

The Model of Gas Supply Capacity Simulation In Regional Energy Security Framework: Policy Studies PT. X Cirebon Area

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Abstract: The needs of energy are increasing every year. The unavailability of energy will cause economic losses and weaken energy security. To overcome the availability of gas supply in the future, planning is crucially needed. Therefore, it is necessary to approach the system, so that the process of gas distribution is running properly. In this research, system dynamic method will be used to measure how much supply capacity planning is needed until 2050, with parameters of demand in industrial, household and commercial sectors. From the model obtained PT.X Cirebon area in 2031 was not able to meet the needs of gas customers in the Cirebon region, as well as with Business as usual scenario, the ratio of gas fulfillment only until 2027. The implementation of the national energy policy that is the use of NRE as government intervention in the model is produced up to 2035 PT.X Cirebon area is still able to supply the gas needs of its customers.

Keyword: Natural Gas, Energy Resilience, Planning, System Dynamic, Simulation.

1. Introduction

Oil and gas sector is an important strategic commodity for the country and affects the livelihood of many people. The need for the oil and gas sector continues to increase every year. For that the government needs to do strategic step through the utilization of natural gas either LNG (Liquified Natural Gas) or LPG (Liquified Petroleum Gas) as alternative energy of oil substitute. The existence of natural gas as an energy substitute for oil has an important role in reducing global warming by reducing carbon dioxide emissions. The government since 2007 began implementing the kerosene conversion program to LPG [1]. The goals of the program are: energy diversification by reducing dependence on petroleum especially kerosene, reducing misuse of subsidized kerosene, and providing practical and clean fuel for households and micro-enterprises.

Land conversion program to LPG is implemented based on Law no. 22/2001 on Oil and Gas, Presidential Regulation no. 5 of 2006 on National Energy Policy, Government Regulation No.104 of 2007 on the Provision, Distribution and Pricing of LPG Tube 3 Kg, and Regulation of Minister of Energy and Mineral Resources No. 26 of 2009 on the Supply and Distribution of LPG [1]. The kerosene to LPG conversion program needs to be anticipated considering that currently around 60% of Indonesia's LPG is supplied through imports [2]. With the import of LPG, the kerosene-to-gas conversion program will make a new problem: the shift of kerosene subsidy to gas subsidy. For 2017 the government plans to set a subsidy of Rp 20 trillion for LPG procurement subsidies [3].

The use of natural gas as fuel is more economical if we see it from the price when compared with other energy sources including LPG. Indonesia's gas reserves of around 151,3 TSCF with annual output reach 3,11 TSCF (Trillion Standard Cubic Feet), it is estimated that 49 years Indonesia still has reserve to production [4]. Nationally, the use of natural gas is mostly used by industry and PLN, for industries 19% and PLN 14%, while for households only 0.02% [5]. Cirebon Regency and City is one of the areas that have gas needs in three sectors including household, commercial and industrial



sectors. Up to 2015 the number of household customers for Cirebon is 12,867 subscribers and 199 commercial sectors and industrial sector 69 customers. To meet these needs Pertamina allocated to PT. X Cirebon area of 10 MMSFCD (Million Standard Cubic Feet per Day) or 10,000 MMBTU (Million British Thermal Unit) if 1 MMBTU equivalent to 28.3205m^3 then the gas quota for PT.X Cirebon area is about 283.205 m^3 / day or 103,369,825 million m^3 of gas for each year [6].

The need for gas either industrial sector, household or commercial will increasingly influence PT.X Cirebon area as one of gas distributor in determining its supply capacity. To overcome the problem one of them is by making a model of gas supply capacity planning PT.X Cirebon area to meet the gas supply in the future. In this research, a gas supply model will be developed to determine the fulfillment ratio up to 2050, and will be scenario using Business as Usual (BaU) scenario of National Energy Council and government intervention in national energy policy that is NRE (New and Renewable Energy).

2. Literature review

The International Energy Agency (IEA) defines energy security as an uninterruptible energy source at an affordable price, and a state is said to have energy resistance if it has 90 days for energy supply [7]. Energy Resilience can be defined as the ability to supply energy to maintain economic growth and performance with reasonable price stability [8]. Energy is the lifeblood of the world economy, cut off the flow of energy and the economic will die. Energy is needed to produce food, manufacture goods, power machines and appliances, transport raw materials and finished product and provide heat and light [9].

