Empirical Exergy Private Limited

Registered Office: 18-E, Sudama Nagar, Indore -452009
Office (Indore): Flat No. 201, Om Apartment, 214 Indrapuri, Indore (M.P.),
Contact: +91-731-4948831, Mobile: +91-78693-27256, 88713-68108
www.eeplgroups.com, email:-eempirical18@gmail.com
CIN No: U74999MP2018PTC045751

Ref No: EEPL/2022-23/ENERGY/002 **Date: - 20-05-2022**

ENERGY AUDIT CERTIFICATE

This is certified that Empirical Exergy Private Limited (EEPL) Indore M.P. has conducted an Energy audit at **Mewar University, Chittorgarh (Rajasthan)** for the academic year 2021-22, and the audit report has been submitted.

We avail this opportunity to express our deep and sincere gratitude to the management for their wholehearted support and co-operations during the energy audit.

This certificate is being issued based on the Energy Audit conducted by EEPL.

For- **Empirical Exergy Private Limited**

Rajesh Kumar Singadiya (Director)

M.Tech (Energy Management), PhD (Research Scholar)
Accredited Energy Auditor [AEA-0284]
Certified Energy Auditor [CEA-7271]
(BEE, Ministry of Power, Govt. of India)
Empanelled Energy Auditor with MPUVN, Bhopal M.P.
Lead Auditor ISO50001:2011 [EnMS) from FICCI, Delhi
Certified Water Auditor (NPC, Govt of India)
Charted Engineer [M-1699118], The Institution of Engineers (India)
Member of ISHRAE [58150]

ENERGY AUDIT REPORT

MEWAR UNIVERSITY

Gangrar Chittorgarh (Rajasthan)

PREPARED BY

EMPIRICAL EXERGY PRIVATE LIMITED

Flat No. 201, OM Apartment,214 Indrapuri Colony,
Bhawarkuan,Indore – 452 001 (M. P.), India
0731-4948831, 7869327256
Email ID:eempirical18@gmail.com
www.eeplgroups.com

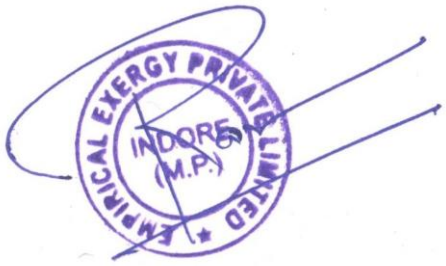
(2021-22)

CONTENT

ACKNOWLEDGEMENT

Empirical Exergy Private Limited (EEPL), Indore (M.P) takes this opportunity to appreciate & thank the management of **Mewar University Gangrar Chittorgarh** for allowing us to conduct an energy audit for the university.

We are indeed touched by the helpful attitude and co-operation of all faculties and technical staff, who rendered their valuable assistance and co-operation during the course of study.



Rajesh Kumar Singadiya

(Director)

M.Tech (Energy Management), PhD (Research Scholar)
Accredited Energy Auditor [AEA-0284]
Certified Energy Auditor [CEA-7271]
(BEE, Ministry of Power, Govt. of India)
Empanelled Energy Auditor with MPUVN, Bhopal M.P.
Lead Auditor ISO50001:2011 [EnMS) from FICCI, Delhi
Certified Water Auditor (NPC, Govt of India)
Charted Engineer [M-1699118], The Institution of Engineers (India)
Member of ISHRAE [58150]

ENERGY IS LIFE
CONSERVE IT

BUREAU OF ENERGY EFFICIENCY

Examination Registration No.: EA- 7271

Accreditation Registration No.: AEA-284

Certificate of Accreditation

This is to certify that Mr./Ms. Shri. Rajesh Kumar Singadiya having its trade/registered office at ..... has been given accreditation as accredited energy auditor. The certificate shall be effective from 9th day of May, 2018

The certificate is subject to the provisions of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

This certificate shall be valid until it is cancelled under regulation 9 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

On cancellation, the certificate of accreditation shall be surrendered to the Bureau within fifteen days from the date of receipt of order of cancellation.

Your name has been entered at AEA No. 284 in the register of list of accredited energy auditors. Your name shall be liable to be struck out on the grounds specified in regulation 8 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

Given under the seal of the Bureau of Energy Efficiency, Ministry of Power, this 5th day of October, 2018

Secretary,
Bureau of Energy Efficiency
New Delhi

Green Monitoring Committee.

OFFICE OF THE REGISTRAR
MEWAR UNIVERSITY, CHITTORGARH (RAJ.).

No. MU/RO/Admin/2022/1450 Dated : 4/5/2022

OFFICE ORDER

Reconstitution of Green, Environment & Energy Auditing Committee

Green Audit, Environment Audit & Energy Audit Committee is reconstituted to conduct the necessary audit in due course. Members of the Audit Committee are mentioned below:

S. No.	Name	Designation	Committee Role
1	Dr. Y. Sudershan	Professor & Dean, Department of Agriculture	Co-Ordinator
2	Mr. Rakesh Kumar Singadiya	Director, Empirical Exergy Pvt. Ltd.	External Auditor
3	Dr. Neelu Jain	Associate Professor, Department of Agriculture	Internal Auditor
4	Dr. Satish Kumar Ameta	Asst. Professor, Department of Life Science	Internal Auditor
5	Mr. Deepak Kumar Joshi	Asst. Professor, Department of Electrical Engg.	Internal Auditor
6	Dr. Mohd. Ashid	Asst. Professor, Department of Chemistry	Member
7	Ms. Nirma Kumari Sharma	Asst. Professor, Department of Electrical Engg.	Member
8	Mr. Suraj Kumhar	Asst. Professor, Department of Electrical Engg	Member
9	Mr. H. Widhani	OSD	Member
10	Mr. Narendra Kumar Ved	Non-Teaching Staff	Member
11	Ms. Sanchita Karnik	Non-Teaching Staff	Member

Registrar
Mewar University
Gangrar, (Chittorgarh)

Copy to:
1. PS to Hon'ble Chairperson for Kind information.
2. PS to President/Pro President for kind information.
3. Deans/Directors/CoE for Information.
4. All HoDs for information.
5. Concerned Committee Members
6. Coordinator, IQAC Cell.
7. Admission/Accounts/Examination/Stores/IT Support/Library/
8. Wardens/Maint.I-C/Receptionist

The Audit Team

The study team constituted of the following senior technical executives from **Empirical Exergy Private Limited,**

- **Mr. Rajesh Kumar Singadiya** [Director & Accredited Energy Auditor AEA-0284]
- **Mr. Rakesh Pathak**, [Director & Electrical Expert]
- **Dr. Suresh Kumar Soni** [Certified Energy Auditor & Energy Expert]
- **Mr. Sachin Kumawat** [Sr. Project Engineer]
- **Mr. Lokesh Kumar Varma** [Project Engineer]
- **Mr. Mohit Malviya** [Fire saftey Engineer]
- **Mr. Aakash Kumawat** [Site Engineer]
- **Mr. Ajay Nahra,** [Sr. Accountant & admin]

EXECUTIVE SUMMARY

The executive summary of the energy audit report furnished in this section briefly gives the identified energy conservation measures and other recommendations during the project that can be implemented in a phased manner to conserve energy and increase productivity inside the university campus.

ENERGY MANAGEMENT INITIATIVE TAKEN BY UNIVERSITY

- **480 KWp SOLAR PHOTOVOLTAIC ROOFTOP INSTALLATION:**

University has a 480 KWp solar photovoltaic rooftop grid-connected system installed on most of the buildings. Total unit generation from Sep-2018 to March- 2022 is **22,87,354** units. The solar unit generated for the year 2021-22 is 6,32,850 units. It is more than 50 % of the total unit consumption of the university campus.

RECOMMENDATION:-

- **POWER FACTOR IMPROVEMENT ON UNIVERSITY FEEDER**

  The average power factor for the year 2021-22 was 0.862 on the university feeder. It is recommended to maintain the power factor unity.

- **LIGHTING SYSTEM**

  University has already initiated the installation of energy-efficient lighting in new construction buildings and the replacement of "conventional tube light by an energy-efficient LED tube light and LED downlighter. **It's Appreciable.**

- **TIMER-CONTROLLED STREET LIGHTS**

  There are 3 high masts on the university campus. The high mast operated with the timer control system. **It's Appreciable.**

- **CEILING FAN AND EXHAUST FAN:**

  University is going to replace "conventional ceiling fan (60 Watt)" with an energy-efficient star-rated fan or BLDC-based energy-efficient fan (28 Watt) in classrooms, laboratories, and faculties cabin in phased mannerand has great potential for energy saving.

  University is going to replace the "conventional exhaust fan (180 Watt)" with an energy-efficient star-rated fan or BLDC-based energy-efficient Fan (40 Watt) in the university's

main building classrooms, laboratories, and faculties cabin has great energy-saving potential.

