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Efficient Energy Use Education Strategy in Bunaken PLTS

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Abstract: ***The energy-saving movement is no longer a rhetoric but is a part of the personal moral responsibility of the community, business entities and all components of the nation. Saver, efficient and effective behavior in energy use should be part of daily culture and lifestyle. Energy is used wisely that is efficient and rational without reducing comfort, health and productivity.PLTS is a government program to develop new renewable energy sources to reduce the use of non-renewable energy derived from fossil materials. This study uses the Importance-Peformance Analysis (IPA) technique. This technique consists of two components, namely quadrant analysis and gap analysis.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).***

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

1. Introduction

The Government of Indonesia has committed to reduce emissions (mitigation) GHG (Greenhouse Gases) by 29% by 2030 which is delivered in the form of a draft understanding of the Intendendal Nationally Determine Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC).

However, Indonesia's government efforts to achieve GHG emission reduction targets by 29% need a harder effort because in the report of the American Council for an Energy-Efficient Economy (ACEEE) Indonesia ranked 18th out of 23 countries with the greatest energy consumption and low energy efficiency.

PLN's 2015 Electricity Statistics Data shows that PLN continues to increase installed capacity annually to meet customer needs that continue to increase every year. The electrification ratio of North Sulawesi Province has only reached 71.6% and the ratio of villages with electricity is 99.8% and the PLN waiting list has reached 16,051 requests or 82.9 MVA [1]. Especially for Bunaken Island has added a solar power plant (PLTS) which is operated hybridly with PLTD.

PLTS is one of the renewable energy sources (EBT) developed by the government to reduce energy use made from fossil or nonrenewable energy. The use of renewable energy (renewable energy) such as solar energy is a solution to serve the archipelago community primarily to produce electrical energy.

The readiness of the community must be prepared properly, otherwise it will cause some problems such as unemployment and consumer consumption behavior. The government program in the form of energy-saving movement has been proclaimed since 2015 due to the rate of population growth and energy use not proportional to the increase in energy availability especially since the Indonesian people are among the most wasteful consumers of energy use [2].

The energy-saving movement is no longer a rhetoric but is part of the personal moral responsibility of the community, business entities and all components of the nation. Saver, efficient and effective behavior in energy use should be part of daily culture and lifestyle. Energy is used wisely that is efficient and rational without reducing comfort, health and productivity.

The purpose of this study is to formulate a methodology for educating the public with energy-efficient electricity.

2. Community Education Strategy

Renewable energy education is a relatively new field and previously it formed a minor part of traditional engineering courses. These days it has an identity of its own, with special techniques, standards and requirements which are not normally encountered in other disciplines. Attempts to add one or two units of study on renewables into traditional science and engineering degrees are unlikely to produce graduates with sufficient knowledge or understanding to use renewables effectively. Modern renewable energy education includes a study of the technology, resources, systems design, economics, industry structure and policies in an integrated package. This prepares the graduates to design sound systems from amongst the range of options available. There are more pitfalls in the use of renewables than there are in using the more mature conventional technologies and systems. Designers, installers and service personnel need to be particularly aware of the industry and the characteristics of the various firms and their technologies [3].

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 [4].

Utilization of renewable energy sources and the application of environmentally sound energy technologies are essential to sustainable development and will help to secure the quality of living and the well-being of the future generations [5].

3. Solar Sustainable Energy

Most of the energy generated globally utilize fossil fuels involving the emission of environmentally hazardous carbon dioxide and depletion of fossil fuel resources. The continuous variation in fuel prices has added a major concern on its sustainable use for future energy requirements. In order to minimize the environmental degradation during energy production process due to emissions of hazardous gases, the utilization of renewable energy resources can make the energy use clean as well as sustainable [6].

The idea of integrating intermittent sources of energy such as solar and wind with energy storage has several benefits for the electricity grid. The first benefit is that energy storage can help the grid during the periods that grid is facing high peak demand. The second benefit is that using energy storage would help shifting the grid load from peak and busy time to a less demand time. And the third benefit is that using energy storage would help smoothing the variations in power generation fed into the grid by variable and intermittent renewable resources. The third benefit is of particular important because in future more renewable energy sources will be integrated into the electricity grid worldwide [7].

