# FACTORS AFFECTING NATURAL GAS CONSUMPTION DEMAND IN GAS COMPANY, CASE INVESTMENT OF DURI-DUMAI TRANSMISSION GAS PIPELINE PROJECT (PGDD)

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ABSTRACT. *Natural gas is one of the energy sources which the government of the Republic of Indonesia has started to promote, through the conversion program from fuel oil to gas fuel in accordance with the direction of the Ministry of Energy and Mineral Resource (KESDM) with end users from the household and industry. Even though the government's role is very pronounced in the natural gas business, entrepreneurs who will enter this business should be conducted profit oriented with a Break Even Point (BEP) in 5 years, 10 years or up to 20 years based on contract. The fact is that consumers who use natural gas are not in accordance with the plan so that the realization of natural gas consumption is below the plan. In this research, the authors raise the problem of the gas business at PT Pertamina Gas, reviewing the Investment of Duri-Dumai Transmission Gas Pipeline Project (PGDD) which started operating in mid-2019 and in April 2020, the volume of natural gas consumption by end users was still below the plan. To determine the deviation in natural gas consumption, the authors identify the factors that cause this deviation, look for a model that is able to describe it, and analyze strategic steps for the future. The analysis techniques used in this research are factor analysis and regression analysis. Involve 105 valid respondents from industries domiciled in Riau province and its surroundings and also involve respondents from regulators/government. The results of this research indicate that there are five factors that influence natural gas consumption demand. There are two factors that have a positive effect, namely* **Sediagas** *and* **Purnagas**. *While the three factors that have a negative effect are* **Promogas**, **Desagas** *and* **Revegas**. *By considering the five factors that have been obtained, the criteria for consumers can be determined when planning, building and operating natural gas so as to increase natural gas consumption and limit any deviations that occur. Based on the research results, it was found that the company can improve demand for natural gas consumption reaching*

*a value of 13,239. However, if a company does not pay attention to these factors, the demand for natural gas consumption can be down to 1,546. So in this case the company is expected to take steps that can achieve the optimum value for each factor.*
**Keywords:** Natural gas, Factor analysis, Evaluation model, Gas consumption, Gas availability

1. **Introduction.** The investment for the Duri-Dumai Gas Pipeline Project (PGDD) Construction Project was built with the aim of meeting the needs of the Oil Refinery industry of PT Pertamina Persero-RU II Dumai with natural gas needs at the beginning of operation (estimated at the end of 2018) of 57 MMSCFD (volume 1,767 MMSCF in 1 month) as a substitute for fuel oil and feed gas H2 Plant and will increase by 120 MM-SCFD (volume 3,720 MMSCF in 1 month) in 2021. In addition, pipes are used to supply gas to Industry in the Riau region, namely PGN customers (industry), at 7 MMSCFD (volume 217 MMSCF in 1 month) at the start and ramp-up to 95 MMSCFD (volume 2,914 MMSCF in 1 month). In the spirit of Holding Oil and Gas, the government through the Ministry of Energy and Mineral Resources assigned PT Pertamina (Persero) and PT PGN Tbk to build the Duri-Dumai Gas Pipe through the Minister of Energy and Mineral Resources No. 5975 K/12/MEM/2016 dated 27 June 2016. Pertamina and PGN have agreed to the terms of the Cooperation Agreement for the Development and Operation of the Joint Gas Pipeline Network from Duri to Dumai on June 9, 2017 ("HOA Duri-Dumai") with shares of 60% for Pertamina and 40% for PGN in the form of Administrative Operations Cooperation (KSO) [1]. Pertamina with a Novasi letter assigned its subsidiary, namely PT Pertamina Gas to represent Pertamina (Persero) with full rights and authority. The length of the Duri-Dumai Gas Pipeline is 67 km through Bengkalis district and Dumai municipality, Riau province. The pipe to be built is a pipe with a diameter of 24 with a maximum capacity of 268 MMSCFD [2]. To carry out the business process for the construction of the Duri-Dumai Gas Pipeline (PGDD), an administrative body was formed in the form of a Joint Operation (KSO) consisting of Pertagas personnel and PGN personnel. Duri-Dumai Gas Pipeline infrastructure work can be completed within 17 months, since the kick off meeting on 27 November 2017 and finished on 9 April 2019.