ENERGY CONSERVATION MEASURES FOR ELECTRICAL SYSTEM

Case Study	Section	Identification	Observation	Recommendation	Annual energy saving (kWh)	Annual cost saving (Rs.)	Investment (Rs.)	Simple payback Period (Year)
1	Lighting System	98 No. FTL tubelight	Power consumption by T-12 LED (08 to 10-watt blast power)	Replacement of conventional (T-12) with (T-5 Watt)	5,096	44,997	24,600	0.54
2	Lighting System	506 No CFL	Power consumption by CFL (18 Watt)	Replacement of conventional downlighter with 09 Watt.	9,108	81,334	80,900	01
3	Celling Fan	2702 No celling fan working with 60 Watt	Power consumption by exesting celling fan (60 Watt)	Replacement of 60W conventional ceiling fan by 28W BLDC energy efficient ceiling fan	1,72,928	15,44,247	68,55,000	4.43

CHAPTER-1
INTRODUCTION

1.1 About University

Mewar University is an autonomous body set up by the Government of Rajasthan through Act. No. 4 of 2009 passed by the Rajasthan Legislative Assembly (Government of Rajasthan). The University is recognized by the UGC u/s 2(f) of UGC Act with powers to confer degrees u/s 22(1) of the UGC Act, 1956 vide their letter no. F.9-15/2009(CPP-I) dated 30th March 2009. This is the only private and self-financed University in Rajasthan which is also approved by the UGC u/s 12B of the UGC Act vide their letter No. F.9-15/2009 (CPP-I/PU) dated15th October 2018. The University is also NAAC accredited.

Mewar University has never affiliated any institution, nor has the University ever set up any study center in any part of the country other than its main campus at Gangrar in Chittorgarh (Rajasthan).

Mewar University is promoted by the Mewar Education Society (MES). It is controlled by a Board of Management, constituted by the MES, which is headed by Chairperson Shri Ashok Kumar Gadiya, a great visionary, educationist, and nationalist, who translated his ideas and dreams of promoting higher education into reality by setting up institutes of learning in various subjects. In no time, he has carved out a niche for himself as an educationist, who believes in the inculcation of values through education in the young generation.

The group, under the able leadership of Dr.Ashok Kumar Gadiya and the active support and association of renowned academicians, experienced professionals, and technocrats, has established a chain of Institutes of higher education and learning:

- **Mewar Institute of Management**

  Mewar Institute of Management, Vasundhara, Ghaziabad (U.P.) [Approved by the UGC and affiliated with C.C.S. University, Meerut, conducting courses for B.B.A., M.B.A., B.C.A., M.C.S., M.I.S., B.Ed, B.Lib, and M.Sc. (Biotech)]

- **Mewar Law Institute**

  Mewar Law Institute, Vasundhara, Ghaziabad (U.P.) [Approved by the UGC, Bar Council of India and affiliated to C.C.S. University, Meerut, conducting courses for L.L.B. (3Yrs) & L.L.B. (5Yrs)]

- **Mewar Girls Business School**

  MewarGirls Business School, Vasundhara, Ghaziabad (U.P.) [Approved by the AICTE and affiliated to UP Tech University, Lucknow, conducting M.B.A. courses for Girls]

- **Mewar Girls College**

  MewarGirls College, Chittorgarh [Approved by Government of Rajasthan and affiliated to Mohan Lal Sukhadia University, Udaipur, conducting courses for M.I.B., B.Sc (Biotech.), B.B.M., B.C.A. & P.G.D.C.A.]

- **Mewar Girls Ayurved Nursing Centre**

  Mewar Girls Ayurved Nursing Centre, Chittorgarh [Approved by Government of Rajasthan and affiliated to Rajasthan Ayurved University, Jodhpur, conducting courses for Ayurved Nursing]

- **Mewar Girls Industrial Training Centre**

  Mewar Girls Industrial Training Centre, Chittorgarh [Approved by Government of India (NCVT) and Board of Technical Education, Jodhpur, (SCVT), conducting courses for Computer Operator and Programming Assistant, Interior Decoration, Fashion Designing, Dress Making, English Language Proficiency and Personality Development]

- **Mewar Girls College of Teachers Training**

  Mewar Girls College of Teachers Training, Chittorgarh [Approved by Government of India (NCTE) and affiliated to Mohan Lal Sukhadia University, Udaipur, conducting courses for B.Ed., N.T.T, S.T.C]

  These centers of learning exemplify the group's mission to promote quality technical and higher education. And as a result, the number of students has gone up considerably, and now it has more than 10,000 students on its campuses.

  The group, continuing with its mission to provide higher and technical education to a larger section of people, has touched a new height by promoting and sponsoring Mewar University. The promoting body, with its honest efforts and unstinting dedication, has the conviction to build a strong partnership with the Government of Rajasthan for ensuring the spread of higher and technical education in the state.

  Mewar's culture, ethos, tradition, and values are so ingrained in its soil that it is bestowed with the magical powers to sprout prodigious talent and genius. Anyone groomed in this environment will undergo a steady transformation to blossom in life and imbibe the traits of greatness associated with this historical place.

VISION:-

To develop a center of excellence for technical, professional, and vocational education and research at par with national and international standards.

MISSION:-

To develop the framework for effectively conducting various educational and research programmes of the highest standards to produce confident, self-reliant, and responsible youth for society and outstanding professionals for government, industry, and business. The mission is to "**Reach the unreached**"

OBJECTIVE:-

- Provide easy access to high-quality education in Management, Engineering, as well as other academic & professional fields to its students, irrespective of their caste, creed, age, gender, region, or country, at an affordable cost.
- To offer a conducive environment for pursuing research and vocational studies with a market-driven orientation.
- To expose students to new ideas, fresh vision, and pragmatic ambition and enhance their competency in the ever-changing business environment.
- To provide a flexible choice-based credit system of education and dual-degree programmes while flexible adopting modes of delivery to suit students' requirements of learning.
- To prepare and assist students in improving their prospects through career counseling and placement support, on-the-job training, industrial visits, presentations, and group discussions.
- To Promote and practice a convenient distance education concept in India and abroad.
- To spread job-oriented Skill Development education in rural and tribal areas

1.2 About Campus: -

Table 1.1 Details are the total build-up area given in the table:-

TOTAL GROUND COVERED. =20856.78 SQ.MT									
TOTAL OVERALL BUILT-UP ALL FLOORS AREA:- 76024.72 SQ.MT									
S.NO	BLOCK	FAR AREA				BUILT AREA			
		GROUND FLOOR AREA IN SQ.MT	FIRST FLOOR AREA IN SQ.MT	SECOND FLOOR AREA IN SQ.MT	THIRD FLOOR AREA IN SQ.MT	GROUND FLOOR AREA IN SQ.MT	FIRST FLOOR SQ.MT	SECOND FLOOR AREA IN SQ.MT	THIRD FLOOR AREA IN SQ.MT
1	ADMINISTRATIVE AND ACADEMIC BLOCK	8890.84	8519.33	8675.24	8675.24	8966.05	9050.97	9206.74	9206.74
2	EDUCATION BLOCK	1062.08	1170.08	1062.08	1062.1	1193.08	1253.27	1126.29	1126.29
3	ENGINEERING BLOCK	1979.9	11979.9	1979.9	0	2126.84	2093.74	2093.74	0
4	MEWAR HOSPITAL	1337.03	1337.03	0	0	1590.91	1590.91	0	0
5	BHAMASHAH HOSTEL	1382.11	1382.11	1382.11	1382.1	1601.64	1572.82	1572.82	1572.82
6	SANGA HOSTEL	1189.78	1189.78	1189.78	1189.8	1359.6	1341.62	1341.62	1341.62
7	KUMBHA HOSTEL	602.71	602.71	620.65	620.65	709.19	697.35	697.35	697.35
8	PRATAP HOSTEL	640.52	640.52	665.78	665.78	749.38	739.64	739.64	739.64

S.NO	BLOCK	FAR AREA				BUILT AREA			
		GROUND FLOOR AREA IN SQ.MT	FIRST FLOOR AREA IN SQ.MT	SECOND FLOOR AREA IN SQ.MT	THIRD FLOOR AREA IN SQ.MT	GROUND FLOOR AREA IN SQ.MT	FIRST FLOOR SQ.MT	SECOND FLOOR AREA IN SQ.MT	THIRD FLOOR AREA IN SQ.MT
9	PANNA DHAI HOSTEL	376.53	376.53	382.3	382.3	447.6	435.97	435.97	435.97
10	MEERA HOSTEL	323.13	323.13	323.13	323.13	386.87	381.68	381.68	381.68
11	GUEST HOUSE	229.94	223.58	223.58	223.58	295.78	258.82	258.82	258.82
12	STAFF QUARTERS(1 BHK)	285.11	285.11	285.11	285.11	367.6	362.67	362.67	362.67
13	STAFF QUARTER	276.99	276.99	276.99	276.99	353.84	349.18	349.18	349.18
14	ANNAPURNA MESS	613.7	0	0	0	708.4	0	0	0
	TOTAL	19190.37	28306.8	17066.65	15086.78	20856.78	20128.64	18566.52	16472.78

