A feasibility study of flare gas utilization through a small-scale LNG development in South Sumatra, Indonesia

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Abstract. This study focused on assessing the economic feasibility of Small-Scale LNG (SSLNG) development from a flare gas in South Sumatra, Indonesia. The study measured profitability using three financial indicators: internal rate of return (IRR), net present value (NPV), and payback period (PP). The study also used sensitivity analysis to find selected variables that are strongly correlated with the economic aspects of SSLNG production. The variables consist of (1) Average flare gas production; (2) Flare gas price; (3) LNG selling price; (4) CAPEX; and (5) OPEX. The study also used those variables to find the optimum result with scenario analysis. The results show that the SSLNG development from a flare gas is economically feasible if three variables: LNG selling price, CAPEX, and flare gas price follow the optimum scenario.

1. Introduction
Flare gas is an excess gas from hydrocarbon production which cannot be recovered or recycled. It is commonly burned off in oil and gas upstream industries. The composition of flare gas is dominated by methane (80% of the total composition), followed by propane, butane, ethane, and a small number of other hydrocarbons, inert gases, sulfide acid (H2S), and other sulfur compounds (Table 1).

There are several reasons why the flare gas is burned off in the oil and gas industry. First, the flare gas is usually economically unattractive, so the investors are unwilling to construct production facilities as it only generates a small revenue. Second, burning flare gas is done for emergency pressure relief to prevent the risk of explosions from simply venting large amounts of reactive gases [1], [2]. Third, releasing the excess gas directly to open air is more harmful to the environment. This is because methane, the major substance in hydrocarbon gases, is more dangerous than if the gas is transformed into carbon dioxide (CO2). In particular, methane has about 25 times more tremendous global warming potential than CO2 on a mass basis [3]. The methane is also more prevalent in flares that burn at a lower efficiency [4]. Products of burned flare gas consist of water and CO2 with usually greater than 98% combustion of volatile organic compounds [5], and it is reasonable why burning off flare gas is safer from a toxicity standpoint.

However, flare gas utilization becomes one of the most challenging problems in the energy and environmental sector. Environmental consequences associated with burned flare gas have a considerable impact on the local population, which often results in severe health issues [6]. Also, the occurrence of CO2 emissions from a burning flare gas has high global warming potential and contributes to climate change. Therefore, several studies show that the utilization of flare gas will alleviate emission problems [7]–[10]. The utilization of a flare gas will also secure the national supply of natural gas to support the current energy transition from fossil-based fuels to low carbon fuels and, further, be spared from natural gas scarcity.
Indonesia is one of the top 30 gas flaring countries [11]. The Special Task Force for Upstream Oil and Gas Business (SKK Migas) indicates that the potency of flare gas production in Indonesia has reached 19,369 MMSCFD by 2018 [12]. The Government of Indonesia (GoI) also has encouraged the utilization of the flare gas to minimize the carbon emitted into the air from the oil and gas business industry. This mission is aligned with the World Bank program of “Zero Routine Flaring by 2030”. The utilization of flare gas is also supported by the Ministry of Energy and Mineral Resources (MEMR) Regulation No. 32/2017 [13]. In particular, the regulation shows that flare gas can be utilized as liquefied natural gas (LNG), compressed natural gas (CNG), and dimethyl ether (DME) [14]. LNG is favorable compared to others because of its smaller storage capacity and shorter travel distance [15], [16]. It means that LNG is easier to store and to transport in an archipelagic country like Indonesia.

There are challenges in optimizing the flare gas utilization for LNG. In some regions, the flare gas is located in a remote area where there are poor infrastructures or transportation accessibilities. Given these issues, Small-Scale LNG (SSLNG) development can be one of the solutions. There are two main advantages of developing SSLNG compared to large-scale LNG: (1) SSLNG has a more efficient distribution process and low initial investment; (2) SSLNG requires less space than large-scale LNG. The flare gas used by SSLNG is generally less than 1 million tons per annum (MTPA) [17].

