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Effective and Efficient CGS Strategy to Mitigate NDC Unplanned Total Shutdown: A Case in PT. Capital Petroleum Indonesia

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Abstract – **DME (Dimethyl Eter) is one of alternative fuel that will be implemented for household in Indonesia. The paper presents the result of economic feasibility study of Dimethyl Ether (DME) transportation from coal gasification from Tanjung Enim DME Plant using pipeline. The research aims to determine the project feasibility by conducting the qualitative and quantitative analysis. The tools that used in this research include PESTEL analysis, Five Porter Forces, VRCN analysis for qualitative analysis. For quantitative analysis, the author uses Discounted Cash Flow (DCF) Analysis to analyse the economic feasibility of the project during 20 years of project lifetime.**

From the qualitative analysis results, it is concluded that DME Pipeline is a very prospective business and will create a competitive advantage for the company, meanwhile from the quantitative analysis, the DME pipeline project is feasible with the result of indicative toll fee value is US$ 0,13/Ton-Km. In the long term, tbe DME pipeline business will create a big impact as new revenue stream and business diversification in the long term.

Keywords – **DME, Pipeline, Feasibility, Coal, Gasification**

I. INTRODUCTION

Coal is an abundant energy source that available in Indonesia with total production 562 million ton in 2020 [4]. Currently, Coal is directly sold to customer directly to domestic and export market [4]. On 2020, the Government of Indonesia release the Presidential Decree 109/2020 which stipulate the Coal Gasification in Tanjung Enim as Strategic National Project. The objective of this program is to increase the value of coal at downstream sector and to reduce the LPG Import by creating alternative energy sources which is suitable for domestic household such as City Gas development, Absorbed Natural Gas (ANG), and Di-Methyl Ether (DME). According to *Rencana Umum Energi Nasional (RUEN) 2017* established by Dewan Energi Nasional (DEN), Government of Indonesia has target to produce 1-million-ton DME in 2025 and increase to 1,9 million ton in 2050 as shown in Figure 1.

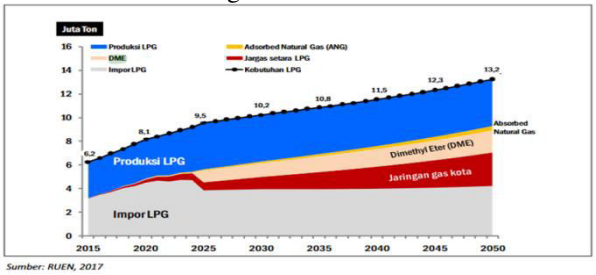

Fig 1. Indonesia LPG Demand & alternatives (source: RUEN 2017)

The first DME plant from Coal Gasification in Indonesia is planned to develop by consortium of Pertamina, PT. Bukit Asam, Tbk and Air Product & Chemical, Inc. The plant is designed to produce 1,4 million Ton DME per year. The plant location is Tanjung Enim, South Sumatera, while the consumers are spread in many locations such as Java and Kalimantan Island [3].

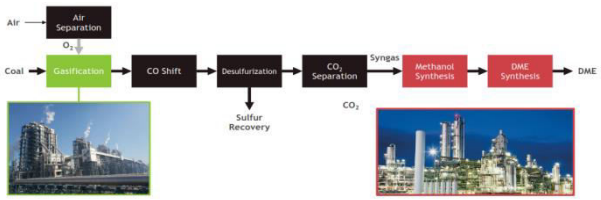

Figure 2. Schematic Diagram of Coal Gasification and DME synthesis system (Source: PT. Bukit Asam)

One of the main challenges to develop DME project is the transportation of DME product from DME plant to consumers. DME product must be transported to DME storage hub before the product shipped or transported using truck. Due to the location of DME plant in Tanjung Enim is relatively remote and long distance from the customers, DME must be transported by land (pipeline, truck or train) and sea or river transportation. As one of the critical supply chains, DME transportation must be taken into consideration to be as efficient as possible to find the best price for DME to become more competitive than LPG.

