Evidence(s)
UI GreenMetric Questionnaire

University : Universitas Muhammadiyah Semarang
Country : Indonesia
Web Address : https://greenmetric.unimus.ac.id/

[2] Energy and Climate Change (EC)

[2.1] Energy Efficient Appliances Usage (EC.1)

LED BULB, LED T18, LED T8: Use of LED lighting and lamps with light detection (Universitas Muhammadiyah Semarang, Indonesia)

Solar Panel Street Lighting (Universitas Muhammadiyah Semarang, Indonesia)

PLTS OFF GRID Gazebo Unimus

	
Ac Inverter (Universitas Muhammadiyah Semarang, Indonesia)	Ac Inverter (Universitas Muhammadiyah Semarang, Indonesia)

Description:

Universitas Muhammadiyah Semarang (UNIMUS) has continued its energy-efficiency enhancement initiatives throughout the campus area by optimizing the use of environmentally friendly and low-consumption electrical equipment. The university has completed a total replacement of conventional lighting with energy-saving LED lamps (LED Bulb, LED T18, and LED T8), covering 18,752 units, which represents 100% transition to LED-based illumination systems across classrooms, laboratories, offices, and outdoor areas.

In addition, UNIMUS has gradually implemented inverter-type air conditioners to further reduce electricity consumption. Currently, 274 out of 1,184 units (23%) use inverter technology. The university also promotes the use of renewable energy through the installation of solar-powered street lighting (PJU Solar Panels), with 25 of 78 points (33%) already operating on solar energy.

Based on these implementations, the average percentage of energy-efficient equipment use on campus has reached approximately **52%**, placing UNIMUS in the “>50–75%” category under the UI Green Metric indicator EC.1. This progress reflects the university’s commitment to energy conservation and its alignment with the Sustainable Development Goals (SDG 7 – Affordable and Clean Energy and SDG 13 – Climate Action). Through the integration of LED lighting, inverter cooling systems, and solar infrastructure, UNIMUS actively contributes to reducing carbon emissions and promoting a sustainable campus environment.

Appliance	**Total Number**	**Total number energy Efficient appliances**	**Percentage**
LED Lamp	18.752	18.752	100%
Ac Inverter	1184	274	23%
PJU Solar Panel	78	25	33%
		Average Percentage	**52%**

Evidence(s)
UI GreenMetric Questionnaire

University : Universitas Muhammadiyah Semarang
Country : Indonesia
Web Address : https://greenmetric.unimus.ac.id/

[2] Energy and Climate Change (EC)

[2.3] Smart Building Implementation (EC.2)

No	Name	Place	automation		safety				energy		water		Indoor environment				lighting				Building Area (m²)
			B1	B2	S1	S2	S3	S4	E1	E2	A1	A2	I1	I2	I3	I4	L1	L2	L3	L4	
			Penggunaan Ruang		Keamanan	Sensor Kehadiran	CCTV	Fire SYSTEM	Sistim Pembagian		Sistim Pen			Manajemen Udara			Manajemen Cahay				
1	ATM Center	City, Country	V																		23.73
2	Gedung UMC	City, Country	V																		143.05
3	Pos Satpam	City, Country	V																		53.34
4	Gedung Rektorat		V		V	V	V	V	V								V				593.98
5	Kantin																				318.05
6	Gedung Labkes		V		V	V	V	V	V		V						V				1,313.19
7	Gedung NRC		V		V	V	V	V	V												941.39
8	Garasi																				164.79
9	Masjid		V																		1,106.66
10	Gedung Driver																				88.04
11	Rumah Cubicle																				18.06
12	Gedung GKB 1-FK		V		V	V	V	V	V		V										2,150.42
13	Rumah Pompa																				60.09
14	Power House																				65.62
15	Rumah Genset																				68.75
16	Lap. Tenis																				1,353.19
17	Lap. Futsal																				1,162.59
18	GSG		V																		1,734.58
19	Rumah Pompa																				
20	Gedung Lab. Hewan Coba		V																		234.95
21	Area Parkir Lab. Hewan Coba		V																		
22	Bak Sampah																				
23	Gedung Asrama Putri		V		V	V	V	V	V												1,058.98
24	PKM Lama																				188.76
25	PKM Baru																				149.58
26	Kantin FT																				397.76
27	Gedung FT, MIPA, & GKB 2		V		V	V	V	V	V		V										2,394.52
28	Power House FT																				200.80
29	Rumah Pompa FT																				119.41
30	Unimus Mart		V																		395.93
31	Lap. Futsal Baru																				7,600.00
32	BLKK		V																		195.42
33	Gudang UPPU																				229.95
34	Embung																				
35	Rusunawa Putra		V																		886.55
36	RSP		V																		3,929.96
37	Pos Satpam RSP																				25.00
38	Bekas Gudang Sapua 1																				702.27
39	Bekas Gudang Sapua 2																				821.47
40	Joglo																				216.00
41	Unimus Farm																				
42	Gedung FKG, FKM, & GKB 3		V		V	V	V	V	V		V										1,870.53
43	Direksi Kit GKB 3																				
44	Pos Satpam GKB 2																				50.73
45	Gedung Service RSP																				396.93
46	Gedung Lab FTIK		V																		214.56

Smart building implementation

$$\frac{total\ smart\ building\ area}{total\ building\ area} \times 100\%$$

***Total Building Area: 105.442 m²**

$$\frac{79.448{,}00\ m^2}{105.442\ m^2} \times 100\% = 75.34\%$$

Universitas Muhammadiyah Semarang (UNIMUS) has integrated the concept of *smart building* into several key facilities that meet at least five intelligent features, including room automation, safety systems (CCTV and motion sensors), energy management, water waste management, and indoor environmental control.

As of 2025, UNIMUS has implemented smart building technology in multiple core buildings such as the Rectorate Building, Integrated Health Laboratory (Labkes), NRC Building, GKB I–III, Faculty of Engineering and Science (FT–MIPA), At-Taqwa Mosque, Research and Animal Laboratory, Unimus Medical Center (UMC), Vocational Training Center (BLK), Unimus Mart, and both Male and Female Islamic Boarding Schools (KH. Sahlan Rosjidi Complex).

The total area of these buildings is approximately 79,448 m², which represents 75.34% of the total campus building area (105,442 m²). This percentage places UNIMUS in the “>75–100%” category (Score 5) according to the UI GreenMetric criteria for Smart Building Implementation.

These buildings are equipped with various smart systems, including:

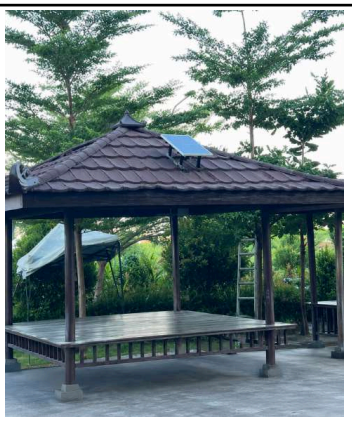
- Automated lighting using LED with motion and illumination sensors.
- Air conditioning management systems with timer and inverter-based operation.
- CCTV, digital access control, and safety monitoring integrated through a centralized network.
- IoT-based environmental monitoring for temperature, humidity, and energy consumption.
- Solar-powered outdoor lighting and efficient electrical distribution systems.

Through these initiatives, UNIMUS continues to strengthen energy efficiency, campus security, and sustainable building operations, aligning its development with Sustainable Development Goals (SDG 7 – Affordable and Clean Energy) and SDG 13 – Climate Action.

List of Smart Buildings Implemented at UNIMUS:

1. Rectorate Building
2. NRC Building
3. Integrated Health Laboratory (Labkes)
4. GKB I
5. GKB II
6. GKB III
7. Faculty of Engineering and Science (FT–MIPA)
8. At-Taqwa Mosque
9. Research and Animal Laboratory
10. Unimus Medical Center (UMC)
11. Vocational Training Center (BLK)
12. Unimus Mart
13. KH. Sahlan Rosjidi Male Boarding School
14. KH. Sahlan Rosjidi Female Boarding School

Rectorate Building	NRC Building
	
Integrated Health Laboratory (Labkes)	GKB I
	
Multipurpose building	GKB II
	
GKB III	AT-TAQWA Mosque
	
Research and Animal Laboratory	*Unimus Medical Center (UMC)*

	
KH. Sahlan Rosjidi Male Boarding School	KH. Sahlan Rosjidi Female Boarding School
	
FTIK laboratory building	Vocational Training Center (BLK) Building
	
Unimus Mart	Gazebo Unimus
	

Evidence(s)
UI GreenMetric Questionnaire

University : Universitas Muhammadiyah Semarang
Country : Indonesia
Web Address : https://greenmetric.unimus.ac.id/

[2] Energy and Climate Change (EC)

[2.5] Renewable Energy Sources in Campus

	
Biodiesel-Ready Diesel Power Generator Unit (Universitas Muhammadiyah Semarang, Indonesia)	Biodiesel-Ready Diesel Power Generator Unit (Universitas Muhammadiyah Semarang, Indonesia)
	
PJU Solar Panel (Universitas Muhammadiyah Semarang)	PJU Solar Panel (Universitas Muhammadiyah Semarang)

	
Solar Panel BLK	Pilot Project PLTS OFF GRID Gazebo Unimus

Universitas Muhammadiyah Semarang (UNIMUS) has developed several renewable energy initiatives to enhance sustainability and energy independence within the campus area. The university utilizes three main renewable energy sources: biodiesel, solar power, and clean biomass (briquette stoves). These systems form part of UNIMUS's long-term strategy to transition toward green energy and reduce greenhouse gas emissions.

1. Biodiesel Power Generation
   UNIMUS operates two biodiesel-ready generator systems (CAT and MG Diesel Power) located in strategic facilities such as the Integrated Health Laboratory (Labkes), Unimus Medical Center (UMC), and the Data Center. Based on operational data, assuming an average 30 running hours per month, the generators produce approximately 45,840 kWh/month.
   The transition from conventional diesel to biodiesel (B20–B30) significantly reduces fossil fuel dependency and supports the national renewable energy policy.
2. Solar Power Systems
   UNIMUS operates two types of solar installations:
   - Solar-Powered Street Lighting (PJU Solar Panel): 25 units × 200 Wp = 5 kWp, producing roughly 675 kWh/month (assuming 4.5 peak sun hours/day).
   - Rooftop Solar at Vocational Training Center (BLK): 2 kWp system generating 270 kWh/month.
     The combined solar production equals 945 kWh/month, equivalent to ~1% of total monthly electricity consumption.
3. As part of the *Clean Biomass Program*, UNIMUS has introduced biomass briquette stoves in campus canteens. The briquettes, made from agricultural residues such as coconut shells and rice husks, are used for daily cooking. This initiative serves as a pilot project to reduce LPG consumption and promote renewable biomass energy utilization. The estimated energy contribution will be monitored during the next reporting period and included in subsequent GreenMetric evaluations.

Future initiatives include the integration of hybrid solar–diesel systems for laboratories and parking areas, along with the expansion of solar photovoltaic panels in new academic buildings. These actions reflect UNIMUS's continuous progress toward sustainable energy practices and are directly aligned with Sustainable Development Goals (SDG 7 – Affordable and Clean Energy) and SDG 13 – Climate Action.

