CHAPTER 1

INTRODUCTION

Access to reliable and sustainable electricity is essential for the development and well-being of any community. However, many remote tribal colonies in rural areas often face significant challenges in accessing a reliable grid-based power supply. The tribal colonies of Kuttampuzha Grama Panchayat are no exception to this predicament. In an effort to address this issue and improve the quality of life in these tribal colonies, the installation of a microgrid solar PV system in the community center has been proposed. This project aims to harness the abundant solar energy available in the region and utilize it to power the community center, a vital hub for various social and developmental activities.The proposed microgrid solar PV system consists of a 1.5 KVA PCU, two 335-watt solar panels, and a 24V 80Ah battery. This combination of components has been carefully chosen to ensure optimal power generation, storage, and distribution within the community center. By installing this solar PV system, the tribal colonies of Kuttampuzha Grama Panchayat can overcome the challenges associated with unreliable grid-based electricity. The solar panels will capture sunlight and convert it into usable electricity, providing a sustainable and clean energy source. The excess energy generated will be stored in the battery, ensuring a continuous power supply even during periods of low or no sunlight. The benefits of implementing this project are numerous. Firstly, it will provide a reliable and uninterrupted power supply to the community center, enabling various activities such as educational programs, healthcare services, and social gatherings.Moreover, the use of solar energy will reduce the dependence on fossil fuels, mitigating the environmental impact and promoting sustainable practices. The project will create awareness among the tribal communities about the potential of renewable energy sources, encouraging their active participation in sustainable development initiatives.Furthermore, this project has the potential to serve as a model for similar endeavors in other tribal colonies and rural areas. By demonstrating the viability and benefits of solar PV systems, it can inspire and catalyze the adoption of renewable energy solutions, leading to a broader energy transition in remote and underserved regions.

CHAPTER 2

COMPONENTS USED IN SOLAR POWER PLANT

1. 330W SOLAR PANEL

Fig 2.1 Solar Panel

A monocrystalline 330W solar panel is a highly efficient and visually appealing photovoltaic panel. It is constructed using monocrystalline silicon cells, which are derived from a single crystal structure, resulting in a uniform appearance with a sleek black color. With an efficiency rating of around 18% to 20%, these panels can convert a significant portion of sunlight into usable electrical power. Their space efficiency is notable, as they can generate more electricity per unit area compared to other panel types, making them ideal for installations with limited space. Monocrystalline panels are known for their durability and longevity, capable of withstanding harsh weather conditions for over 25 years. Their aesthetic appeal, with a sleek and consistent look, makes them a popular choice for residential and commercial installations. Additionally, monocrystalline panels perform well in low-light conditions, allowing them to generate electricity even during cloudy weather or partially shaded areas. Overall, a monocrystalline 330W solar panel offers high efficiency, durability, and an appealing appearance, making it an excellent choice for solar energy applications.

2. 1.5 KVA 24V 80AH 330W PCU

Fig 2.2 PCU

A PCU (Power Conditioning Unit) is an essential component of a solar PV system that helps manage the power flow and ensure optimal utilization of the generated electricity. Let's break down the characteristics of a 1.5 KVA, 24V, 80Ah, 660W PCU. 1.5 KVA: KVA stands for kilovolt-ampere and is a unit of apparent power. In this case, the PCU has a capacity of 1.5 KVA, meaning it can handle a maximum power load of 1.5 kilovolt-amperes. This specification indicates the capacity of the PCU to handle the electrical load requirements of the connected devices or appliances. 24V: The PCU operates at a voltage level of 24 volts. This specification indicates the DC voltage level at which the PCU functions and is typically matched with the battery bank voltage in the solar PV system. 80Ah: Ah stands for ampere-hours and represents the battery capacity. In this case, the PCU is designed to work with a battery bank that has a capacity of 80 ampere-hours. This specification indicates the amount of charge the battery can store and supply to the PCU for powering electrical loads. 330W: The PCU has a power rating of 330 watts. This specification indicates the maximum power output or input that the PCU can handle. It is important to ensure that the power rating of the PCU matches the capacity of the solar panels to ensure efficient power conversion and utilization.The PCU's role is to regulate the power flow between the solar panels, the battery bank, and the electrical loads in the system. It ensures that the power generated by the solar panels is properly converted and supplied to the connected devices while also managing the charging and discharging of the battery bank.Overall, a 1.5 KVA, 24V, 80Ah, 660W PCU is designed to handle a specific power load and voltage range in a solar PV system. It acts as a crucial interface between the solar panels, battery bank, and electrical loads, ensuring efficient and reliable power distribution

