	191.430.218	106.931	53.473.252
2009	256.181.000	198.366.000	68.804	56.295.000
2010	275.164.196	208.000.000	55.230	67.000.000
2011	353.387.341	272.671.351	42.449	79.557.800
2012*	76.816.644	50.262.819		24.690.385

Source: Gerenal Directorate of Coal Mining, Pusdatin Proceed

* Temporary

From production aspect, on Chart 1 show that Indonesian coal production number from year 2004 until year 2011 and the number always increasing that is from 132.352.025 Ton in year 2004 become 353.387.341 Ton in year 2011 or having average growth from year 2004 until year 2011 as big as 15,35%. While the export coal number also increase from year 2004 as many as 93.758.806 Ton become 272.671.351 Ton in year 2011.

Chart 4
Indonesian Coal Condition from 2004 until 2011

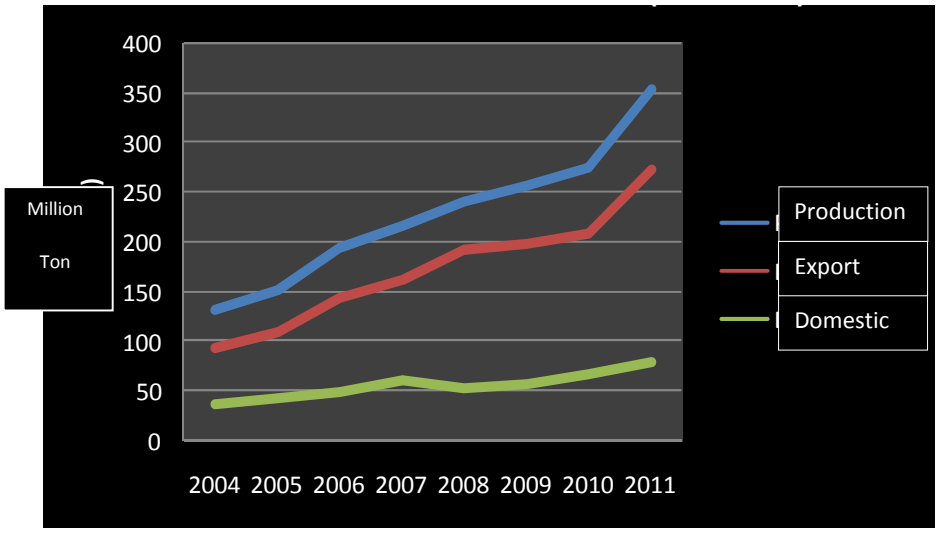


Table 2
The Number of Coal Resource and Reserve in Some Province Year 2011 (Million Ton)

Province	Resources					
	Hypothetic	Inferred	Indicated	Measured	Total	Reserves
Banten	5,47	5,75	4,86	2,72	18,80	0,00
West Java	0,00	0,00	0,00	0,00	0,00	0,00
Central Java	0,00	0,82	0,00	0,00	0,82	0,00
East Java	0,00	0,08	0,00	0,00	0,08	0,00
Nanggroe Aceh Darussaalam	0,00	346,35	13,40	90,40	450,15	0,00
NorthSumatera	0,00	7,00	0,00	19,97	26,97	0,00
Riau	12,79	168,06	626,38	948,05	1755,27	645,67
West Sumatera	24,95	294,50	231,16	249,45	800,06	158,43
Bengkulu	15,15	17,86	104,08	71,21	208,30	19,02
Jambi	190,84	656,90	699,08	443,50	1990,32	351,65
SouthSumatera	19909,99	14508,95	14808,82	10026,59	59254,35	13625,22
Lampung	0,00	106,95	0,00	0,00	106,95	0,00
West Kalimantan	0,00	477,69	6,85	4,70	489,24	0,00
Central Kalimantan	197,58	1838,50	808,28	704,89	3549,25	577,42
South Kalimantan	0,00	3833,53	3344,05	3481,66	10659,24	3778,04
East Kalimantan	13101,53	13276,66	6286,62	8004,19	40665,00	8861,90
South Sulawesi	0,00	48,81	129,22	53,09	231,12	0,12
Central Sulawesi	0,00	1,98	0,00	0,00	1,98	0,00
North Maluku	2,13	0,00	0,00	0,00	2,13	0,00
West Irian	95,59	32,82	0,00	0,00	2,16	0,00
Papua	0,00	2,16	0,00	0,00	2,16	0,00
TOTAL	33554,03	35625,36	27058,79	24100,42	120338,60	28017,46

Source : Geologycal Agencies (treated)

East Kalimantan province is including to region that have the biggest resources and take the second place after South Sumatera province. The number of resource and reserve in East Kalimantan province each **40.665 Million Ton** and **8.861,90 Million Ton**.

Some of coal mining company in East Kalimantan has been operated by holding mining business license. The number of resource and reserve also mining company that operated in East Kalimantan are shown on Table 3 and Table 4.

Table 3
The Number of Resource and Reserve in Every Regency/ City
in East Kalimantan Province (Ton)

No	Regency/ City	Year 2011		Year 2012	
		Resources	Reserves	Resources	Reserves
1	Samarinda	1.323.877.815	516.371.655	576.154.570	275.010.550
2	Kukar	5.055.959.110	1.711.650.625	6.281.747.672	2.000.040.517
3	East Kutai	15.528.827.097	4.107.882.421	17.618.457.436	4.927.606.027
4	West Kutai	1.274.670.043	196.585.418	1.559.335.685	204.287.116
5	Ppu	30.103.695		30.103.695	307.793
6	Paser	1.204.367.708	745.163.040	1.204.367.708	745.163.040
7	Berau	2.969.013.631	395.332.484	2.969.013.631	395.332.484
8	Bulungan	1.345.858.388	576.336.224	1.345.858.388	576.336.224
9	Nunukan	90.809.478	30.482.845	95.979.872	75.141.552
10	Malinau	103.963.600	54.550.800	136.251.160	45.182.148
11	Tana Tidung	-	-	-	-
12	Bontang	-	-	-	-
13	Balikpapan	-	-	-	-
14	Tarakan	-	-	-	-
Total		**28.927.450.565**	**8.334.355.512**	**31.817.269.817**	**9.244.407.451**

Table 4
Mining Company that Operated in East Kalimantan Province

No	Company's Name	Act. Location (Regency)	Wide Area (Ha)	Stages	Generation
1	PT. Berau Coal	Berau	118.400,00	Exploitation	**I**
2	PT. BHP	Paser	1.869,00	Close Mining	**I**
3	PT. Indominco Mandiri	East Kutai, Bontang & Kutai Kartanegara	25.121,00	Exploitation	**I**
4	PT. Kaltim Prima Coal	East Kutai	90.938,00	Exploitation	**I**
5	PT. Kideco Jaya Agung	Paser	50.400,00	Exploitation	**I**
6	PT. Multi Harapan Utama	Kutai Kartanegara & Samarinda	47.232,35	Exploitation	**I**

7	PT. Tanito Harum	Kukar Kutai Kartanegara	35.757,00	Exploitation	**I**
8	PT. Gunung Bayan PC	West Kutai	33.940,00	Exploitation	**II**
9	PT. Indexim Coalindo	East Kutai	24.050,00	Exploitation	**II**
10	PT. Kartika Selabumi Mining	Kutai Kartanegara	4.600,30	Exploitation	**II**
11	PT. Mandiri Inti Perkasa	Nunukan & Bulungan	9.240,00	Exploitation	**II**
12	PT. Trubaindo Coal Mining	West Kutai	23.650,00	Exploitation	**II**
13	PT. Bharinto Ekatama	West Kutai (East Kalimantan) & Central Kalimantan	22.000,00	Construction	**III**
14	PT. Dharma Puspita Mining	Kutai Kartanegara	2.811,00	Exploitation	**III**
15	PT. Firman Ketaun Perkasa	West Kutai	24.840,00	Exploitation	**III**
16	PT. Insani Bara Perkasa	Kutai Kartanegara & Samarinda	24.477,60	Exploitation	**III**
17	PT. Interex Sacra Raya	Paser	15.650,00	Exploitation	**III**
18	PT. Lahai Coal	West Kutai & Barut	46.620,00	Exploration	**III**
19	PT. Lana Harita Indonesia	Kutai Kartanegara & Samarinda	14.690,00	Exploitation	**III**
20	PT. Mahakam Sumber Jaya	Kutai Kartanegara & Samarinda	20.380,00	Exploitation	**III**
21	PT. Maruwai Coal	West Kutai & Barut	48.860,00	Construction	**III**
22	PT. Pari Coal	West Kutai	38.040,00	Exploration	**III**
23	PT. Perkasa Inakakerta	East Kutai	10.110,00	Exploitation	**III**
24	PT. Pesona Khatulistiwa	Bulungan	23.646,00	Exploration	**III**
25	PT. Ratah Coal	West Kutai	36.490,00	Exploration	**III**
26	PT. Santan Batubara	Kutai Kartanegara & Samarinda	24.930,00	Exploitation	**III**
27	PT. Singlurus Pratama	Kutai Kartanegara & Balikpapan	5.619,00	Exploitation	**III**
28	PT. Tambang Damai	East Kutai & Bontang	97.580,00	Exploitation	**III**

29	PT. Teguh Sinar Abadi	West Kutai	2.404,00	Exploitation	**III**
30	PT. Delma Mining Corp	Berau & Bulungan	20.160,00	Construction	**III**
31	PT. Batubara Selaras Sapta	Paser	68.360,00	Exploration	**III**
32	PT. Bumi Laksana Perkasa	East Kutai	11.330,00	Exploration	**III**
33	PT. Sumber Barito Coal	West Kutai	44.650,00	Exploration	**III**
	Total		**1.068.845,25**		

c. Potency of Liquid Coal Production in Indonesia

Coal production in Indonesian mostly being exported to the main destination countries like China, Korea, and Japan. From Table 1 show that Indonesian coal export until year 2011 reach 272.671351 Ton with the production at the same year as big as 353.387.341 Ton. While for the reserve number noted that 104,8 billion ton which if produced reach 500 million ton every year, then the coal reserves is estimated will empty about 200 years later.

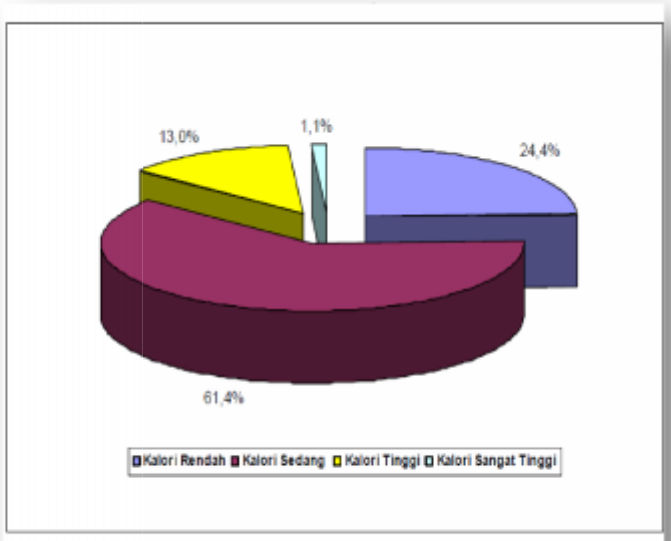
With that coal potency, Indonesia has opportunity to develop liquid coal into fuel substitute that during this always causing problems. Besides that, development of liquid coal for this fuel can be an alternative solution in facing world energy problems in the future.

How big of coal potency can be processed into liquid coal in Indonesia? This question is so interesting, remembering that the exist coal type has specific characteristics especially about the calorie content.

