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## The Role of Renewable Power Supply of Biogas Palm Oil Plant by PT. Ukindo in Accelerating Economic Growth and Regional Development in Kuala Sub-District, Langkat Regency

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### ABSTRACT

*This study aims to determine the impact of the addition of electrical energy supplies from PKS PT.Ukindo with economic growth and regional development in Blankahan Village, Kuala Sub-District, Langkat Regency, North Sumatra Province. The analytical method used in this research is a combination analysis between quantitative and qualitative with 100 respondents. From the research results, it can be seen that the average income of the people in Kuala Sub-District has increased, the frequency of rotating blackouts has decreased and the level of satisfaction in the community is getting better due to the biogas program from PT. Ukindo - AEP who can help with electrical problems in Kuala Sub-District. The average income level of the community in Kuala Sub-District has increased quite significantly so that it can encourage economic growth and regional development in Kuala Sub-District, Langkat Regency.*

**Keywords:** *Palm Oil Mill, Biogas, Electrical Energy, Economic Growth, Regional Development*

## **1. INTRODUCTION**

Indonesia is one of the largest palm oil-producing countries in the world and since 2006, Indonesia has shifted Malaysia as the largest palm oil-producing country in the world. According to the Central Bureau of Statistics and the Directorate General of Indonesian Plantation in 2017, the area of oil palm plantations in Indonesia was 12,307,677 hectares with details of smallholders of 4,756,272 hectares, 752,585 hectares of state-owned plantations (government estate), and private plantations (private estate) of 6,798,820 hectares.

The production of crude palm oil (CPO) is 35,359,384 tons and Indonesia's Crude Palm Oil (CPO) production hit 43 million tons in 2018 according to the Indonesian Palm Oil Association (GAPKI), which means a rise of around 21.61 percent and at the same time making Indonesia the world's largest palm oil producer (CPO). Overall, in 2018, the world produced 67.9 million tonnes of palm oil and Indonesia alone produced 58 percent of the overall world production, exceeding the production of soybeans.

POME contains relatively high levels of organic and inorganic materials so that the level of pollution will be even higher. The liquid waste produced by palm oil mills ranges from 550-670 kg/ton Fresh Fruit Bunches (FFB). Liquid waste and solid waste as a final product or disposal from palm oil mills will be a serious problem for the environment if not managed properly. Even liquid waste will be beneficial to the community around the existence of the palm oil mill by using biogas technology and can produce renewable electrical energy which is very useful to improve the community's economy.

For this reason, PT. Anglo-Eastern Plantation (AEP) with one of its subsidiaries PT. Ukindo with its Blankahan Garden and Palm Oil Mill (PKS) wants to help with the electrical energy issue in Kuala Sub-District through Biogas Technology with its Blankahan Garden and Palm Oil Mill (PKS), which can generate electrical energy and can be supplied to the community through a work contract with the State Electricity Company (PLN).

People in Langkat Regency often experience problems with electricity, especially in Kuala Sub-District. As for the

electrical problems that often occur, such as frequent rotating blackouts, unstable electric currents and often damage to people's electronic devices, especially in Kuala Sub-District, Langkat Regency.

## **2. LITERATURE REVIEW**

Eddon Mufrizon and Purwo Subekti (2013) state that the contribution of non-renewable energy sources for electric power generation (PTL) nationally reaches 85%. Therefore it is necessary to immediately formulate policies to encourage the use of renewable energy sources. Sarono, E.Gembira-Sa'id, Ono Suparno, SupRYin (2014) stated that the right strategy to accelerate the implementation of the use of palm oil mill effluent (POME) into electricity is the target of the Indonesian government to have a methane capture facility by 2020. Safrizal (2015) states that the electricity crisis that hit Sumatra Island in 2010 required the Riau Regional Government to seek alternative renewable energy sources to overcome the electricity deficit problem.

