# ENERGY AUDIT REPORT

FY 2025–26

IIHMR UNIVERSITY

JAIPUR, RAJASTHAN

**Submitted by:**


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*This report has been prepared based on the information provided by the institute, available records, and observations made during the site visit.*

# Contents

## EXECUTIVE SUMMARY

This energy audit assesses energy consumption at IIHMR University, Jaipur, focusing on key load drivers, system performance, and improvement opportunities.

Electricity is the primary energy source, with air conditioning identified as the dominant load. Consumption increases during summer and monsoon months due to cooling demand. Water pumping and utility systems form the next major load category due to dependence on groundwater extraction and wastewater treatment, while lighting and IT loads remain distributed across campus operations.

The electrical system operates efficiently, with the power factor consistently above 0.95 and an annual average of 0.98. DG sets are used strictly for backup. LPG used for cooking contributes a significant share of total energy use.

Priority areas include strengthening energy monitoring, improving load management, and expanding renewable energy capacity in a phased manner to enhance efficiency and reduce operating costs.

### Key Performance Indicators

| Parameter | Value | Unit |
|---|---:|---|
| Total Energy Consumption | 11,44,477 | kWh (Equivalent) |
| Electricity Consumption | 10,04,907 | kWh |
| Average Power Factor | 0.98 | — |
| Renewable Electricity Share | 13.33 | % |
| Renewable Energy Share | 11.71 | % |
| Electricity Use Intensity | 1,168 | kWh/student/year |
| Energy Use Intensity | 1,331 | kWh/student/year |

### Cost Performance Indicators

| Parameter | Value |
|---|---|
| Average Electricity Cost | ₹12.81/kWh |
| Solar Savings | ₹17.71 lakh/year |
| DG Cost of Generation | ₹26/kWh |
| Power Factor Incentive | ₹1.49 lakh/year |

# 1. Introduction

The energy demand in India continues to grow steadily, with electricity generation still predominantly dependent on conventional sources. This underscores the direct relationship between energy consumption and associated environmental impacts.

The IIHMR University, Jaipur, has undertaken initiatives to integrate renewable energy within its campus operations and improve its energy performance.

The present energy audit has been conducted to assess energy consumption patterns, evaluate system performance, and identify opportunities for improving energy efficiency. The audit provides a structured basis for reducing energy costs, optimizing resource use, and supporting long-term sustainability planning.

# 2. Institute Profile

## 2.1 About Institute

IIHMR University, Jaipur, was established in 2014 under the IIHMR University Act, 2014 by the Government of Rajasthan. It has its origin in the Indian Institute of Health Management Research, founded in 1984, and functions as a postgraduate research university in the field of health and development studies.

