Open Access Indonesia Journal of Social Sciences

Journal Homepage: https://journalsocialsciences.com/index.php/OAIJSS

Hybrid Solar Energy System as Alternative Power Supply in Mindanao State University-Sulu: Impact on Quality Services

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ARTICLE INFO

Keywords:
Hybrid Solar Energy System
Alternative Power Supply
Impact on Quality Service
Philippines

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The author has reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/oaijss.v4i2.63

ABSTRACT

To ascertain the hybrid solar energy system as alternative power supply in Mindanao State University-Sulu and its impact to quality service, This study aims to investigate the extent of benefits of hybrid solar power in terms of a) cost, b) availability, and c.)sustainability, moreover, it also investigate its preferability of hybrid solar power over traditional electricity, while it identifies the significant impact of Hybrid Solar power as a source of power supply to the quality of service of MSU-Sulu Administration, significant correlation between the preferability level and the impact of Hybrid Solar power. The quantitative data was analysed and interpreted using statistical tools weighted arithmetic mean and correlation and for qualitative data which is the interview, thematic analysis was utilized. The researcher was able to analyzed the gathered data through Mix Method for the preferability of hybrid solar power over traditional electricity and hybrid solar power its impact to quality service were obtained. The respondents of this study were the forty eight (48) teaching personnel and thirty eight (38) non-teaching personnel and an expert on solar panels. Purposive and random Sampling was used in the selection of the respondents. The instruments of the study were Guided Interview Questions and survey questionnaire. The qualitative data were obtained from the interview by the expert on solar panels. The quantitative data checklist questionnaire were obtained personally by the researcher and validated by three (3) Experts. The study revealed that the use of hybrid solar energy system as an alternative power supply has an impact to the quality service of Mindanao State University-Sulu, thus, both teaching and non-teaching personnel preferred the use of Hybrid solar energy system over traditional electricity. The extent of benefits of hybrid solar power in term costs is feasible for the costs of its installation will be treated as an investment for its 5 or more years of use of its naturally free electric power supply. In the long run, the Hybrid Solar energy will ensure a return of investment in its electric consumption. In terms of availability, it is guaranteed available by the partner company and in terms of its sustainability, it can support the entire university for 5 year's or more with quality solar equipment that it turns, the university will be able to provide quality service to its clientele. Hence, the following are the recommendations of the study. on research agenda, the school administrator should consider this study as beneficial to the school, the adaption of the Hybrid Solar Energy power to the electric supply of the Mindanao State University-Sulu, Quality service entails the need of uninterrupted power supply and this hybrid solar energy power is the solution, and Quality service rendered by both teaching and non-teaching personnel would be maximized with the help of this hybrid power energy system. On this note, the following are the recommended policy: School administrator must look into ways on the adaptation of the hybrid power energy system into the university, Rigorous planning and careful assessment on the applicability of hybrid solar energy power on each college as well as administrative offices, pioneered application among key services provider of the university like registrar and cashier's office, gradual use of hybrid Solar Energy power among colleges, mainly on the enrolment process to the releasing of grades, and School administrator should conduct a seminar to its constituents on the cognizance on the benefits of using solar power and raising an awareness on how to conserve Energy and use it in a proper way.

1. Introduction

It is observed that the supply of electricity in Sulu Province is insufficient; it has been noticed by sporadic brownouts. In this connection the researcher came up with an idea of alternative source of power supply of electricity in Mindanao State University- Sulu to address the said issue. It is the goal of the researcher to produce a clean and renewable energy to the school so that the university will produce a great service to the clientele.

According to Eng. Idowu Olugbenga Adewumi (2015), power supply from the national grid is insufficient and unreliable; hence, the need to provide alternative source of power is imperative that if the country is to be self-sufficient in power generation, transmission and distribution, the source of energy must be based largely on indigenous engineering initiative and researchers to design, adopt, develop and manufacture natural solar based renewable energy.

The researcher has an aspiration to conduct a study about Hybrid solar energy system (HSES) as a power supply to MSU-Sulu. HSES is a power system that combines solar power from photovoltaic system with another power generating energy source from Suleco. In this idea the school will produce quality service and generate clean and cheap electricity as well as it is beneficial to the environment. Based on the idea of AphaZee System (2018) emphasized that Solar power generation (SPG) has become one of the fastest growing renewable sources of electricity over other forms of electricity generation. SPG has several advantages, whether used at home, at business or at the municipal building; people are at a benefit of installing solar panels. Furthermore, solar energy may cut down the big electricity bills; thus, a huge amount of money can be saved. Joseph Kantenbacher and Rebekah Shirley stated in Sustainable Cities and Communities Design Handbook (2018) Hybrid Systems pairing renewable energy systems has the potential to improve economics or performance over what could be achieved by each system working in isolation.