An article issued by Department of Chemical Technology for Energy Source, East China University of Science, and Technology China, conclude that coal liquefaction result depends either from molecular structure and chemical content or from petrography composition and the material. Young bituminous and old lignite

are very suitable to be processed into liquid coal. Besides that, some references are using calorie content as a referral which coal with low calorie value is more prospective than coal with high calorie value

Chart 5
Indonesian Coal Quality Distribution Based on Calorie at Year 2005



Sumber : Pusat Sumber Daya Geologi, 2006, diolah kembali

Table 5
Quality of Indonesian Coal Resources and Reserves in Every Province, 2006 (be proceed)

No.	Province	Quality		Resources (Million Ton)					Reserves (Million Ton)
		Class	Criteria cal/gr.adb	Hypothetic	Inferred	Indicated	Measured	Total	
1	BANTEN	Medium Calorie	5100 - 6100	5,47	2,78	0,00	0,00	8,25	0,00
		High Calorie	6100 - 7100	0,00	2,97	0,00	0,00	2,97	0,00
				5,47	**5,75**	**0,00**	**0,00**	**11,22**	**0,00**
2	CENTRAL JAVA	Low Calorie	< 5100	0,00	0,82	0,00	0,00	0,82	0,00
				0,00	**0,82**	**0,00**	**0,00**	**0,82**	**0,00**
3	EAST JAVA	Medium Calorie	5100 - 6100	0,00	0,08	0,00	0,00	0,08	0,00
				0,00	**0,08**	**0,00**	**0,00**	**0,08**	**0,00**
4	NANGROE ACEH DARUSALAM	Low Calorie	< 5100	0,00	20,92	6,70	64,14	91,76	0,00
		Medium Calorie	5100 - 6100	0,00	325,43	6,70	26,26	358,39	0,00
				0,00	**346,35**	**13,40**	**90,40**	**450,15**	**0,00**
5	NORTH SUMATERA	Low Calorie	< 5100	0,00	0,00	0,00	19,97	19,97	0,00
		Medium Calorie	5100 - 6100	0,00	7,00	0,00	0,00	7,00	0,00
				0,00	**7,00**	**0,00**	**19,97**	**26,97**	**0,00**
6	RIAU	Low Calorie	< 5100	0,00	1345,69	0,00	268,06	1613,75	0,00
		Medium Calorie	5100 - 6100	0,00	30,62	0,00	51,57	82,19	0,00
		High Calorie	6100 - 7100	12,79	359,60	0,00	16,99	389,38	16,54
				12,79	**1735,91**	**0,00**	**336,62**	**2085,32**	**16,54**
7	WEST SUMATERA	Medium Calorie	5100 - 6100	19,19	284,36	42,72	22,97	369,24	2,83
		High Calorie	6100 - 7100	5,76	164,58	0,00	144,27	314,61	19,24
		Very High Calorie	> 7100	0,00	27,00	0,00	14,00	41,00	14,00
				24,95	**475,94**	**42,72**	**181,24**	**724,85**	**36,07**
8	JAMBI	Low Calorie	< 5100	0	51,13	0,00	0,00	51,13	0,00
		Medium Calorie	5100 - 6100	190,84	1200,09	36,32	90,24	1517,49	18,00
		High Calorie	6100 - 7100	0	210,81	0,00	82,96	293,77	0,00
				190,84	**1462,03**	**36,32**	**173,20**	**1862,39**	**18,00**

Sequel Table 5

No.	Province	Quality		Resources (Million Ton)					Reserves (Million Ton)
		Class	Criteria cal/gr.adb	Hypothetic	Inferred	Indicated	Measured	Total	
9	BENGKULU	Low Calorie	< 5100	0,00	11,34	0,00	10,58	21,92	0,00
		Medium Calorie	5100 - 6100	0,00	0,81	0,00	5,86	6,67	3,79
		High Calorie	6100 - 7100	15,15	100,62	8,11	45,49	169,37	17,33
		Very High Calorie	> 7100	0,00	0,32	0,00	0,37	0,69	0,00
				15,15	**113,09**	**8,11**	**62,30**	**198,65**	**21,12**
10	SOUTH SUMATERA	Low Calorie	< 5100	326,55	7400,27	2300,07	1358,00	11384,89	2426,00
		Medium Calorie	5100 - 6100	198,93	1629,28	9139,87	366,01	11334,09	186,00
		High Calorie	6100 - 7100	0,00	31,00	433,89	14,00	478,89	67,00
				525,48	**9060,55**	**11873,83**	**1738,01**	**23197,87**	**2679,00**
11	LAMPUNG	Medium Calorie	5100 - 6100	0,00	14,00	0,00	0,00	14,00	0,00
		High Calorie	6100 - 7100	0,00	92,95	0,00	0,00	92,95	0,00
				0,00	**106,95**	**0,00**	**0,00**	**106,95**	**0,00**
12	WEST KALIMANTAN	High Calorie	6100 - 7100	42,12	378,60	0,00	0,00	420,72	0,00
		Very High Calorie	> 7100	0,00	104,00	1,32	1,48	106,80	0,00
				42,12	**482,60**	**1,32**	**1,48**	**527,52**	**0,00**
13	CENTRAL KALIMANTAN	Low Calorie	< 5100	0,00	483,92	0,00	0,00	483,92	0,00
		Medium Calorie	5100 - 6100	0,00	296,75	5,08	44,36	346,19	4,05
		High Calorie	6100 - 7100	114,11	262,72	0,00	72,64	449,47	0,00
		Very High Calorie	> 7100	0,00	247,62	0,00	77,02	324,64	44,54
				114,11	**1291,01**	**5,08**	**194,02**	**1604,22**	**48,59**
14	SOUTH KALIMANTAN	Low Calorie	< 5100	0,00	370,87	0,00	600,99	971,86	536,33
		Medium Calorie	5100 - 6100	0,00	4793,13	301,36	2526,46	7620,95	1287,01
		High Calorie	6100 - 7100	0,00	336,19	33,12	109,64	478,95	44,36
		Very High Calorie	> 7100	0,00	17,62	0,00	12,00	29,62	0,14
				0,00	**5517,81**	**334,48**	**3249,09**	**9101,38**	**1867,84**

Sequel Table 5

No.	Province	Quality		Resources (Million Ton)					Reserves (Million Ton)
		Class	Criteria cal/gr.adb	Hypothetic	Inferred	Indicated	Measured	Total	
15	EAST KALIMANTAN	Low Calorie	< 5100	0,00	201,93	13,76	89,83	305,52	0,00
		Medium Calorie	5100 - 6100	2285,84	10630,35	121,61	2609,46	15647,26	941,62
		High Calorie	6100 - 7100	502,96	2611,07	191,77	1558,62	4864,42	1064,82
		Very High Calorie	> 7100	90,11	60,84	4,48	14,40	169,83	65,24
				2878,91	**13504,19**	**331,62**	**4272,31**	**20987,03**	**2071,68**
16	SOUTH SULAWESI	Medium Calorie	5100 - 6100	0,00	131,03	32,31	53,10	216,44	0,06
		High Calorie	6100 - 7100	0,00	13,90	0,78	0,00	14,68	0,00
				0,00	**144,93**	**33,09**	**53,10**	**231,12**	**0,06**
17	CENTRAL SULAWESI	Low Calorie	< 5100	0,00	1,98	0,00	0,00	1,98	0,00
				0,00	**1,98**	**0,00**	**0,00**	**1,98**	**0,00**
18	NORTH MALUKU	Low Calorie	< 5100	0,00	2,13	0,00	0,00	2,13	0,00
				0,00	**2,13**	**0,00**	**0,00**	**2,13**	**0,00**
19	WEST PAPUA	Medium Calorie	5100 - 6100	89,40	30,95	0,00	0,00	120,35	0,00
		High Calorie	6100 - 7100	0,00	5,38	0,00	0,00	5,38	0,00
		Very High Calorie	> 7100	0,00	25,53	0,00	0,00	25,53	0,00
				89,40	**61,86**	**0,00**	**0,00**	**151,26**	**0,00**
COAL RESOURCES NUMBER IN EVERY PROVINCE				**3899,22**	**34320,98**	**12679,97**	**10391,71**	**61269,78**	**6758,90**

Source: Geology Resource Center, 2006

From Chart 2 and Table 5 show the coal reserve number in Indonesia is 24,4% for low calorie. If the liquid coal processing is focused on low calorie coal and only takes 50% from 24,4% from existing reserve, then reserve number that can be processed into liquid coal with total reserve number assumption as big as **6.758,90 Million Ton (data year 2005)** is approximately 800 Million Ton.

If it assumed that in 1 ton of coal can be converted into 2 barrels gasoline, then will produce gasoline approximately 1.600 Million barrel or 254.400.000.000 liter. This value could certainly be improved if there is policy and strong commitment from all party to develop this coal liquefaction programmed becomes more intensive. Besides that, this value can be increased by adding coal with medium calorie which its number is bigger that is approximately 61,4%.

d. Development of coal prices in Indonesia

Development of coal prices will influence the coal liquefaction investment opportunity. According to Directorate General of Mineral and Coal, coal prices development during year 2009-2911 are shown on this table below:

Table 6
Coal Prices Development in Indonesia Year 2009-2011

Year	Coal Prices (USD/ton)								
	HBA CV 6.322	CV 7.000	CV 6.700	CV 6.150	CV 5.700	CV 5.400	CV 5.000	CV 4.400	CV 4.200
2009	70.70	75.97	75.26	67.88	57.73	55.07	51.21	41.27	38.30
2010	91.74	98.78	96.61	87.07	74.75	70.21	64.60	52.19	47.70
2011	118.40	128.08	125.16	112.80	96.89	90.93	83.61	67.43	61.05

Note:

Realisation price of PKP2B and IUP has represented by HBA and coal marker in one year because forecast price which doing by coal prices index publisher is set based on real price in a field

Source: Directorate General of Mineral and Coal

Chart 6
Indonesian Reference Coal Prices Development during 1 Year in USD
(GCV 6322 kcal/kg gar; Average 4 Index in Calorie Equality in US$/ton, FOB Vessel)

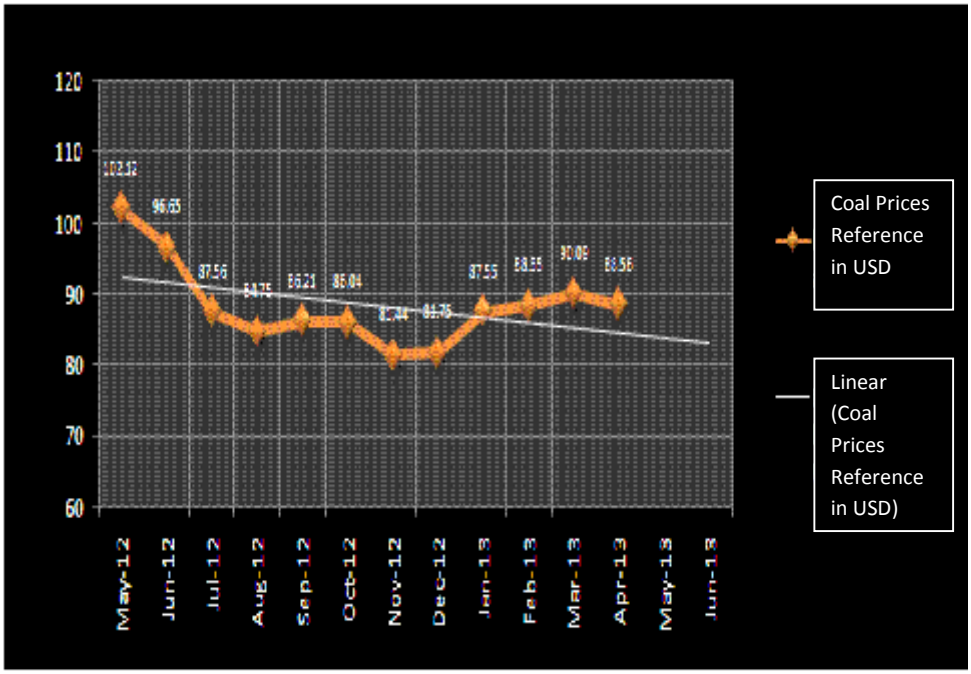


Table 7
Indonesian Reference Coal Prices Development during 1 Year in USD
(GCV 6322 kcal/kg gar; Average 4 Index in Calorie Equality in US$/ton, FOB Vessel)

No	Month	Price (USD/ton)	Increase/Decrease (%)
1	Jan-13	109.29	-3
2	Feb-13	111.58	2.1
3	Mar-13	112.87	1.16
4	Apr-13	106.61	-5.55
5	May-13	102.12	-4.21
6	Jun-13	96.65	-5.36
7	Jul-13	87.56	-9.41
8	Aug-12	84.75	-3.21
9	Sep-13	86.21	1.72
10	Oct-12	86.04	-0.2
11	Nov-13	81.44	-5.35
12	Dec-12	81.75	0.38

