ANNASAHEB DANGE
COLLEGE OF ENGINEERING AND TECHNOLOGY, ASHTA

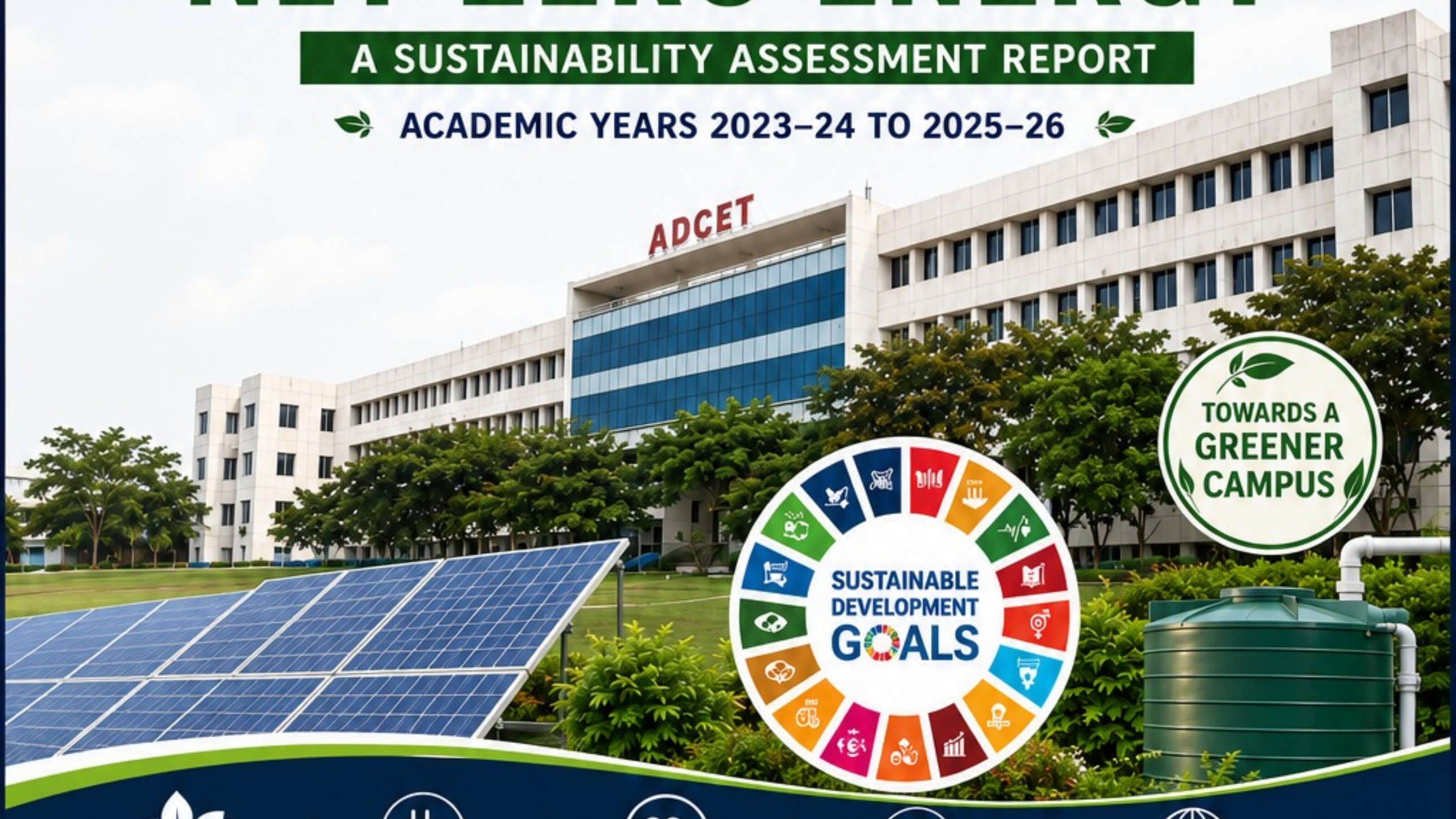
(An Empowered Autonomous Institute
affiliated to Shivaji University Kolhapur)

EDUCATE | ENGAGE | EMPOWER | SUSTAIN | TOGETHER FOR A BETTER FUTURE

SOLAR ENERGY UTILIZATION AND PROGRESS TOWARDS NET ZERO ENERGY

A SUSTAINABILITY ASSESSMENT REPORT

ACADEMIC YEARS 2023–24 TO 2025–26



RENEWABLE ENERGY | CLEAN & GREEN CAMPUS | CARBON REDUCTION | ECONOMIC SAVINGS | SUSTAINABLE FUTURE

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Message from the Director:

It gives me immense pleasure to present this report titled **"Solar Energy Utilization and Progress Towards Net Zero Energy"**, which reflects the commitment of Annasaheb Dange College of Engineering and Technology (ADCET), Ashta towards sustainable development and environmental responsibility.

In today's rapidly evolving world, institutions of higher education have a vital role in promoting sustainable practices that contribute to environmental protection while creating awareness among future engineers and professionals. At ADCET, sustainability is not merely an initiative but an integral part of our institutional philosophy, guiding our academic programs, research activities, campus development, and resource management practices.

