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ELECTRICITY SUPPLY PLANNING FOR ECONOMIC DEVELOPMENT IN MERAUKE REGENCY, INDONESIA

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Abstract

Planning and forecasting of electrical energy needs is a major requirement that cannot be delayed for the economic development of a developing region. The purpose of this research is to forecast population growth and the need for electrical energy to achieve development goals in Merauke Regency. The analytical method of this research uses forecasting with serial calculations based on population growth data, data on the number of consumers, installed power, production, and electricity distribution using secondary data obtained from PT. PLN (Persero) and BPS Data for Merauke Regency.

Research result shows that there will be an increase in the number of consumers and the necessity to provide energy production and installed power for energy needs with the dominant electricity customers being business customers. Household customers show the lowest position, thus the need for electrical planning that is prepared to become an urban or business area.

Keywords: Business Areas, Economics Development, Forecasting Electrical Energy Needs, Population Growth,

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1. Introduction

Access to electricity is one of the basic prerequisites for improving the quality of life and strengthening the economic competitiveness of the community and nation. Improving access to modern forms of energy is critical to unlocking faster economic and social development, no country in the world can reach a high stage of development and prosperity without paying attention to adequate and sustainable access to electricity for its people (Birol et al., 2014).

The availability of electricity to maintain industrial productivity and competitiveness as well as ensure adequate welfare of its citizens is still a big challenge in Indonesia. According to the International Energy Agency (2014), Indonesia is relatively lagging behind in terms of the electrification ratio (the ratio of the number of households that have access to electricity to the total number of households) in the ASEAN region. With an electrification ratio of 76%, Indonesia is only slightly better than the Philippines (70%),(Birol et al., 2014)

Law No. 30 of 2007 also confirms that the central and regional governments are responsible for ensuring the fulfillment of the energy needs of the community. Furthermore, Law no. 30 of 2009, Article 3 Paragraph 1 concerning Electricity explains that the supply of electricity is controlled by the state, which is carried out by the government and local governments based on the principle of regional autonomy. This means that in the spirit of regional autonomy, local governments are obliged to actively participate in increasing access to electricity in their regions.

Electricity Supply Planning for the community in important sectors (household, public, commercial, and industrial) is seen as a consumer or user of electricity and PLN as a producer or provider of electricity, then it is PLN who should be seen as a party that must seriously pay attention to electricity supply throughout the region. Indonesia(Janis & et al, 2013). However, if viewed from the perspective of energy scarcity, high investment in power generation, and because PLN is a state company with a high subsidy burden, priority and serious attention to the issue of electricity availability should be a shared responsibility (Adam, 2016).

The need for long-term development of the electricity system is driven by the need for PLN to have an efficient investment plan, in the sense that PLN does not carry out an electricity project without being based on good planning. This is important because investment decisions in the electricity industry will require long-term benefits. To achieve this, PLN prepares a planning document for the next ten years called the Electricity Supply Business Plan, or RUPTL.(Minister of Energy and Mineral Resources of the Republic of Indonesia, 2016)

Forecasting errors can result in under or over-estimating future electricity needs, and neither is an option. Under-estimate in forecasting will lead to a lack of electricity production by PLN with the consequence of slow regional growth while over-estimation will lead to over-production by PLN with the consequence of wasting state resources (Bahtiar, 2014).

Good electrical energy planning for electrical energy consumption is very necessary to help make policies for increasing electrical energy in the short, medium and long term, in which infrastructure development must also consider the energy needs of Indonesia and the world in the future in accordance with the Vision and Direction of Development Long Term (Pjp) 2005 – 2025 and to achieve increased access of the poor and/or living in remote areas to energy in order to realize the welfare and prosperity of the people in a fair and equitable manner in accordance with Law no. 30 of 2007 Article 3, point f explains how to: 1) provide assistance to increase energy availability to poor people;

Population growth that continues to increase must be balanced with the availability of electricity, this is because the demand for electricity from the community is also increasing. PLN, which is an electricity service company, continues to strive to provide the best service to the community, one of which is by increasing the supply of electricity. Of course, Merauke as the second largest city in Papua has a large consumption of electricity needs compared to other cities in Papua Province.

Electrical energy is one of the most important components in the development of an area (Asian Development Bank, 2016). The development of sustainable development and improvement in living standards can cause the consumption of electrical energy to continue to increase, and Merauke Regency is no exception. To meet the needs of electrical energy in the future, it is necessary to build and develop an electrical system so that it is able to serve the needs of electrical energy in the future. One way is to predict or estimate the need for electrical energy.