This paper presents results of a research assessing the feasibility of DME pipeline project from DME Plant and aim to answer these research questions:

1. What is the pipeline toll fee for DME transportation by pipeline?
2. What is the financial feasibility of DME Pipeline in these projects?
3. What is the impact of this business to company overall performance in future?

II. LITERATURE REVIEW

Dimethyl Ether (DME) with chemical formula $(CH_3)_2O$, is a fuel that has similar characteristics with LPG as shown in the Table 1 [18]. Therefore, DME can be used for cooking fuel for household or industry. DME can be made from many sources such as coal, natural gas, and biomass. DME is a colorless gas at ambient pressure and temperature. It is widely used as aerosol propellant in hair spray and other personal care products [19].

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World production of DME today stands at approximately 9 million tons per year. The majority of global DME production is currently in China. Japan, Korea and Brazil have significant new production facilities, and major new capacity additions are planned or under construction in Egypt, India, Indonesia, Iran and Uzbekistan [18].

TABLE 1. PHYSICAL PROPERTIES OF DME AND LPG

Property	DME	Propane	Butane
Boiling point (°C)	-24.9	-42.1	-0.5
Vapor pressure at 20°C (bar)	5.1	8.4	2.1
Liquid density at 20°C (kg/m^3)	668	501	610
Specific density (gas)	1.59	1.52	2.01
Lower heating value (MJ/kg)	28.43	46.36	45.74
Auto ignition temperature at 1 atm (deg C)	235-350	470	365
Flammability limits in air (vol. %)	3.4-17	2.1-9.4	1.9-8.4

DME delivery from the source to the consumers is one important aspect in developing DME project. There are three main infrastructures to deliver DME to consumers: (1) bulk storage at coastal terminal or production site, (2) transportation in bulk to bottling facility and (3) bottling and distribution to end users [19]. Cost of bulk transportation depends on whether the transportation is by trucking, train or pipeline. For short and small volume, trucking is less costly compare with others. For long distance of large volume, pipeline is likely to be the best option. Table 2 show the comparison between three types of DME transportation.

TABLE 2. COMPARISON OF TRANSPORTATION METHOD

	Advantages (+)	Disadvantages (-)
Trucking	+ Low capital investment (suitable for low volume) + can be rent from third parties + no need land acquisition	- Highest fatality rate - Highest Cost per barrel - Risk of spill is very high - Highly dependent on traffic - Limited capacity
Train	+ Fastest transportation + Risk of spill is lower + more flexible location + may add extra volume by additional train	- Costly (2 or 3 times compare with pipeline) - High capital investment - High potential of interruption - limited access - need land acquisition
Pipeline	+ Lowest fatality rate + Most efficient (lowest cost) + Effective for high volume + Not depend on traffic + High access to remote area + Lower emissions footprint	- high capital investment - need land acquisition - limited rate of return (highly regulated business) - pipe leakage may lead to disastrous event

According to Larson & Yang [19], the cost structure of DME consist of production cost, transportation cost, storage cost and retailing cost. Production cost has the largest portion of total cost, followed by bottling/retailing, bulk transportation and bulk storage. For the transportation cost, it depends on the distance from source to users. Based on their study, the total cost of pipeline transportation is $0,014/ton-km which consist of $0,011/ton-km for capital cost and $0,003/ton-km for Operation & Maintenance cost. This cost is assumed for US$ 250 million capex, 12%/yr capital charge, 90% utilization, 3,5% O&M cost and 1246 km pipeline.

