PRELIMINARY STUDY OF ENERGY SUPPLY ELECTION TO THE AREA OF THE ISLANDS

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The spatial condition of population and the energy sources segregated according to the island's territory demand a reliable service delivery system or logistics system. This is required in the effort to meet the energy needs for the community and for other development activities. Energy needs in Indonesia in general are still dominated by the type of fuel oil, which in the process of distribution specifically for communities in remote islands and outer is still faced with technical and economic problems. The distribution network structure consists of several levels starting from the refinery to the next storage terminal to the depot and the last at the agent level prior to the final consumer. This paper analyzes the process of distributing fuel oils in the archipelago which impacts on the formation of fuel prices at the consumer level, which is further made comparative in the effort of providing energy in other forms in the archipelago. Begin by identifying the fuel distribution chain especially on the agent prior to the final consumer, the level of need and price. The result of analysis shows that in certain area with certain distribution area condition give significant influence to fuel price at consumer level. This condition will have an impact on community activities and regional economic growth.

Keywords: *Energy Availability. Archipelago*

1. INTRODUCTION

The important and strategic commodities in supporting economic and development activities is energy, especially fuel oil, gas and electricity that is needed for industry, transportation, agriculture and household purposes. Energy is a subdeterminannational resilience is very strategic and critical and is an inherent need of human life, the life of a nation and the life of a country including Indonesia. The survival of the human race of the nation and state is expected to be ensured, so that the future access to cheap and safe energy must be very important in order to function the modern economy (Muladi, 2009).

Petroleum statistics Ministry of Energy and Mineral Resources (ESDM), shows the consumption of Indonesian Fuel Oil (BBM) graphically, as shown in Figure 1. Fuel consumption is much higher than non-fuel and LPG consumption. The average consumption of fuel oil in the last 7 years (Year 2005 - 2011) amounted to 88.13% of energy consumption nationally. While the consumption of LPG by 7.55% and the remaining 4.32% of non-fuel consumption. Fuel oil has become a major energy source, not only in Indonesia, but also throughout the world.

From 2005 to 2011, national fuel consumption increased from 297.807 million barrels in 2005 to 394,052 million barrels in 2011. Significant increase occurred in 2006

to be 374,691 million barrels. After 2006 to 2011, the increase in fuel consumption is not too significant.

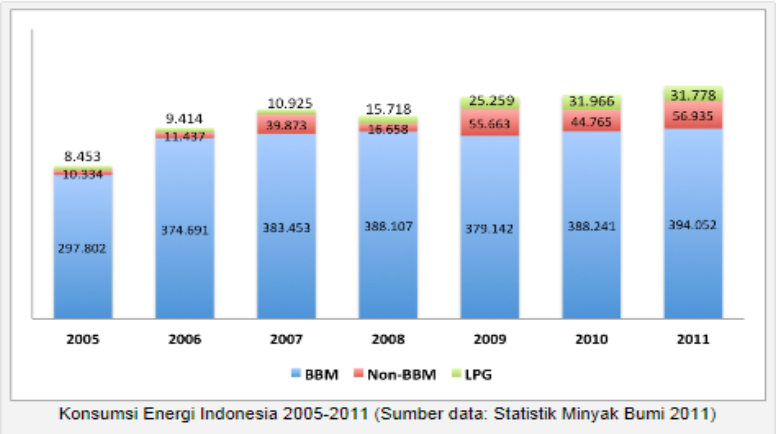

Figure 1. Indonesia Energy Consumption

From the various studies conducted, it appears that energy in any form is a factor that is needed and affect the activities of society. The availability of energy is an important factor although in reality, it is faced with territorial conditions that require good arrangement of transport and distribution systems. In the context of an archipelago region with relatively small-scale economic activity with an unequally dispersed population, will it also have an impact on energy demand in this case fuel oil.