Bahar Buasan (2016) states that to overcome the electrical problem in the form of a deficit in the supply of electrical energy which causes frequent rotating blackouts in Dendang District, East Belitung Regency, Bangka Belitung Islands Province, PT. Austindo Aufwind New Energy (PT. AANE) uses liquid waste from its oil palm plantations (POME) as a feedstock for biogas. Irhan Febijanto (2017) notes that since there is a carbon credit opportunity as an additional benefit from the use of biogas in the form of flaring and the sale of power to PLN, the decomposition of liquid waste from the method of producing coconut oil in palm oil mills (PKS) has started to be commonly used. Stieven N. Rumokoy and Dezetty Monika (2018) observed that it will pollute and damage the environment if this liquid waste is not treated properly. Using special technologies, POME can be refined to generate biogas that will finally become electricity.

Widiatmini Sih Winanti (2019) states that processing Palm Oil Mill Effluent (POME) into Biogas with a Fix Bed Type Anaerobic System without Neutralization Process is cheaper than biogas technology using the old system, namely Covered Lagoon. Regional development is defined as an effort

to formulate and apply a theoretical framework to economic policies and development programs that consider regional aspects by integrating social and environmental aspects towards achieving optimal and sustainable welfare (Nugroho and Dahuri, 2004). Sirojuzilam (2005), regional development means increasing the value of the benefits of the area for the people of a certain area and being able to accommodate more residents, with a level of community welfare that is on average the number of facilities/infrastructure, goods or services available and community business activities which are increasing, both in terms of type, intensity, service, and quality.

According to Gie (1983), the problem of regional inequality can be viewed from three aspects, namely regional income disparity, urban-rural income disparity, the size of distribution on income. Glasson (1997) explains that regions can be classified into homogeneous regions, administrative regions, and nodal regions. (Nikolas Kaldor in Sjafrizal, 2012) criticizes the Neo-Classical Model. Kaldor does not assume that, even on market processes, equitable development within regions can be accomplished by itself. According to this model, only by intensive government interventions can regional development disparities be minimized. If left just to the market mechanism, regional inequalities, along with an acceleration in the development process, will continue to increase.

The types of energy resources are potential energy, kinetic energy, chemical energy, heating energy, sound energy, nuclear energy, radiation energy, and electrical energy (Setyawan, 2008). Electricity is a very important source of energy for human life both for industrial activities, commercial activities, as well as in daily life in households, so to preserve energy sources, strategic steps are needed to support the provision of electrical energy in an optimal and affordable manner (Saepudin, 2013).

The characteristics of electric energy users are household, commercial and business, industry, and public facilities and social facilities. For electrical energy users in the household sector, the character is that the peak load occurs in the morning and at night, for example, fans, refrigerators, air conditioners, and others. For users of electrical energy in the

commercial and business sector, the character is during the day and at night, for example offices and restaurants.

The character is small industry/home industry for electrical energy consumers in the industrial sector, the peak load occurs during the day while the peak load for large industries occurs at night. The characteristics of electrical energy consumers in the public services and social facilities market are that peak loads arise in the morning, during the day, and at night, such as ventilators, air conditioners, lighting, speakers, sound systems, etc.

The general characteristics of electrical loads are: (a) Relating to the planning of electric power distribution, (b) Relating to the voltage system & "thermic effect" of loading (easily analyzed properly), (c) Requiring loading evaluation on distribution substations and planning a new distribution substation.

Empirical data from various countries in the world shows that every 1 kWh of electricity consumption will contribute around \$ 4 - \$ 5 Gross Domestic Product (GDP). The existence of a country through local government can be felt by the community through roads that can be passed by motorized vehicles, primary to secondary schools, health services, and of course lighting (electricity). Without lighting (electricity) in an area, the community will not feel the state's existence.

Obtaining an affordable electricity supply is a basic right of society guaranteed by law. This means that electricity is a bond or obligation for the government to provide it as a public road. The use of electrical energy, both for industry and households, is often inefficient. The cause can be from human factors or technical factors. Both of these factors have the potential to cause a lot of losses. If it is related to the amount of rupiah that we have to pay to PLN, these two factors have contributed to creating a "loss" of an amount of rupiah which is not comparable to the "little" energy we use.

