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The Green Campus Building's Rooftop Photovoltaic System Design Project

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Abstrak

Universitas Jenderal Achmad Yani yang terletak di Kota Cimahi, saat ini sedang dalam pembangunan kampus berskala besar dimana kegiatan masif ini akan berbanding lurus dengan besarnya konsumsi energi listrik yang digunakan. Kenaikan konsumsi energi listrik ini dapat diminimalisir dengan adanya pemanfaatan sumber energi terbarukan yang ramah lingkungan untuk menyuplai beban dan mengurangi penggunaan energi eksisting dari jaringan PT. PLN. Latar belakang tersebut mendorong suatu usulan desain pembuatan PLTS jenis berbasis fotovoltaik di kampus Universitas Jenderal Achmad Yani, khususnya di dua gedung yang memiliki potensi atap yang ideal. Dalam makalah ini, pemodelan yang dilakukan bertujuan untuk membantu suplai energi listrik berbasis energi terbarukan. Rancang Bangun Rekayasa Instalasi PV on Grid pada Gedung di Universitas Jenderal Achmad Yani yang dilakukan dalam makalah ini meliputi tata letak penempatan PV, konstruksi PV, dan Simulasi dengan menggunakan PVsyst. PLTS terhubung jaringan jenis atap dimodelkan di Gedung Fakultas Ilmu dan Teknologi Kesehatan (FITKES) dan Gedung Rektorat yang disusun atas panel PV, inverter, dan komponen pendukung lainnya. Pemodelan desain dan simulasi PV On Grid telah dilakukan di atap Gedung FITKES dan Rektorat dengan menghasilkan total kapasitas PV yang dapat diinstal sebesar 420 kWp, dengan hasil Performance Ratio rata - rata tahunan sebesar 80,6% dan memiliki potensi output energi rata-rata mencapai 702 MWh/Tahun.

Keywords:
photovoltaic;
rooftop pv system;
grid-connected.

Abstract

Universitas Jenderal Achmad Yani, whose major campus is in Cimahi City, is constructing a large-scale campus development, the size of which is directly proportionate to the quantity of energy consumed. This increase in electrical energy consumption can be minimized by utilizing environmentally friendly renewable energy sources to supply loads and reduce the use of existing energy from the grid (PT. PLN). This context supports a design proposal for the production of photovoltaic-based photovoltaic on the Universitas Jenderal Achmad Yani campus, particularly in two buildings with exceptional roof potential. In this paper, the modeling carried out aims to help supply renewable energy-based electrical energy. The design of PV on Grid Installation Engineering in Buildings at Universitas Jenderal Achmad Yani carried out in this paper includes PV placement layout, PV construction, and simulation using PVsyst. The rooftop-type grid-connected PV is modeled in the Faculty of Health Sciences and Technology (FHST) Building and the Rectorate Building, which are composed of PV panels, inverters, and other supporting components. Grid PV design and simulation modeling on the roofs of FITKES and Rectorate Buildings resulted in a total installable PV capacity of 420 kWp, an annual average Performance Ratio of 80.6%, and an average potential energy output of 702 MWh/year. This energy potential is undoubtedly proposed to fulfill future electricity needs.

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1. Introduction

The potential for solar energy in Indonesia is quite large, so the impact of pollution and carbon emissions can be avoided with renewable energy[1][2]. Several studies have been conducted related to improvements made by[3], [4], [5] ground mounted or rooftop PV deployment. Universitas Jenderal Achmad Yani is one of the universities in Indonesia, with its main campus in the military sector of Cimahi City's. It is currently undergoing enormous development under the Smart Military University concept[6]. In addition to the ICT-based campus and toward the international stage, the increase in the number of students will be double that of the previous one and will be exactly proportionate to the increase in consumption, with substantially higher electricity payments[7].

More than 70 million rupiah is the outcome of the interviews done for the payment of one building for one month. This document discusses the technical installation and the quantity of components utilized, but it does not compare to after the installation of PV systems. To reduce cost overruns caused by rising electricity use, one idea is to establish a Solar Power Plant as an alternate way of lowering electricity bills[8].

This paper aims to present a design with several factors to be considered including the proposed configuration for a grid-connected photovoltaic system, providing an analysis of the performance ratio of the photovoltaic system using a rooftop PV model and simulation using PVsyst. The potential is derived from the amount of annual Global Horizon Irradiation (GHI) that can be captured at the planning site which can be converted into a nominal amount of annual usable energy.