Satellite Image of Mewar university from Google map

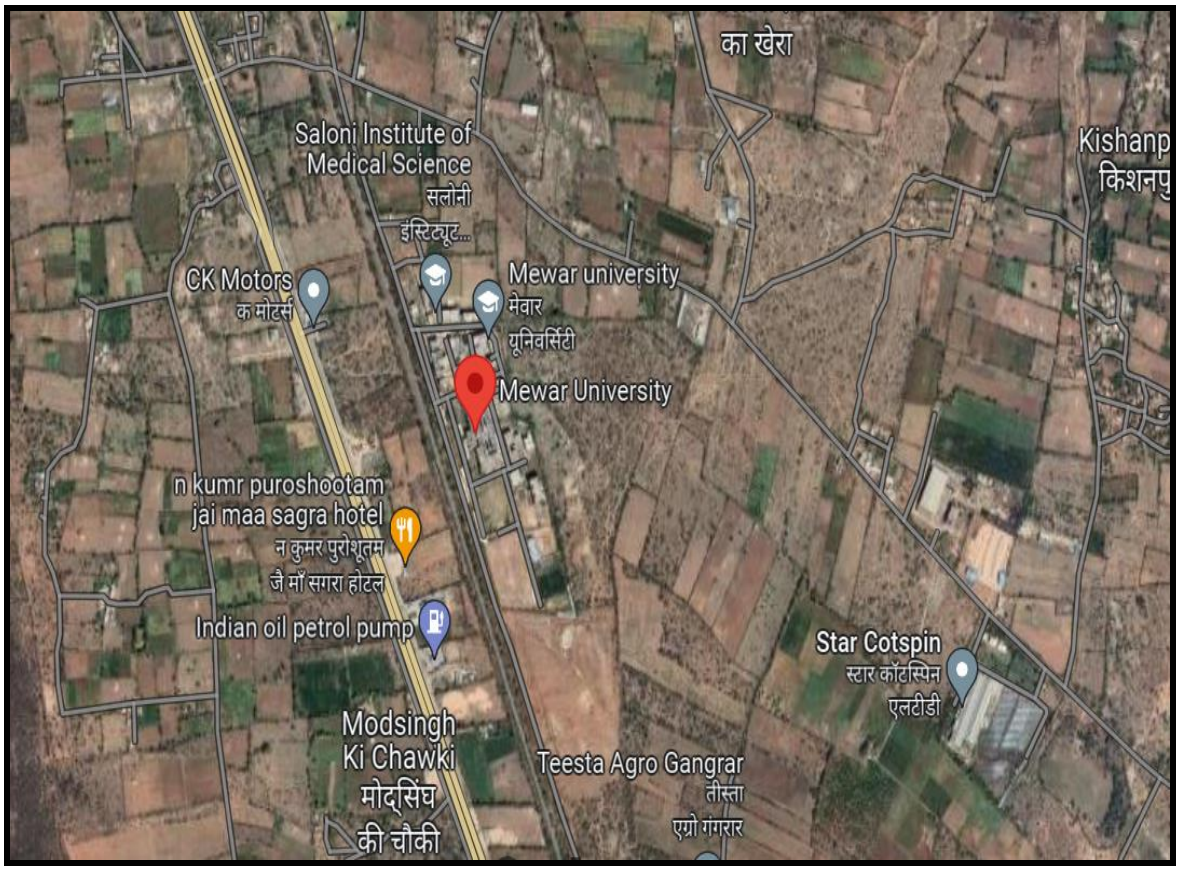
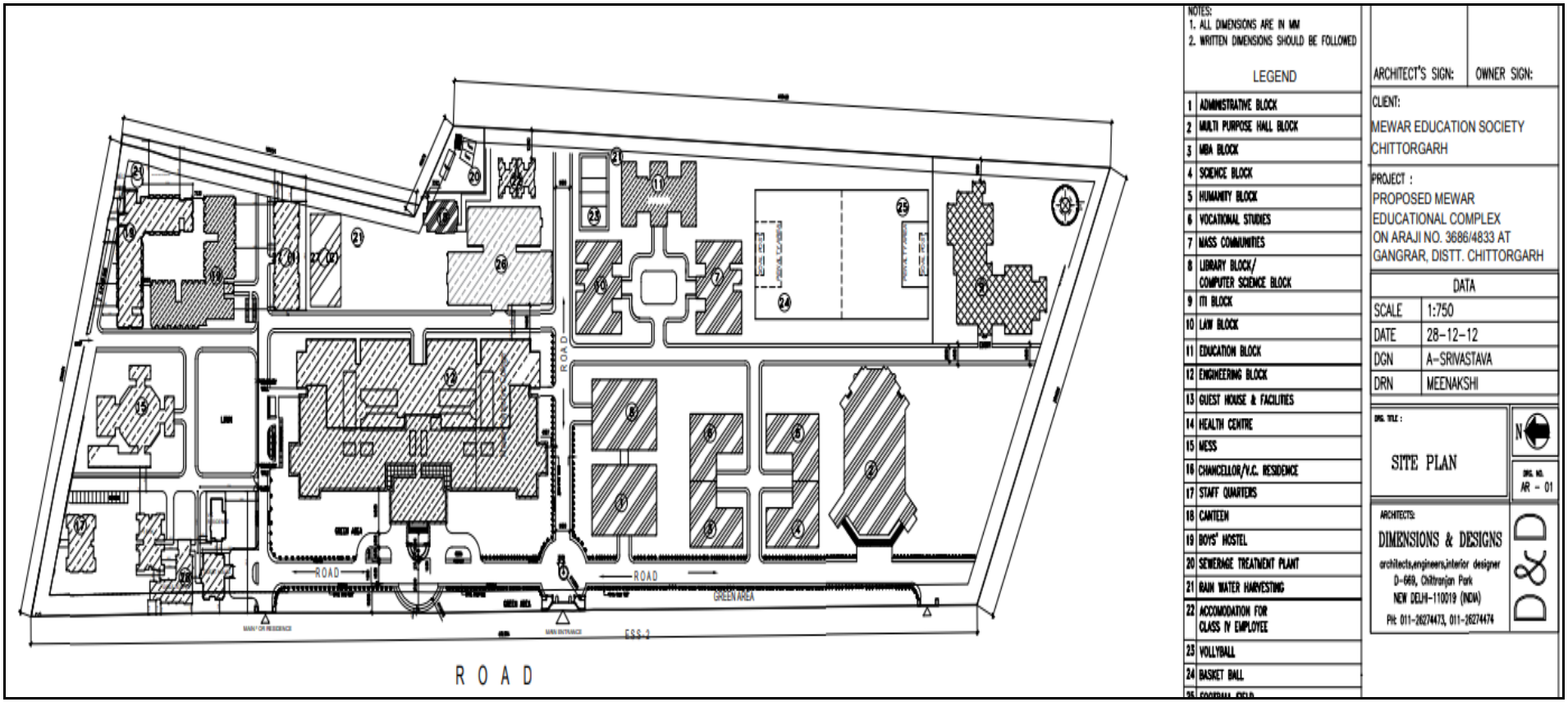


Figure 1.1: - Satellite Image of Mewar university from Google map

1.3 MEWAR UNIVERSITY LAYOUT OF VARIOUS BUILDINGS

Layout map of Mewar University



1.4 About Energy Audit

An energy audit helps to understand more about the ways energy is used in any plant and helps in identifying areas where waste may occur and scope for improvement exists. The overall energy efficiency from generation to the final consumer becomes 50%. Hence one unit saved in the end user is equivalent to two units generated in the power plant.

An energy audit is the most efficient way to identify the strength and weaknesses of energy management practices and to find a way to solve problems. An energy audit is a professional approach to utilizing economic, financial, social, and natural resources responsibly. Energy audits "adds value" to management control and are a way of evaluating the system.

Empirical Exergy Private Limited (EEPL), Indore M.P. carried out the "Energy Audit" at the site to find gaps in the energy consumption pattern for **Mewar University, Chittorgarh**. A technical report is prepared as per the need and the requirement of the project.

1.5 Objectives of Energy Auditing

An energy audit provides a vital information base for an overall energy conservation program covering essentially energy utilization analysis and evaluation of energy conservation measures. It aims at:

- Identifying the quality and cost of various energy inputs.
- Assessing the present pattern of energy consumption in different cost centers of operations.
- Relating energy inputs and production output.
- Identifying potential areas of the thermal and electrical energy economy.
- Highlighting wastage in major areas.
- Fixing of energy-saving potential targets for individual cost centers.
- Implementation of measures for energy conservation & realization of savings.

1.6 Methodology:

The methodology adopted for achieving the desired objectives viz.: Assessment of the current operational status and energy savings includes the following:

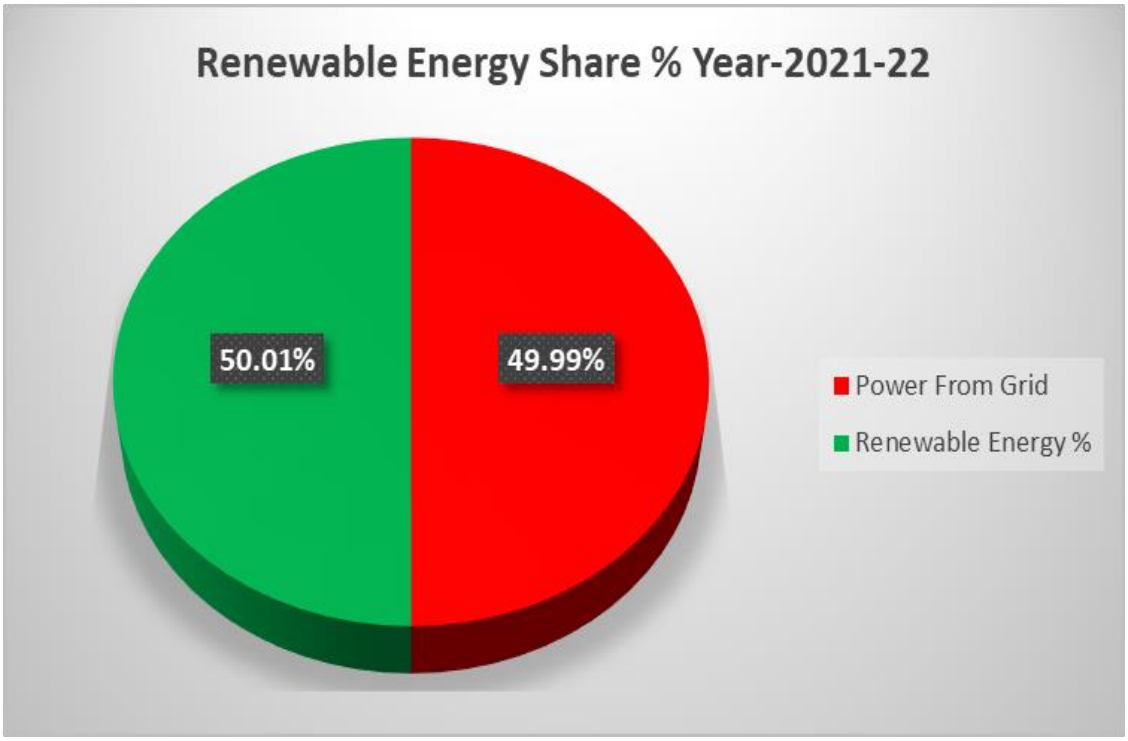
- Discussions with the concerned officials for identification of major areas of focus and other related systems.
- A team of engineers visited the site and had discussions with the concerned officials/supervisors to collect data/information on the operations and load distribution within the plant and the same for the overall premises. The data were analyzed to arrive at a baseline energy consumption pattern.
- Measurements and monitoring with the help of appropriate instruments including continuous and/or time-lapse recording, as appropriate and visual observations were made to identify the energy usage pattern and losses in the system.
- Trend analysis of costs and consumptions.
- Capacity and efficiency test of major utility equipments, wherever applicable.
- Estimation of various losses
- Computation and **in-depth analysis** of the collected data, including utilization of computerized analysis and other techniques as appropriate, were done to draw inferences and to evolve suitable energy conservation plan/s for improvements/ reduction in specific energy consumption.

1.7 Mewar University Present Energy Scenario:

Mewar university uses energy in the form of electricity purchased from the grid and a 480 KWp solar grid-connected system for the university campus. There are two feeders one is for education building and the other for residency

The annual energy consumption of **Mewar University** campus is about **12,65,488** units (Grid + Solar) period from April - 2021 to March- 2022.

Mewar University has a 480 KWp solar photovoltaic rooftop grid-connected system installed on almost all buildings. Total Solar generation from Sep-2018 to March- 2022 is **22,87,345** units. Annual Solar unit generation for the year 2021-22 is 6,32,850 units.



CHAPTER- 2
POWER SUPPLY SYSTEM

2.1 Transformer and substation

The power supply for the Mewar university is from AVVNL with the help of 11 kV feeders. There are 3 electricity connections. One is a university feeder under Tariff 2620G 11 KV Non-Industrial with sanctioned load of 425 kW. The second is a residency feeder under tariff 1011, 11 KV Non-Industrial with sanctioned load of 400 kW, and the third are bank feeder with 14 kW. There are two step-down transformers having capacities are 630 KVA and 500 KVA. university and residential respectively. The details are given in following table 2.1

Table: 2.1 Nameplate details of transformers -01 and 02

Sr. No.	Items	Technical Specification of Transformer -01 (University Feeder)	Technical Specification of Transformer -02 (Residency Feeder)
1	Make	Ganga Sagar Agro Pipes Private Limited	Uttam (Bharat) Electrical Private Limited
2	Year	2008	2012
3	Rating (kVA)	630	500
4	Voltage (HV/ LV)	11000/433	11000/433
5	Current Rating (HV/ LV)	33.10 / 838	26.24/666.71
6	Frequency (Hz)	50	50
7	Impedance at 75°C (%)	4 %	4 %
8	Vector group	Dyn-11	Dyn-11
9	Type of cooling	ONAN	ONAN
10	Total no of Tap	5	5

Figure 2.1:- 11 kV Feeder and 630 kVA and 500 kVA

Table 2.2: Calculated Transformer loading on university feeder loading % Year (2021-22)

Sr.No.	Month & Year	Transformer Capacity (KVA)	Maximum Demand (kVA)	Transformer loading %
1	Apr-21	630	63	9.97
2	May-21	630	64	10.16
3	Jun-21	630	84	13.33
4	Jul-21	630	109	17.30
5	Aug-21	630	114	18.10
6	Sep-21	630	120	19.05
7	Oct-21	630	92	14.54
8	Nov-21	630	92	14.54
9	Dec-21	630	82	13.02
10	Jan-22	630	73	11.56
11	Feb-22	630	70	11.11
12	Mar-22	630	72	11.49
	Average Transformer loading %			**13.68**

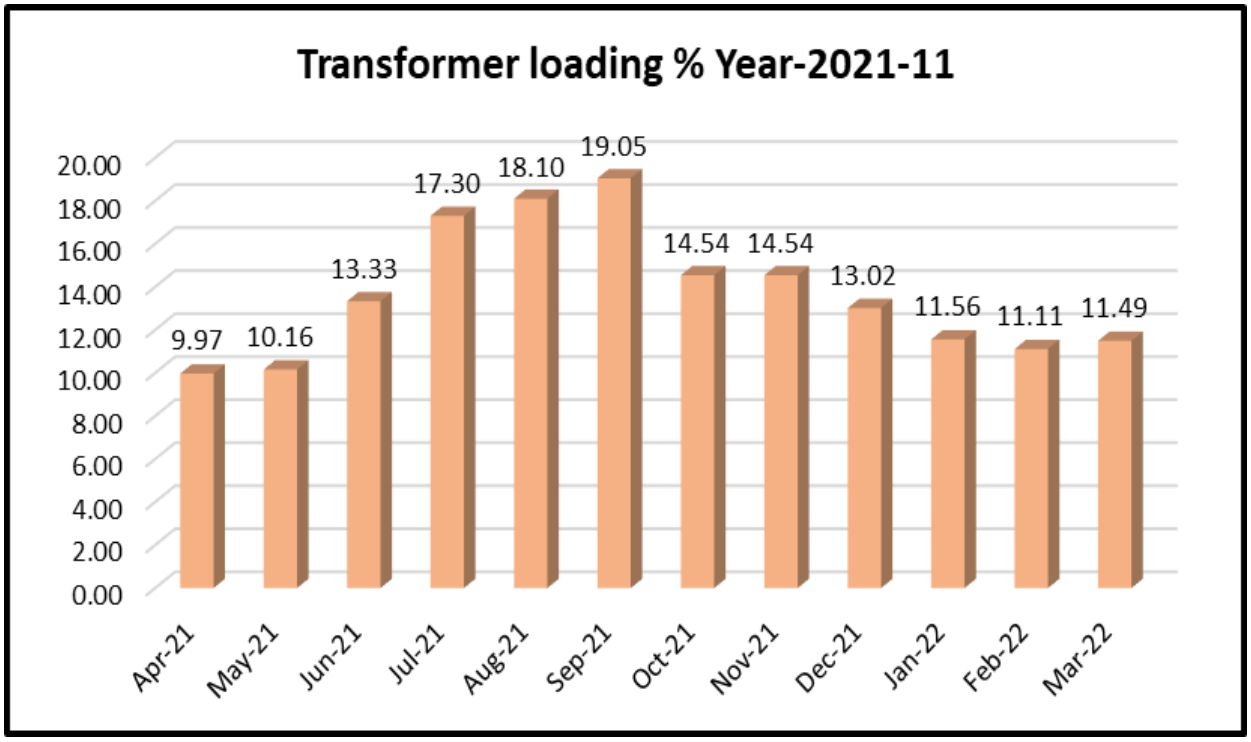


Figure 2.2:- Graphical presentation of TR loading percentage Year 2021-22

Observation: -

The average loading of the transformer is 13.68 %. It is acceptable.

Table 2.3: Calculated Transformer loading on residency Feeder Loading %
Year (2021-22)

Sr.No.	Month & Year	Transformer Capacity (KVA)	Maximum Demand (KVA)	Transformer loading %
1	Apr-21	500	136	27.28
2	May-21	500	96	19.20
3	Jun-21	500	102	20.40
4	Jul-21	500	79	15.76
5	Aug-21	500	92	18.40
6	Sep-21	500	71	14.16
7	Oct-21	500	79	15.76
8	Nov-21	500	106	21.20
9	Dec-21	500	137	27.36
10	Jan-22	500	195	38.96
11	Feb-22	500	200	39.92
12	Mar-22	500	140	28.08
	Average Transformer loading %			**23.87**