The adoption of renewable energy, implementation of energy-efficient technologies, and promotion of responsible energy management are important milestones in our journey towards building a sustainable campus. These initiatives demonstrate our commitment to reducing environmental impact, conserving natural resources, and supporting national and global efforts towards clean energy and climate action.

This report presents a systematic assessment of the institute's renewable energy initiatives and highlights the progress made towards achieving long-term energy sustainability. It serves as a valuable record of our efforts and reinforces our resolve to continuously improve our environmental performance through innovation, responsible governance, and collective participation.

I congratulate the faculty members and all those associated with the preparation of this report for their dedicated efforts. I am confident that this document will not only showcase the institute's commitment to sustainability but will also inspire continuous improvement in creating a greener, cleaner, and more energy-efficient campus.

I extend my best wishes for the successful implementation of our future sustainability initiatives and reaffirm the institute's commitment to contributing towards a more sustainable future.

Dr. L Y. Waghmode
Director
Annasaheb Dange College of Engineering and Technology, Ashta

About this Report:

This report presents a comprehensive assessment of the utilization of solar energy at Annasaheb Dange College of Engineering and Technology (ADCET), Ashta, and documents the institute's progress towards achieving a Net Zero Energy Campus.

The report has been prepared using actual solar energy generation records, electricity consumption data, net metering records, and institutional sustainability initiatives. It highlights the environmental, economic, and operational benefits of renewable energy adoption while outlining the institute's future roadmap for expanding renewable energy infrastructure.

The document has been prepared as part of the institute's commitment to quality assurance, environmental sustainability, and continuous improvement. It serves as documentary evidence for institutional assessment, accreditation, green audits, and sustainability reporting.

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Disclaimer:
This publication has been prepared using authenticated institutional records, solar energy generation data, electricity consumption records, and other relevant information available at the time of publication. Every effort has been made to ensure the accuracy and reliability of the information presented. The institute reserves the right to revise or update the contents of this publication in light of new data, technological advancements, or changes in institutional policies.

1. Preamble

The increasing impacts of climate change, rapid urbanization and growing energy demand have made the transition towards clean and sustainable energy systems a global priority. Rising greenhouse gas emissions resulting from the extensive use of fossil fuels have contributed significantly to global warming, environmental degradation and resource depletion. Consequently, governments, industries and educational institutions across the world are increasingly adopting renewable energy technologies as an effective strategy to reduce carbon emissions, improve energy security and promote sustainable development.

Recognizing the urgency of addressing climate change, the Government of India has committed to achieving **Net Zero greenhouse gas emissions by the year 2070**, while simultaneously expanding the share of renewable energy in the national energy mix. This national commitment aligns with the United Nations Sustainable Development Goals (SDGs), particularly **SDG 7 (Affordable and Clean Energy)** and **SDG 13 (Climate Action)**, and encourages institutions across all sectors to adopt environmentally responsible practices that contribute to a low-carbon future.

Higher Educational Institutions have a unique responsibility in this national transition. Beyond imparting knowledge, they serve as living laboratories where sustainable technologies can be demonstrated, evaluated and integrated into institutional practices. Adoption of renewable energy systems within educational campuses not only reduces dependence on conventional grid electricity but also provides valuable opportunities for experiential learning, environmental awareness and responsible resource management among students and faculty members.

In line with its commitment to environmental sustainability and responsible campus development, **Annasaheb Dange College of Engineering and Technology (ADCET), Ashta**, has progressively adopted renewable energy as an integral component of its campus energy management strategy. The installation of a **100 kW grid-connected rooftop Solar Photovoltaic (PV) system under the Net Metering scheme**, commissioned in **March 2019**, represents a significant milestone in the institute's journey towards clean energy utilization. The system contributes to meeting the campus electricity demand through renewable energy while reducing dependence on conventional power sources and lowering the institute's carbon footprint.

This report presents a comprehensive assessment of ADCET's solar energy utilization during the **last three academic years (2023–24 to 2025–26)**. It analyses solar energy generation, campus electricity consumption, renewable energy contribution, carbon emission reduction, environmental benefits and economic savings, thereby demonstrating the institute's progressive movement towards a **Net Zero Energy campus** and its commitment to sustainable institutional development.

2. Solar Energy Generation Performance

The 100 kW grid-connected rooftop Solar Photovoltaic (PV) system installed at Annasaheb Dange College of Engineering and Technology (ADCET), Ashta, has been playing a significant role in enhancing renewable energy utilization and reducing dependence on conventional grid electricity. The system has consistently generated clean electrical energy while contributing towards the institute's commitment to sustainable campus development and its long-term vision of progressing towards Net Zero Energy.

This section presents a comprehensive analysis of the solar energy generated during the last three academic years. The analysis includes monthly electricity generation, annual performance, seasonal trends and key performance indicators, thereby providing an overall assessment of the operational performance of the solar PV installation.

2.1 Month-wise Solar Energy Generation

Table 2.1 presents the month-wise electricity generated through the rooftop solar PV system during the three academic years under consideration.