4. 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.

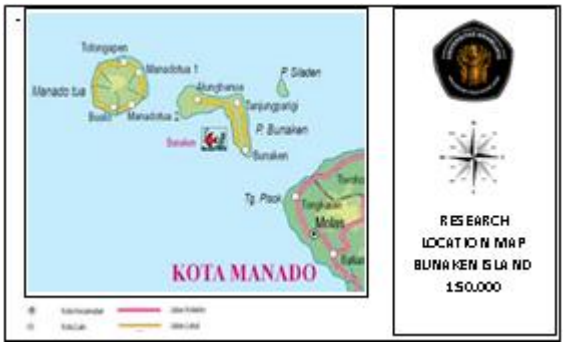

Figure 2: Research Location Map Bunaken Island

Figure 3: Location of Solar Power Plants

5. Methodology

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.

6. 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:

$$Tk_i = \frac{X_i}{Y_i} x100\%$$

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:

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

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.

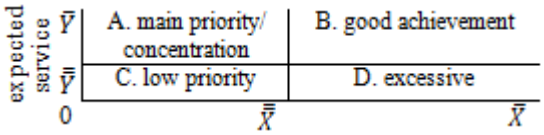

Figure 4: Cartesian Diagram Analysis of Performance Interests

7. Research Results

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

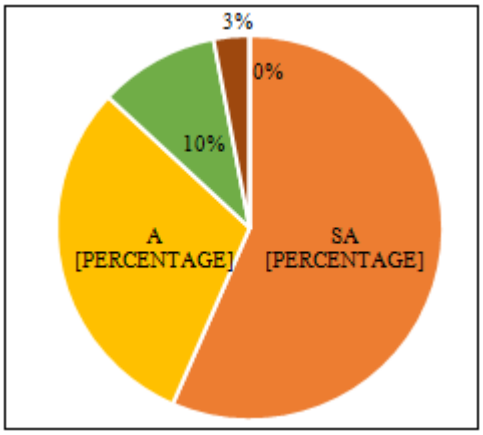