No.	Renewable Energy Source	Production (kWh/month)	Application / Location	Remarks
1	**Biodiesel (B20–B30)**	45,840	Diesel generators at Labkes, UMC, and Data Center	Operational 2 × 200 kVA units, 30 hours/month
2	**Solar Power (PJU)**	0,180	Street lighting Main Campus Area	25 units × 200 Wp
3	**Solar Power – Rooftop BLK**	0,270	Vocational Training Center (BLK)	2 kWp rooftop array
4	**Clean Biomass (Briquette Stove)**	*(pilot stage)*	Campus canteen	Under evaluation
	Total Renewable Energy Production	**46,29 kWh/month**		

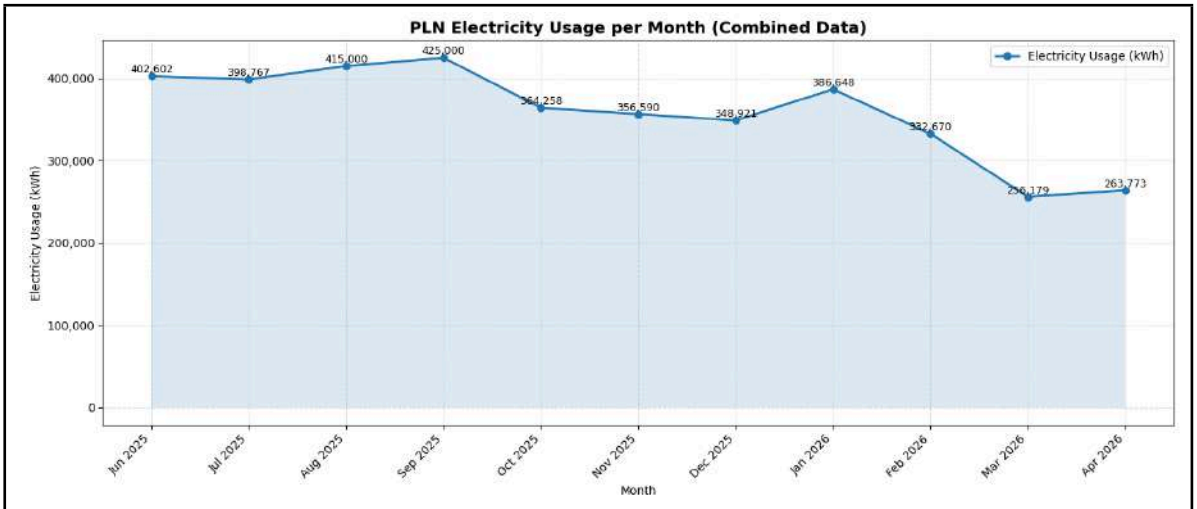
$$Renewable\ Energy\ Ratio\ =\ \frac{46{,}290}{383{,}430}\ x\ 100\%\ =\ 12,07\%$$

Evidence
UI GreenMetric Questionnaire

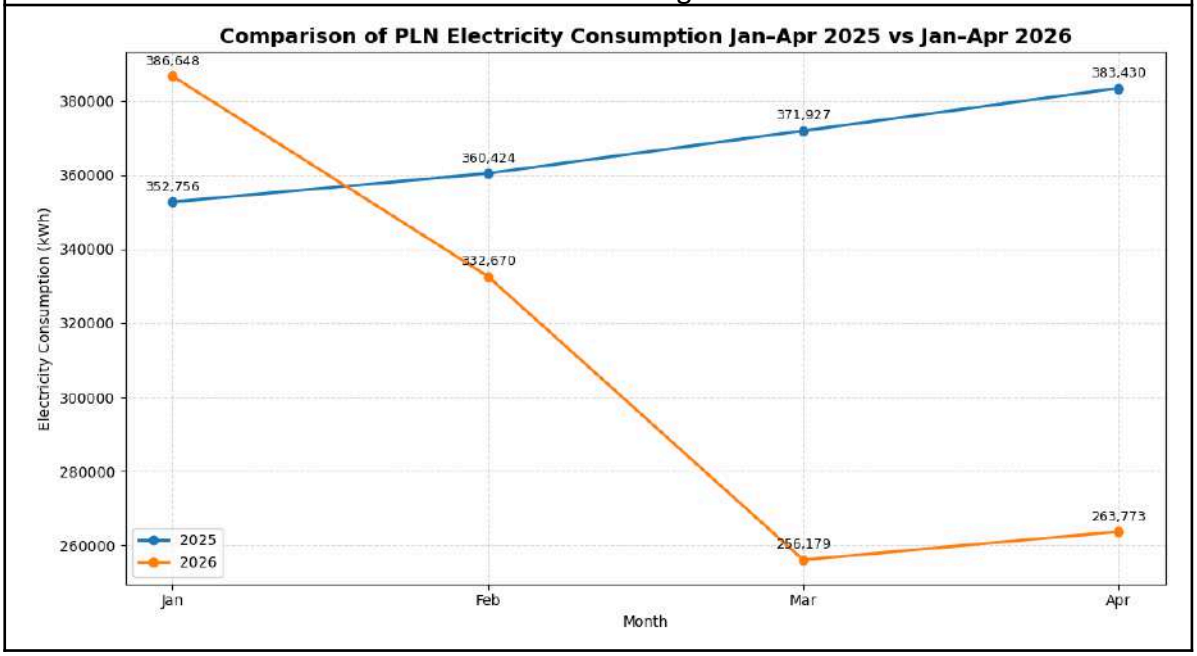
University : Universitas Muhammadiyah Semarang
Country : Indonesia
Web Address : unimus.ac.id

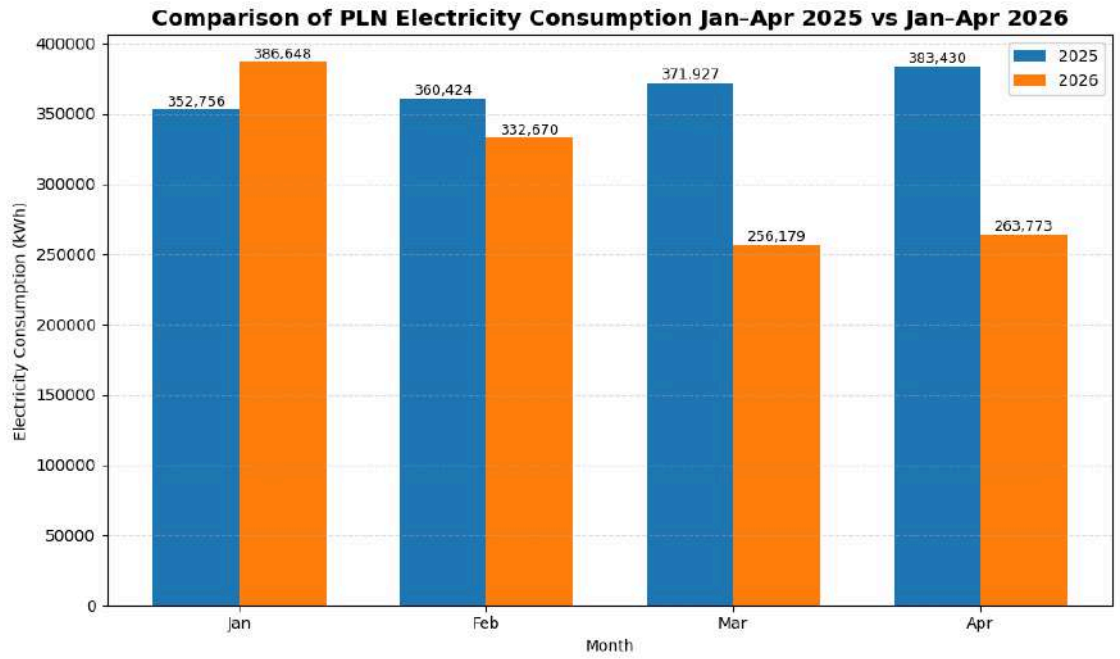
[2] Energy and Climate Change (EC)

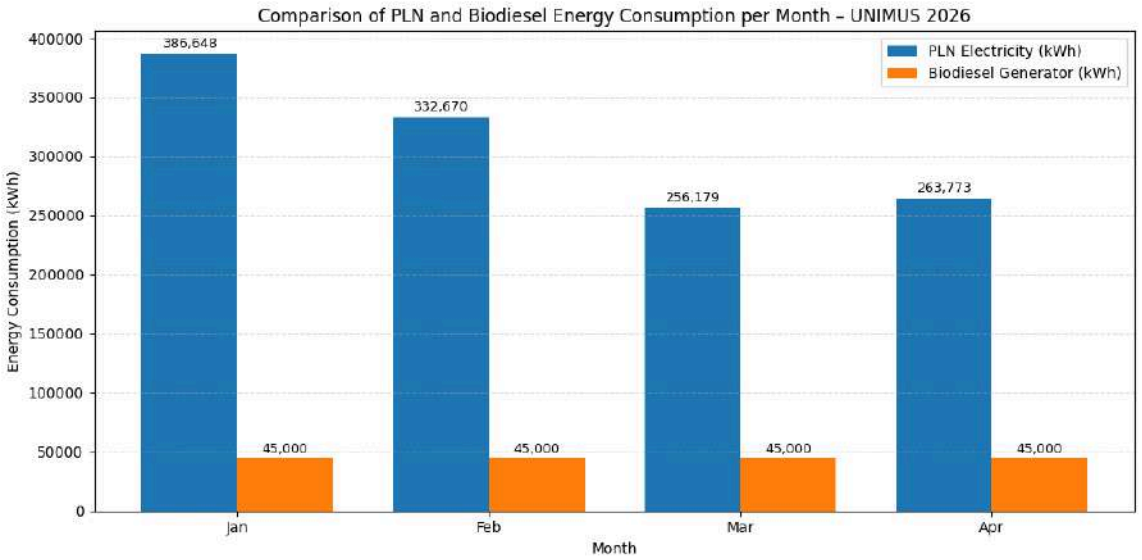
[2.6] Electricity Usage per Year (in Kilowatt hour)



Total Annual Kwh Usage of PLN







Example of Electricity Usage (kWh) Unimus

Universitas Muhammadiyah Semarang (UNIMUS) continuously monitors electricity consumption as part of its energy efficiency and sustainability initiatives. Based on the recorded monthly data, total PLN electricity consumption in 2025 reached 4,434,958 kWh, with an average monthly consumption of approximately 369,580 kWh. The highest consumption occurred in November 2025 at 480,773 kWh, while the lowest was recorded in March 2025 at 264,449 kWh. These variations reflect changes in academic, administrative, laboratory, clinical, and general campus operational activities throughout the year.

For 2026, the available data cover January to April, with total PLN electricity consumption reaching 1,239,270 kWh. The highest consumption during this period occurred in January at 386,648 kWh, followed by February at 332,670 kWh. Electricity consumption decreased further in March and April, reaching 256,179 kWh and 263,773 kWh, respectively.

A comparison of electricity consumption during the January–April period shows a significant overall reduction in 2026 compared with the same period in 2025. Total PLN electricity consumption decreased from 1,468,537 kWh in January–April 2025 to 1,239,270 kWh in January–April 2026. This represents a reduction of 229,267 kWh, or approximately 15.61%. Although electricity consumption in January 2026 was higher than in January 2025, consumption declined by approximately 7.70% in February, 31.12% in March, and 31.20% in April. The most substantial reductions occurred in March and April, indicating a marked decrease in electricity demand during these months.

Electricity usage by meter and location indicates that the Faculty of Engineering (FT), Faculty of Medicine (FK), GKB 3, RGSM, NRC, Rectorate Building, Rusun Putra, and PPNI/FKG are among the main electricity-consuming facilities at UNIMUS. Buildings with intensive academic, laboratory, clinical, and administrative activities generally require higher electricity consumption.

