The Analysis of the LPG Storage Tank Planning Based on the Potential Demand in Belitung Island

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ABSTRACT
The growing demand for LPG has increased the number of LPG tanker ships/gas carriers entering X Port, resulting in queues that will impede the distribution of LPG to the people of Belitung Island. PT XYZ intends to construct an LPG tank in the X Port area to facilitate LPG distribution on Belitung Island. The tank capacity is expected to meet Belitung Island’s LPG demand for the next five years. The authors forecast the potential demand for the next five years using LPG revenue data from January 2019 to February 2021, with forecasting results from March 2021 to February 2026. The Time Series Method was used to forecast by comparing the smallest MAD (Mean Absolute Deviation) values between the Linear Trend Model and the Exponential Trend Model. According to the forecasting calculations conducted using the linear trend model, the potential demand for February 2026 is 973.4098 Tons with a ten-day stock resistance. According to these calculations, the proposed tank is a spherical tank with a capacity of 1000 tons, which means that the LPG tank stock resistance in the last period, namely February 2026, is 11 days, which is in compliance with the Regulation of the Ministry of Energy and Mineral Resources Number 26 of 2009 concerning the Provision and Distribution of Liquefied Petroleum Gas.

Keywords: LPG, LPG Tank, Forecasting, Demand

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1. Introduction

The community uses LPG (Liquified Petroleum Gas) as cooking fuel. LPG began being marketed in 2007 as a fuel alternative to kerosene. LPG is more economical than kerosene, and it is also cleaner and more environmentally friendly. The government has successfully implemented energy conversion programs, as evidenced by the annual increase in national LPG consumption [6].

The current issue is that there is frequently a shortage of LPG in several areas due to demand exceeding supply. To ensure the resilience of LPG stocks, accurate forecasts of LPG demand for the following year are required. Incorrect calculations will result in complications. If storage capacity is insufficient, there will be a shortage of LPG. On the other hand, maintenance costs will be high if the storage facility exceeds the number of requirements.

LPG distribution can only be conducted by business entities that hold LPG commercial business licenses and conduct their operations in a fair, healthy, and transparent manner. Due to the nature of LPG cylinder filling activities (bottling plant) and ensuring business activities' security, business entities engaged exclusively in LPG cylinder filling activities must obtain an
LPG storage business license. Business entities engaged in the distribution of LPG are required to maintain a minimum LPG operational reserve of 11 days, which includes a minimum working reserve of 3 (three) days and a minimum operational reserve of 8 (eight) days calculated from the previous year’s average daily distribution volume\(^5\).

In connection with the above, PT XYZ is a multipurpose terminal operator with extensive experience in the loading and unloading of a variety of cargo types, including liquid bulk cargo, dry bulk, and general cargo\(^4\). Port X serves as the primary seaport for importing a variety of commodities to meet the needs of the people of Belitung Island. One of the commodities included in PT. X’s scope of business is the receipt of LPG (Liquified Petroleum Gas). According to the report of PT XYZ on the flow of LPG commodity goods for 2019-2021, the number of LPG receipts has always increased year after year. LPG is supplied to Belitung Island via cargo ships in the form of LPG cylinders, which are then distributed to LPG agents and finally to consumers. The growing demand for LPG has increased the number of ships bringing LPG cylinders into Port X, creating queues that impede the process of distributing LPG to the people of Belitung Island. As a result of this queue, it is necessary to alter the supply pattern in order to ensure that the community of Belitung Island’s LPG needs are met in the future.

PT XYZ intends to construct an LPG storage tank in the Port X area. Prior to constructing an LPG tank, it is necessary to perform a careful calculation to determine the capacity of the LPG tank to be constructed. Calculating and forecasting LPG receipts in the coming period is critical to ensuring that tank capacity can meet LPG needs at least until 2026. Choosing the appropriate LPG tank capacity will impact the tank’s distribution and availability of stock.