Chart 7
Indonesian Reference Coal Prices Development during 1 Year in USD
(GCV 6322 kcal/kg gar; Average 4 Index in Calorie Equality in US$/ton, FOB Vessel)

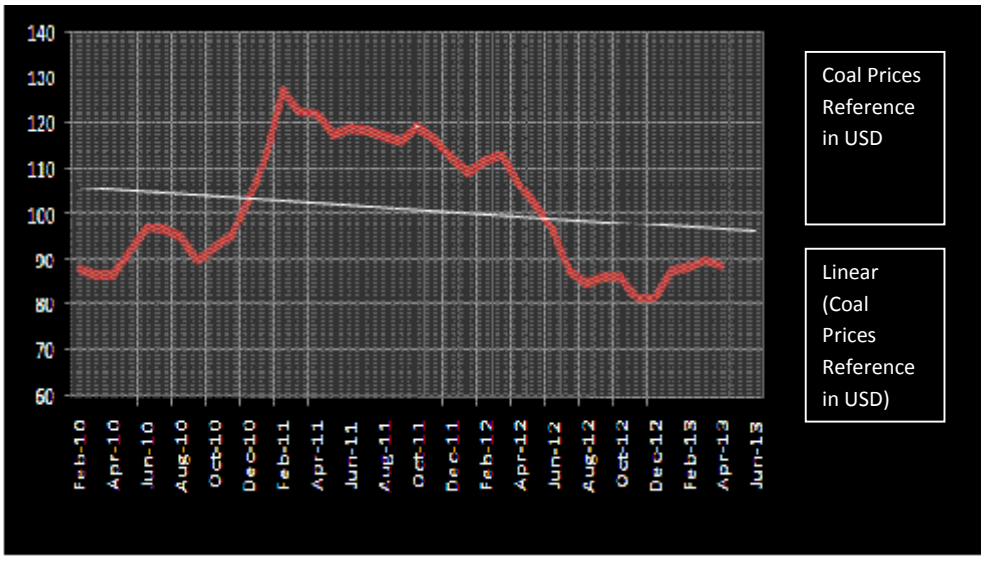


Table 8
Indonesian Reference Coal Prices Development during 1 Year in USD
(GCV 6322 kcal/kg gar; Average 4 Index in Calorie Equality in US$/ton, FOB Vessel)

No	Month	Price (USD/ton)	Increase/Decrease (%)
1	Feb-10	87.81	
2	Mar-10	86.64	-1.33
3	Apr-10	86.58	-0.07
4	May-10	92.07	6.34
5	Jun-10	97.22	5.59
6	Jul-10	96.65	-0.59
7	Aug-10	94.86	-1.85
8	Sep-10	90.05	-5.07
9	Oct-10	92.68	2.92
10	Nov-10	95.51	3.05
11	Dec-10	103.41	8.27

12	Jan-11	112.4	8.69
13	Feb-11	127.05	13.03
14	Mar-11	122.43	-3.64
15	Apr-11	122.02	-0.33
16	May-11	117.61	-3.61
17	Jun-11	119.03	1.21
18	Jul-11	118.24	-0.66
19	Aug-11	117.21	-0.87
20	Sep-11	116.26	-0.81
21	Oct-11	119.24	2.56
22	Nov-11	116.65	-2.17
23	Dec-11	112.67	-3.41
24	Jan-12	109.29	-3
25	Feb-12	111.58	2.1
26	Mar-12	112.87	1.16
27	Apr-12	106.61	-5.55
28	May-12	102.12	-4.21
29	Jun-12	96.65	-5.36
30	Jul-12	87.56	-9.41
31	Aug-12	84.75	-3.21
32	Sep-12	86.21	1.72
33	Oct-12	86.04	-0.2
34	Nov-12	81.44	-5.35
35	Dec-12	81.75	0.38
36	Jan-13	87.55	7.09
37	Feb-13	88.35	0.91
38	Mar-13	90.09	1.97
39	Apr-13	88.56	-1.70

Chart 8
Indonesian Reference Coal Prices Development during 1 Year in IDR
Based on Average Exchange Rate in One Month
(GCV 6322 kcal/kg gar; Average 4 Index in Calorie Equality in US$/ton, FOB Vessel)

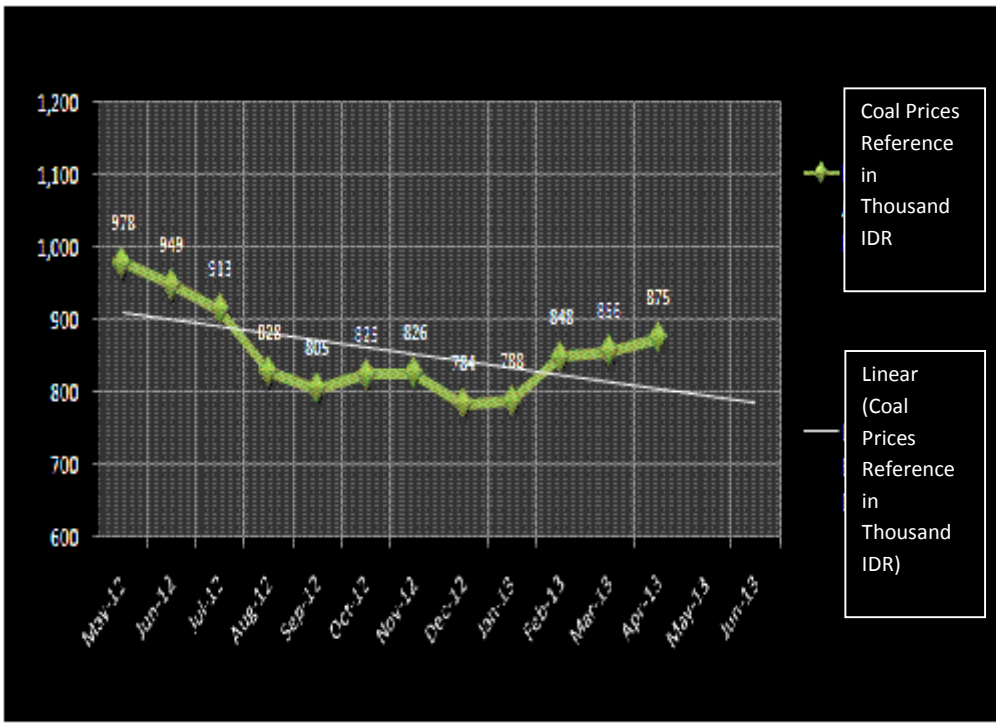


Table 9
Indonesian Reference Coal Prices Development during 1 Year in IDR
Based on Average Exchange Rate in One Month
(GCV 6322 kcal/kg gar; Average 4 Index in Calorie Equality in US$/ton, FOB Vessel)

No.	Month	HBA in USD	Rupiah Value Against USD	HBA in IDR	Increase/ Decrease
1	Dec-11	112.67	9,094	1,025	-2.55
2	Jan-12	109.29	9,102	995	-2.91
3	Feb-12	111.58	9,026	1,007	1.24
4	Mar-12	112.87	9,166	1,035	2.72
5	Apr-12	106.61	9,176	978	-5.44
6	May-12	102.12	9,289	949	-3.03
7	Jun-12	96.65	9,451	913	-3.71

8	Jul-12	87.56	9,455	828	-9.37
9	Aug-12	84.75	9,499	805	-2.76
10	Sep-12	86.21	9,566	825	2.44
11	Oct-12	86.04	9,597	826	0.13
12	Nov-12	81.44	9,628	784	-5.04
13	Dec-12	81.75	9,642	788	0.53
14	Jan-13	87.55	9,687	848	7.59
15	Feb-13	88.35	9,687	856	0.91

e. Development of Liquid Coal Processing in Indonesia

Currently, liquid coal development is still in pilot stage or in research stage. One of investor that is Sugico MOK Energy, have begin to build liquid coal processing factory in South Sumatera. Sugico MOK Energy is joint venture company between PT. Sugico Graha (Coal Mining Company in South Sumatera) and Mok Industries LLC from United States (company that produce solar cells technology). Sugico Mok is using Hydrogenation system in his liquid coal processing (Coal Liquefaction). With solar cells innovation technology, solar energy that is needed by solar cells has changed into electrical energy. On this project, electrical energy that has been produced as big as 1 Megawatt for every panel in one hour with cost less then US$ 5 every barrel. There are two kinds of current that is produced by this solar cell, which are: Alternating Current (AC) which used for lightning and other equipments and Direct Current (DC) to change water (H2O) into oxygen and hydrogen. Hydrogen is used in hydrogenation process, which changed solid coal into liquid coal. Hydrogenation process is used in Bergius Reactor. For 1 ton of solid coal which is processed on this reactor will produce approximately 6,2 barrel of high quality synthetic fuel.

There are 11 companies that have sign Memorandum of Understanding (MOU) about the consortia formation to participate in Coal Liquefaction programmed in Indonesia. This consortium is using B to B pattern (Bussiness to Bussiness) and involving companies that come from Japan and Indonesia. Those companies are: PT Adaro Indonesia, PT Jorong Barutama Gestron, PT Berau Coal, PT Bumi Resources, PT DH Power, PT Bayan Resources, PT Ilthabi Bara Utama, PT Rekayasa Industri, PT Tambang Batubara Bukit Asam (Persero) Tbk., PT Pertamina (Persero), AES Asia & Middle East. This consortium is cooperating with some institution in Japan, such as: METI, NEDO, JBIC, JCOAL, Kobe Steel Ltd, andSojitz. Teknologi BCL (The brown coal liquefaction) that come from Japan are used in this coal liquefaction process.

Liquid coal processing activity has already done by BPPT cooperate with New Energy and Industrial Technology Development Organization (NEDO) from Japan. In year 1994 until 2003 had already done basic research and applied research about those technology.

BPPT result study year 2003 show coal liquefaction technology are potential to be applied in semi commercial or commercial scale. This research is not only done in laboratory (Coal Liquefaction Center/CLC) in Serpong West Java, but also carried to Japan.

Several kinds of young coal have been tested in CLC, among others are from south and central Banko, Musi Rawas, Berau Lati, Berau Kerai, Wara, Mulia and Satui also Kideco. Feasibility study for the application is also done in three location, that are Muara Enim-Banko PT Bukit Asam for the coal that its location is far from shoreline (inland), Satui asam PT Bumi Resources South

Kalimantan, and Berau Lati PT Berau Coal East Kalimantan for the coal that its location is near from shoreline (costal case).

BPPT cooperation with New Energy and Industrial Technology Development Organization (NEDO), Japan is using direct liquefaction method (brown coal liquefaction/BCL). Coal that has been disbursed by using limonite soroako catalyst is changed into dilute slurry like crude oil then be processed into oil.

f. Investment

To develop liquid coal processing center with 13.500 barrel capacity per day, needed investment approximately Rp. 11,7 trillion with rupiah exchange rate assumption as big as Rp. 9.000.00 per USD. Estimated that Indonesia needs around 7 liquefaction processing station to reach 2% target in year 2025.

Ministry of Energy and Mineral Resource – Research and Development of Mineral and Coal Technology Agency, have made some liquid coal production plan, which divided into three phase, that are: Phase 1. Build semi commercial processing station in year 2009 with 13.500 barrel capacity per day with investment as big as US$ 1. 3 billion. Phase 2. Build additional processing station with the same capacity in phase 1 with investment as big as US$ 800 million in year 2017 with the harsh estimation capacity as big as 27.000 barrel. Phase 3. Build commercial processing station that contain with 8 unit of processing station with investment as big as US$ 9.6 billion.

For the funds, Indonesian government will looking for investor and Japan government has committed to give help in grant form as big as US$ 110 million for Supporting Process Unit. While 60% funds from loan will be financed by Japan Bank for International Cooperation (JBIC).

Rough estimation for competitive coal prices is US$ 42/barrel, with world oil price assumption did not changed significantly, between US$ 60 until US$ 70 per barrel.