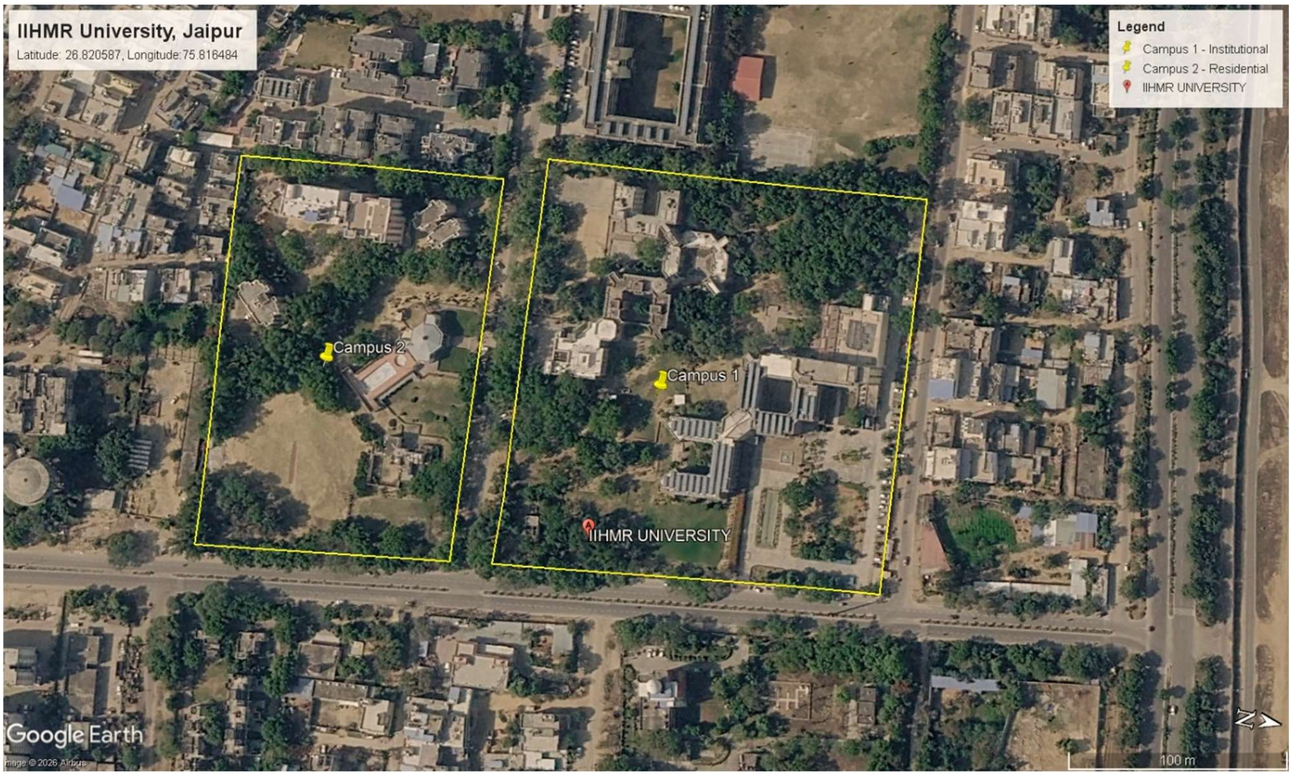
The campus is spread over approximately 14.37 acres and comprises academic, administrative, and residential facilities.

The University operates through five schools covering health management, public health, pharmaceutical management, development studies, and digital health. It offers MBA programs in Hospital and Health Management, Pharmaceutical Management, Healthcare Analytics, and Development Management, along with a Master of Public Health program. Doctoral programs are offered in public health, health management, hospital management, digital health, and development management, along with executive programs in related domains.

The University maintains academic collaborations with national and international institutions for academic exchange and research. It has a diverse student base from different regions and academic backgrounds, supporting an interdisciplinary learning environment.

## 2.2 Site Location

IIHMR University is located in Jaipur, Rajasthan, within a semi-arid climatic zone characterized by high temperatures, low to moderate rainfall, and water stress conditions. The climatic conditions significantly influence energy consumption patterns, particularly due to high cooling demand during summer months.




## 3. Objective and Scope

### a) Objective

The objective of the energy audit is to assess energy consumption patterns of the institute, establish baseline energy performance, and identify opportunities for improving energy efficiency and reducing energy costs. The audit also aims to evaluate key energy performance indicators and recommend practical measures for performance improvement.

### b) Scope

The scope of the audit covers analysis of electricity consumption and energy use within the campus, including major systems such as lighting, air conditioning, water pumping, and other significant electrical loads. The assessment is based on available utility data, equipment details, and operational practices, with focus on identifying energy saving opportunities and improving energy performance.

## 4. Methodology

The methodology adopted for the audit comprises the following steps:

### *i.* Data Collection

Data was collected through site visits, observations, interaction with concerned personnel, and review of available records including electricity bills, equipment inventory, and operational data.

***ii.*** **Data Analysis**

The collected data was analysed to assess energy consumption patterns, identify major energy consuming systems, and evaluate energy performance indicators such as energy intensity.

***iii.*** **Findings and Recommendations**

Based on analysis and observations, practical and feasible recommendations were developed to improve energy efficiency and optimize energy use.

## 5. Energy Consumption Analysis

### 5.1 Energy Sources

The campus primarily relies on grid electricity supplied by the Jaipur Vidyut Vitran Nigam to meet its energy requirements across academic, administrative, and residential facilities.