2. LITERATURE REVIUW

The role of energy is very important for the improvement of economic activities and national resilience, so that the energy management which includes the provision, utilization, and exploitation must be implemented in a just, sustainable, rational, optimal, and integrated manner. Non-renewable energy resources reserves are limited, it is necessary to diversify its energy resources to ensure the availability of energy. Dewan Energi Nasional, [2010]

Energy consumption has become the main focus of the global economy. Asmann and Sieber, [2005], stated that one of the main reasons for the increasing demand for energy use is due to the rapid increase in population, mobility, business, globalization and transportation demand. There is a strong correlation between energy consumption and the rate of economic development. It also correlates with relatively low energy prices and the need to move people, commodities and information, Jean-Paul Rodrique, [2006].

An important aspect in the fulfillment of energy needs is the availability factor in accordance with the development of demand that occurs. To make future projections of transportation energy consumption, Huseyin Ceylan, O. Baskan [2008] conducted a study to model energy demand in Turkey from 2006 to 2025. The mathematical models developed were linear, exponential and quadratic in order to estimate the need energy transport to forecast consumption sectorally. In this study, GDP, population and total average length of trip each year are made as independent variables. Hsiao-Tien Pao [2009] also uses GDP to examine causal relationships between electricity consumption and economic growth in Taiwan using co-integration and error-correction models. The results of this study indicate that there is a relationship that affect each other between electricity consumption and real GDP.

Alice Shiu, Pun-Lee Lam [2004], applied a test of the causal relationship between electricity consumption and real GDP in China during 1971-2000 by applying the error correction model. The estimation results show that real consumption of GDP and electricity for China is co-integrated and there is a direct causal relationship of electricity consumption to real GDP but not vice versa. Emmanuel Ziramba [2008] took a similar approach to assessing the demand for household electrical energy consumption in South Africa. Statistic approach is applied, using three independent variables, each GDP, electricity consumption rate and electricity tariff.

Emmanuel Ziramba [2008], takes an approach to assess the demand for household electrical energy consumption in South Africa. The econometric statistics approach is applied, using three independent variables, each GDP, the level of electricity consumption and the electricity tariff. Estimates of price and income elasticity imply that household electricity demand in South Africa is inelastic to prices and revenues. This suggests that rising prices alone will not hamper the consumption of residential electricity and that an increase in income also does not lead to a significant increase in demand for residential electricity consumption.

Tomislav Puk, et al [2013], developed the EDT Model (Energy Demand Transport) to predict long-term energy needs as a basis for energy policy making in Croatia. The transportation sector is one of the largest consumers of energy, with a share of nearly a third of the country's energy needs. This model combines with detailed capital structure of the Croatian transportation sector, including road, rail, air, public and water transportation modes. Four long-term energy demand scenarios are analyzed up to 2050. In addition to electricity, various forms of energy such as fuel oil, gas, are forms of energy that are always in demand along with the development and growth of society. Mehmet Melikoglu, [2014], Provides information on demand and forecasting of road transport fuel consumption in Turkey from an academic and economic perspective. In this study, the demand for gasoline, diesel, LPG, bioethanol and Turkish biodiesel is predicted by using semi empirical models. This estimate suggests that by 2023, increases in diesel consumption and LPG consumption will be much higher than average consumption. As a result, Turkey's dependence on this fuel can reach to a very crucial level in the next decade.

Boqiang Lin; Zhili Du [2015], Estimating transportation energy consumption from 30 provinces in China from 1997 to 2011. By examining the relationship between urbanization and transport energy consumption by using control variables such as population, GDP per capita and the proportion of tertiary industry in GDP. The results show different effects in energy consumption for each variable used.

The results of research that has been done shows that macroeconomic variables such as GDP as one indicator of the level of economic activity of a region, also the number of people who significantly affect the energy demand. Generally stated that, the high per capita energy consumption is related to; high income, relatively low energy prices and the need to move people, commodities and information. Thus the availability of energy in a region is an important factor in efforts to improve the economy and welfare of the community. The problem that arises then is how to provide energy in accordance with the level of community needs.