III. METHODOLOGY

This paper uses qualitative analysis and quantitative analysis. Qualitative Analysis is using Internal Analysis such as Resources, Competencies and VRCN Analysis and External Analysis using Porter Five Forces and PESTEL Analysis to analyse the project environment and integration in the project implementation. Quantitative analysis using primary and secondary data. Primary data were obtained from field survey, meetings, on site measurement and interview. Secondary data were obtained from books, journals, technical reports, and research reports. The main source of data is from company financial information, operation data, technical data, and supported by various sources from online and offline media. All this data used for desktop analysis to produce a pre-feasibility study report. To complete the desktop analysis, more data will be completed using site survey, pipeline hydraulic analysis, and data verification from many sources. The output of this Pre-Feasibility study is the estimated Capital Expenditure (CAPEX), Operation Expenditure (OPEX) and indicative DME toll fee.

The final step of this research is In Depth Feasibility Study that focus on the optimization of the CAPEX and OPEX, Risk Analysis of project, and sensitivity analysis. The final output as result of this research is Design Basis, Layout, Economic Parameter, Risk Analysis and Optimized DME pipeline toll fee. The Economic Analysis will be analysed using Discounted Cash Flow (DCF) method by measuring the NPV, IRR, Payback Period and Profitability Index to find out whether the project will be economically feasible or not.The research methodology is shown in Figure 3.

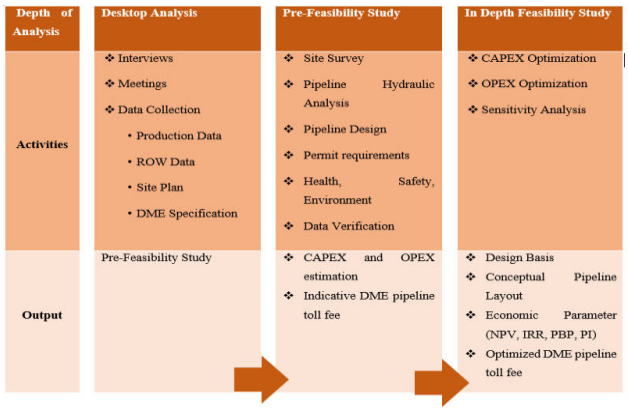

Figure 3. Research Methodology

The scope of this research is the assessment of DME pipeline project using capital budgeting method. The financial model is assessed by some economic indicators such as Net Cash Flow (NCF), Net Present Value (NPV), and Internal Rate of Return (IRR). The change of some

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pre-determined factors such as DME Volume, Capital Expenditure, and Operation Expenditure are measured to identify the sensitivity of those factors to financial outlook in DME pipeline project investment. Data used in this final project mainly from unpublished internal data, and some additional data from published external sources.

The limitations of this research are the financial model in DME Pipeline is forecasted for 20 years of lifetime (started 2025 until 2045). The financial model is made based on some assumptions and approximation, thus, the actual result may different. Since DME Pipeline project is a part of DME from Coal Gasification big project, so the overall economic of the project will actually depend on the overall project economic feasibility of from upstream (DME Plant), midstream (Pipeline, Hub Terminal, Shipping, Trucking, and Bottling) and downstream (DME Customers). However, this paper focus on the DME pipeline feasibility only.

IV. RESULTS AND DISCUSSION

A. *Qualitative Analysis (External & Internal Analysis)*

Based on PESTEL Analysis, DME business in midstream (DME pipeline) is a very challenging business because many external factors will give high impact and imposed high risk for the business. Considering post COVID19 pandemic situation, the economic situation is predicted to be rebound in 2021 onward, so the customers spending will increase as well. The political stability situation in Indonesia will also support the business development, especially in area of South Sumatera with good energy business environment. The technology of DME pipeline is another challenge for Pertagas because it is the first DME pipeline in Indonesia, and last but not least, Pertagas, together with other parties that involved in this project, must have good approach to the Government of Indonesia to support the overall business chain from upstream to downstream by releasing the supportive regulation to make the overall DME project become successful.