Inefficiency in the use of electrical energy is a technical factor that is generally caused by a power factor that is not maximal, including installation systems (wiring) that do not meet standardization, load characteristics on equipment, grid voltage (network). , the technical age of the old equipment, the grounding (protective Earth) that is not

suitable, the use of a Power Supply device that is not suitable for capacity, although the inefficiency of the human element is normally caused by the lack of accountability of relevant parties in the measurement of accounts (billing), periodic calibration systems, Meter Monitoring (kWh Meters) that have not been run regularly, mistakes also arise in the classification of meters and programs. Consumer guidance, which has not been continuously applied in regards to the utilization of electrical energy, typically does not optimally incorporate the power plant system in the industry.

### 3. RESEARCH METHODOLOGY

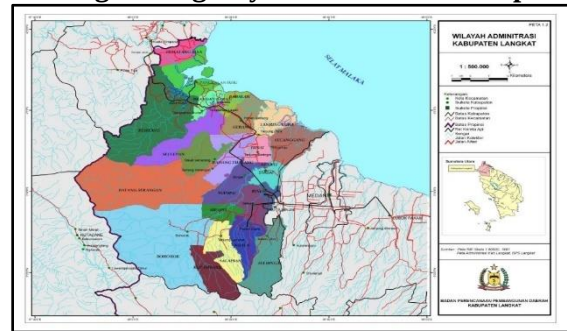
The study is located at PT. Ukindo - Blankahan Estate with a Palm Oil Mill (PKS) in Blankahan Village, Kuala District, Langkat Regency, Province of North Sumatra, which is one of the Palm Oil Mills (PKS) owned by PT. Anglo-Eastern Plantation (AEP).). A combination of quantitative and qualitative analysis was the method of study. The total population of this analysis was all people in eleven villages in Kuala district, totaling 31,703 people, then up to 100 people were sampled using the Slovin formula.

.Primary collection of data such as questionnaires and interviews with community members in 11 villages that provide by PT Ukindo - AEPMI with electrical power , it obvious that biogas has a positive effect on regional development in the Kuala sub-district, electricity as one of the main development pillars, can already be adequately supplied. It would be performed using the Dependent T-Test or Paired Sample t-Test to measure the significance or insignificance of the data from questionnaires and interviews with community members as research respondents. A significant value would be provided by the T-Test results, which will see if the results will be at  $H_0$  or  $H_1$ .

### 4. RESULT

Langkat Regency is one of the regencies in North Sumatra Province. Geographically, Langkat Regency is located at 3o14'0,0 " - 4o13'0,0 North Latitude and 97o52'0,0" - 98o45'0,0 "East Longitude. Langkat Regency's location at an altitude of 4 - 105 m above sea level (MSL).

**Figure 1**  
**Langkat Regency Administration Map**



Source: Langkat District Regional Development Planning Agency, 2016

Kuala sub-district is 1 (one) sub-district out of 23 (twenty-three) sub-districts in Langkat Regency, North Sumatra Province. Kuala District administratively consists of 14 (fourteen) villages and 2 (two) urban villages.

Administratively, Langkat regency is bordered by Aceh Province and Malacca Strait in the north, Karo Regency in the south, Aceh Province in the west, and Deli Serdang Regency and Binjai City in the east.

Geographically, Kuala Subdistrict is in the position of 03°17'31 " - 03°31'51 "North Latitude and 98°19'30" - 98°27'16 "East Longitude. The distance between the Kuala sub-district head office and the Langkat Regency Regent's office is 40 km. Kuala sub-district has an altitude of 35 meters above mean sea level (MSL). Kuala sub-district is one of the sub-districts in Langkat Regency which has a less strategic position because it is not on a cross-provincial road such as Stabat Sub-District, therefore economic growth and regional development in Kuala Subdistrict are still far behind other sub-districts in Langkat Regency such as Stabat Subdistrict as the capital of Langkat Regency.

Kuala Subdistrict is directly adjacent to 4 (four) sub-districts, namely the north bordering Selesai and Serapit Sub-Districts, to the south by Sei Bingai Sub-District, to the west by Salapian Sub-District, to the east to the Selesai Sub-District.