Table 2.1 Month-wise Solar Energy Generation

Month	AY 2023–24 (kWh)	AY 2024–25 (kWh)	AY 2025–26* (kWh)
June	10,218	3,241	7,756
July	6,680	22	7,795
August	9,058	3,766	6,902
September	8,269	8,198	4,570
October	9,140	8,351	4,585
November	7,812	8,347	4,588
December	8,134	7,292	4,591
January	7,952	7,908	6,860
February	7,496	6,754	8,367
March	7,788	8,056	9,640
April	8,260	9,835	10,118
May	10,268	8,936	10,470
Annual Total	**1,01,075**	**80,706**	**86,242**

Interpretation:

The solar PV system demonstrated stable electricity generation during AY 2023–24, with monthly generation varying between **6,680 kWh and 10,268 kWh**. Higher electricity generation was recorded during the summer months, particularly **May and June**, owing to longer sunshine duration and higher solar irradiance.

Comparatively lower generation was observed during the monsoon period due to increased cloud cover and reduced solar radiation.

During AY 2024–25, a significant reduction in electricity generation was observed during **June, July and August**, after which the system resumed normal performance. From September onwards, monthly generation remained consistently between **6,700 kWh and 9,800 kWh**, indicating satisfactory operational performance during the remaining period. Similar trends have been found in AY 2025-26.

2.2 Annual Solar Energy Generation

Table 2.2 summarizes the annual electricity generated by the rooftop solar PV system during the assessment period.

Table 2.2 Annual Solar Energy Generation

Academic Year	Total Solar Generation (kWh)	Average Monthly Generation (kWh)	Average Daily Generation (kWh/day)
AY 2023–24	**101,075**	**8,423**	**277**
AY 2024–25	**80,706**	**6,726**	**221**
AY 2025–26*	**86,206**	**7,183**	**236**

2.3 Seasonal Performance Analysis

Solar photovoltaic systems are directly influenced by seasonal climatic conditions such as solar irradiance, cloud cover, rainfall and ambient temperature. Based on the observed generation data, the seasonal performance of the system may be summarized as follows.

Table 2.3 Seasonal Performance of the Solar PV System

Season	Months	Performance
Monsoon	June – September	Moderate generation due to frequent cloud cover and rainfall.
Post-Monsoon	October – November	Improved performance with clearer skies and higher solar radiation.
Winter	December – February	Stable generation under favorable atmospheric conditions.
Summer	March – May	Highest electricity generation owing to maximum sunshine hours and higher solar intensity.

2.4 Key Performance Indicators

The overall operational performance of the rooftop solar PV system is summarized below.

Table 2.4 Key Performance Indicators

Performance Indicator	Value
Installed Solar PV Capacity	**100 kW**
Highest Annual Generation	**101,075 kWh (AY 2023–24)**
Highest Monthly Generation	**10,268 kWh (May 2024)**
Lowest Monthly Generation	**22 kWh (July 2024)**
Average Annual Generation	**90,891 kWh**
Average Daily Generation (AY 2023–24)	**277 kWh/day**
Average Daily Generation (AY 2024–25)	**221 kWh/day**
Average Daily Generation (AY 2025-26)	**236 kWh/day**

2.5 Performance Highlights

The analysis of the solar generation data leads to the following observations:

- The rooftop Solar PV system generated 2,67,987 **kWh** of clean electricity during the three completed academic years (AY 2023–24 to AY 2025–26).
- The **highest annual electricity generation** was recorded during **AY 2023–24 (101,075 kWh)**.
- **May 2024** recorded the highest monthly generation (**10,268 kWh**), reflecting favorable solar radiation during the summer season.
- The system exhibited a clear seasonal pattern, with higher electricity generation during the summer months and comparatively lower generation during the monsoon season.
- A temporary reduction in generation was observed during the initial months of AY 2024–25, after which the system resumed stable operation.
- Overall, the solar PV installation has consistently contributed to the institute's renewable energy portfolio and forms a strong foundation for ADCET's progressive journey towards a **Net Zero Energy Campus**.

3. Campus Electricity Consumption Analysis

Electricity is the primary source of energy supporting the academic, research and administrative activities at Annasaheb Dange College of Engineering and Technology (ADCET), Ashta. The campus comprises academic buildings, laboratories, workshops, library, administrative offices, hostels, sports facilities and other student support infrastructure, all of which contribute to the overall electricity demand. Monitoring electricity consumption is essential for assessing campus energy requirements, identifying consumption trends and evaluating the contribution of renewable energy systems towards meeting the institutional energy demand.

The electricity consumption data presented in this section have been obtained from the monthly electricity bills issued by the Maharashtra State Electricity Distribution Company Limited (MSEDCL). The analysis covers the last three academic years and provides an understanding of monthly and annual energy consumption patterns across the campus.

3.1 Month-wise Campus Electricity Consumption

Table 3.1 presents the month-wise electricity consumption of ADCET for the last three academic years.