Backup power is provided through diesel generator sets to ensure continuity of operations during grid outages. The institute has also adopted renewable energy through rooftop solar photovoltaic systems, which contribute to a portion of the campus electricity demand and reduce dependence on conventional energy sources.

In addition, diesel and LPG are used for transportation and cooking purposes respectively.

### 5.2 Electricity Infrastructure Details

| Source / System | Capacity / Rating | Quantity | Purpose | Remarks |
|---|---|---|---|---|
| Grid Electricity | 1,250 kVA (Transformer) | 1 | Primary power supply | Main source of energy |
| DG Set | 320 kVA, 250 kVA | 2 | Backup power supply | Used during power outages |
| Solar PV | 100 kWp | 1 | Renewable generation | Grid connected rooftop system |
| Capacitor Bank & APFC | 350 kVAR (Combined) | Installed system | Power factor correction | Improves electrical efficiency and reduces losses |

### 5.3 Electrical Load Assessment

The electrical load characteristics of the campus were reviewed to understand demand levels, load distribution, and system utilization.

The sanctioned load of the institute is 950 kW, with a reported connected load of 950 kW. The contract demand is maintained at 900 kVA for billing purposes. Based on available records, the connected load is within the sanctioned limit.

However, a complete and updated equipment inventory was not available. Accordingly, the load assessment has been carried out using available data, supported by site observations and reference information from previous records.

The connected load summary is presented below:

| Equipment | Watt (W) | Number |
|---|---|---|
| **Major Loads** | | |
| Air Conditioning (Split / Window / Tower Units) | Typical 1,500–3,500 per unit | 500 |
| Air Conditioning (VRV Systems) | Approx. 30,000–32,000 per system (26 TR basis) | 2 |
| **Mechanical Loads (Water & Utilities)** | | |
| Submersible Pump (Borewell) | 5,593 (7.5 HP) | 1 |
| Submersible Pump (Borewell) | 2,610 (3.5 HP) | 2 |
| Open Well Pump | 5,593 (7.5 HP) | 1 |
| Open Well Pump | 3,729 (5 HP) | 1 |
| STP Pump | 2,237 (3 HP) | 6 |
| STP Pump | 746 (1 HP) | 1 |
| Submersible STP Pump | 2,237 (3 HP) | 1 |
| RO System | 120 | 16 |
| Water Cooler | 600 | 16 |
| **Heating Loads** | | |
| Room Heater / Blower | 1,000 | 100 |
| Microwave Oven | 1,000 | 34 |
| **IT & Office Loads** | | |
| Desktop | 200 | 312 |
| Printers & Scanners | Typical 300–600 | 97 |
| Other IT Equipment (Servers, WiFi access points, UPS, projectors, network switches, digital displays) | Typical 100–800 | 244 |
| CCTV Camera | 10 | 158 |
| **Lighting Loads** | | |
| LED High Mast | 20 | 5 |
| LED Lamp | 3 | 198 |
| LED Lights / Bulbs | Typical 5–35 | 2,872 |
| LED Panel | Typical 50–100 | 66 |
| CFL | Typical 25–55 | 25 |
| Tube Light | Typical 36–40 | 838 |
| Focus Light | 100 | 40 |
| Foot Light | 20 | 20 |
| **Ventilation & Fans** | | |

| | | |
|---|---|---|
| Ceiling Fan | 56 | 700 |
| Exhaust Fan (18") | 450 | 40 |
| Exhaust Fan (6") | 150 | 250 |
| **Miscellaneous** | | |
| Hand Dryer | 500 | 20 |
| Refrigerator (65 L) | 100 | 44 |

### 5.4 Load Distribution Analysis

The connected load has been categorized into major functional groups to understand the distribution of energy demand across different systems.

Air conditioning systems constitute the dominant share of the connected load, indicating cooling as the primary energy driver within the campus. Water pumping and utility systems form the next significant load category due to dependence on groundwater extraction and treatment systems.

Lighting and IT equipment represent distributed loads across academic and administrative areas; while heating and miscellaneous appliances contribute comparatively lower shares.

