COAL LIQUEFACTION IN INDONESIA: CURRENT STATUS AND FUTURE PROGRAMME

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ABSTRACT

The Presidential Decree No. 5/2006 and Presidential Instruction No. 2/2006 about Supply and Exploitation of Liquefied Coal as Other Fuel has instructed the interrelated department, including the Ministry of Energy and Mineral Resources, to bring about the development of coal liquefaction plant in Indonesia, and make use of its product - in the form of oil fuel. To implement the instruction, the Coordinating Ministry for Economic Affairs issued Decision Letter, No. KEP-11/M.EKON/02/2006 about Coordinator of Team Action Programmed Supply and Use of Alternative Energy and KEP-01/D.III.M.EKON/02/2006 about Technical Coordinator Action Programme Supply and Use of Alternative Energy. Some activities that have been done by the coal liquefaction team in 2006 were the socialization of coal liquefaction to introduce the coal liquefaction technology to the investors. It is expected that the investors will be interested in investing their financial capital in the coal liquefaction.

Keywords : Coal liquefaction, presidential decree, presidential instruction, investors

1. INTRODUCTION

Energy resource from petroleum, nowadays, has come to a critical condition. Meanwhile, there are a huge amount of other forms of energy resources that can substitute petroleum, either it can be renewed or can unrenewed. However, many of those energy resources need further researches in order to be optimally exploited.

One of those energy resources that can be relaid on is coal, which is available in a big amount and fulfilled the qualification to substitute petroleum or to add the supply of oil fuel. Additionally, it has several insufficiencies, particularly when it is related to its waste that is often issued to have damage of the environment. It has a lot of superiorities compared with other non-oil energy resources; e.g. coal can be directly used in solid form or converted it into gas and liquid; coal can be processed by available technologies and it is also economical. Moreover, the supplies of coal are enormous; amounting about 61 billion tons (Sukarjo, 2006). More than 60 % of the coal is characterized as low rank coal that has not been exploited optimally, but it can be a feed for the liquefaction of coal. Due to the increasing number of coal mining, the supplies of coal may be decreasing, but those may be also increasing as there are big possibilities that existing coal mining companies found new supplies and coal resources.

Relating to the exploitation of coal as an energy resource, the Presidential Decree No.5 Year 2006 about the National Energy Policy says that coal and other energy resources, beside petroleum will be increased in its role in the national energy mix. Specifically on coal, its role will reach more than 33% in the year of 2025 (Figure 1). Besides that, liquefied coal is predicted to contribute above 2% of the national energy resource. Liquefied coal is a new product that was not included in the energy mix in the previous years.

The Presidential Instruction No. 2 Year 2006 about Supply and Exploitation of Liquefied Coal as Other Fuel has instructed the interrelated department, including the Ministry of Energy and Mineral Resources, to bring about the development of coal liquefaction plant in Indonesia, and makes the use of its product in the form of oil fuel.

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Table 1. Indonesia coal reserves and resources (2005) [amendment I-SNI 13-50414-1998]

