Syngas to Synfuel Plant for Eastern Indonesia

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ABSTRACT

As we know, proven oil reserves in the world have decreased, as well as in Indonesia. Currently, proven oil reserves in Indonesia is about 2.483,97 MMSTB in 2019. Assuming a constant production without the discovery of new reserves, then in the next 10 to 11 years Indonesia will not be able to produce petroleum anymore. On the other hand, compared to proven petroleum reserves in Indonesia, proven natural gas reserves in Indonesia are quite large. It is around 49,74 TSCF in 2019. And the reserve to production is about 34 years since 2009 to 2018. Therefore, in this work, a syngas to synfuel plant has been prepared as a contribution for preparation of a shifting from producing fuel with petroleum as raw material, to fuel with natural gas as raw material. Particularly for eastern Indonesia, where access to several areas is difficult to reach so that the distribution of gas products is less relevant.

Keywords: *Problem-Solving Ability, MEAs, Graph Application.*

1. INTRODUCTION

Indonesia has many rural and remote areas, because of its geography and topography [1]. This condition made Indonesia consist of beautiful islands especially in Eastern Indonesia [2], but also caused some issues, including the disparities of demand-supply of energy [3]. On the other hand, Indonesia still has petroleum and gas reserves in those areas. Indonesian petroleum reserves were 3.774,6 MMSSTB in 2019 with proven reserves of 2.483,97 MMSTB. And in 2018, the reserve to production of proven petroleum reserves in Indonesia is 10-11 years. For the natural gas reserves, Indonesia still has 77,29 TSCF in 2019, with proven reserves of 49,74 TSCF. And the reserve to production of the proven natural gas reserves is about 34 years since 2009 to 2018. So we know that Indonesian natural gas reserves is higher than petroleum reserves. And the area that still has much proven natural gas reserves is in eastern Indonesia [4], [5]. Table 1. Show Proven Natural Gas Reserves in 2019 of Indonesia (BSCF).

As the Indonesia's economic and population continues to grow, the demand of energy will also grow significantly. However, the increased demand also needs to minimize the impact of fuel on the environment by the quest for cleaner energy. So, demand for natural gas probably will also increase due to its availability, accessibility, and smaller environmental footprint than other fossil fuels [6], [7]. Table 2 Show Natural Gas Lifting and Consumption in Indonesia (MBOEPD) [5].

Table 1. Proven Natural Gas Reserves in 2019 of Indonesia (BSCF) [5]

Item	Proven Natural Gas Reserves
NAD	727,15
North Sumatera	83,13
Central Sumatera	139,41
South Sumatera	5.414,04
Natuna	1.045,62
West Java	1.496,82
East Java	2.422,59
Kalimantan	7.872,44
Sulawei	3.480,96
Maluku	11.928,14
Papua	15.127,85

Table 2. Natural Gas Lifting and Consumption in Indonesia (MBOEPD) [5]

Item	2015	2016	2017	2018	2019
Target	1.221	1.150	1.150	1.200	1.250
Production Domestik	1.202	1.188	1.141	1.133	1.058
Consump-tion	NA	59%	59%	60%	64%

In the Table 1, it is shown that there are still some amounts of natural gas that can be used domestically. If those amounts can be used for people in eastern Indonesia that is still in remote area that will help the government in their equitable development program. However, one of the Indonesian government's energy development programs was also to optimize the use of natural gas domestically [8].

Syngas to synfuel technology is one of technologies in Gas-to-Liquid (technologies). Gas can be converting into clean and useful liquid hydrocarbons using this GTL technologies. These technologies are suitable for addressing problems of remote gas utilization, depletion of fossil fuel, increase in crude oil price, environmental pollution and has emerged as a commercially viable industry over the thirty years [6], [9].

2. METHOD

In this paper, the study to review recent development in syngas to synfuel was done. Finally challenges in syngas to synfuel plant has been discussed as a contribution for preparation of a shifting from producing fuel with petroleum as raw material, to fuel with natural gas as raw material. Particularly for eastern Indonesia, where access to several areas is difficult to reach so that the distribution of gas products is less relevant.

3. RESULT AND DISCUSSION

3.1. Gas-to-Liquid (GTL) Technologies

GTL technology was first discovered in Germany in the 1920s. This technology uses a process called Fischer-Tropsch synthesis (FTS). GTL fuels can be produced from coal, natural gas, and biomass using FTS process. The liquids produced by this process include synfuel (naphtha, diesel) and petrochemical feedstocks. The GTL route to produce clean liquid synfuels based on this process is shown in Figure 1.