Table 1 Some of flare gas compositions in a plant [18]

| Gas Flaring Constituent | Gas Composition | Gas Flaring (%) |
|------------------------|-----------------|-----------------|
|                        |                 | Min  | Max  | Average |
| Methane                | CH₄             | 7.17 | 82   | 43.6    |
| Propane                | C₃H₈            | 2.04 | 64.2 | 20.3    |
| Isobutane              | C₄H₁₀           | 1.33 | 57.6 | 14.3    |
| Carbon dioxide         | CO₂             | 0.023| 2.85 | 0.713   |
| Hydrogen sulfide       | H₂S             | 0    | 3.8  | 0.256   |
| Hydrogen               | H₂              | 0    | 37.6 | 5.54    |
| Oxygen                 | O₂              | 0.019| 5.43 | 0.357   |
| Nitrogen               | N₂              | 0.073| 32.2 | 1.3     |
| Water                  | H₂O             | 0    | 14.7 | 1.14    |

In Indonesia, the SSLNG already exists in East Kalimantan. However, the flare gas utilization in SSLNG has not been built up to now. Given the potential of developing SSLNG in Indonesia, this study aims to conduct an assessment of the economic feasibility of developing an SSLNG from flare gas. We chose a case study in the oil and gas industry in South Sumatra, Indonesia.

The study uses three methods in sequence. First, the study uses three financial indicators of internal rate of return (IRR), net present value (NPV), and payback period (PP) to measure the profitability of the development of SSLNG. Second, the study aims to investigate the sensitivity of variables related to the economic aspects of SSLNG development, such as average flare gas production, flare gas price, LNG selling price, capital expenditure (CAPEX), and operational expenditure (OPEX). Third, the study identifies which scenario that provides the optimum results. There is a lack of similar studies, thus, the results of this study can be used as a future reference on flare gas utilization through an SSLNG.

The paper is organized as follows. Section 1 depicts the background and purpose of this study. Then, Section 2 describes the quantitative model used to calculate the economic aspects of the SSLNG. Section 3 presents the main results and discussion based on economic, sensitivity, and scenario analyses to obtain the optimum results. Finally, Section 4 provides conclusions and recommendations for further study.
2. Data collection and methods
In this study, we collected data from expert interviews and previous literature. We used three methods of analysis: (1) Profitability analysis; (2) Sensitivity analysis; and (3) Scenario analysis. These methods will be done in sequence. The profitability analysis was conducted to analyze the profitability of SSLNG development. The sensitivity analysis was used to determine the magnitude of change (sensitivity) for each of the selected variables in SSLNG development. The scenario analysis was conducted to identify the most feasible scenario to realize positive NPV and IRR of 14% while meeting some other requirements. We present the methods in the following subsections. The followings present the stepwise approach.

2.1. Profitability analysis
We analyzed NPV, IRR, and PP as the financial indicators for profitability analysis. To calculate the NPV, we estimated and calculated the potential revenue less the expected costs, i.e. LNG production, OPEX, CAPEX, depreciation cost, and taxable income. To calculate the IRR, we used the future and present value of the cash flow. Lastly, to calculate the PP, we used cumulative cash flow. To calculate the NPV, we calculated the cash flow of the SSLNG development, which will be derived from potential revenue less than the total costs. In our calculation, we assumed a discount rate, \( i = 10\% \) and \( 1 \text{ USD} = 14,500 \text{ IDR} \). We estimated the potential revenue by calculating the amount of LNG production using the data of flare gas production collected from an oil and gas company in South Sumatra (Table 2). Meanwhile, we estimated the total costs by calculating the total operational expenditure (OPEX), capital expenditure (CAPEX), depreciation cost, and taxable income. The details are presented below.

