

Behavior in the Use of Bunaken Solar Power Plant

Sarina Julien Binti¹, Zainal Fanani², Endah Setyowati³, Bagyo Yanuwidi⁴

¹ Doctoral Program of Environmental Science, Brawijaya University, Indonesia.

² Farm Faculty, Brawijaya University, Indonesia.

³ Administrative Science Faculty, Brawijaya University, Indonesia.

⁴ Match and Science Faculty, Brawijaya University, Indonesia.

Abstract

The use of electricity for productive purposes is generally used to increase people's productive activities. This increase in productive activities will ultimately increase the number of jobs, agricultural production and other services so that it will increase the income of the population. This study will present how to present education patterns of community behavior in the Bunaken PLTS area. This study has the aim that the community has a good perception and participates in renewable energy use, so that the community has an effective and efficient behavior education and actively participates in maintaining the stability of the Bunaken island ecosystem. The results of this study, the main perception in the use of renewable energy, especially in Bunaken Island is that the increasing energy needs by the community must be accompanied by the addition of energy, but people want the addition of energy must come from renewable energy.

Keywords: Energy, Renewable Energy, Solar Plant, Electricity, Bunaken Island

INTRODUCTION

The availability of electricity in North Sulawesi Province is supplied by power plants such as Geothermal Power Plants (PLTP), Steam Power Plants (PLTU), Hydro / Hydro Power Plants (PLTA / M), Diesel Power Plants (PLTD) and Solar Power Plants (PLTS).

The rate of growth of electricity consumption is not comparable to the development of electricity generation so the government also seeks to reduce the rate of consumption of electricity by launching an energy-saving movement.

PLTS is one of the renewable energy sources (EBT) developed by the government to reduce energy use made from fossil or nonrenewable energy.

The current policy paradigm of the government has changed, where EBT used to be alternative energy must now be maximized while energy derived from fossil materials is only a balancing factor.

Society as an energy user must be wise in using that energy. Furthermore, the readiness of the community must be prepared properly, otherwise it will cause some problems such as unemployment and consumer consumption behavior.

CONSUMER BEHAVIOR

Associated with the community's need for energy means the relationship is related to consumer behavior. Consumer behavior is the study of how individuals, groups, organizations choose, buy, use and place goods and services, ideas or experiences to satisfy their wants and needs [1].

In essence everyone must have the needs they want to fulfill. To meet this need will certainly have different behaviors, depending on the situation and condition of the environment around the person. Related to the use of renewable energy, the community is not yet fully aware of renewable energy [2].

In Figure 1 a chart of consumer behavior, in which there are several factors that influence, namely cultural, social, personal and psychological factors. Each factor has subfactors that influence each other.

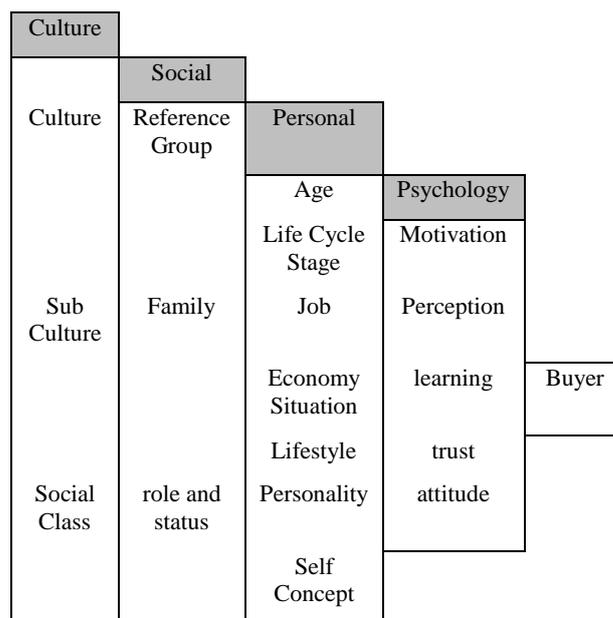


Figure 1. Factors that influence consumer behavior [1]

In the cultural factors there are subfactors, namely the culture itself, sub-culture, and social classes, where these subfactors are very important for later buying behavior. Culture is one of

the initial determinants of desire and the most basic form of behavior that influences purchasing.