Diesel that is produced here can be used neat or blended with today's diesel fuel in existing diesel engines. We can reduce the dependence on petroleum-based fuels and reduce tail pipe emissions using this option. There are some routes to convert methane into useful liquid hydrocarbons, those are direct methane conversion and indirect methane conversion. For now, the technology that based on the indirect route that consists of multistep reaction processes is the route that used commercially. These processes consist of five key steps: (1) air separation, (2) gas processing, (3) syngas production, (4) conversion of syngas to a Syncrude or oxygenate (Fischer–Tropsch Synthesis) and (5) upgradation of Syncrude by hydro processing to marketable products (synfuels) [9].

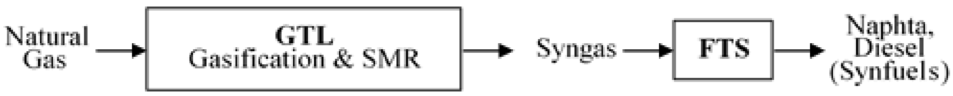

Figure 1 The GTL route to produce clean liquid synfuels

3.2. Syngas

Synthetic gas (also called syngas) is a mixture produced by the gasification of carbonaceous material such as natural gas, coal, petroleum residua, biomass, and opportunity fuels such as industrial and municipal waste. It is consisting of primarily of carbon monoxide and hydrogen but also contain water, carbon dioxide, methane, and nitrogen. Synthesis gas can also be produced to yield a range of compositions ranging from high-purity hydrogen to high-purity carbon monoxide [10].

3.3. Synfuel

Synthetic fuel (also called synfuel) is a liquid fuel that is obtained from an FTS process. One of the synfuel that is produced from GTL process is Diesel. Diesel that is obtained from GTL process today has a higher quality than the fuel that is obtained from typical refining processes applied to crude oil, because it has higher cetane number (at least 70 compared with a 45 to 55 rating of most diesels), lower aromatics (less than 1%), lower density, and lower Sulphur content (less than 5 ppm) [6].

3.4. Syngas to Synfuel Plant

Producing synfuel from syngas using GTL process is proven as an effective way to increase the utilization of natural gas especially in remote area. It also has been used commercially, the syngas manufacturing developmental stages at each company developing GTL technology is shown in Table 3.

Natural gas reserve located in the remote areas of Indonesia such as eastern Indonesia can also be converted to liquid on site and that will make the transportation of these natural gas easier, and more economical. In 2019, about 36% of 1.058 MBOEPD produced natural gas was not used domestically. If in the next several years, those numbers are constant and 35% of those number comes from remote area such as eastern Indonesia, so if the 0,1% of that amount is being used for syngas to synfuel plant, then the remote area will have the plant in about 140.000 B/d production capacity in total. Based on the comparison data in table 3, this production capacity is enough to build a syngas to synfuel plant commercially in several remote areas.

Table 3. Comparison of GTL technology [9], [11]

Item	Singes Production	FT Synthesis (cat)	Production
JOGMEC (Japan)	Tubular Reformer (Chuyoda)	Slurry bed (Co) <NSC>	7B/day Pilot
Sasol (South Africa)	Auto Thermal Reformer (Topsoe)	Slurry bed (Co) <Sasol>	17.000 B/d Commercial (x2)
Shell (Malaysia)	POX (Shell)	Fixed bed (Co) <Shell>	3.000 B/d Commercial (x4)
ExxonMobil (USA)	Auto Thermal Reformer (ExxonMobil)	Slurry bed (Co) <ExxonMobil>	200 B/day Demonstration
Conoco (USA)	CPOX (Conoco)	Slurry bed (Co) <Conoco>	400 B/day Demonstration
BP (USA)	Compact Reformer (BP)	Slurry bed (Co) <BP>	300 B/day Demonstration
Sweetwater Project (Australia)	Auto Thermal Reactor	Fixed bed (Co) and Slurry Reactor	11.500 B/day
ExxonMobil (Qatar)	NA	NA	154.000 B/day
Oryx (Qatar)	NA	NA	100.000 B/day
Pearl-Shell (Qatar)	NA	NA	140.000 B/day

4. CONCLUSION

From this study we find that syngas to synfuel process is one of the gas conversion processes using Gas to Liquid (GTL) technology, and this technology is already been used commercially. In the other hand, Indonesia has large quantity of proven natural gas reserves, but not all of them are used for domestic needs. Based on the production amount of natural gas and the amount of proven natural gas in eastern Indonesia, it's possible to build commercial syngas to synfuel plant in remote areas. If the natural gas in remote area such in eastern Indonesia could be converted in to liquid through syngas to synfuel process, the people there could get the fuel easily for their daily needs. Fuel Products from syngas to synfuel process will also have higher quality, lower emissions, and can be more easily transported than natural gas, especially in remote area.

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