| Year | Average daily flare gas production (MMSCFD) | Year | Average daily flare gas production (MMSCFD) |
|------|--------------------------------------------|------|--------------------------------------------|
| 2021 | 1.5251                                     | 2026 | 2.0478                                     |
| 2022 | 1.7762                                     | 2027 | 1.6384                                     |
| 2023 | 2.1437                                     | 2028 | 1.3107                                     |
| 2024 | 3.0180                                     | 2029 | 1.0528                                     |
| 2025 | 2.5495                                     | 2030 | 0.8484                                     |

First, we calculated the potential revenues through a series of conversions and with the assumptions: (1) LNG plant efficiency would be 98% (the number was based on an interview with the technical expert); (2) One million British thermal unit (MMBTU) of flare gas (natural gas) was estimated to be equal to 0.022 tons of LNG [19]; (3) Flare gas price at USD 9.35/MMBTU; and (4) LNG selling price at USD 6/MMBTU.

Second, we calculated total OPEX per year by using five variables: (1) Flare gas price; (2) Transportation cost; (3) Storage and maintenance cost; (4) Electricity cost; and (5) Labor wage. There were several assumptions used for this calculation:

1. Flare gas price: The study assumed the flare gas price at 0.35 USD/MMBTU from 2021 to 2030. This was based on the lowest selling price of flare gas according to the MEMR Regulation No. 32/2017 [13].

2. Transportation cost: The transportation costs refer to the transport costs from the LNG production facilities to the consumers by using trucks. The transportation costs consist of diesel price (fuel), lubricant and spare parts, drivers and helpers salary, as well as retribution fees. Several assumptions were made. First, the trucks would be owned by the company, and therefore, the costs of buying the trucks were included in the CAPEX calculation. The trucks would commute a roundtrip daily. We also assumed each truck would have a capacity of 10,000 L.
3. Storage and maintenance cost: The storage and annual maintenance cost refer to the cost to run and maintain the storage facilities of the produced LNG, estimating an area of 30,000 m³. Based on our interview with an oil and gas company in South Sumatra, the estimated cost for storage and annual maintenance would be around USD 350,000/year and USD 150,000/year in 2021-2030, respectively.

4. Electricity cost: To calculate the electricity cost to produce LNG, we first estimated the cost of producing one ton of LNG. We assumed a constant electricity consumption of around 200 kWh/ton LNG from 2021 to 2030.

5. Labor wage: Given that SSLNG development is an expansion project from an existing oil and gas company in South Sumatra, the labor wage for current office staff will not be considered in the calculation. Thus, the assumption was made that the SSLNG development would require 12 additional staff in total; and they would be three supervisors and nine operators. They will be in three shifts of eight hours every day, with one supervisor and three operators working in each shift. The assumed salary used for calculation was based on the local minimum payment (UMR) of South Sumatra. We assumed there will be an increase of 5% each year for the labor wage.

Third, We calculated the total CAPEX per year, by using four variables: (1) Trucks price; (2) Insulated storage tanks; (3) LNG containers cost; and (4) Processing facilities. To calculate the total CAPEX, we summed up the estimated trucks price, insulated storage tanks, LNG containers, and processing facility. All of these capitals would be imported to Indonesia so they would be the subject of an import tax of 5%, based on the Minister of Finance (MoF) Regulation No. 26/PMK.010/2017 [20]. There were several assumptions used for this calculation:

1. Trucks price: We calculated the total cost to buy the trucks needed to deliver the LNG. We also calculated two reserved trucks for emergency cases. Therefore, the total costs for the trucks would be the sum of the price of the number of trucks needed. According to our interview with the technical expert, each truck would cost USD 50,000. Hence, the total CAPEX for trucks would be the sum of total trucks needed including the reserves, multiplied by USD 50,000.

2. Insulated storage LNG tanks: Based on our interview with the technical expert, the number of LNG storage tanks needed would be 4 units of 150 cubic meters tanks. Those tanks would cost USD 900,000. In our calculation, the tanks would all be purchased in January 2021.

