

The Acceptability of the Installed Photovoltaic Park Lighting System at the Municipality of Sison, Surigao Del Norte

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Abstract— Overcoming negative environmental effects of using fossil fuels is one of the major factors why free energy such as solar, wind, water, thermal, etc., is currently popular. A lot of research was done over the years on how to decrease the harmful effects of using fossil fuels and finding new alternatives sources for energy. Solar Energy is currently one of the best sources for free energy specially in the places near the equator and has widely range of applications like lighting, communications, refrigeration, building sensors, etc. The aim of the study is to determine the local's acceptance on the installed PV Park Lighting System which will help the Government to decide whether this type of project is a good project or not. This social study presents a survey approach on determining the satisfaction on the installed solar park lighting system at the Municipality of Sison, Surigao Del Norte which is the adopted municipality of Surigao State College of Technology for its extension program. The selected respondents are locals who are living near the area. Results shows that 66% of the respondents were satisfied on the installed Photovoltaic Park Lighting System.

Keywords— Photo-Voltaic, Park Lighting System, Solar Energy.

I. INTRODUCTION

Today, electricity is one of the major driver for economic growth globally [1]. Electricity is the greatest invention discovered by humans which plays a pivotal role specially in improving human daily lives. With electricity, it lighted our world and we can easily communicate with other people globally. Majority of the research and development uses electricity as a starting point and plays a crucial role.

Humans have an increasing demand of using electricity. This is the result of industrialization and the increase amount of home electric appliances [2]. In China, the sources for electricity are from the use of coal, oil, hydroelectric power, natural gas, nuclear, other renewables as shown in Figure 1. As shown in Figure 1, majority of the sources came from coal and oil which are non-renewable energy [3]. These non-renewable energy sources are the major cause of the increasing amount of greenhouse gases resulting to climate change.

Researchers have been finding ways to mitigate the harmful effects in the environment cause by using non-renewable energy by finding an alternative energy source. Solar Energy is currently popular in providing free energy. It is an energy that came from the sun.

Free Energy is like getting energy on an unlimited source. Places near the equator is the best place for harvesting solar

energy throughout the year because it only has two (2) seasons, rainy and sunny season.

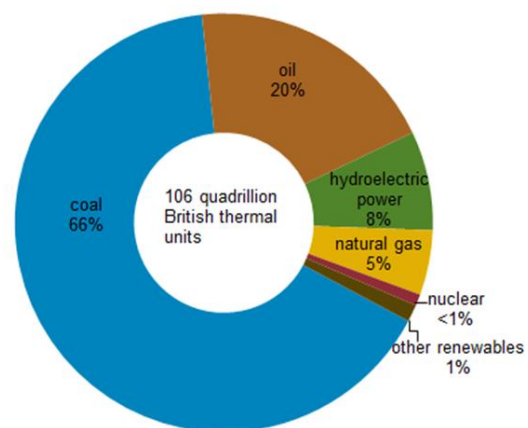


Fig. 1. Total Primary Energy Consumption in China by fuel type, 2012 [3]

In harvesting solar energy, a photovoltaic (PV) system is needed. It is also known as solar power system and is designed to harvest solar energy and convert it to usable electricity using a semiconductor material, usually silicon.