2. **Materials and methods**

The research flow in determining the capacity of the LPG tank includes: (1) Collecting data obtained from PT XYZ, (2) Forecasting by choosing the best method based on the smallest error value, (3) The results of the forecasting are used to calculate the planned capacity of the tank to be built, (4) Calculating stock resilience, which can be seen in Figure 1 as follows:
Figure 1. Research Study Flow Chart

A. Type of Research
This research was a quantitative study since the findings were based on mathematical calculations. The results of the calculation are believed to be correct and have been confirmed. The data source was PT XYZ's 2019-2021 LPG commodity flow report.

B. Data Processing
The data processing stage of this article was carried out quantitatively using the trend analysis method, which utilized historical data patterns to forecast future data patterns. Forecasting with the Time Series method could be accomplished by using the Linear Trend and Exponential Trend approaches. In this case, the Mean Absolute Deviation method was used to determine the best forecasting approach with the smallest error value. The forecasted LPG revenue for 2021-2026 was used to determine the capacity of the LPG tank and then the tank stock's resilience.

3. Results
A. LPG Revenue Data
The data comes from a report on the movement of goods for the LPG commodity of PT. XYZ. LPG Unloading Activities at PT. XYZ is a fully charged LPG cylinder that is reloaded into
an empty cylinder. As a result, it can be assumed that PT XYZ’s LPG revenue is the weight of LPG unloaded minus the weight of LPG loaded.

Table 1. LPG Revenue Data for 2019-2021

| MONTH       | LPG RECEIVED (Ton) |
|-------------|---------------------|
|             | 2019    | 2020    | 2021    |
| JANUARY     | 48      | 401     | 914     |
| FEBRUARY    | 86      | 500     | 515     |
| MARCH       | 104     | 526     | -       |
| APRIL       | 61      | 687     | -       |
| MAY         | 238     | 493     | -       |
| JUNE        | 121     | 574     | -       |
| JULY        | 477     | 602     | -       |
| AUGUST      | 310     | 796     | -       |
| SEPTEMBER  | 358     | 758     | -       |
| OCTOBER    | 395     | 877     | -       |
| NOVEMBER   | 518     | 763     | -       |
| DECEMBER   | 605     | 706     | -       |
| TOTAL      | 3321    | 7683    | 1429    |

B. Forecasting LPG Revenue in 2021-2026

Mean Absolute Deviation (MAD) measures forecasting accuracy by averaging the absolute value of forecasting error. Errors are measured in the same units of measure as the original data. MAD is used to measure the accuracy of the estimated value of the model expressed in the form of the absolute average error and to compare the predictions between different forecasting methods [7]. The following is a comparison of the MAD (Mean Absolute Deviation) value between the linear trend and the exponential trend obtained from the Minitab Software calculation. A comparison of the MAD values was performed to determine the smallest MAD value, indicating the correct method to use as a basis for forecasting. MAD value for the linear trend method is 83.6, while MAD value for the exponential trend method is 132.7. As a result of the Minitab software’s calculations, it is clear that the MAD value for the linear trend method is less, and thus the method becomes the basis for the analysis.

Due to the fact that the MAD value for the linear trend is less than the MAD value for the exponential trend, the linear trend model was chosen to forecast LPG revenues. Forecasting will be done using the planned tank capacity available for 60 months or five years in the future. The results of the forecasting presented graphically, as follows:

Figure 2. Forecasting Graph of LPG Revenue
According to the forecast results, the potential demand for LPG will continue to grow continuously over the next 60 months if operational activities proceed normally and without impediments or other impediments.

C. Determining LPG Tank Capacity

After forecasting LPG revenue for the next five years, it is clear that revenue will increase. The LPG tank is planned to meet Belitung Island's LPG needs for the next five years. Its capacity was calculated using a minimum stock holding of 11 days in accordance with Regulation of Ministry of Energy and Mineral Resources Number 26 of 2009.

According forecasted data results, the anticipated value of LPG in February 2026, or the 60th period, is 2,654,7538 Tons. The following is the calculation for determining the LPG tank capacity.