After the Duri-Dumai Gas Pipeline project is completed and the operation stage is carried out data is obtained that there is a deviation and problems can be identified as follows:

1) There is a difference in gas absorption from the plan
2) A model that describes the deviation of gas absorption
3) Strategies to overcome gas absorption deviations

Based on the background of the problem and the formulation of the existing problems, questions of this research are as follows:

1) What are the factors that cause the difference in gas absorption
2) How can the model describe the deviation of gas absorption
3) What are the strategies for overcoming the gas absorption gap to suit plan

Based on the background of the problem and the formulation of the existing problem, then the objective of this research is as follows:

1) Look for the factors that cause the difference in gas absorption to occur
2) Build a model that can describe the deviation of gas absorption
3) Prepare a strategy to overcome the deviation of gas absorption to match plan

2. **Literature Review.** The amount of demand for an item is influenced by factors as follows: the price of the goods themselves, income consumers, prices for substituted goods, advertisements and consumer tastes, population and population consumer expectations and other factors such as health threats if consumed cigarette [3]. The item referred to here is natural gas, so the explanation of the Demand theory directed to Natural

Gas specifications, where quality influence analysis business relations and service quality towards customer satisfaction [4]. Expectations are the standards used by customers to judge the quality of services that will be experienced [5]. The further stated that there are 2 customer expectations, namely first desired service and both services are adequate [6]. For desired service is the level of expectation of service quality that customers believe will be obtained and will be given. Meanwhile, adequate service is the minimum level of service acceptable to the customer [7]. Customers will be satisfied if they accept services in accordance with what is expected or more. Customers will be dissatisfied if the service received is less than the minimum acceptable standard. There are 7 factors that can affect the price level of goods [8], namely:

1) *The State of the Economy*
   The state of the economy can influence the price level. During a recession, the price of goods is in a lower position.
2) *Supply and Demand*
   Demand is a number of items that can be purchased at a certain price. If the price is low, the demand increases and vice versa. While the offer is the amount offered by the seller at a certain price. In general, the higher the price of goods, the higher the quantity of goods.
3) *Elasticity of Demand*
   In the event of market demand, it will affect the price and volume of goods that can be sold. For certain goods, this sales volume and price will be inversely proportional, meaning that if an increase in price occurs then sales will tend to decrease and vice versa.
4) *Competition*
   In competitive conditions, the selling price of goods will be affected. In competitive conditions, a large number of sellers will face a large number of buyers. Many sellers and buyers will make it difficult for the individual seller to sell at a higher price level (increase the price) to other buyers.
5) *Costs*
   The price of an item is largely determined by the cost of production. The price of an item that is unable to cover production costs will result in losses. And vice versa the price of goods that provide profit is the price that can cover production costs.
6) *Company/Manager's Goals*
   In determining the price of an item, it is often related to the goals the company wants to achieve. Different companies will have different strategies and goals/directions.
7) *Government Oversight*
   Government oversight also has an important influence on pricing. Government supervision is manifested in the existence of maximum and minimum prices, price discrimination, and other practices that can encourage or prevent towards monopoly.

3. **Methodology.** The method used in this study is a descriptive method with a convenience sampling approach and a survey technique. In data collection, this research will do the following.

1) *Observation*
   To determine the deviation in gas consumption that is currently happening, the observation method can be used.
2) *Questionnaire*
   A number of samples were taken from several industries where the samples were asked to answer several questions and statements and were closed. Respondents were asked to choose one of the available answers. The questions in the questionnaire were made referring to seven factors of hypothesis model shown in Figure 1 and the research instrument development shown in Table 1.
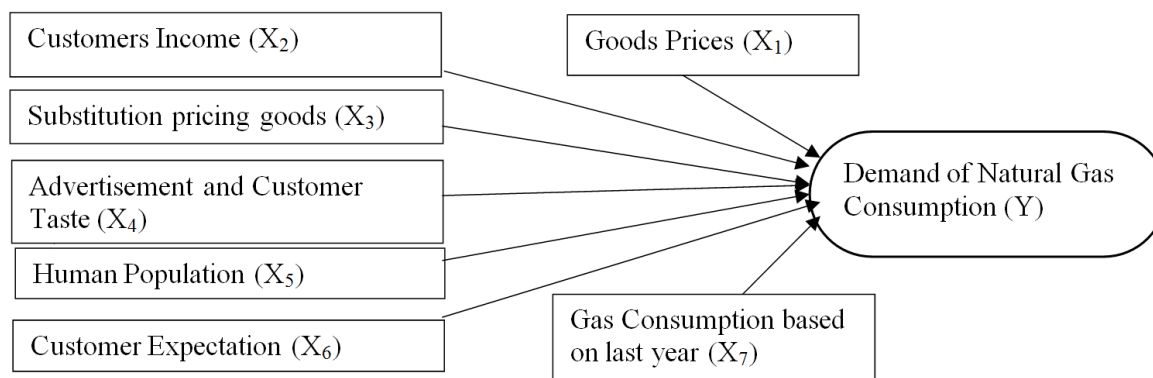
FIGURE 1. Hypothesis model of natural gas consumption demand