Table 3.1 Month-wise Electricity Consumption

Month	AY 2023–24 (kWh)	AY 2024–25 (kWh)	AY 2025–26 (kWh)*
June	81,225	82,304	74,493
July	78,566	76,052	81,093
August	78,193	89,006	81,863
September	77,976	82,349	94,435
October	92,977	85,622	80,437
November	61,441	62,876	62,876
December	78,122	78,590	71,589
January	68,027	81,055	77,713
February	78,636	86,920	86,200
March	98,495	99,549	1,02,377
April	1,01,673	95,494	1,00,471
May	94,575	74,335	92,571
Annual Consumption	**989,906**	**994,152**	**1,006,118**

*AY 2025–26 values are based on the billing history available up to June 2026.

Interpretation

The monthly electricity consumption indicates that the campus energy demand remained close to **1.0 million units annually** throughout the assessment period. Although monthly consumption varied according to academic schedules and climatic conditions, the overall demand remained remarkably consistent, demonstrating stable campus operations.

Electricity consumption generally increased during **March and April**, coinciding with intensive laboratory work, examinations, project activities and increased cooling requirements due to higher ambient temperatures. Comparatively lower consumption was observed during **November and January**, reflecting reduced campus activity and favorable climatic conditions.

Unlike many institutions where energy demand fluctuates significantly, ADCET exhibits a relatively uniform consumption profile throughout the year, indicating continuous utilization of academic, research and residential facilities.

3.2 Annual Electricity Consumption Analysis:

The annual electricity consumption of the institute during the assessment period is summarized in Table 3.2.

Table 3.2 Annual Electricity Consumption:

Academic Year	Total Consumption (kWh)	Average Monthly Consumption (kWh)	Average Daily Consumption (kWh/day)
AY 2023–24	**989,906**	**82,492**	**2,712**
AY 2024–25	**994,152**	**82,846**	**2,724**
AY 2025–26	**1,006,118**	**83,843**	**2,757**

Interpretation:

The institute consumed approximately **one million units of electricity every year**, indicating a stable energy demand despite continuous expansion of academic infrastructure and institutional activities.

Annual electricity consumption increased marginally from **989,906 kVAh** during AY 2023–24 to **994,152 kVAh** during AY 2024–25, representing an increase of approximately **0.43%**. During AY 2025–26, annual consumption further increased to **1,006,118 kVAh**, corresponding to a **1.20%** increase over the previous year.

The gradual increase in electricity demand reflects enhanced utilization of laboratories, research facilities, digital infrastructure, hostel occupancy and academic activities while indicating effective energy management practices that prevented substantial escalation in energy consumption.

3.3 Peak and Minimum Electricity Consumption

Table 3.3 Peak and Minimum Electricity Consumption

Indicator	AY 2023–24	AY 2024–25	AY 2025–26
Highest Monthly Consumption	**101,673**	**99,549**	**102,377**
Month	April	March	March
Lowest Monthly Consumption	**61,441**	**62,876**	**62,876**
Month	November	November	November

Interpretation

The highest electricity demand was consistently recorded during **March and April**, which correspond to periods of intensive academic activity, laboratory utilization and elevated ambient temperatures. These months also coincide with increased operation of cooling equipment and research laboratories.

The minimum electricity consumption occurred during **November**, when climatic conditions are comparatively moderate and cooling requirements are minimal. The variation between the maximum and minimum monthly demand is moderate, indicating a well-balanced annual load profile.

3.4 Consumption Trend Analysis

The electricity consumption pattern over the three academic years demonstrates several important characteristics:

- Annual campus electricity demand remained consistently around **1.0 GWh**, reflecting stable institutional growth.
- Average monthly electricity consumption remained between **82,500 and 84,000 units**, indicating balanced utilization of campus infrastructure.
- The highest energy demand occurred during the summer and examination periods due to increased laboratory usage and cooling requirements.
- Lower electricity demand during the post-monsoon period reflects favorable weather conditions and reduced dependence on electrical cooling systems.
- The absence of abrupt fluctuations indicates effective operational management and consistent utilization of institutional facilities.

Overall, the electricity consumption profile demonstrates that the campus has a predictable and well-managed energy demand, making it well-suited for integrating renewable energy systems such as rooftop solar photovoltaic generation.

3.5 Key Performance Indicators

Table 3.5 Key Electricity Consumption Indicators

Performance Indicator	Value
Average Annual Electricity Consumption	**996,725 kVAh**
Highest Annual Consumption	**1,006,118 kVAh (AY 2025–26)**
Lowest Annual Consumption	**989,906 kVAh (AY 2023–24)**
Average Monthly Consumption	**83,060 kVAh**
Average Daily Consumption	**2,731 kVAh/day**
Maximum Monthly Consumption	**102,377 kVAh (March 2026)**
Minimum Monthly Consumption	**61,441 kVAh (November 2023)**

3.6 Key Observations

The analysis of electricity consumption reveals the following:

- ADCET maintained a **stable annual electricity demand of approximately one million units**, demonstrating consistent utilization of campus facilities.
- Annual electricity consumption increased only marginally (**0.43%** from AY 2023–24 to AY 2024–25 and **1.20%** from AY 2024–25 to AY 2025–26), indicating controlled growth despite increasing institutional activities.
- Electricity demand was highest during **March and April**, while comparatively lower consumption was recorded during **November**, reflecting seasonal influences on campus operations.
- The consistent energy consumption profile provides a reliable basis for evaluating the contribution of the 100 kW rooftop solar photovoltaic system towards meeting the institute's energy requirements.
- The electricity consumption data presented in this section serve as the baseline for assessing renewable energy contribution, carbon emission reduction and the institute's progress towards becoming a **Net Zero Energy Campus** in the subsequent sections.