3. 24V 80Ah LiFePo4 BATTERY

Fig 2.3 LiFepO4 Battery

A 24V 80Ah LiFePO4 (Lithium Iron Phosphate) battery is a versatile and high-performance energy storage solution commonly used in solar PV systems. With a nominal voltage of 24 volts, this battery is compatible with a range of electrical systems and can effectively store and supply energy. The 80Ah capacity of the LiFePO4 battery indicates its ability to deliver a continuous current of 80 amps for one hour or a proportionate current over a longer duration. One of the key advantages of LiFePO4 chemistry is its enhanced safety features compared to other lithium-ion battery chemistries. The use of lithium iron phosphate as the cathode material significantly reduces the risk of thermal runaway or combustion, ensuring a safer energy storage solution. Additionally, LiFePO4 batteries have a longer cycle life, capable of enduring several thousand charge-discharge cycles before experiencing significant capacity degradation. The efficiency of LiFePO4 batteries is also noteworthy, with charge and discharge efficiencies often exceeding 95%. This means that a large percentage of the energy put into the battery during charging is effectively stored and can be retrieved during discharge, maximizing the overall efficiency of the system. The 24V 80Ah LiFePO4 battery offers reliable and durable energy storage for solar PV systems, enabling efficient utilization of solar energy. Its high-performance characteristics, long cycle life, efficiency, and enhanced safety features make it a preferred choice for renewable energy applications, providing a reliable and sustainable power supply.

4. AC DISTRIBUTION BOX

A solar AC distribution board is a crucial component in a solar PV system that facilitates the efficient distribution of electricity generated by solar panels to various AC loads in a building or premises. This distribution board serves as a central hub for connecting the solar inverter, grid supply, and AC loads, ensuring proper electrical management and safety.The primary function of the solar AC distribution board is to receive the AC output from the solar inverter and distribute it to different electrical circuits within the building. It typically consists of circuit breakers or MCBs (Miniature Circuit Breakers) that protect each individual circuit from overload or short circuits, ensuring the safety of the electrical system and preventing any damage to the connected appliances or devices. The solar AC distribution board plays a critical role in optimizing the utilization of solar energy by efficiently managing the distribution of electricity to various AC loads. It enhances the safety and reliability of the solar PV system while providing seamless integration with the grid supply when necessary. Overall, the solar AC distribution board acts as a central control unit, enabling efficient and reliable power distribution in buildings powered by solar energy

CHAPTER 3

METHODOLOGY AND SITE SELECTION

1. METHODOLOGY

The methodology for the project "Microgrid Solar PV System Installation in Community Center in Tribal Colonies of Kuttampuzha Grama Panchayat" involves several key steps to ensure successful implementation. Firstly, a detailed survey and assessment of the community center and the tribal colonies will be conducted. This survey will include gathering information about the energy requirements, available space for solar panel installation, and the existing electrical infrastructure. Based on the survey findings, the solar PV system components will be selected. In this case, a 1.5 KVA PCU, two 335W solar panels, and a 24V 80Ah battery will be used. The selection of these components is based on the energy demand of the community center and the specific characteristics of the location. Next, the solar panels will be installed on the roof or suitable area of the community center. The installation will involve positioning the panels at an optimal angle and direction to maximize solar energy absorption. The wiring connections between the panels, PCU, and battery will be carefully installed to ensure proper electrical connectivity and safety. The PCU, battery, and other necessary equipment will be installed in a secure location within the community center. The PCU will be connected to the solar panels and battery, allowing for efficient power conversion, energy storage, and distribution. Once the installation is complete, the system will undergo testing and commissioning. This involves verifying the electrical connections, ensuring the proper functioning of the PCU, battery charging and discharging cycles, and conducting performance tests under various conditions. After successful commissioning, the system will be ready for operation. Regular monitoring and maintenance will be carried out to ensure the optimal performance of the solar PV system. This includes checking the battery charge levels, inspecting the panels for any damage or dirt accumulation, and troubleshooting any potential issues that may arise. Throughout the project, community engagement and training programs will be conducted to raise awareness about the benefits of solar energy, promote responsible energy usage, and empower the tribal communities to take ownership of the system. This will involve conducting workshops, providing training on system maintenance, and fostering a sense of ownership and pride among the community members. Overall, the methodology for the project involves a comprehensive approach, including survey and assessment, component selection, installation, testing, commissioning, and ongoing monitoring and maintenance. The engagement and training of the tribal communities are vital components to ensure the long-term success and sustainability of the microgrid solar PV system in the community center.