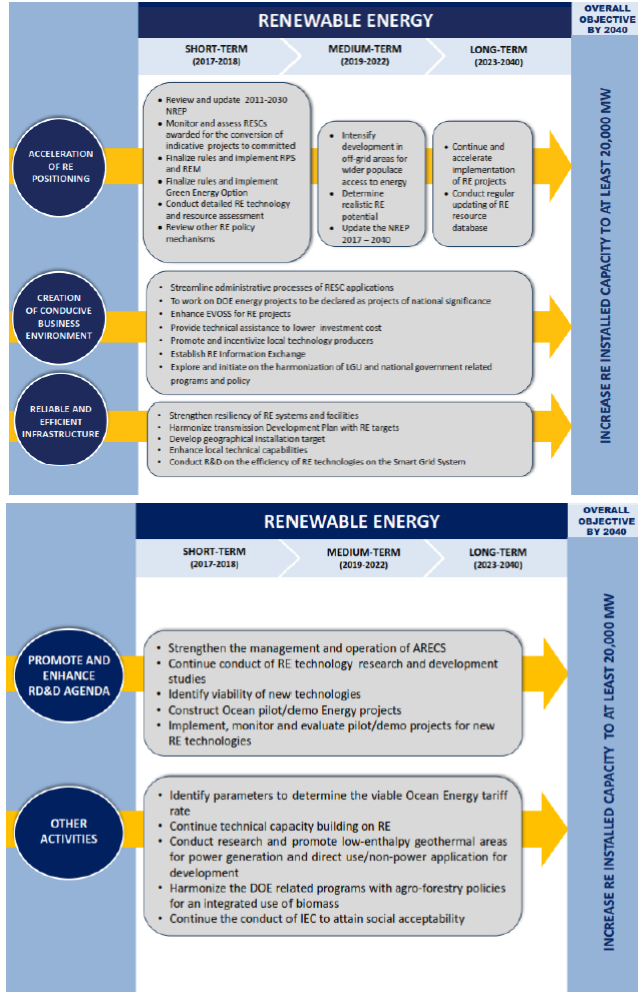
With the advancement of technology, solar energy harvesting is currently popular in supplying electricity to sensors, lighting, home appliances, hosting servers, satellites, etc. The major advantage of using solar energy is that it has an unlimited source which is the sun. It is also cheap, clean, and does not emit greenhouse gases. Another advantage is that it can provide electricity to people who are living in places where transmission lines cannot be reach.

This year 2018, in regards to the usage of PV system as a source of electricity, Philippines outperforms other flourishing Asian countries. Currently, it is ranked first in Asia and fifth globally. The ranking was based on Philippines getting seven (7) active projects that ranked top 50 [4]. This is also the result of the support from the Philippine Government especially the Department of Energy (DOE) [10], Department of Science and Technology (DOST) and Commission on Higher Education (CHED). These three departments promote and sponsor research and extension projects relating to the usage of free energy.

Table 1 shows the Philippines renewable energy roadmap for the year 2017 to 2040 and this shows that Philippines

government are promoting in using renewable energy sources in the field of business, infrastructures, and research and development in the Philippines [12].

TABLE 1. Department of Energy: Renewable Energy RoadMap 2017 – 2040



causing these which are political issue, lack of supply and more demand, oligarchy, lack of competition etc. Having lack of market competition, contractors are selling expensive electricity to gain more profits.

In the Philippines, the population growth is at 1.72% from 2010 to 2015 and this year 2018, Philippines population is estimated at 106.51 million. It was said that it is currently ranked 12 the most populated country in world. In economics, the population plays a crucial role in the demand. It means that more resources are needed like home appliances, urbanization, industrialization, etc. to cater all the needs of the people in improving their daily life. This will lead to an increase demand of electricity. Table 2 shows that household used electricity as the number one power source in the Philippines [11].

TABLE 2. Philippines: Percentage of Households by Type of Fuel Used in 2004 and 2011

Type of Fuel	2011	2004
Total Number of Households (In thousands)	20,969	16,973
Electricity	87.2	87.6
LPG	41.2	52.1
Kerosene	34.3	56.1
Gasoline	23.6	11.7
Diesel	4.9	3.3
Fuelwood	54.2	55.1
Charcoal	36.4	34.2
Biomass residues	22.3	18.7
Biogas	*	0.2

Today, the industry sector is recorded to be the fastest growing sector having a growth rate of 7.9% in the Philippines [7]. Having more demand, means it is more expensive according to the law of supply and demand. With solar energy harvesting, these could solve the lack of market competition and demand issues. Another good thing is that its environmentally friendly and will not produce harmful gasses.