4. Contribution of Solar Energy Towards Campus Energy Demand

The rooftop Solar Photovoltaic (PV) system installed at ADCET significantly contributes towards meeting the campus electricity demand through clean and renewable energy generation. The contribution of solar energy is evaluated by comparing the annual solar electricity generated with the total annual campus electricity consumption. This analysis provides a clear understanding of the extent to which renewable energy supports the institute's overall energy requirement and reduces dependence on conventional grid electricity.

The contribution of solar energy has been calculated using the following relationship:

Solar Contribution (%) = Annual Solar Generation (kWh) / Annual Electricity Consumption (kWh) × 100

4.1 Annual Contribution of Solar Energy

The annual contribution of the rooftop solar PV system towards meeting the campus electricity demand is presented in Table 4.1.

Table 4.1 Contribution of Solar Energy towards Campus Electricity Demand:

Academic Year	Campus Electricity Consumption (kWh)	Solar Energy Generated (kWh)	Solar Contribution (%)
AY 2023–24	989,906	101,075	**10.21**
AY 2024–25	994,152	80,706	**8.12**
AY 2025–26	1,006,118	86,206	**8.57**
Average	**996,725.3**	**89,329**	**8.97**

Interpretation

The rooftop solar photovoltaic system contributed **10.21%** of the total campus electricity demand during AY 2023–24 by generating **101,075 kWh** of clean electricity against an annual campus consumption of **989,906 kWh**.

During AY 2024–25, the contribution reduced to **8.12%**, with a total solar generation of **80,706 kWh** against a campus electricity consumption of **994,152 kWh**. The reduction in renewable energy contribution is primarily attributable to the comparatively lower solar electricity generation observed during the initial months of the academic year rather than any significant increase in campus electricity demand.

Overall, the rooftop solar PV system supplied an average of **8.97 %** of the institute's annual electricity requirement over the three completed academic years. This demonstrates that nearly **one-tenth of the campus electricity demand is presently met through renewable solar energy**, thereby reducing dependence on conventional grid electricity.

4.2 Renewable Energy Offset

The electricity generated through the rooftop solar PV system directly offsets the electricity that would otherwise have been purchased from the utility grid. During the assessment period:

- Total campus electricity consumption (three academic years): **10,06,118 kWh**
- Total solar electricity generated: **267,987 kWh**
- Average annual renewable electricity generation: **89,329 kWh**
- Average annual renewable energy contribution: **8.97 %**

This renewable energy generation substantially reduces the institute's dependence on fossil-fuel-based electricity while contributing towards sustainable campus operations.

4.3 Trend of Renewable Energy Contribution

The comparison between campus electricity consumption and solar energy generation indicates that:

- Campus electricity demand remained relatively constant at approximately **1.0 GWh per year**.
- The rooftop solar PV system consistently generated between **80 and 100 MWh** of electricity annually.
- Renewable energy contributed between **8% and 10%** of the total campus electricity demand.
- The system continued to perform reliably despite seasonal variations in solar irradiance.
- The observed variation in annual contribution primarily reflects changes in solar generation rather than fluctuations in electricity demand.

4.4 Significance of Solar Energy Contribution

Although the installed solar PV capacity is **100 kW**, its contribution extends beyond electricity generation. The system demonstrates ADCET's commitment to sustainable campus development by:

- reducing dependence on conventional grid electricity,
- promoting the use of renewable energy resources,
- lowering greenhouse gas emissions,
- reducing long-term electricity expenditure,
- enhancing institutional resilience against future energy price escalation, and
- supporting national initiatives on renewable energy adoption and sustainable development.

The successful integration of rooftop solar energy also provides students with a practical demonstration of renewable energy technologies, reinforcing the institute's commitment to experiential learning and sustainability education.

4.5 Key Observations

The analysis of renewable energy contribution reveals the following:

- The rooftop solar PV system generated **267,987 kWh** of renewable electricity during the three completed academic years.
- Approximately **8.97 %** of the campus electricity demand was met through renewable solar energy.
- The highest renewable energy contribution (**10.21%**) was achieved during AY 2023–24.
- Campus electricity demand remained relatively stable across the assessment period, indicating that variations in renewable energy contribution were primarily governed by solar electricity generation.
- The existing 100 kW solar PV installation represents a significant step towards the institute's long-term vision of achieving a **Net Zero Energy Campus**.
- The renewable energy contribution established in this section forms the basis for quantifying **carbon emission reduction** and **economic savings**, which are presented in the subsequent sections.