In addition to PLN electricity, UNIMUS uses biodiesel generators as supporting and backup power sources, particularly to maintain electricity reliability for critical campus facilities during power interruptions or operational emergencies. The electricity equivalent generated from biodiesel is estimated at approximately 46,000 kWh per month, or 552,000 kWh annually. Based on this estimate, biodiesel generator usage during January–April 2026 was approximately 184,000 kWh.

Compared with the estimated total annual energy consumption, PLN electricity contributes approximately 88.93%, while biodiesel generators contribute approximately 11.07%. This composition shows that PLN remains the primary energy source for campus operations, while biodiesel generators play an important supporting role in ensuring continuity and reliability of electricity supply. The biodiesel contribution should therefore be interpreted as supplementary and backup energy rather than as a replacement for the main PLN electricity supply.

Overall, the electricity consumption data provide an important basis for strengthening energy efficiency and sustainability programs at UNIMUS. The significant reduction in PLN electricity consumption during January–April 2026 may indicate improvements in energy-use efficiency, load management, or changes in campus operational activities. Relevant programs include the implementation of LED lighting, optimization of air-conditioning systems, electricity-load management, efficient laboratory scheduling, regular energy monitoring, and energy-saving awareness campaigns through the UNIMUS Green Campus program. Further evaluation of building occupancy, academic schedules, laboratory activities, and equipment usage is required to identify the specific factors contributing to the observed reduction.

Evidence
UI GreenMetric Questionnaire

University : Universitas Muhammadiyah Semarang
Country : Indonesia
Web Address : https://greenmetric.unimus.ac.id/

[2] Energy and Climate Change (EC)

[2.8] ratio of renewable energy production divided by total energy usage per year (EC.5)

<table>
<tr><td> 
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<tr><td>Bio Diesel Caterpilar Unimus</td><td>Bio Diesel MG Unimus</td></tr>
<tr><td> 
</td><td> 
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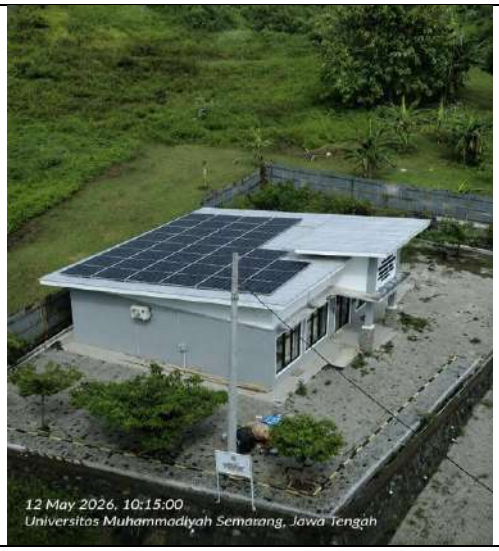
<tr><td>Solar Power (PJU)</td><td>Solar Power (PJU)</td></tr>
</table>

	
Solar Power – Rooftop BLK	**Pilot Project PLTS OFF GRID Gazebo Unimus**

Description:

Universitas Muhammadiyah Semarang (UNIMUS) actively promotes the transition toward renewable and low-emission energy sources to reduce its dependency on fossil fuels. As of 2025, three major renewable energy systems are in operation across the campus: biodiesel power generation, solar-powered street lighting (PJU), and rooftop solar panels installed at the Vocational Training Center (BLK).

1. Biodiesel Power Generation – Two biodiesel-ready generator units (CAT & MG Diesel Power) serve critical facilities such as the Integrated Health Laboratory (Labkes), Unimus Medical Center (UMC), and the Data Center. With an average operation of 30 hours per month, these systems produce approximately 45,840 kWh/month, replacing conventional diesel with cleaner biodiesel (B20–B30).
2. Solar-Powered Street Lighting (PJU) – A network of 25 solar streetlight units (each 200 Wp) generates an estimated 675 kWh/month, supplying renewable electricity for outdoor lighting across main campus areas.
3. Rooftop Solar Installation (BLK) – A 2 kWp rooftop photovoltaic system installed at the Vocational Training Center produces roughly 270 kWh/month for local facility use.
4. Off-Grid Solar PV Gazebo – UNIMUS also operates an off-grid photovoltaic (PV) system installed at the campus gazebo. The system functions independently from the utility grid and supplies renewable electricity for lighting and small electrical loads in the surrounding area. The installation contributes approximately 200 kWh/month of clean electricity while serving as a demonstration facility for

The total renewable energy production amounts to 46,985 kWh/month, equivalent to 563,820 kWh/year. When compared to the university's total electricity consumption of 383,430 kWh/month (≈ 4,601,160 kWh/year), the ratio of renewable energy production is calculated as:

No	Renewable Energy	Production (in kWh)
1	Biodiesel	45,840
2	Solar panel	0,180
3	Solar Power Rooftop BLK	0,270
4	PLTS off grid gazebo	0,200
	Total	46,290

$$Renewable\ Energy\ Ratio\ = \frac{46{,}290}{369{,}547}\ x\ 100\%\ =\ 12.53\%$$

Evidence
UI GreenMetric Questionnaire

University : Universitas Muhammadiyah Semarang
Country : Semarang, Central Java, Indonesia
Web Address : https://greenmetric.unimus.ac.id/

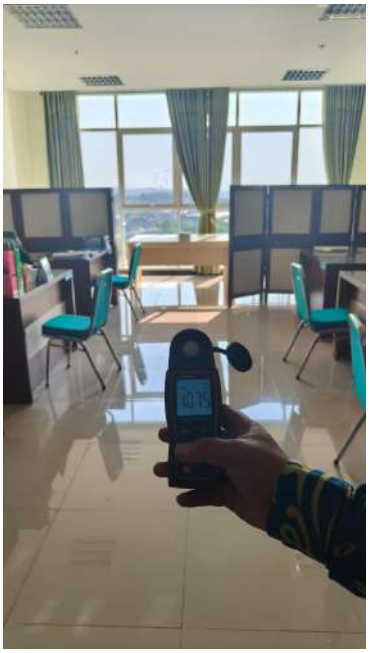
[2] Energy and Climate Change (EC)

[2.9] Elements of Green Building Implementation as Reflected in All Buildings (EC.6)

Large windows allow for ample natural daylight, minimizing the use of artificial lighting during daytime hours (Universitas Muhammadiyah Semarang, Indonesia)


1139

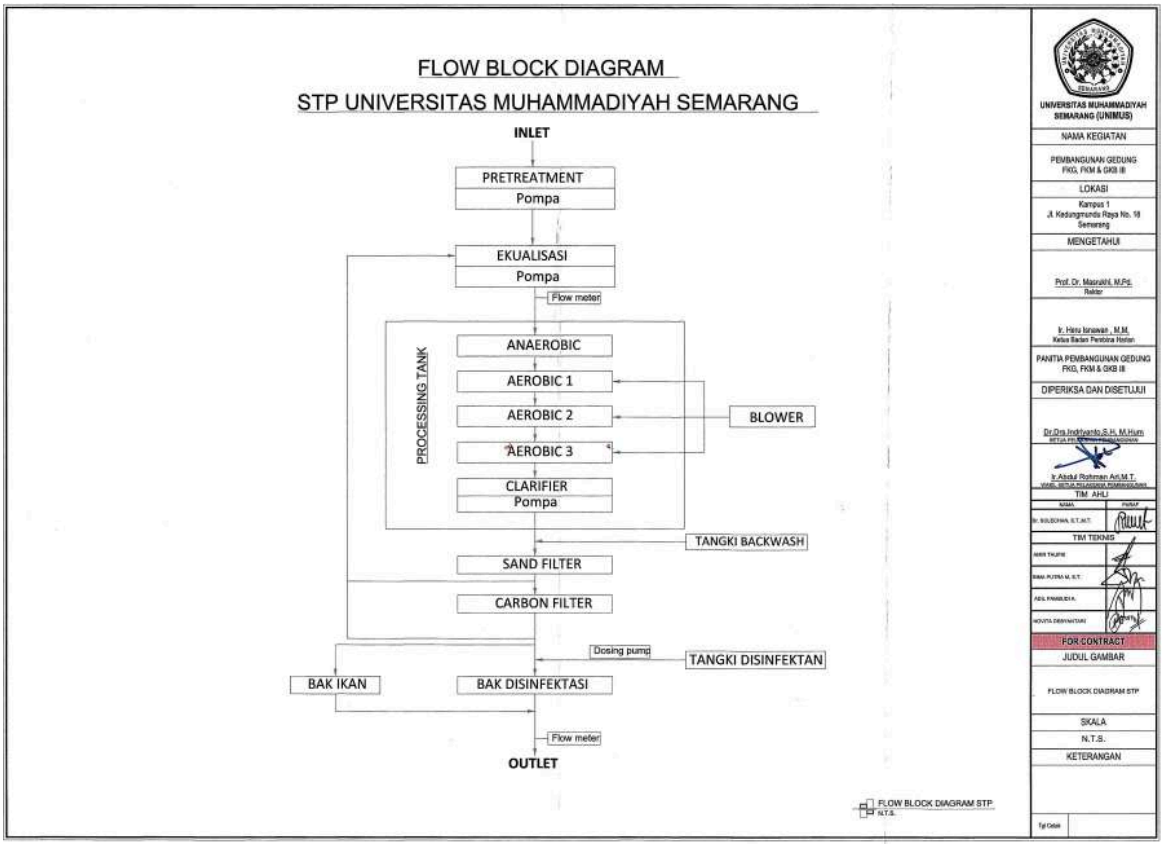

1045

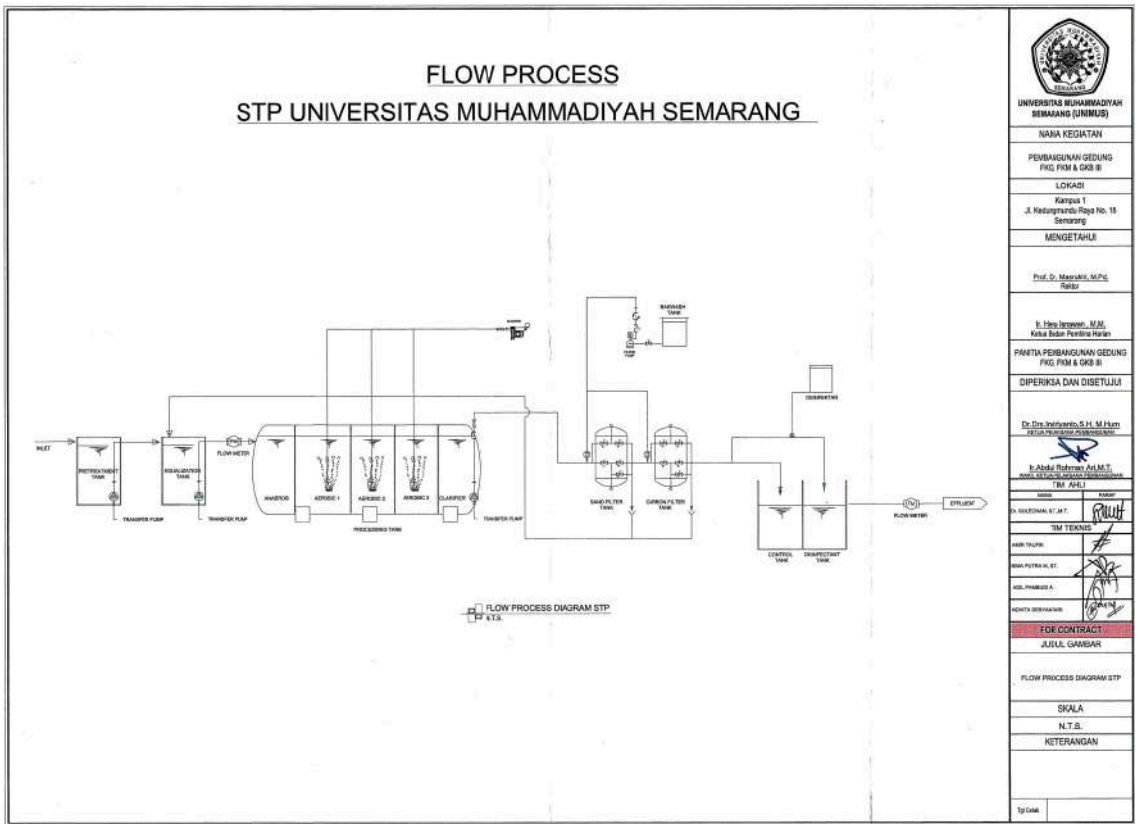


The presence of natural ventilation systems promotes healthy air circulation and thermal comfort while reducing reliance on mechanical air conditioning (Universitas Muhammadiyah Semarang, Indonesia)