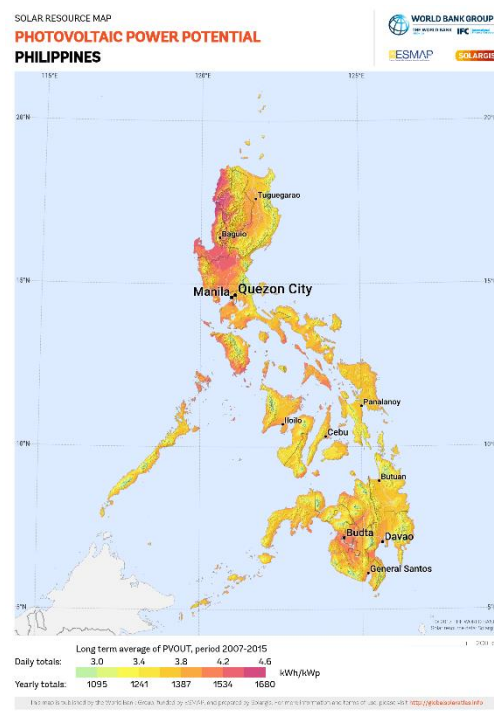


Fig. 2. Photovoltaic Power Potential in the Philippines

Researching and Developing alternative energy resources is also mandated by CHED in the policies, standards and guidelines for the Bachelor of Science in Electrical Engineering Program [5]. This promotes students to explore and research a clean and free alternative energy source.

To follow the mandate of CHED, Surigao State College of Technology (SSCT) had used PV system technology in one of our extension programs at the Municipality of Sison, Surigao Del Norte. It was requested by the mayor to install PV light system on its park to replace the traditional park light powered by the transmission lines. This project was initiated using green technology and hopes that it will be adopted by other municipalities. This study will research the economic effects and local's satisfaction on the installed PV system park light.

II. REVIEW ON SOLAR ENERGY POTENTIAL IN THE PHILIPPINES

Philippines is located near the equator where there is enough exposure of solar energy throughout the year. Based on global ranking, Philippines is ranking number 5 for having a very expensive electricity cost [6]. There were several factors

Figure 2 shows the Photovoltaic Power Potential in the Philippines having an yearly average of 1300 to 1500 kilowatt-hour/kilowattpeak (kWh/kWp) [8]. This data shows that Philippines is a good source of solar energy. Having a good source and not using it is a big sin. Using the potential power of solar energy will also make the Philippines less dependent on oil. Oil are very expensive and in the long run will become more expensive because it does not have an unlimited source. According to economics, oil is one of the major contributing factors of the modern global economy. When the prices of oil increases, all cost increases also. That's why its best that the Philippines should use more renewable energy sources such as solar energy.

III. METHODS

This study uses a simple random sampling survey approach research method. Survey questionnaires were develop using the local's language and it was made sure that it was simple and technical terms were minimal. The purpose was to make sure that the locals will easily understand it even if they have different backgrounds and specialties. This study uses primary data only. There were two (2) conditions needed in making the sample design. First, the respondent must be a local and have stayed near the area where the PV light system was installed. Second, is that the respondent must be mature and have an age of 16 and above. The size of sample taken was 50. The respondents were also informed about the study's purpose, content, and duration. The aim of the study is to determined the acceptance of the PV light system.

IV. RESULTS

The satisfaction of locals on the PV Park Lighting System had been surveyed using the criteria mentioned above. In this section, the researchers present the demographics characteristics of the respondents, the satisfaction of the installed PV system based on quality, aesthetics, perception of safety, effects on crime, and the overall satisfaction. The survey was conducted between October 1 to October 5, 2018 and the number of survey forms distributed were 60 and received 50 respondents, 25 males and 25 females. Data analysis uses advance excel data manipulation.