2.4. Development Direction of Liquid Coal Utilization in Indonesia

According to feasibility study that has been done in Berau Lati, show that the profitable products form the liquid coal processing is **gasoline**. This is also appropriate with the energy needs development in the future that still be dominated by transportation sector. Other product basically still have prospect, but for early process should develop gasoline product.

CHAPTER III
REGIONAL POTENCY AND PRODUCTION TECHNIC OF LIQUID COAL UTILIZATION IN EAST KALIMANTAN

3.1. Regional potency and production technique of liquid coal utilization in East Kalimantan

Statistic data show that Indonesian coal potency largely is come from Kalimantan Island (east and south side) and Sumatera Island (South Sumatera). For East Kalimantan, according to data from Geology Center and Mineral Resource ESDM Ministry show that resource and reserve respectively:

a. Low Calorie (< 5.100 kal/gr): resource as big as 305,52 million ton and the reserve 0.
b. Medium Calorie (5.100 s/d 6.100 kal/gr): resource as big as 15.482,72 million Ton and the reserve 941,62 million Ton.
c. High Calorie (6.100 s/d 7.100 kal/gr): resource 4.918,92 million Ton and the reserve 1.064,82 million Ton.
d. Very High Calorie (> 7.100 kal/gr): resource as big as 169,82 million and the reserve 65, 24 million Ton.

Total coal resources in East Kalimantan as big as 21.076,98 Million Ton and the total reserve is 2.071,68 Million Ton.

From the previous part explanation, note that coal which is more possible to be process into fuel through liquefaction process is coal with low until medium calorie.

East Kalimantan has big enough coal resources and reserves with medium and low calorie. From data year 2005 (Table 5) show that coal resource number with medium and low calorie as big as **15.788,24 Million Ton** while the coal reserve number with medium and low calorie as big as **2.006,44 Million Ton.**

For coal resources and reserves with low and medium calorie in East Kalimantan until year 2013 not yet available. But data of coal

resources and reserves without calorie value detail is shown on Table 3.

See the potential that exist, and by assume the number of coal resources and reserves with low and medium calorie in year 2005 as big as 75,63% and 45,45%, coal potential number based on data year 2012 which have potency to be process into liquid coal as big as **15.788,24 Million Ton (resources)** and **941,62 Million Ton (reserves)**.

3.2 Potential Region of liquid coal producer and existing coal reserve

From Table 3, show that coal resources and reserves in East Kalimantan until year 2012 each are 31.817.269.817 ton and 9.244.407.451 ton with three region that has the biggest coal resources and reserves, that are East Kutai (resources as big as 17.618.457.436 Ton and reserves as big as 4.927.606.027 ton), Kutai Kartanegara (resources as big as 6.281.747.672 ton and reserves as big as 2.000.040.517 ton), and Berau (resources as big as 2.969.013.031 ton and reserves as big as 395.332.484 ton).

See the potential that exists, those three regions with the biggest coal content can be used as liquid coal processing base. But need more detail about problems to be faced, such as reserves number that already controlled, land status that would be mined, mining company commitment in supporting this programmed, and still many their problems. However, if we see regency that has big potency in coal, especially those three regions, then **East Kutai Regency** is very decent, and then followed by **Kutai Kartanegara Regency** and then **Berau Regency**.

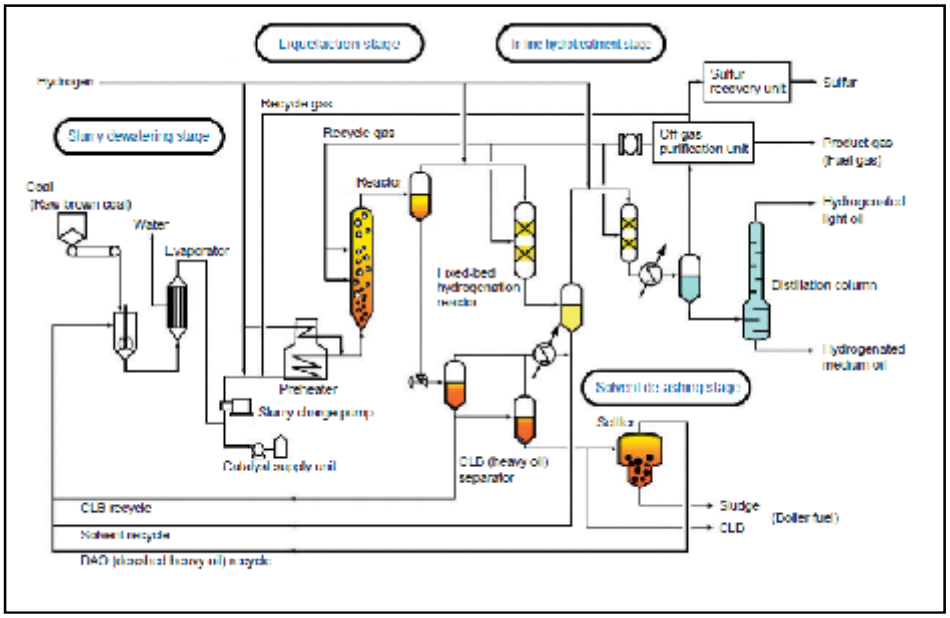
Feasibility study has been done in year 2003, for liquid coal application in Berau Lati, PT Berau Coal for the coal that its location near to shoreline (coastal case) and coal calorie is low.

From the feasibility study, PT. Berau Coal is planning to build factory with capacity 3.000 ton/day and with lands wide approximately 60 ha. But this plan is still constrained with funds. For the description, to build factory capacity 3.000 ton/day, it needed funds approximately USD 800 million and the oil product is 13.350 barrel/day or 2.122.650 liter/day. This thing is also promising and needs strong commitment to follow-up this programmed.

3.3 Production Techniques of development and utilization of coal liquid in East Kalimantan

From several feasibility studies that have been done either in Berau Lati or other places show that coal liquefaction process by using **Direct Coal Liquefaction (DCL)** model with Brown Coal Liquefaction (BCL) or Improved Brown Liquefaction (IBCL) process. Below are flowcharts of BCL process

Figure 5
BCL Process Chart



Country that has developed Direct Liquefaction Process technology is Japan, United States and German. For Indonesia,

Conversion technique of Coal Direct Liquefaction is more profitable this time. Besides the simple in processing, liquefaction is relative cheaper and cleaner then compare to gasification techniques. This technique also suitable for low level coal (lignite) that many in Indonesia.

Business scale that can be afforded is very depending on region condition especially at resources stock for raw material of coal liquefaction also applicable investment policy.

CHAPTER IV
LEGAL BASE AND POLICY OF DEVELOPMENT AND UTILIZATION OF LIQUID COAL IN EAST KALIMANTAN

From regulation side has been set to support coal usefulness in the context of energy security and autonomy energy. For province and regency/ city level, there is policy to support that coal utilization. Some rules and policy that have been issued are follows:

Rules about Mineral and Coal (UU Minerba). Inside of UU Minerba has been annunciate that coal mining business people (PKP2B, KP/IUP Batubara) to do increasing effort of coal product value added in according to purification and processing technology enhancement. Especially through coal utilization with coal product diversification.

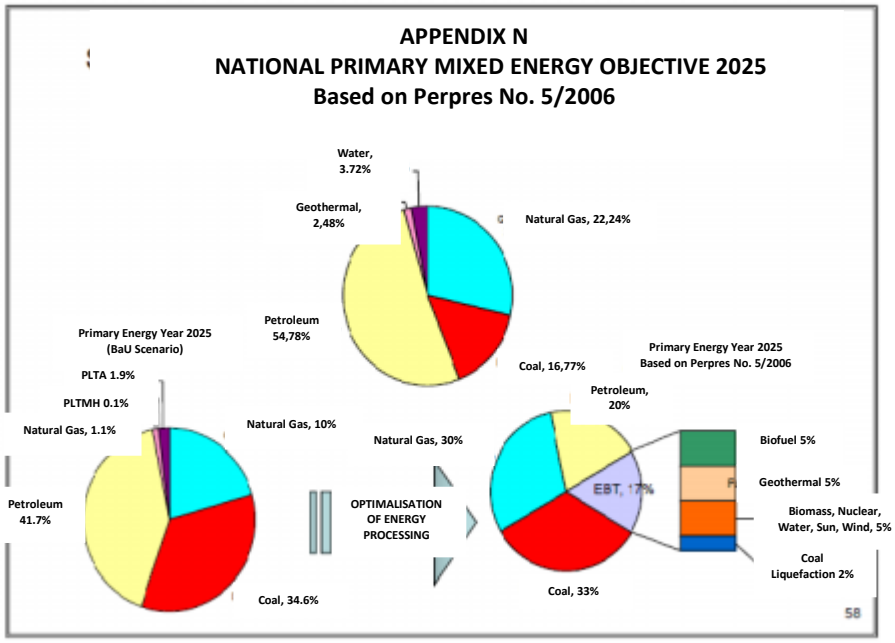
However, inside of UU Minerba still annunciate that coal is a commodity material that targeted to become zip state revenues.

Government Rule (PP) about Minerba Coal Business Activity Implementation. As well as with UU Minerba that also annunciate about coal value added enhancement in terms of purification and processing technology enhancement.

Government Rule No.24 Year 2012 about Transformation of Government Rule No. 23 Year 2010 about Implementation of Coal and Mineral Mining Business Activity.

President Rule No. 5 Year 2006 about National Energy Policy. Inside those rule has been established the new and renewable energy scale that has to take on the role of national energy as big as 17% in year 2025, while for the liquid coal has to take role as many as 2% from total new renewable energy. Inside of national mix energy objective, coal is occupying the first rank in the use of energy.

Figure 6
National Primary Mixed Energy Objective 2025



President RI Rule No.47 Year 2011 about The Second Transformation of President Rule No. 71 Year 2006 about Assignment to PT. PLN (Persero) to Make Acceleration of Powerhouse Development that Using Coal.

President Instruction (Inpres) No. 2 Year 2006 about Provision and Utilization of Liquid Coal as an Alternative Fuel. This President Instruction is followed up with Decision of Mineral Resource and Energy Ministry No. 1128 Year 2004 about National Coal Policy.

Kepmen ESDM No.1128 Year 2004, about National Coal Policy.

Kepmen ESDM No. 2934 K/30/MEM/2012 about Determination of Needs and Minimum Percentage of Coal Selling for Domestic Interest Year 2013. This decision is setting as follows:

1. Coal estimation need for domestic needs (end user domestic) for coal consumer in year 2013 as big as 74.320.000 ton.
2. Coal Mining Business Agency is required to fulfill minimum percentage of coal selling for domestic needs as referred to in First

Diktum as big as 20,30% from coal production estimation in year 2013 as big as 366.042.287 ton, that come from:

a. 45 companies of Holder Agreement of Coal Mining Company;
b. 1 company of Owned-state Enterprises; and
c. 28 companies of Coal Mining License Holder.

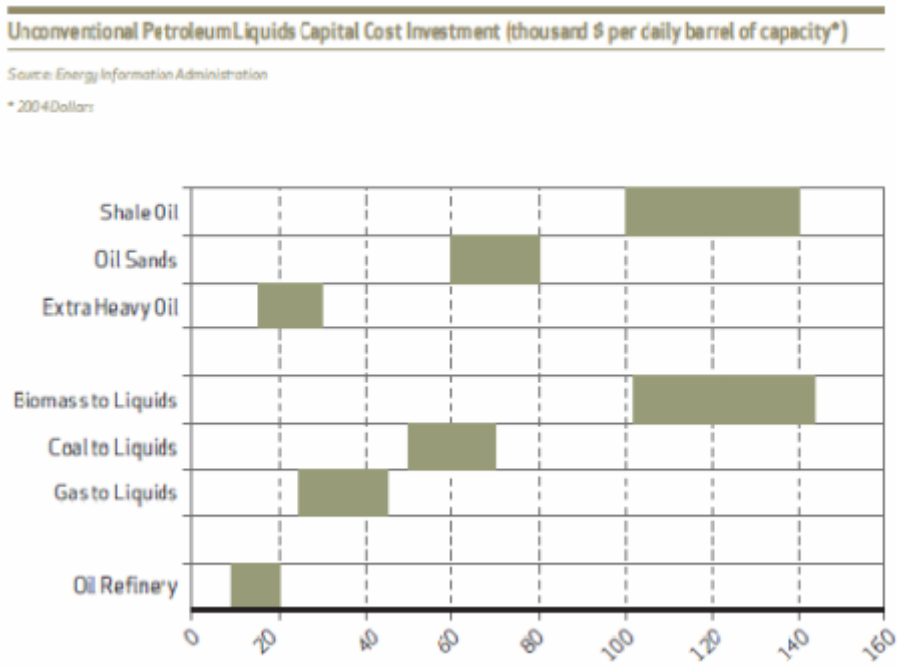
ESDM Ministry Rule No 34 Year 2009 (Permen 34/2009) about Prioritization of Coal and Mineral Needs Supply for Domestic Needs. This rule is aim to overcome and prevent the scarcity of coal and mineral supply also to ensure domestic coal and mineral supply.