2. Related Litrature

Development of Hybrid Solar System and its History

Solar technology isn't new. Its history spans from the 7th Century B.C. to today. We started out concentrating the sun's heat with glass and mirrors to light fires. Today, we have everything from solar-powered buildings to solar powered vehicles. (U.S Department of Energy, Energy Efficiency and Renewable Energy).The history of solar energy is old as man kind. Its history spans from the 7th century B.C, during the 19th century, several experiment with solar powered engine. In 1839, Alexander Edmund Becquerel, a French scientist first discovered the photovoltaic effect while experimenting with an electrolytic cell made up of two metal electrodes placed in an electricity-conducting solution, electricity increase when exposed to light. In 1921 Albert Einstein won the Novel Prize for his theories explaining on the effect of photoelectric. But the first solar cell, developed by Daryl M. Chapin, Calvin Fuller, and Gerald Pearson in 1954. They developed the silicon photovoltaic (PV) cell at Bell Laboratory- the first solar cell capable of converting enough of the suns energy into power to run everyday electrical equipment. Bell telephone laboratories produced a silicon cell with 4% efficiency and later achieved 11% efficiency. Only two years later, the first solar cells were used on the Vonguard I orbiting satellite. Since then the use of solar electricity is going on increasing year by year and some have been in continuous outdoor operation on Earth or in space for over 30 years.

Definition of Hybrid Solar Power and types of Solar Power System

ZeeShan Hyder (2019) Hybrid solar system combines the best from grid-tied and off-grid solar with utility backup power, or grid-tied solar with extra battery storage.

AlphaZee System (2018) The solar systems can be classified into 3 different categories based on their grid-connectivity. They are on-grid solar, off-grid solar and hybrid system which are combination of both. On grid solar power system is a solar power generation system where it is connected to the utility grid. The electricity produced by system is routed to the grid from where it is used to run the various appliances. The excess power at any point of time is transmitted back to the grid. An on-grid solar system is much more attractive than an off-grid system. In an on-grid solar system, the solar power is produced only when the grid is available. The power supply gets completely cut-off in case of the grid outage. Hence, one needs to depend on back-ups supply. The power shut down happens, mostly in case of

safety and technical reasons. One of the main types of solar power system is off-grid also known as a stand-alone power system (SAPS). It works by generating electricity from solar panels and and using it to charge a solar battery via charger controller. That electricity is then converted using an inverter so that it can power the home or business appliances. By saving the electricity in a solar battery, it is possible to run home with solar energy, even at night or during times when there is less sun exposure.

Systems that combine RE and traditional power generation such as diesel generators are called hybrid power systems. These systems use a wide variety of enabling technologies to overcome the difficulties associated with RE resource variability and allow RE generation to be smoothly integrated into diesel power systems. The possible configurations of hybrid systems are numerous owing to the wide variety of RE sources and existing enabling technologies. However, hybrid systems can generally be classified – based on the level of RE integration they can support – as low, medium or high penetration. The U.S. National Renewable Energy Lab (NREL) has developed definitions for low, medium and high penetration hybrid systems based on its experience with wind and diesel hybrid systems.

Components and Mechanism

Photovoltaic cells manufacturing develops the most abundant solid element on earth, Silicon, as raw material. Photovoltaic cells alone convert sunlight into one of the most highly priced energy forms. (Stobaugh and Yergin,1979). Components of solar panels consist of "dozens of small, square-shaped solar cells which can convert light directly into electricity. A typical solar cell uses semiconductors made from silicon. Absorption of photons is the function of semiconductors. Release of the atoms is the outcome of this absorption, and the flow of atoms thus facilitates electrical charge production. (Rutledge, N.D.) Bohn et al. (1986) found out that solar panels contain wafers which consist of silicon layer and a boron-layer. Silicon layer is regarded as positive and the boron layer on the other hand is regarded as negative. Solar cells on consequently have a positive and a negative side. Loosely clutched electrons can be found in a central region of the cell called the positive-negative junction. Excitation and motion of loosely held electrons generate direct current electricity as cell's surface was hit by sunlight.

This motion of electrons is the basis of direct current. "Direct current can be used as is, stored in batteries for later use or converted to alternating current for use in homes." (Adrian Fletcher, N.D.)

Solar Energy is radiant energy produced in the sun as a result of nuclear fusion reactions. It is transmitted to the earth through space by electromagnetic radiation in quanta of energy called photons, which interact with the earth atmosphere and surface.

Solar power is the technology of obtaining usable energy from the light of the Sun. Solar energy has been used in many traditional technologies for centuries, and has come into widespread use where other power supplies are absent, such as in remote locations and in space.

Availability of solar energy, There is no shortage of solar-derived energy on Earth. Indeed the storages and flows of energy on the planet are very large relative to human needs. The amount of solar energy intercepted by the Earth every minute is greater than the amount of energy the world uses in fossil fuels each year. Solar Radiation reaches the Earth's upper atmosphere at a rate of 1.37 kwatts per square meter (kW/m2). Tropical oceans absorb 560 trillion gigajoules (GJ) of solar energy each year, equivalent to 1,600 times the world's annual energy use. The strength of the solar energy available at any point on the earth is depends, in a complicated but predictable way, on the day of the year, the time of the day, the latitude of the collection point. Solar energy is currently used in a number of applications:

Heat (hot water building heat, cooking)

Electricity generation (Photovoltaic, heat engines)

Desalination of seawater.