2. SITE SELECTION

Site selection for the installation of the microgrid solar PV system in the tribal colonies of Kuttampuzha Grama Panchayat is a critical step in ensuring optimal energy generation and system performance. The selection process involves careful consideration of several factors. Firstly, the site should have ample available space with adequate sunlight exposure. This is essential for maximizing the solar energy capture and optimizing the electricity generation of the solar panels. A site with minimal shading from surrounding trees, buildings, or other structures is preferable to ensure uninterrupted sunlight throughout the day. Additionally, the site should have a suitable structural foundation or roof space for mounting the solar panels securely. This could involve assessing the structural integrity of existing roofs or identifying areas for ground-mounted panel installations. The site should also provide easy accessibility for installation and subsequent maintenance activities. The proximity of the site to the community center is another crucial factor. It is desirable to minimize the distance between the solar PV system and the center to minimize energy losses during transmission and distribution. This also helps in optimizing the utilization of generated electricity within the community center. Furthermore, the site selection process should take into account the local weather conditions and environmental factors. Considering the geographical location of Kuttampuzha Grama Panchayat, an assessment of factors such as average sunlight hours, rainfall patterns, and wind speeds will help in determining the solar potential and assessing any potential risks or challenges. Lastly, community engagement and consultation should be an integral part of the site selection process. The input and feedback from the tribal communities can provide valuable insights into identifying suitable sites that align with their needs and preferences. It is essential to ensure that the selected site respects the cultural values, traditions, and community priorities.By carefully considering these factors, the site selection process for the microgrid solar PV system installation can identify optimal locations that maximize solar energy capture, promote system efficiency, and meet the specific requirements of the tribal communities in Kuttampuzha Grama Panchayat

Location of the plant	10°9′0″N 76°44′0″E
Elevation	8.6 meters from ground level
Time of proper sunlight	10 AM - 4PM
Tilt angle of panel	11.5 degree facing north
Size of a single solar panel	65 inch x 45 inch
Type	Off-grid

Table 3.1 Location

CHAPTER 4

DESIGN AND CALCULATIONS

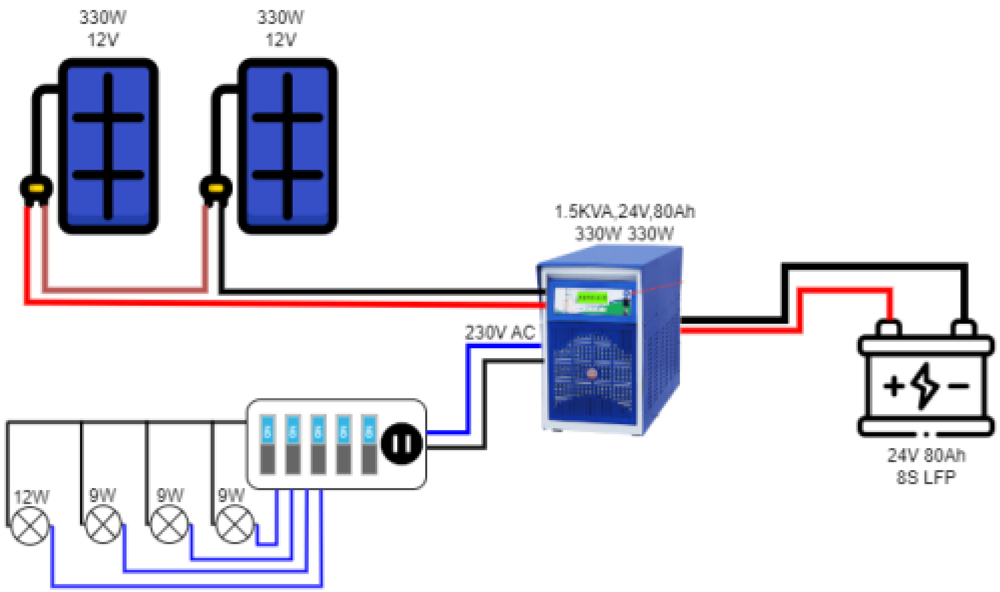

Fig 4.1 Design

1. Load Calculation

SL No.	Electric Home Appliances	No. of items	power	Time(Hrs)	Energy
1	Bulb	3	9	8	216
2	12W bulb	1	12	6	72
3	Bulb	1	9	2	18
4	Socket	1	50	6	300
5	Charging Socket	1	10	3	30
		Total	86	Total	636
				Total Energy	763.2
				Ampere Hour	63.6
		Battery	12v	Ampere Hour	80Ah
					960Whr