### 5.5 Energy Conservation Measures Implemented

The institute has implemented several energy conservation measures aimed at improving energy efficiency and reducing operational energy consumption. These measures contribute to optimized system performance and cost savings.

a) **Motion Sensors**
Motion sensors have been installed in selected areas such as corridors, washrooms, and low-occupancy spaces. These sensors automatically control lighting based on occupancy, thereby reducing unnecessary energy consumption during non-utilized periods.

b) **Capacitor Bank and APFC System**
The institute has installed capacitor banks along with an Automatic Power Factor Correction (APFC) system to maintain a high-power factor. This reduces reactive power losses, improves electrical system efficiency, and results in financial benefits through power factor incentives.

| S. No | Particular | Capacity | No. |
|---|---|---|---|
| 1 | Capacitor Bank | 100 kVAR | 2 |
| 2 | Capacitor Bank | 25 kVAR | 1 |
| 3 | APFC | 100 kVAR | 1 |
| 4 | APFC | 25 kVAR | 1 |

## 5.6 Electricity Consumption Analysis

The total annual electricity consumption of the campus is 10,04,907 kWh. Monthly consumption trends indicate higher electricity demand during peak cooling periods (August–September), with reduced consumption during winter months.

Solar energy contribution remains relatively stable across months, while DG usage is minimal and limited to backup requirements.

**Electricity Consumption Accounting**

Total electricity consumption is calculated as the sum of:

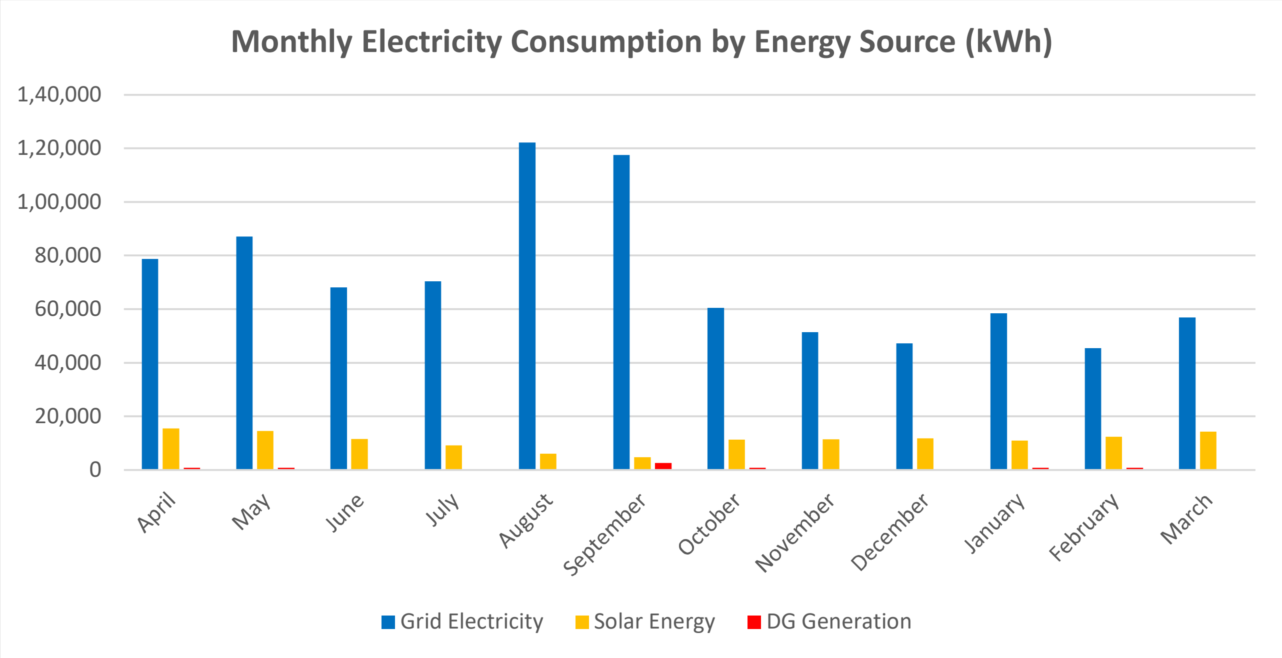
- Grid electricity (net import basis)
- Solar energy self-consumed
- DG generation

