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ELECTRICITY PLANNING THROUGH RENEWABLE ENERGY UTILIZATION IN NORTH KALIMANTAN

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ABSTRACT

North Kalimantan is the most recent constituting province in Indonesia. Due to the condition, one of main the problems that happens is the availability of electricity. By the increasing of population growth in the last five years, the availability of electricity in each district should be added or continue to grow in order to support the welfare of the citizens. In addition, fossil energy used as the main source of power plants is running on depleting the number. Thus required an examination, defined as the study about energy needs, the potential of renewable energy sources, technical study to get the scale of production of particular importance and sustainable, the study of economic welfare of the people that foster community empowerment and the pattern community empowerment assistance with the government that makes a pattern and the utilization of the fulfillment of a dynamic and sustainable. The result is the duty of renewable energy sources that has identified in each district namely micro hydro energy and solar energy. In addition also the projection demand of electrical energy needs of people use software LEAP which is keep increasing until year 2030 by 10 times as much. The analysis that is done are from their economic and technical aspect in power plant buildment, the planning location and year of construction, as well as financial feasibility study of the building of the power plant construction, where all the power station is feasible to be built by looking at their NPV which are both positive.
***Keywords**: Renewable Energy, Electricity, LEAP, Technical-Economic*

1. INTRODUCTION

1.1. Background and Purpose

Energy consumption in Indonesia for fossil fuels is very large. Petroleum dominated 52.5% of energy consumption in Indonesia, natural gas 19%, coal 21.5%, hydro 3.7% and renewable energy is only about 2% of total energy use. Reserves of petroleum Indonesia is only about 500 million barrels per year [1]. This means that if it continues be consumed and not found oil reserves or new technologies, reserves of petroleum Indonesia is estimated will be exhausted within the next twenty-three years.

North Kalimantan is a province 34th in Indonesia, which was officially established since 2012. Construction of infrastructure in this province is primary needed, but in fact electric condition in this Province still become major problems which must be resolved. Electrical energy demands in this Province were increased, but the supply was unable to meet the demand. Some areas still met with the fulfillment of a limited capacity. Electrification ratio in District Bulungan still amounted to 61% at 2013, District Tana Tidung 52%, District Malinau 64.97%, District Nunukan 56.46% and Tarakan city still amounted to 67.87%. That value is still below the ratio of electrification Indonesia has reached 78.06 %. Therefore, it is essential to find an alternative energy from renewable energy. North Kalimantan is geographically strategic for implementation Photovoltaic (PV) because it have average daily radiation from 4.07 kwh kwh/m² until 5.15 kwh/m². Else, the total potential of hydro power is predicted to be 28.8% from 75 GW in Indonesia, which is primarily located in Kalimantan Island [2]. This research was intended to do a study of the estimation of energy needs and identify potential sources of renewable energy in the

North Kalimantan Province. To ensure continuity of supply and the demand side, model based supply chain management it be constructed. The production of energy is also unique, model Computer Integrated Manufacturing Open System Architecture will be adapted to ensure sustainability of reliability and energy production.

2. THEORETICAL BACKGROUND

2.1 Renewable Energy

There are several energy issues faced by Indonesia, such as: energy subsidies increases up to Rp 255,6 trillion in 2011; the number of people have not got access to electricity in amount of 87,69 million; etc. dependence on fossil energy were still very dominant even up to 49.7% while renewable energy utilization are still approximately 6%. Renewable energy represents the non-fossil resources that can be renewed and if well managed will not be exhausted (ESDM RI, 2012). The types of renewable energy that can be used in the fulfillment of electrical energy needs are such as solar, wind, micro hydro, biomass, geothermal and tidal energy. Until now, the source of energy in the electrical sector is still dominated by coal, gas and petroleum as fuel for power plant, both owned by PT PLN and Independent Power Producer (IPP). The role of renewable energy is limited to geothermal and hydropower, while another renewable energy consumption is still very small.