Figure 5: PLN involves the community in the construction of PLTS

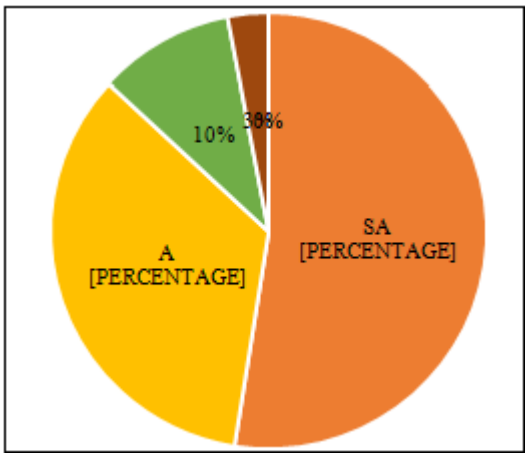

Figure 6: Energy-saving behavior must be cultivated

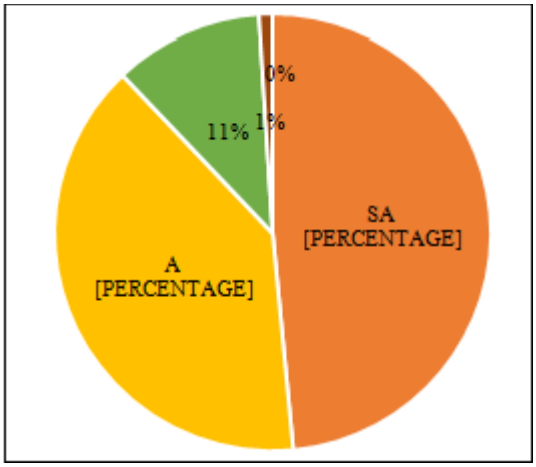

Figure 7: Society needs guidance in the use of solar energy

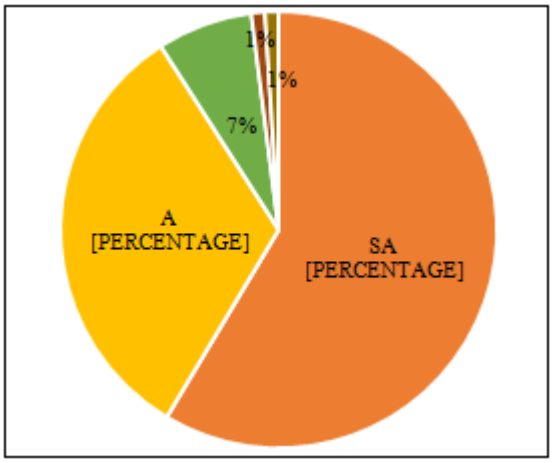

Figure 8: Electronic media is an easy source of information

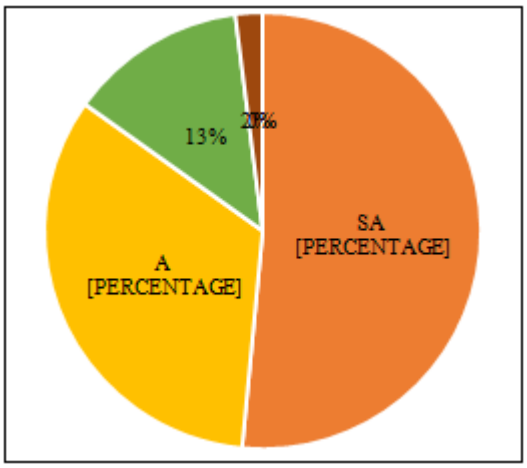

Figure 9: It takes a character to motivate about energy saving

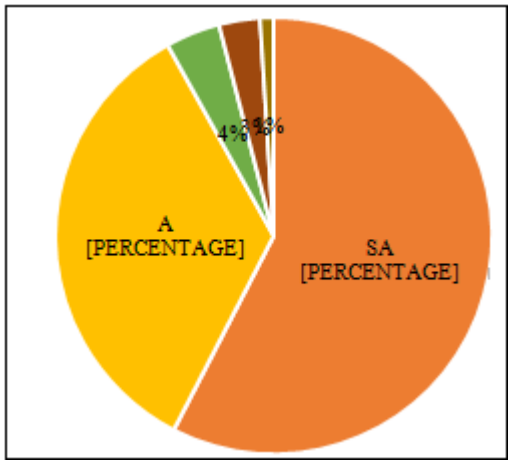

Figure 10: Society needs knowledge of solar energy

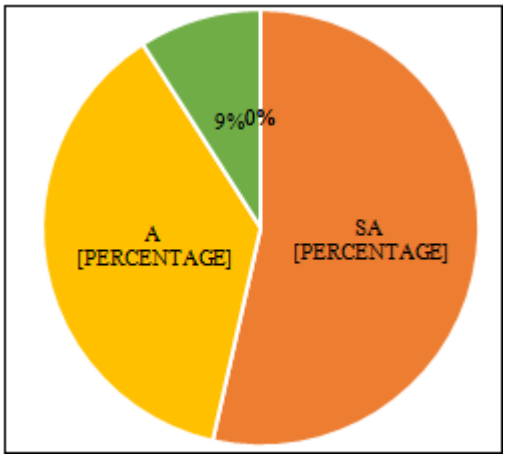

Figure 11: The establishment of an energy-saving community will encourage awareness of energy-saving behavior