The background and pertinent research, methodology, component calculations and specifications, current conductivity, protection systems, combination and number of inverters, and simulation techniques utilizing PV systems to ascertain PV panel characteristics and suggested layouts are all covered in the introduction of this paper. The investigation's conclusions are presented at the end of the study, which also covers the design and computation of the rooftop PV panel string. In accordance with the presentation in the introduction, since this research is closely related to previous research, the proposed novelty in this paper is summarized in table 1. Table 1 compares the proposed and the amount of PV-based renewable energy generation that can be utilized.

2. Method

2.1 Meteorology Data and Location

In this study, the most relevant data collection and processing methods are literature as a reference from other studies and observation methods where field surveys are an alternative to obtaining the data needed for the design of rooftop PV systems at Universitas Jenderal Achmad Yani.

Table 1. Bibliography Review of Proposed Rooftop PV Systems

No	References	Location	Rooftop PV Proposed Design	Total Power (kWp)
1	Truong, Nguyen Xuan, etc, 2017 [9]	Hanoi, Vietnam.	A PV array will be erected on the roof top of a building designated as a Zero Emission Building (ZEB) to increase energy efficiency and minimize power consumption costs under various scenarios in Hanoi.	15 kWp
2	Saxena G, Gidwani D, 2018[10]	Rajasthan, India.	Feasibility analysis of a 100 kWp rooftop solar power plant with an estimated annual energy production from PVsyst software of 167,822 kWh.	100 kWp
3	Shilpa S, and Sridevi H, 2019[11]	Bangalore, India.	The proposed design and economic characteristics of a grid interactive rooftop PV system configuration for a Bangalore educational campus are presented in this article. A comparison study is also carried out for an on-grid PV system and an off-grid PV-DG (diesel generator) system.	150 kWp
4	Ogbuefi U, et al, 2002[12]	South Nigeria, Africa.	The proposed stand-alone rooftop solar PV system is a realistic and cost-effective alternative to expensive and unreliable grid electricity for improving rural dwellers' quality of life.	3.3 kWp
5	H.R Iskandar, et al in 2019[13] and continues research in 2021[14].	Cimahi, West Java, Indonesia.	Proposed rooftop PV system of 32.1 kWp connected to the off-grid, which is then optimized to increase PV capacity by 47.2%, resulting in a electrical engineering department laboratory rooftop PV system of 250Wp. Also proposed for the next 25 years is hybrid generation (rooftop PV system, diesel gas, battery, and converter) in Universitas Jenderal Achmad Yani.	▪ 32.1 kWp, and ▪ 60.750 kWp
6	Ariawan A, WindartaJ, et al, 2022[15]	Central Java, Indonesia.	The utilization of Rooftop PV within one year of installation shows that the amount of electrical energy generated is 40,558 kWh, so the office manager of the Central Java Provincial DPRD Secretariat uses a 30 kWp PV panel.	30 kWp
7	H. R Iskandar, et al proposed in 2023	Cimahi, West Java, Indonesia.	Proposed design PV Array using components layout for Faculty of Health Science and Technology (FHST) and Rectorate building in Universitas Jenderal Achmad Yani.	410.11 kWp

Figure 1 depicts the research flowchart, beginning with the software-based desk evaluation study, data collection during the survey and external building data (if any), capacity calculation, and simulation so that the PV system installation can be fulfilled based on the building's roof area.