Consumer behavior is also influenced by social factors, which consist of reference groups or references, family, roles and social status. Reference groups or references consist of all groups that have a direct or indirect influence on the person's attitude or behavior. While the family is the most important consumer purchasing organization in the community and family members become the most influential reference group or reference. The role and social status of a person shows the person's position in the social group he occupies.

Characteristics of personal factors include age and stages in the life cycle, work, economic conditions, personality and self-concept, as well as the values and lifestyle of the buyer.

To better understand consumer behavior is the need for external marketing stimuli such as economics, technology, politics, culture. One psychological tool combines with certain consumer characteristics to produce a decision process and purchasing decisions.

EDUCATION IN USING ENERGY

Education is a learning process both formally and informally to someone or more than one person both together and individually.

One of the factors that make energy conservation not develop in Indonesia is that there is a view among the public that Indonesia is a country that is blessed with abundant energy resources, therefore using energy economically is not considered a necessity.

The effort to fulfill Indonesian energy so that it can be fulfilled properly will require intensification and diversification of existing energy sources and the addition of new oil refinery infrastructure for national economic development [3].

At present human needs for energy are increasingly growing. Starting from household activities to industries requires what is called energy. Areas that are far from reach also require that energy. Like the one on Bunaken Island. As a tourist destination, of course Bunaken Island needs electricity related infrastructure.

Bunaken Island which previously used electricity with PLTD (Diesel Power Plant) which operates only 12 hours, is expected that with PLTS as a renewable energy it can make electricity needs on Bunaken Island fulfilled for 24 hours.

SOLAR ENERGY

The growth of photovoltaic (PV) solar energy capacity worldwide has been hailed as a great leap forward in the battle to curb climate change, reduce dependence on finite fossil fuel reserves, and achieve energy independence for many nations. In the past decade, installed capacity has risen from 5.1 to 320 GWe [4][5].

RESEARCH SITES

Determination of the location on Bunaken Island because at this location a Solar Power Plant (PLTS) was built. The research location is located in the Bunaken District of Manado City North Sulawesi Province.

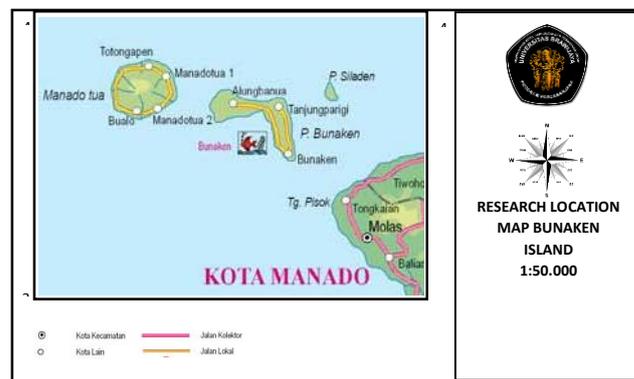


Figure 2. Research Location Map Bunaken Island

The focus of this research is to describe people's perceptions on the use of renewable energy on Bunaken Island and Analyze educational solutions for community participation to be efficient and effective in using renewable energy.

DATA SOURCE

Data sources can be divided into primary data sources and secondary data sources. Primary data is research data obtained directly from the original source or without intermediaries. The secondary data is research data obtained indirectly through intermediary media or obtained and recorded by other parties.

Primary data in this study was carried out by distributing questionnaires to the community around the island of Bunaken. The number of respondents was obtained from existing secondary data, in the form of population.

The population of the number of respondents is the number of families on Bunaken Island, namely in 2016 BPS data totaling 12,208 families in 2015. This number comes from two sub-districts, namely Bunaken District and Bunaken Island District.