5. Carbon Footprint Reduction and Environmental Benefits

The generation of electricity through renewable energy sources significantly contributes to climate change mitigation by reducing dependence on fossil-fuel-based electricity. Electricity generated from conventional thermal power plants is associated with greenhouse gas emissions, particularly carbon dioxide (CO_2), which is the principal contributor to global warming. By replacing a portion of grid electricity with clean solar energy, ADCET has substantially reduced its carbon footprint while contributing towards national and global sustainability goals.

The environmental benefits of the rooftop Solar Photovoltaic (PV) system have been assessed based on the actual annual solar electricity generation. For estimating the reduction in greenhouse gas emissions, the **Central Electricity Authority (CEA), Government of India**, grid emission factor of **0.716 kg CO_2 per kWh of electricity generated** has been adopted.

5.1 Annual Carbon Dioxide Emission Reduction

The avoided carbon dioxide emissions have been calculated using the following equation:

Avoided CO_2 Emissions (kg) = Solar Energy Generated (kWh) × Grid Emission Factor (kg CO_2/kWh)

Where,

- Grid Emission Factor = **0.716 kg CO_2/kWh**

Note: Carbon dioxide emission reductions have been estimated using the **All India Grid Emission Factor of **0.716 kg CO_2/kWh** (0.716 tCO_2/MWh) as reported in the *CO_2 Baseline Database for the Indian Power Sector, Version 19.0*, published by the Central Electricity Authority (CEA), Ministry of Power, Government of India.

Table 5.1 Annual Carbon Emission Reduction

Academic Year	Solar Energy Generated (kWh)	CO_2 Emissions Avoided (kg)	CO_2 Emissions Avoided (tons)
AY 2023–24	101,075	72,370	**72.37**
AY 2024–25	80,706	57,785	**57.79**
AY 2025-26	86,206	61,700	**67.70**
Total	**267,987**	**191,855**	**191.86**

Interpretation:

During the last three academic years, the rooftop Solar PV system generated **267,987 kWh** of renewable electricity, resulting in an estimated avoidance of approximately **191.86 tons of carbon dioxide emissions**. This reduction represents a significant environmental contribution by lowering the institute's dependence on electricity generated from fossil-fuel-based power plants.

The reduction achieved demonstrates ADCET's commitment towards mitigating climate change and promoting clean energy practices within the higher education sector.

5.2 Equivalent Environmental Benefits

To better understand the environmental significance of the solar PV installation, the avoided carbon emissions can be expressed in terms of commonly accepted environmental equivalents.

Table 5.2 Equivalent Environmental Benefits

Environmental Indicator	Equivalent Value
Total Solar Electricity Generated	**267,987 kWh**
CO_2 Emissions Avoided	**191.86 tons**
Equivalent Mature Trees Required to Absorb CO_2*	**≈ 8,721 trees**
Equivalent Coal Consumption Avoided**	**≈ 77.7 tons**

*Assuming one mature tree absorbs approximately **22 kg CO_2 per year**.

Assuming approximately **0.29 kg of coal is required to generate one unit (kWh) of electricity in conventional thermal power plants.

Interpretation:

The environmental benefits of the rooftop solar PV system extend well beyond electricity generation. The clean electricity produced during the assessment period has an environmental impact equivalent to the annual carbon sequestration capacity of approximately **8,721 mature trees**. Additionally, it has reduced the requirement for nearly **77.7 tons of coal**, thereby conserving natural resources and reducing emissions associated with coal mining, transportation and combustion.

These environmental benefits demonstrate the institute's proactive approach towards sustainable resource management and climate-resilient campus development.

5.3 Contribution towards Climate Action

The installation and operation of the rooftop Solar PV system contribute directly to several national and international sustainability initiatives. By generating renewable electricity, the institute:

- Reduces dependence on fossil-fuel-based electricity.
- Minimizes greenhouse gas emissions associated with conventional electricity generation.
- Supports India's commitment towards achieving **Net Zero emissions by 2070**.
- Promotes renewable energy adoption in the higher education sector.
- Enhances environmental awareness among students, faculty and stakeholders by demonstrating the practical implementation of clean energy technologies.

The continued operation of the solar PV system reinforces ADCET's commitment to environmentally responsible campus management and sustainable institutional development.

5.4 Key Observations

The environmental assessment of the rooftop Solar PV system highlights the following:

- A total of **267,987 kWh** of renewable electricity was generated during the three completed academic years.
- The system prevented approximately **191.86 tons of carbon dioxide emissions**, thereby significantly reducing the institute's carbon footprint.
- The environmental impact is comparable to the annual carbon absorption capacity of approximately **8,721 mature trees**.
- Approximately **77.7 tons of coal consumption** were avoided through renewable electricity generation.
- The rooftop Solar PV system represents one of the institute's major initiatives towards climate change mitigation, environmental stewardship and sustainable campus operations.
- The measurable reduction in greenhouse gas emissions strengthens ADCET's contribution towards national clean energy goals and the United Nations Sustainable Development Goals (SDGs).