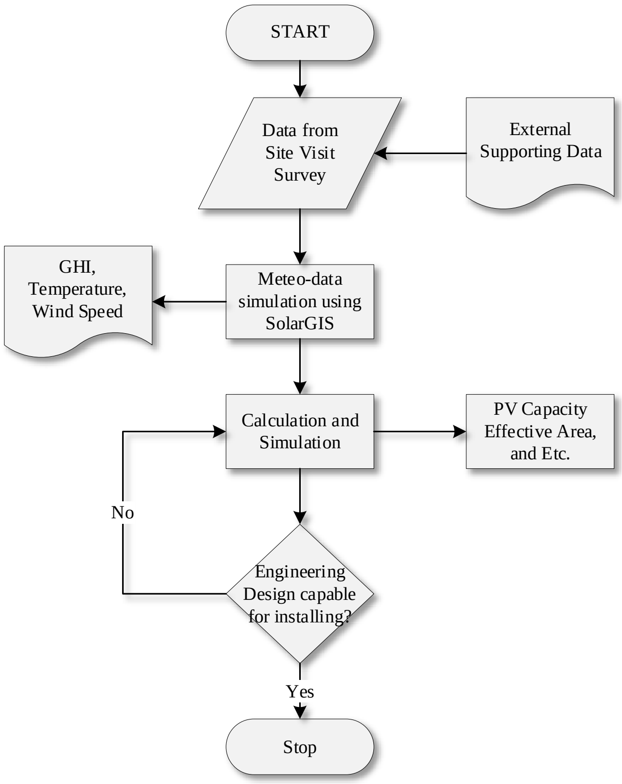

Figure 1. Drafting and Design Flowchart

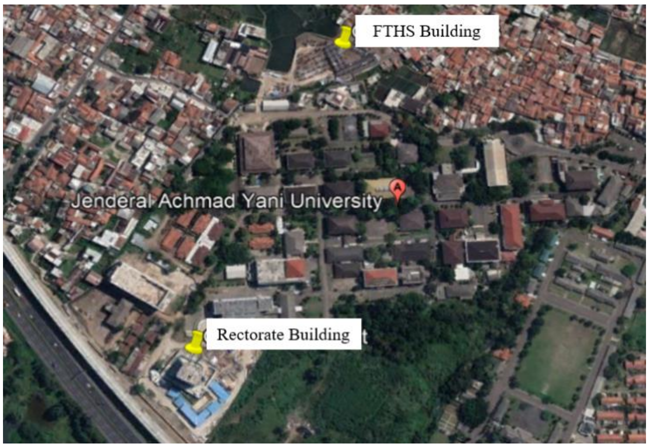

Figure 2. Building location and selection

Based on the observation results, the object of the planning location for the installation of Grid-connected rooftop PV systems, the research location of the building with higher potential is the building and the Faculty of Health Sciences and Technology Building, as well as the Rectorate building, at the coordinates -06°53'10", 107°31'36". See figure 2.

This PV is intended to power the loads present in the existing electrical system of the Faculty of Health Science and Technology (FHST) and Rectorate Buildings. This area has an average annual Global Horizontal Irradiation of 142.3 kWh/m^2, an average annual air temperature of 23.6 ° C, and an average annual wind speed of 1 m/s, according to SolarGis data. Table 2 shows the meteorological data from the study site. The first step is to select a location, and meteorological data will determine how much solar energy can be harvested each year (which PV panels can use).

Table 2. Solargis Meteo-data

Month	**GHI (kWh/m^2)**	**Av. Temp. (° C)**	**Av. Wind Speed (m/s)**
Jan	137.2	23.1	1.2
Feb	121.1	23.1	1.2
Mar	144.8	23.5	1.1
Apr	137.0	23.9	0.9
May	137.8	24.1	0.8
June	134.1	23.6	0.8
July	148.7	23.3	0.9
Aug	163.4	23.5	0.9
Sept	164.9	23.9	0.9
Oct	153.9	24.0	0.9
Nov	130.6	23.7	0.9
Dec	134.7	23.5	1.1
Annual Av.	142.3	23.6	1.0

2.2 Components Sizing and Specifications

In this paper, the design of estimating the PV capacity to be put on the FHST and Rectorate buildings is based on the roof area of each structure using Google Earth, and the building area profile is 278 m^2 for the Rectorate and 1728.6 m^2 for the FHST. The technical features of the Seraphim SRP-540-BMA-HV solar module are shown in Table 3. The dimensions of the PV module to be installed can be estimated using the data from the table. As shown below, use Equation (1) to get the PV area of the module[16].

$$L_{mod} = P \times l \quad (1)$$

Where the P is the length of the PV module, l is its width, and L is its area, as shown in Equation (1). Using equation (2), calculate the number of PV modules that can be installed based on the roof area of the FHST Building and the Rectorate Building[17].

$$n_{mod} = L_{Building} \div L_{mod} \quad (2)$$

The DC power capacity that can be installed in each building is determined by the number of modules in the building. See Equation (3)[18].

$$Tot\_Cap_{mod} = n_{PV\_mod} \times Cap_{per\_mod} \quad (3)$$

According to table 4, the inverter's technical characteristics will operate when the DC input (U_{PV}) is between 200 and 1100 V, thus use the following equation (4).

$$U_{MPPT,min} = 200V \leq U_{PV} \leq 1100V = U_{MPPT,max} \quad (4)$$

Furthermore, another variable that must be known is the correction factor, which is influenced by temperature[19]. According to data recorded in online meteorological data, temperature conditions in the last 10 years for Bandung and surrounding temperatures have been