Electricity is needed not only in household life activities and public services, but also in various trade and industrial activities. The absence of electricity can affect the pattern of household life, public services, trade, and the running of industry, and therefore can be a benchmark or indicator of the "progress" of a region.

Places where there is no electricity can be seen as underdeveloped, undeveloped, and untouched by development, for this reason, PLN and the Government are obliged to provide and ensure access to affordable energy.(Virgayanti, 2017), reliable, sustainable, is one of the reasons why electrical problems must receive serious priority and attention (2013) show various possible benefits of the electrification program on people's welfare seen from three outcomes indicators, namely education, income, and public health.

The novelty element of this research lies in forecasting the need for electricity supply planning that is able to support economic growth and the welfare of society by using the population level, and electricity consumption in Merauke Regency.

1.2. Urgency (Priority) This research is an attempt to overcome the current electricity crisis, so that PLN and the local government can immediately make plans and the availability of electricity does not become an obstacle to development in Merauke Regency, within the limitations of rural communities who are struggling with poverty due to limited capabilities owned, as well as creating an even distribution of community welfare with those still at the poverty line

1.3 The purpose of this research is to forecast population growth and the need for electrical energy to achieve development goals in Merauke Regency.

2. Research Method

Sources of data This research uses secondary data obtained from PT. PLN (Persero) Merauke which is divided into five sectors, namely social, household, business, industrial, and public sectors. The data is a report on the results of electrical energy consumption and the number of electricity customers for the period 2010 to 2018 in Merauke Regency

The data analysis step is carried out by identifying the characteristics of the electrical energy needs of all customers in the Regency and forecasting the electrical energy needs of each sector in Merauke Regency. Forecasting uses the geometric series method with series input, namely data on the number of consumers, installed power, production and distribution of electricity

3. Finding and Discussion

Literature Review of Electrical Energy and Community Welfare

According to the results of the Alkire study (2014), the lack of access to electricity is one of the causes of poverty (see Table 4.1). In the case of Indonesia, access to electricity along with other factors contribute to poverty reduction(IESR, 2019).

Economic growth is one of the important factors for alleviating the problem of poverty in a region. To support high economic growth, excellent infrastructure support is needed which is vital for the economy, namely access to electricity, access to electricity(Utomo, 2015) and has a close relationship, either directly or indirectly with indicators of health, education, income, and the environment there is a link between access to electricity and improving people's welfare (Esteban et al., 2018)(Wildan, 2019)

Rural electrification programs have an important role in improving social status and improving living standards (amenities and public services) (Directorate General of P2P, 2015); reducing the negative impact of using conventional energy (firewood and coal) on the level of health and environmental quality; increase in employment (direct and indirect impacts indirectly from the electrification program) as well as increasing business productivity (Reiche, Covarrubias, and Martinot (2000).

Forecasting Model

PA forecast or forecast is basically a conjecture or forecast regarding the occurrence of an event or event in the future. Forecasts can be qualitative or quantitative. Quantitative forecasts are divided into two types:(Goldstone, 2008), that is:

1. Single Forecast (point forecast)
2. Interval forecast

According to the time period, the forecasting is divided into three periods, according to the material being forecasted (Heizer, Renders, 2014). In electrical load forecasting, the forecasting period is divided into three, namely:

1. Long-Term Forecasting

   It is a forecast that predicts the situation in the next few years. The goal is to be able to prepare for the availability of generation units, transmission systems, and distribution.

2. Medium Term Forecasting

   It is a forecast in a monthly or weekly timeframe. The aim is to prepare a schedule for the preparation and operation of the generator side.

3. Short-Term Forecasting

   It is a forecast within a daily to hourly timeframe. Usually used for comparison studies of estimated electrical loads with actual (realtime).

The function of forecasting or forecasting is seen at the time of decision making. A good decision is a decision that is based on consideration of what will happen when the decision is implemented. If the forecasts that we make are not accurate, the forecasting problem is also a problem that we always face (Heizer and Render, 2009), forecasting or forecasting has the following objectives:

1. To review the current and past company policies and see the extent of their influence in the future.
2. Forecasting is needed because of the time lag or delay between the time a company policy is set and the time of implementation.
3. Forecasting is the basis of business depreciation in a company so that it can increase the effectiveness of a business plan.