Water Efficiency The on-site Wastewater Treatment Installation (IPAL)







Electrical distribution panels and sub-metering systems are installed in several buildings to monitor and control energy usage efficiently

The photographs above illustrate the implementation of four Green Building elements within the UNIMUS campus facilities:

1. **Indoor Environmental Quality** The presence of natural ventilation systems promotes healthy air circulation and thermal comfort while reducing reliance on mechanical air conditioning. This approach enhances occupant well-being and supports energy conservation.

2. **Energy Efficiency** Large windows allow for ample natural daylight, minimizing the use of artificial lighting during daytime hours. This design strategy decreases electricity consumption and improves visual comfort within classrooms and laboratories.
3. **Water Efficiency** The On-site **Wastewater Treatment Installation (IPAL)** processes and reuses greywater for irrigation and sanitary flushing. This system demonstrates UNIMUS's commitment to responsible water management and conservation.
4. **Energy Management** Electrical distribution panels and sub-metering systems are installed in several buildings to monitor and control energy usage efficiently. These systems support energy audits and ensure continuous improvement in campus energy performance.

These elements collectively reflect a strong application of the **Green Building Index (GBI)** framework, integrating principles of efficiency, health, and sustainability across the campus. The combination of ventilation, daylighting, water recycling, and energy monitoring demonstrates UNIMUS's tangible actions toward sustainable campus management, aligned with SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).

Evidence
UI GreenMetric Questionnaire

University : Universitas Muhammadiyah Semarang
Country : Semarang, Central Java, Indonesia
Web Address : https://greenmetric.unimus.ac.id/

[2] Energy and Climate Change (EC)

[2.10] Greenhouse gas emission reduction program (EC.7)

	
1. Charge parking (RS Unimus)	2. Renewable energy (UNIMUS, Indonesia)

3. Ride Share (Universitas Muhammadiyah Semarang)

Description:

Universitas Muhammadiyah Semarang (UNIMUS) implements a systematic approach to reduce greenhouse gas emissions, focusing on energy transition and operational efficiency across all three scopes. The university employs **biodiesel-powered generators** to substitute fossil-based fuels (Scope 1), installs **solar-powered lighting systems** and LED-based energy-saving fixtures to reduce dependency on PLN electricity (Scope 2), and operates a comprehensive **wastewater treatment (IPAL)** and **waste segregation program** to minimize indirect emissions (Scope 3).

These programs are designed to minimize the university's carbon footprint through renewable energy utilization, improved energy efficiency, and sustainable waste management practices. The initiatives are aligned with **SDG 7 (Affordable and Clean Energy)**, **SDG 11 (Sustainable Cities and Communities)**, and **SDG 13 (Climate Action)**, contributing to UNIMUS's vision of a low-carbon, environmentally responsible campus.

Mapping of UNIMUS Activities to Greenhouse Gas Emission Scopes

Scope	Emission Data	UNIMUS Activities / Evidence (from document)	Description & Impact
Scope 1	Stationary combustion	Use of biodiesel generator (Bio Solar B20–B30)	Reduces CO_2 emissions from on-site power generation by replacing fossil diesel with biodiesel fuel.
	Mobile combustion	Limited vehicle usage and controlled university transport fleet	Minimizes direct fuel combustion emissions within campus operations.
	Process emissions	Proper ventilation and fume hood systems in laboratories	Prevents direct gas or chemical vapor release from lab activities.
Scope 2	Purchased electricity	Solar-powered Street lighting (PJU) and efficient lighting systems	Reduces dependency on electricity from PLN, which primarily sources energy from fossil fuels.
		Energy conservation programs and LED retrofitting	Decreases campus-wide electricity consumption and lowers indirect emissions.
Scope 3	Waste	Waste management and wastewater treatment (IPAL)	Reduces methane and CO_2 emissions from waste decomposition and water pollution.
	Purchased water	Water efficiency through reuse and recycling systems	Reduces energy required for municipal water treatment and delivery.
	Commuting	Campus area layout supporting pedestrian access	Lowers emissions generated from commuting by vehicles inside campus.

Evidence
UI GreenMetric Questionnaire

University : Universitas Muhammadiyah Semarang
Country : Semarang, Central Java, Indonesia
Web Address : https://greenmetric.unimus.ac.id/

[2] Energy and Climate Change (EC)

[2.11] Please Provide The Total Carbon Footprint (CO_2 emission in the last 12 months, in metric tons)

CO_2 (electricity)

$$= \frac{electricity\ usage\ per\ year\ (kWh)}{1000} \times 0,84$$

$$= \frac{1.239.270\ kWh}{1000} \times 0,84$$

$$= 1.040,99 \text{ metric tons}$$

CO_2 (bus)

$$= \frac{number\ of\ shuttle\ bus\ in\ your\ university \times total\ trips\ for\ shuttle\ bus\ service\ each\ day \times approximate\ travel\ distance\ of\ vehicle\ each\ day\ insid}{100}$$

$$= \frac{1 \times 9 \times 1.966 \times 240}{100} \times 0,01$$

$$= 0,42 \text{ metric tons}$$

CO_2 (cars)

$$= \frac{number\ of\ cars\ entering\ your\ university \times 2 \times approximate\ travel\ distance\ of\ vehicle\ each\ day\ inside\ campus\ only\ (KM) \times 240}{100} \times 0,02$$

$$= \frac{517 \times 2 \times 1.966 \times 240}{100} \times 0,01$$

$$= 48,79 \text{ metric tons}$$

CO_2 (motorcycle)

$$= \frac{number\ of\ motorcycle\ entering\ your\ university \times 2 \times approximate\ travel\ distance\ of\ vehicle\ each\ day\ inside\ campus\ only\ (KM) \times 240}{100} \times 0,0$$

$$= \frac{5177 \times 2 \times 1.966 \times 240}{100} \times 0,01$$

$$= 482,88 \text{ metric tons}$$

CO_2 (total)

$$= 1.040,00 + + 0,42 + 48,79 + 482,88$$

$$= 1.573,08 \text{ metric tons}$$

Carbon footprint = 1.573,08 metric tons

Total Carbon Footprint (UI GreenMetric)

Evidence
UI GreenMetric Questionnaire

University : Universitas Muhammadiyah Semarang
Country : Semarang, Central Java, Indonesia
Web Address : https://greenmetric.unimus.ac.id/

[2] Energy and Climate Change (EC)

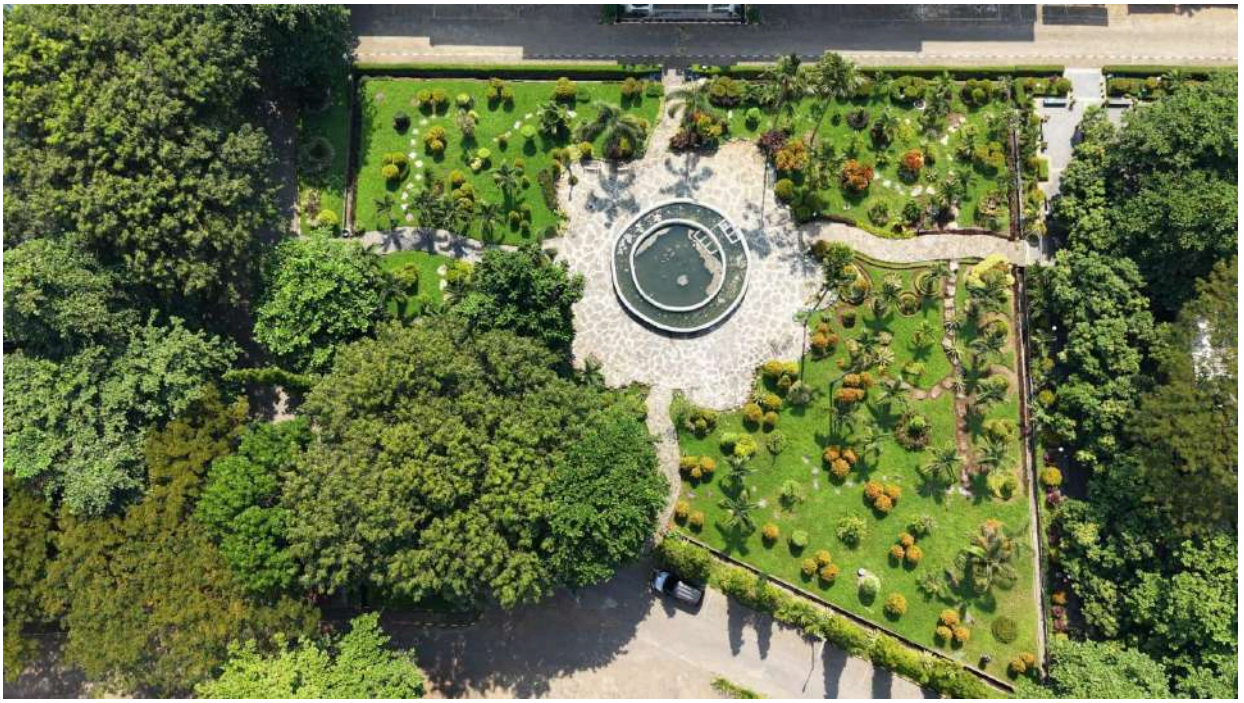
[2.13] Number of innovative program(s) in energy and climate change (EC.9)