4.1 Demographics

As shown in Figure 3, fifty (50) respondents were randomly selected, twenty-five (25) males and twenty-five (25) females. The respondents were selected using random sampling and balance number of respondents was used. The greatest number of respondents was at the age group of 25 – 34 years old group (38%) as shown if Figure 4. The lowest was at the age group of 65 and above (4%).

4.2 Quality and Aesthetics of PV Park Lighting

Eighty-eight percent (88%) of the participants were satisfied on the quality of the installed PV Park Lighting as shown in Figure 5. The female respondents were slightly more satisfied compared to the male respondents. Conversely, two percent (2%) of the respondents felt that new PV Park Lighting has less

quality. These results showed that the type of PV Park Lighting installed was a correct choice based on quality.

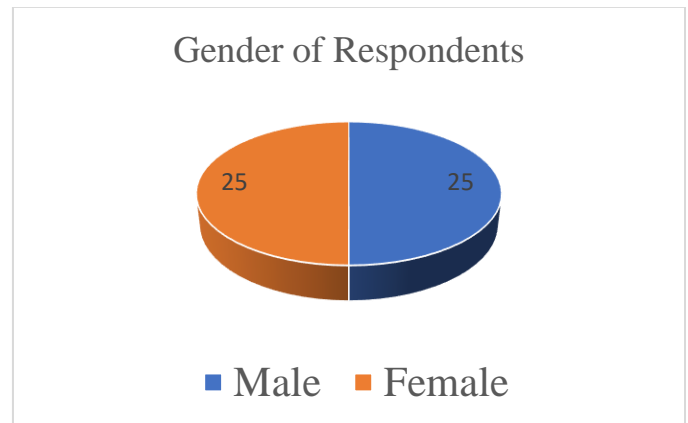


Fig. 3. The gender of respondents

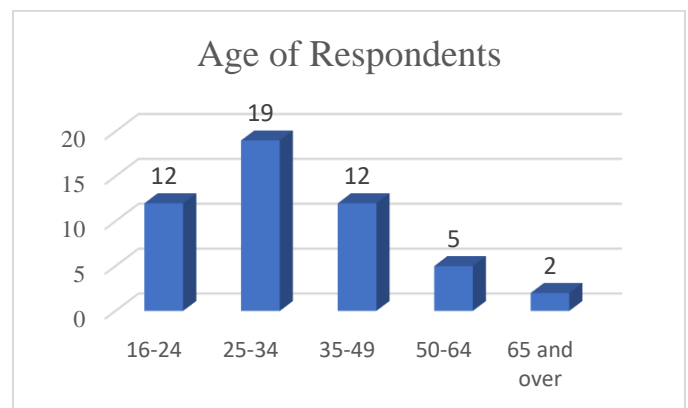


Fig. 4. The age of respondents

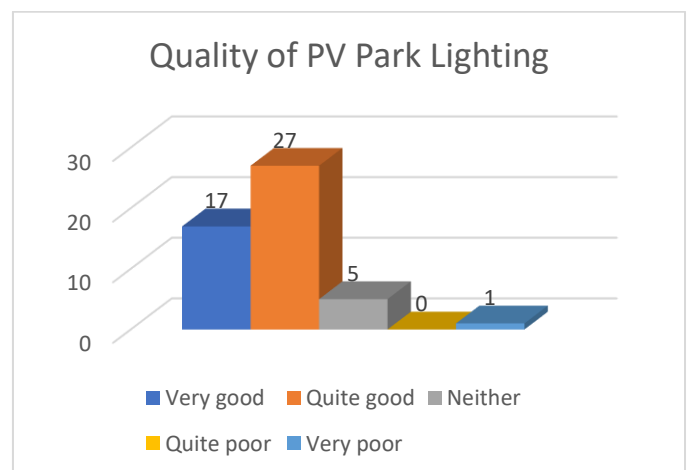


Fig. 5. The quality of PV Park Lighting

Ninety percent (80%) of the respondents had not found any problems on the installed PV Park Lighting as shown in Figure 6 and these results shows that PV systems rarely fails.