On the other hand, the UN Economic Commission for Europe (UNECE) Energy Security Forum defines energy security as the availability of energy supply that can be used, at the point of final consumption, in sufficient quantities and timeliness, thus encouraging energy efficiency, economic development has no effect on the state social condition [10]. Energy resistance is disrupted if the energy supply is not balanced with the energy needs of the community. Threats to safety and energy security are influenced by several aspects, including political stability, manipulation of energy supply, competition and attack on production facilities, natural disasters and accidents. Soaring prices, limited access to energy sources, energy supply safeguards have a role in enlarging the threat of energy security.

Energy security is a concept whereby a country can defend itself and do development by prioritizing the security and availability of adequate energy reserves at affordable prices, whether oil or other types of energy variations. This is increasingly important with the fact that the economic and political dynamics also affect the energy supply that is crucial to the development activities of a country. Matters affecting the sustainability of energy reserves include the availability of energy reserves, price fluctuations, the threat of terrorism, the domestic instability of energy-exporting countries, the existence of war, geopolitical competition, to energy maps by the world's major energy-consuming countries [11].

The concept of energy resilience involves two dimensions, namely the dimensions of a country's independence to meet its energy needs derived from domestic energy resources, and the global interferential dimension in which the energy fulfillment of each country cannot be separated from the world's energy supply originating from particularly resource-rich exporting countries oil and gas. The availability of energy supply becomes a significant problem firstly, if the energy supply decreases, it will cause an increase in energy price which resulted in the decrease of energy purchasing power. This will impact on the collapse of economic activity and is destructive to the production and consumption activities of society. Secondly, with the discovery of new energy supplies, this can delay the scarcity of energy that may occur and secure energy reserves in a certain period. Supply plays a very important role, as the demand for energy as a primary commodity tends to remain constant and

inelastic [12]. The Asia Pacific Energy Research Center states that a country can be said to have achieved energy security if it has fulfilled the 4 A indicator, namely: Accessibility (Access to energy sources), Availability (Increased reserves and energy resources), Affordability (Energy purchasing power to energy), Acceptability (Which is environmentally friendly and sustainable) [13].

In his book William N. Dunn mentions the policy analysis is "our problem is not doing what is right, our problem is knowing what is right". Knowledge of what is (fact), what is right (value), and what needs to be done (action), raises the need for five types of information, i.e. policy, alternative policies, policy actions, policy outcomes, and achievement of wisdom. They are all related. Robert C. Wood in policy analysis raises five interrelated information that are issues, alternatives, actions, results and policy achievements. [14].

3. Methodology Research

3.1 System Dynamic

In this study using system dynamic method by looking at the causal relationship between the dominant factor factors in the system and considered interrelated with certain limitations or assumptions [15]. In making the model follow several stages: 1. Observation of the actual system, 2. Preparing the structure of the problem, 3. Model Making (Causal Loop Diagram and Stock Flow Diagram), 4. Validation model, 5. Simulation of BaU scenario model, 6. Simulation model of intervention scenario, 7. Interpretation and use of modal simulation results. Implementation of data modeling can be seen in the following stock flow diagram:

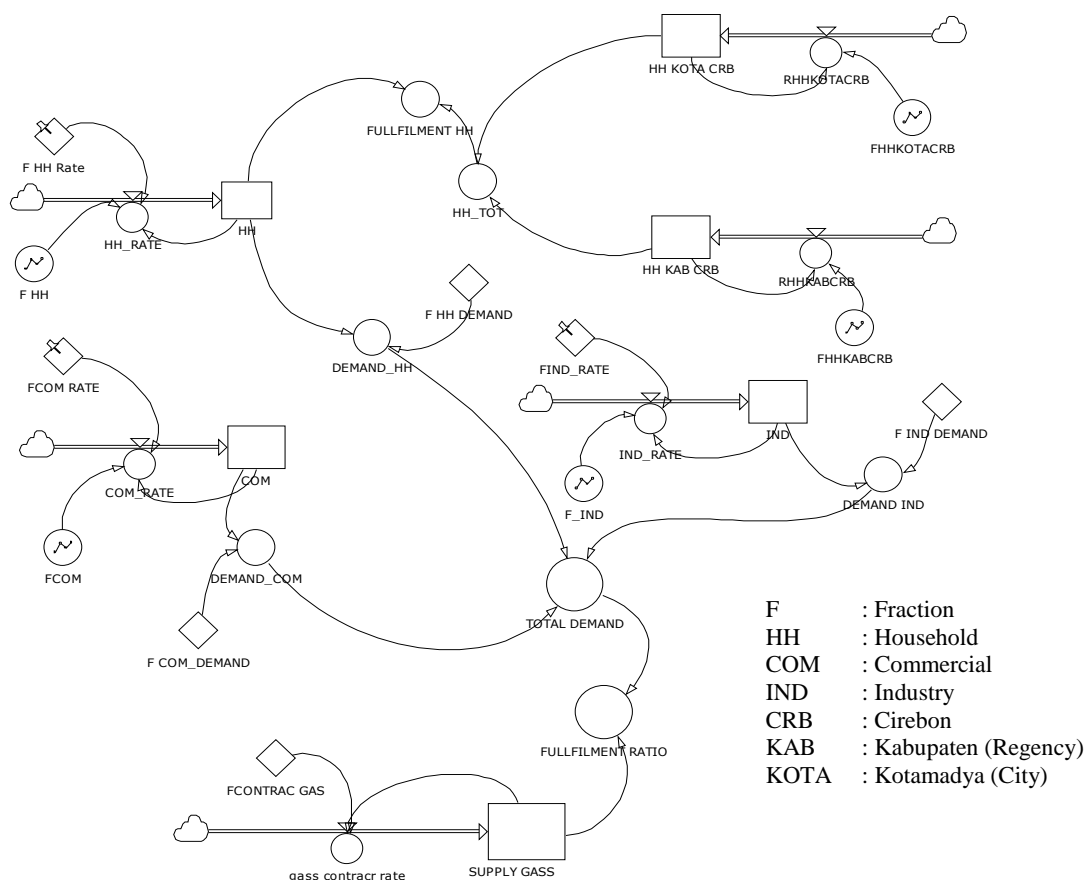


Figure 1. Stock Flow Diagram gas requirement

3.2 Validation

The purpose of the validation is the extent to which the model we created its performance equal to the performance of the real system. AME (absolute mean error) is one way of calculating the validation of the model we created by looking for deviations between the average simulation to the actual. The acceptable deviation limit is $< 5\%$. [16]

$AME = ([S-A]) / A$ with S = Average value of simulation result and A = Average rating of data.

3.3 Scenario Development

In this research, two policy scenarios are made:

1. Scenario BaU (Business as Usual) National Energy Council is for the year 2015-2050 industrial sector grows 5.3% per year, the commercial sector grows 7.7% per year and the household sector grows 2.1% per year. [17].
2. National Energy Policy Scenario on national energy mix that is 2025 use of NRE 23%, 2030 use of NRE 25% and year 2050 31% use of NRE. [13].