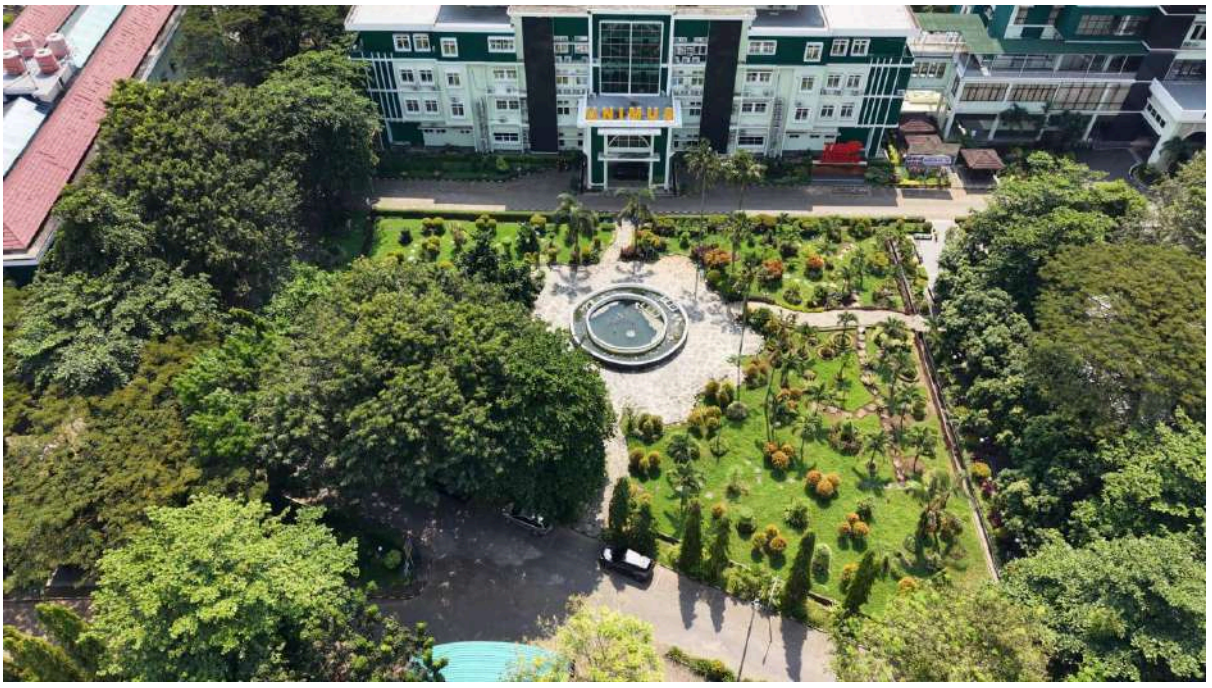

Renewable Energy System : Solar panel rooftop, biodiesel generator, smart microgrid.


Water & Waste Energy Recovery (Waste-to-energy project)

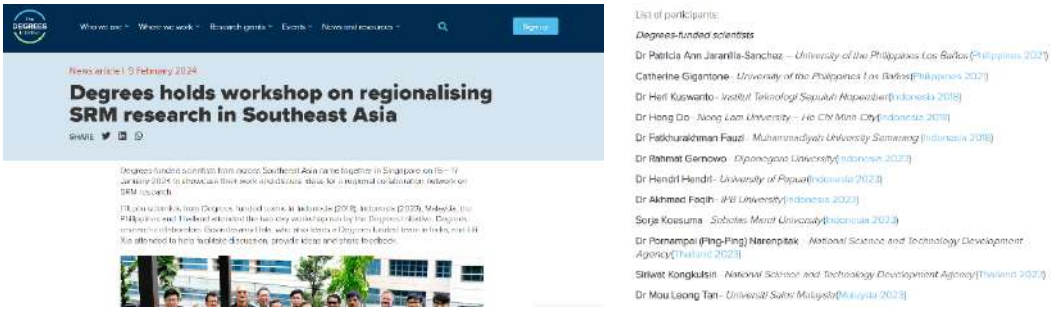

UNIMUS




UNIMUS


UNIMUS

Climate Resilience Program (Green open space expansion)



Education or Community-based Innovation

Description:

Universitas Muhammadiyah Semarang (UNIMUS) has initiated several innovative programs to enhance energy efficiency and mitigate the impact of climate change. These programs reflect a comprehensive approach to sustainability through the integration of renewable energy systems, efficient energy management, and environmental resilience initiatives.

1. **Renewable Energy System**
   UNIMUS operates solar-powered systems, including rooftop solar panels and solar-powered street lighting (PJU), to supply renewable electricity for campus operations. The university also implements

biodiesel generators (Bio Solar B20–B30) as an alternative to fossil-based fuels, reducing direct carbon emissions from campus energy use.

2. **Energy Efficiency and Management Innovation**
   The implementation of IoT-based energy monitoring and automation systems optimizes lighting, air conditioning, and other electrical devices to minimize energy waste. Additionally, the campus lighting has been upgraded to LED technology to ensure long-term efficiency and reduced electricity consumption.
3. **Water and Waste Energy Recovery**
   The university operates an **IPAL wastewater treatment system**, where treated greywater is reused for irrigation and cleaning purposes. This reduces the energy required for municipal water processing while supporting sustainable resource management.
4. **Climate Resilience and Green Campus Program**
   UNIMUS continuously expands **green open spaces** and vegetation coverage across campus to enhance carbon absorption and reduce heat island effects. These initiatives contribute to local climate adaptation and promote biodiversity within the university environment.
5. **Education and Community-Based Innovation**
   The university conducts awareness campaigns and community training on renewable energy and climate action, aligning academic learning with environmental practice.

Link Evidence Program

KEPUTUSAN REKTOR
UNIVERSITAS MUHAMMADIYAH SEMARANG
Nomor : 190/UNIMUS/SK.LL/2024
tentang
KEBIJAKAN PENGGUNAAN LAMPU *LIGHT EMITTING DIODE* (LED)
DI LINGKUNGAN UNIVERSITAS MUHAMMADIYAH SEMARANG

REKTOR UNIVERSITAS MUHAMMADIYAH SEMARANG

Menimbang : a. bahwa untuk meningkatkan efisiensi energi dan mendukung program penghematan listrik di lingkungan Universitas Muhammadiyah Semarang, perlu dilakukan penggantian lampu konvensional menjadi Lampu *Light Emitting Diode* (LED);
b. bahwa penggunaan Lampu *Light Emitting Diode* (LED) terbukti lebih hemat energi, ramah lingkungan, serta memiliki usia pakai yang lebih panjang;
c. bahwa sebagai perwujudannya perlu ditetapkan dengan surat keputusan Rektor.

Mengingat : 1. Undang–Undang Nomor 20 Tahun 2003, tentang Sistem Pendidikan Nasional;
2. Undang–Undang Nomor 12 Tahun 2012, tentang Pendidikan Tinggi;
3. Undang-Undang Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup;
4. Peraturan Pemerintah Nomor 70 Tahun 2009 tentang Konservasi Energi;
5. Keputusan Mendikbud Nomor:139/D/O/1999, tentang Pendirian Universitas Muhammadiyah di Semarang;
6. Keputusan PP Muhammadiyah Nomor:433/KEP/I.0/D/2023 tentang Pengangkatan Rektor Universitas Muhammadiyah Semarang Masa Jabatan 2023-2027

MEMUTUSKAN

Menetapkan : KEPUTUSAN REKTOR UNIVERSITAS MUHAMMADIYAH SEMARANG TENTANG KEBIJAKAN PENGGUNAAN LAMPU *LIGHT EMITTING DIODE* (LED) DI LINGKUNGAN UNIVERSITAS MUHAMMADIYAH SEMARANG

PERTAMA : Mengesahkan *Standard Operating Procedure* (SOP) Pemanfaatan Listrik di Lingkungan Universitas Muhammadiyah Semarang sebagaimana tercantum dalam Lampiran Keputusan ini;

KEDUA : Unit Pelaksana Teknis (UPT) Pengembangan Proyek Universitas wajib melakukan inventarisasi dan penggantian lampu konvensional secara bertahap sesuai dengan ketersediaan anggaran dan prioritas kebutuhan.

KETIGA : Keputusan ini berlaku sejak tanggal ditetapkan dengan ketentuan apabila di kemudian hari ternyata terdapat kekeliruan dalam penetapan ini segala sesuatunya akan diperbaiki sebagaimana mestinya.

Ditetapkan di : Semarang
Pada tanggal : 17 Jumadil Awal 1446 H
19 November 2024 M

Rektor,

Prof. Dr. Masrokhi, M.Pd.

Salinan disampaikan kepada Yth :
1. Para Wakil Rektor
2. Para Dekan dan Ka Lembaga
3. Para Ka UPT
4. Para Ka Biro

KEPUTUSAN REKTOR
UNIVERSITAS MUHAMMADIYAH SEMARANG
Nomor : 189/UNIMUS/SK.LL/2024
tentang
PENAMBAHAN SOLAR PANEL DI MASING-MASING GEDUNG
DI LINGKUNGAN UNIVERSITAS MUHAMMADIYAH SEMARANG

REKTOR UNIVERSITAS MUHAMMADIYAH SEMARANG

Menimbang : a. bahwa untuk meningkatkan efisiensi energi dan mendukung program pengurangan emisi karbon di lingkungan Universitas Muhammadiyah Semarang, perlu dilakukan penambahan solar panel pada masing-masing gedung;
b. bahwa pelaksanaan penambahan solar panel dimaksud sebagai upaya mendukung penerapan energi terbarukan dan keberlanjutan operasional
c. bahwa sebagai perwujudannya perlu ditetapkan dengan surat keputusan Rektor.

Mengingat : 1. Undang–Undang Nomor 20 Tahun 2003, tentang Sistem Pendidikan Nasional;
2. Undang–Undang Nomor 12 Tahun 2012, tentang Pendidikan Tinggi;
3. Undang-Undang Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup;
4. Peraturan Pemerintah Nomor 70 Tahun 2009 tentang Konservasi Energi;
5. Keputusan Mendikbud Nomor:139/D/O/1999, tentang Pendirian Universitas Muhammadiyah di Semarang;
6. Keputusan PP Muhammadiyah Nomor:433/KEP/I.0/D/2023 tentang Pengangkatan Rektor Universitas Muhammadiyah Semarang Masa Jabatan 2023-2027

MEMUTUSKAN

Menetapkan : KEPUTUSAN REKTOR UNIVERSITAS MUHAMMADIYAH SEMARANG TENTANG PENAMBAHAN SOLAR PANEL DI MASING-MASING GEDUNG DI LINGKUNGAN UNIVERSITAS MUHAMMADIYAH SEMARANG

PERTAMA : Melaksanakan penambahan solar panel di masing-masing gedung yang berada dalam lingkungan Universitas Muhammadiyah Semarang

KEDUA : Daftar gedung prioritas pemasangan solar panel sebagaimana dalam lampiran Surat Keputusan ini;

KETIGA : Pemasangan solar panel di masing-masing gedung di bawah koordinasi Unit Pelaksana Teknis (UPT) Pengembangan Proyek Universitas;

KEEMPAT : Keputusan ini berlaku sejak tanggal ditetapkan dengan ketentuan apabila di kemudian hari ternyata terdapat kekeliruan dalam penetapan ini segala sesuatunya akan diperbaiki sebagaimana mestinya.

Ditetapkan di : Semarang
Pada tanggal : 26 Rabiul Akhir 1446 H
29 Oktober 2024 M

Rektor,

Prof. Dr. Masrokhi, M.Pd.

Salinan disampaikan kepada Yth :
1. Para Wakil Rektor
2. Para Dekan dan Ka Lembaga
3. Para Ka Biro
4. Ka UPT UPPU

KEPUTUSAN REKTOR
UNIVERSITAS MUHAMMADIYAH SEMARANG
Nomor : 170/UNIMUS/SK.LL/2024

tentang

STANDARD OPERATING PROCEDURE (SOP) PEMANFAATAN LISTRIK
DI LINGKUNGAN UNIVERSITAS MUHAMMADIYAH SEMARANG

REKTOR UNIVERSITAS MUHAMMADIYAH SEMARANG

Menimbang :
a. bahwa penggunaan listrik di lingkungan Universitas Muhammadiyah Semarang perlu dikelola secara efektif dan efisien untuk mendukung kelestarian lingkungan dan penghematan energi;
b. bahwa diperlukan pedoman baku berupa *Standard Operating Procedure* (SOP) dalam pemanfaatan listrik di setiap unit kerja;
c. bahwa sebagai perwujudannya perlu ditetapkan dengan surat keputusan Rektor.