No	Locality	Quality		Resources (million tons)					Reserves (million tons)
		Class	Criteria (Cal/g, adb)	Hypotethic	Inferred	Indicated	Measured	Total	
1	Java	Low Calory	< 5100	0.00	0.90	0.00	0.00	0.90	0.00
		Medium	5100 - 6100	5.47	4.87	0.00	0.00	10.34	0.00
		High	6100 - 7100	0.00	2.97	0.00	0.00	2.97	0.00
	Total Coal Resources in Java			5.47	8.74	0.00	0.00	14.21	0.00
2	Sumatera	Low Calory	< 5100	326.55	8.829.35	2.306.77	1.720.75	13.183.42	2.426.00
		Medium	5100 - 6100	408.96	3.491.59	9.225.61	562.91	13.689.08	210.62
		High	6100 - 7100	33.70	959.56	442.00	303.71	1.738.97	120.11
		Very High	> 7100	0.00	27.32	0.00	14.37	41.69	14.00
	Total Coal Resources in Sumatera			769.21	13.307.82	11.974.38	2.601.74	28.653.16	2.770.73
3	Kalimantan	Low Calory	< 5100	0.00	1.056.72	13.76	690.82	1.761.30	536.33
		Medium	5100 - 6100	2.285.84	15.720.23	426.05	5.180.28	23.614.39	2.232.68
		High	6100 - 7100	659.19	3.588.58	224.89	1.740.90	6.213.56	1.109.18
		Very High	> 7100	90.11	430.08	5.80	104.90	630.88	109.92
	Total Coal Resources in Kalimantan			3.035.13	20.795.60	672.50	7.716.90	32.220.14	3.988.11
4	Sulawesi	Low Calory	< 5100	0.00	1.98	0.00	0.00	1.98	0.00
		Medium	5100 - 6100	0.00	131.03	32.31	53.10	216.44	0.06
		High	6100 - 7100	0.00	13.90	0.78	0.00	14.68	0.00
	Total Coal Resources in Sulawesi			0.00	146.91	33.09	53.10	233.10	0.06
5	Maluku	Low Calory	< 5100	0.00	2.13	0.00	0.00	2.13	0.00
	Total Coal Resources in Moluccas			0.00	2.13	0.00	0.00	2.13	0.00
6	Papua	Low Calory	< 5100	89.40	30.95	0.00	0.00	120.35	0.00
		Medium	5100 - 6100	0.00	5.38	0.00	0.00	5.38	0.00
		High	6100 - 7100	0.00	25.53	0.00	0.00	25.53	0.00
	Total Coal Resources in Papua			89.40	61.86	0.00	0.00	151.26	0.00
	Total Indonesian Coal Resources			3.899.22	34.323.06	12.679.98	10.371.74	61.273.99	6.758.90

Source : Sukarjo (2006)

This paper provides a brief summary of the current status and future programme of coal liquefaction in Indonesia.

2. COAL TECHNOLOGY DEVELOPMENT

Coal is a solid material that accumulates solar energy in the form of hydrocarbon. The molecular weight of the coal is larger than that of petroleum, and it contains less hydrogen but more oxygen, sulphur and nitrogen. In order to make coal more efficiently and easily usable as a hopeful alternative energy source of petroleum, it is necessary to convert coal into clean fuel with higher energy density by removing sulphur and nitrogen, and increasing hydrogen.

The reaction of coal liquefaction is the conversion of coal into liquid by the thermal decomposition and hydrogenation with catalyst under pressurized condition. As a feedstock for liquefaction, it is more effective to use low rank coals with low energy density and limited utilization, because the low rank coals are easily liquefied.

The only country that has produced oil fuel from coal (crude synthetic oil/CSO) is the Republic of South Africa (RSA), which has persisted for more than 40 years. The existence of CSO has successfully solved the lack of oil fuel supplies in RSA; in fact, they can export the technology to several countries. At this time, China and India are in the process of developing coal liquefaction plant by the support from RSA. Meanwhile, Qatar and Ni-

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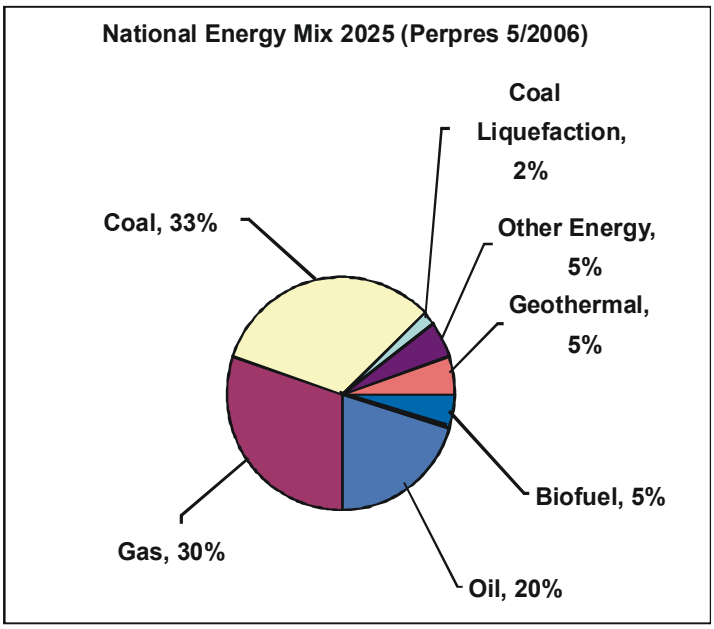