Vision and Mission of East Kalimantan Province Government. In Medium Term of Development Plan (RPJMD) East Kalimantan Province Year 2009-2013, East Borrneo Province Vision is "Create East Kalimantan as Agro industry and Leading Energy Center to Create Fair and Prosperous Society". To actualize those vision, is taken 3 big agendas, that are: (1) Creating safe, democratic and peace in East Kalimantan supported by clean and commanding government, (2) Actualize regional economic competitiveness and pro-people, (3) Increasing human resources quality and people welfare. From the experience of some companies engaged in the Coal Liquefaction industry, conclude that it needs incentive form government to stimulate investment of liquid coal processing development. The incentive form can be funds support, tax incentive (including tax holiday and royalty) and coal prices scheme.

CHAPTER V
FINANCIAL ANALYSIS OF LIQUID COAL UTILIZATION

Raw material conversion into alternative fuel material needs early investment that more expensive than by building conventional oil plant. Manufacturing development cost is varies and depending on those industrial site were built. But this time, the manufacture of Coal Liquefaction plant is one of the industry that using the cheapest cost if compare to other fuel manufacture plant, especially if considering the whole operation cost problem and the cheaper coal prices. Investment cost of coal liquefaction plant approximately $50.000 - $70.000 for capacity 1 barrel per day, while for biomass liquefaction plant needs $100.000 - $ 145.000 for every barrel per day [US DOE 2005].

Chart 9
Investment Cost Liquefaction Plant



Liquid fuel processing technology that come from coal is not a new thing, but the development of this processing technology is facing problem because of the low of oil price currently. Liquid coal will reach its economic value to be produced if the world oil price is above US$35 per

barrel. Assumption: 1 ton coal can produce 2 barrel liquid coal. So, it needs coal supply approximately 40.000 ton/day to the liquefaction fabric to produce 90.000 barrel/day. Project investment value is about 5 billion US$.

5.1. Techno economic Analysis

To reach economic value in Coal Liquefaction Manufacturing Plant needed techno economic analysis. In this analysis, it wills also considering technical components of liquid coal fuel manufacturing plant (CTL). This economic analysis is comparing between cost, income and benefit. Costs in CTL manufacturing are:

A. Plant Manufacturing Cost

In year 2008, Kreutz has done study and make some synthetic fuel plant configuration with several capacity types, such as:

1. CTL – RC-V : Coal To Liquid, Recycle CO_2 process Venting to air.
2. CTL – RC-CCS : Coal To Liquid, Recycle CO_2 is save ini CCS (Carbon Capture Storage).

If this plant is projected to be operated in year 2020, then need to know the fuel consumption projection in year 2020. BPH Migas had issued

Table 10
Fuel Consumption Projection in Year 2020

Fuel Type	Fuel Consumption Year 2020 (kl)
Premium (gasoline)	67.022.923
Solar (diesel)	65.825.243

Source: BPH Migas, 2012. Processed.

Plant manufacturing cost is divided into 3 parts that are:

1. Inside Battery Limit (ISBL), is main equipment cost consist of:
   a. Air Separation Unit (ASU);
   b. H2 Manufacturing + Syngas Conditioning;
   c. Rectisol Unit
   d. Fischer – Tropsch Synthesis
   e. Product Upgrading.

   According to Borreigter study, ISBL (TPC) can be calculated by the formula:

   TPC(ScaleX)= 〖1.800×(((scaleX[bbld]))/34.000[bbld])〗 ^0,7 [Million $]

   That above calculation result has not entered CCSC cost (Carbon Capture Storage Cost) for CO_2. Thus, TPC cost (ScaleX) is added with CCS cost.

   Total ISBL cost = TPC (ScaleX) + CCAC.
   Total ISBL =1.800 x (10.000/34.000)^0,7 [Million $]
   =$764, 25 Million
   CCS =$79 Million
   Total ISBL =$764 Million + $ 79 Million
   =$843, 25 Million

2. OSBL (Outside Battery Limit) is Indirect Cost that consist of:
   a. Auxillary Buldings;
   b. Site Improvement;
   c. Utility and Service Facilities;
   d. Storage and Distribution;
   e. Land Purchase.

According to Borreigter, OSBL the value is 100% from ISBL or OSBL = 100% x ISBL.

OSBL =100% x ISBL

=100% x $ 843 Million

So EPC = ISBL + OSBL

= $843, 25 Million + $843, 25 Million

= $1.686,50 Million

= Rp 16.865.063.906.380

3. Owner's Cost, that consist of:
   a. Indirect cost for up front R&D, up front license, engineering construction, contractor's fee and contingencies;
   b. Working Capital;
   c. Start up Cost.

   Owner's Cost as big as 20% from EPC.

   Owner Cost =20% x $ 1.686,50 Million

   = $ 337,30 Million

   = Rp 3.373.012.781.276

   So Total Plant Manufacturing Cost = EPC + Owner's Cost.

   Total Plant Manufacturing Cost with capacity 10.000 ton/day = $1.686,50 Million + $ 337,30 Million

   = $ 2.023,80 Million

   =Rp 20.238.076.687.656

B. Raw Material Cost

Raw material for CTL Plant is coal. To calculate raw material cost for this plant is only based on applicable coal prices. Coal price which is used is Indonesian Coal Reference Price in April 2013 that is in American Dollar Currency as big as USD 88,56/ton.

So raw material cost = [coal prices/ton] x [coal consumption (ton)/day].

Raw material cost =$88,56 ton x 10.000 ton/day = $885.600 /ton/day

=Rp 8.856.000.000/ton/day

=Rp 2.656.800.000.000/year

C. Operation & Maintanance Cost (O&M).

According to Kreutz, et al (Kreutz, 2008) study, cost for Operation and Maintenance (O&M) as big as 4% from total cost manufacturing plant. So:

O&M Cost = 4% x Total Cost Manufacturing Plant.

= 4% x (EPC + Owner's Cost).

= 4% x $ 2.023,81 million

= $80,95 million

= Rp 809.523.067.506

D. Benefit

Benefit is obtained from product selling prices such as gasoline that calculated based on CTL Plant capacity in bbl/day (barrel per day) unit.

5.2. Financial Analysis

Financial calculation of liquid coal manufacturing plant is very important. If financially the plant manufacturing is not profitable, then there isn't investor who wants to embed their capital.

5.2.1. Business Assumption

Some assumption and parameter that used in financial calculation of coal liquefaction manufacturing plant as follows:

Table 11
Assumption and Parameter of Financial Analysis of Liquid Coal Manufacturing Plant in East Kalimantan

No	Description	Number	Unit
1	Capacity	10.000	ton/day
2	Project age	20	Year
3	Working day in 1 year	300	day
4	Coal Prices	88,56	USD/ton
	Rupiah Exchange Rate to US$	10.000	Rp/1$
	IDR	885.600	Rp/ton
5	Coal prices enhancement per year	2	%
6	Conversion of 1 ton coal	2	barrel gasoline
7	Product such as gasoline		
	Gasoline price per liter	6.500	Rp
	1 barrel	159,00	liter
8	Discount Factor	12	%
9	Owned Capital Proporsion: loan	70:30	%
10	Credit		
	a. Investment credit	30	%
	b. Working capital credit	30	%
	Interest Rate	10	% flat p.a
	Payback Period	10 years	

5.2.2. Investment Cost

Investment cost of coal liquefaction manufacturing plant consists of ISBL cost, OSBL cost, Owner cost. Detail calculation has been described on techno economic analysis. Cost recapitulation as follow:

Table 12
Investment Cost of Liquid Coal Manufacturing Plant in East Kalimantan Capacity 10.000 ton/day

No	Description	Number (Rp)
1	ISBL	8.432.531.953.190
2	OSBL	8.432.531.953.190
3	Owner's Cost	3.373.012.781.276
Total		20.238.076.687.656

5.2.3. Operational Cost

Operational cost consists of fixed cost and variable cost. Fixed cost consists of depreciation cost, and variable cost consists of raw material cost, operational and maintenance (O & M) cost. Operational cost for raw material is assumed increase every year because of raw material price increases as big as 2% per year. Operational cost recapitulation of coal liquefaction manufacturing plant in East Kalimantan as follow:

Table13
Operational Cost of Liquid Coal Manufacturing Plant in East Kalimantan
Capacity 10.000 ton/day

No	Description	Number (Rp/Year)
1	Raw material cost	2.656.800.000.000
2	O & M cost	809.523.067.506
3	Depreciation	1.011.903.834.383
	Total	4.478.226.901.889

5.2.4. Production and Acceptance

Products planned that will be generated from coal liquefaction manufacturing plant in East Kalimantan are gasoline. Plant with capacity 10.000 ton/day can produce gasoline as much as 20.000 bbl/d or equal with 3.180.000 liter/day. If the capacity factor that is used in the production is 90% then we can get gasoline as many as 2.862.000 liter/hari. If the product price is Rp 6.500 per liter then we can get income.

Table14
Liquid Coal Production and Business Acceptance in East Kalimantan
Capacity 10.000 ton/day

Plant Product	Volume	Volume	90% capacity factor	Volume	Product Prices	Income
	(bbl/d)	(liter/day)		(liter/day) 90%C	IDR	(cash in) per year 90%C IDR
Gasoline	20.000	3.180.000	18.000	2.862.000	6.500	5.580.900.000.000

5.2.5. Credit

This study is using assumption of capital proportion between the interest itself and bank loan 70% : 30%. Bank loan consist of investment credit and working capital credit. Payback period during 10 years with interest rate 10% flat per year. Payback period is beginning on the fourth year as the first year production plant. Investment loan number as big as Rp 6.071.423.006.297 and working capital loan number as big as Rp 1.039.896.920.252.

5.2.6. Cashflow

Cahflow consist of inflow and outflow. Inflow consist of acceptance from product selling and credit while outflow consist of investment cost and raw material cost, O & M costs also loan and interest payment. Cash flow detail of liquid coal in East Kalimantan is shown on Appendix 3, 4, and 5.

5.2.7. Investment criteria and sensitivity analysis

Investment criteria that being used to assess the feasibility of coal liquefaction manufacturing plant is consist of: *Net Present Value* (NPV), *Benefit Cost Ratio* (B/C ratio), *Internal Rate of Return* (IRR) and *Payback Period* (PP).

Financial calculation result of liquid coal manufacturing plant with capacity 1.000 ton/day in East Kalimantan as follow:

1. *Net Present Value* (NPV)

$$NPV = \sum_{t=1}^{n} \frac{Bt - Ct}{(1+i)^t}$$

where:
Bt = Project usefulness in t year
Ct = Project cost in t year
n = Interest rate
t = Year
From those calculations, if it obtained:
NPV > 0, then the project is feasible to be continued.
NPV < 0, then the project is not feasible to be continued.
NPV = 0, then project will return precisely as big as in force intererst rate.

NPV = 295.184.295.603 - 15.111.511.227.569 = (14.876.232.256.018)

NPV is negative valuable so that investment is not feasible.

2. Net Benefit Cost Ratio (Net/B/C ratio)

$$\text{NetB/C} = \frac{\sum_{t=1}^{n} \frac{Bt - Ct}{(1+i)^t} (Bt - Ct > 0)}{\sum_{t=1}^{n} \frac{Bt - Ct}{(1+i)^t} (Bt - Ct < 0)}$$

From those calculations if acquired:

Net B/C Ratio >1, then the project is feasible to be continued.