LPG revenue in the 60th period:
1 Month = 2,654,7538 Ton
Average per day = 2,654,7538/30
= 88,4918 Ton

LPG Received for 11 days:
LPG Received for 11 days = Average per day × 11
LPG Received for 11 days = 88,4918 × 11
LPG Received for 11 days = 973,4098 Ton

According to the above calculations, the estimated LPG revenue for the 60th period and the average of 11 days is 973,4098 Tons. When determining the capacity of the LPG tank, rounding is required to match the Spherical Tank Type. The value from 973,4098 Tons was rounded up to 1000 Tons.

D. LPG Tank Stock Resistance

Based on the calculation of LPG revenue forecasting for 60 periods in Figure 2, then the LPG tank stock resistance is calculated. LPG tank stock resistance is the ratio between daily throughput and tank capacity.

\[
\text{Stock Resilience} = \frac{\text{Tank Capacity}}{\text{Average Throughput Per Day}}
\]

The results of the calculation of the resilience of the LPG tank stock are as follows:

| YEAR | MONTH | NEEDS LPG (Ton) | AVERAGE PER DAY | STOCK RESILIENCE (Day) |
|------|-------|----------------|----------------|------------------------|
| 2021 | MARCH | 883.4831       | 29.4494        | 34                     |
|      | APRIL | 913.5046       | 30.4502        | 33                     |
|      | MAY   | 943.5262       | 31.4509        | 32                     |
|      | JUNE  | 973.5477       | 32.4516        | 31                     |
|      | JULY  | 1003.5692      | 33.4523        | 30                     |
|      | AUGUST| 1033.5908      | 34.4530        | 29                     |

[44]
| YEAR | MONTH     | NEEDS LPG (Ton) | AVERAGE PER DAY | STOCK RESILIENCE (Day) |
|------|-----------|-----------------|-----------------|------------------------|
| 2022 | SEPTEMBER | 1063.6123       | 35.4537         | 28                     |
|      | OCTOBER   | 1093.6338       | 36.4545         | 27                     |
|      | NOVEMBER  | 1123.6554       | 37.4552         | 27                     |
|      | DECEMBER  | 1153.6769       | 38.4559         | 26                     |
|      | JANUARY   | 1183.6985       | 39.4566         | 25                     |
|      | FEBRUARY  | 1213.7200       | 40.4573         | 25                     |
|      | MARCH     | 1243.7415       | 41.4581         | 24                     |
|      | APRIL     | 1273.7631       | 42.4588         | 24                     |
|      | MAY       | 1303.7846       | 43.4595         | 23                     |
|      | JUNE      | 1333.8062       | 44.4602         | 22                     |
|      | JULY      | 1363.8277       | 45.4609         | 22                     |
|      | AUGUST    | 1393.8492       | 46.4616         | 22                     |
|      | SEPTEMBER | 1423.8708       | 47.4624         | 21                     |
|      | OCTOBER   | 1453.8923       | 48.4631         | 21                     |
|      | NOVEMBER  | 1483.9138       | 49.4638         | 20                     |
|      | DECEMBER  | 1513.9354       | 50.4645         | 20                     |
| 2023 | JANUARY   | 1543.9569       | 51.4652         | 19                     |
|      | FEBRUARY  | 1573.9785       | 52.4659         | 19                     |
|      | MARCH     | 1604.0000       | 53.4667         | 19                     |
|      | APRIL     | 1634.0215       | 54.4674         | 18                     |
|      | MAY       | 1664.0431       | 55.4681         | 18                     |
|      | JUNE      | 1694.0646       | 56.4688         | 18                     |
|      | JULY      | 1724.0862       | 57.4695         | 17                     |
|      | AUGUST    | 1754.1077       | 58.4703         | 17                     |
|      | SEPTEMBER | 1784.1292       | 59.4710         | 17                     |
|      | OCTOBER   | 1814.1508       | 60.4717         | 17                     |
|      | NOVEMBER  | 1844.1723       | 61.4724         | 16                     |
|      | DECEMBER  | 1874.1938       | 62.4731         | 16                     |
| 2024 | JANUARY   | 1904.2154       | 63.4738         | 16                     |
|      | FEBRUARY  | 1934.2369       | 64.4746         | 16                     |
|      | MARCH     | 1964.2585       | 65.4753         | 15                     |
|      | APRIL     | 1994.2800       | 66.4760         | 15                     |
|      | MAY       | 2024.3015       | 67.4767         | 15                     |
|      | JUNE      | 2054.3231       | 68.4774         | 15                     |
|      | JULY      | 2084.3446       | 69.4782         | 14                     |
|      | AUGUST    | 2114.3662       | 70.4789         | 14                     |
|      | SEPTEMBER | 2144.3877       | 71.4796         | 14                     |
|      | OCTOBER   | 2174.4092       | 72.4803         | 14                     |
|      | NOVEMBER  | 2204.4308       | 73.4810         | 14                     |
|      | DECEMBER  | 2234.4523       | 74.4817         | 13                     |
| 2025 | JANUARY   | 2264.4738       | 75.4825         | 13                     |
|      | FEBRUARY  | 2294.4954       | 76.4832         | 13                     |
|      | MARCH     | 2324.5169       | 77.4839         | 13                     |
|      | APRIL     | 2354.5385       | 78.4846         | 13                     |
|      | MAY       | 2384.5600       | 79.4853         | 13                     |
|      | JUNE      | 2414.5815       | 80.4861         | 12                     |
|      | JULY      | 2444.6031       | 81.4868         | 12                     |
As shown in Table 4, the resilience of the LPG tank stock always decreases from the first to the sixty-fifth periods, owing to the increasing demand for LPG. In the 60th period, the LPG tank stock resilience is 11 days, which is in accordance with the Regulation of Ministry of Energy and Mineral Resources Number 26 of 2009 and sufficient to meet LPG distribution needs for the next five years.