Forecasting trend projection

It is a time-series forecasting method that adjusts a trend line on a set of past data and then projects it on a line to forecast the future for short-term or long-term forecasting (Stamatic, 2002). If the thing being studied shows symptoms of an increase, then the trend that we have shown an average growth (Condolences & Megasari, 2011), is often called a positive trend, but what we examine shows symptoms that are decreasing, the trend we have shows an average decline or is also called a negative trend.

Pre-estimated Electrical Energy Needs.

Pre-estimated energy demand forecast (demand forecast) is the first step of the Electricity Supply Business Plan (RUPTL). RUPTL compiled by PT. PLN (Persero) Center. Forecasting electricity demand in PLN business units in each region has a very important role in the preparation of RUPTL(Minister of Energy and Mineral Resources of the Republic of Indonesia, 2016). This is clearly seen in the process of formulating the RUPTL which can be described as follows:

(a) Top-Down: determination of general policies and basic assumptions,

(b) Bottom-Up: demand forecast, generation plan, transmission-GI plan, distribution plan, and isolated area plan,

(c) The arrangement is adjusted to the authority of each UB PLN,

(d) Coordination or planning forum of related units at least 2 (two) times a year,

(e) Approval is carried out by the central PLN,

Factor Influencing the forecast

In forecasting the demand for electricity, we cannot ignore factors outside the influential electricity sector, such as population development, economic growth, regional development plans, industrial growth as well as several government policies from both the central and regional governments.(Minister of Energy and Mineral Resources of the Republic of Indonesia, 2016). If these factors can be taken into account entirely, it is hoped that the forecast results will be close to the truth. Exceptions to these factors are always discussed in depth and used as forecast calculation variables.

Forecasting forIn developed cities with a high level of economic turnover, carefulness in electrical energy forecasting is more needed than for small cities that are just developing. Especially for industrial and commercial cities, underestimates in forecasting electricity demand can cause huge economic losses (Fadillah et al., 2015).

The development of planning for the provision of electricity does not only depend on fossil/diesel-based generators, but can also come from wind, hydropower and electric power (D Parenden, P Sahupala, 2018) which are not included in this plan.

Forecasting methodology

Each forecasting method can be carried out using a method which is a combination of these methods so that a method that is responsive to the effects of economic activity, electricity prices, shifts in usage patterns, technological advances, and government policies will be obtained.

One of the good model that has been built for forecasting electrical energy needs is the DKL 3.02 Model PT. PLN. PLN's DKL model is a simple but effective model that is prepared by considering the availability of existing data and is usually used by PLN in calculating electricity demand forecasts. This

model is built by combining several existing methods (econometrics, trends and analytics) and using a sectoral approach where customers are grouped into 4 sectors: household, commercial, public, and industrial sector customers (Wahyudi & Firdaus, 2016). The historical electricity consumption data from the 4 customer sectors is then used in the DKL model to forecast future electricity needs.

The choice of the method to be used depends on several things, including: the purpose of the forecast, the subjectivity of the forecaster, as well as the ease of the method and the ease of obtaining supporting data. The reason for not using the PLN 3.02 DKL method is because of insufficient data. In this study, the data obtained are limited to data on the number of residents, the number of KVA installed, the amount of installed power, the number of machines, and the number of consumers. Data on the number of consumers (in units of people or institutions or families) is different from data on electricity consumption by consumers whose units are KWH. Data on electricity consumption by consumers cannot be obtained by the author due to various constraints, both for total consumption data and per sector.

Electrical Energy Demand Forecasting Analysis

Estimates of the need for electrical energy are needed to answer the high demand for electricity which from time to time continues to increase. Estimates of the Merauke Regency's Electrical Energy Needs need to be carried out to anticipate the availability of electricity needs. The estimation method for calculating the electricity demand used is the geometric series.