6. Economic Benefits

The installation of the 100 kW rooftop Solar Photovoltaic (PV) system has provided significant economic benefits to Annasaheb Dange College of Engineering and Technology (ADCET), Ashta, by reducing dependence on grid electricity and lowering annual electricity expenditure. The electricity generated by the solar PV system is consumed within the campus through the net metering mechanism, thereby offsetting a portion of the electricity purchased from the utility.

Apart from supporting environmental sustainability, the solar PV system contributes towards long-term financial sustainability by reducing operational costs, protecting the institution from future increases in electricity tariffs, and ensuring better utilization of renewable energy resources.

6.1 Annual Renewable Energy Generation

The economic benefits of the solar PV system are directly related to the amount of electricity generated annually. During the assessment period, the system generated substantial quantities of renewable electricity, thereby reducing the electricity purchased from the grid.

Table 6.1 Annual Solar Energy Generation

Academic Year	Solar Energy Generated (kWh)
AY 2023–24	101,075
AY 2024–25	80,706
AY 2025-26	86,206
Total	**267,987**

6.2 Estimated Annual Cost Savings

The monetary savings resulting from solar electricity generation can be estimated by considering the prevailing average electricity tariff applicable to the institute.

For estimation purposes, an average electricity tariff of **₹11.0 per kWh** has been considered based on the effective energy charges reflected in the MSEDCL electricity bills during the assessment period.

Table 6.2 Estimated Savings Due to Solar Energy Generation:

Academic Year	Solar Generation (kWh)	Average Tariff (₹/kWh)	Estimated Savings (₹)
AY 2023–24	101,075	11.00	**11,11,825**
AY 2024–25	80,706	11.00	**8,87,766**
AY 2025-26	86,206	11.00	**9,48,266**
Total	**2,67,987**	11.00	**29,47,857**

Interpretation:

The rooftop solar PV system generated renewable electricity equivalent to an estimated monetary saving of approximately **₹29.5 lakh** over the two completed academic years. These savings represent electricity costs that would otherwise have been incurred through grid electricity consumption.

The annual savings demonstrate that the solar PV installation not only contributes towards environmental sustainability but also provides measurable economic benefits by reducing recurring electricity expenditure.

6.3 Long-Term Economic Benefits

In addition to direct savings on electricity bills, the rooftop solar PV system offers several long-term financial advantages:

- Reduction in annual electricity expenditure through on-site renewable energy generation.
- Protection against future escalation in electricity tariffs.
- Improved financial sustainability of campus operations.
- Reduced dependence on conventional energy sources.
- Better utilization of institutional infrastructure through clean energy generation.
- Enhanced value of institutional investment in sustainable infrastructure.

These long-term benefits improve the overall economic resilience of the institution while supporting its sustainability objectives.

6.4 Return on Sustainable Investment

The installation of the rooftop solar PV system should be viewed as a long-term investment in sustainable infrastructure. Although the initial capital investment is significant, the continuous generation of renewable electricity throughout the operational life of the system results in recurring savings on electricity expenditure.

Considering the expected service life of approximately **25 years**, the solar PV system is expected to generate several million units of clean electricity during its lifetime, resulting in substantial cumulative financial savings while requiring comparatively low operational and maintenance costs.

6.5 Key Observations

The economic assessment highlights the following:

- The rooftop solar PV system generated **267,997 kWh** of renewable electricity during the two completed academic years.

- The corresponding estimated reduction in electricity expenditure is approximately **₹29.5 lakh**.
- The system provides recurring annual financial benefits through reduced electricity purchases from the grid.
- Long-term operation of the system will continue to reduce institutional energy costs while enhancing financial sustainability.
- The investment in rooftop solar energy aligns environmental responsibility with sound financial management, thereby supporting the institute's vision of sustainable campus development.

7.1 Present Status of Renewable Energy

Based on the operational 100 kW Solar PV system, the institute currently meets a significant portion of its annual electricity demand through renewable energy.

Table 7.1 Current Renewable Energy Status

Parameter	Value
Operational Solar PV Capacity	**100 kW**
Average Annual Campus Electricity Consumption	**992,029 kWh**
Average Annual Solar Energy Generation	**90,891 kWh**
Renewable Energy Contribution	**8.97 %**
Grid Electricity Dependence	**91.03%**
Current Net Zero Energy Status	**In Progress**

Interpretation

The existing 100 kW rooftop Solar PV system contributes approximately **8.97 %** of the institute's annual electricity requirement through clean and renewable energy. Although the institute has not yet achieved Net Zero Energy status, the operational system has established a strong foundation for sustainable energy management by reducing dependence on conventional grid electricity and lowering greenhouse gas emissions.

The current renewable energy contribution serves as a measurable benchmark against which future improvements can be evaluated following the commissioning of additional renewable energy infrastructure.

7.2 Expansion of Renewable Energy Infrastructure

To accelerate its journey towards Net Zero Energy, ADCET has recently completed the installation of an **additional 178 kW rooftop Solar Photovoltaic system** across the campus. At the time of preparation of this report, the installation work has been completed and the system is **awaiting commissioning**.