18°C, with a high temperature of 32°C. The temperature coefficient or Vmpp value on the module is required to measure the voltage against 1°C so that the number of PV modules per string can be computed using equation (5).

$$n_{(min/).T} = \frac{U_{MPPT\_(max/min)}}{V_{MPPT,STC}[1 + \Delta V_{MPPT}(T - 25°C)]} \quad (5)$$

Table 3. PV Panel Specification

Parameters	Information
Manufacture/type	Seraphim SRP-540 BMA
Max. Power at STC (Pmp)	540 Wp
Open Circuit Voltage (Voc)	49.50 V
Short Circuit Current (Isc)	13.81 A
Max. Power Voltage (Vmp)	41.55 V
Max. Power Current (Imp)	13.00 A
Module Eff. at STC(ηm)	20.89 %
Power Tolerance	(0, +3%)
Max. System Voltage	1500V DC
Max. Series Fuse Rating	25 A
Pmax Temperature Coefficient	0.35 %/°C
Voc Temperature Coefficient	-0.27 %/°C
Isc Temperature Coefficient	+0.05 %/°C
External Dimensions	2279x1134x35 mm

Table 4. Inverter Specification

Parameters	Information
Manufacture/type	SUN2000-100KTL-M1
Max. Efficiency	98.6%
Max. Input Voltage	1.1 kV
Max. Current per MPPT	26 A
Max. I_{SC} per MPPT	40 A
Start Voltage	200 V
MPPT Op. Volt. Range	200 V ~ 1 kV
Rated Input Volt.	570 V
Number of Inputs	20
Number of MPP Trackers	10
Rated AC Active Power	100 kW
Max. AC Apparent Power	110 kVA
Max. AC Active Power (cosφ=1)	110 kW
Rated AC Grid Frequency	50 Hz / 60 Hz
Rated Output Current	152.0 A
Max. Output Current	168.8 A
Max. Total Harmonic Distortion	<3%

Table 5. PV Cable Data-sheet

Rated Diameter mm^2	Kind of installation		
	Single cable free in air	Single cable on surfaces	To cables adjacent on surfaces
1.5	30	29	24
2.5	41	39	33
4	55	52	44
6	70	67	57
10	98	93	79
16	132	125	107
25	176	167	142
35	218	207	176

The total number of PV modules determined using equation (2), the number of PV modules linked varies every string, ranging from 5 to 21 PV modules in one string. String variations of 18, 14, and 20 are made for one string in this study, and each string is examined using the equation (6) below.

$$I_T = I_{STC}\,[1 + \Delta I_{sc}(T - 25°C)] \quad (6)$$

In Equation (5), knowing $I_{.STC}$ is the PV Module Current at Normal Temperature in Amperes (A), and ΔI_{sc} is the temperature coefficient Isc in %/°C, and T is the temperature of the PV Module when operating in (°C).