A geometric series is a series whose terms change based on the multiplication of a certain number. A number that distinguishes the terms of a geometric series is called a multiplier, which is the result of dividing the value of a term against the value of the term in front of it.(Choudary et al., 2010). The sum of a geometric series up to a certain term is the sum of the values of its terms from the first term to the corresponding nth term.

$$S_i = i\,.S_1 + S_2 + S_3 + \ldots + S_n$$

$$P_n = \sum_{i=1}^{n} i$$

Based on the formula Sn = apn-1, then each S can be described:

Pn = a + ai + ai2 + ai3 + ... + ain−2 + ain−1 .... (1)

pPn = ai + ai2 + ai3 + ai4 + ... + ain−1 + ain .... (2)

So the difference between the two equations above is

Pn pPn = i ain

$$P_n = \frac{a\,(1 - i^n)}{1 - i} \text{ Jika } |i| < 1 \text{ dan}$$

$$P_n = \frac{a\,(i^n - 1)}{i - 1} \text{ If } |i| > 1$$

By using the geometric series formula for the calculation of the predicted growth rate

Pn = Po(1 + i)n..... ..... (3)

Where :

Pn = Population in base year (1st year)

Po = Population in year n

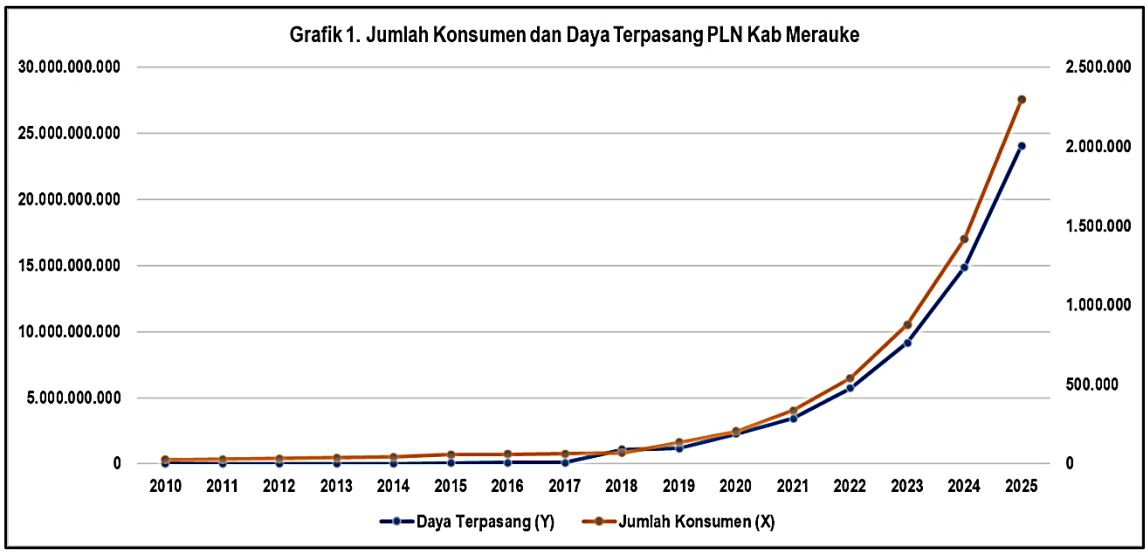
i = Percentage of growth per year

n = Number of years

Table 1. Number of Consumers and Installed Power of PLN Merauke Regency

Year	Amount Consumer (X)	Power Installed (Y)
2010	26.283	23.134
2011	28,319	24,093
2012	33,533	24,242
2013	38,942	25,429
2014	43,334	25,420
2015	56,897	80,246,915
2016	59,119	86,458,952
2017	63.607	96,859,750
2018	69.984	1,085,141,450
2019	133,591	1,182,001,200
2020	203.575	2,267,142,650
2021	337,166	3,449,143,850
2022	540.741	5,716,286,500
2023	877,907	9,165,430,350
2024	1,418,648	14,881,716,850
2025	2,296,555	24,047,147,200

Source: Processed Data (2019)