PV System PV stands for photo (light) and voltaic (electricity), whereby sunlight photons free electrons from common silicon. The phenomenon was first discovered in the 18th century. The photovoltaic cells were developed at Bell Labs in 1950 primarily initially for space applications. Photovoltaic cells take advantage of the photovoltaic effect that occurs when a junction of two suitable materials, susch as metal and semiconductor or two opposite polarity semiconductors, is exposed to electromagnetic radiation. As solar radiation is absorbed by PV cell, electrons are mobilized at the negative contact, and if a suitable circuit is made to positive contact, an electrical current is generated. Several cells connected together and encapsulated for protection form a PV module. PV modules are available in variety of power outputs, typically rated from 20 to 160W, though the exact power output varies directly with the intensity of solar radiation. PV modules produce electricity in direct (DC) format, so if alternating current (AC) electricity is required, the output must be converted with an inverter. Set of Solar Modules Crystalline cell modules with 36 cells are basically used with charge controller. PV Modules

Typical Solar System Components: PV Module, Hybrid inverter, Solar Controller, Battery, Load, Switches and wires.

Typical Solar System Components Battery

The battery that is most often used in solar home systems is a lead-acid battery of the type used in automobiles, sized to operate for up to three cloudy days. Automotive batteries are often used because they are relatively inexpensive and available locally.

Ideally, solar home systems should use deep-cycle lead-acid batteries, which have thicker plates and more electrolyte reserves than automotive batteries and allow for deep discharge without seriously reducing the life of or damaging the battery.

In a well-designed solar home system, such batteries can last over five years. However, deep-cycle

The charge and load controller prevents system overload or overcharging. Photovoltaic systems are already used in a broad array of rural energy applications. They provide households and small businesses with services such as lighting, refrigeration, and entertainment; they are used to pump water for agricultural purposes; to deliver public services, including health care, water purification, and street lighting and to power remote telecommunications facilities.

Economic and environmental advantages

Advantage of Solar Hybrid System it stores solar low cost electricity it also allow use of solar energy during peak time. In time of brown out power is still available, in addition to that it reduces power consumption from grid. (Alphazee System)

Whenever we choose solar energy power system, we consider only two options. First is on-grid and second is off-grid solar energy system. Both these systems are helpful to you in times when you have ample of sunlight. As soon as the sun is less bright, in night or in rainy seasons, these systems are not helpful and you will need other energy options.

The solution to this problem is the hybrid solar energy systems. Generally, the hybrid solar systems are the systems combining two renewable sources of energy, like solar and wind. Then, energy is generated through solar on sunny days and when there is limited sunshine but there is wind, energy can be generated through it. However, recently hybrid solar energy systems have changed their configuration. Now, they are often solar energy systems connected to batteries to store the energy that was generated. (add me here types of other type of HSES)

Advantages of Solar Power

The 89 petawatts of sunlight reaching the earth's surface is plentiful compared to the 15 terawatts of average power consumed by humans. Additionally, solar electric generation has the highest power density (global mean of 170 W/m2) among renewable energies.

Solar power is pollution free during use. Production end wastes and emissions are manageable using existing pollution controls.

Facilities can operate with little maintenance or intervention after initial setup.

Solar electric generation is economically competitive where grid connection or fuel transport is difficult, costly or impossible. Examples include satellites, island communities, remote locations and ocean vessels.

When grid connected, solar electric generation can displace the highest cost electricity during times of peak demand (in most climatic regions), can reduce grid loading, and can eliminate the need for local battery power for use in times of darkness and high local demand; such application is encouraged by net metering. Time-of-use net metering can be highly favorable to small photovoltaic systems.

Grid connected solar electricity can be used locally thus minimizing transmission/distribution losses (approximately 7.2%).

Once the initial capital cost of building a solar power plant has been spent, operating costs are low when compared to existing power technologies.

Solar electricity is expensive compared to grid electricity.

Disadvantages of Solar Power

Limited power density: Average daily insolation in the contiguous U.S. is 3-9 kW·h/m2 usable by 7-17.7% efficient solar**,** panels. in Sri Lanka 5.5 kW.h/m2/day**.**

To get enough energy for larger applications, a large number of photovoltaic cells is needed. This increases the cost of the technology**,** and requires a large plot of land.

Like electricity from nuclear or fossil fuel plants, it can only realistically be used to power transport vehicles by converting light energy into another form of stored energy (e.g. battery stored electricity or by electrolyzing water to produce hydrogen) suitable for transport.

Solar cells produce DC which must be converted to AC when used in currently existing distribution grids. This incurs an energy loss of 4-12%. PV systems are safer, environment friendly and more convenient than kerosene lanterns and dry cell or automotive batteries which are widely used in developing countries for lighting and to power small appliances.

The Cost of Installing a Solar Panel System

According to Solar Power Authority, by 2016, a solar panel system will cost you around $7-$9 per watt produced, including installation costs. Some utility companies offer discounts and incentives up to 50%, meaning a 10kw system will cost around $50,000-$75,000 including discounts.

In Botswana, REFAD conducted a careful evaluation of the government's 40-home photovoltaic (PV) pilot project.The evaluation showed that the introduction of solar technology to this rural village had a decided positive impact on microeconomic development, health improvements, and school performance—each of which plays an important role in ensuring continued sustainability in rural villages. When you talk with the beneficiaries of these solar projects, you cannot help but be impressed by how much these initiatives are needed by those of us who labor at the grass-roots level in developing countries.Renewable Energy in Rural Schools" is an inexpensive, yet comprehensive reference source for all local NGOs and schools that are seeking technical guidance for the integration of renewables as a part of the physical and instructional aspects of their schools.(Leonard H.O.Spearman, Ph.D, Chair, Renewable Energy for African Development Distinguished Professor, Coppin State College (add prizes in the Phil).