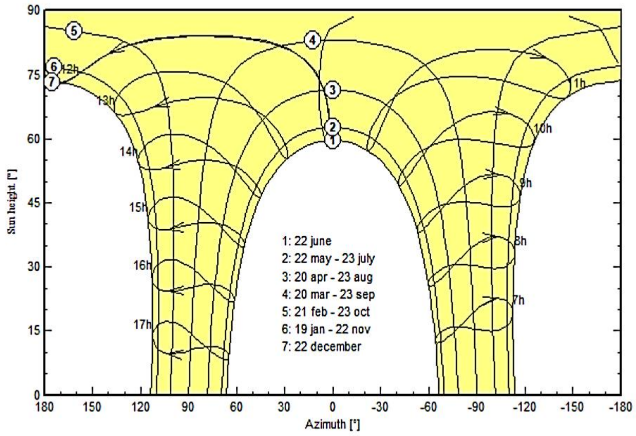

Figure 3. Sun Path Siagram on Location

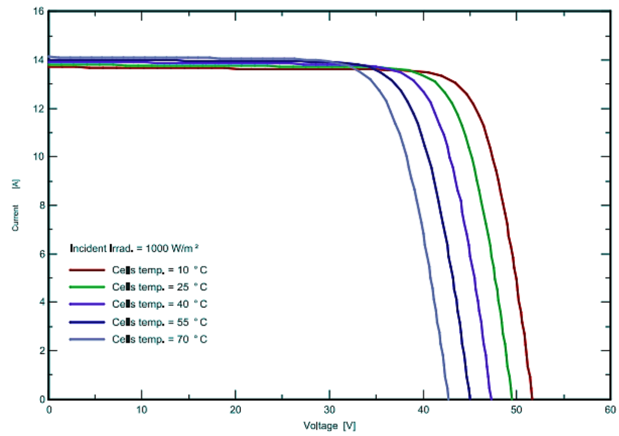

Figure 4. Current and Voltage Versus Temperature

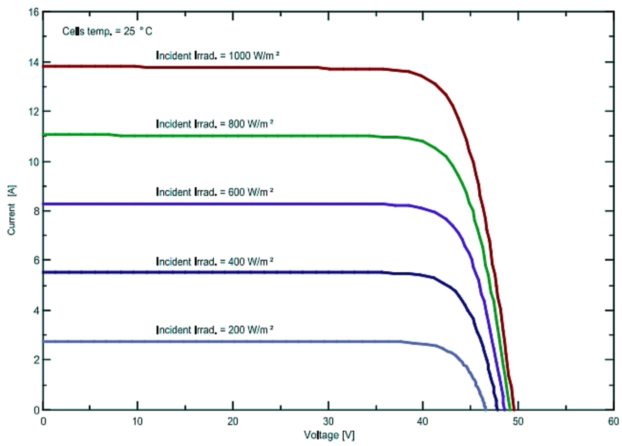

Figure 5. Current and Voltage Versus Irradiation

The insulator's function is to act as an insulating medium (depending on the type of material) between the copper (usually) within. See table 5, the selection of cable cross-sectional area must be taken into consideration and is critical; hence, calculating and selecting the cable cross-sectional area (mm^2) based on the manufacturer's data sheet is critical. Consider the ambient temperature and group installation method in the installation group as a correction factor when calculating cable cross-section (mm^2). The cable correction factor is based on EN 50618, and IEC 60364-5-52 standard. The following equation (7) is used to calculate the overall derating factor of temperature and grouping concerns in cable installations.

$$D._{Factor} = D.Fact_{Temp.} \times D.Fact_{Grouping} \qquad (7)$$

Tables 3–5 show a selection of components with manufacturer specifications available in software libraries that were chosen as reference considerations in the design. Capacity selection can be adjusted using market-available components based on similar assumptions.

2.3 Modeling Design and Simulation

PVSyst is a piece of software that many researchers utilize. PVSyst is used to simulate and analyze the upcoming PV system[20]. There are numerous characteristics that must be entered into PVsyst, including data on PV equipment components to be utilized, orientation of solar panel deployment, PV system configuration, system losses, and many more. Figures 4 and 5 depict the preliminary simulation results for determining the characteristics of the PV panel based on the chosen specification table. When starting this simulation, the PVSyst software facilitates the description of the characteristic test based on the solar radiation that has been determined through the coordinates.

3. Result and Discussion

It is also required to examine the calculation analysis for the selection of PV system equipment based on the equipment components to be put in the PV installation in the FHST & Rectorate Building so that it can run efficiently.

3.1 Characteristics and PV Sizing

Jenderal Achmad Yani University is located at coordinates -6.8881 °S, 107.5250 °E, or 736 meters above sea level, according to an early desk estimate. The Solargis data provides lines from solar irradiation to the area with the following attributes and sun path diagrams, as shown in Figure 3. PVSyst software was used to model the tilt angle of PV panels on a level roof. The outcomes of the PV panel orientation (tilt) and layout, for which the Rectorate Building utilizes Orient#1 with an Azimuth of 21° and the FHST Building employs Orient#2 with an Azimuth of -23°. PV modules will be put in series, with one series referred to as one string. The number of modules per string must be accurately determined. With their specifications, PV modules can generate currents and voltages that are impacted by temperature and solar irradiation in table 1 column Global Horizontal Irradiation (GHI) kWh/m^2. When the PV module is cold, the current value will be lower than the value in the datasheet and the voltage value will be higher, and vice versa. When the temperature of the PV module is high, the current value is significantly higher and the voltage value is substantially lower (see Fig. 4). Furthermore, the value of current and voltage is highly impacted by the amount of solar irradiation. When the value of solar irradiation is high, the value of current and voltage of the PV module is high, and when the value of irradiation is low, the value of current and voltage of the PV module is comparatively low show by Figure 5 for the simulation result.