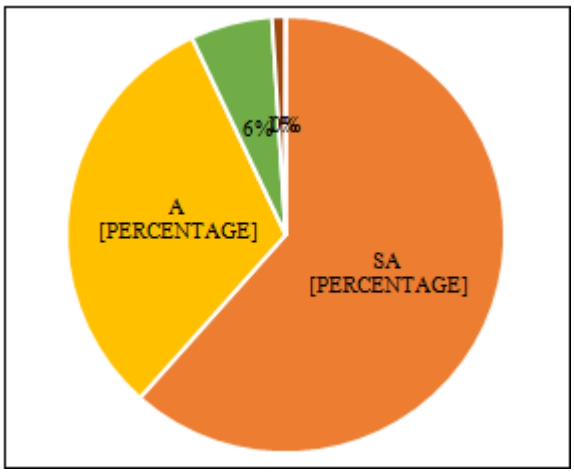

Figure 12: The socialization of energy-saving movements will change the behavior pattern of renewable energy use

There are eight diagrams showing the results of the study. Of all the diagrams that exist, indicate that the statements in the questionnaire were responded to strongly by the public more than 50%. 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

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

No	performance (Xi)	Interests (Yi)	Suitability (Tki) (%)
1	4.34	4.76	91.25
2	4.09	4.55	89.91
3	4.40	4.92	89.51
4	4.24	4.87	87.11
5	3.96	4.57	86.64
6	3.60	4.44	80.99
7	4.36	4.89	89.24
8	4.35	4.86	89.58
9	4.15	4.75	87.40
10	4.46	4.85	92.05
11	4.34	4.91	88.46
12	4.44	4.84	91.83
13	4.44	4.89	90.89
14	4.54	4.79	94.68
15	4.30	4.68	91.95
16	4.41	4.73	93.32
Average	4.28	4.77	89.68

Overall Assessment Criteria:

0.81 – 1.00 (Verygood)
0.66 – 0.80 (good)
0.51 – 0.65 (Prettygood)
0.35 – 0.50 (Not good)
0.00 – 0.34 (Verybad)

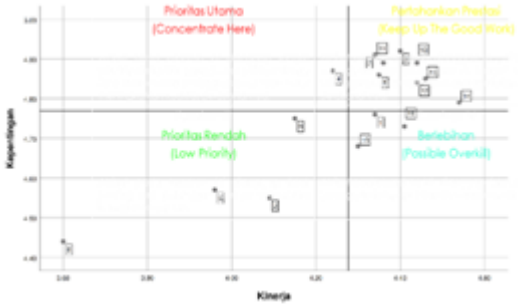

Figure 6: Educational Strategy Quadrant (learning) On the Use of Solar Cell

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.

Quadrant I (Concentrate Here) Attribute Number: 4 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.	**Quadrant II** (Keep Up The Good Work) Attribute Number: 3, 7, 8, 10,11, 12, 13, 14 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.
Quadrant III (Low Priority) Attribute Number: 2, 5, 6, 9 Attributes in this quadrant are considered unimportant by the customer and the service is not satisfactory.	**Quadrant IV** (Possible Overkill) Attribute Number: 1, 15, 16 Attributes in this quadrant are considered unimportant by the customer but the service is satisfying.

Figure 7: Quadrant in the Use of Renewable Energy

The educational strategy offered in this study is to design and create an environmentally friendly solar cell power generation system with an independent system with the guidance of relevant agencies. This strategy is carried out due to the following principles can be operated easily by members of the community who are still actively low in technological skills,can stimulate the growth of the technology skills of the community concerned easily, infrastructure and supporting facilities for the operation of this technology can be provided easily.

This strategy is carried out by providing training on how to make PLTS installations independently followed by young people and local community leaders. Data obtained from the field states that most of the community in general education level up to high school and low income, it requires funding from the government and informal technical guidance. The material provided includes how to design a standalone PLTS network system, installation and maintenance.

8. Conclusions

Education in the use of renewable energy is needed. There are eight attributes that must be prioritized, ranging from involving residents in planning and building PLTS, cultivating patterns of energy-saving behavior, receiving guidance in renewable energy use, using the right media to convey information related to renewable energy, finding figures for motivating energy-saving behavior, giving knowledge of solar energy technology, forming energy-saving communities and socializing energy-saving movements regularly.

Overall, PLN can cooperate with residents in the planning and construction of solar power plants in Bunaken island, and can motivate residents to foster energy-saving behavior by providing examples or role models or figures, forming communities and regularly holding socialization for energy-saving movements.

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