Regarding the attractiveness of the PV Park Lighting, eighty-six percent (86%) felt that the installed system made the park more attractive as shown in Figure 7. This show that is was a great choice in choosing the type of PV Park Lighting installed

based on aesthetics. Contrarywise, six percent (6%) of the respondents felt that installation of the PV system made the area less attractive. Results also shows that female respondents are slightly more satisfied on the aesthetics effect of the installed PV Park Lighting.

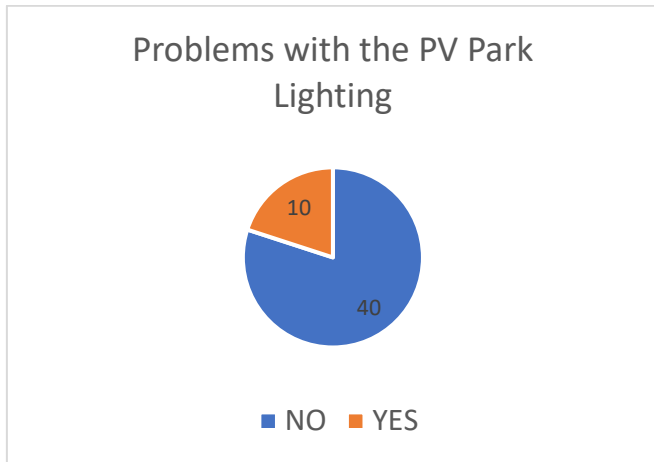


Fig. 6. Problems found with the PV Park Lighting

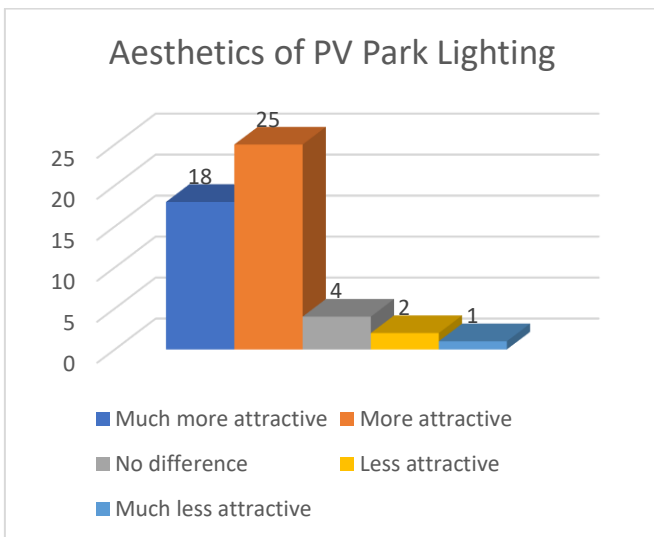


Fig. 7. The aesthetics of PV Park Lighting

4.3 Perception of Safety and Effect on Crime

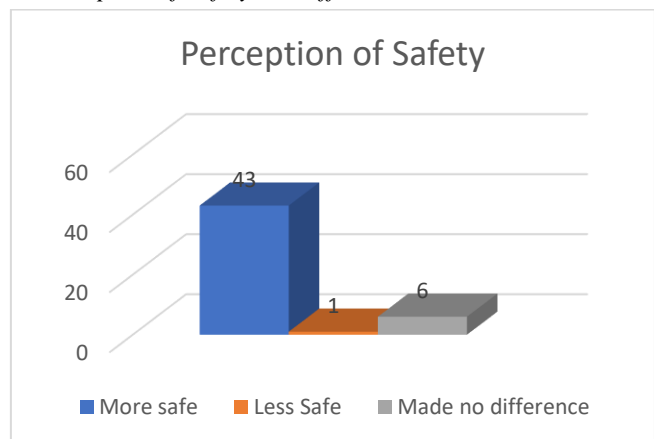


Fig. 8. The Perception of Safety

The PV Park Lighting made the eighty-six percent (86%) of the respondents felt safer in the area as shown in Figure 8. Two percent (2%) of the respondents felt that there is no difference in terms of perception of safety. This shows that the installation of PV Park Lighting made them feel safer compared to the traditional park lighting. Again, results also show that female respondents felt more safer compared to the male respondents.

