FEASIBILITY STUDY OF FLARE GAS UTILIZATION THROUGH A SMALL-SCALE LNG IN SOUTH SUMATERA, INDONESIA

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Overview

Climate change issue has become one of the global concerns that significantly affects the entire human life. In order to mitigate this issue, many countries have agreed to undertake ambitious efforts to combat climate change through the Paris Agreement. Indonesia, as one of the top ten global carbon emitters [1]–[3], has an important role in making this agreement's goal achievable. The Government of Indonesia (GoI) has encouraged the utilization of flare gas to minimize the carbon emitted to the air from oil and gas business activity. This action is aligned with GoI supports to the World Bank program of "Zero Routine Flaring by 2030". By utilizing the flare gas, this will alleviate the emission problems. In addition, it will increase the national supply of natural gas to support the current energy transition from fossil-based fuels to low carbon fuels.

According to Minister of Energy and Mineral Resources (MEMR) Regulation No. 32/2017, natural gas can be utilized as liquefied natural gas (LNG), compressed natural gas (CNG) and dimethyl ether (DME) [4]. Referring to previous studies [5], [6], LNG is favorable compared to other options in terms of capacity and travel distance. Given that Indonesia is an archipelagic country, LNG is suitable to distribute natural gas to the end users where pipelines are unavailable because LNG is easier to store and to transport. However, the challenges of optimizing the flare gas for LNG lay on the small and fluctuant volume of gas produced. In some regions, the flare gas is located in a remote area where poor infrastructure or transportation to access is at present. Thereby, small-scale LNG (SSLNG) development can be one of the solutions. The advantages of developing SSLNG facilities are more efficient distribution and low initial investment cost if compared to the large-scale LNG. It also requires less space because the flare gas used is less than 1 million tonnes per annum (MTPA) [7].

The SSLNG already exists in East Kalimantan, Indonesia. However, SSLNG utilizing the flare gas has not been built in Indonesia up to now. Thus, it is important to conduct a feasibility study of flare gas utilization for SSLNG in Indonesia. The study focuses on assessing the economically feasible SSLNG development from a flare gas in South Sumatera, Indonesia. The study uses financial indicators of internal rate of return (IRR), net present value (NPV), and payback period (PP). We also study which variables that correlated strongly with economic aspects of SSLNG production and which scenario that provides the optimum results. The results of this study can be a reference for other SSLNG developments from flare gas with a similar condition.

The paper will be organized as follows. Section 1 depicts the background and purpose of this study. Section 2 reviews the relevant literature which consists of the benefits of SSLNG development, SSLNG implementation in other countries, and policies to support SSLNG development in Indonesia. Section 3 describes the quantitative model to calculate the economic aspects of the SSLNG. Section 4 presents the main results based on economic, sensitivity and scenario analyses to obtain the optimum results. Section 5 provides the conclusion and recommendations for future study.

Methods

The study of flare gas utilization to produce SSLNG was performed through literature study, interviews and quantitative analysis. The literature study was conducted to understand the implementation of SSLNG in other countries. Interviews were done to collect the data needed for the quantitative analysis. Meanwhile, quantitative analysis was carried out to calculate the economical aspect of the SSLNG implementation by calculating NPV, IRR, and PP. For this study, modified IRR (MIRR) was used to calculate IRR due to its strengths. MIRR accounts for the reinvestment rate and changes of cash flow from negative to positive among many other benefits [8]. In this study, MIRR will be referred to as IRR.

We also used a sensitivity analysis and scenario analysis to analyze which of the five variables contribute to the optimum economic value of developing SSLNG from flare gas utilization in South Sumatera. The use of such analysis to reveal the most optimum scenario has been done by previous studies before [5], [7], [9], [10]. The

five variables are LNG market price, average gas production in 10 years project, total capital expenditure (CAPEX), total operational expenditure (OPEX), and flare gas selling price, as shown in Table 1.

Table 1. Assumptions on variables used for the basic scenario of NPV and IRR assessment

Flare gas price	USD 0.35 /MMBTU	**Total OPEX**	USD 20,123,151.00
LNG market price	USD 6 /MMBTU	**Total CAPEX**	USD 10,218,600.00
Flare gas production	1.79 MMSCFD		

Results

Using the assumptions in Table 1, the calculation reveals that OPEX accounts for around 68% of the total cost. In addition, the SSLNG development in South Sumatera for 10 years would yield IRR and NPV of 7% and USD 800,686.34, respectively. Meanwhile, the PP for the SSLNG development is seven years. Based on some studies [8], [11], IRR should be above the assumed cost of capital to be considered as an economically feasible project. This result suggests that the SSLNG development in South Sumatera with the given assumptions is economically unattractive as the IRR (7%) is below the cost of capital (10%), although it has a positive NPV. Other previous studies [9], [10] show that it is possible to achieve an IRR of more than 14%, even though they do not have a similar condition to this study. Nevertheless, this suggests that there are still possibilities to achieve higher IRR by adjusting some variables.

Sensitivity analysis was performed on five different variables, namely: 1) Flare gas price; 2) LNG market price; 3) Flare gas production; 4) OPEX, and 5) CAPEX. Based on the calculation, flare gas price is the most sensitive variable, followed by CAPEX and OPEX. It means that the flare gas price fluctuation will highly impact the attractiveness of the project's economic value. Besides the OPEX and flare gas production are unlikely to be changed in practice, based on our interviews in the field. As a result, three variables should be adjusted for optimizing this SSLNG project: 1) flare gas price needs to be at least USD 0.5 /MMBTU, 2) LNG market price should be maintained around USD 6 /MMBTU and 3) CAPEX is under USD 6,131,160 or about 40% less than the current CAPEX.

Conclusion

We conclude that the SSLNG development from a flare gas in South Sumatera is economically feasible if three variables: LNG market price, CAPEX and flare gas selling price are following the optimum scenario. A scenario where the flare gas price is at least USD 0.5 /MMBTU, LNG market price is at around USD 6 /MMBTU and CAPEX of no more than USD 6,131,160 would give a positive NPV, reasonable PP and IRR of 14%. We recommend a further study on the CNG development in South Sumatera to allow a comparison between SSLNG and CNG development in South Sumatera.

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