3. LNG containers: The LNG containers refer to the containers used on the trucks to transport the LNG to the consumers. We assumed that the number of containers used would be equal to the number of trucks needed and the reserved trucks. Based on our interview, each LNG container would cost USD 2,000 and could take 10,000 liters of LNG.

4. Processing facility: Based on our interview with the technical expert, the recommended processing facility area would be 100,000 m³, which costs USD 8,000,000.

Fourth, we calculated the depreciation cost. Depreciation cost accounts for the annual decreasing value of the facilities by taking the usage and lifetime into consideration. In this study, we used the linear depreciation method to calculate the depreciation cost, which was derived from the total CAPEX and import tax divided by the lifetime of the project.

Lastly, the taxable income. Based on Indonesia’s Law No. 36/2008 [21], a business entity developing an SSLNG plant is required to pay a tax of 25% for its earning. The tax fee would be taken from the business entity’s earnings before interest and taxes (EBIT) or it would be exempted if the EBIT is negative.

After the NPV calculation, we calculated the IRR using the modified internal rate of return (MIRR) equation. For simplicity, we refer to the MIRR as IRR in this paper. Lastly, we determined the PP by calculating the cumulative cash flow. The year in which the cumulative cash flow became positive would be referred to as the PP.

2.2. Sensitivity Analysis
We conducted the sensitivity analysis by evaluating five variables: (1) Average flare gas production; (2) Flare gas price; (3) LNG selling price; (4) Change in CAPEX; and (5) Change in OPEX. We
evaluated the sensitivity of flare gas prices even though it was part of OPEX because it could be used as a strategic negotiation tool between stakeholders. It is also important for investors who are interested in developing SSLNG to understand the ceiling price of flare gas purchased to meet their desired level of profitability. We studied the sensitivity degree of each variable against two factors: (1) NPV and (2) IRR. Hence, we could identify the desired value of each of the variables to get a positive NPV and IRR of 14%.

Several settings were conducted for the sensitivity analysis. First, we set a varied value for the average flare gas production from 0.45 MMSCFD to 3.58 MMSCFD. Second, we set the value range of USD 0.35-3.57 per MMBTU for the flare gas price. This is based on Indonesia’s MEMR Regulation No. 32/2017. Third, we set a varied value for the LNG selling price produced from the flare gas from USD 3.5-8.0 per MMBTU. Fourth, we set a varied value for both CAPEX and OPEX between -50% and +50%.

2.3. Scenario analysis
We performed the sensitivity analysis by integrating the external factors such as existing regulations and economic assumptions to determine whether the SSLNG project is still possible to be continued in the study area. As for the scenario analysis, we considered three external factors, as follows:
1. MEMR Regulation No. 32/2017 [13] on Flare Gas Utilization and Pricing in Oil and Gas Upstream Business Activities. According to this regulation, the government has suggested that industries utilize their gas flaring as a power generator, alternative fuel, CNG, LPG, Dimethyl Ether, etc. The gas flaring buyer shall be set through tender by SKK Migas with the price between USD 0.35 - USD 3.67 per MMBTU. SKK Migas appoints the price based on its economics analysis, as well as CO₂ and H₂S content. The low CO₂ and H₂S content will lead to a higher flare gas price as it has a better gas quality.
2. The existing regulations have set new natural gas maximum prices of USD 6 /MMBTU for several industries. The regulations are issued on the (1) Presidential Regulation No. 40/2016 on The Determination of the Natural Gas Price[22]; (2) MEMR Regulation No. 8 of 2020 on The Procedure for Determination of the User and Specific Price of Natural Gas in the Industrial Sector [23]; and (3) MEMR Decree No. 89K/10/MEM/2020 on The User and Specific Price of Natural Gas in Industrial Sector [24]. Although the regulations are yet to cover all the natural gas’ end-users, this benchmark price should be considered to guarantee the market competitiveness and attract buyers.
3. Based on interviews with business experts, the maximum CAPEX decrease is 40%.