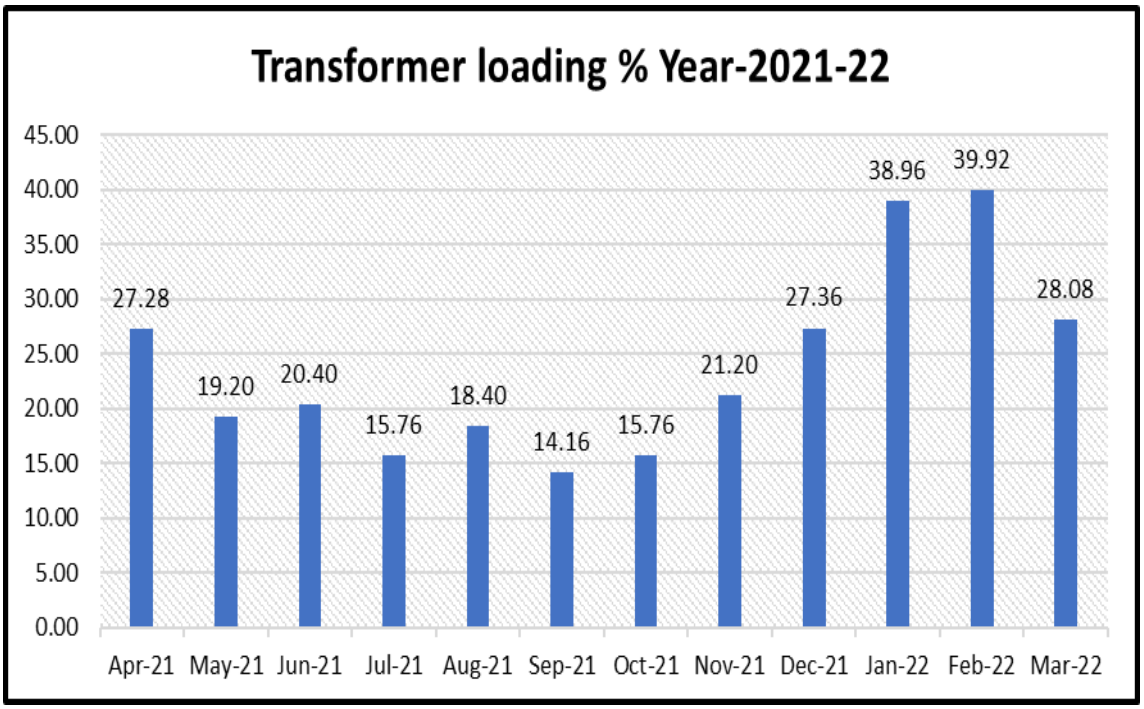


Figure 2.3:- Graphical presentation of TR loading percentage Year 2021-22

Observation: -

The average loading of the transformer is 23.67%. It is acceptable.

2.2 DG Set:-

There are 2 DG sets on the university campus. Details of the DG Sets are given table. 2.4

Table 2.4 Technical specifications for DG sets- 01 and 02

Sr. No.	Parameter	Technical Specification DG Set-01 (University Feeder)	Technical Specification DG Set-02 (Residency Feeder)
1	Make	Stamford	Stamford
2	M/C No	N136288779	N02609855
3	Capacity (KVA)	250	200
4	Rated Voltage	415	415
5	Full load current	347.8	278
6	Frequency	50	50
7	Power factor	0.8	0.8
8	RPM	1500	1500
9	Phase	3	3

Figure 2.4:- DG set in Power House

Observation & Suggestion:

- DG set is used only in case of grid power failure.
- There is no system to monitor fuel consumption w.r.t. unit generation.

2.3 Capacitor Bank

The energy audit team examine of existing capacitor bank at the powerhouse. Details of the capacitor are given in table 2.5

Table: 2.5 Details of Capacitor bank

Sr. no	Capacitor no	Capacity	Location	Remark
1	Capacitor -01	5 kVAr	Main University Panel	Working
2	Capacitor -02	5 kVAr	Main University Panel	Working
3	Capacitor -03	5 kVAr	Main Residential Panel	Working
4	Capacitor -04	5 kVAr	Main Residential Panel	Working

Figure 2.5 Capacitor bank on main penal

Observation:- Energy audit team examined individual capacitors at the site. It was found that all the capacitors are in working condition.

2.4 Grid Connected Solar Photovoltaic System (490 Kwp)

There is a 480KWp solar photovoltaic rooftop grid-connected system installed on various buildings. System details are given below:

Table: - 2.6 Solar plant detailed

Sr. No	Description	Technical Specification
1	Plant Information	
1.1	Plant capacity	480 kWp
1.2	Locations	1. Administrative and Academic building 2. Kumbha Hostel building. 3. Pratap Hostel building. 4. Sanga Hostel building. 5. Mewar Hospital 6. Panna Dhai Girls Hostel . 7. Meera Girls Hostel.
1.3	Latitude & Longitude	23.3103 N & 77.3619 E
2	PV Panel Details	
2.1	Make	M/s. Goldi Green Technologies Pvt. Ltd
2.2	Panel Type	Poly-crystalline
2.3	Panel Wattage	320 Wp
2.4	No of PV Panels	1478
2.5	Total Capacity	480 kWp
3	Inverter Information	
3.1	Make	KSTAR
3.2	Model	1. KSG-50K = 04 2. KSG-20K = 06 3. KSG-15K = 01 4. KSG-20K =05
3.3	Capacity	480 Kw

Sr. No	Building Name	Total No of Inverter	Inverter Modal	No of Penal
1	Administrative and Academic building	2	KSG-20 K	730
		4	KSG-50 K	
2	Kumbha Hostel	2	KSG-20 K	110
3	Pratap Hostel	1	KSG-15 K	108
		1	KSG-20 K	
4	Sanga Hostel	2	KSG-30 K	190
5	Mewar Hospital	2	KSG-30 K	190
6	Panna Dhai Hostel	1	KSG-20 K	60
7	Meera Girls Hostel	1	KSG-30 K	90

Photographs of Solar Plant:-

Figure 2.6:- Solar Plant 480 KWp and Inverter System

Total Solar unit generation:-

Table 2.7:- Total Solar Unit generation Year-2018 to 2022

Sr. No	Year	Unit
1	2018-19	4,15,350
2	2019-20	5,69,087
3	2020-21	6,29,936
4	2021-22	6,20,672
	Total	**22,35,045**

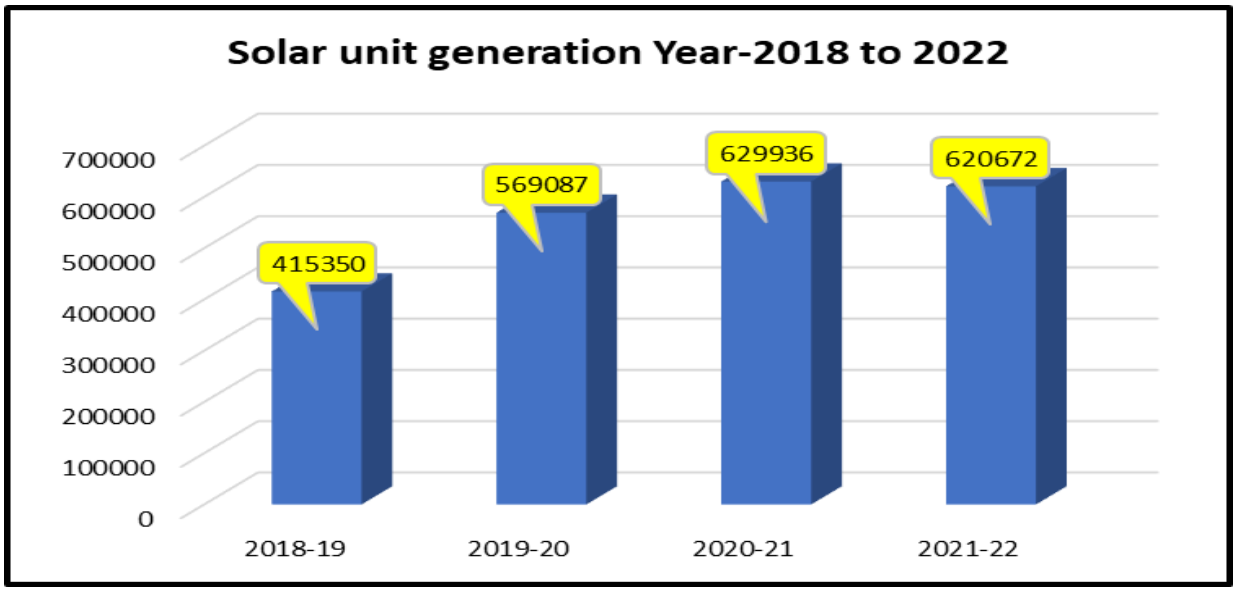


Figure: - 2.7 Graphical presentation of Solar unit generation

Observation: -

Total unit generation from the installation of the solar system up to march-2022 is 22,35,045 units.