In this study using the Slovin technique with the following formula

$$n = \frac{N}{1 + Ne^2} = \frac{12.208}{1 + 12.208(0,1)^2} = \frac{12.208}{123,08} = 99$$

Based on the above calculation, the minimum sample size is 99 families, so that the sample used is more representative.

ANALYSIS DATA

This study uses the Importance-Performance Analysis (IPA) technique. This technique consists of two components, namely quadrant analysis and gap analysis.

Related to the gap analysis, the model used is a service quality model that is very popular and until now many have been used

as a reference in marketing research, namely the SERVQUAL model (short for service quality)

This model includes an analysis of five gaps that affect service quality, namely the gap between consumer expectations and management perceptions, the gap between management perceptions and service quality specifications, the gap between service specifications and service delivery, the gap between service delivery and external communication, and the gap between perceived services and expected services.

In conducting research, this method will be used to analyze descriptively the quality of services, seen based on the level of suitability between the services expected (consumer interests) and perceived services (company performance).

The formula used to assess the level of suitability is:

$$Tk_i = \frac{X_i}{Y_i} \times 100\%$$

information:

Tk_i = Level of Conformity

X_i = Perceived service assessment score *

Y_i = The expected service score **

The assessment scores will be simplified to get the average value of each factor. Simplification of each of these assessment factors by using the following formula:

$$\bar{X} = \frac{\sum X_i}{n} \quad \bar{Y} = \frac{\sum Y_i}{n}$$

Information:

X_i = Perceived service assessment score

Y_i = Appraised service score

\bar{X} = Score of perceived service ratings

\bar{Y} = The expected service score average score

n = Number of Samples

Each assessment dimension is both the perceived average service score (X) and the expected service rating average score (Y) translated into four parts of the Cartesian Diagram.

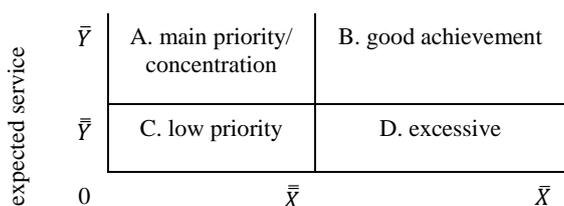


Figure 3. Cartesian Diagram Analysis of Performance Interests

RESEARCH RESULTS

Based on the questionnaire that has been distributed to several respondents, the following data obtained from the research.

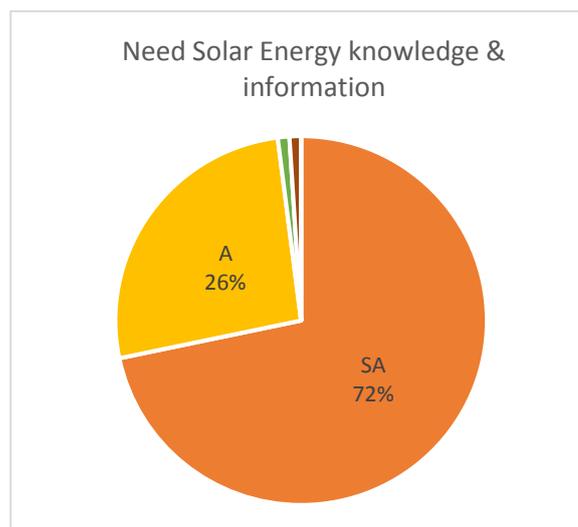


Figure 4. Perception of the need for knowledge and information on solar energy

Figure 4 shows that people need knowledge and information related to solar energy. Respondents who strongly agree as much as 72% and who agree as much as 26%, means that only 2% of respondents who do not need that knowledge.

From these results it can be said that, not all people or respondents have knowledge related to solar energy. The government needs to provide information regarding this matter, so that it can increase motivation in the use of solar energy.