Upon commissioning, the institute's total installed solar photovoltaic capacity will increase from **100 kW to 278 kW**, representing an increase of **178%** over the existing capacity. This expansion reflects the institute's strategic investment in renewable energy infrastructure and demonstrates its long-term commitment to environmental sustainability and energy resilience.

The additional solar capacity is expected to substantially increase renewable electricity generation, reduce dependence on grid electricity, lower annual carbon emissions, and improve the institute's progress towards achieving a Net Zero Energy Campus.

7.3 Future Outlook towards Net Zero Energy

The commissioning of the additional 178 kW Solar PV system will significantly enhance the institute's renewable energy generation capacity. Coupled with ongoing energy conservation measures, this expansion is expected to considerably increase the share of renewable energy in the campus energy mix.

To further strengthen its progress towards Net Zero Energy, the institute will continue to:

- Monitor and optimize the performance of both rooftop solar PV systems.
- Promote energy-efficient practices across all academic and administrative buildings.
- Replace conventional electrical equipment with high-efficiency alternatives as part of infrastructure upgrades.
- Strengthen energy monitoring through regular energy audits and performance assessments.
- Explore advanced technologies such as battery energy storage systems and smart energy management solutions to maximize the utilization of renewable energy.

These initiatives will further reduce dependence on conventional energy sources while improving the overall sustainability of campus operations.

7.4 Institutional Commitment

ADCET views the transition towards Net Zero Energy as a continuous process requiring sustained planning, investment and innovation. The successful operation of the existing 100 kW Solar PV system, together with the completed installation of the additional 178 kW system, reflects the institute's proactive approach towards sustainable infrastructure development.

By continuously expanding renewable energy capacity and implementing energy-efficient practices, the institute is creating a resilient and environmentally responsible campus that aligns with national renewable energy policies and global sustainability objectives.

7.5 Key Observations

- The institute presently operates a **100 kW rooftop Solar PV system**, supplying approximately **8.97 %** of its annual electricity demand through renewable energy.
- The installation of an **additional 178 kW rooftop Solar PV system** has been successfully completed and is presently awaiting commissioning.
- Upon commissioning, the institute's total installed solar capacity will increase to **278 kW**, significantly enhancing renewable energy generation.
- The phased expansion of solar energy infrastructure demonstrates the institute's long-term strategic commitment to achieving a **Net Zero Energy Campus**.
- Continued investment in renewable energy and energy-efficient technologies will further reduce dependence on conventional electricity and strengthen the institute's contribution to environmental sustainability.

8. Conclusion

The implementation of renewable energy initiatives at Annasaheb Dange College of Engineering and Technology (ADCET), Ashta reflects the institute's strong commitment to sustainable campus development, environmental stewardship, and responsible resource management. The installation and successful operation of the **100 kW rooftop Solar Photovoltaic (PV) system** has enabled the institute to harness clean and renewable energy, thereby reducing dependence on conventional grid electricity and contributing towards a low-carbon campus.

The analysis presented in this report demonstrates that the operational solar PV system has consistently generated a significant quantity of renewable electricity, meeting an average of **8.97 %** of the campus's annual electricity demand during the assessment period. This has resulted in measurable environmental benefits through the reduction of greenhouse gas emissions, conservation of conventional energy resources, and substantial savings in electricity expenditure. The integration of renewable energy has also strengthened the institute's energy security and established a practical model of sustainable infrastructure within the higher education sector.

A major milestone in the institute's sustainability journey has been the **successful installation of an additional 178 kW rooftop Solar PV system**, which is presently awaiting commissioning. Upon becoming operational, the institute's total installed solar capacity will increase to **278 kW**, significantly enhancing renewable energy generation and accelerating progress towards the long-term vision of becoming a **Net Zero Energy Campus**. This expansion demonstrates the institute's proactive approach in anticipating future energy requirements and investing in sustainable infrastructure.

Beyond infrastructure development, ADCET continues to promote a culture of energy conservation and environmental responsibility through systematic energy monitoring, adoption of energy-efficient technologies, regular energy audits, and the integration of sustainability principles into academic, research, and campus activities. These initiatives collectively reinforce the institute's commitment to continuous improvement in energy performance and sustainable campus operations.

The achievements documented in this report clearly indicate that the institute has established a strong foundation for renewable energy utilization and is steadily progressing towards greater energy independence. The planned expansion of solar energy infrastructure, coupled with ongoing energy efficiency measures, positions ADCET as a progressive institution committed to supporting national renewable energy goals, addressing climate change challenges, and contributing to the realization of the **United Nations Sustainable Development Goals (SDGs)**.

In conclusion, the institute's sustained investment in renewable energy and sustainable practices not only enhances operational efficiency and environmental performance but also serves as an inspiration for students, faculty, and the wider community. Through its continued commitment to clean energy and

responsible resource management, ADCET is well positioned to emerge as a model institution for sustainable and resilient campus development.

"ADCET firmly believes that investments in renewable energy are investments in a sustainable future. Through continuous expansion of clean energy infrastructure, responsible energy management, and a steadfast commitment to environmental sustainability, the institute is transforming its campus into a living laboratory of sustainable development and progressing confidently towards the realization of a Net Zero Energy Campus."