Based on competition model by using Porter Five Forces, the stronger the five forces, the lower the industry's profit potential, making the industry less attractive for competitors. The reverse is also true that the weaker the five forces, the greater the industry's profit potential, making the industry more attractive. In case of DME pipeline business development, overall, the forces are weak so it indicates that this business is very attractive to Pertagas, particularly due to low competition in the pipeline business and Pertagas has sustainable competitive advantage in this business for a long time and become the pioneer as first DME pipeline transporter in Indonesia.

Based on VRCN Analysis, majority of the resources & capabilities has sustainable competitive advantage. The combination of strong organizational capabilities, human resources, corporate culture, supported by strong financial position, good reputation and strategic location are become strength of Pertagas to win the competition in the DME Pipeline market, and it will be very difficult to imitate by the competitors. However, Pertagas must improve their technology mastery, project management and business diversification to create more sustainable competitive advantage and win more competition in new business such as DME pipeline.

B. *Quantitative Analysis*

DME Plant location in Tanjung Enim, South Sumatera, will produce approximately 1,4 million Ton DME per year or equal to 4,487 MT/day. For DME Pipeline, the standard that used to create basic design is ANSI/ASME Standard B31.4, Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols. This standard applies to onshore oil pipeline facilities. Figure 5 show the basic pipeline schematic design consist of pumping station, metering station, pipeline and tanks. The pipe size of DME pipeline is 12 inch.

Figure 4. Basic Pipeline Schematic Design of DME Pipeline

The Right of Way (ROW) is the reserved land that utilized to the buried pipeline of DME from Tanjung Enim to Pulau Layang. ROW selection is a very critical factor to determine the overall capital expenditure to build the pipeline. Based on the site survey that conducted on January 18th to 22nd, 2021, there are 3 (three) alternatives options for the ROW of DME Pipeline, which is shown in Figure 5. DME Pipeline mostly located in Class 3 and Class 4 location. The alternative 2 is the best option because the it is the shortest distance and the land owner is mostly from other company so the land acquisition will be easier compare with other option.

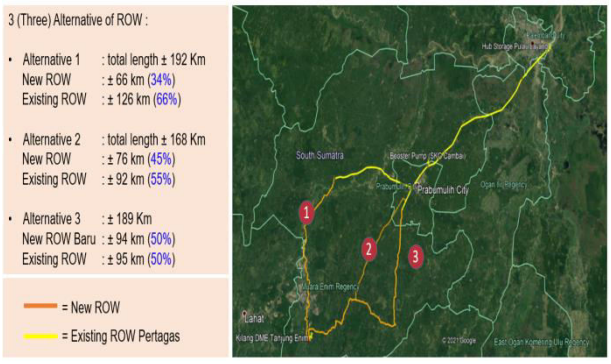

Figure 5. DME Pipeline Right of Way (ROW) selection

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In order to calculate the economic analysis, the following assumptions is used to determine the investment feasibility:

- The project will be started on January 2022 and will be finished on December 2023
- The operation lifetime of pipeline is 20 years
- DME volume is assumed flat 4,487 MT./Day during operation lifetime.
- No additional volume of DME during operation
- Corporate Tax 22%
- Equity portion 100% (no debt)
- Exchange rate: 1 USD = Rp. 14.600
- Hurdle Rate: 11,19% refer to Pertamina standard
- Discount rate at hurdle rate (11,19%)
- Minimum throughput 90%
- Insurance is assumed 1% of Capital Expenditure

Capital Expenditure is all the cost that related with the investment such as Engineering, Procurement and Construction Cost (EPC Cost), Land Acquisition, Permit, Health Safety & Environment Cost (HSE Cost), Quality Control (QC), Social Cost, Consultant cost on FEED (Front End Engineering Design), Business Consultant, Law Consultant, Insurance of EPC, Project Management Cost, and General / Administrative Cost. The total CAPEX for this project is estimated USD 94.200.655. The OPEX cost for DME pipeline project is assumed 5% of Capital Expenditure. The OPEX escalated 2% increase every year. Land rent is assumed to be paid every 3 (three) years during operation to pay the ROW that isn't owned by Pertagas. Land rent escalated 2% increase every year. The losses prevention in pipeline is considered as cost because transporter must prepare a certain amount of money to prevent the DME losses in case of pipeline leak or rupture during operation. The assumption of losses prevention is 0,5%. ARO (Asset Retirement Obligation) is a legal obligation associated with the retirement of a tangible long-lived asset in which the timing or method of settlement may be conditional on a future event, the occurrence of which may not be within the control of the entity burdened by the obligation. For DME pipeline, ARO is calculated as future value of current value of asset with an estimate for inflation for the removal and remediation work over the next 20 years is 2% per year. This ARO cost will be spread during 14 years of operation from 2031 until 2044.