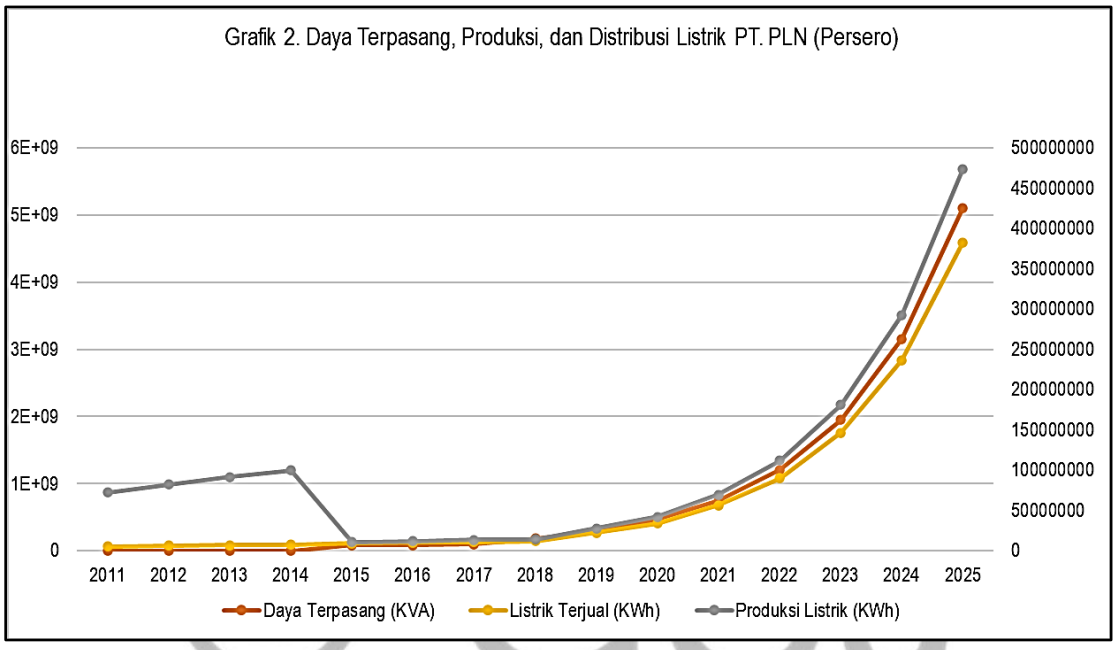
From the table of forecasting results above, it can be seen that there will be an increase in the number of consumers and installed power every year where the increase tends to increase from 2020. The results of forecasting the number of consumers for the year 2019-2025 that have been carried out combined with the amount of installed power show the amount of installed power is lower than the number of consumers so that progressive investment is needed to anticipate these conditions.

Table 2. Installed Power, Production and Distribution of Electricity PT. PLN (Persero) 2011-2018

Year	Installed Power (KVA)	Electricity Production (KWh)	Electricity Sold (KWh)	Self Use (KWh)	Loss/Loss (KWh)	Customer
2011	24093	72333855	64,724,046	-	7,609,809	-
2012	24242	82200899	74,516,167	-	7,684,732	-
2013	25420	91468159	84,332,049	-	7,136,110	-
2014	25420	99829053	91.343.583	-	8,485,470	-
2015	80,246,915	10,918,568	108,615,202	-	-	56,897
2016	86,458,952	11,684,770	123.575.016	-	-	59,119
2017	96,859,750	13,320,581	127,286,992	-	-	63.607
2018	183,318,702	14,336,026	139,984,578	-	-	69.984
2019	280,178,452	27,656,607	267,271,570	-	-	133,591
2020	463.497,154	41,992,633	407.256.148	-	-	203.575
2021	743,675.606	69,649,240	674,527,718	-	-	337,166

2022	1,207,172,760	111,641,873	1,081,783,866	-	-	540.741
2023	1,950,848,366	181.291.113	1,756,311,584	-	-	877,907
2024	3.158.021.126	292.932.986	2,838,095,450	-	-	1,418,648
2025	5,108,869,492	474,224,099	4,594,407,034	-	-	2,296,555

Source: Processed Data (2019)



From the results of the graph shown above, it can be seen that there was an excess of electricity production from 2011 to 2015, which subsequently increased the installed power and electricity sold along with the installed data.

4. Conclusions and suggestions

Based on the forecasting analysis of the number of consumers and installed power, it shows that there will be an increase in the number of consumers and the necessity to provide energy production and installed power for energy needs in Merauke Regency.

The results of the forecasting of the Electricity Consumption Sector (KWh) Per Year show that the dominant number of electricity customers is from business customers and household customers showing the lowest position, this is the need for appropriate electricity planning to become a business city.

The PT PLN (Persero) Merauke Branch would be able to pay attention to the increase in the amount of electric power installed in the future and pay attention to load characteristics in order to optimize the operation of the electrical system, because only by understanding the characteristics of the load can an optimal electrical system operation be expected in the future. in the future, by making investment plans to increase electricity capacity with priority in the business sector

For future research, it is suggested that the formulation of the research model involves various other variables such as the development of an area that causes an increase in the use of electrical energy in the area and research on the model of developing electricity with coal, solar power and hydropower.