Table 4.1 Calculation

2. Energy Calculation

Energy = No. of items * Power consumed by each appliances* Time

Total Energy = Sum of the energy of each appliances

Total Energy = 1.2*(216+72+18+300+30)= 763.2Whr

3. Battery Selection

The battery capacity is obtained by,

Capacity=Total Energy / Voltage

Let, the voltage be 12v,

Battery Capacity(Ah)= 763.2/12=63.6Ah

Therefore, the battery rating is selected as 12V,80Ah

Since, there is higher load the chance for voltage drop is higher therefore 24V is preferred and for that two panels are Required with a Battery Rating of 24V, 80Ah

- Cell Chemistry: Lithium Ferro Phosphate(LFP)
- Nominal Cell Voltage=3.2v
- Peak Cell Voltage= 4.2v
- Cell Combination=8s(series)

Total Energy for one panel= 12*80=960Whr

4. Panel

Panel Rating=1.2*(Total Energy/ Backup time)

where backup time in our site=4 Hours

Panel rating = 1.2*(960/4) = 288W

The panel available in the market is 330W

Therefore the panel rating is 330w,12v

Two panels are required for considering 24V supply

5.PCU(Power Control Unit)

PCU is a combination circuit of Inverter and Solar charge controller.

Therefore the PCU is designed for 2 Solar panel of 330w Connected in series and the Battery capacity of 24V,80Ah.The PCU is rated at 1.5KVa with a output of 230V AC.

6.Wire Calculation

Wire Calculation	Sqmm
MPPT-Battery	6
Panel-MPPT	6
Battery-Appliances	1.5

6A=1 Sq Mm

The wire gauge is calculated according to the current flowing for the required load.

CHAPTER 5

ECONOMIC ANALYSIS

The main drawback of the plant is that it is economically less feasible in Kerala due to heavy monsoon and frequent cloudy atmosphere. So, production is not up to the marked expectation. Reasonable money received per unit for production from the government. (3.60/-).

COST ANALYSIS OF 5KW ON-GRID SOLAR PLANT

1. Solar panel cost

Cost of a 330W single panel = 11500

Rs Total no of panels = 2 Nos

Total cost = 11500*2= 23000 Rs

2. Battery Cost

8 X 3.2 V 80AH $LiFePO_4$ Cell is used.

Cost of 3.2 V 80AH $LiFePO_4$ = 4000Rs

Total Cost of battery = 8 x 4000

= 32000Rs

3.Cost of other components

Battery Box = 2500 Rs

Connecting Rod = 300 Rs

Lighting Arrester = 2000 Rs

DC Cabling = 5000 Rs

AC Cabling = 5000 Rs

4. Installing and Commissioning

Cost for transportation, loading & unloading , panel mounting, AC and DC cabling ,

3 year onsite service warranty = 20000 Rs

Total cost = 89800 Rs

CHAPTER 6
CONCLUSION

The project holds significant promise in providing sustainable and reliable electricity to the tribal communities. By utilizing a 1.5 KVA PCU, two 335W solar panels, and a 24V 80Ah LiFePO4 battery, the project aims to harness solar energy and enhance the energy access in the community center. The installation of the solar PV system brings numerous benefits to the tribal colonies. It provides a clean and renewable source of energy, reducing dependence on traditional fossil fuel-based power sources. The system's capacity to generate electricity and store it in the battery ensures a stable power supply, even in remote areas with limited grid connectivity. The project contributes to environmental sustainability by reducing carbon emissions and mitigating the impacts of climate change. The use of solar energy promotes a greener and cleaner energy alternative, aligning with the global efforts towards a low-carbon future.The project fosters community engagement and empowerment. Through workshops, training programs, and involvement in the project, the tribal communities gain knowledge about solar energy, its benefits, and maintenance practices. This empowers them to take ownership of the system, enhancing their technical skills, and fostering a sense of pride and self-sufficiency. Overall, the installation of the microgrid solar PV system in the community center of the tribal colonies of Kuttampuzha Grama Panchayat signifies a significant step towards sustainable development. It provides reliable electricity, promotes environmental conservation, and empowers the tribal communities. The project sets an inspiring example for other communities and encourages the wider adoption of renewable energy solutions to address energy needs while preserving our planet's resources for future generations.

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