Factors impact to Quality Service

Work has been done to understand the relationship between work environment and job satisfaction all around the world in different

contexts over the years. The study is gaining more and more importance with the passage of time because of its nature and impact on the society. The findings of a Danish study suggest that a firm can increase its productivity through the improvement of physical dimensions of work environment (internal climate) and may have a positive impact on firms' productivity (Buhai, Cottini, & Nielseny, 2008).

Bakotic & Babic (2013) found that for the workers who work under difficult working conditions, working condition is an important factor for job satisfaction, so workers under difficult working conditions are dissatisfied through this factor. To improve satisfaction of employees working under difficult working conditions, it is necessary for the management to improve the working conditions. This will make them equally satisfied with those who work under normal working condition and in return overall performance will increase.

According to the research entitled Impact of Working Environment on Job Satisfaction by Abdul Raziqa, Raheela Maulabakhsha (2014), working environment has a positive impact on the Job satisfaction of employees. Bad working conditions restrict employees to portray their capabilities and attain full potential, so it is imperative that the businesses realize the importance of good working environment.

3. Rationale and Purpose

This study is designed to achieve the following objectives:

To investigate the extent benefits of hybrid solar power in terms of cost, availability and sustainability

To discuss the extent of preferability of hybrid solar power over traditional electricity.

To find out if there is a significant impact of Hybrid Solar power as a source of power supply to the quality of service of MSU-Sulu Administration.

To determine the correlation between the preferability level and the impact of Hybrid Solar power

4. Research Questions

The supply of electricity in Sulu Province is insufficient; it has been observed by occasional brownouts; thus the concern of the researcher is mainly to give alternative solution to the issue on the power supply of Mindanao State University Sulu in order to provide, without interruption, quality service to its clientele. Hence, the researcher seeks to answer the following inquiries:

What is the extent of benefits of hybrid solar power in terms of, cost, availability and sustainability.

What is the extent of preferability of hybrid solar power over traditional electricity?

Is there a significant impact of Hybrid Solar power as a source of power supply to the quality of service of MSU-Sulu Administration?

Is there significant correlation between the preferability level and the impact of Hybrid Solar power?

5. Methodology

Research Design

In this study, the researcher used Mix Method. Thematic analysis was used for the qualitative data. Georgi (1985) defined thematic analysis as synthesis of transformated meaning units into a consistent statement of the structure of the experience. In addition, Van Manen (1990) infers that it is a decribing emperical activities using human sciences method. On the other hand, in quantitive, she data used Descriptive Survey Method. Descriptive research is a study designed to depict the participants in an acurate way in the quantitative research design data was gathered using checklist questionnaire.

Research Locale

This study was conducted at Mindanao State University-Sulu, Capitol Site, Jolo Sulu. The said university comprised of 7 colleges with junior and senior high school department.

Respondents of the Study

The respondents of this study were the forty eight (48) teaching personnel, thirty eight (38) non-teaching personnel and 1 technician of A.M Sulu Solar panel store situated within Jolo, Sulu. The respondents were obtained by using the 30% of the total population of the teaching personnel and non-teaching personnel as recommended by the statistician.

Research Instrument

Guided Interview Questions was utilized as an instrument for the qualitative data of this study. It permits a researcher to obtain important data by a purposeful interaction. Simultaneously, it allows for more individualized responses since so many different kinds of responses are received. Moreover, Survey Questionnaire was used as a tool in gathering quantitative data. The said questionnaire was guided by the objectives and goals of the study. It is composed of two parts for teaching personnel and non-teaching personnel. The latter is close-ended statement with which the respondents must check their level of agreement complement with various statements about the preferability of Hybrid Solar Power over Traditional Electricity and Impact of Hybrid Solar Power to the quality service of the teaching and non-teaching personnel. Close-ended questions were convenient to use, score and code for analysis on a computer, since all subjects respond to the same opinions, standardized data are provided. The ratio scales were classified as (5) strongly agree, (4) agree, (3) moderately agree, (2) disagree, (1) strongly disagree as a verbal description.

The researcher submitted the first draft of questionnaire to the three expert professors at the Graduate School for corrections and suggestions.

Sampling Procedure

In this study purposive and random Sampling was used Purposive Sampling is a process of selecting cases that are likely to be "information-rich" with respect to the purposes of the qualitative research study while random Sampling refer to the method were all population is given fair chance of selection to be included as the study subjects. It ensures freedom form bias and partiality.

Statistical Treatment

The obtained data from the responses in the questionnaire were tallied accordingly, tabulated and treated using spss or statistical program in social sciences. The statistical tools used for computation were weighted arithmetic mean and correlation. The raw qualitative data was analyzed through thematic analysis and synthesis.

Data Gathering Procedures

The researcher secured an approval letter from the researcher's adviser and the Dean of the Graduate School. Upon approval, the researcher sent the letter and explained the informed consent process. Afterwards, the researcher administered her guided question interview to the solar power panel store personally here in Sulu. The checklist questionnaire was launched to the different colleges and offices at Mindanao State University- Sulu.

6. Result

This chapter presents the findings of benefits of hybrid solar power in terms of (1) cost, availability, and sustainability, (2) the preferability of hybrid solar power over traditional electricity, (3) impact of Hybrid Solar power as a source of power supply to the quality of service of MSU-Sulu Administration, and (4) the significant correlation between the preferability level and the impact of Hybrid Solar power. The interpretation in the textual presentation is hereby made after the data analysis has been done using the prescribed statistical tools. Tables are also drawn to help present the table.