Net B/C Ratio < 1, then the project is not feasible to be continued.

Net B/C Ratio = 1, then the project will enough covering cost and investment during project's age.

Net B/C ratio= 295.184.295.603/15.111.511.227.569 = 0,02

Net B/C ratio < 1 then the investment is not feasible

Based on above two investment criteria then could be concluded if production capacity of coal liquefaction plant in East Kalimantan only 10.000 ton/day with single product such as gasoline with product selling price Rp 6.500 per liter then investment of liquid coal manufacturing plant in East Kalimantan ***is not feasible to be done.***

Liquid coal manufacturing plant in East Kalimantan can be feasible if there are some changes, such as:

1. Changes in Production Capacity
2. Product Variety Enhancement
3. Product selling price enhancement.

Based on calculation result show that investment is not feasible, and then sensitivity analysis can be done by doing changes in production cost, increasing output number or by increasing product selling price. Sensitivity analysis that very possible to be done in this research is by

increasing product selling price. Sensitivity analysis result by increasing product selling price from Rp 6.500 per liter become Rp 10.500,- and Rp 11.000.

Table 15
Sensitivity Analysis of Liquid Coal Development Plant in East Kalimantan Capacity 10.000 ton/day with Increasing Product Selling Price

Investment Criteria	Product Selling Price 10.500/liter	Product Selling Price Rp 11.000/liter	Feasibility Justification
NPV	2.527.975.619.793	4.703.501.604.269	NPV> 0; feasible
B/C Ratio	1,18%	1,34	Net B/C >1; feasible
IRR	14,24%	15,60%	IRR>14% (credit interest rate); feasible
PP	14 years 10 months	12 years 7 months	*Payback Period* < business age; feasible

Based on sensitivity analysis result then liquid coal manufacturing plant in East Kalimantan with capacity 10.000 ton/day is feasible to be done if the gasoline product price >Rp 10.000/liter.

This research report is supported by Mahendratama research from Indonesian University year 2012 about "Synthetic Fuel Feasibility from Coal and Biomass to fulfill domestic fuel needs".

This research shows that synthetic fuel plant is recommended to be built in Kalimantan and Sumatera Island with 1 plant capacity 104.415 bbl/day with minimum gasoline and diesel product prices Rp 7.500 with Payback Period 6-7 years.

CHAPTER VI
CLOSING

The result of this research shows that liquid coal investment has opportunity and potency to be developed in East Kalimantan Province. The availability of big resources and coal reserves become special attraction to investors. Based on financial calculating result, coal liquid business is feasible if there is product diversification (not only producing one product type) and product price assurance is above from prevailing price. This study is still need to be further investigated with the several variation of production capacity and the type of products produced also product selling price.

If the investors want to know further information about liquid coal investment in East Kalimantan, they can do contact business to this address:

Investment Coordination Agency (BKPM)

Jl. Gatot Subroto 44 Jakarta 12190-Indonesia PO Box 3186

Telp. +62-021-5252008, 5254981, Fax +62-0215227609, 5254945, 5253866

E-mail : sysadm@ bkpm.go.id

Website : http://www.bkpm.go.id

Mining and Energy Services East Kalimantan Province

Samarinda East Kalimantan

Licensing Agency and Regional Investment (BPPMD) East Kalimantan Province

Jl Basuki Rahmat No 56 Samarinda East Kalimantan 75117 Telp. 62-0541-743235 – 742487 Fax : 0541-736446 E-mail : Humas@bppmd.kaltimprov.go.id

Website : http://www.bppmd.kaltimprov.go.id

REFERENCE

Alfred G. Comolli, Theo L.K. Lee, Gabriel A. Popper, Robert H. Stalzer, And Peizheng Zhou (Project Manager), THE SHENHUA DIRECT LIQUEFACTION PLANT, Hydrocarbon Technologies, Inc. (HTI), 1501 New York Avenue, Lawrenceville, NJ 08648.

D.S Hoover: Correlation of Coal Quality to Coal Liquefaction, International Coal Refining Company, P.O. Box: 2757, Allentown, PA 18001.

Direktoral Jenderal Mineral dan Batubara ESDM. 2011.Mineral dan batu bara 2011. Dirjen minerba ESDM, Jakarta.

Kadariah. 2001. Evaluasi Proyek Analisis Ekonomis. LPFE-UI, Jakarta.

Mahendratama, A.Y. 2012. Kelayakan BBM Sintetik dari Batu Bara dan Biomassa untuk memenuhi kebutuhan BBM dalam negeri. Tesis. Universitas Indonesia, Jakarta.

National Energy Technology Laboratory, Direct Coal Liquefaction Overview,

Pusdatin ESDM. 2013. Handbook of Energy and Economic statistics of Indonesia. Pusdatin ESDM, Jakarta.

Putra, S.M. 2011. Teknologi Pemanfaatan Batu Bara untuk Menghasilkan Batu Bara Cair, Pembangkit Tenaga Listrik, Gas metana, dan Briket Batu Bara. Prosiding Seminar Nasional AVoER ke-3 Palembang, 26-27 Oktober 2011. Jurusan Teknik Pertambangan Universitas Sriwijaya, Palembang.

R. A. Durie, R.W. Miller & Co. Pty. Ltd.,THE CHARACTERISTICS OF AUSTRALIAN COALS AND THEIR IMPLICATIONS IN COAL LIQUEFACTION, 213 Miller Street, North Sydney, N.S.W., 2060.

Republik Indonesia, Blue Print Pengelolaan Energi nasional Tahun 2006 - 2025,Jakarta 2006.

Tim Kajian Batubara Nasional Kelompok Kajian Kebijakan Mineral dan Batubara, Pusat Litbang Teknologi Mineral dan Batubara, 2006, Statistik Batubara Indonesia

U.S. Department of Energy National Energy Technology Laboratory 626 Cochrans Mill Road PO Box 10940, MS 921-107, Pittsburgh, PA 15236-0940, FEASIBILITY OF DIRECT COAL LIQUEFACTION IN THE MODERN ECONOMIC CLIMATE.

World Coal Institute, Coal : Liquid Fuels, October 2006

World Coal Institute. Sumber Daya Batubara (Tinjauan Lengkap Batubara), www. worldcoal.org,

TERMINOLOGY

Coal Resources is part of coal sediment that can be useful. This coal resource is divided into class resources based on level of geological confider which specified qualitatively by geology condition/ complexity level and quantitatively by information point distance. This resource can increase into reserves if after doing feasibility study is stated feasible.

Coal Reserves is parts of coal resources that have been known the dimension, quantity distribution, and its quality, when the feasibility study has done is stated feasible to be mined.

Coal resource and reserves classification is based on level of geological confider and feasibility study. This grouping contains two aspects that are geology aspect and economic aspect.

Hypothetical Coal Resource. Hypothetical coal resource is coal number in investigation area or parts of investigation area, which calculated based on data that fulfilling laid conditions for review survey investigation stage.

Inferred Coal Resource. Inferred coal resource is coal number in investigation area or parts of investigation area, which calculated based on data that fulfilling laid conditions for prospecting investigation stage.

Indicated Coal Resource. Indicated coal resource resource is coal number in investigation area or parts of investigation area, which calculated based on data that fulfilling laid conditions for preliminary exploration stage.

Measured Coal Resourced. Measured Coal Resource is coal number in investigation area or parts of investigation area, which calculated based on data that fulfilling laid conditions for detail exploration stage.

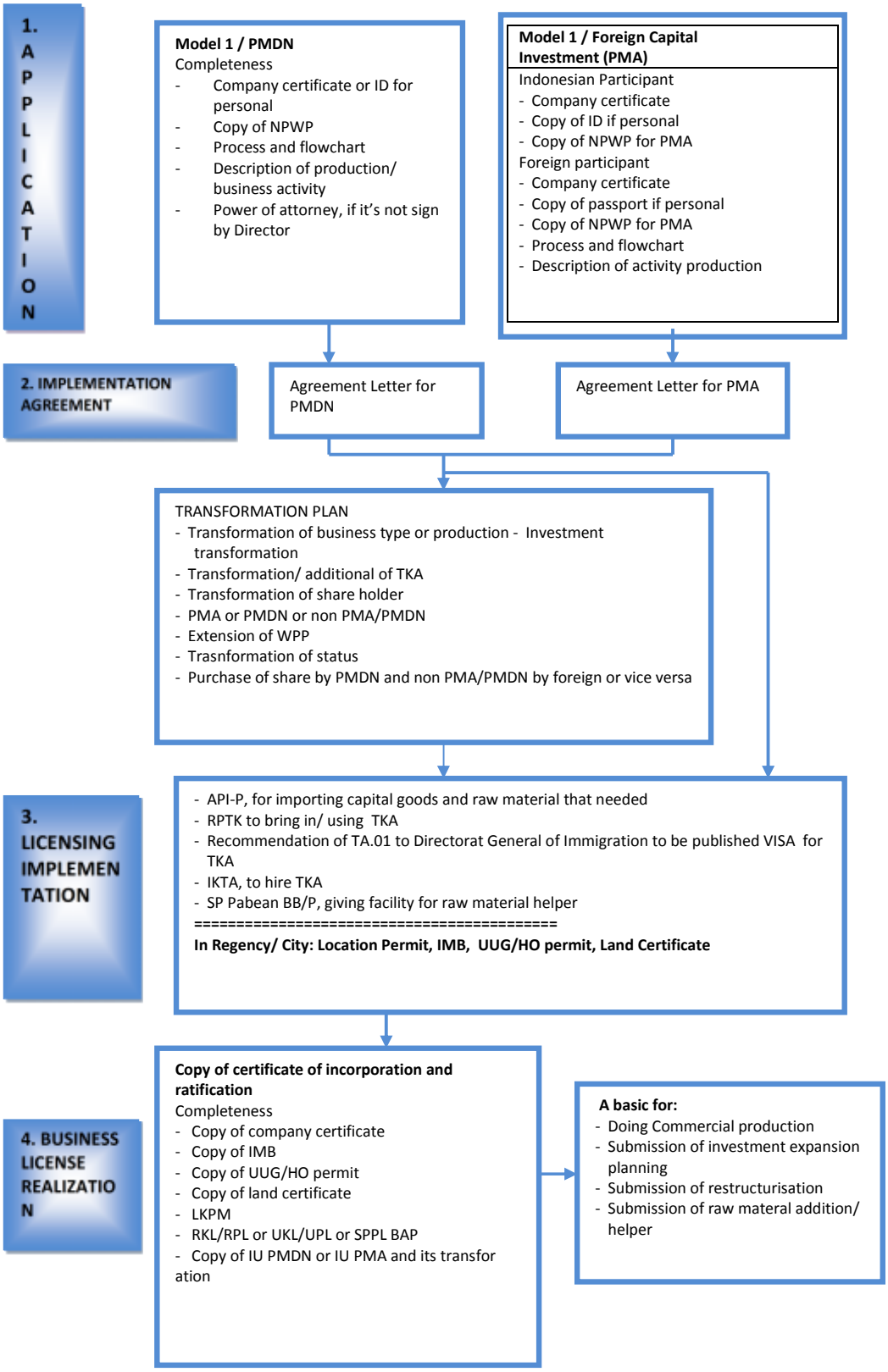
Low Calorie Coal, is coal type with the lowest rank, soft-hard characteristic, easily crushed, contain high water content (10-70%), show the woods structure, calorie content is less than 5100 kal/gr (adb).

Medium Calorie Coal, is coal type with the higher level than low calorie coal, harder characteristic, easily crushed - can't be crushed, water content is relative lower, generally wood structure still seems, calorie value 5100 – 6100 kal/gr (adb).