4. Conclusion

From the results of this study entitled “The Analysis of the LPG Storage Tank Planning Based on Potential Demand in Belitung Island”, the following conclusions can be drawn:

1. Due to the pattern of LPG revenue data from January 2019 to February 2021 has a trend, the calculation was performed using the time series method with a linear trend model and an exponential trend model and then compared using the model with the smallest error value.

2. Based on the smallest Mean Absolute Deviation (MAD) value, which is 83.6, the linear trend model was used as a model in forecasting.

3. The proposed capacity for constructing an LPG tank at PT Pelabuhan Tanjung Priok Tanjungpandan Branch is 1000 Tons with the Spherical Tank type.

4. The LPG tank stock resilience in the last period of the 5th year is 11 days, meaning that the stock resistance is in accordance with the Ministry of Energy and Mineral Resources Number 26 Year of 2009 and can still meet the needs of LPG distribution for up to 5 years.

References

[1] Zaenuddin, Muhammad, 2020, “Statistik Terapan Untuk Ekonomi Dan Bisnis (Teori Dan Praktik Komputer Dengan Menggunakan SPSS & Excel)”, Yogyakarta, Deepublish Publisher.
[2] Yudaruddin, Rizky, 2019. “Forecasting: untuk Kegiatan Ekonomi dan Bisnis”, Samarinda, RV Pustaka Horizon.
[3] Heizer, J., Render, B., & Munson, C., 2017. “Operations management: sustainability and supply chain management’, Boston, Pearson.
[4] XYZ. 2021. Company Profil PT XYZ.
[5] Kementrian ESDM 2009. Peraturan Kementrian Energi dan Sumber Daya Mineral Nomor 26-year 2009 Tentang Penyediaan dan Pendistribusian.
[6] Robial, Siti Muawanah. 2018. “Perbandingan Model Statistik Pada Analisis Metode Peramalan Time Series (Studi Kasus: PT. Telekomunikasi Indonesia, TBK Kandatel Sukabumi)”. Universitas Muhammadiyah Sukabumi. Sukabumi