When the PV modules in a string are overloaded, the input voltage value to the inverter exceeds the maximum limit listed on the inverter name plate, causing damage to other components. To operate, an inverter must have a minimum incoming voltage limit and a maximum incoming voltage limit. As a result, the quantity of PV modules per string and string sizing method must be determined. PV module specifications, particularly the value of Voltage Open Circuit (VOC) and maximum voltage at peak (Vmp), must be understood before adopting this string sizing approach. Using the aforementioned mathematical method and specification table, the outcome is 5 modules per string and a maximum of 21 PV modules and the most effective module PV area is 2.58m^2.

3.2 Layout and PV String System

Figure 6 depicts a rooftop PV system with a PV capacity of 361.8 kWp Module capacity when the inverter intended to be placed has a capacity of 100 kW as many as three pieces with variations in the number of modules per string based on the inverter specifications. Figure 7 depict the Rectorate Building is proposed to be installed with a PV Module capacity of 58.32 kWp where a 60 kW capacity inverter is 1 piece with a variant number of modules per string according to the specifications of the inverter. Table 7 shows each variant of the PV module series in one string, as well as the total VMP value that will enter the inverter with string variants of 10 modules/string. This voltage value is 381.8 V, 534.52 V, and 687.24 V for 14 modules/string and 18 modules/string, respectively. The total VMP value that will enter the inverter for the rectorate building is 18 modules/strings, or 687.24 Volts per string. If the maximum temperature of the PV module is assumed to be 55°C, the short circuit current is 14.02 A. Table 8 provides information on the feasibility of inverter installation based on the inverter characteristics available in both buildings.

When the PV module temperature conditions are running, it is critical to monitor the MPPT voltage in line with the requirements of the inverter brand utilized. The maximum temperature of the PV module utilized is 80°C, according to the datasheet of the PV module of type SRP-540-BMA-HV, while the minimum temperature of the solar PV module refers to the temperature of Bandung and surrounding areas, namely 18°C. The minimum and maximum number of PV modules in one string can be computed using equation 4 and the PV module data in table 3 and the inverter data in table 3. Each variety of the greetings in one string can be said as long as the Isc on the PV Module is less than the Imax inverter per MPPT. and the following is a feasibility test of all series options in one string. The number of PV modules that can be installed on

Figure 6. PV Module Layout in FHST Building

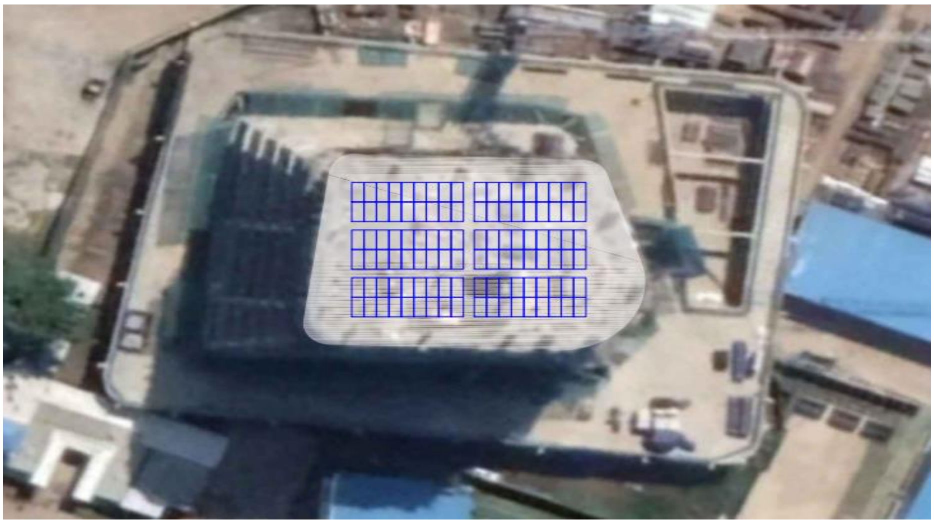

Figure 7. PV Module Layout in Rectorate Building

the FHST Building is 670 PV modules. The capacity in theFHST Building is 361.8 kWp based on the number of modules. Meanwhile, the rectorate building, can be installed in the building is 108 PV modules 58.32 kWp. See table 6.