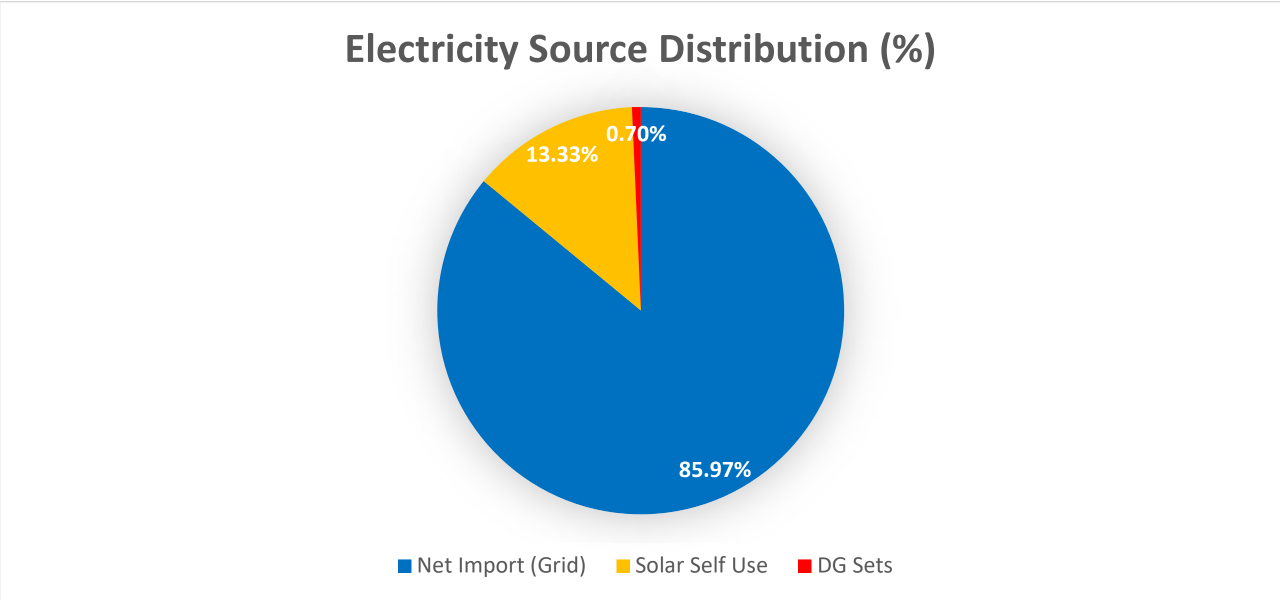
The solar PV system is predominantly utilized for on-site consumption, with minimal export to the grid. Under the net metering mechanism, solar generation directly offsets internal demand, thereby reducing net grid import.

Accordingly, net grid import represents residual electricity demand after on-site renewable contribution, while total electricity consumption reflects actual campus electricity use.

| Month | Grid Electricity (Net Import Basis) (kWh) | Solar Energy - Self Use (kWh) | DG Generation (kWh) | Total Electricity Consumption (kWh) |
|---|---|---|---|---|
| April | 78,710 | 15,464 | 875 | 95,049 |
| May | 87,064 | 14,563 | 875 | 1,02,502 |
| June | 68,132 | 11,616 | — | 79,748 |
| July | 70,340 | 9,160 | — | 79,500 |
| August | 1,22,190 | 6,075 | — | 1,28,265 |
| September | 1,17,545 | 4,768 | 2,625 | 1,24,938 |
| October | 60,460 | 11,347 | 875 | 72,682 |
| November | 51,400 | 11,420 | — | 62,820 |
| December | 47,280 | 11,844 | — | 59,124 |
| January | 58,465 | 10,936 | 875 | 70,276 |
| February | 45,405 | 12,463 | 875 | 58,743 |
| March | 56,920 | 14,340 | — | 71,260 |
| **Total** | **8,63,911** | **1,33,996** | **7,000** | **10,04,907** |

DG generation is estimated using 1 litre diesel = 3.5 kWh (electrical output), based on standard DG efficiency assumptions due to unavailability of generation records.