2.2 Software LEAP

Long-Range Energy Alternatives Planning (LEAP) is the energy-based software with modelling scenario (Sukhono, 2010). LEAP can be used to do the analysis and evaluation policy also energy planning. LEAP developed by The Stockholm Environment Institute headquartered in Boston The United States. LEAP is capable of making scenario to find how energy consumption used, converted and produced in a system energized with various alternatives with the assumption of population of economic users in obtaining connection between aspect of electricity to be researched. For example by knowing the condition of the economy which has indicated by the income data gross domestic regional (PDRB).

2.3 Software HOMER

HOMER is a software used to help modeling of a system of electric power by using a choice variety of the specification of the most optimal from several sources of energy would likely be applied as a power plant. In HOMER, should be included some data to get the desired results, for example, data of sun and wind resources (of areas where the plant will be built), the economic data, constraints, system inputs, data of emissions and the price of diesel fuel. But the implementation of this research, HOMER is used by focus on to find the potential of solar power. So that data be included in regional coordinate points targeted to be carried out the construction of solar energy power plants (PLTS).

3. RESEARCH METHOD

In this research, HOMER software can used to get average daily radiation based on coordinat location. Electricity forecasting in this study was conducted by econometrics and sectoral approach well as solved with software LEAP (Long Range Energy Planning). Generally, the research method in this research can be seen in this flow chart below:

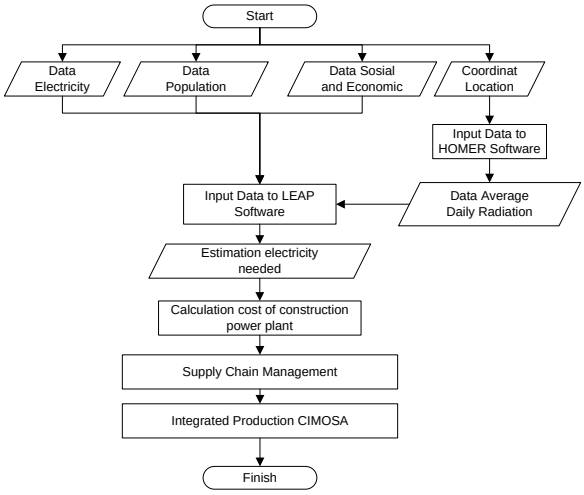

Figure 1 Flow Chart of Research Method

This research begins with collecting the data of the electricity, population, social economic and potential energy in North Kalimantan. Based on identification of potential energy and estimated electric results, then amount of plant construction is calculated. Then in this research is continued to calculate cost of construction power plant, supply chain

management and integrated production CIMOSA.

4. RESULT AND DISCUSSION

In the calculation of electrical energy needs forecasting by using LEAP, data are necessary growth rate of intensity of electrical energy and growth rate of the customer's number.

Table 1. The Growth Rate Data

Sector	Energy Intensity	Customer's Number
Household	13%	2.6%
Industry	4%	0.5%
Business	3%	0.2%
Social	9.5%	1%
Public	1.7%	0.3%

Then, done the calculations of the outcome or projection demand of electrical power for each sector, obtained the results of demand of electrical power until 2030, which is found in figure below.

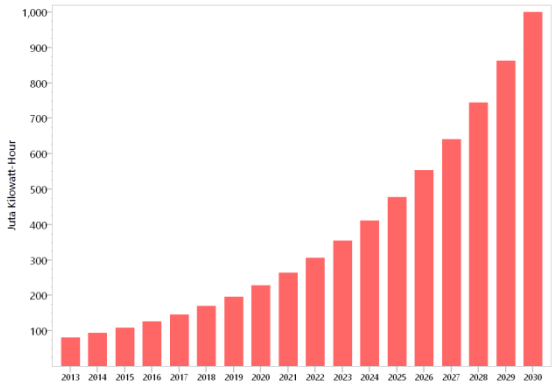

Figure 2 Results of Energy Demand Projection Using LEAP

Figure above show that produced growth energy needs increased as well per year from 2013 to 2030. With the first goal of which is fulfilling the electricity necessity of the population who have not get electricity by a ratio of electrification (RE) remain low, hence the need for electricity to the projected that focused ony to the household sectors.