Interview with the Local Solar Panel Installer Expert about the Benefits of hybrid solar power in terms of cost, availability, and sustainability.

Cost

The question raised to the respondent,"Is installation of hybrid solar power expensive? Kindly elaborate."

The Interviewee answered: "In the installation process, we should base it upon the afforded number of capacity of the buyer. How many wattage it will take to use electronics like that of TV, electric fan etc. we will compute the installation fee based upon all the mentioned."

He furthermore explained, "In the installation fee, it will depend upon the panel's capacity like in metro manila, they most likely to have 200watts per 15 pesos. If we talk about the province of Sulu, it will cost P20-P30 per wattage. That is their computation standard due to distance and life risk that is why they set it higher"

Moreover, based on the interview conducted to A.M Solar Sulu, the interviewee stated that in the case of MSU-Sulu, the amount of materials including the installation fee and the maintenance, ranging from 250,000 to 500,000 pesos considering the amount of loads, in one college or building like the cashier and registrar office.

The researcher posed another inquiry on how many days will be spent in installing the hybrid solar power?

He replied, "I can say that it depends upon the installation team you will hire. In our case, we do it within a day. We've been able to do it from 9'oclock am to 3pm. like what we did in Panamao, we installed 130 thousand panels for just a day. As I say, it all depends upon the installation team's industriousness and diligence to do the work."

As for the saving of money in using hybrid solar electricity?

things. All electronics have their limits. In our case, whenever we have interested client, we see to it that we give orientation of the overall usage of the said material. For instance, if a certain electronics functions for 130 watts for ascertain amount of time like 3 hours, and a client uses it more than what it is installed for, it will cause the damage to some of it part. And the client cannot expect us to just listen to their explanation. The number will tell if it really exceeds. The electronic will not be damage if it does not go beyond its limitation. It is really a matter of discipline usage. A thing will be used for a long period of time if we observe its limitation. The company produces such product sets its limitation of use. A service technician will be train to be able to handle the product for a long period of time. Just like us, we are train on its utilization."

Cost has been the primary concern of every consumer before utilizing the product or services. SPES is costly in terms of installation and getting the necessary materials but, if you see it as an investment for its long term use and guaranteed outcome, it could be a worthwhile endeavour.

Interview with MSU School Administration

The researcher asked question to respondent number 3 about the Electricity bills of the school, and she replied,

"actually the amount of it, is not constant it will always depend on our consumption and if we can pay it on time, we would not pay anymore for the arrears, so far for the month of april we pay it on time and it is lesser from the other month, our bill for this month is 147,440.47 pesos." The researcher followed up her question, ma'am do we have separated meter according to department or we just have one meter as a whole, the respondent number 3 replied" the breakdown of the bills are the following:

MSU- Nursing	*7,939.40*
Lab-high	*2,822.77*
I.T	*6,633.72*
MSU Admin	*58.093.67*
Econ Building	*6,976.45*
Water pump	*727.77*
MSU	*64,246.69*

Electric consumption has been one of the paramount expenses of every organization and it is the lifeblood of the organizational effectivity and efficiency, to take some actions into maximizing its use while saving is a big step in the life long services of the organization.

For instance, for the MSU admin, Php58,093.63 is its monthly electric bills and per annum is equal to Php697,123.56, and if the university happened to have this hybrid solar panel , the university would still need to pay both the common electric consumption as well as the maintenance of the panels. Therefore, if the panels has been used, a year expenses of Php697,123.56 would be divided by two, for it only has to pay half of it to the electric distributer. Php348, 561.78 would now be the cost of electric consumption per annum of the university. Taking into account the minimum life span 5years of these solar panels, the amount of Php348, 561.78 multiplied by 5 years would result to 1,742, 808.9 as the saving of the university.

Availability

In an interview with the expert with the expert regarding the availability of the hybrid solar power, he answered positively.

He said, "Yes." The materials are available and I'm happy to say that we have complete materials at hand. As a matter of fact, we have the 3 types of inverter which are the on grid tie inverter, off grid inverter, and hybrid type inverter. The hybrid type of inverter is the fusion of on grid tie inverter and off grid inverter. We can produce rellings here in Sulu."

The researcher earnestly inquired another question, pertaining to service for the installation of HSP in the province.

He promptly responded, *"We have undergone series of trainings in Manila, and yes, the experts themselves were present in the installation process. We are available anytime when our customers need our service."*

Solar panels availability attracts consumer. There is availability of materials as well as the man power for its installation and maintenance made this study feasible to the university.

Sustainability

The researcher raised a question in terms of sustainability," how many years will it will last and, in case it needs to undergo repair, will human and material resources be still available?"

The interviewee humbly responded, *"In case of malfunction of the inverter, there is no automatic replacement for it will costs us more than its price and we will wait for 3-4 months from the company's technician to do it. The inverter will be sent to them because there is no such technician within our area. So we must be careful in using it and always avoid overloading the panels. If it just fuse, it is easy for us to replace it but it is different if we talk about the inverter. in our store, after the orientation on the responsibility of using it on the user's end, we as the provider on the other hand, gives 5 months warranty so long the user comply its responsibility. If it happened to be the materials malfunction we replace it so long that it is within the 5 month's warranty period. "*

The researcher added "Is there a written contract sir on that part of agreement?