Mengingat :
1. Undang-Undang Nomor 20 Tahun 2003, tentang Sistem Pendidikan Nasional;
2. Undang-Undang Nomor 12 Tahun 2012, tentang Pendidikan Tinggi;
3. Undang-Undang Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup;
4. Peraturan Pemerintah Nomor 70 Tahun 2009 tentang Konservasi Energi;
5. Keputusan Mendikbud Nomor:139/D/O/1999, tentang Pendirian Universitas Muhammadiyah di Semarang;
6. Keputusan PP Muhammadiyah Nomor:433/KEP/I.0/D/2023 tentang Pengangkatan Rektor Universitas Muhammadiyah Semarang Masa Jabatan 2023-2027

MEMUTUSKAN

Menetapkan : KEPUTUSAN REKTOR UNIVERSITAS MUHAMMADIYAH SEMARANG TENTANG *STANDARD OPERATING PROCEDURE* (SOP) PEMANFAATAN LISTRIK DI LINGKUNGAN UNIVERSITAS MUHAMMADIYAH SEMARANG

PERTAMA : Mengesahkan *Standard Operating Procedure* (SOP) Pemanfaatan Listrik di Lingkungan Universitas Muhammadiyah Semarang sebagaimana tercantum dalam Lampiran Keputusan ini;

KEDUA : *Standard Operating Procedure* (SOP) sebagaimana dimaksud dalam Diktum KESATU menjadi pedoman seluruh unit kerja dalam pengelolaan, penggunaan, dan penghematan energi listrik;

KETIGA : Seluruh pimpinan unit kerja wajib melakukan sosialisasi, pelaksanaan, serta pengawasan terhadap implementasi *Standard Operating Procedure* (SOP) ini;

KEEMPAT : Keputusan ini berlaku sejak tanggal ditetapkan dengan ketentuan apabila di kemudian hari ternyata terdapat kekeliruan dalam penetapan ini segala sesuatunya akan diperbaiki sebagaimana mestinya.

Ditetapkan di : Semarang
Pada tanggal : 16 Rabiul Akhir 1446 H
19 Oktober 2024 M

Rektor,

Prof. Dr. Masrukhi, M.Pd.

Salinan disampaikan kepada Yth :
1. Para Wakil Rektor
2. Para Dekan dan Ka Lembaga
3. Para Ka UPT
4. Para Ka Biro

KEPUTUSAN REKTOR
UNIVERSITAS MUHAMMADIYAH SEMARANG
Nomor : 188/UNIMUS/SK.LL/2024

tentang

KEBIJAKAN PENGGANTIAN PENERANGAN JALAN UMUM (PJU) DENGAN SOLAR PANEL
UNIVERSITAS MUHAMMADIYAH SEMARANG

REKTOR UNIVERSITAS MUHAMMADIYAH SEMARANG

Menimbang :
a. bahwa dalam rangka peningkatan efisiensi energi dan mendukung gerakan lingkungan berkelanjutan, perlu dilakukan penggantian sistem penerangan jalan umum dengan energi terbarukan di lingkungan Universitas Muhammadiyah Semarang;
b. bahwa untuk mewujudkan hal tersebut, diperlukan kebijakan yang menjadi pedoman dalam pelaksanaan penggantian Penerangan Jalan Umum (PJU) dengan Solar Panel di lingkungan Universitas Muhammadiyah Semarang;
c. bahwa sebagai perwujudannya perlu ditetapkan dengan surat keputusan Rektor.

Mengingat :
1. Undang-Undang Nomor 20 Tahun 2003, tentang Sistem Pendidikan Nasional;
2. Undang-Undang Nomor 12 Tahun 2012, tentang Pendidikan Tinggi;
3. Undang-Undang Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup;
4 Peraturan Pemerintah Nomor 70 Tahun 2009 tentang Konservasi Energi;
5. Keputusan Mendikbud Nomor:139/D/O/1999, tentang Pendirian Universitas Muhammadiyah di Semarang;
6. Keputusan PP Muhammadiyah Nomor:433/KEP/I.0/D/2023 tentang Pengangkatan Rektor Universitas Muhammadiyah Semarang Masa Jabatan 2023-2027

MEMUTUSKAN

Menetapkan : KEPUTUSAN REKTOR UNIVERSITAS MUHAMMADIYAH SEMARANG TENTANG KEBIJAKAN PENGGANTIAN PENERANGAN JALAN UMUM (PJU) DENGAN SOLAR PANEL UNIVERSITAS MUHAMMADIYAH SEMARANG

PERTAMA : Menetapkan Kebijakan Penggantian Penerangan Jalan Umum (PJU) dengan Solar Panel di Universitas Muhammadiyah Semarang;

KEDUA : Kebijakan Penggantian Penerangan Jalan Umum (PJU) sebagaimana dalam lampiran Surat Keputusan ini;

KETIGA : Penggantian Penerangan Jalan Umum (PJU) Dengan Solar Panel berada di bawah koordinasi Unit Pelaksana Teknis (UPT) Pengembangan Proyek Universitas;

KEEMPAT : Keputusan ini berlaku sejak tanggal ditetapkan dengan ketentuan apabila di kemudian hari ternyata terdapat kekeliruan dalam penetapan ini segala sesuatunya akan diperbaiki sebagaimana mestinya.

Ditetapkan di : Semarang
Pada tanggal : 26 Rabiul Akhir 1446 H
29 Oktober 2024 M

Rektor,

Prof. Dr. Masrukhi, M.Pd.

Salinan disampaikan kepada Yth :
1. Para Wakil Rektor
2. Para Dekan
3. Para Program Studi
4. Para Ka Biro

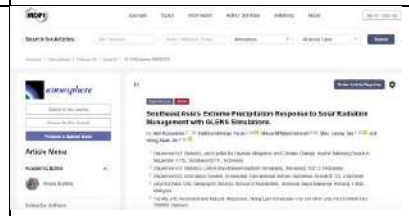
Evidence
UI GreenMetric Questionnaire

University : Universitas Muhammadiyah Semarang
Country : Semarang, Centrak Java, Indonesia
Web Address : https://greenmetric.unimus.ac.id/

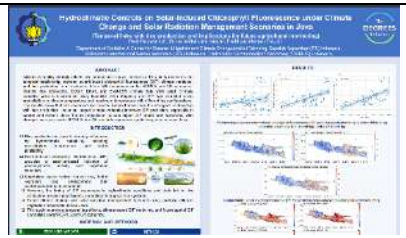
[2] Energy and Climate Change (EC)
[2.14] Impactful university program(s) on climate change (EC.10)

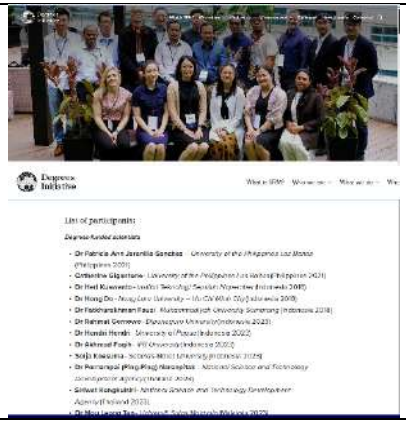
Supporting evidence must include the training materials and a list of participants

No	Programs	Scope (international / regional / national / local / etc)	Total Participants	Photo	URL	Short Description
1	UI GreenMetric Online Course on Sustainability 2021 (September 2021 – January 2022)	International	100 Students		URL https://www.atlantis-press.com/proceedings/lewis-eas-24/126014400	Countries along the equator receive a relatively high level of solar radiation, which is crucial for solar power plants. In this context, Indonesia is well-suited for the implementation of solar power plants. The amount of power generated by a solar power plant is directly related to the intensity of solar radiation that reaches the solar panels. To maximize electricity production, it is essential to design the optimal tilt angle for the solar panel units to be installed on the roof of Rusunawa Putra. This study explores the impact of the solar panel installation's tilt design on the

						power output of a building within a campus setting. The research method involves testing a combination of tilt angles—20°, 30°, and 40°—to determine the most efficient energy production. Daily sunlight data is simulated using PvSyst software. The findings indicate that the most efficient energy production occurs when the solar panels are tilted at a 20° angle relative to the horizontal roof plane. Additionally, connecting more modules in series increases the total voltage, while connecting more modules in parallel enhances the total current.
2	Southeast Asia's Extreme Precipitation Response to Solar Radiation Management with GLENS Simulations	Publication	...		https://www.mdpi.com/2073-4433/16/6/725	This study evaluates the impacts of Solar Radiation Management (SRM) on precipitation-related climate extremes in Southeast Asia. Using simulations from the Geoengineering Large Ensemble (GLENS), we assess spatial anomalies and differences in extreme precipitation indices—number of wet days (RR1), very heavy precipitation days (R20mm), maximum 5-day precipitation (Rx5day), consecutive dry days (CDD), and consecutive wet days (CWD)—relative to historical (1980–2009) and Representative Concentration Pathway 8.5 (RCP8.5) baselines. The results reveal that SRM induces highly heterogeneous precipitation responses across the region. While SRM increases rainfall frequency in parts of Indonesia, it reduces the number of wet days and lengthens dry spells over Vietnam, Thailand, and the Philippines. Spatial variations are also observed in changes to heavy precipitation days and multi-day rainfall events,

						with potential implications for flood and drought risks. These findings highlight the complex trade-offs in hydrological responses under SRM deployment, with important considerations for agriculture, water resource management, and climate adaptation strategies in Southeast Asia.
3	Hydro-climatic extremes in Southeast Asia under SRM	Publication			https://www.degrees.ngo/our-work/projects/indonesia/	Prof. Kuswanto and his team are researching the potential impacts of SRM on the climate in Southeast Asia. The project builds on the pioneering SRM research conducted by the team since 2018 on extreme temperature and precipitation over Indonesia. Their goal is now to understand how SRM could influence rainfall and temperature extremes as well as floods and droughts in the river basins of Bengawan Solo in Indonesia, Kelantan in Malaysia, and Vu Gia-Thu Bon in Vietnam. The project is hosted at the Institut Teknologi Sepuluh Nopember in Surabaya, Indonesia, and features collaborations with researchers from Universiti Sains Malaysia and Nong Lam University in Vietnam.
4	K-Nearest Neighbor (KNN) Method for Weather Data Prediction	Publication			https://jurnalnew.unimus.ac.id/index.php/jodi/article/view/214	The weather tends to change frequently every day, so weather forecasts are made to be used as an early warning if sudden weather changes occur. By forecasting the weather, losses can be minimized and people are alert to carry out outdoor activities. From this problem, the K-Nearest Neighbor (KNN) method was applied. This method is expected to provide accurate and efficient information to obtain weather predictions for existing conditions. The data used is secondary data. After conducting research on

						training data (old data) amounting to 80% and test data (new data) amounting to 20%. The accuracy results from the testing data predictions are 75% with a value of k = 8.
5	PERBANDINGAN METODE NAÏVE BAYES, KNN, DECISION TREE PADA LAPORAN WATER LEVEL JAKARTA	Publication			https://amikjtc.com/jurnal/index.php/jurnal/article/view/175	The purpose of this study is to compare the Naïve Bayes, K-Nearest Neighbor (KNN), and Decision Tree methods. The dataset used in this research consists of water level reports in Jakarta obtained from data.go.id. The evaluation includes measuring the confusion matrix, precision, recall, accuracy, and F-measure, as well as calculating the root mean square error (RMSE) for each method. Based on the results, the Decision Tree method achieved the highest accuracy of 96.56%, indicating that the Decision Tree classification method performs better than Naïve Bayes and KNN.
6	Hydroclimatic Controls on Solar-Induced Chlorophyll Fluorescence under Climate Change and Solar Radiation Management Scenarios in Java	International				Climate variability strongly affects rice production in Java, Indonesia. This study examines the temporal relationship between solar-induced chlorophyll fluorescence (SIF), climate variables, and rice production, and evaluates future SIF responses under RCP4.5 and G4 scenarios. Monthly rice production, GOSIF, ERA5, and BNU-ESM climate data were used. Climate variables were bias-corrected using Quantile Delta Mapping, and SIF was modeled using precipitation, minimum temperature, and maximum temperature with different lag configurations. The results show that SIF observed two months before harvest has the strongest relationship with rice production.