To get the potential electrical power from each river in North Kalimantan, conducted a search of secondary data through the local BAPPEDA and DISTAMBEN department from each district. The agencies provide results about the rivers that have the potential to be used as a source of micro hydro power plant (PLTMH). The following is the rivers data potentially as sources of PLTMH:

Table 2. The Potential Rivers for Electrical Energy in North Kalimantan

District	River	Capacity (kW)
MALINAU	Paking	40
	Long Berang	45
	Long Semamu	10
	Long Pala	8
	Long Pujungan	60
	Long Aran	80
	Long Alango	60
	Apau Ping	24
	Data Dian	10
	Sei Anai & Metun	32
	Long Sule & Long Pipa	375
	Long Ampung	35
	Sei Barang	25
	Long Uro	32
	Mahak Baru	80
	Long Payau	112.5
NUNUKAN	Sembakung	500
BULUNGAN	Boom	31.9
	Isau	182.9
	Pelban	11
	Tajo	28.8
	Piteng	133
	Bang	60
	Gunung Berum	343
	Bengara	301
TOTAL POTENSI (Kw)		2620.1

The potential of solar energy in each district can be calculated using the following equation:

$$Ps = \frac{Rs \; x \; LDP \; x \; \frac{P}{100}}{8} \; x \; 365 \; x \; 10^{-3}$$

Ps : Potential of solar energy (MW)
Rs : Average daily radiation (Kwh/m^2)
LDP : Potential area (m^2)
P : Prosentation area (%)

The potential of solar energy in North Kalimantan can be seen in this Table below.

Table 3. The Solar Energy Potential Each District.

Tahun	Potential of Solar Energy Per Year (MW)				
	Bulungan	Tana Tidung	Malinau	Nunukan	Tarakan
2015	57	19	179	64	3
2016	85	28	224	96	4
2017	114	38	268	128	5
2018	142	47	313	161	6

Tahun	Potential of Solar Energy Per Year (MW)				
	Bulungan	Tana Tidung	Malinau	Nunukan	Tarakan
2019	170	57	358	193	8
2020	204	66	402	225	9
2021	241	75	492	257	10
2022	284	85	581	289	12
2023	334	94	671	337	13
2024	397	104	760	385	15
2025	468	118	894	433	16
2026	554	132	1029	482	18
2027	653	146	1163	546	20
2028	766	160	1342	610	22
2029	901	174	1520	690	24
2030	1057	198	1699	803	26

In Figure 3, indicated the chart of the value chain of renewable energy industry discussed in this research. The activity that seen in the picture is the activity occurred in and moving upstream to downstream to get the results of the utilization of the end effect. And in Figure 4 is a diagram of system integration study on analysis of power plant production to meet electricity needs in North Kalimantan, by following the model of Computer Integrated Manufacturing for Open System Architecture (CIMOSA).