We identified the most sensitive variables from the sensitivity analysis to be used for the scenario analysis. We selected and modified three variables: (1) Flare gas price; (2) CAPEX; and (3) LNG selling price. These variables were measured to identify a scenario which meets Indonesia’s regulation and the profitable business criteria using these four following requirements: (1) Positive NPV; (2) IRR of 14%; (3) Maximum LNG selling price of USD 6 per MMBTU; and (4) Flare gas price range between USD 0.35–3.67/MMBTU. In total, we used 24 scenarios to do the analyses.

3. Results and discussion
This section presents the results of our analyses: (1) Profitability analysis; (2) Sensitivity analysis; and (3) Scenario analysis.

3.1 Profitability analysis
Figure 1 shows the CAPEX and OPEX components that were used in this study. The CAPEX components are (1) Storage tank; (2) LNG container; (3) Processing facilities; and (4) Truck. Based on our calculation, processing facilities would dominate the CAPEX by taking 82% of the overall CAPEX. The reduction of processing facilities would significantly increase the profitability of the project. Meanwhile, on the OPEX side, transportation cost would take more than half of the overall SSNLG project's OPEX, followed by storage cost and flare gas price. However, since the
transportation cost is dependent on the distance between the buyers and the SSLNG location plant, it is unlikely to be adjusted unless the SSLNG plant could be relocated. Therefore, other OPEX components such as flare gas price could be the target of adjustment to reduce the OPEX.

![CAPEX COMPONENT](image)

![OPEX COMPONENT](image)

**Figure 1.** Breakdown of (a) CAPEX and (b) OPEX components

We used a cash flow projection in nine years to evaluate the project’s profitability. This is shown in Figure 2. The figure shows that the SSLNG project would start to generate profit in 2027 if the LNG production starts in January 2021. According to our calculation, the IRR would be 7% and the NPV would be USD 800,686.

![Cash flow projection](image)

**Figure 2.** Cash flow projection

According to previous studies [25], [26], IRR should be above the assumed discount rate to be considered as an economically attractive project. Thus, the results suggest that, although the SSLNG development project would have a positive NPV, it is economically unattractive. This is because the resulted IRR of 7% is below the assumed discount rate of 10%. Nevertheless, based on previous studies [27], [28], there are possibilities of achieving higher IRR up to 14% for SSLNG development if some variables can be adjusted. For our study, a sensitivity analysis was conducted further to see which variables should be adjusted as these variables have a significant impact on the profitability of the SSLNG project.

### 3.2 Sensitivity analysis

Sensitivity analysis was performed on five variables: (1) Average Flare Gas Production; (2) Flare gas price; (3) LNG selling price; (4) CAPEX; and (5) OPEX. We focused on analyzing those variable's impacts on IRR because IRR could provide better guidance on project development’s value and
associated risks. We also presented NPV only to show the project’s future cash flows throughout its life cycle.

3.2.1 Average flare gas production

Figure 3 shows the impacts of average flare gas production changes to NPV and IRR. We adjusted the average flare gas production that needs to be produced to meet the project’s goal of 14% IRR. Based on our initial calculation, the projected average flare gas production is 1.79 MMSCFD within ten years (2021-2030).

The sensitivity analysis shows that the projected average flare gas production should be more than 1.97 MMSCFD for IRR value to be above the 10% discount rate. In particular, to reach the desired IRR of 14%, the average flare gas production should reach 2.15 MMSCFD or 20% more from our initial calculation of average flare gas production. Meanwhile, the slight decreases in the average flare gas production to 1.70 MMSCFD could generate negative NPV. This makes the volume of flare gas production becomes overly sensitive to project profitability. Since the volume of flare gas is related to the oil and gas field capacity and production capabilities, it is unlikely to be easily adjusted.