						Including lagged climate variables improves SIF prediction, especially in central and eastern Java. Future projections indicate higher SIF under both scenarios, with stronger increases under RCP4.5 than G4 and heterogeneous spatial responses across Java.
7	Regionalising SRM Research: Southeast Asian Scientists Unite Against Climate Challenges	International			https://degrees.ngo/degrees-holds-workshop-on-regionalising-srm-research-in-southeast-asia/	

Description:

The listed programs and publications highlight various sustainability and climate-related research initiatives. The *UI GreenMetric Online Course on Sustainability 2021* involved 100 international students exploring optimal solar panel tilt designs to enhance energy efficiency in tropical regions like Indonesia. The study *Southeast Asia's Extreme Precipitation Response to Solar Radiation Management (SRM)* analyzed GLENS simulations, revealing diverse precipitation impacts across Southeast Asia, with increased rainfall in Indonesia but longer dry periods in Vietnam, Thailand, and the Philippines. Similarly, *Hydro-climatic Extremes in Southeast Asia under SRM* examined SRM's influence on temperature, rainfall, and flood patterns in river basins across Indonesia, Malaysia, and Vietnam through a regional research collaboration. The publication *K-Nearest Neighbor (KNN) Method for Weather Data Prediction* applied the KNN algorithm for weather forecasting, achieving 75% prediction accuracy, while *Comparison of Naïve Bayes, KNN, and Decision Tree Methods on Jakarta Water Level Reports* found that the Decision Tree method achieved the highest accuracy (96.56%) for classifying water level data, indicating its superiority for environmental prediction tasks.

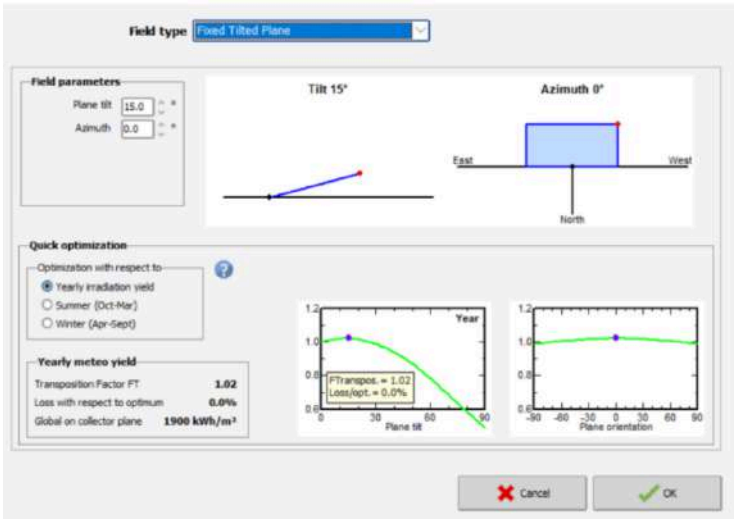
Evidence
UI GreenMetric Questionnaire

University : Universitas Muhammadiyah Semarang
Country : Semarang, Central Java, Indonesia
Web Address : https://greenmetric.unimus.ac.id/

[2] Energy and Climate Change (EC)

[2.15] Planning, implementation, monitoring and/or evaluation of all programs related to Energy and Climate Change through the utilization of Information and Communication Technology (ICT) (EC.11)

Stage	Activities/Programs	ICT Utilization	Evidence	Timeline	Responsible Team/Department
Planning	Assess potential for solar panel installations	PVSyst mapping, renewable energy simulation software, GLENS software for climate change simulation, GELNS software for climate change simulation	Feasibility studies, site assessment reports	2022-2024	Unit Proyek Pengembangan Universitas
Implementation	Automated Lighting, AC Management, and Centralized Security	Project management lighting, AC, and CCTV	Installation logs, energy generation data	2022-now	Unit Proyek Pengembangan Universitas
Monitoring	IoT and Smart Monitoring, Electrical Sub-metering, and Consumption Logging	Renewable energy and efficiency monitoring systems	Energy production reports, performance analytics	On going	Unit Proyek Pengembangan Universitas



Renewable energy simulation software PVSyst and installation of renewable energy

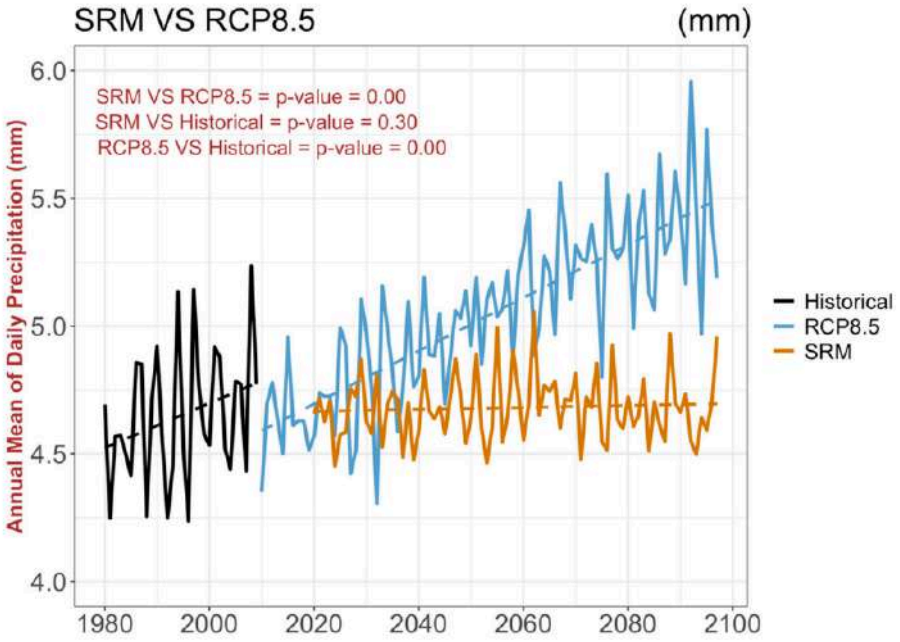
Description:

These systems form part of UNIMUS's long-term strategy to transition toward green energy and reduce greenhouse gas emissions.

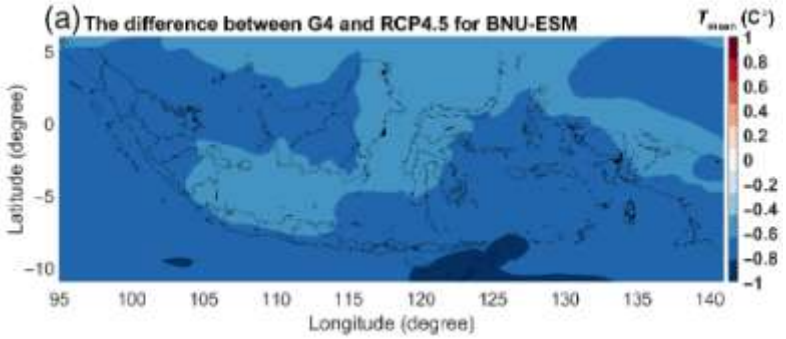
1. Biodiesel Power Generation
   UNIMUS operates two biodiesel-ready generator systems (CAT and MG Diesel Power) located in strategic facilities such as the Integrated Health Laboratory (Labkes), Unimus Medical Center (UMC), and the Data Center. Based on operational data, assuming an average 30 running hours per month, the generators produce approximately 45,840 kWh/month. The transition from conventional diesel to biodiesel (B20–B30) significantly reduces fossil fuel dependency and supports the national renewable energy policy.
2. Solar Power Systems UNIMUS operates two types of solar installations:
   - Solar-Powered Street Lighting (PJU Solar Panel): 25 units × 200 Wp = 5 kWp, producing roughly 675 kWh/month (assuming 4.5 peak sun hours/day).
   - Rooftop Solar at Vocational Training Center (BLK): 2 kWp system generating 270 kWh/month. The combined solar production equals 945 kWh/month, equivalent to ~1% of total monthly electricity consumption.
3. As part of the Clean Biomass Program, UNIMUS has introduced biomass briquette stoves in campus canteens. The briquettes, made from agricultural residues such as coconut shells and rice husks, are used for daily cooking. This initiative serves as a pilot project to reduce LPG consumption and promote renewable biomass energy utilization.

Here are the details of ICT utilization across these programs:

1. Planning with Simulation and Data Analysis
   ICT is used in the planning and research phases to model scenarios and predict outcomes related to climate and energy.
   Renewable Energy Simulation: Researchers at UNIMUS use PvSyst software to simulate daily sunlight data. This is done to design and determine the optimal tilt angle for solar panels to maximize energy production at the Rusunawa Putra (men's dormitory).
   Climate Modeling: Research at the university uses GLENS Simulations (Geoengineering Large Ensemble) to evaluate the impact of Solar Radiation Management (SRM).



Simulation Daily Precipitation with GLENS



Simulation with GELNS

2. Implementation on Smart Building and Automation
   ICT is at the core of the Smart Building concept implementation at UNIMUS, which covers 78.28% of the total campus building area. This system actively manages energy consumption through:

   Building Automation Systems: Automated Lighting: LED lights are equipped with motion sensors and illumination sensors, as well as light detection, to minimize energy waste.
   AC Management: Air conditioning systems are managed with timers and inverter-based operations.
   Centralized Security: CCTV and digital access control are integrated through a centralized network for security and monitoring.