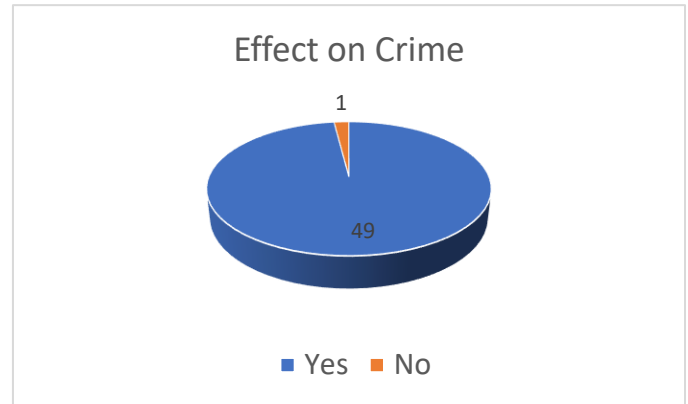


Fig. 9. The potential effect on crime in the area

The installation of the PV Park Lighting has a helpful effect on the crime in the area felt by ninety-eight percent (98%) of the respondents and 2 percent (2%) of the respondents felt that these will not have an effect on the crime in the area as shown in Figure 9. This shows that its best to install more of these to lessen the crime based on what the respondents felt. The male respondents felt more helpful effect on the crime in the area after installing the PV park lighting.

4.4 Amount and Brightness of PV Park Lighting

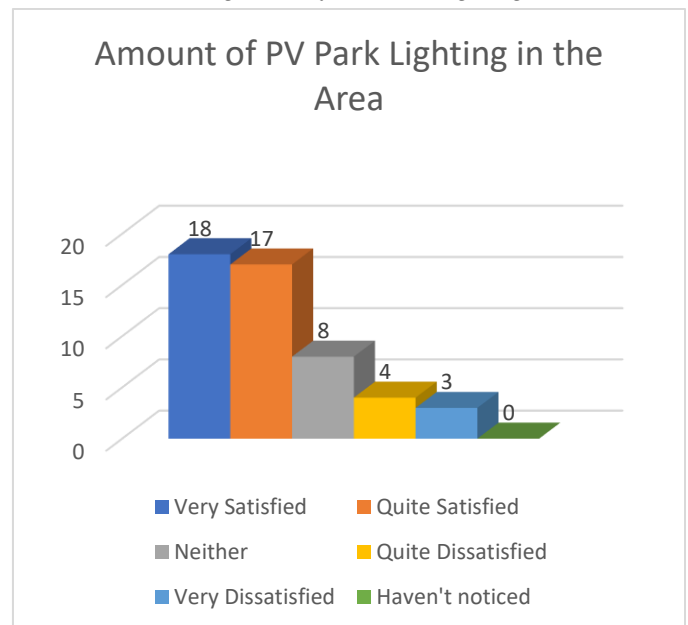


Fig. 10. The satisfaction on the amount of PV Park Lighting in the area

Seventy percent (70%) of the respondents expressed positive satisfaction on the number of installed PV Park Lighting in the area and dissatisfied were at fourteen percent

(14%) as shown in Figure 10. Results shows that there is a slightly need to install more of these in the area. Lastly, female respondents are more slightly satisfied on the number of installed PV Park Lighting in the area.