Solar unit generation Year-2021-22:-

Table 2.8:- Monthly Solar unit generation Year-2022

Sr. No	Month & Year	Unit (kWh)	Amount (Rs/-)	per unit Charges (Rs/kWh)
1	Apr-21	64,125	2,88,563/-	4.50
2	May-21	56,511	2,54,300/-	4.50
3	Jun-21	52,918	2,38,131/-	4.50
4	Jul-21	46,334	2,08,501/-	4.50
5	Aug-21	44,791	2,01,560/-	4.50
6	Sep-21	41,335	1,86,008/-	4.50
7	Oct-21	60,348	2,71,568/-	4.50
8	Nov-21	47,370	2,13,165/-	4.50
9	Dec-21	42,208	1,89,936/-	4.50
10	Jan-22	50,107	2,25,479/-	4.50
11	Feb-22	52,226	2,35,015/-	4.50
12	Mar-22	62,401	2,80,802/-	4.50
	Total	**6,20,672**	**27,93,028/-**	**4.50**

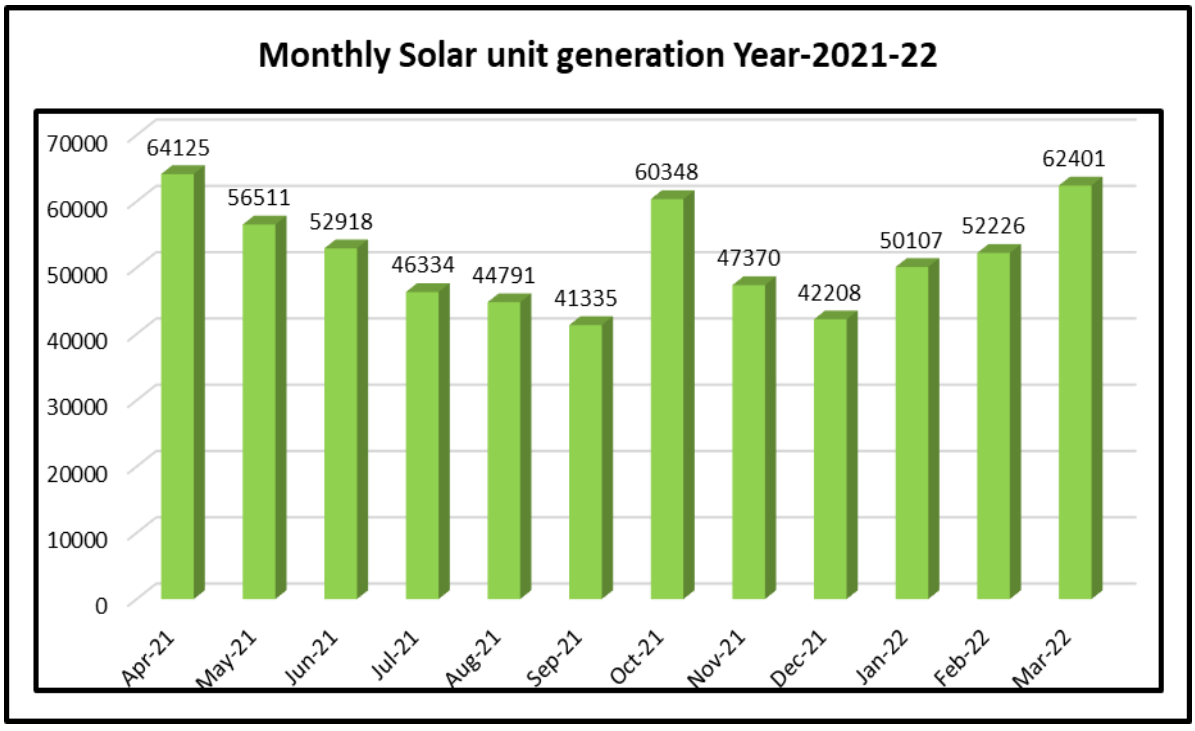


Figure 2.8:- Monthly Solar unit generation Year-2021-22

CHAPTER- 3
ELECTRICITY BILL ANALYSIS

3.0 Electricity Bill Analysis: -

Electricity bills for the last four years were analyzed. Detailed unit consumption, Solar unit generation, and % of renewable energy sources.

Table 3.0 :- Electricity bill analysis last 04 Year

Sr. no	Year	Unit consumption (Residentail)	Unit Consumption (University)	Total unit Consumption by AVVNL	Total Solar Unit Generation	Total Unit consumption (AVVNL + Solar)	Renewable Energy Share %
1	2018-19	3,81,399	2,55,912	6,37,311	4,15,350	10,52,661	39.46
2	2019-20	4,81,500	2,03,160	6,84,660	6,09,209	12,93,869	47.08
3	2020-21	3,36,507	2,30,656	5,67,163	6,29,936	11,97,099	52.62
4	2021-22	1,76,178	4,56,460	6,32,638	6,32,850	12,65,488	50.01
	Total	**13,75,584**	**11,46,188**	**25,21,772**	**22,87,345**	**48,09,117**	

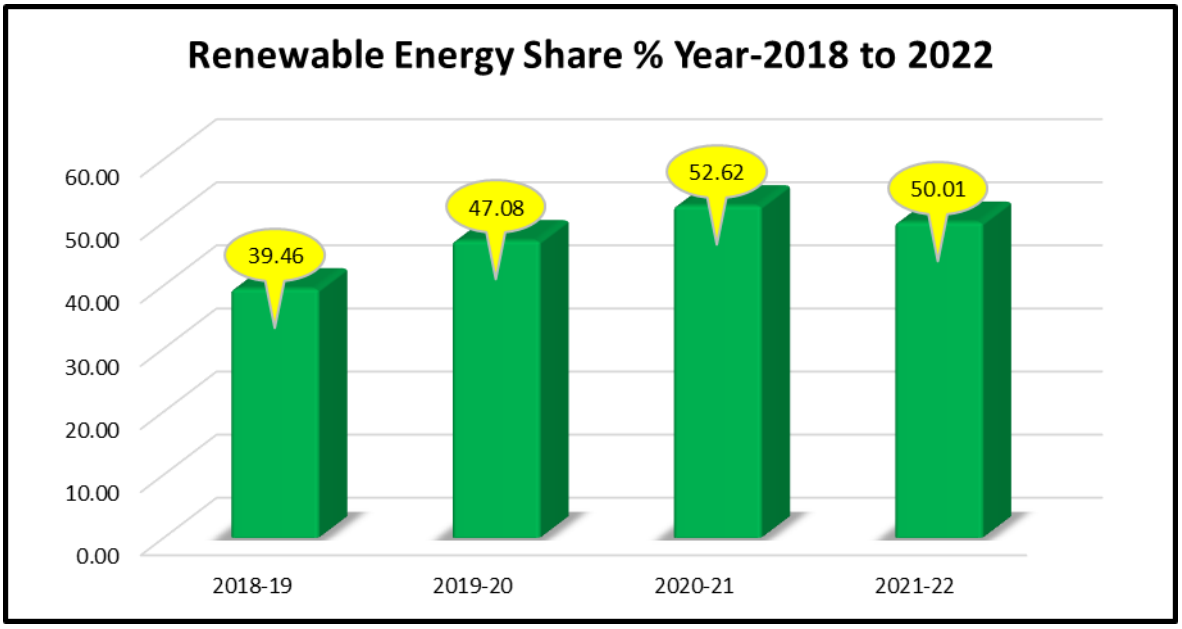


Figure 3.0:- Renewable energy share % Year-2018 to 2022

3.1 Monthly electrical energy consumption 2021-22:- (University Feeder)

The monthly electrical consumption for the university is given in the table.

Table 3.1 Energy consumption and billing amount (the year 2021-22)

Sr.No.	Month & Year	Unit Consumption (kWh)	Energy Charge (Rs/-)	Energy Charges (Rs./KWh)
1	Apr-21	11,012	98,342 /-	8.93
2	May-21	10,810	96,533/-	8.93
3	Jun-21	17,244	1,54,161/-	8.94
4	Jul-21	8,352	74,666/-	8.94
5	Aug-21	2,764	24,523/-	8.87
6	Sep-21	16,328	1,45,921/-	8.94
7	Oct-21	13,284	1,18,677/-	8.93
8	Nov-21	34,156	3,05,404/-	8.94
9	Dec-21	16,392	1,46,566/-	8.94
10	Jan-22	16,164	1,44,453/-	8.94
11	Feb-22	15,296	1,36,684/-	8.94
12	Mar-22	14,376	1,28,450/-	8.94
	Total	**1,76,178**	**15,74,380**/-	**8.93**

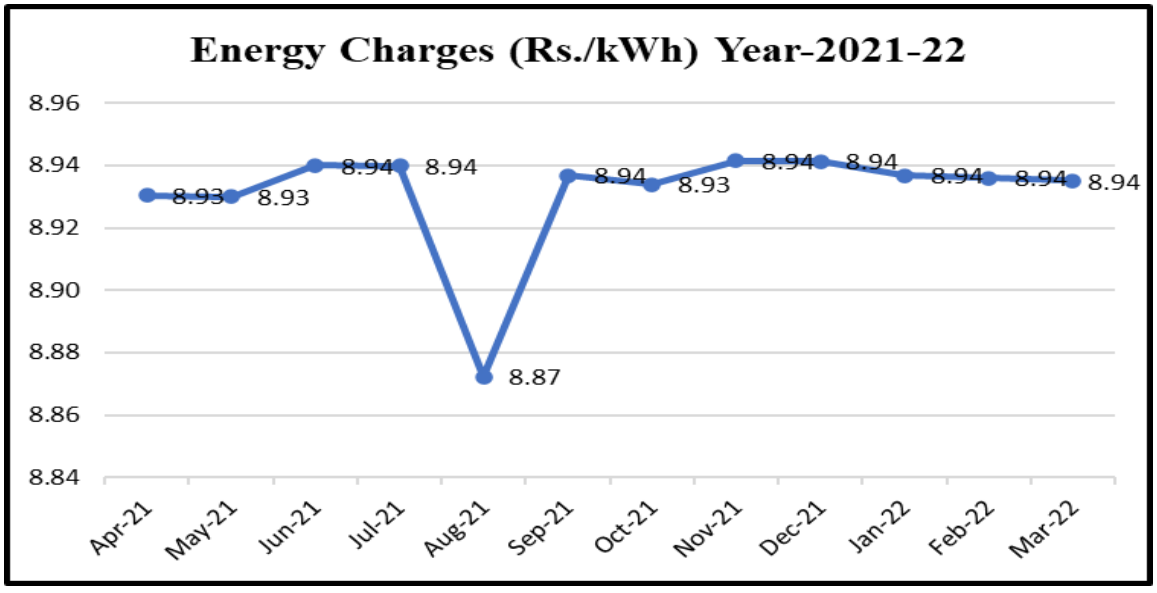


Figure 3.1:- Graphical presentation of actual per-unit charges for the year 2021-22

Observation:

It was found that total energy consumption in the last 12 months was 1,76,178 units. The average annual energy charge is Rs 8.93 /kWh.