TABLE 1. Research instrument development

| | Variables | Indicators | | References |
|---|---|---|---|---|
| | | Economic Condition | (HG_Kond) | [10] |
| | | Supply and Demand | (HG_Juml) | [11] |
| | | Elasticity Demand | (HG_Elas) | [12] |
| | Goods Prices (X₁) | Competition | (HG_Pers) | [13] |
| | | Production Cost | (HG_Bpro) | [14,15] |
| | | Company/Manager Policy | (HG_TujM) | [16-18] |
| | | Government Oversight | (HG_Pemr) | [19-21] |
| | | Working Capital | (PK_Mod) | [22] |
| | Customers Income (X₂) | Manpower | (PK_Ten) | [23] |
| Natural | | Company Age | (PK_Lam) | [24] |
| Gas | Substitution Price (X₃) | Substitution Pricing | (Hrg_Sub) | [25,26] |
| Consumption | | Attention | (ISK_Att) | [27] |
| Demand | Advertisement and | Interest | (ISK_Int) | [28] |
| | Customer Taste (X₄) | Desire | (ISK_Des) | [29] |
| | | Action | (ISK_Act) | [30] |
| | | Fertility | (JP_Kel) | [31] |
| | Human Population (X₅) | Mortality | (JP_Kem) | [32] |
| | | Migration | (JP_Mig) | [33-35] |
| | Customer Expectation (X₆) | Desired Service | (EK_Des) | [36] |
| | | Adequate Service | (EK_Ade) | [37] |
| | Gas Consumption based on last year (X₇) | Last Year Consumption | (PS_Gas) | [38] |

3) *Literature Study*

In conducting literature studies, several sources from journals and books and articles that are closely related to research are used. The function of references is to determine the knowledge claim and information used in the external environment and the internal environment of the company [9].

Several stages in the factor analysis method by feeding data are as per Table 1. Research instrument development in this study can be presented,

1) Perform a reliability test from the results of the questionnaire which aims to determine whether the questionnaire is feasible or not to be used as research data.
2) Among the existing variables, the correlation matrix setting is done by determining the validity value, which functions to determine the significant or insignificant correlation between variables, and for the Adequancy Sampling Test, Meyers Keizer Oklin's can be used.
3) In a set of variables that are formed, factor extraction techniques can be carried out to produce one or more factors.

4) Rotate the factors using the varimax rotation method so that the factor matrix becomes a matrix that is simpler and easier to interpret.
5) Form the name of the new factors based on the variables that have been determined.
6) For further analysis, a factor score is required.

## 4. Result and Discussion.

### 4.1. Gathering data.

4.1.1. *List of respondent.* Total respondents are 105 from several industries type in Riau and outside Riau Province that potential used natural gas.

4.1.2. *Demographic data of respondents.* The criteria of the respondents can be stated as follows.

Based on Table 2, there were 9 respondents with the position of Directors/Top Management, then 6 respondents as Vice President/General Manager, then 22 respondents as manager, and 68 respondents as staff.

TABLE 2. Respondents' data based on position

| Position | Respondent | Percentage |
|---|---|---|
| Staff | 68 | 65% |
| Manager | 22 | 21% |
| Vice President, General Manager | 6 | 6% |
| Director/Top Management | 9 | 8% |
| Total | 105 | 100% |

In Table 3, it can be stated as follows, there are 28 respondents with high school education, 5 people for vocational education, 58 for undergraduate, and 13 people with postgraduate education and 1 person with doctoral education. Most of the respondents' education is undergraduate, so it is expected that they have a good knowledge and understanding of natural gas.