## 5.7 Energy Consumption from Other Sources

In addition to electricity, LPG is used for cooking, while diesel is used for transportation.

### LPG Gas Consumption

| Area | Annual Consumption (kg) | kWh Equivalent* |
|---|---|---|
| Mess/Canteen | 8,208 | 1,05,062 |
| Pantry | 342 | 4,378 |
| **Total** | **8,550** | **1,09,440** |

*LPG energy content is considered as 12.8 kWh/kg on NCV Basis

**Transportation - Diesel**

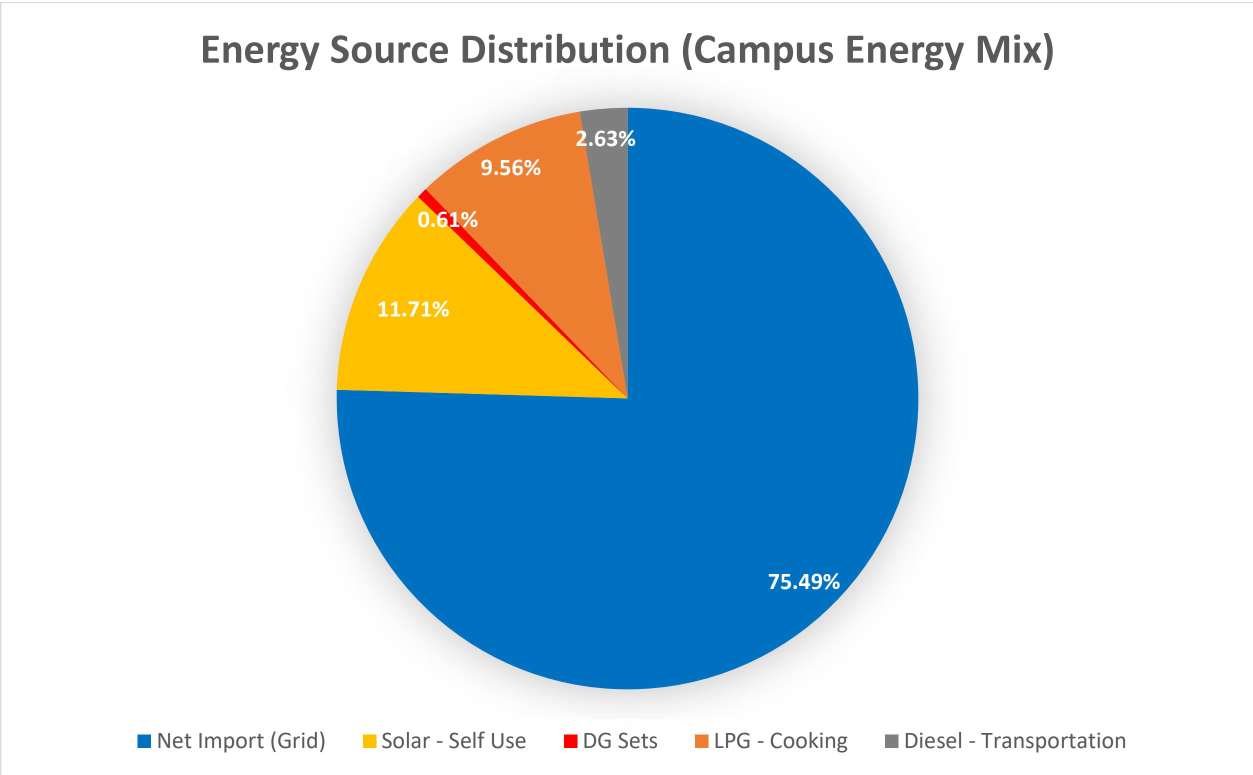
| Vehicle | Quantity (L) | kWh Equivalent* |
|---|---|---|
| Innova | 2,213 | 22,130 |
| Tempo Traveller | 800 | 8,000 |
| **Total** | **3,013** | **30,130** |