**Figure 2**  
**Sub-District Area Comparison Map**

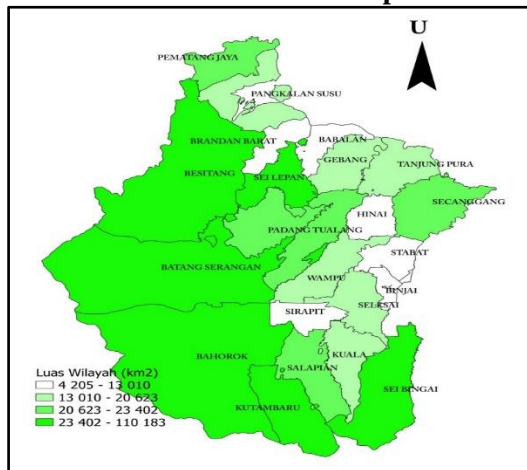
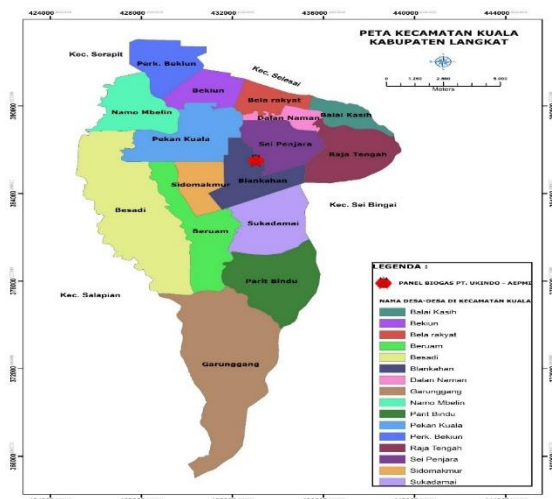


**Figure 3**  
**Location Map of Biogas PT. Ukindo in**  
**Kuala Sub-District**



Source: Processed from administrative boundary data of Kuala Sub-District and Biogas Location of PT. Ukindo, 2020

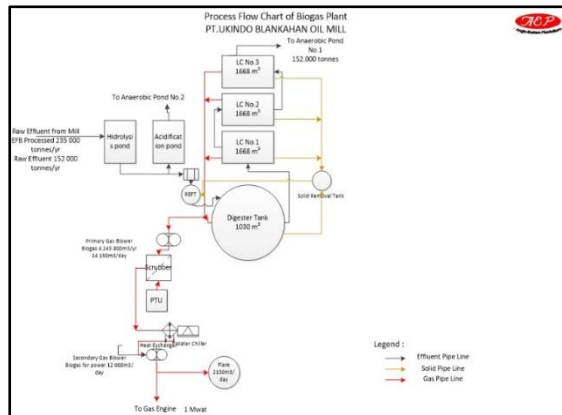
**Table 3**  
**Customers of State Electricity Companies (PLN) and Non Customers of State Electricity Companies (PLN) and Drinking Water Companies (PMA) in Kuala Sub-District in 2018**

| No | Village/<br>Urban<br>Village | Type of<br>customer |            | Family<br>Without<br>Electricity | PAM        |
|----|------------------------------|---------------------|------------|----------------------------------|------------|
|    |                              | PLN                 | Non<br>PLN |                                  |            |
| 1  | Garunggang                   | 651                 | 0          | 21                               | 0          |
| 2  | Parit Bindu                  | 500                 | 0          | 14                               | 180        |
| 3  | Beruam                       | 572                 | 0          | 0                                | 0          |
| 4  | Besadi                       | 607                 | 0          | 0                                | 0          |
|    | Perkebunan                   |                     |            |                                  |            |
| 5  | Blankahan                    | 433                 | 0          | 50                               | 0          |
| 6  | Sei Penjara                  | 191                 | 0          | 0                                | 0          |
| 7  | Raja Tengah                  | 814                 | 0          | 0                                | 0          |
|    | Namo                         |                     |            |                                  |            |
| 8  | Mbelin                       | 1.154               | 0          | 0                                | 0          |
| 9  | Bekiung                      | 600                 | 0          | 5                                | 0          |
| 10 | Balai Kasih                  | 720                 | 0          | 0                                | 0          |
|    | Dalan                        |                     |            |                                  |            |
| 11 | Naman                        | 344                 | 0          | 3                                | 0          |
| 12 | Pekan Kuala                  | 1.716               | 0          | 0                                | 376        |
|    | Perkebunan                   |                     |            |                                  |            |
| 13 | Bekiun                       | 572                 | 0          | 0                                | 0          |
| 14 | Suka Damai                   | 384                 | 0          | 0                                | 0          |
|    | Sido                         |                     |            |                                  |            |
| 15 | Makmur                       | 370                 | 0          | 0                                | 0          |
| 16 | Bela Rakyat                  | 1.870               | 0          | 0                                | 60         |
|    | <b>Total</b>                 | <b>11498</b>        | <b>0</b>   | <b>93</b>                        | <b>616</b> |