He amptly responds "Yes. The receipt we provide will act as a contract on the said matter. 5 months warranty period and one year service of our technician."

In addition, the researcher inquired on what are the possible impacts of using hybrid solar energy system to our institution (MSU-Sulu) in connection to the following:

working environment of the employee and b. quality service of the employee.

The interviewee answered, "If we talk about the installation, we are practicing the minimum standards abide by the rules implemented in the instalment process of our product. Improper installation causes side effects. For example, the incompatible battery and panel, it will cause the battery to balloon as it exert effort and it will most likely to overcharge. It results to low battery storage that is why when it is used at night it will just produce dim light, the mechanism inside the battery is already damage .that it why we really highlight the

importance of using controller with exact wiring and proper computation for safe installation"

He added his statement, "Lack of controller causes the battery to overcharge to some extend it will moist like the common practice in our province of using jeep's battery on their solar panel consumption."

The last question raised by the researcher were, what are the benefits of hybrid solar energy system? If we are using it in our university, and how can this hybrid solar power can help to save the environment?

He responded "*There are a number of benefits you can derive from hybrid solar energy system. Foremost, you will not be bothered by the power interruption in doing your work. The costs will lessen like paying the electric bill will not cost you too much. You can make use of electronics anytime, everyday. You can use electric fan, watch TV, etc. "while he added, "The process goes like this, electronic appliances consumes 220voltage, the solar inverter will automatically dispose 220 voltage it needs.it is automatic, in the sense that it gives off only what is needed. It works through the power source output where it is place, like here in the Philippines, we are able to produce automation on the matter. "*

Before an organization partake an endeavour, there is an inevitable question on its sustainability. Foremost, hybrid Solar Energy power ensures minimum 5 years of lifespan, thus, it can be used for more than 5 years all depends on the usage of the consumer. With this, power interruption will be lessened and electric expenses will be lessened. So, we can safely assume that it can provide the university with uninterrupted power supply for it to serve its clientele on work hours with smooth transaction and there will be no unfinished workloads and MSU-Sulu can now provide a good and quality service to its clientele. Henceforth, The University may depend on solar power energy simultaneously with the traditional used of electricity.

Preferability of Hybrid Solar Power over Traditional Electricity

This section contains the preferability of Hybrid Solar Power over Traditional Electricity. Teaching personnel and non-teaching personnel were the respondents of whom 38 were non-teaching and 48 were teaching personnel They received 15 item-questionnaire by which they could rate such preferability using 5.0 rating scale. Table 4.2 depicts the means of preferability.

Table 1. Preferability of Hybrid Solar Power over Traditional Electricity among Teaching Personnel.

	Mean	Description
1. Solar energy provided by the solar panels is considered as the cleanest energy.	4.14	Agree
2. Solar energy does not produce any harmful substances to the environment.	4.19	Agree
3. Solar energy does not produce hazardous waste to the environment.	4.02	Agree
4. Solar energy does not produce noise and air pollution.	4.31	Agree
5. Solar energy produces no greenhouse gases.	4.31	Agree
6. Solar energy does not release heat that could contribute to global warming.	4.14	Agree
7. Using solar energy helps us aware on how to save Mother Earth.	4.31	Agree
8. Using solar energy can reduce the amount of pollutants and chemicals being emitted into the atmosphere.	4.40	Agree
9. Hybrid Solar power installation is less expensive than expenses of annual bills from Traditional Electricity.	4.40	Agree
10. Hybrid Solar power is less expensive than traditional electricity.	4.29	Agree
11. Hybrid Solar power provides unlimited supply of solar energy.	3.90	Agree
12. Hybrid Solar power collects energy during day time and stored in batteries for future use.	4.21	Agree
13. Electricity from hybrid solar power is free.	4.14	Agree
14. By using solar power, school and business expenditure on electricity will be reduce.	4.36	Agree
15. Solar energy helps reliance on fossil fuels.	4.17	Agree
Grand mean	4.22	Agree

Legend: 5- 4.50-5.00= Strongly Agree, 4- 3.50-4.49=Agree, 3- 2.50-3.49= Moderately Agree, 2- 1.50-2.49= Disagree;and 1-1.00-1.49=Strongly Disagree

Table 2. Preferability of Hybrid Solar Power over Traditional Electricity among non-teaching Personnel

	Mean	Description
1. Solar energy provides by the solar panels considered as the cleanest energy.	4.18	Agree
2. Solar energy does not produce any harmful substances to the environment.	4.08	Agree
3. Solar energy does not produce hazardous waste to the environment.	4.08	Agree
4. Solar energy does not produce noise and air pollution.	4.32	Agree
5. Solar energy produces no greenhouse gases.	4.29	Agree
6. Solar energy does not release heat that could contribute to global warming.	4.34	Agree
7. Using solar energy helps us aware on how to save Mother Earth.	4.29	Agree
8. Using solar energy can reduce the amount of pollutants and chemicals being emitted into the atmosphere.	4.11	Agree
9. Hybrid Solar power installation is less expensive than expenses of annual bills from Traditional Electricity.	4.21	Agree
10. Hybrid Solar power is less expensive than traditional electricity.	4.16	Agree
11. Hybrid Solar power provides unlimited supply of solar energy.	4.21	Agree
12. Hybrid Solar power collects energy during day time and stored in batteries for future use.	4.13	Agree
13. Electricity from hybrid solar power is free.	4.11	Agree
14. By using solar power, school and business expenditure on electricity will be reduce.	4.05	Agree
15. Solar energy helps reliance on fossil fuels.	4.13	Agree
Grand mean	4.18	Agree