*Diesel energy content is considered as 10 kWh/L on NCV Basis

### 5.8 Annual Energy Use Summary

The campus energy mix is dominated by grid electricity (75.49%), followed by solar energy (11.71%) and LPG usage (9.56%). DG generation and transportation diesel contribute relatively small shares.

| Energy Source | kWh Equivalent | % Share |
|---|---|---|
| Grid Electricity (Net Import) | 8,63,911 | 75.49 |
| Solar Energy – Self Use | 1,33,996 | 11.71 |
| DG Generation | 7,000 | 0.61 |
| LPG - Cooking | 1,09,440 | 9.56 |
| Diesel - Transportation | 30,130 | 2.63 |
| **Total Consumption** | **11,44,477** | **100.00** |



## 5.9 Energy Intensity

The electricity use intensity is 1,168 kWh per student per year, while the total energy consumption intensity is 1,331 kWh per student per year. These indicators provide a baseline for benchmarking future energy performance and monitoring efficiency improvements.

| Particular | Value |
|---|---|
| No. of Students (Nos) | 860 |
| Electricity Use Intensity (kWh/student) | 1,168 |
| Energy Use Intensity (kWh/student) | 1,331 |

# 6 Electricity Cost Analysis

## 6.1 Average electricity cost from Grid

The average electricity cost from grid supply is ₹12.81 per kWh. A higher cost per unit is observed during winter months due to lower consumption and higher impact of fixed charges. Conversely, lower per-unit cost during peak consumption months indicates better utilization of demand charges. This reflects the influence of tariff structure on electricity cost.

| Month | Net import | Total Bill | Average Electricity Cost (₹/kWh) |
|---|---|---|---|
| April | 78,710 | 9,74,861 | 12.39 |
| May | 87,064 | 10,51,971 | 12.08 |
| June | 68,132 | 8,40,976 | 12.34 |
| July | 70,340 | 8,86,678 | 12.61 |
| August | 1,22,190 | 13,83,932 | 11.33 |
| September | 1,17,545 | 13,65,435 | 11.62 |
| October | 60,460 | 8,44,279 | 13.96 |
| November | 51,400 | 7,47,373 | 14.54 |
| December | 47,280 | 7,10,687 | 15.03 |
| January | 58,465 | 8,16,233 | 13.96 |
| February | 45,405 | 6,90,247 | 15.20 |
| March | 56,920 | 7,50,000 | 13.18 |
| **Total** | **8,63,911** | **1,10,62,672** | **12.81** |

## 6.2 Power Factor Analysis

The power factor is consistently maintained above 0.95 across all months, with an annual average of 0.98, indicating efficient electrical system operation and effective reactive power management.

The institute has benefited from power factor incentives amounting to approximately ₹1.49 lakh annually. This indicates that the installed capacitor banks and APFC system are functioning effectively.

| Month | Power Factor (P.F) | P.F incentive |
|---|---|---|
| April | 0.977 | 11,864 |
| May | 0.977 | 13,063 |
| June | 0.982 | 13,183 |
| July | 0.983 | 14,258 |
| August | 0.991 | 33,384 |
| September | 0.991 | 32,160 |
| October | 0.973 | 6,681 |
| November | 0.976 | 6,990 |
| December | 0.967 | 3,416 |
| January | 0.98 | 9,939 |
| February | 0.971 | 4,245 |
| March | — | — |
| | **Total** | **1,49,183** |

*Data for the month of March was not available.*

### 6.3 DG Sets Energy cost

The DG sets are primarily used as backup during power outages, with total annual generation of 7,000 kWh. The cost of electricity generated from DG sets is approximately ₹26 per kWh, which is significantly higher than grid electricity. This highlights that DG operation is economically unfavourable and should remain limited to emergency usage.

| Annual Diesel consumption (L) | kWh Generated | Average Diesel Cost (₹) | Cost per Unit (₹) |
|---|---|---|---|
| 2,000 | 7,000 | 91 | 26 |

### 6.4 Solar Cost Savings

The solar PV system generated 1,34,320 kWh annually, contributing to direct reduction in grid electricity consumption. The estimated annual cost savings from solar energy is ₹17.71 lakh.

