Economic analysis on the potential of palm oil empty fruit bunch pellets as alternative fuel to reduce the cost of the government's 3 kg LPG subsidy and its role in achieving sustainable development goals

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Abstract. Government subsidies related to 3 kg LPG per year are significant in the last three years if averaged up to IDR 50 trillion per year. Even though the number of users continue to increase, unfortunately, there are still many shortages of 3 kg LPG in areas outside Java; even in Java, there is still a scarcity. The Minister of Energy and Mineral Resources has issued Ministerial Decree No. 128 K / 70 / MEM / 2020 concerning the Task Force on Energy Security and Energy Utilization. In the second statement point, stipulates the LPG Import Reduction Working Group. The purpose of this study is to calculate the economic value of the empty fruit bunch (EFB) pellet business as a recommendation to the government and the private sector. The method used is the calculation of NPV, MIRR, PBP, and ROI. In addition, ethical business and distribution models are used to deliver products to the end-user (customer) and guaranteed availability. Therefore, a breakthrough is needed to process empty fruit bunches (EFB) into industrial-scale solid fuel (pellets) that can replace 3 kg LPG, especially for poor people.

1. Introduction

All human activities require a large amount of energy and are sustainable. Energy can be divided into two types, fossil and non-fossil. The use of fossil energy is inseparable from negative impacts on the environment, including global warming caused by the residue from burning coal, oil, and natural gas in the form of a large amount of carbon dioxide that accumulates in the atmosphere. Therefore, one of the steps that can be taken to reduce global warming is the use of renewable energy.

Renewable energy is divided into several sources, including solar, water, wind, and biomass. The three resources come from nature, while biomass is obtained from the plantation and forestry waste, both liquid and solid. For the liquid waste from palm oil mill effluent (POME), it can produce energy in the form of biogas using a digester. Meanwhile, solid waste, such as empty fruit bunches (EFB), can be made into pellets as fuel to replace coal and firewood. Empty fruit bunches pellets are also used as communal fuel to substitute for 3 kg of Liquid Petroleum Gas (LPG) for residents to cook.

Although renewable energy sources are abundant, the availability of clean energy in Indonesia is currently not evenly distributed. Several areas in Indonesia still lack access to energy sources and use 3 kg LPG, as highlighted by scarcity. Infrastructure constraints are an obstacle to expanding the use of 3 kg LPG because the burden of subsidies continues to increase. Data from the Ministry of Energy and Mineral Resources in 2019 showed that LPG subsidies reached more than 6.5 million tons per year. However, subsidized LPG was often used more by families classified as able-bodied. The distribution of subsidized LPG that is not well targeted caused 30% or around 25,000 villages in 2018 not to use clean energy for cooking, nor do they have sufficient access to use other alternative energy such as electricity, gas, and gas biogas.
In 2017, crude palm oil (CPO) production in Indonesia produced solid waste of around 35-40% of the fresh fruit bunches (FFB) processed into products. The waste is in the form of empty fruit bunches, fiber, shells, and ash. The existence of these wastes, of course, harms the environment. From a study using the life cycle assessment (LCA) method, it was found that the results of the mass balance of palm oil waste showed that the total solid fiber and shell waste produced for each processing of 1 ton of FFB was 130 kg and 65 kg, and could be helpful when used as additional clean energy and renewable. There have been many product developments from these types of solid waste, one of which is the production of bio pellets from empty fruit bunches (EFB).

The Ministry of Energy and Mineral Resources has issued Ministerial Decree No. 128 K / 70 / MEM / 2020 concerning the Task Force on Energy Security and Energy Utilization. One of its functions is to reduce the amount of LPG imports. Furthermore, as quoted from the Ministry of Energy and Mineral Resources website, the government promotes biomass development by utilizing the local potential and optimizing domestic biomass development. The Ministry of Energy and Mineral Resources has also collaborated with academics to develop and innovate something related to biomass, such as a stove that uses biomass fuel. In the future, the government will focus on diversifying renewable energy sources for daily needs in the household and micro, small, and medium enterprises sectors through large-scale biomass potential as cooking fuel.

2. Materials and method

This study analyses the potential of empty fruit bunches (EFB) pellets as fuel to reduce the government's 3 KG LPG subsidy costs and their role in sustainable development goals by analyzing the feasibility of palm oil empty fruit bunches pellet mills. The economic analysis calculation approach used includes:

- **Payback Period (PBP)**
  The payback period is defined as the expected number of years required to recover the original investment. If all factors are held constant, a shorter payback period is considered a better project because the investor can recover the capital invested in a shorter time [1].

- **Net Present Value (NPV)**
  Probably the most popular and most sophisticated economic valuation technique is the NPV approach. It consists of discounting all future cash flows (both in- and out-flow) resulting from the innovation project with a given discount rate and then summing them together. Thus, the merit of innovation is measured considering its contribution to creating economic value out of the investment needed. This technique offers many variations [2].

- **Return of Investment (ROI)**
  ROI was conceived as a financial term and defined as a concept based on rigorous and quantifiable financial returns and costs. At present, ROI has been widely recognized and accepted in business and financial management in the private and public sectors [3]. The most straightforward ROI divides the incremental economic gain from action by its investment costs [4].

- **Compound Annual Growth Rate (CAGR)**
  Compound Annual Growth Rate (CAGR) is the average increase in the value of a measure over a specific interval of time, and it is used to indicate yearly growth [5,6].

- **Modified Internal Rate of Return (MIRR)**
  MIRR can be calculated in two steps. First, the cash flows (CFt) are converted to future value, FVCF, as at the end of the project period at a specified rate, k, usually the cost of capital; then, the rate of return the FVCF implies over the initial investment (INV), i.e., MIRR [7].