Figure 1. National energy mix year 2025 (Perpres No. 5, 2006 and Tjetjep, 2006)

geria are developing a coal gasification plant, also with the support from RSA.

Besides that, Japan and the United States of America (USA) are also striving to develop the coal liquefaction technology. Even though, it is still in the form of a pilot plant and demo plant. These two countries have successfully developed a different coal liquefaction technology. Japan and USA is liquefied coal is by a direct process; changing coal directly from solid form into liquid. Meanwhile, RSA is by an indirect process; coal is gasified before being liquefied. There are many advantages and disadvantages between these indirect and direct processes. However, the most important thing is that both are able to produce a product that has the same function as oil fuel, with a competitive selling price.

This means that coal can substitute the role of oil fuel, or, at least add the supply of oil fuel.

3. THE PRESENT STATUS OF COAL LIQUEFACTION

According to the prediction from existing coal resources, coal liquefaction plant will not be lacking of coal supplies if it is built in Indonesia (Sembiring, 2006). The government through the Ministry of Energy and Mineral Resources will not find any difficulties in constructing the regulation to support the assurance of coal supplies as a feed for the coal liquefaction plant.

Since 1994, research and development on coal liquefaction in laboratory scale and bench scale unit (BSU) have been carried out under the research cooperation between Indonesia (Ministry of Energy and Mineral Resources, and Agency for the Assessment and Application of Technology) and Japan (NEDO). Pre-feasibility studies of Banko coal (South Sumatera), Berau coal (East Kalimantan) and Mulia coals (South Kalimantan) for coal liquefaction were completed under this cooperation. These coals can be liquefied satisfactorily with recovery of around 64% and they produced synthetic fuel with quality similar to fuel for transportation. One ton of coal (dry ash free) produces 1.8 barrels of synthetic crude oil with the selling price of US$ 23 – US$ 29 for one barrel (Makino, 2006). To extend this study into a commercial scale, participation of private companies or consortiums of investors are needed.

In order to bring about the coal liquefaction plant, some activities were done in the year of 2006 to socialize the coal liquefaction with the aim to in-

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troduce the coal liquefaction technology to the investors (SK Menko Perekonomian, 2006 and SK Deputi III Menko Perekonomian, 2006). Hopefully, they will be interested in investing their financial capital in the coal liquefaction. The activities were National Seminar of Coal Liquefaction on July 13th, Round Table Meeting on August 1st, and Round Table Meeting II on September 1st, 2006. All of those activities were conducted by Ministry of Energy and Mineral Resources and Coordinating Ministry for Economic Affairs in Jakarta.

All of the activities were attended by speakers from government decision makers, particularly the Ministry of Energy and Mineral Resources, Coordinating Ministry for Economic Affairs and the stakeholders. The results were recommended as follows:

- It is important for the Government to be consistent in the development of coal liquefaction plant. The government consistency can be manifested in form of policy that is followed by technical policy as supporter, such as tax specialist and coal supply guarantees. Besides that, all of the interrelated departments must support one to another.

- As the development of coal liquefaction plant is included to have an intense technology, intense investment, high risk and slow in the capital return, therefore, it is needed various incentives in various aspects, such as tax holiday, royalty and other components. These can be carried out by dynamic stimulation, until it resulted in formulations that can be negotiated by the government to the investor candidate.