Legend: 5- 4.50-5.00= Strongly Agree, 4- 3.50-4.49=Agree, 3- 2.50-3.49= Moderately Agree, 2- 1.50-2.49= Disagree;and 1-1.00-1.49=Strongly Disagree

Table 1 and 2 show the preferability of Hybrid Solar Power over Traditional Electricity among teaching and non-teaching personnel. They have agreed that solar energy being the cleanest form of energy produces no greenhouse gases and helps reliance on fossil fuels. It does not produce any harmful substances or any hazardous waste to the environment, it does not produce noise and air pollution; and it does not release heat that could contribute to global warming, Moreover, Using solar energy promotes awareness that could save Mother Earth, and it can reduce the amount of pollutants and chemicals being emitted into the atmosphere by school and business expenditures and ultimately reduces electricity consumption.

On the other hand, Hybrid Solar power installation can save a lot of money, for it is quite cheap rather than the traditional electricity usage. It provides unlimited supply of solar energy that have been collected during day time and stored in batteries for future use. It goes to say a naturally free electricity usage.

All in all, the respondents agreed that they prefer to use Hybrid Solar Electricity over traditional electricity usage.

Impact of Hybrid Solar Power

One of the inquiries is regarding how the Hybrid Solar Power impact to the quality service of MSU-Sulu administration, Table 3 and Table 4 depicts the results based on the perceptions of teaching personnel and non-teaching personnel, respectively,

Table 3. Impact of Hybrid Solar Power as a Source of Power Supply to the Quality of service of MSU-Sulu Administration Teaching Personnel

Indicator	Mean	Description
1. Teacher can use their instructional support like power point presentation.	4.45	Agree
2. Teacher can print anytime of their learning materials.	4.50	Strongly agree
3. Teacher can review their lesson through computer anytime.	4.29	Agree
4. Working environment will be more convenient like the use of electric fan/aircon.	4.52	Strongly Agree
5. Teachers can be more updated with new trends of education.	4.19	Agree
6.Teachers can download anytime of their teaching materials	4.00	Agree
7. Teacher can do work here in school due to the availability of electricity.	4.50	Strongly Agree
8. Teachers will be more enthusiastic to work.	4.19	Agree
9. Seminars online will be available for teachers because of no electricity interruption.	4.29	Agree
10.There will be no problem to encounter in relation to the services of technology that uses electricity like computers, aircon, projectors, electric fans, television and etc.	4.12	Agree
Grand mean	4.30	Agree

Legend: 5- 4.50-5.00= Strongly Agree, 4- 3.50-4.49=Agree, 3- 2.50-3.49= Moderately Agree, 2- 1.50-2.49=Disagree; and 1-1.00-1.49=Strongly Disagree

The respondents strongly agree that the working environment will be more convenient like the use of electric fan/aircon, teachers can print anytime their learning materials simultaneously working in school. Moreover, the respondents agree that teacher can use their instructional aid like power point presentation and review their lesson in the computer anytime. Online Seminars will be available and convenient for teachers because of no electricity interruption. Teachers will be motivated and enthusiastic to work while being updated with new trends of education and able to download anytime their instructional materials. There will be no problem to encounter in relation to the services of technology that uses electricity like computers, aircon, projectors, electric fans, television and etc.

Table 4. Impact of Hybrid Solar Power as a Source of Power Supply to the Quality of Service in MSU-Administration as Perceived by non- Teaching Personnel

	Mean	Description
1. There will be no unfinished workloads.	4.11	Agree
2. Students will no longer wait for electricity to return.	4.39	Agree
3. Clientele can be served anytime.	3.92	Agree
4. There will be no delayed request.	3.87	Agree
5. Technology will easily be updated because of no electricity intervention.	4.03	Agree
6. Employee will become more productive.	4.21	Agree
7. Employee will be more enthusiastic to work.	4.00	Agree
8. We can directly connect to the outside world and can be connected anytime.	3.89	Agree
9. Employee can upgrade themselves through the help of online zoom seminars.	4.03	Agree
10. Service of technology that uses electricity like computers and aircon	4.00	Agree
Grand mean	4.045	Agree

Legend: 5- 4.50-5.00= Strongly Agree, 4- 3.50-4.49=Agree, 3- 2.50-3.49= Moderately Agree, 2- 1.50-2.49= Disagree;and 1-1.00-1.49=Strongly Disagree

Table 4. shows the impact of non- teaching Personnel's preferability of Hybrid Solar Power over Traditional Electricity of. The respondents agree that it will save time and students will no longer wait for

electricity to return. Employee will be more productive and there will be no unfinished workloads. Technology automation will be convenient due to no electricity interruption while this could promote professional growth among employees that they enhance their skills through the help of online zoom seminars, employees will more likely be motivated to work when there is less interruption while they are working. The school will undoubtedly be able to serve its constituents anytime during working hours. We would be updated on the trends of technology as well as automations saves time by processing requests for a short period of time.

Finally, the findings show that the respondents agreed on all the impacts of Hybrid Solar Power as a source of Power supply to the quality of service in MSU- Administration to both Teaching and Non-Teaching Personnel.