Table 6. Number and capacity of PV modulest

Building	PV Sizing	
	PV Panel (η)	Capacity (kWp)
FTHS	670	361.8
Rectorates	108	58.32

3.3 Component Capacity and System

The Isc value of the PV module is shown in table 2 of the PV module specs, while the CCC value of the DC cable is shown in the DC cable datahseet table. The feasibility of cable use is tested in this study using a DC cable with a cross-sectional area of 6 mm^2 and the cable's correction factor.

Several corrective considerations must be considered, including cable cross-section and installation grouping manner. The correction factor the correction factor for the grouping of cable installations in accordance Equation (6) and Equation (7).

The minimum KHA value for each capacity per inverter in grid-connected PV systems, as shown in table 9. Cable parameters for inverters with a capacity of 50 kW are type NYY 1C-16 mm^2 per phase, while cables with a capacity of 100 kW are type NYY 1C-50 mm^2 per phase. Kirchhoff's Law states that the amount of current entering a branching point equals the amount of current exiting that point. The output current value of the AC Combiner Box is calculated by multiplying the number of inverters installed by the inverter current value. Table 10 shows the calculation results for the minimal KHA cross section of the cable that will be used from the AC Combiner Box output to the interconnection point. CCC is one of the cable sizes that is near to the minimal KHA value based on the datasheet, type, and cross-sectional area specified. According to the calculations, the FHST Building employs a cable of type NYY 1C 240 mm^2 per phase, while the Rectorate Building employs a cable of type NYY 1C 16 mm^2 per phase. There are several components that must be considered when selecting component specs. One of them is evaluating the components that will be mounted on the AC Combiner Box. In determining the current rating of the Molded Case Circuit Breaker (MCCB), it can be seen from the KHA value that will enter the MCCB. Based on the incoming KHA value of the Inverter can be seen in table 11, and for the KHA that will enter the incoming MCCB from the inverter or outgoing to the interconnection can be seen in table 11.

The following is the MCCB rating that will be used, both for the incoming MCCB from the Inverter or for the outgoing MCCB to the interconnection. There is a primary current rating and a secondary current rating in Current Transformer, which serve as a reference in establishing the CT parameters to be employed. The primary current is determined by the outgoing MCCB rating on the AC Combiner Box, and the secondary current is determined by the datasheet of the power meter product to be used. The needed power meter datasheet is 5 A, thus the CT rating that will be utilized in each PV system is shown in Table 12. The number of string used in each building is shown in Table 13. The FHST Building has three inverters, while the Rectorate Building has one.

Table 7. PV Module Arrays Variation of each Building

Building	PV per-string	Inv. per-string	$V_{MP,\ 50°C}$ (A)	$V_{MP.}$ Tot. System (A)
FTHS	10	2	38.18	381.8
	14	2	38.18	534.52
	18	2	38.18	687.24
Rectorates	18	2	38.18	687.24

Table 8. Feasibility of Each PV Module Variation per String of each Building

Building	PV per-string	Inv. per-string	Inv Sizing		
			I_{SC} (A)	I_{SC}, Tot (A)	$I_{max.}$ Inv/MPPT (A)
FTHS	10	2	14.2	28.04	40
	14	2	14.2	28.04	40
	18	2	14.2	28.04	40
Rectorates	18	2	14.02	28.01	30

Table 9. Min. KHA value of Cable from Inverter to AC Combiner Box (ACCB)

Building	Inv. Cap. (kW)	Current (A)	KHA_min (A)
FTHS	100	152	190
Rectorates	50	76	95

Table 10. Min. KHA value of Cable from AC Combiner Box (ACCB) to Interconnection Terminal

Building	Inv. Cap. (kW)	Qty Inv. (pcs)	KHA_min (A)
FTHS	100	3	570
Rectorates	50	1	95

Table 11. MCCB Rating for AC Combiner Box

Building	KHA_min to Inv. (A)	KHA_min to Int. (A)	MCCB Rating incoming (A)	MCCB Rating_Outgoing (A)
FTHS	190	570	200	600
Rectorates	95	95	100	100

Table 12. Rating of Current Transformer (CT) for Power Meter

Building	MCCB Rating Outgoing (A)	Power Meter Imput (A)	CT Rating (A)
FTHS	600	5	600/5
Rectorates	100	5	100/5

Table 13. PV System Configuration

Building	PV Orientation (°)	PV Module per string	String Number
FTHS	23	18	23
	23	14	4
	23	10	2
Rectorates	21	18	6