Bibliographic

Adam, L. (2016). Dinamika Sektor Kelistrikan Di Indonesia : Kebutuhan Dan Performa Penyediaan. *Ekonomi Dan Pembangunan*, *24* no. *1*, 29–41. https://media.neliti.com/media/publications/201046-dinamika-sektor-kelistrikan-di-indonesia.pdf

Asian Development Bank. (2016). *Achieving Universal Electricity Access in Indonesia*.

Bahtiar, S. M. (2014). Peramalan Beban Dengan Menggunakan Metode Time Series untuk Kebutuhan Tenaga Listrik Di Gardu Induk Sungai Raya. *Universitas Tanjungpura*.

Birol, F., Cozzi, L., Bromhead, A., Gould, T., & Baroni, M. (2014). *World Energy Outlook 2014*. http://www.oecd-ilibrary.org/energy/world-energy-outlook-2014_weo-2014-en

Choudary, A. D. R., Parveen, S., & Varsan, C. (2010). *Partial Differential Equations An Introduction*. http://arxiv.org/abs/1004.2134

Ditjen P2P, M. S. D. (2015). Laporan Kinerja. *Jurnal Abdimas Dewantara*, *53*(9), 1689–1699.

Esteban, A. F. L., Kafarov, V. V., Guerrero, I., Cortes, A., Rosso Cerón, A. M., & Duarte, M. M. (2018). Assessment of access to electricity and the health, education and agricultural productivity effects in rural areas of Colombia. *Chemical Engineering Transactions*, *70*, 1219–1224. https://doi.org/10.3303/CET1870204

Fadillah, M. B., Sukma, D. Y., & Nurhalim. (2015). Analisis Prakiraan Kebutuhan Energi Listrik Tahun 2015-2024 Wilayah Pln Kota Pekanbaru Dengan Metode Gabungan. *Jom FTEKNIK*, *2*(2), 1–10.

Goldstone, J. (2008). Using Quantitative and Qualitative Models to Forecsat Instability. *United States Institute for Peace, Special Re*, 1–16.

IESR. (2019). Sustainable electricity access for rural communities: Status, Challenges, and Opportunities. *Pojok Energi - Seri Diskusi*, 11. http://iesr.or.id/wp-content/uploads/2019/05/Proceeding-PE-11.pdf

Janis, V., & Dkk. (2013). Perencanaan Sistem Distribusi 20 KV Siau Tahun 2020. *E-Journal Teknik Elektro Dan Komputer*, *2*(1), 1–8.

Menteri Energi dan Sumber Daya Mineral Republik indonesia. (2016). *Kepmen 5899 Tahun 2016_Pengesahan RUPTL PLN 2016-2025_Salinan Sesuai Aslinya.pdf*.

D. Parenden, Sahupala, 2018. The Study of Wind Potential in Merauke Used as an Energy Source Atlantis Highlights in Engineering (AHE), volume 1 International Conference on Science and Technology (ICST 2018)

Stamatis, D. (2002). Time Series and Forecasting. *Six Sigma and Beyond*, 169–180. https://doi.org/10.1201/9781420000269.ch12

Sungkawa, I., & Megasari, R. T. (2011). Nilai Ramalan Data Deret Waktu Dalam Seleksi Model Peramalan Volume Penjualan Pt Satriamandiri Citramulia. *ComTech*, *2*(2), 636–645.

Utomo, S. B. (2015). *Improving Rural Electrification in Eastern Indonesia through Institutional Capacity Development*. https://thesis.eur.nl/pub/32937/SUtomo_moodledata_temp_turnitintool_546297015._605_14472240

25_3311.pdf

Virgayanti, W. (2017). Pengakuan Akses Terhadap Jasa Energi (Recognition Access To Energy Services Especially Electricity As Human Rights). *Legislasi Indonesia*, *14*(2), 185–198.

Wahyudi, S., & Firdaus. (2016). Proyeksi Kebutuhan Energi Listrik Kabupaten Indragri Hulu Berdasarkan Pertumbuhan Beban Menggunakan Model DKL 3.2. *Journal FTEKNIK*, *3 No.2*, 1–9.

Wildan, W. (2019). Estimasi Kebutuhan Daya Listrik Di Sulawesi Selatan Sampai Tahun 2025. *CIRCUIT: Jurnal Ilmiah Pendidikan Teknik Elektro*, *3*(2), 131. https://doi.org/10.22373/crc.v3i2.5173