Source: Kuala Sub-District in numbers, 2019

According to information from PLN Kuala Subdistrict staff, the electricity supply from PLN has been able to flow to all people in Kuala Sub-District but there are still people who have not enjoyed electrical energy in their homes even though the percentage is small. The problem experienced by the community is that they often experience rotating power outages, especially during peak loads.

**Figure 4**  
**Flowchart of the Biogas Production Process**  
**in Palm Oil Mills of PT. Ukindo Anglo-**  
**Eastern Plantation (AEP)**



Source: Engineering Department PT.AEPMI, 2020

The process to produce biogas, which is a renewable alternative energy source and can reduce the impact of environmental pollution from liquid waste at PT. Ukindo - AEP which is more commonly known as Palm Oil Mill Effluent (POME).

**Figure 5**  
**Biogas Installations at PT. Ukindo - Anglo Eastern Plantation (AEP)**



**Table 4**  
**Respondent Characteristics**

| Variabel                   | Category | Frequency | Percentage |
|----------------------------|----------|-----------|------------|
| Age                        | ≤ 35     | 14        | 12,73      |
|                            | 36-40    | 12        | 10,91      |
|                            | 41-45    | 20        | 18,18      |
|                            | 46-50    | 23        | 20,91      |
|                            | > 51     | 41        | 37,27      |
| Installed Electrical Power | 450      | 56        | 50,91      |
|                            | 900      | 43        | 39,09      |
|                            | 1300     | 11        | 10,00      |
|                            |          |           |            |

Respondents were dominated by respondents with the age group > 51 years of 41 people (37.27%), and the least was the 36-40 years age group (10.91%). Household electric power is dominated by 450 Watts (50.91%), then 900 Watts of electricity (39.09%), and the least is 1,300 Watts (10.00%).

Process and mechanism of purchasing electrical energy produced from Palm Oil Mills biogas. Ukindo - AEP takes approximately 272 days. The stages are as follows:

**Table 5**  
**The Process of Selling Biogas Electric Energy to State Electricity Companies (PLN)**

| Energy Excess Power Purchase Mechanism to PLN |                                                          |                  |
|-----------------------------------------------|----------------------------------------------------------|------------------|
| No                                            | Description                                              | Estimation (day) |
| 1                                             | Excess Power Developer Proposal                          | 90               |
|                                               | - Company Profile, Generator technical data              |                  |
|                                               | - Power Plant Licensing Data, Feasibility Study          |                  |
| 2                                             | Excess Power sales plan presentation                     | 1                |
| 3                                             | Request for information on the connection point to PLN   | 14               |
| 4                                             | Submission of connection applications to PLN             | 3                |
| 5                                             | Distribution system impact study by developer (info PLN) | 14               |
| 6                                             | Submission of grafting studies                           | 15               |

|       |                                                                                                      |     |
|-------|------------------------------------------------------------------------------------------------------|-----|
| 7     | Review of connection studies by PLN                                                                  | 15  |
| 8     | Preparation of Project Feasibility Study (KKP) by PLN                                                | 15  |
| 9     | PT. PLN informs the requirements and connection facilities that must be carried out by the developer | 3   |
| 10    | Submission of a request for the appointment of a Bio Energy excess power manager by EBT-KEMESDM      | 30  |
| 11    | Determination of the developer and rates by PT. PLN                                                  | 7   |
| 12    | IUPTL from the Minister of Energy and Mineral Resources                                              | 14  |
| 13    | PPA and Contract                                                                                     | 7   |
| 14    | Implementation of Connection                                                                         | 30  |
| 15    | Testing dan Commissioning                                                                            | 7   |
| 16    | Commercial Operation Date                                                                            | 7   |
| Total |                                                                                                      | 272 |