Logistics is an efficient and effective process of planning, implementing and supervising the distribution and storage of materials in the inventory process, handling commodity services as well as information flows from origin to destination according to consumer demand (John J. Coyle, 1996). Supply chain management is the coordination of production, inventory, location, and transportation among the elements in the supply

chain to achieve a good, responsive and efficient interaction for the markets served, (Papageorgiou, 2009). Transportation plays an important role for the industry because the producers have an interest in getting their goods transported to the customer on time, right at the designated place, and goods in good condition. Thus, the transport activity is part of the definition of distribution, (Abbas, 2002). The same thing affirmed John. J. Coyle (1996), that in principle, logistics activities have a function of time and place. Logistics provides a place function by moving goods / commodities from a point of production to a surplus point where demand exists. Logistics extends the physical boundaries of the market area, thereby adding economic value to the goods. Logistics creates utility places primarily through transport activities. Time value implies that goods and services will be available when consumers need them. Logistics creates time utilities by maintaining proper inventory and strategic location of goods and services.

The consequences of the costs incurred in the transportation and storage process are interesting to be studied further to obtain economic value while ensuring the availability of commodity stocks at the consumer level. Chaug-Ing Hsu & Yu-Ping Hsieh (2007), provide an approach to this problem by minimizing shipping costs and inventory costs separately. The same is reviewed by Deni Irawan (2010), by developing Trade-off between suppliers and retailers in the process of distributing petroleum fuels for a single product at PT. Pertamina as the supplier and the SPBU as a retailer. Chaug-Ing & Yu-Ping Hsieh (2007), do the same by optimizing shipping routes, ship size and shipping frequencies in order to minimize shipping costs and inventory costs. Analysis of ship size, route and outing shipping frequencies that have an effect on port costs and storage cost efficiency as optimal decisions. In addition, the proposed model not only provides flexibility for operators on decision making, but also provides a tool for analyzing trade-offs between shipping costs and inventory costs. The research indicates that the proposed model can be used to determine optimal routing, ship size, and sailing frequencies while still referring to inventory costs and shipping costs.

Agostinho Agra, et al, (2015); developed a model for the problem of maritime supply routes where sailing time and waiting time at the port are erratic. In general, the ship's routing and scheduling are associated with unpredictable weather conditions and unexpected waiting times at the port.

3. GENERAL CONDITIONS OF RESEARCH AREA

3.1. Geography

Maluku Province is one of the provinces in Indonesia which has geographical condition of region consist of many islands. Maluku Province has an area of 581,376 km^2, consisting of 53,835.89 km^2 of land area and 471,911.2 km^2 of ocean. The number of islands in the province of Maluku is ± 559 islands. (BPS, Maluku Province, 2016).

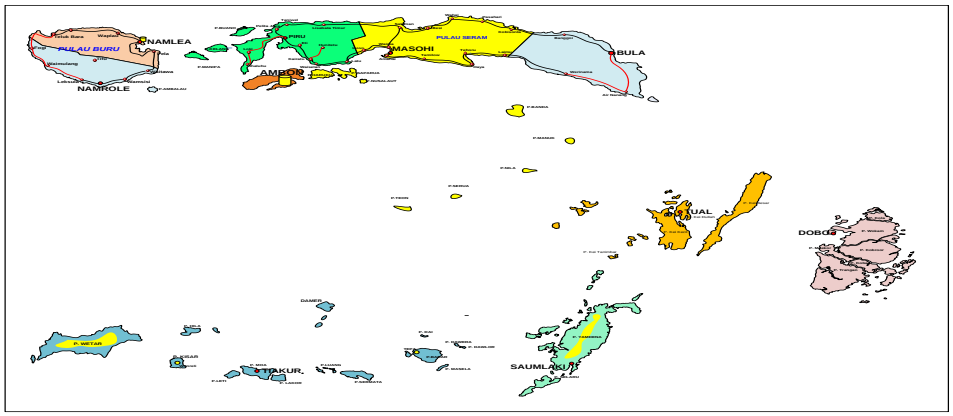

Figure 2. Maluku Province

From the administrative side of the government, Maluku province consists of 11 Level II Regions, namely ; Kota Ambondan Kota Tual, Kabupaten Maluku Tengah, Seram bagian Barat, Seram Bagian Timur, Maluku Tenggara, Maluku Tenggara Barat, Maluku Barat Daya, Kepulauan Aru , Buru Selatan, dan Kabupaten Pulau Buru.Each regency / municipality has a wide area, number of islands, population density as well as varying community economic level.