- If the energy endurance/tenacity becomes the priority, the government must be able to become a pioneer in the development of coal liquefaction plant. Therefore, it is wise not to think about profit or loss in the development of the plant. There must be sacrifices in order to realize the development of coal liquefaction plant.

- It is needed to form a coordinating institution, in the form of a permanent body/committee or institution that specifically handles the coal liquefaction. This committee or institution consists of government people and the interrelated private side.

- Seeing from various considerations, Brown Coal Liquefaction (BCL) technology seems to be the best alternative to be applied in Indonesia in the development of coal liquefaction plant.

According to several considerations, at least there are five advantages of coal liquefaction plant as the follows:

- First, there are extra amount of oil supplies from coal that can enlarge the petroleum supplies, and reduce the dependency towards imported petroleum, and at the same time, save the foreign exchange.

- Second, low rank coal can be used optimally for the coal liquefaction needs. The exploitation of low rank coal gives chances of new industries in mining sector.

- Third, it gives a large multiplier effect toward many things, such as, opens new industries that supply other needs (non-coal), creates new employment and accelerates the process of making a more prosperous life of the people.

- Fourth, from the political aspects, the existence of coal liquefaction plant can make the country's endurance stronger in energy sources.

- Fifth, the sophisticated coal liquefaction technology can be studied.

4. GOVERNMENT POLICY AND FUTURE PROGRAMME

As part of the effort to develop the coal liquefaction plant, Ministry of Energy and Mineral Resources, has prepared several policies, starting from the management, exertion, exploitation, until development policies. In particular, the policies for the development of coal liquefaction are giving special incentive, infrastructure development in the producer area, simplification of the licensing process, the standard of coal specification for the liquefied coal raw material, also the policy on coal supply guarantee for the feed of coal liquefaction industries.

Several other policies that encourage the coal program are special incentive for investors using low

rank coal, encouragement of infrastructure development in the regions that produce low rank coal and simplify process of coal mining permit for low rank coal.

Regarding the future program, the time line of coal liquefaction is shown in Figure 2. From this figure, it can be seen that in the year of 2006 was to prepare design of Process Supporting Unit (PSU) working together with Kobelco (Japan). Hopefully in 2007 the PSU (4.5 bbl/day) will start operating. The next plant (2009) that is semi commercial plant (13.500bbl/day) will be operated. Coal commercial plant 1 (27.000 bbl/day) is programmed to be operated in 2012. In the year of 2025 Indonesia will have six to seven coal liquefaction commercial plants.

5. DISCUSSION

Significant price increases and crude oil reserve shortages have brought energy security to the centre stage. Indonesia has extensive coal reserves with the total resources of 61.3 billion tons. However, over 60% of coal resources are classified as lignite and sub-bituminous C (low rank coal/ LRC).The deposits of LRC are quite widespread throughout the archipelago, particularly in South Sumatera, Jambi, Riau, North Sumatera, Nanggroe Aceh Darussalam (NAD), East Kalimantan and South Kalimantan (mostly in the southern part). Most of the LRC occurs closed to the surface to make it easy and cheap to exploit. These coal reserves may lead to consider technologies that transform coal into clean fuels. Coal liquefaction is a suite of technology that can convert LRC into clean liquid fuel, which can be used for transportation.

There are two types of coal liquefaction technologies; they are indirect coal liquefaction (ICL) and direct coal liquefaction (DCL). ICL is already develop in South Africa (SASOL) modified by Fisher Tropsh (FT) produces good quality distillate for high quality diesels but requires considerable refining to meet gasoline specification. DCL is being developing by NEDO Japan using Brown Coal Liquefaction (BCL) and produces good quality naphtha for gasoline but distillate requires significant ring opening to meet diesel specification.

In order to develop coal liquefaction plant, the Presidential Decree No. 5/2006 has been issued. The decree stated that more than 2% of energy mix in 2025 will be provided from coal liquefaction.