In carrying out the analysis calculations, a comparison of the feasibility of the mill with the production capacity is carried out to determine the minimum production capacity of an EFB pellet mill is the most optimal and feasible. In addition, an analysis of the benefits obtained by the community and the government is also carried out.
3. Result and discussion

To determine the economic analysis, the first thing to do is choose the Cost of Goods Sold (COGS) between 1 million kg per month and 2 million kg per month. There are two cost components used: fixed costs and variable costs. Fixed costs are employee monthly salaries, employee holiday allowances, annual employee bonuses, employee pension benefits, employee training programs, employee health and employment insurance, fire insurance, and other general costs. Meanwhile, variable costs are in the form of empty palm oil bunches, logistics to factories, pellet packaging, fuel, electricity, machine repairs, land rent, and asset depreciation. Table 1 shows a comparison of the COGS of the two production capacities.

| Fixed cost | 1,000,000 kg | 2,000,000 kg |
|------------|--------------|--------------|
| Variable cost | 1,382 | 671 |

Table 1. Comparison of COGS 1 million Kg and 2 million kg

From table 1, it can be seen that the COGS production capacity of 1 million kg per month is IDR 1,891 per kg, while the COGS production capacity of 2 million kg per month is IDR 893 per kg. Therefore, it can be concluded that the company targets to sell EFB pellets to agents for IDR 1,500 per kg if they choose a production capacity of 1 million kg per month. However, this calculation will not benefit the company considering that the production cost is greater than the selling price. Therefore, this study decided to choose a production capacity of 2 million kg per month.

The determination of fixed costs and variable costs using equation (1) and (2).

\[
\text{Price per ton} = \frac{\text{Total Cost per Year}}{\text{Total Production Capacity per Year}} \tag{1}
\]

\[
\text{Price per kg} = \frac{\text{Price per ton}}{1,000} \tag{2}
\]

After knowing the details of the figures (costs) forming COGS, then the total investment costs are calculated with the constituent variables as listed in table 2.

| Item                                | Quantity | Amount per Unit   | Total              |
|-------------------------------------|----------|-------------------|--------------------|
| Building Factory (0,6 ha)           | 1        | IDR 18,000,000,000| IDR 18,000,000,000 |
| Machinery                           | 1        | IDR 18,000,000,000| IDR 18,000,000,000 |
| Electricity installation (2.200 kVA)| 1        | IDR 1,854,600,000 | IDR 1,854,600,000  |
| Water installation                   | 1        | IDR 625,000,000   | IDR 625,000,000    |
| EPC service                          | 1        | IDR 1,440,000,000 | IDR 1,440,000,000  |
| Working capital (1 month)           | 1        | IDR 1,785,722,779 | IDR 1,785,722,779  |

IDR 41,705,322,779
Table 3. Financial Summary

|                      | PESSIMISTIC | REALISTIC | OPTIMISTIC |
|----------------------|-------------|-----------|------------|
| Ex-Work Price (Kg)   | IDR 1,350   | IDR 1,500 | IDR 1,650  |
| Payback Period (Year)| 9.02        | 5.93      | 4.43       |
| NPV                  | IDR 25,739,852,904 | IDR 48,818,676,013 | IDR 71,897,499,123 |
| MIRR                 | 20.19%      | 23.78%    | 26.62%     |
| CAGR                 | 6.64%       | 5.49%     | 4.87%      |
| ROI                  | 13.41%      | 19.89%    | 26.36%     |
| **Total Investment** | **IDR 41,705,322,779** | **IDR 41,705,322,779** | **IDR 41,705,322,779** |

From the results of economic analysis, the selling price of products from agents to end-users is IDR 2,000 per kg. All parties will benefit from the sale proceeds, starting from the factory and then the agent to the end-users. The difference in the price obtained by the community by buying these empty palm oil bunches of pellets is:

LPG 3 kg:
- Calories: 11,000 kcal/kg
- End user price: IDR 21,000/tube (3 kg) IDR 7,000 per kg

EFB Pellets:
- Calories: 4400 kcal/kg
- End-user price: IDR 2,000 per kg
- Calorie conversion price: IDR 5,000 per kg (11,000 kcal/kg LPG calories)

The difference price of LPG 3 Kg with EFB Pellet: IDR 7,000 – IDR 5,000 = IDR 2,000 per kg

The price efficiency obtained by the final buyer is:

\[
\frac{\text{The difference price per kg}}{\text{Price per kg LPG}} = \frac{2,000}{7,000} = 28.6\%
\]

4. Conclusion
Based on the results of the feasibility analysis of the empty fruit bunch (EFB) pellet mill that has been carried out, it can be concluded that the feasibility study for establishing a factory with an investment value of IDR 41,705,322,779 and with the factory selling price of IDR 1,500 per kg, obtained an economic value that is feasible for the establishment of a factory because it has an NPV of IDR 48,818,676,013, MIRR 23.78%, PBP in 5.93 years, CAGR 5.49%, and ROI 19.89%.

Meanwhile, from the analysis of the benefits obtained by the community with the presence of EFB pellets, the availability of EFB pellets is guaranteed. It becomes a clean fuel (green fuel) compared to LPG, a limited number of fossil fuels. In addition, the public also gets a price lower than 3 kg LPG, where LPG costs IDR 7,000 per kg and EFB costs IDR 2,000 per kg for pellets. Apart from the price, there are also benefits in packaging where EFB pellets use non-tube packaging for safer and easier handling. Local governments will benefit from establishing factories, improving the regional economy, and becoming an energy-independent area with clean energy for the environment. Meanwhile, the central government will benefit from reducing the 3 kg LPG subsidy and reducing carbon emissions.

5. Reference
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