Table1. Regency / City in Maluku Province

No	Regency/ City	Area (km^2)		Number of Islands	Number of Districts.
		Land	Sea		
1	AMQ	377,00	---	1	5
2	MALTENG	11595,50	264.311,4	42	18
3	SBB	4046,35	79.005,0	46	11
4	SBT	3952,08	14.877,7	45	15
5	MALRA	3410,61	3.180,7	134	11
6	MTB	10102,90	42.892,2	85	10
7	MBD	4581,06	63,77	36	17
8	ARU	6269,00	48.844,4	547	10
9	BURSEL	3780,56	-----	27	6
10	BURU	5466,44	-----	3	10
11	TUAL	254,39	18.736	1	5
	Total	**53.835,89**	**471.911,2**	**972**	**118**

Sumber : BPS Provinsi Maluku, 2016

3.2. Population Conditions

The demand-side energy policy should be based on population situations, since user elements from upstream to downstream energy-value chains are residents. Therefore, population is one of the most important keys to national energy resilience policy. Without a comprehensive population analysis, energy management steps from conservation to diversification can be futile. Not only seen from the population, but the population situation as a whole.

Generally development and population density varies on each island within an archipelago. The islands with adequate public facilities and also with high economic activity have a relatively higher degree of density. Maluku Province has a population of ± 1.657.409 Soul (Year 2016), with an average density of 30 people / km2.

Table 2. Population and Population Density of Maluku Province by Regency / City in 2016

No	Regency / City	Population (Soul)	Population Density (Soul / km^2)
1	Kota Ambon	395.423	1.049
2	Maluku Tengah	368.290	32
3	Seram Bagian Barat	168.829	42
4	Seram Bagian Timur	106.698	27
5	Maluku Tenggara	98.474	29
6	Maluku Tenggara Barat	109.589	11
7	Maluku Barat Daya	72.010	16
8	Kepulauan Aru	89.995	14
9	Buru Selatan	58.197	15
10	Pulau Buru	124.002	19
11	Kota Tual	65.882	259

Sumber : BPS Provinsi Maluku, 2016

3.3. Distribution Network

The fuel distribution network generally starts from the refining center, then distributed to existing shelter terminals in a particular area with service coverage sometimes covering several provinces. From the shelter terminal (transit terminal), then the distribution to the petroleum depots in the area of the smaller area in accordance with the quantity or quota of fuel needed. Furthermore, from the fuel depots will be channeled to the official channeling agencies as part of the distribution chain, prior to the final consumer.

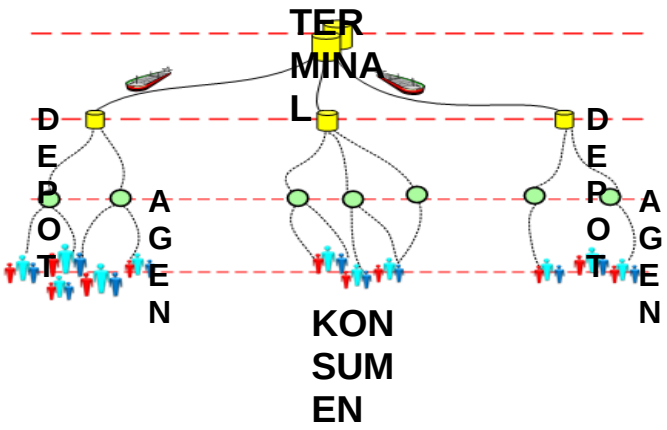

Figure 3. BBM Distribution Network

At the level of distribution at the last level there are generally technical problems of conveyance and weather factors that cause oil fuel is not available in accordance with the time required.

4. METHODE RESEARCH.

This research is conducted by studying the system of oil fuel distribution that has been happening in the archipelago especially on the outlying islands. Besides also using literature sources that support this research. Some observations made are

- An overview of fuel supply chains, customers, sales networks
- Costs incurred in the process of distributing fuel oil
- Comparative to get alternative energy supply.

5. CASE STUDY

The need for fuel oil to support the daily activities of people in Wetar Island in the supply of distribution agents located in Kisar Island. Supply done by using ship type of LCT from Ambon to fulfill requirement of BBM in Kisar Island and Wetar Island in accordance with quota which have been determined.Furthermore, the need for fuel oil in Wetar is supplied by local entrepreneurs using sea transport. The ship used is a type of people's shipping vessel with loading system using drum with ship loading capacity ± 10 tons. The time required by the ship for the transportation of fuel oil since departing from Wetar until the return of approximately 3 days.