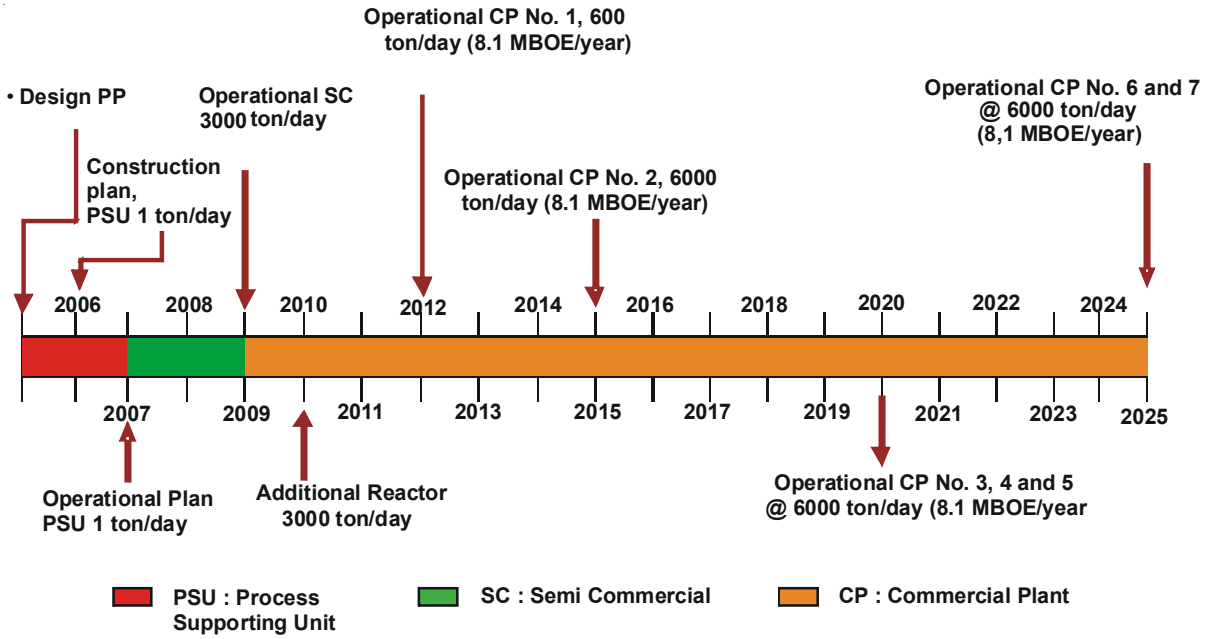

Figure 2. Future program of coal liquefaction (Balia, 2006)

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As a part of the effort to develop the coal liquefaction plant, the Indonesian Government approaches Japanese, the Government to construct coal liquefaction plant in the country. In addition, several discussions have been conducted to prepare several policies that facilitate this project.

6. CLOSING REMARKS

- In 1994, the collaboration between Indonesian and Japanese Governments has started to realize construction of a pioneer commercial plant in the beginning of 21st century. Pre-feasibility studies of 3 types of Indonesia low rank coals were completed with the oil yield of more than 64%. One ton of coal produces 1.8 bbl oil with the selling price of less than US$ 30/ bbl.

- The Indonesian Government has issued the Presidential Decree No. 5/2006 and Presidential Instruction No. 2/2006 related to the construction of coal to liquid.

- The Indonesian Government is considering an established Coal liquefaction Board to accommodate the realization of coal to liquid construction with the support from the Japanese Government.

- The Indonesian Government supports the development of a 3,000 ton/day semi commercial plant by providing various incentives, such as tax import duty rate, royalty and so forth.

- Having a high technology, high cost and high-risked, the construction of a 3,000 ton/day semi commercial plant is required full support from Japanese Government.

- 1 (one) ton coal/day Process Supporting Unit (PSU) is required for supporting the construction of semi commercial plant.

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