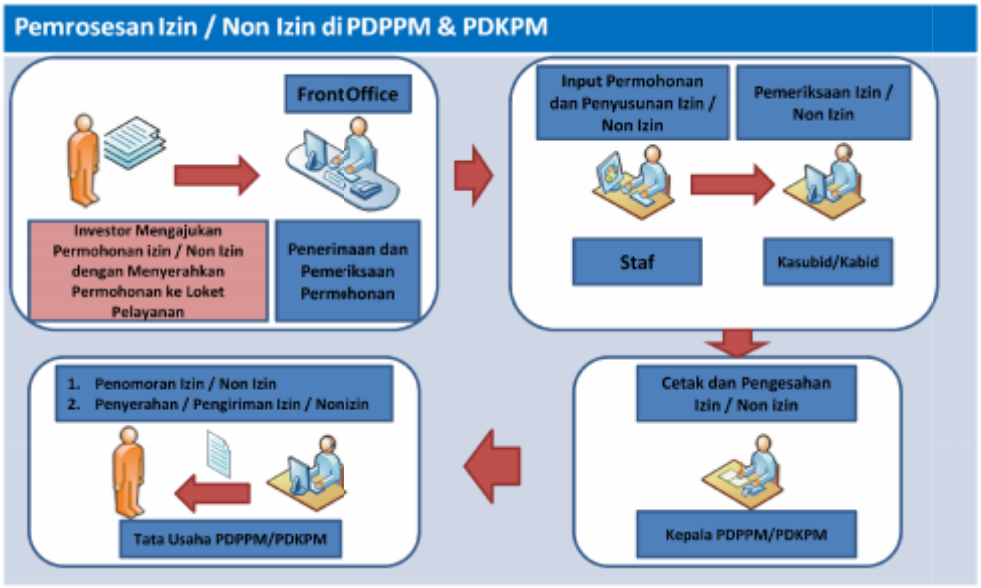
High Calorie Coal, is coal type with more higher level, water content is relative lower than medium calorie coal, generally wood structure doesn't seem, calorie value 6100 – 7100 kal/gr (adb).

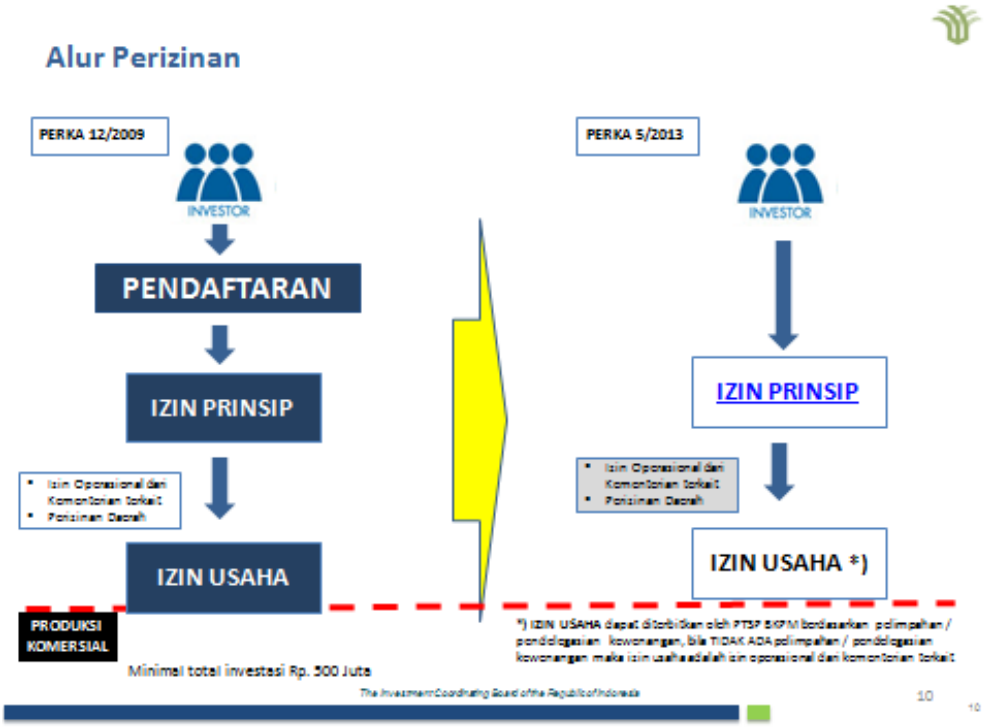
Very High Calorie Coal, is coal type with the highest rank. generally influenced by intrusion or other structure, very low water content, calorie value is more than 7100 kal/gr (adb). This calorie class is set to limit high calorie coal.

Appendix 1. Licensing Flowcharts

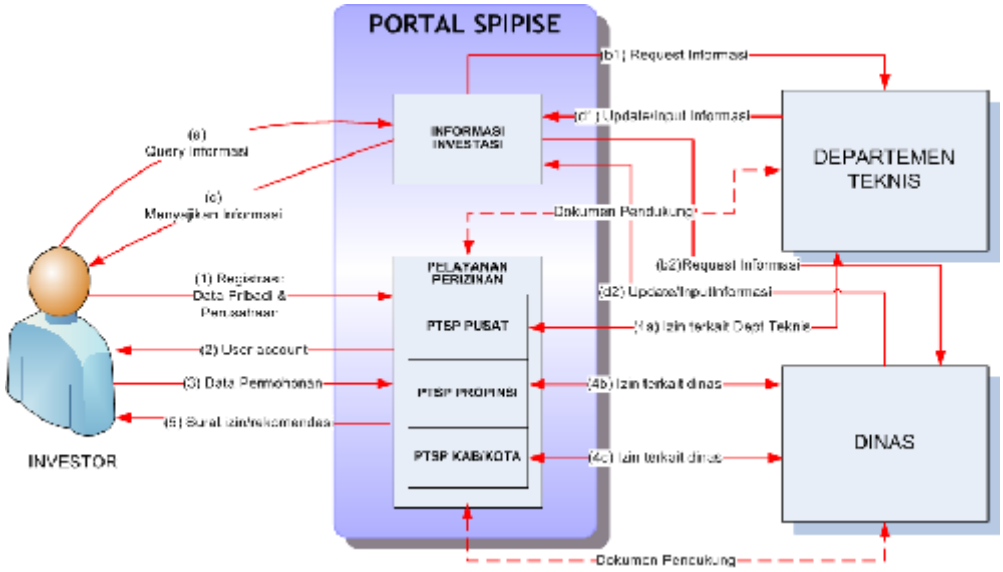


Appendix 2. Licensing Flowcharts in PDPPM & PDKPM





Appendix 3. Scheme of Information Service and Investment allowance System in Electronic Method (SPIPISE)



Appendix 4. Cost Per Equivalent Barrel of Crude Oil for Various Direct Coal Liquefaction Process (CTL).

COST PER EQUIVALENT BARREL OF CRUDE OIL FOR VARIOUS DIRECT COAL LIQUEFACTION PROCESSES

Process	2009 $ per Equivalent Barrel of Crude Oil	Source
H-Coal	$93.82	A.1
Catalytic Two-Stage Liquefaction (CTSL)	$140.16	A.1
CTSL w/Bottoms Recycle	$78.32	A.1
Lummus ITSL	$69.35	A.2
244-B ITSL (Wilsonville)	$68.46	A.2
250-D CC-RITSL	$58.86	A.2
250-G-RAR (Wilsonville)	$57.42	A.2
H-Coal	$80.24	A.3
ITSL	$49.67	A.3
CMSL	$40.76	A.3
Direct	$44.55	A.4
H-Coal (coal)	$81.25	A.1
ITSL (coal)	$49.43	A.1
CMSL (coal)	$40.48	A.1
CMSL (natural gas)	$40.71	A.1
SH-I	$31.22	A.5
SH-II	$25.54	A.5

A.1 – Burke, F.P.; Brandes, S.D.; McCoy, D.C.; Winschel, R.A.; Gray, D.; Tomlinson, G. *Summary Report of the DOE Direct Liquefaction Process Development Campaign of the Late Twentieth Century*; Topical Report for U.S. Department of Energy Contract No. DE-AC22-94PC93054; CONSOL Energy Inc.: South Park, PA; Mitretek Systems: McLean, VA, July 2001; pp 107, Tables 7–10.

A.2 – Gray, D.; Tomlinson, G. Progress in Direct Coal Liquefaction: The Economic Perspective. The MITRE Corporation Civil Systems Division: McLean, VA, 1988.

A.3 – Malhotra, R. Direct Coal Liquefaction: Lessons Learned. Presented at GCEP Advanced Coal Workshop, Brigham Young University, Provo, UT; March 16, 2005.

A.4 – Lepinski, J.A. Overview of Coal Liquefaction. U.S.–India Coal Working Group Meeting, Washington, DC, Nov 18, 2008.

A.5 – Sun, Q.; Fletcher, J.J.; Zhang, Y.; Ren, X.; Comparative Analysis of Costs of Alternative Coal Liquefaction Processes. *Energy Fuels* **2005**, *19*, 1160–1164.

Appendix 5. Liquid Coal Investment Cash Flow in East Kalimantan Capacity 10.000 ton/day with Gasoline Product Selling Prices Rp 6.500/liter

No	Description	Year									
		1	2	3	4	5	6	7	8	9	10
A.	INFLOW										
1	Acceptance				5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000
2	Credit										
	a. Investment	6.071.423.006.297									
	b. Working Capital		1.039.896.920.252								
	Total INFLOW	6.071.423.006.297	1.039.896.920.252	-	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000
B.	OUTFLOW										
1	Manufacturing Plant Investment Cost										
	a.ISBL	7.642.531.953.190									
	b.CCS	790.000.000.000									
	c. OSBL		8.432.531.953.190								
	d. Owner Cost		3.373.012.781.276								

		1	2	3	4	5	6	7	8	9	10
2	Operational Cost			4.478.226.901.889	4.531.362.901.889	4.585.561.621.889	4.640.844.316.289	4.697.232.664.577	4.754.748.779.831	4.813.415.217.390	4.873.254.983.700
3	Credit										
	Investment										
	a. Loan Primary Installment				607.142.300.630	607.142.300.630	607.142.300.630	607.142.300.630	607.142.300.630	607.142.300.630	607.142.300.630
	b. Loan interest				607.142.300.630	546.428.070.567	485.713.840.504	424.999.610.441	364.285.380.378	303.571.150.315	242.856.920.252
	Working capital										
	a. Loan Primary Installment				103.989.692.025	103.989.692.025	103.989.692.025	103.989.692.025	103.989.692.025	103.989.692.025	103.989.692.025
	b. Loan interest				103.989.692.025	93.590.722.823	83.191.753.620	72.792.784.418	62.393.815.215	51.994.846.013	41.595.876.810
	Out Cash Flow Total	8.432.531.953.190	11.805.544.734.466	4.478.226.901.889	5.953.626.887.199	5.936.712.407.933	5.920.881.903.068	5.906.157.052.090	5.892.559.968.079	5.880.113.206.372	5.868.839.773.416
	Net Cash Flow	(2.361.108.946.893)	(10.765.647.814.214)	(4.478.226.901.889)	(372.726.887.199)	(355.812.407.933)	(339.981.903.068)	(325.257.052.090)	(311.659.968.079)	(299.213.206.372)	(287.939.773.416)
	DF	0,8929	0,7972	0,7118	0,6355	0,5674	0,5066	0,4523	0,4039	0,3606	0,3220
	Present Value	(2.108.132.988.297)	(8.582.308.525.362)	(3.187.513.453.991)	(236.874.675.122)	(201.897.515.859)	(172.245.412.731)	(147.129.772.296)	(125.874.233.940)	(107.899.281.825)	(92.708.900.790)
	Cumulative Present Value	(2.108.132.988.297)	(10.690.441.513.659)	(13.877.954.967.651)	(14.114.829.642.773)	(14.316.727.158.632)	(14.488.972.571.363)	(14.636.102.343.659)	(14.761.976.577.599)	(14.869.875.859.423)	(14.962.584.760.213)

No	Description	Year									
		11	12	13	14	15	16	17	18	19	20
A.	INFLOW										
1	Acceptance	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000
2	Credit										
	a. Investment										
	b. Working Capital										
	Total INFLOW	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000	5.580.900.000.000
B.	OUTFLOW										
1	Manufacturing Plant Investment Cost										
	a.ISBL										
	b.CCS										
	c. OSBL										
	d. Owner Cost										
2	Operational Cost	4.934.291.545.336	4.996.548.838.205	5.060.051.276.931	5.124.823.764.432	5.190.891.701.683	5.258.280.997.679	5.327.018.079.594	5.397.129.903.149	5.468.643.963.174	5.541.588.304.399