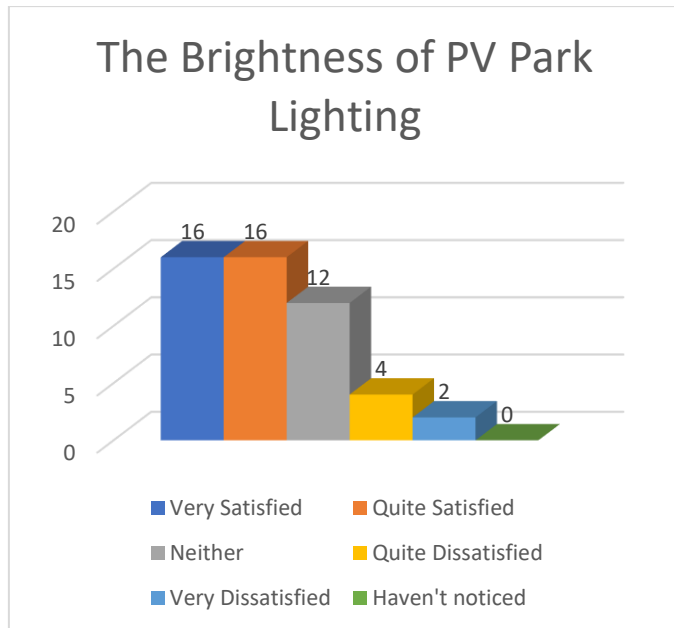


Fig. 11. The satisfaction on the brightness of PV Park Lighting

Sixty-four percent (64%) of the respondents expressed satisfaction in regards with the brightness of the PV Park Lighting and twelve percent (12%) were dissatisfied. There is a slight need to choose a better PV Park Lighting in terms of brightness it gives off as shown in Figure 11. Both Female and Male respondents showed an equal satisfaction and dissatisfaction in terms of brightness.

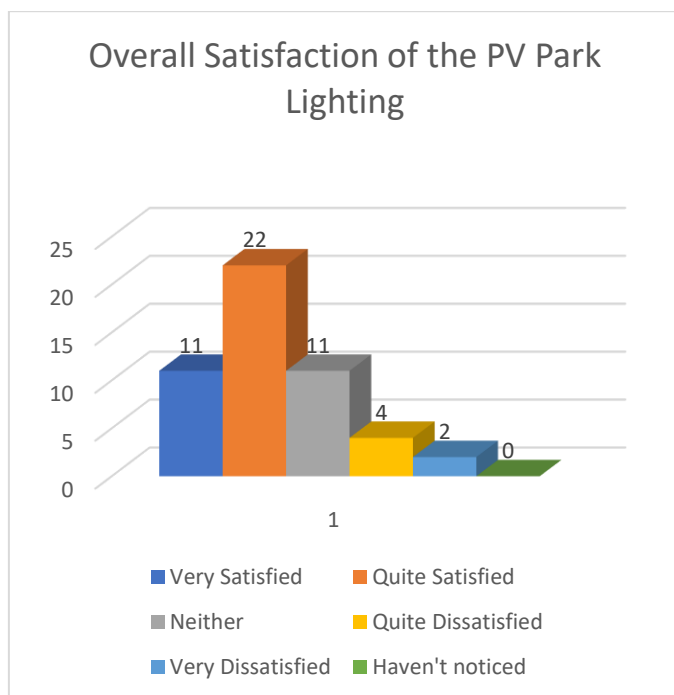


Fig. 12. The overall satisfaction of the PV Park Lighting

4.5 Overall Satisfaction of the PV Park Lighting

Regarding the overall satisfaction of the installed PV Park Lighting, sixty-six percent (66%) of the respondents expressed satisfaction and twelve percent (12%) were not satisfied. This shows that majority of the respondents were satisfied of the PV system. This means that installing more of these is acceptable on the locals and will cause harmful effects in the environment. Results shows that male respondents were slightly satisfied compared with the female respondents as shown in Figure 12.