Correlation

Table 5. Correlation between the Preferability Level of Teaching Personnel and the Impact of Hybrid Solar Power

		Impact of Hybrid Solar power	**Ho Decision**
Level of preferability of teaching personnel	Pearson Correlation	.504	Accept
	Sig. (2-tailed)	.001	
	N	48	

Table 5. shows the computation using correlation. The Pearson correlation coefficient is 0.504 with sig. Value (two-tailed) of 0.001 is lesser than the alpha level of 0.05. Thus, the data suggests that the null hypothesis is rejected. The evidence indicates that there is significant correlation between the preferability level of teaching personnel and the impact of hybrid solar power.

Table 6. Correlation between the Preferability Level of Non-Teaching Personnel and the Impact of Hybrid Solar Power

		Impact of Hybrid Solar power	**Ho Decision**
Level of preferability of non- teaching personnel	Pearson Correlation	.451	Accept
	Sig. (2-tailed)	.004	
	N	38	

Table 6 shows the computation using correlation. The Pearson correlation coefficient is 0.451 with sig. Value (two-tailed) of 0.004 is lesser than the alpha level of 0.05. Thus, the data suggests that the null hypothesis is rejected. The evidence indicates that there is significant correlation between the preferability level of non-teaching personnel and the impact of hybrid solar power.

7. Discussions

This study aimed to investigate the Hybrid Solar energy system as alternative power supply in Mindanao State University-Sulu and its impact to quality service, It explore further the extent of benefits of hybrid solar power in terms of a) cost, b) availability and c) sustainability, moreover, it also investigate its preferability of hybrid solar power over traditional electricity, while it identifies the significant impact of Hybrid Solar power as a source of power supply to the quality of service of MSU-Sulu Administration, significant correlation between the preferability level and the impact of Hybrid Solar power.

Mix Method was used as the research design. The respondent of this study were the fourth eight (48) teaching personnel and thirty eight (38) non-

teaching personnel and an expert on solar panels. Purposive and Random Sampling was used in the selection of the respondents. The instruments of the study were Guided Interview Questions and survey questionnaire. The qualitative data were obtained from the interview by the expert of solar panels. The quantitative data for the preferability of hybrid solar power over traditional electricity and hybrid solar power its impact to quality service were obtained from both teaching and non-teaching personnel. The raw quantitative data was analysed and interpreted using statistical tools weighted arithmetic mean and correlation and for qualitative data which is the interview, thematic analysis was utilized. Checklist questionnaire were obtained by the researcher personally and validated by three (3) experts.

In light of the analysis and interpretation, the data collected revealed the following findings: On the preferability of Hybrid Solar Power over Traditional Electricity among teaching and non-teaching personnel, It was found out that this study raises environmental awareness among workers for no hazardous waste or any kind of harmful substances be emitted to the environment as well as no noise or air pollution produces to the atmosphere. Solar energy promotes the use of the cleanest form of energy which helps rely on fossil fuels with no greenhouse gases being produce. Ultimately, the reduce electricity consumption by traditional method may saves both the earth and the university expenses. Hybrid Solar power provides unlimited supply of solar energy, that is, a naturally free electricity usage.

On its impact of Hybrid Solar Power over Traditional Electricity, convenience while working will be realized because of uninterrupted power supply. Smooth transaction will be guaranteed. Teaching personnel will be more productive in using electronics in its entire endeavor, while non-teaching Personnel will provide technology automation in its daily transaction on processing requests for a short period of time.

All in all, the respondents agreed that they prefer to use Hybrid Solar Electricity over traditional electricity usage. Correspondingly, agreed on all the impacts of Hybrid Solar Power as a source of Power supply to the quality of service in MSU-Administration to both teaching and non-teaching personnel. In addition, there is significant correlation between the preferability level of teaching personnel and Non- Teaching Personnel and the impact of hybrid solar power.

8. Conclusion

The evidence provided conclude that, the use of hybrid solar energy system as an alternative power supply has an impact to the quality service of Mindanao State University-Sulu, thus, both teaching and non-teaching personnel preferred the use of Hybrid solar energy system over traditional electricity.

The extent of benefits of hybrid solar power in term costs is feasible for the costs of its installation will be treated as an investment for its 5 or more years of use of its naturally free electric power supply. In the long run, the Hybrid Solar energy will ensure a return of investment in its electric consumption. In terms of availability, it is guaranteed available by the partner company and in terms of its sustainability, it can support the entire university for 5 year or more with quality solar equipment that it turns, the university will be able to provide quality service to its clientele.

9. Recommendation

School administrator should consider this study as beneficial to the school.

Adaption of the Hybrid Solar Energy power to the electric supply of the Mindanao State University-Sulu.

Quality service entails the need of uninterrupted power supply and this hybrid Solar Energy power is the solution.

Quality service rendered by both teaching and non-teaching personnel would be maximized with the help of this hybrid power energy system.

School administrator must look into ways on the adaptation of the hybrid power energy system into the university.

Rigorous planning and careful assessment on the applicability of this hybrid solar energy power on each college as well as administrative offices.

Pioneered application among key services provider of the university like that of registrar and cashier office.

Gradual use of hybrid Solar Energy power among colleges, mainly on the enrolment process to the releasing of grades.

School administrator should conduct a seminar to its constituent on cognizance on the benefits of using solar power and raising awareness on how to conserve Energy and use it in a proper way.

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