TABLE 3. ECONOMIC FEASIBILITY CALCULATION RESULT (SCENARIO 2)

Economic Parameter	Value (US$)
Net Present Value (NPV)	**17.939.799,68**
IRR	16,54%
Discounted Payback Period	12,40
PI	1,22
Conclusion	**FEASIBLE**

From quantitative analysis using DCF method, it is concluded that DME Pipeline project is a feasible project, and the DME Pipeline Toll Fee that will be applied is US$ 22,9 / MT, and the economic parameter is shown in the Table 3. The cash flow diagram is shown in Figure 6.

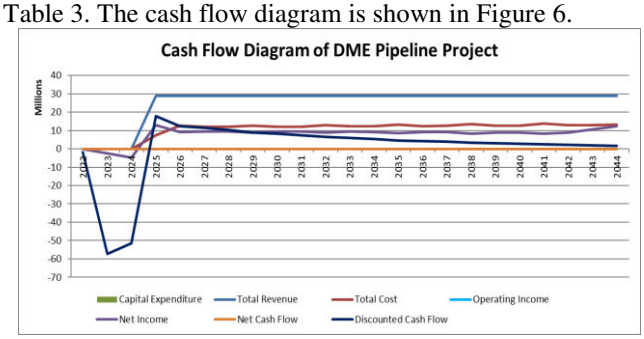

Figure 6. Cash Flow Diagram of DME Pipeline Project

The DME Pipeline Project also has a good impact for the long-term performance of Pertagas financial position. Based on the Revenue and Net Profit for Long Term Planning (2021 – 2026), DME Pipeline project will create higher growth compare with the financial performance without DME Pipeline project, as shown in Figure 7 and Figure 8.

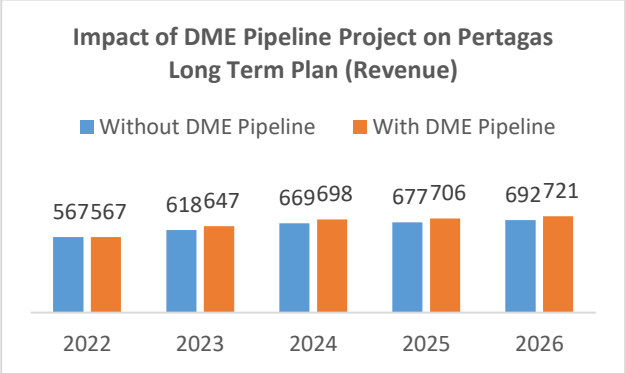

Figure 7. Impact of DME Pipeline Project on Pertagas Long Term Revenue

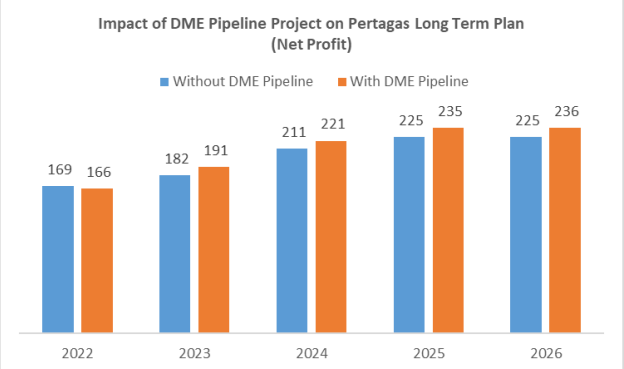

Figure 8. Impact of DME Pipeline Project on Pertagas Long Term Net Profit

Sensitivity analysis is conducted in this research by increasing the OPEX and CAPEX by 10%, and reducing DME Volume 10%. The result can be shown in Table 4.