Source: Engineering Department PT.AEP, 2020

**Table 6**  
**Average Income and Rotating Power Outages and Satisfaction Levels Before 2015 (Biogas is not yet operational)**

| No | Village/<br>Urban village | Income/<br>Month (IDR) | Blackout /<br>day (hours) | Blackout /<br>week (hours) | Blackout /<br>month (hours) | Satisfaction Level<br>(1-5) |
|----|---------------------------|------------------------|---------------------------|----------------------------|-----------------------------|-----------------------------|
| 1  | Sido Makmur               | 0                      | 2,50                      | 6,20                       | 24,80                       | 4,00                        |
| 2  | Namo Mbelin               | 0                      | 2,40                      | 4,40                       | 17,60                       | 3,50                        |
| 3  | Parit Bindu               | 0                      | 2,50                      | 7,30                       | 29,20                       | 4,10                        |
| 4  | Suka Damai                | 970.000                | 2,30                      | 4,40                       | 17,60                       | 3,90                        |
| 5  | Bela Rakyat               | 0                      | 2,10                      | 4,80                       | 19,20                       | 3,40                        |
| 6  | Dalan Naman               | 2.167.500              | 2,00                      | 5,00                       | 20,00                       | 3,60                        |
| 7  | Pekan Kuala               | 6.611.111              | 1,60                      | 3,70                       | 14,80                       | 3,40                        |
| 8  | Sei Penjara               | 0                      | 2,70                      | 5,70                       | 22,80                       | 3,40                        |
| 9  | Raja Tengah               | 0                      | 2,70                      | 7,10                       | 28,40                       | 4,40                        |
| 10 | Beruam                    | 0                      | 2,20                      | 7,20                       | 28,80                       | 4,00                        |
| 11 | Blankahan                 | 0                      | 3,20                      | 5,60                       | 22,40                       | 3,20                        |

Source: Questionnaire Data (Primary), Processed, 2020

**Table 6**  
**Average Income and Rotating Power Outages and Satisfaction Levels Before 2015 (Biogas is not yet operational)**

| No | Village/<br>Urban village | Income/<br>Month (IDR) | Blackout /<br>day (hours) | Blackout /<br>week (hours) | Blackout /<br>month (hours) | Satisfaction Level<br>(1-5) |
|----|---------------------------|------------------------|---------------------------|----------------------------|-----------------------------|-----------------------------|
| 1  | Sido Makmur               | 0                      | 0,55                      | 0,90                       | 3,60                        | 2,20                        |
| 2  | Namo Mbelin               | 0                      | 0,40                      | 0,50                       | 2,00                        | 2,00                        |
| 3  | Parit Bindu               | 0                      | 0,60                      | 0,80                       | 3,20                        | 2,60                        |
| 4  | Suka Damai                | 1.280.000              | 0,63                      | 0,78                       | 3,10                        | 2,00                        |
| 5  | Bela Rakyat               | 0                      | 0,38                      | 0,80                       | 3,20                        | 2,40                        |

|    |             |            |      |      |      |      |
|----|-------------|------------|------|------|------|------|
| 6  | Dalan Naman | 2.992.500  | 0,70 | 1,20 | 4,80 | 2,40 |
| 7  | Pekan Kuala | 10.000.000 | 0,38 | 0,63 | 2,50 | 2,30 |
| 8  | Sei Penjara | 0          | 0,50 | 0,50 | 2,00 | 2,30 |
| 9  | Raja Tengah | 0          | 0,68 | 1,18 | 4,70 | 2,50 |
| 10 | Beruam      | 0          | 0,80 | 1,40 | 5,60 | 2,40 |
| 11 | Blankahan   | 0          | 0,53 | 0,73 | 2,90 | 1,90 |

Source: Questionnaire Data (Primary), Processed, 2020

From table 5 and table 6 above, it can be seen that there has been a significant change in the average income, frequency of rotating blackouts, and the level of satisfaction of the 11 (eleven) villages in the vicinity of the PT. Ukindo - AEP, from before the operation of biogas with electrical energy that is distributed to the community through the State Electricity Company (PLN) to the operation of biogas from the PKS PT. Ukindo - AEP.