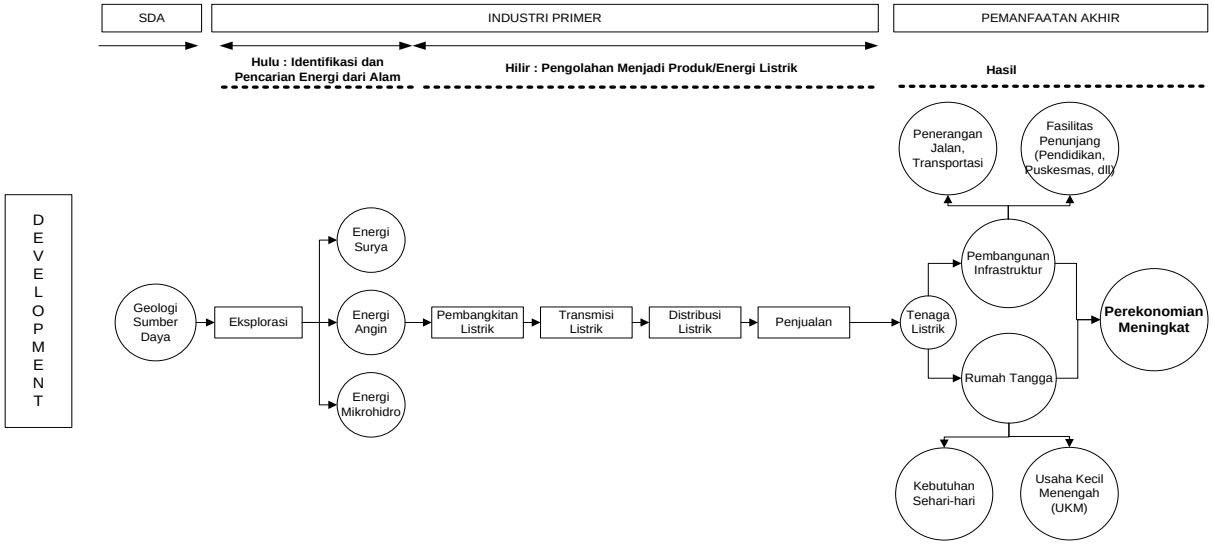

Figure 3. Value Chain of Renewable Energy Industry

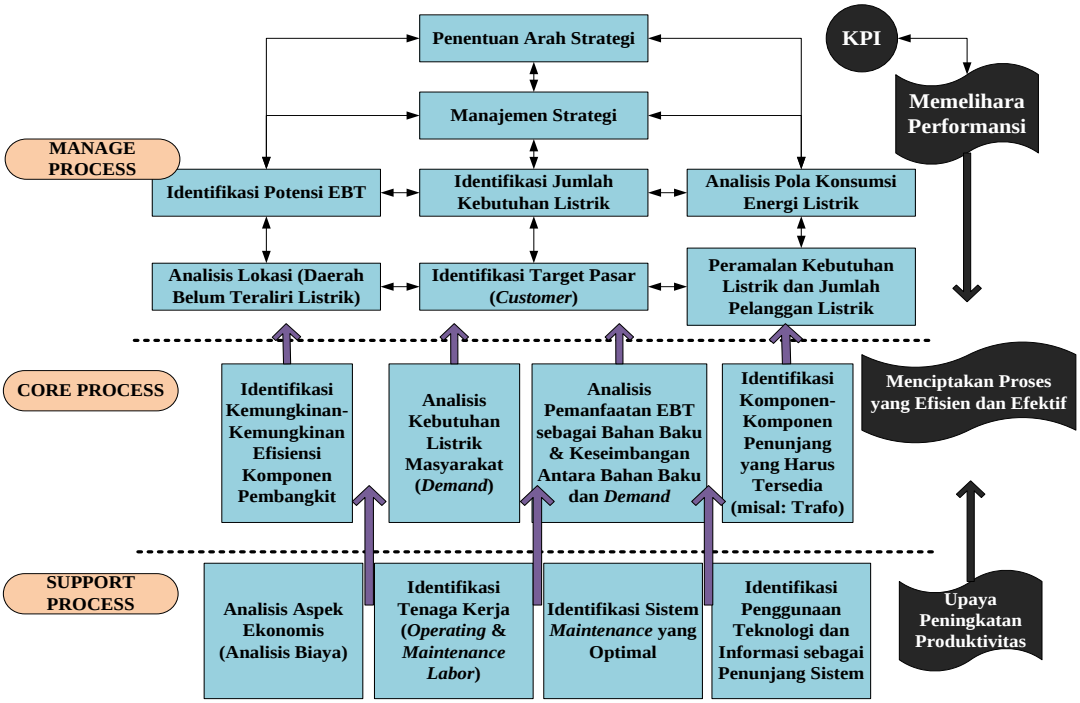

Figure 4. Integrated System of Renewable Energy Power Plant Production.

5. CONCLUSION

According to the outcome of prediction electric needs in North Kalimantan, we can see that the electricity demand increasingly per year until 2030. Utilization of solar energy and micro hydro is not able to meet the electricity needs in North Kalimantan. Therefore, to meet the shortage of energy supply is needed alternative energy utilization, such as wind, ocean waves, biogas, etc.

6. REFERENCES

(a) Ministry of Energy and Mineral Resources Indonesia (2012).
(b) Department of Mining and Energy North Kalimantan (2014)
(c) Department of Region Planning Developing each District (2014)

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