3	Credit										
	Investment										
	a. Loan Primary Installment	607.142.300.630	607.142.300.630	607.142.300.630							
	b. Loan interest	182.142.690.189	121.428.460.126	60.714.230.063							
	Working capital										
	a. Loan Primary Installment	103.989.692.025	103.989.692.025	103.989.692.025							
	b. Loan interest	31.196.907.608	20.797.938.405	10.398.969.203							
	Out Cash Flow Total	5.858.763.135.787	5.849.907.229.391	5.842.296.468.851	5.124.823.764.432	5.190.891.701.683	5.258.280.997.679	5.327.018.079.594	5.397.129.903.149	5.468.643.963.174	5.541.588.304.399
	Net Cash Flow	(277.863.135.787)	(269.007.229.391)	(261.396.468.851)	456.076.235.568	390.008.298.317	322.619.002.321	253.881.920.406	183.770.096.851	112.256.036.826	39.311.695.601
	DF	0,2875	0,2567	0,2292	0,2046	0,1827	0,1631	0,1456	0,1300	0,1161	0,1037
	Present Value	(79.879.011.749)	(69.047.455.607)	(59.905.324.052)	93.322.233.861	71.253.057.965	52.626.147.801	36.976.464.972	23.897.388.070	13.033.686.622	4.075.316.313
	Cumulative Present Value	(15.042.463.771.962)	(15.111.511.227.569)	(15.171.416.551.621)	(15.078.094.317.760)	(15.006.841.259.796)	(14.954.215.111.995)	(14.917.238.647.023)	(14.893.341.258.953)	(14.880.307.572.330)	(14.876.232.256.018)

Appendix 6. Liquid Coal Investment Cash Flow in East Kalimantan Capacity 10.000 ton/day with Gasoline Product Selling Prices Rp 10.500/liter

No	Description	Year									
		1	2	3	4	5	6	7	8	9	10
A.	INFLOW										
1	Acceptance				9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000
2	Credit										
	a. Investment	6.071.423.006.297									
	b. Working Capital										
	Total INFLOW		1.039.896.920.252								
	OUTFLOW	6.071.423.006.297	1.039.896.920.252	-	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000
B.	Manufacturing Plant Investment Cost										
1	Acceptance										
	a.ISBL	7.642.531.953.190									
	b.CCS	790.000.000.000									
	c. OSBL		8.432.531.953.190								

	d. Owner Cost		3.373.012.781.276								
2	Operational Cost			4.478.226.901.889	4.531.362.901.889	4.585.561.621.889	4.640.844.316.289	4.697.232.664.577	4.754.748.779.831	4.813.415.217.390	4.873.254.983.700
3	Credit										
	Investment										
	a. Loan Primary Installment				607.142.300.630	607.142.300.630	607.142.300.630	607.142.300.630	607.142.300.630	607.142.300.630	607.142.300.630
	b. Loan interest				607.142.300.630	546.428.070.567	485.713.840.504	424.999.610.441	364.285.380.378	303.571.150.315	242.856.920.252
	Working capital										
	a. Loan Primary Installment				103.989.692.025	103.989.692.025	103.989.692.025	103.989.692.025	103.989.692.025	103.989.692.025	103.989.692.025
	b. Loan interest				103.989.692.025	93.590.722.823	83.191.753.620	72.792.784.418	62.393.815.215	51.994.846.013	41.595.876.810
	Out Cash Flow Total	8.432.531.953.190	11.805.544.734.466	4.478.226.901.889	5.953.626.887.199	5.936.712.407.933	5.920.881.903.068	5.906.157.052.090	5.892.559.968.079	5.880.113.206.372	5.868.839.773.416
	Net Cash Flow	(2.361.108.946.893)	(10.765.647.814.214)	(4.478.226.901.889)	3.061.673.112.801	3.078.587.592.067	3.094.418.096.932	3.109.142.947.910	3.122.740.031.921	3.135.186.793.628	3.146.460.226.584
	DF	0,8929	0,7972	0,7118	0,6355	0,5674	0,5066	0,4523	0,4039	0,3606	0,3220
	Present Value	(2.108.132.988.297)	(8.582.308.525.362)	(3.187.513.453.991)	1.945.748.613.351	1.746.873.277.421	1.567.728.509.840	1.406.418.372.857	1.261.222.324.233	1.130.579.787.972	1.013.075.982.957
	Cumulative Present Value	(2.108.132.988.297)	(10.690.441.513.659)	(13.877.954.967.651)	(11.932.206.354.299)	(10.185.333.076.879)	(8.617.604.567.038)	(7.211.186.194.181)	(5.949.963.869.948)	(4.819.384.081.976)	(3.806.308.099.019)

No	Description	Year									
		11	12	13	14	15	16	17	18	19	20
A.	INFLOW										
1	Acceptance	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000
2	Credit										
	a. Investment										
	b. Working Capital										
	Total INFLOW										
	OUTFLOW	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000	9.015.300.000.000
B.	Manufacturing Plant Investment Cost										
1	Acceptance										
	a.ISBL										
	b.CCS										
	c. OSBL										
	d. Owner Cost										
2	Operational Cost	4.934.291.545.336	4.996.548.838.205	5.060.051.276.931	5.124.823.764.432	5.190.891.701.683	5.258.280.997.679	5.327.018.079.594	5.397.129.903.149	5.468.643.963.174	5.541.588.304.399
3	Credit										
	Investment										

	a. Loan Primary Installment	607.142.300.630	607.142.300.630	607.142.300.630							
	b. Loan interest	182.142.690.189	121.428.460.126	60.714.230.063							
	Working capital										
	a. Loan Primary Installment	103.989.692.025	103.989.692.025	103.989.692.025							
	b. Loan interest	31.196.907.608	20.797.938.405	10.398.969.203							
	Out Cash Flow Total	5.858.763.135.787	5.849.907.229.391	5.842.296.468.851	5.124.823.764.432	5.190.891.701.683	5.258.280.997.679	5.327.018.079.594	5.397.129.903.149	5.468.643.963.174	5.541.588.304.399
	Net Cash Flow	3.156.536.864.213	3.165.392.770.609	3.173.003.531.149	3.890.476.235.568	3.824.408.298.317	3.757.019.002.321	3.688.281.920.406	3.618.170.096.851	3.546.656.036.826	3.473.711.695.601
	DF	0,2875	0,2567	0,2292	0,2046	0,1827	0,1631	0,1456	0,1300	0,1161	0,1037
	Present Value	907.428.920.168	812.477.483.605	727.170.514.530	796.068.518.309	698.705.097.650	612.851.183.235	537.177.389.466	470.505.356.369	411.790.801.175	360.108.454.306
	Cumulative Present Value	(2.898.879.178.851)	(2.086.401.695.246)	(1.359.231.180.716)	(563.162.662.408)	135.542.435.243	748.393.618.477	1.285.571.007.943	1.756.076.364.312	2.167.867.165.487	2.527.975.619.793

Appendix 7. Liquid Coal Investment Cash Flow in East Kalimantan Capacity 10.000 ton/day with Gasoline Product Selling Prices Rp 11.000/liter

No	Description	Year									
		1	2	3	4	5	6	7	8	9	10
A.	INFLOW										
1	Acceptance				9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000
2	Credit										
	a. Investment	6.071.423.006.297									
	b. Working Capital		1.039.896.920.252								
	Total INFLOW	6.071.423.006.297	1.039.896.920.252	-	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000
B.	OUTFLOW										
1	Manufacturing Plant Investment Cost										
	a.ISBL	7.642.531.953.190									
	b.CCS	790.000.000.000									
	c. OSBL		8.432.531.953.190								
	d. Owner Cost		3.373.012.781.276								

2	Operational Cost			4.478.226.901.889	4.531.362.901.889	4.585.561.621.889	4.640.844.316.289	4.697.232.664.577	4.754.748.779.831	4.813.415.217.390	4.873.254.983.700
3	Credit										
	Investment										
	a. Loan Primary Installment				607.142.300.630	607.142.300.630	607.142.300.630	607.142.300.630	607.142.300.630	607.142.300.630	607.142.300.630
	b. Loan interest				607.142.300.630	546.428.070.567	485.713.840.504	424.999.610.441	364.285.380.378	303.571.150.315	242.856.920.252
	Working capital										
	a. Loan Primary Installment				103.989.692.025	103.989.692.025	103.989.692.025	103.989.692.025	103.989.692.025	103.989.692.025	103.989.692.025
	b. Loan interest				103.989.692.025	93.590.722.823	83.191.753.620	72.792.784.418	62.393.815.215	51.994.846.013	41.595.876.810
	Out Cash Flow Total	8.432.531.953.190	11.805.544.734.466	4.478.226.901.889	5.953.626.887.199	5.936.712.407.933	5.920.881.903.068	5.906.157.052.090	5.892.559.968.079	5.880.113.206.372	5.868.839.773.416
	Net Cash Flow	(2.361.108.946.893)	(10.765.647.814.214)	(4.478.226.901.889)	3.490.973.112.801	3.507.887.592.067	3.523.718.096.932	3.538.442.947.910	3.552.040.031.921	3.564.486.793.628	3.575.760.226.584
	DF	0,8929	0,7972	0,7118	0,6355	0,5674	0,5066	0,4523	0,4039	0,3606	0,3220
	Present Value	(2.108.132.988.297)	(8.582.308.525.362)	(3.187.513.453.991)	2.218.576.524.410	1.990.469.626.581	1.785.225.250.162	1.600.611.891.001	1.434.609.394.004	1.285.389.671.697	1.151.299.093.425
	Cumulative Present Value	(2.108.132.988.297)	(10.690.441.513.659)	(13.877.954.967.651)	(11.659.378.443.240)	(9.668.908.816.659)	(7.883.683.566.498)	(6.283.071.675.497)	(4.848.462.281.492)	(3.563.072.609.795)	(2.411.773.516.370)

No	Description	Year									
		11	12	13	14	15	16	17	18	19	20
A.	INFLOW										
1	Acceptance	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000
2	Credit										
	a. Investment										
	b. Working Capital										
	Total INFLOW	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000	9.444.600.000.000
B.	OUTFLOW										
1	Manufacturing Plant Investment Cost										
	a.ISBL										
	b.CCS										
	c. OSBL										
	d. Owner Cost										
2	Operational Cost	4.934.291.545.336	4.996.548.838.205	5.060.051.276.931	5.124.823.764.432	5.190.891.701.683	5.258.280.997.679	5.327.018.079.594	5.397.129.903.149	5.468.643.963.174	5.541.588.304.399
3	Credit										
	Investment										
	a. Loan Primary Installment	607.142.300.630	607.142.300.630	607.142.300.630							

	b. Loan interest	182.142.690.189	121.428.460.126	60.714.230.063							
	Working capital										
	a. Loan Primary Installment	103.989.692.025	103.989.692.025	103.989.692.025							
	b. Loan interest	31.196.907.608	20.797.938.405	10.398.969.203							
	Out Cash Flow Total	5.858.763.135.787	5.849.907.229.391	5.842.296.468.851	5.124.823.764.432	5.190.891.701.683	5.258.280.997.679	5.327.018.079.594	5.397.129.903.149	5.468.643.963.174	5.541.588.304.399
	Net Cash Flow	3.585.836.864.213	3.594.692.770.609	3.602.303.531.149	4.319.776.235.568	4.253.708.298.317	4.186.319.002.321	4.117.581.920.406	4.047.470.096.851	3.975.956.036.826	3.903.011.695.601
	DF	0,2875	0,2567	0,2292	0,2046	0,1827	0,1631	0,1456	0,1300	0,1161	0,1037
	Present Value	1.030.842.411.658	922.668.101.006	825.554.994.353	883.911.803.865	777.136.602.611	682.879.312.664	599.702.505.028	526.331.352.406	461.635.440.494	404.612.596.555
	Cumulative Present Value	(1.380.931.104.712)	(458.263.003.706)	367.291.990.647	1.251.203.794.511	2.028.340.397.123	2.711.219.709.786	3.310.922.214.814	3.837.253.567.221	4.298.889.007.714	4.703.501.604.269