The system demonstrates consistent performance across the year, with slightly reduced output during monsoon months.

| Month | Total Solar Generation* | Net Savings |
|---|---|---|
| April | 15,464 | 2,03,970 |
| May | 14,564 | 1,92,099 |
| June | 11,704 | 1,54,376 |
| July | 9,160 | 1,20,820 |
| August | 6,080 | 80,195 |
| September | 4,768 | 62,890 |
| October | 11,572 | 1,52,635 |
| November | 11,420 | 1,50,630 |
| December | 11,844 | 1,56,222 |
| January | 10,936 | 1,44,246 |
| February | 12,468 | 1,64,453 |

| | | |
|---|---|---|
| March | 14,340 | 1,89,145 |
| **Total** | **1,34,320** | **17,71,681** |

* Total solar generation includes both self-consumption and grid export.

## 7. Conclusion and Recommendations

The campus energy profile is driven by electricity consumption, with air conditioning systems as the primary load. LPG contributes a significant share of total energy use, while solar energy provides partial support through on-site generation. Energy consumption varies seasonally, with higher demand during periods of increased cooling requirement. Water pumping systems also contribute notably due to groundwater dependence.

The electrical system is operating efficiently, supported by high power factor levels and effective functioning of capacitor banks and APFC systems. DG sets are used strictly for backup. The campus has a stable energy infrastructure with partial integration of renewable energy. Improvement opportunities lie in structured energy monitoring, optimized operational practices, and phased expansion of solar capacity.

These actions will improve energy efficiency, reduce operating costs, and support long-term sustainability performance.

**Recommendations**

| Area | Recommendation | Action Plan | Impact | Priority |
|---|---|---|---|---|
| **Energy Monitoring & Data** | Establish structured equipment inventory | Maintain an updated electrical load inventory including wattage, quantity, and location. | Foundation for all future audits and decisions | High |
| | Implement sub-metering (building-wise) | Install submeters for academic blocks, hostels, utilities (STP, pumps) | Enables building-wise energy intensity tracking | High |
| | Monthly energy tracking system | Record electricity, DG fuel, LPG consumption, solar generation, and vehicle diesel on monthly basis | Improves control and anomaly detection | High |
| | Track asset lifecycle | Maintain yearly record of new equipment additions and discarded units | Ensures accurate load and planning data | High |
| | Introduce Electricity Use Intensity (kWh/m²/year) | Assess total built-up area of buildings and track electricity use intensity (kWh/m²/year) alongside existing per student metrics | Enables benchmarking and tracking | Medium |

| | | | | |
|---|---|---|---|---|
| **Load Management (TOD Optimization)** | Shift non-critical loads to off-peak hours | Schedule groundwater pumping, STP operations, and water treatment during non-peak hours (Day-time) | Reduces TOD charges | High |
| | Optimize operational scheduling | Avoid simultaneous operation of high-load systems where not required | Reduces peak demand impact | Medium |
| **Air Conditioning** | Phased replacement of inefficient ACs | Replace older units in phases (e.g., 5–10% annually) with 4/5 star or inverter ACs, prioritizing high-usage areas | Significant long-term savings | High |
| | Improve operational control | Maintain temperature settings (24–26°C), restrict use in unoccupied areas | Immediate energy savings | High |
| **Lighting & Fans** | Upgrade to efficient systems | Replace conventional fans with BLDC fans and remaining tube lights/CFLs with LED | High savings with short payback | High |
| **Renewable Energy** | Expand solar PV capacity | Assess rooftop solar potential during the current year and plan phased installation in subsequent period based on feasibility. | Reduces grid dependency and cost | High |
| **Cooking Energy** | Evaluate transition to PNG | Assess feasibility of switching from LPG to PNG based on availability | Lower cost and reduced emissions | Medium |
| **DG Set Operation** | Restrict DG usage | Operate DG sets strictly during grid outages and critical operations; avoid non-essential usage, particularly in residential areas during daytime. | Reduced emissions and cost savings | Medium |