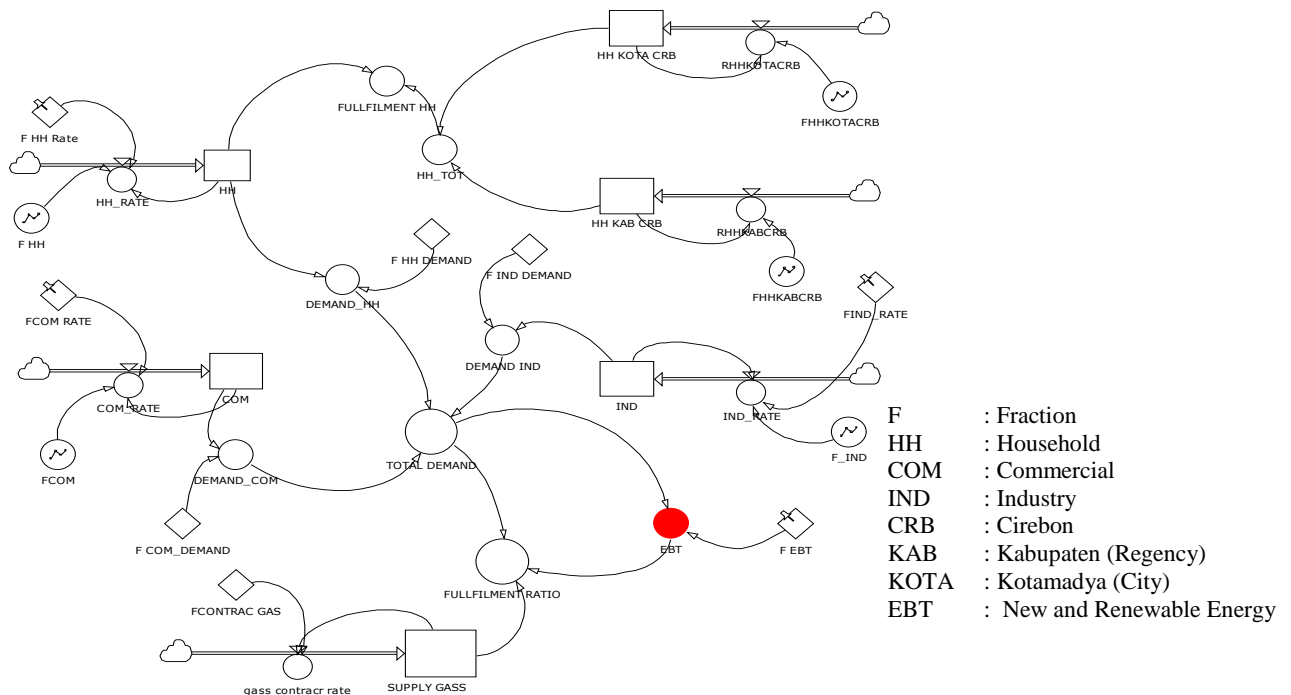


Figure 2. Stock Flow Diagram with mix national energy in years 2025 used of NRE 23%, years 2030 used of NRE 25 % and years 2050 used of NRE 31%.

4. Results and Discussion

After done if the data and validation test result to the model made shows high validity number that is $AME < 5\%$, so that model can be accepted and continued with scenario and intervention to model.

Table 1. The results of the AME validation test in percent

No	Customers	AME by customer	AME by gas used
1	House Hold	0,00097	1,15

2	Commercial	0,06906	4,13
3	Industry	0,18382	3,75

The need for the gas sector as a source of energy is getting higher every year, in the model simulation as shown in Figure 3 obtained in 2030, the PT.X Cirebon area is no longer able to supply the gas needs for its customers which is described with a fulfillment ratio (comparison between supply and demand) of less than 1 on Year 2031. From the results of the scenario BaU resulting shortage of fulfillment ratio faster, PT. X Cirebon area in 2029 was not able to meet the gas needs of its customers. While the scenario of the intervention of the National Energy Policy with the use of NRE, it is estimated that PT.X Cirebon area in 2037 is not able to meet the needs of its customers' gas as shown in Figure 4.

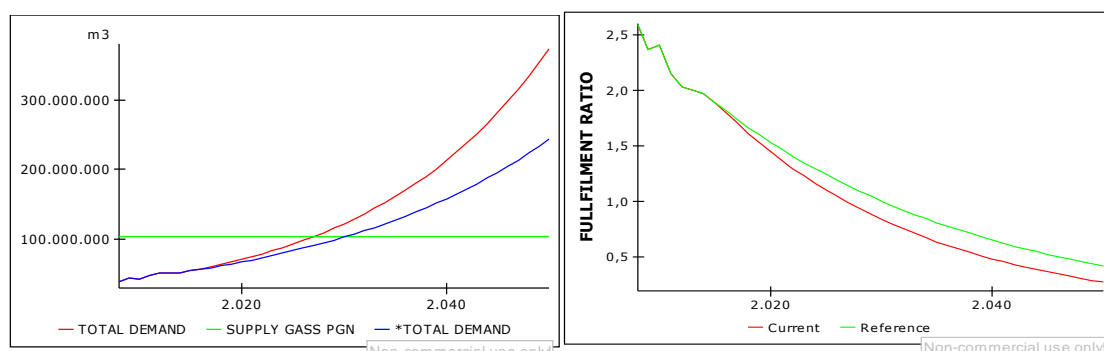


Figure. 3 Comparison ratio of total needs and ratio of gas fulfillment before and after BaU scenario

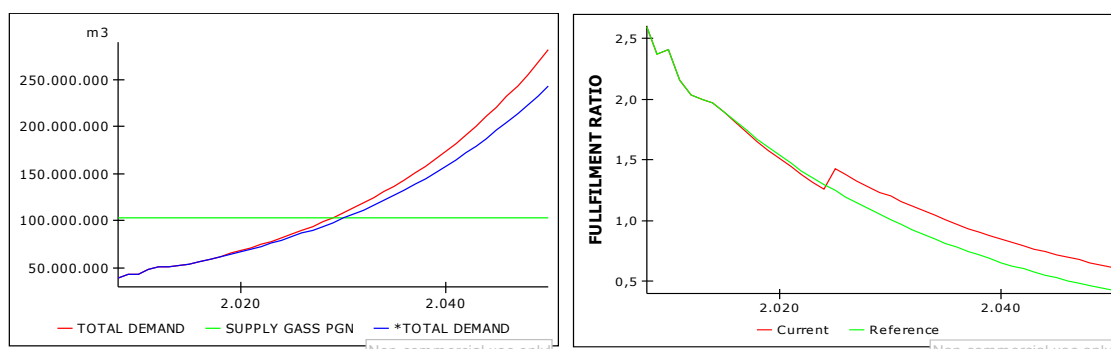


Figure. 4 Graph of the ratio of total needs and ratio of gas fulfillment before and after NRE scenario

The development of transportation infrastructure such as the construction of the Palikanci and Cipali toll roads is one of the causes of the increasing industrial development in the Cirebon region. Increased industrial sector will cause the need for human resources is increasing. The increase of industrial sector is expected to increase the economic level of the people around Cirebon area. Increased industrial sector, residence and supporting facilities such as hotels and restaurants will lead to an increase in energy demand, one of which is the need for gas. The need will continue to increase every year.