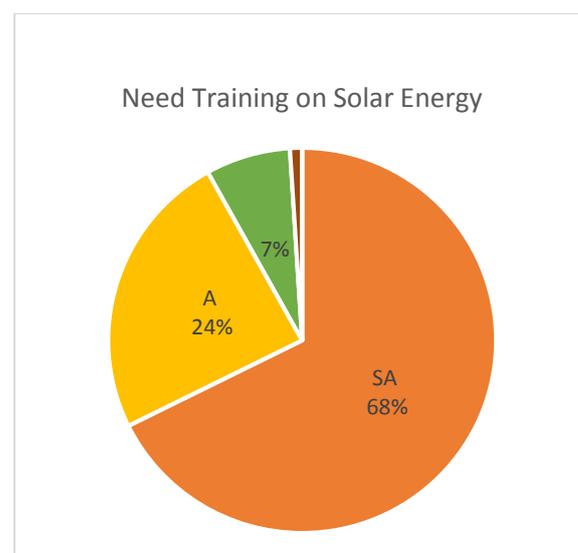


Figure 5. Perception of the Need Training on Solar Energy

Figure 5 shows that people need training in solar energy. Respondents who strongly agree as much as 68% and who agree as much as 24%.

In full, the level of suitability between the level of importance and the level of performance of perception in the use of renewable energy is shown in the following table

Training on solar energy is needed by the community. The training, starting from the introduction, benefits, how to assemble, and caring for equipment related to solar energy.

Table 1. The level of suitability between the level of importance and the level of performance

| No | performance (Xi) | Interests (Yi) | Suitability (Tki) (%) |
|---------|------------------|----------------|-----------------------|
| 1 | 4.838384 | 4.686869 | 103.2328 |
| 2 | 4.161616 | 4.676768 | 88.98488 |
| 3 | 3.222222 | 4.353535 | 74.01392 |
| 4 | 4.676768 | 4.343434 | 107.6744 |
| 5 | 4.757576 | 4.525253 | 105.1339 |
| 6 | 4.79798 | 4.585859 | 104.6256 |
| 7 | 4.777778 | 4.585859 | 104.185 |
| 8 | 2.393939 | 4.090909 | 58.51852 |
| 9 | 4.818182 | 4.59596 | 104.8352 |
| 10 | 4.656566 | 4.20202 | 110.8173 |
| 11 | 4.727273 | 4.474747 | 105.6433 |
| 12 | 3.323232 | 4.373737 | 75.98152 |
| 13 | 3.949495 | 4.313131 | 91.56909 |
| 14 | 3.808081 | 4.020202 | 94.72362 |
| 15 | 3.060606 | 3.777778 | 81.01604 |
| 16 | 3.919192 | 4.171717 | 93.94673 |
| 17 | 4.585859 | 4 | 114.6465 |
| 18 | 4.787879 | 4.616162 | 103.7199 |
| Average | 4.181257 | 4.355219 | 95.73712 |

Overall Assessment Criteria:

- 0.81 – 1.00 (Very good)
- 0.66 – 0.80 (good)
- 0.51 – 0.65 (Pretty good)
- 0.35 – 0.50 (Not good)
- 0.00 – 0.34 (Very bad)