TABLE 4. STRESS TEST ANALYSIS ON THREE PARAMETER (OPEX, CAPEX, DME VOLUME)

Economical Parameter	Base Case	Scenario 1 Opex + 10%	Scenario 2 Capex + 10%	Scenario 3 DME Volume - 10%
Cumulative Net Cash Flows (USD million)	166,57	146,41	146,04	115,85
NPV (USD million)	9,4	6,5	1,5	(3,4)
Project IRR (%)	13,0%	12,4%	11,5%	10,5%
Equity IRR (%)	16,5%	15,7%	14,1%	12,8%

C. Risk Analysis

In the Risk Analysis Phase, qualitative methods are used to determine the probability and impact of the identified risk events as well as project aspects that are affected by these risk events (Scope, Time, Cash Flow, HSE and Quality). The value of the multiplication of probability and impact is used to determine the level of risk from the identified risks.

In the DME project, there are some risks identified that will impact the project itself. The identified risks are:

1. *Project Management Risk,*
   The complexity of the project implementation area will affect the project scope, which if not anticipated during the project planning period, it will potentially lead to additional costs or delays in project implementation time. The identified potential risks include the potential risk of delays in the arrival of long lead item materials and the potential for pipe suppliers not being able to meet the quantity or delivery time.
2. *Health, Safety & Environment (HSE) Risk*
   The potential risk of work accidents during the construction period and the potential risk of environmental pollution are potential risks contained in the HSE risk category in this project.
3. *External Risk*
   The external risks that may occur and may hinder the implementation of this project include:
   a. Potential risk of delay in issuing principle permits from local governments.
   b. Potential risk of delay in the issuance of Environmental Permits.
   b. Potential risk of delayed land acquisition.
   c. Potential risk of delay in obtaining the toll fee agreement.
   d. Potential risk of DME volume is below the target or projection
   e. Potential natural disaster risk.
   f. Potential risk of non-performing cooperation partners.

D. Risk Mitigation

Some mitigation of several risks that arise in the implementation of DME pipeline project include:

1. To mitigate if the DME flow volume realization is below the target or projection, the commercial agreement must include a Ship or Pay (SoP) clause.
2. In the selection of partners during project, it is necessary to carry out due diligence in accordance with the company's rules and policies.
3. In determining the Right of Way (RoW) utilization, a social mapping will be carried out, so that the potential risks of social barriers during construction can be minimized
4. To mitigate delays in obtaining permits at the local government, close coordination with the local government needs to be carried out, so that the permit application process can run smoothly.
5. To mitigate the delays in obtaining Environmental permit, In the management of environmental permits, the route/RoW that will be used should not pass through protected forest areas.

V. CONCLUSION

The conclusion that can be derived from this research are:

1. DME Pipeline Toll Fee of South Sumatera Project that calculated using this research is US$ 22,9 / MT or equal to US$ 0,13/km-MT. This toll fee consists not only capital cost and O&M Cost but also other components such as ARO, Insurance and Losses as part of the risk mitigation of the project.
2. Based on Quantitative analysis using DCF method, the DME Pipeline Project in South Sumatera is a feasible project which resulted on NPV US$ 9.358.856 and IRR 12,98%, Payback Period 16 years and Profitability Index 1,12 with hurdle rate 11.19%.
3. The DME Pipeline Project has a good impact for the long-term performance of Pertagas financial position. Based on the Revenue and Net Profit for Long Term Planning (2021 – 2026), DME Pipeline project will create higher growth compare with the financial performance without DME Pipeline project.

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