V. CONCLUSION

Renewable energy is very important nowadays to mitigate the climate change. Using solar energy as a source of electricity in the Philippines is a good choice because of the high potential output of solar energy. This study will help local government officials in deciding whether to use PV system in government projects by checking the results of respondent’s satisfaction towards using PV Park Lighting at the Municipality of Sison, Surigao Del Norte, Philippines.

The main discoveries and conclusions are enumerated below

1. Majority of the respondents (88%) were satisfied with the quality of the PV Park Lighting
2. Majority of the respondents (86%) were satisfied with the aesthetics of the PV Park Lighting
3. Eighty-six percent (86%) of the respondents felt safer after the installation of PV Park Lighting
4. Ninety-eight percent (98%) of the respondents felt that it has a positive effect on the crime in the area.
5. Seventy percent (70%) of the respondents expressed positive satisfaction on the number of installed PV Park Lighting in the area
6. Sixty-four percent (64%) of the respondents expressed satisfaction in regards with the brightness of the PV Park Lighting
7. Sixty-six percent (66%) of the respondents expressed satisfaction regarding the overall satisfaction of the installed PV Park Lighting

Based on the results, the locals are satisfied on the installation of the PV Park Lighting System at the Municipality of Sison, Surigao Del Norte and will highly recommend the usage of the PV system in government projects.

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REFERENCES

[1] Faisal Faisal, Turgut Tursoy, Nil Günsel Resatoglu & Niyazi Berk (2018) Electricity consumption, economic growth, urbanisation and trade nexus: empirical evidence from Iceland, *Economic Research-Ekonomska Istraživanja*, 31:1, 664-680, DOI: 10.1080/1331677X.2018.1438907

[2] Athukorala, Ppa W. and Wilson, Clevo (2009) Estimating short and long-term residential demand for electricity: new evidence from Sri Lanka. *Energy Economics*. pp. 1-7.

- [3] Eia.gov (2015). China - International - Analysis - U.S. Energy Information Administration (EIA). Retrieved from <https://www.eia.gov/beta/international/analysis.php?iso=CHN>
- [4] Inquirer.net (2018). PH 5th worldwide, top in Asia in solar power. Retrieved from <https://business.inquirer.net/243407/ph-5th-worldwide-top-asia-solar-power>
- [5] CHED Memorandum Order No. 88 Series of 2017. Policies, Standards and Guidelines for the Bachelor of Science in Electrical Engineering (BSEE) Program Effective Academic Year (AY) 2018-2019. pp 18
- [6] Malicdem, Ervin. (2015). Optimal Tilt of Solar Panels in the Philippines. 10.13140/RG.2.2.19886.61764.
- [7] PSA.gov.ph (2018). Philippine economy grows by 6.8 percent in the first quarter of 2018. Retrieved from <http://www.psa.gov.ph/content/philippine-economy-grows-68-percent-first-quarter-2018>
- [8] Globalsolaratlas.info (2018). Photovoltaic Power Potential Philippines. Retrieved from <http://globalsolaratlas.info/downloads/philippines>
- [9] Worldpopulationreview.com (2018). Philippines Population 2018. Retrieved from <http://worldpopulationreview.com/countries/philippines-population/>
- [10] DOE.gov.ph (2018). PHILIPPINE ENERGY PLAN 2017-2040. Retrieved from <https://www.doe.gov.ph/pep>
- [11] PSA.gov.ph (2011). Percentage of Households by Type of Fuel Used, Philippines 2004 and 2011. Retrieved from <https://psa.gov.ph/sites/default/files/attachments/hsd/pressrelease/TABLE%201%20Percentage%20of%20Households%20by%20Type%20of%20Fuel%20Used%2C%20Philippines%202004%20and%202011.pdf>
- [12] DOE.gov.ph (2018). RENEWABLE ENERGY ROADMAP 2017-2040. Retrieved from <https://www.doe.gov.ph/pep/renewable-energy-roadmap-2017-2040>