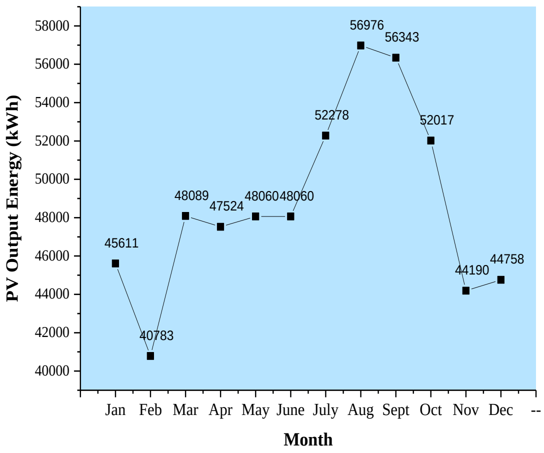

Figure 8. PV Output Energy (kWh)

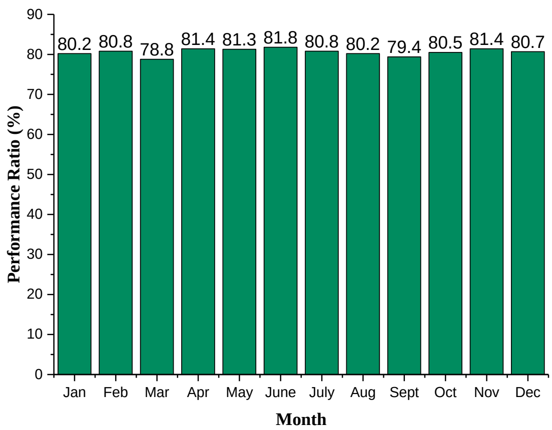

Figure 9. PV Performance Ratio

3.4 Energy Production Analysis of PV System

The PV system in the FHST and Rectorate Buildings is modelled in 1 PVsyst simulation, with a total power of 420 kWp from PV modules in both buildings. According to the simulation data, the least PV Performance Ratio is in March at 78.8%, while the biggest is in June at 81.8%, with an annual average Performance Ratio of 80.6% and an annual energy production generated by PV of 585,350 kWh.

The energy produced by PV modules cannot be compared to the energy received by the load since PV module production is still in the DC system, whilst the load is already in the AC system, where the cable lines connecting to the system generate losses. IEC standards govern normalized manufacturing, and it is frequently used to assess the quality of PV performance to be installed. According to the graph above, the collection loss is 0.85 kWh/kWp/day, the inverter system loss is 0.07 kWh/kWp/day, and the produced useable energy is 3 kWh/kWp/day.

The simulation result, the figures 8 and 9 demonstrate that Universitas Jenderal Achmad Yani yearly worldwide horizontal irradiation is 1715 kWh/m^2, with an effective irradiation of 1670 kWh/m^2. The figure above also depicts the PV module's efficiency under STC circumstances of 16%, implying that the nominal energy obtained in the PV module is 702 MWh. At this step, many losses occur, such as those caused by temperature, irradiation, the quality of PV modules and inverters, and so on, reducing the available energy to 585 MWh.

4. Conclusion

Several conclusions can be deduced based on the results of modeling, calculations, simulations, and analysis performed on the design of rooftop PV Grid-connected in the FHST & Rectorate Building of Universitas Jenderal Achmad Yani, first the FHST Building has a reliable PV capacity of 351.8 kWp, while the Rectorate Building has a capacity of 58.32 kWp, for a total capacity of 420 kWp when the two buildings are combined. The PV system proposed for the FHST Building has three inverters, each with a NYY 1 Core 70 mm2 cable cross-section per phase and an MCCB safety rating of 200 A. The incoming MCCB is rated at 600 A and has a cross-sectional area of 240 mm^2 per phase to the interconnection point. The Rectorate Building PV system employs three inverters, each with a NYY 1 Core 16 mm2 cable cross-section per phase and a 100 A MCCB. The incoming MCCB for the Building PV system has a rating of 100 A and a cross-sectional area of 16 mm^2 per phase.

According to the PVsyst simulation data, the solar power plant performance ratio of the two buildings is the lowest in March, at 78.8%. In terms of PV Performance Ratio, the highest is in June at 81.8%, with an annual average of 80.6%. At this location, the annual global horizontal irradiation is 1715 kWh/m2 with an effective irradiation of 1670 kWh/m2, and the PV module efficiency under STC circumstances is 16%, resulting in a nominal energy in the PV module of 702 MWh.

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