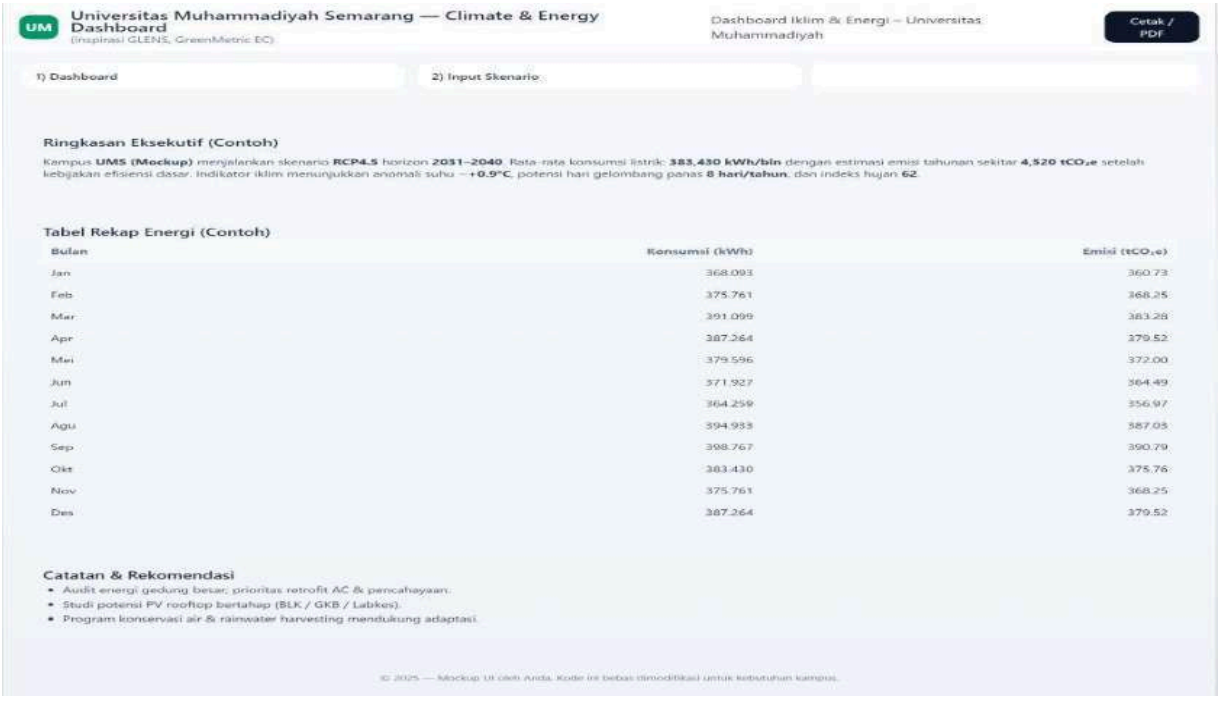
3. Monitoring and Evaluation: IoT and Sub-metering
   UNIMUS uses ICT extensively to monitor and evaluate the effectiveness of its energy efficiency programs.

Electrical Sub Metering PLN and other sources from solar cell

IoT and Smart Monitoring: The university has implemented an "IoT-based energy monitoring and automation system". This innovative program is specifically implemented in the FKG-FKM and UMC buildings as "IoT / Smart Energy Monitoring".

Electrical Sub-metering: Electrical distribution panels and sub-metering systems are installed in 10 main campus buildings. This ICT system is crucial for monitoring and controlling energy usage efficiently. Providing the necessary data to support energy audits. The ICT system can monitoring energy from PLN and energy from other sources like solar panels.

Consumption Logging: UNIMUS continuously monitors and records electricity consumption, with data visualized in monthly consumption graphs.



Universitas Muhammadiyah Semarang — Climate & Energy Dashboard

(inspirasi GLENS, GreenMetric EC)

Dashboard Iklim & Energi – Universitas Muhammadiyah

Cetak / PDF

1) Dashboard | 2) Input Skenario

Ringkasan Eksekutif (Contoh)

Kampus **UMS (Mockup)** menjalankan skenario **RCP4.5** horizon **2031–2040**. Rata-rata konsumsi listrik: **383,430 kWh/bln** dengan estimasi emisi tahunan sekitar **4,520 tCO₂e** setelah kebijakan efisiensi dasar. Indikator iklim menunjukkan anomali suhu ~ **+0.9°C**, potensi hari gelombang panas **8 hari/tahun**, dan indeks hujan **62**.

Tabel Rekap Energi (Contoh)

Bulan	Konsumsi (kWh)	Emisi (tCO₂e)
Jan	368.093	360.73
Feb	375.761	368.25
Mar	391.099	383.28
Apr	387.264	379.52
Mei	379.596	372.00
Jun	371.927	364.49
Jul	364.259	356.97
Agu	394.933	387.03
Sep	398.767	390.79
Okt	383.430	375.76
Nov	375.761	368.25
Des	387.264	379.52

Catatan & Rekomendasi

- Audit energi gedung besar; prioritas retrofit AC & pencahayaan.
- Studi potensi PV rooftop bertahap (BLK / GKB / Labkes).
- Program konservasi air & rainwater harvesting mendukung adaptasi.

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Consumption Logging kWh and Emision

Evidence
UI GreenMetric Questionnaire

University : Universitas Muhammadiyah Semarang
Country : Semarang, Central Java, Indonesia
Web Address : https://greenmetric.unimus.ac.id/

[2] Energy and Climate Change (EC)

[2.16] Impact of Energy and Climate Change programs in supporting the Sustainable Development Goals (SDGs)

Solar Power Systems

Description:

The university has undertaken a wide range of energy and climate-related programs that contribute significantly to the achievement of the **17 Sustainable Development Goals (SDGs)**. These initiatives demonstrate a strong commitment to reducing carbon emissions, enhancing energy efficiency, and fostering climate resilience. These efforts directly support **17 SDG's** contribute direct and indirectly, including:

SDG 1: No Poverty (Indirect Impact) -- UNIMUS's EC programs indirectly support SDG 1 through initiatives focused on skills development. The university operates a Vocational Training Center (BLK), which is itself powered by a rooftop solar panel system. By providing vocational training, the university equips individuals with practical, in-demand skills, which is a fundamental pathway to securing employment and alleviating poverty.

SDG 2: Zero Hunger (Indirect Impact) -- A connection to SDG 2 can be seen in the university's Clean Biomass Program. UNIMUS has introduced biomass briquette stoves for use in campus canteens. These briquettes are notable for being "made from agricultural residues such as coconut shells and rice husks". This initiative supports a more sustainable food system (canteen operations) by creating clean energy from agricultural waste products, promoting a circular economy within the food-energy nexus.

SDG 3: Good Health and Well-being -- The *Green Building* initiatives directly foster a healthier campus environment for students and staff. A key element is the focus on Indoor Environmental Quality, which is enhanced through natural ventilation systems designed to promote healthy air circulation and improve thermal comfort. In key buildings, this is further supported by the installation of "Carbon Dioxide Monitoring and Control" systems.

SDG 4: Quality Education -- The EC programs are integrated into the university's core educational mission. The campus itself functions as a living laboratory for sustainable practices. UNIMUS actively conducts community training and awareness campaigns focused on renewable energy and climate action. This practical application is backed by academic research, with faculty and students publishing studies on topics such as *Solar Radiation Management (SRM)*.

SDG 6: Clean Water and Sanitation -- Water conservation is a key part of the university's *Green Building* and *GHG Reduction* programs. UNIMUS operates an on-site Wastewater Treatment Installation (IPAL). This facility processes and reuses greywater for non-potable uses such as irrigation, which simultaneously conserves water and contributes to the university's Scope 3 emissions reduction strategy.

SDG 7: Affordable and Clean Energy -- This goal is central to UNIMUS's EC programs. The university actively supports this goal by generating 12.07% of its energy from on-campus renewable sources. This production is achieved through two biodiesel generators (B20-B30) that produce approximately 45,840 kWh/month and solar power systems, including 25 solar-powered street lights(PJU) and a rooftop installation on the Vocational Training Center (BLK). This is complemented by a strong focus on energy efficiency, with an average of 52% of campus appliances being energy-efficient. Key achievements include a 100% transition to 18,752 LED lamps and the gradual adoption of inverter-based AC units.

SDG 8: Decent Work and Economic Growth (Indirect Impact) -- The EC programs directly contribute to SDG 8 by fostering "green jobs" and supporting an efficient, modern economy. The implementation, management, and maintenance of advanced infrastructure *Smart Building* coverage, Green Building elements, solar panel installations, and biodiesel generators —create a clear demand for a skilled workforce in engineering, technology, and energy management. The Vocational Training Center (BLK) further supports this by developing a competent workforce

SDG 9: Industry, Innovation, and Infrastructure -- The EC programs are built on a foundation of technological innovation. The university has developed smart infrastructure, including IoT-based energy monitoring systems, automated lighting and AC controls, and the development of a *smart microgrid*. This commitment to innovation extends to research and development, where faculty use PvSyst software to simulate and optimize solar panel designs and GLENS simulations to model climate change impacts.

SDG 10: Reduced Inequalities (Indirect Impact) -- UNIMUS's campus management initiatives support SDG 10 by helping reduce inequalities in accessibility and mobility. The provision of on-campus transportation, such as the "Ride Share" electric golf carts, and ensuring the campus is connected to public transport, like the "Trans Semarang Feeder F2B", helps ensure that all campus facilities are accessible to every member of the community, including those with potential mobility limitations.

SDG 11: Sustainable Cities and Communities -- UNIMUS contributes to this goal by creating a sustainable "micro-city" environment on its campus. A major component is the *Smart Building* implementation. This is supported by *Green Building* elements integrated into all facilities, such as the use of large windows to maximize natural daylight and building designs that promote natural ventilation to reduce reliance on air conditioning. Sustainable transport is also promoted through a campus layout that supports pedestrian access and the use of electric golf carts for mobility.

SDG 12: Responsible Consumption and Production -- The university actively promotes sustainable consumption and production patterns. This is demonstrated through its sustainable procurement policies, such as the campus-wide replacement of conventional bulbs with LEDs and the prioritization of energy-efficient inverter AC units. Furthermore, the institutional switch to cleaner fuels, specifically B20-B30 biodiesel for its generators, represents a significant move toward more sustainable energy consumption.

SDG 13: Climate Action This is the primary objective of the EC initiatives. UNIMUS addresses this goal by first calculating its total carbon footprint, which amounts to 4,141.17 metric tons. The university then implements systematic reduction programs across all three emission scopes. Scope 1 emissions are reduced by substituting conventional diesel with cleaner biodiesel in its generators. Scope 2 emissions are tackled by reducing dependence on purchased electricity through on-site solar power generation and campus-wide efficiency measures like the LED retrofitting. Furthermore, UNIMUS enhances climate resilience by expanding green open spaces to increase carbon absorption and mitigate the urban heat island effect.

SDG 14: Life Below Water (Indirect Impact) -- The EC programs have a direct and positive impact on SDG 14. The university operates an on-site Wastewater Treatment Installation (IPAL). This system processes wastewater on campus and allows for the reuse of greywater. By treating wastewater before it is discharged, UNIMUS

significantly reduces the volume of pollutants entering local rivers, thereby preventing land-based pollution from reaching and harming marine ecosystems.

SDG 15: Life on Land (Indirect Impact) -- The EC programs are highly relevant to SDG 15. One of the university's key innovative initiatives is the "Climate Resilience and Green Campus Program". This program is explicitly focused on the continuous expansion of "green open spaces and vegetation coverage" across the campus. This action directly contributes to enhancing carbon absorption, mitigating urban heat island effects, and promoting biodiversity within the campus environment.

SDG 16: Peace, Justice, and Strong Institutions (Indirect Impact) -- The entire EC reporting effort is a testament to SDG 16. By participating in the UI GreenMetric Questionnaire and committing to transparent data reporting, UNIMUS demonstrates its role as an effective, accountable, and strong institution. Systemic actions like "monitoring and recording electricity consumption", calculating the "Total Carbon Footprint", and implementing "IoT-based energy monitoring" and "sub-metering systems" are all clear evidence of robust institutional governance and integrity.

SDG 17: Partnerships for the Goals -- UNIMUS actively pursues SDG 17 by forging multi-sectoral and international partnerships to achieve its sustainability goals. The university is engaged in a "Collaboration in Green Energy" with Gading Kencana SDN Berhad, a private sector company from Malaysia. Its researchers also collaborate internationally on projects, such as a study on Solar Radiation Management (SRM) involving partners from Institut Teknologi Sepuluh Nopember, Universiti Sains Malaysia, and Nong Lam University in Vietnam.