3.2 Monthly demand analysis (2021-22) at University feeder.

The monthly demand consumption for the university is given in the table.

Table 3.2:- Monthly demand analysis (KVA) consumption pattern year 2021-22

Sr.No.	Month & Year	Contrect Demand (kVA)	Billing Demand (kVA)	Maximum Demand (kVA)
1	Apr-21	300	225	63
2	May-21	300	225	64
3	Jun-21	300	225	84
4	Jul-21	300	225	109
5	Aug-21	300	225	114
6	Sep-21	300	225	120
7	Oct-21	300	225	92
8	Nov-21	300	225	92
9	Dec-21	300	225	82
10	Jan-22	300	225	73
11	Feb-22	300	225	70
12	Mar-22	300	225	72
Minimum Demand				**63**
Maximum Demand				**120**
Average Demand				**87**

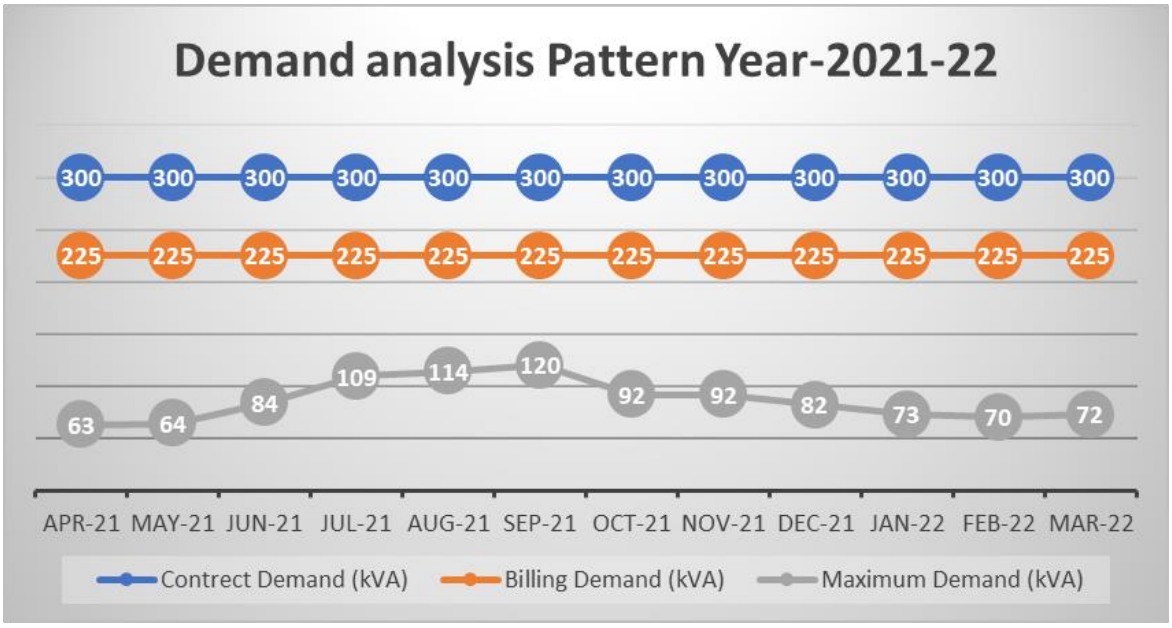


Figure 3.2:- Graphical presentation of demand consumption in the university year 2021-22

Observation: It was observed that the contract demand of the university is 300 kVA. There is a large variation in maximum demand. It is a maximum of 120 kVA in the Month of Sep-2021 and a minimum of 63 kVA in Apr- 2021.

3.3 Monthly Power factor analysis Year-2021-22 (University Feeder)

The monthly power factor for the university is given in the following table.

Table 3.3:- Power factor of the university year 2021-22

Sr.No.	Month & Year	Power Factor
1	Apr-21	0.863
2	May-21	0.832
3	Jun-21	0.854
4	Jul-21	0.876
5	Aug-21	0.822
6	Sep-21	0.822
7	Oct-21	0.822
8	Nov-21	0.897
9	Dec-21	0.887
10	Jan-22	0.885
11	Feb-22	0.877
12	Mar-22	0.907
		Average = 0.862

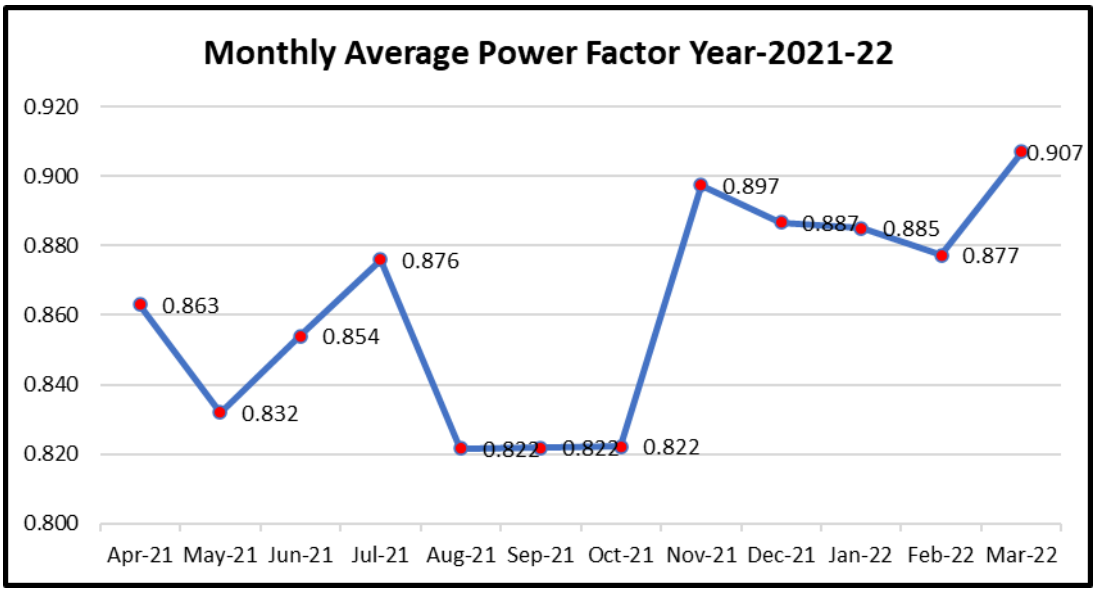


Figure 3.3 Graphical presentation of average power factor year 2021-22

Observation:

The average power factor was 0.862 for the year 2021-22. It is recommended to maintain power factor unity.

3.4 Monthly electrical energy consumption 2021-22 at (Residency Feeder)

The monthly electrical consumption for the university is given in the table.

Table 3.4 Energy consumption and billing amount year 2021-22

Sr.No.	Month & Year	Unit Consumption (kW)	Energy Charge (Rs/-)	Energy Charges (Rs./KWh)
1	Apr-21	32,388	2,57,030 /-	7.94
2	May-21	39,894	3,16,359/-	7.93
3	Jun-21	53,000	4,20,820/-	7.94
4	Jul-21	20,388	1,61,629/-	7.93
5	Aug-21	24,368	1,93,271/-	7.93
6	Sep-21	19,940	1,58,068/-	7.93
7	Oct-21	27,818	2,20,582/-	7.93
8	Nov-21	32,048	2,54,162/-	7.93
9	Dec-21	36,908	2,93,117/-	7.94
10	Jan-22	63,920	5,07,709/-	7.94
11	Feb-22	66,392	5,27,361/-	7.94
12	Mar-22	39,396	3,12,743/-	7.94
	Total	4,56,460	36,22,851/-	7.94

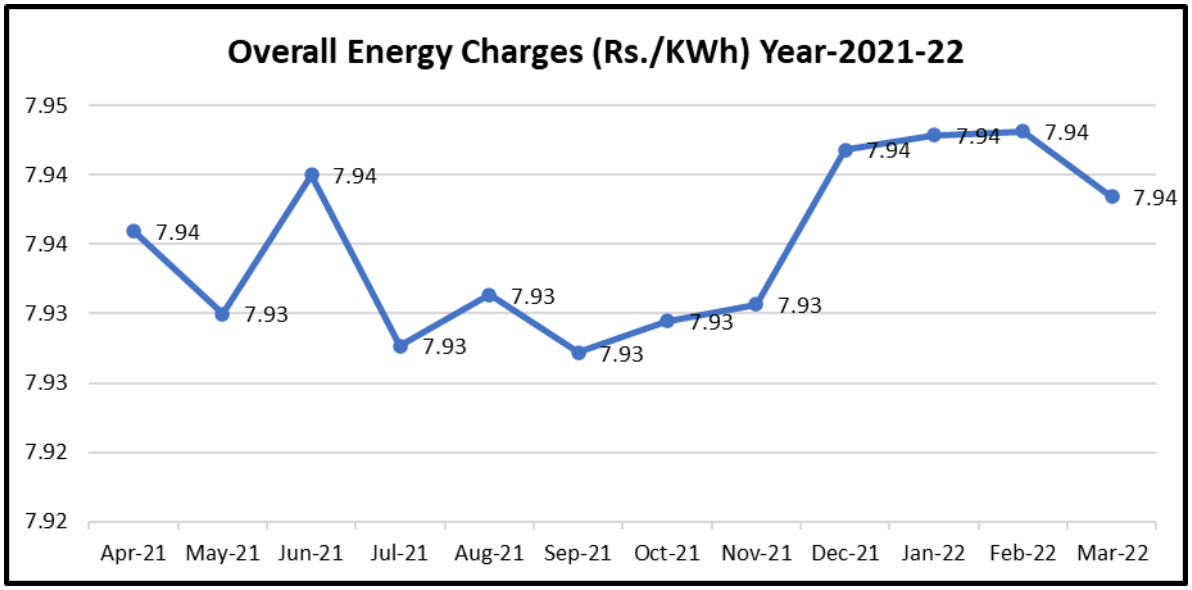


Figure 3.4:- Graphical presentation of actual per-unit charges for years 2021-22

Observation:

It was found that total energy consumption in the last 12 months was 1,76,178/- units. The average annual energy charge is Rs 8.93 kWh.