TABLE 3. Education categories

| Latest Education | Respondent | Percentage |
|---|---|---|
| High School | 28 | 27% |
| Vocational | 5 | 5% |
| Undergraduate | 58 | 55% |
| Graduate | 13 | 12% |
| Post Graduate | 1 | 1% |
| Total | 105 | 100% |

It can be seen in Table 4, there were 57 respondents with the type of CPO Industry (palm oil processing), 13 respondents in the gas transporter industry, 8 respondents in the Oil Refining Industry, 6 respondents in government and 21 respondents are in other industries (Coal, Hotels, Trading gas, EPS, Consultant). The results above indicate that the majority of respondents come from the CPO-Agri industry.

Information from Table 5 shows that 69 respondents represented companies domiciled in Riau Province and 36 respondents represented companies domiciled outside Riau Province. The results obtained show that the most respondent companies are in Riau Province.

In the obtained data, there are 5 respondents who gave a score of 1, and a score of 2 was given by 2 respondents, then 3 respondents gave a score of 3, respondents who gave a

TABLE 4. Type of industries

| Type of Industries | Respondent | Percentage |
|---|---|---|
| CPO-Agri | 57 | 54% |
| Gas Transporter | 13 | 12% |
| Oil Refining Industry | 8 | 8% |
| Regulator/Government | 6 | 6% |
| Other Industries (Coal, Hotels, Trading gas, EPS, Consultant) | 21 | 20% |
| Total | 105 | 100% |

TABLE 5. Domicile of industries

| Domicile of Industries | Respondent | Percentage |
|---|---|---|
| Riau | 69 | 66% |
| Outside Riau | 36 | 34% |
| Total | 105 | 100% |

score of 4 were 7, respondents who gave a score of 5 were 11, for score 6 was given by 13 respondents, for respondents who gave a score of 7 there were 13 people, respondents who gave a score of 8 were 15, respondents who gave a score of 9 were 17, and a score of 10 was given by 19 respondents. The results that the majority of respondents (77 people) who have a score of 6-10 indicate that most respondents understand the benefits of natural gas.

### 4.2. **Reliability and factor analysis.**

4.2.1. *Reliability test.* The results of the reliability test of 21 indicators obtained the Cronbach Alpha value of 0.883. This value explains that the instrument variable used is reliable.

4.2.2. *Factor analysis.* In the factor analysis test, variables that have a KMO-MSA value > 0.5 are said to be feasible. Based on this, the data collected can be continued to be a factor.

Anti Image Correlation, the variables used as a composite component were selected based on the anti-image value obtained with the following criteria.

1) MSA = 1, this variable can be predicted by other variables without any errors.

2) MSA $\geq$ 0.5, this variable is predictable and requires further analysis.

3) MSA < 0.5, this variable cannot be edited and also cannot be analyzed further.

Total Variance Explained, Eigenvalues are used as guidelines for measuring the variance of all variables. The results of data processing with eigenvalues greater than one are 5 new factors and the cumulative yield of the component variant extraction in question was 63.59%.

There are 5 new factors obtained through factor analysis, namely *Promogas*, *Sediagas*, *Desagas*, *Purnagas* and *Revegas*, where these five factors will be used to analyze for natural gas consumption demand. Figure 2 that shows new factors affecting demand of natural gas consumption provides an overview of these new factors. The demand for natural gas consumption is the dependent variable and the factor score is the independent variable, the analysis is continued by making a regression of these new factors. From the analysis results we obtain an equation, then it is used as a formula that describes the natural gas consumption demand and getting result that states new factors value effecting of natural gas consumption demand.
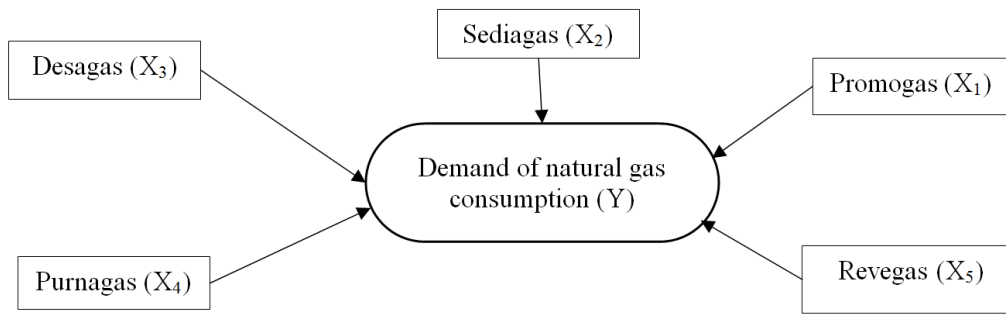
FIGURE 2. New factors affecting natural gas consumption demand

Based on the proposed model shown in Figure 2 new factors value effecting of natural gas consumption demand is able to describe 17.4 percent of the variance in natural gas consumption demand (R2), and it is able to predict the value of the factors in practice as follows.