Based on the results of the paired sample t-test using SPSS 23 on income and rotating power outages and the level of satisfaction, the following values:

Table 7

The results of the t sample test

| Research variable                           | t-<br>statistic | t-<br>table |
|---------------------------------------------|-----------------|-------------|
| Community income                            | 5,032           | 2,410.      |
| The frequency of rotating blackouts per day | 19,125          | 2,270       |
| Frequency of Rotating Blackouts Per Week    | 14,149          | 2,270.      |
| Frequency of Monthly Turning Outages        | 14,149          | 2,270.      |
| Satisfaction Level                          | 25,288          | 2,270.      |

The conclusion from the results of the paired two-sample test shows that  $H_1$  is accepted and  $H_0$  is rejected, which means:

1.  $H_1$  = there is a significant difference between the average income of the community before and after the operation of biogas as additional electrical energy produced by the PT. Ukindo - AEP.  
The increase in the average income of the community is caused by several things:
  - a. The addition of electrical energy through the biogas program from the palm oil mill of PT. Ukindo - AEP has resulted in better electricity conditions in the community.
  - b. The condition of electricity in the community is getting better, it will further encourage micro and small, and medium enterprises in the

community to live and develop due to adequate and sufficient electricity supply.

2.  $H_1$  = there is a significant difference in the decrease in the frequency of rotating blackouts per day after the biogas operates as additional electrical energy produced by the PT. Ukindo - AEPMI compared to before the biogas operation.
3.  $H_1$  = there is a significant difference in the decrease in the frequency of rotating blackouts after the operation of biogas as additional electrical energy produced by PKS PT. Ukindo - AEPMI compared to before the biogas operation.
4.  $H_1$  = there is a real and positive difference in the level of community satisfaction after biogas operates as additional electrical energy produced by the PT. Ukindo - AEPMI compared to before the biogas operation.

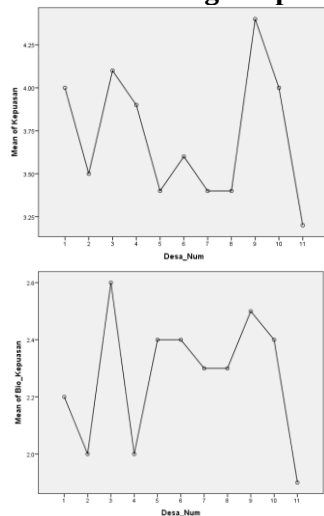
## 5. DISCUSSION

The role of the presence of biogas from the palm oil mill (PKS) of PT. Ukindo - AEP to overcome electricity problems that often occur and greatly interfere with community activities in 11 (eleven) villages in Kuala District, Langkat Regency. Before the supply of electrical energy from the palm oil mill (PKS) biogas, PT. Ukindo - AEP often blackouts occur in the community, especially during peak loads, namely during the day and at night. But after the flow of electrical energy from the biogas of the Ukindo - AEP palm oil mill (PKS) through a collaboration in the form of a contract of work with the State Electricity Company (PLN) of 1.1 MW. According to Safrizal (2015) and Yulian Mara Alkusma (2016), there is often a deficit of electricity in a region or region due to insufficient supply of electrical energy by PLN with electricity consumption by the community.

For this reason, it is necessary to find alternative and renewable sources of electrical energy to replace conventional sources of

electric energy originating from fossils such as petroleum, coal, and natural gas. With the current development of a Biogas Power Plant (PLTBg) from processing palm oil mill effluent (POME), including what has been done at the palm oil mill (PKS) PT. Ukindo - AEP will be able to help solve electricity problems, namely in the form of rotating power outages in Kuala Sub-District, Langkat Regency.

**Figure 5**  
**Graph of Satisfaction Level Difference**  
**Before and After Biogas Operations**



## 6. CONCLUSION

Based on the results of data analysis in this study, it is concluded that the biogas program from the PT, Ukindo - AEP Palm Oil Mill (PKS), which was started in 2015 and flowed through PLN to the community by 800 KWatt, is useful for helping with electricity problems with frequent occurrences. power cut by PLN, especially during peak loads in 11 (eleven) villages in Kuala District.

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