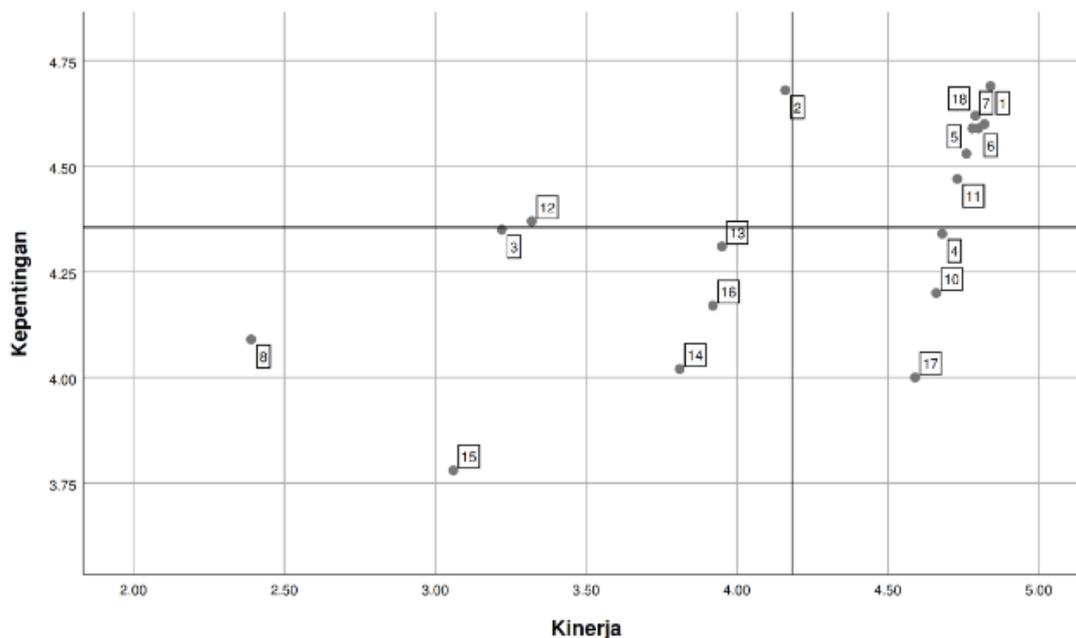


Figure 6. Perception Quadrants in the Use of Renewable Energy

X values cut perpendicular to the horizontal axis, namely the axis that reflects attribute performance (X) or customer perception, while the Y value cuts perpendicular to the vertical

axis, the axis that reflects the interests of the attribute (Y) or customer expectations.

| | |
|---|---|
| <p>Quadrant I (Concentrate Here)</p> <p>Attribute Number: 2, 12</p> <p>Attributes in this quadrant are considered very important by customers but the service is not satisfactory so the company must improve the quality of its services.</p> | <p>Quadrant II (Keep Up The Good Work)</p> <p>Attribute Number: 1, 5, 6, 7 11, 18</p> <p>Attributes in this quadrant are considered very important by the customer and the service is very satisfying, so the company must maintain the quality of its services.</p> |
| <p>Quadrant III (Low Priority)</p> <p>Attribute Number: 3, 8, 13, 14, 15, 16</p> <p>Attributes in this quadrant are considered unimportant by the customer and the service is not satisfactory.</p> | <p>Quadrant IV (Possible Overkill)</p> <p>Attribute Number: 4, 10, 17</p> <p>Attributes in this quadrant are considered unimportant by the customer but the service is satisfying.</p> |

Figure 7. Quadrant in the Use of Renewable Energy

In the perception decision making in the use of renewable energy there are 2 attributes that occupy quadrant I. Both of these attributes are perceptions of renewable energy needs in the form of solar energy and the availability of land for the solar panels on Bunaken Island.

Electricity is the most important thing in everyday life. In the absence of electricity, currently business entities owned by the community will also experience problems. For this

reason, the government is required to be able to meet the needs of the community's electricity by using new and renewable energy, because according to the research of renewable energy sources it is also capable of addressing the problem of climate change that occurs.

There are 6 attributes that must be maintained in the perception of the use of renewable energy. The first attribute (attribute 1) is needed knowledge or information about

renewable energy, especially solar energy. Not many people know about renewable energy, especially solar energy. The second attribute (attribute 5) is the need for easy access to renewable energy information. Communities need direct access to information related to renewable energy, both through print and electronic media. The third attribute (attribute 6) is an activity of socializing the use of energy efficiently and effectively continuously. The government in this case appoints the Ministry of Energy and Mineral Resources through the Directorate General of New Energy, has attempted to disseminate to schools. The fourth attribute (attribute 7) is the need for training and technological knowledge about the operation of the solar energy system. This is indeed very necessary, because the community will also be able to help the government in maintaining and making maximum use of solar panels installed in their environment. The fifth attribute (attribute 11) is the use of renewable energy / solar energy to improve the environmental quality of Bunaken Island. With the existence of renewable energy in the form of solar energy, people can save more money and reduce conventional energy consumption. The last attribute (attribute 18) is the use of renewable energy / solar energy is the best choice for the population of the island of Bunaken. Looking at the condition of the Bunaken island region, the use of renewable energy is indeed one of the right solutions in the use of energy to support daily life and business of the surrounding community.