1) *The Promogas* factor is negative with a coefficient of 0.215 which is in line with the needs where the lower the *Promogas*, the level of demand for natural gas will increase. Every one point decrease against the *Promogas* factor, will increase the demand for natural gas by 0.215 assuming the other factors are constant. This factor does not have a significant effect because the significance value of this factor is $0.348 > 0.050$.

2) *The Sediagas* factor is positive with a coefficient of 0.499 which is in line with the needs where the increase in *Sediagas* means the level of natural gas consumption will increase. Every one point increase to the *Sediagas* factor will increase natural gas consumption by 0.499 assuming the other factors are constant. This factor has a significant effect because the significance value of this factor is $0.031 < 0.050$.

3) *The Desagas* factor is negative with a coefficient of 0.729 which is in line with the needs where the decline in *Desagas*, the level of natural gas consumption will increase. Every one point decrease in the *Desagas* factor will increase natural gas consumption by 0.729, assuming other factors are constant. This factor has a significant effect because the significance value of this factor is $0.002 < 0.050$.

4) *The Purnagas* factor has a positive value with a coefficient of 0.165 which is in line with the need where the *Purnagas* increases, the level of natural gas consumption increases. Every one point increase to the *Purnagas* factor will increase natural gas consumption by 0.165 assuming the other factors are constant. This factor does not have a significant effect because the significance value of this factor is $0.473 > 0.050$.

5) *The Revegas* factor is negative with a coefficient of 0.489 which is in line with the needs where the decline in *Revegas*, the higher the level of natural gas consumption. Every point of reduction in the *Revegas* factor will increase natural gas consumption by 0.489 assuming the other factors are constant. This factor has a significant effect because the significance value of this factor is $0.035 < 0.050$.

In the form of a mathematical model, the above model can be explained by the following equation:

$$Y = 6.981 - 0.215X_1 + 0.499X_2 - 0.729X_3 + 0.165X_4 - 0.489X_5$$

with an explanation of the X value limit:

$$-2.594 \leq X_1 \leq 2.173$$
$$-3.047 \leq X_2 \leq 2.790$$
$$-3.548 \leq X_3 \leq 2.189$$
$$-3.070 \leq X_4 \leq 3.192$$
$$-2.439 \leq X_5 \leq 2.744$$

and after the model is simulated, an illustration is obtained for achieving the optimum value of the implementation of demand of natural gas consumption as 13.239 with a scale between 1.000 and 13.355. However, if this condition is not considered, then the level of implementation will drop to a value of 1.546 as shown in Table 6.

TABLE 6. Simulation model readiness for implementation of natural gas consumption demand

| Variable / Condition | Y | $\beta_0$ | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ |
|---|---|---|---|---|---|---|---|
| Normal | 6.981 | 6.981 | 0 | 0 | 0 | 0 | 0 |
| Un-expected | 1.546 | 6.981 | 2.173 | $-3.047$ | 2.189 | $-3.070$ | 2.744 |
| Optimum | **13.239** | **6.981** | **$-2.594$** | **2.790** | **$-3.548$** | **3.192** | **$-2.439$** |

5. **Conclusion.** The proposed model is able to describe 17.4% of the variance in demand for natural gas consumption (R2), and in practice there are 5 factors causing gaps between targets and achievements in gas consumption as follows:

1) *Promogas* factor ($X_1$) which represents Attention, Interest, Desire, and Action
2) The *Sediagas* factor ($X_2$) which represents the Economic Conditions, Competition, Producion Costs, Elasticity of Demand, and Substitution Price (BBM)
3) *Desagas* factor ($X_3$) which represents Death, Birth, Supply and Demand
4) *Purnagas* factor ($X_4$) which represents the Desire Service (Service that desired), Adequate Service (standard service), Government Oversight, and Production cost
5) The *Revegas* factor ($X_5$) which represents the Labor, Long Trying, Substitution Price (BBM), and Working Capital

Based on the research results, it was found that the company can improve demand for natural gas consumption reaching a value of 13,239. However, if a company does not pay attention to these factors, the demand for natural gas consumption can be down to 1,546. So in this case the company is expected to take steps that can achieve the optimum value for each factor.

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