![Figure 3](image)

(a) NPV (b) IRR

**Figure 3.** Sensitivity analysis of NPV (a) and IRR (b) with changes in an average flare gas production (MMSCFD)

3.2.2 Flare gas price

It is expected that the increases in flare gas prices would generate lower IRR and NPV, and vice versa. Figure 4 shows the impacts of flare gas price changes on NPV and IRR. The result shows that the flare gas price is one of the most sensitive variables with the changes. However, it is impossible to achieve the desired IRR by changing the flare gas price only. The reasons are as follows. First, if we set the flare gas price to USD 0.35/MMBTU, a number based on the lowest price stated in the MEMR Regulation No. 32/2017 on “Utilization and price of gas flaring in oil and gas business activities” [13], the results show that although it can give a positive NPV, the IRR value would still below the discount rate of 10%. Even if we set a zero flare gas price, which means the flare gas did not have any value at all, IRR value is still unable to surpass its discount rate of 10%. Thus, it is important to adjust other variables along with the flare gas price adjustment.

3.2.3 LNG selling price

The LNG selling price will determine how much revenue would be generated by this SSLNG project. However, the price itself should still guarantee the competitiveness between competitors. The LNG selling price is not only affected by the global oil price, but also the domestic market regulation. The government has the privilege to adjust several strategic commodities, including natural gas. Based on the natural gas domestic market price analysis, we conducted a sensitivity analysis for the LNG selling price within the range of USD 3.5-8.0/MMBTU. Currently, the natural gas selling price to several industries is set at USD 6/MMBTU by the government. This number was also used as a basic scenario of the LNG selling price.
Figure 4 Sensitivity analysis of NPV (a) and IRR (b) with changes in flare gas price (USD/MMBTU)

Figure 5 shows the impacts of LNG selling price changes to NPV and IRR. The result is that LNG should be sold above USD 6.8/MMBTU to exceed the discount rate of 10% and reach a positive NPV. Meanwhile, the desired IRR of 14% could only be achieved when the LNG is sold at a higher price of around 8.0 USD/MMBTU. This means that although the increases in LNG selling price could help the SSLNG project to reach the desired IRR of 14%, the required price will lower the competitiveness as it is significantly higher than the market price. Thus, another economic variable should be adjusted along with the LNG selling price to be able to achieve an IRR of 14% while maintaining the price competitiveness.

Figure 5. Sensitivity analysis of NPV (a) and IRR (b) with changes in LNG Selling Price (USD/MMBTU)

3.2.4 Changes in capital expenditure (CAPEX)

Figure 6 shows the impacts of CAPEX changes to NPV and IRR. It is found that CAPEX needs to be reduced from USD 10,218,600 to USD 8,174,880 or a 20% decreases from the initial calculation to surpass the 10% discount rate. Moreover, to achieve the desired IRR of 14%, CAPEX should be decreased further for about 40% of our calculation or about USD 6,131,160.
3.2.5 Changes in operational expenditure (OPEX)

Figure 7 shows the impacts of OPEX changes to NPV and IRR. The result shows that the OPEX should be reduced from USD 20,123,151.35 to USD 16,098,521.08 or 20% of the initial calculation so the IRR can surpass the discount rate of 10%. Meanwhile, we found that the OPEX has to be decreased by more than 50% of our initial calculation or USD 10,061,575.67 to achieve the desired IRR of 14%. Thus, the CAPEX variable is proven to be more realistic to be adjusted to achieve an IRR of 14% for this project.