There are several attributes that are considered not too important by the customer and the service is less satisfying. The first attribute (attribute 3) is that the use of renewable energy has been felt by the population. The second attribute (attribute 8) is that the population is able to assemble SHS. In reality not everyone is able to assemble SHS. The third attribute (attribute 13) is that the more energy needs, then the need for land for solar cell placement will also increase. National electricity consumption continues to show an increase as electricity access or electrification increases and changes in people's lifestyles. The fourth attribute (attribute 14) is the placement of solar panels in an open area will reduce the area of agricultural or forest land. As many as 46% of the people stated strongly agree with the statement. The public has a perception that the placement of more and more solar cells will reduce the agricultural land occupied by the community. The fifth attribute (attribute 15) is the placement of solar panels in an open area will interfere with the stability of the ecosystem of Bunaken Island. Based on the previous statement, if the public is willing to use the mounting free standing model, the placement of solar panels on open land is not a problem, even greater benefits. The last attribute (attribute 16) is stated that the source of electricity and fossil energy is limited or depleting. The availability of fossil fuels is currently depleting one of them because of the high use of fuel oil (BBM) for transportation.

There are three attributes in the Excess Perception quadrant in the use of Renewable Energy, where the service is satisfying but is considered not too important by the community. The first attribute (attribute 4) is that the use of renewable energy provides hope for increased income. The next attribute (attribute 10) is the use of renewable energy

means reducing carbon emissions. In accordance with the perception of the previous attributes, the use of renewable energy is a solution to reduce the use of fossil energy which means it can also reduce carbon emissions. The last attribute (attribute 17) is understanding that the use of fossil energy will increase the concentration of carbon gas. As explained in the previous point, Indonesia is currently a country with high energy consumption in the world.

CONCLUSIONS

A summary of several IPA decisions that have been described previously, among others, the Company or PLN prioritizes to focus on improving the attributes that are in this quadrant, due to energy needs by the community. PLN must also think of the right land for the placement of solar panels to be installed. The company or PLN must maintain the service quality attributes in this quadrant. Renewable energy is needed for the people of Bunaken Island. PLN can provide training and technological knowledge about renewable energy, because residents want information about it. Residents have not been able to assemble SHS themselves and do not understand the linkages or the need for additional energy using solar panels with the needs of land area and the relationship with the stability of the ecosystem. These attributes are indeed considered unimportant by the population. Residents do not understand the relationship between renewable energy use and increasing income and reducing carbon emissions, so that they are considered not too important.

REFERENCES

- [1] Kotler, P dan Keller, K.L., 2008. *Manajemen Pemasaran, Jilid 1*, Penerbit Erlangga. Jakarta.
- [2] Khoiriyah, N., 2013. Preferensi Konsumsi Masyarakat Terhadap Energi Terbarukan (Biofuel) (Studi Kasus Pada Komplek Perumahan Tambak Rejo Indah, Waru, Sidoarjo). In *Jurnal Ilmiah Fakultas Ekonomi dan Bisnis*, University of Brawijaya.
- [3] Heyko, E., 2017. Strategi Pengembangan Energi Terbarukan: Studi pada Biodiesel, Bioethanol, Biomassa, dan Biogas di Indonesia. Jurusan Manajemen dan Bisnis Universitas Brawijaya.
- [4] S. Philipps, W. Warmuth, 2017. Photovoltaics Report Fraunhofer Institute for Solar Energy Systems, ISE
- [5] A.Mellor D., Alonso Alvarez, I. Guarracino, A.Ramos, A.Riverola Lacasta, L.Ferre Llin, A.J.Murrell, D.J.Paul, D.Chemisana, C.N.Markides, N.J.Ekins-Daukes, 2018. Roadmap for the next-generation of hybrid photovoltaic-thermal solar energy collectors. In *Solar Energy Journal*, Volume 174, 1 November 2018, Pages 386-398.