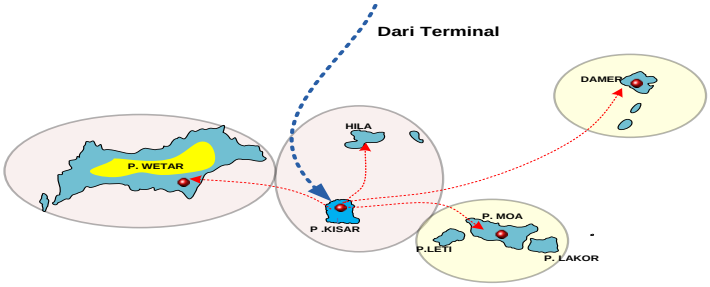

Figure 4. Fuel Distribution Network to Kisar Island – Maluku

The stock of fuel oil on Wetar island can be said to be less awake. This is due to certain times of unfriendly natural conditions (high waves) resulting in the operation of the fuel carrier. This irregular supply frequency often creates scarcity which will lead to higher fuel prices. The price of fuel oil on Wetar island under normal conditions ranges from Rp.23.000, - per 1.5 liters for the area in the center of the district. This price increases to Rp.25.000 - Rp.30.000, - per 1.5 liters in the surrounding village, depending on the distance of the village with the district center. If the bad weather conditions usually occur in December-February and then in May-June every year, the carrier can not sail. This condition makes oil fuel scarcity so it will trigger an increase in selling price to the range of Rp.50.000, - per 1.5 liters, even the inventory void

The condition of the provision of fuel oil as happened in Wetar is also a problem that generally occurs in other islands in Maluku and even in Indonesia, especially in outermost and foremost islands.

6. RESULTS AND DISCUSSION

In general, the increase in energy demand has a close relationship with the growing economic activity and the growing number of people. In Indonesia, with population increasing from year to year and continuing economic growth indicated by increasing output and various economic activities undertaken by the community, the increase in energy demand is inevitable.

Meeting the energy needs in this case the oil fuel in the archipelagic region is faced with several problems:

- Geographical conditions of the region.
- Small number and population density.
- Community economy, generally growing relatively slow.
- Business activities / economy more oriented to the consumption factor or to meet daily needs.
- Dependence / interaction with other islands is severely lacking due to long distance factors as well as minimal transportation support.

Distribution	Vehicles	Delivery	Problem	Impact

Network		Schedule		
• Refinery - Terminal	Tanker	Scheduled because BBM Stocks are monitored through the Information System	Not a significant problem	-
• Terminal - Depot	Tanker	Scheduled because BBM Stocks are monitored through the Information System	Not a significant problem	-
• Depot - Agent	• LCT • Truck • Ships	Depend on agen request	• Physical Fleet • Fleet Performance, • Weather conditions, • Loading and unloading conditions	• High price, • Out of stock, • Community activities are disrupted • Unloading costs
• Retailers	Ships	Depend on retailer request	• Physical Fleet • Fleet Performance, • Weather conditions,	• High price, • Out of stock, • Community activities are disrupted

The things mentioned above, have an impact on the fulfillment of fuel needs itself. The amount of oil fuel demand is also relatively small / small, in addition to reach far enough service. This condition has a technical and economic impact on the supply process.

Provision conditions that are economically quite expensive in the distribution process in addition to the condition of the area which in a certain time very dangerous provide a possible choice to diversify energy in accordance with the needs of people in the island region.

7. CONCLUSION

Fuel Supply Issues in remote, outlying and foremost islands, including the limitations of dock infrastructure, ports, roads, especially the distribution of fuel, the difficulty of transporting fuel as an obstacle due to natural factors such as high sea waves, sea tides and rivers, landslides and others . In addition, limited fuel supply infrastructure in remote, outlying and leading areas (fuel depots, barges, tanker trucks, etc.), and the latter lack of investor interest in investment in the fuel dispensing industry in remote areas.

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