3.2 Scenario analysis

The variables used in the scenario analysis are solely on flare gas price, changes in CAPEX, and LNG selling price which consider being easily adjusted to reach the desired economic criteria, IRR of 14%. Table 3 shows the results of 24 scenario analyses performed using the external factors explained in Subsection 2.3. The results show that to fulfill the requirements of the external factors and to achieve an IRR of 14%, the project should have a minimum LNG selling price of USD 6/MMBTU, a maximum CAPEX of USD 6,131,160 (40% less than the basic scenario), and a maximum flare gas price of USD 0.5/MMBTU. Hence, this project could be considered economically feasible if these three specific requirements on the scenario analysis are fulfilled. However, it is important to note that this scenario is possible only if the CO₂ and H₂S content in the flare gas is considered high enough to be able to claim for a flare gas reduction to USD 0.35–0.5/MMBTU.
Table 3. Scenario analysis results

| No | Flare Gas Price (MMBTU) | LNG Selling Price (MMBTU) | CAPEX Decrease | No | Flare Gas Price (MMBTU) | LNG Selling Price (MMBTU) | CAPEX Decrease |
|----|--------------------------|---------------------------|----------------|----|--------------------------|---------------------------|----------------|
| 1  | USD 7.00                 | USD 5.00                  | -70%           | 13 | USD 8.00                 | USD 5.00                  | -50%           |
| 2  | USD 8.00                 | USD 7.00                  | -65%           | 14 | USD 9.00                 | USD 6.00                  | -30%           |
| 3  | 3.67 USD 9.00           | 1.00 USD 8.00             | -30%           | 15 | 5.00 USD 7.00            | 10.00 USD 6.00           | -10%           |
| 4  | USD 6.50                 | USD 5.00                  | -60%           | 16 | USD 6.00                 | USD 5.00                  | -40%           |
| 5  | USD 7.00                 | USD 6.00                  | -50%           | 17 | USD 7.00                 | USD 5.00                  | -30%           |
| 6  | USD 7.00                 | USD 6.00                  | -72%           | 18 | 0.50 USD 6.00            | 0.50 USD 6.00            | -40%           |
| 7  | 3.00 USD 8.00           | 3.00 USD 8.00             | -50%           | 19 | 0.50 USD 7.00            | 0.50 USD 7.00            | -20%           |
| 8  | USD 9.00                 | USD 8.00                  | -30%           | 20 | USD 5.00                 | USD 8.00                  | 0%             |
| 9  | USD 5.00                 | USD 8.00                  | -83%           | 21 | USD 5.00                 | USD 8.00                  | -58%           |
| 10 | USD 6.00                 | USD 5.00                  | -72%           | 22 | 0.35 USD 6.00            | 0.35 USD 6.00            | -38%           |
| 11 | 2.00 USD 7.00           | 2.00 USD 7.00             | -50%           | 23 | 0.35 USD 6.00            | 0.35 USD 6.00            | -38%           |
| 12 | USD 8.00                 | USD 7.00                  | -30%           | 24 | USD 7.00                 | USD 7.00                  | -18%           |

*The most feasible scenario

4. Conclusions and recommendations

In this paper, the feasibility study of the SSLNG project was conducted by using profitability, sensitivity, and scenario analysis. The results also have been integrated with the existing regulations such as MEMR Regulation No. 32/2017[13], Presidential Regulation No. 40/2016 [22], MEMR Regulation No. 8/2020 [23], and MEMR Decree No. 89K/10/MEM/2020 [24] as well as other external factors. There are two conclusions. First, we conclude that the development of SSLNG is not feasible, unless there are several adjustments applied: (1) LNG selling price around USD 6/MMBTU or above; (2) Reduction of the CAPEX to about USD 6.131.160 (40% less than the basic scenario); (3) Flare gas price below USD 0.5/MMBTU. Second, the changes in average flare gas production and flare gas price can affect the economic calculation significantly.

Several recommendations for future research are given. First, flare gas price, as one of the most sensitive variables in developing SSLNG, should be flexible in the business to business (B2B) negotiation. Second, future research should further test the optimum distances between SSLNG plant and buyers to generate higher profitability. This is because of the significant contribution of transportation costs in the OPEX. Third, the possibility to develop alternative distribution infrastructures such as terminal hub and pipeline to reduce the transportation cost. Lastly, a similar calculation and analysis could also be conducted for the CNG plant to compare which is better to be developed for future research.

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