Energy scarcity is one of the inhibitors of the development wheel, although people's purchasing power of energy exists but if the energy source does not exist then the energy resistance will not be achieved. The concept of 4A in energy security says they are related to each other. Determination of policies in the face of gas scarcity needs to be done. Government intervention in

national program with NRE mix target reaches 23% in 2025 and 2030 NRE blend becomes 25%, resulting in increasing energy shortage that is 2035.

According to Robert C wood in policy analysis raises five interrelated information that is problem, alternative, action, result and policy achievement. Gas is one of the fossil energy types that cannot be renewable, with continuous exploration it is not possible to make a problem in the future when the energy source runs out. Resilience Energy will be disturbed and even impossible Indonesia's integrity as a country will be affected so that the use of energy must be done effectively and efficiently, one of them is by increasing the use and production of alternative energy and one of them is new and renewable energy (NRE)

5. Conclusion

From the research conducted it can be concluded, that is as follows:

1. The gas fulfillment ratio of the model made up to 2031 is still feasible, while the BaU scenario of gas fulfillment ratio is only up to 2027. So that gas supply planning needs to be prepared for energy resilience of the region could be the use of other gas replacement energy sources
2. With intervention in the form of government policy intervention in the form of national energy mix as intervention in model that is utilization of NRE as alternative energy, it is estimated that gas fulfillment ratio until 2035. So, it is necessary to plan the source of NRE to increase the energy security of the region.

Reference

- [1] Direktorat Jenderal Minyak dan Gas Bumi Kementerian Energi dan Sumber Daya Mineral. 2007. *Konversi Mitan Ke Gas*, (Jakarta: Kementerian ESDM)
- [2] Kementerian ESDM. 2015. *Rencana Strategis Kementerian Energi dan Sumber Daya Mineral 2015-2019*. (Jakarta: Kementerian ESDM)
- [3] <http://www.migas.esdm.go.id/post/read/subsidi-lpg-3-kg-tahun-2017-ditetapkan-rp-20-triliun>.
- [4] Kementerian ESDM. 2016. *Handbook of Energy & Economic Statistics of Indonesia 2016*. (Jakarta: Kementerian ESDM)
- [5] Kementerian ESDM. 2016. *Statistik Minyak dan Gas Bumi 2015*. (Jakarta: Kementerian ESDM)
- [6] PT.PGN(Persero).2016. *PT Perusahaan Gas Negara (Persero) Dan Entitas Anaknya/And Its Subsidiaries Laporan Keuangan Konsolidasian Interim*. (Jakarta : PT.PGN (Persero))
- [7] International Energy Agency. 2014. *Energy Supply Security*. (Paris : IEA)
- [8] Asia Pasific Energy Research Centre.2003 .*Energy Security Initiative : Some Aspect of Oil Security*. (Japan. APERC)
- [9] Purbo, S Suwondo, 2007. *Pertimbangan-Pertimbangan Teoritik Dan Konseptual Yang Penting Untuk Perencanaan Strategik*. (Jakarta)
- [10] UN. Economic Commission for Europe,2003. *Energy Security Forum*. (UN. Economic and Sosial Council : Committee on Sustainable Energy)
- [11] Daniel Yergin,2006 “*Ensuring Energy Security*”, in journal *foreign affairs* . (Volume 85 No. 2 March/April 2006)
- [12] Florian Baumann,2008. *Energy Security As Multidimensional Concept*, (dalam jurnal CAP policy analysis, no. 1 March 2008)
- [13] Dewan Energi Nasioal 2016. *Ketahanan Energi Indonesia 2015* (.Jakarta: DEN)
- [14] William N.Dunn, 1988,*Analisa Kebijakan Publik (Terjemahan)*, (Hanindita Ofset,Yogyakarta.)
- [15] Forrester, J. W. 1961. *Industrial Dynamics*. (Waltham, Pegasus Communications).
- [16] Muhammadi, Erman Aminullah, Budhi Soesilo, 2001. *Analisis Sistem Dinamik : Lingkungan Hidup, Sosial, Ekonomi, Manajemen*. (UMJ Press. Jakarta).
- [17] Dewan Energi Nasinoal 2016. *Outlook Energi Indonesia 2015* (.Jakarta: DEN)