3.5 Monthly Demand analysis (2021-22) on (Residency Feeder)

The monthly demand consumption for the residency feeder is given in the table.

Table 3.5 Monthly demand analysis (KVA) consumption pattern year 2021-22

Sr.No.	Month & Year	Contrect Demand (kVA)	Billing Demand (kVA)	Maximum Demand (KVA)
1	Apr-21	300	225	136
2	May-21	300	225	96
3	Jun-21	300	225	102
4	Jul-21	300	225	79
5	Aug-21	300	225	92
6	Sep-21	300	225	71
7	Oct-21	300	225	79
8	Nov-21	300	225	106
9	Dec-21	300	225	137
10	Jan-22	300	225	195
11	Feb-22	300	225	200
12	Mar-22	300	225	140
Minimum Demand				**71**
Maximum Demand				**200**
Average Demand				**122**

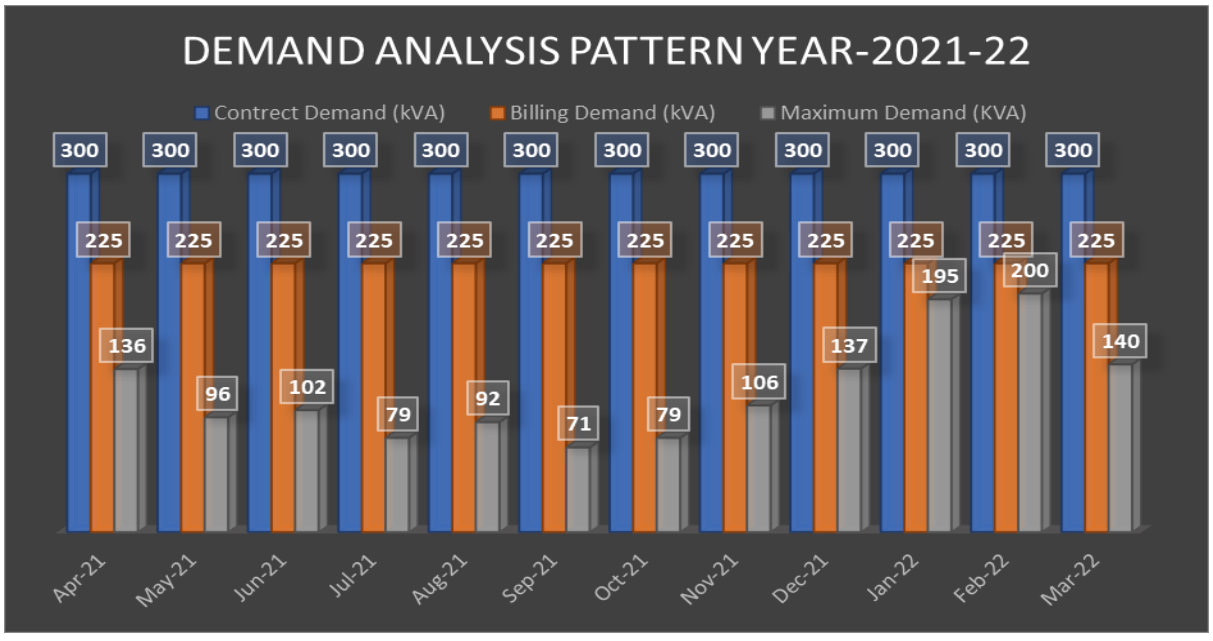


Figure 3.5:- Graphical presentation of demand consumption year 2021-22

Observation: It was observed that the contract demand of the university is 300 kVA. There is a large variation in maximum demand. It is a maximum of 20 kVA in the Month of Feb-2022 and a minimum of 71 kVA in Sep-2021.

3.6 Monthly Power factor analysis Year-2021-22 (Residency Feeder)

The monthly power factor is given in the following table.

Table 3.6 Power factor for the year 2021-22

Sr.No.	Month & Year	Power Factor	PF Penalty (Rs/-)	PF Incentive (Rs/-)
1	Apr-21	0.989	0.00	7,197
2	May-21	0.973	0.00	6,527
3	Jun-21	0.982	0.00	8,726
4	Jul-21	0.985	0.00	3,879
5	Aug-21	0.986	0.00	4,832
6	Sep-21	0.977	0.00	2,529
7	Oct-21	0.988	0.00	5,958
8	Nov-21	0.988	0.00	6,862
9	Dec-21	0.979	0.00	5,569
10	Jan-22	0.976	0.00	8,123
11	Feb-22	0.981	0.00	10,547
12	Mar-22	0.979	0.00	5,942
		Average = 0.981		**Total = 76,691**

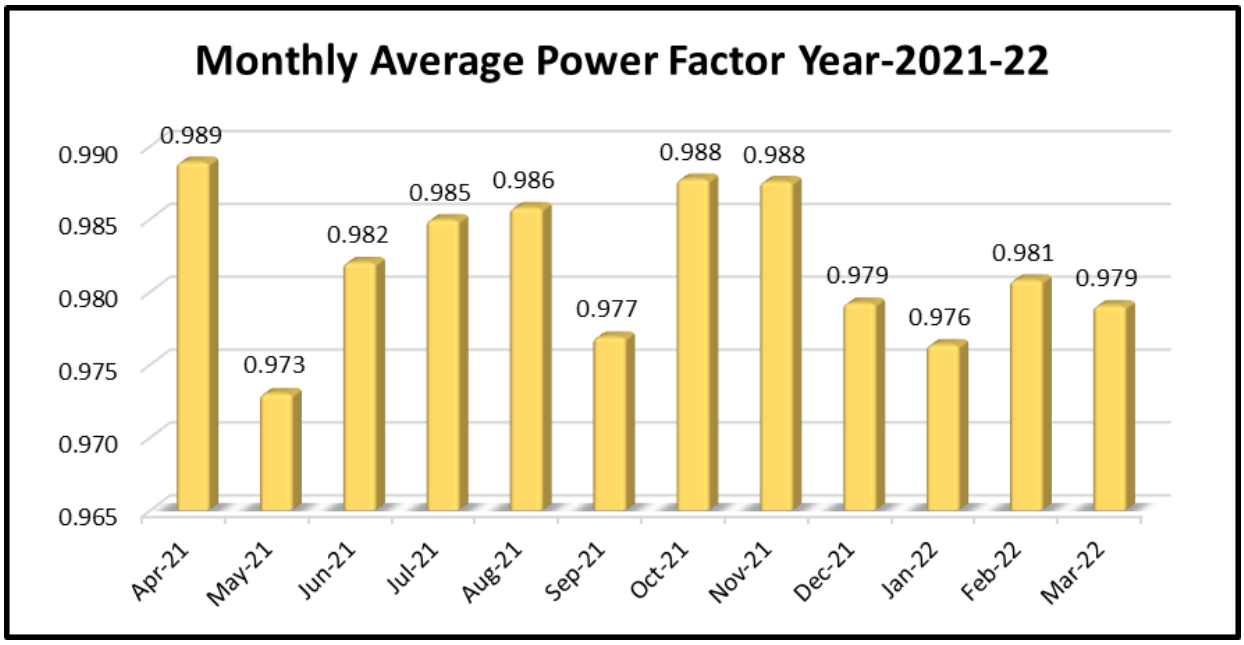


Figure 3.6 Graphical presentation of average power factor year 2021-22

Observation:

The average power factor for the year 2021-22 was 0.981. University has taken an incentive of Rs. 76,691 /- in the year 2021-22. **It's Appreciable.**

3.7 ON Site power measurement in Mewar University:-

Table 3.7 Operating load measurement on various buildings.

Sr. No	Building / Section	Voltage	Currient	P.F	Total Kw
1	MBA Building	395	61.22	0.912	38.20
2	Engineering Block	398	63.30	0.901	39.32
3	Admin Building Penal-01 (Near Draiver room G.F)	412	91.23	0.981	63.86
4	Admin Building Penal-02 (Near Temple Side)	402	24.10	0.913	15.32
5	Residency Feeder	423	176.81	0.97	125.65
6	Guest House	412	5.23	0.942	3.52
7	Meera Girls Hostel	414	4.32	0.965	2.99
8	Panna Girls Hostel	408	9.12	0.963	6.21
9	Mess	412	4.20	0.956	2.87
10	Sanga Hostel	410	58.00	0.978	40.28
11	International Hostel	413	42.21	0.976	29.47
12	Kumbha Hostel	412	7.30	0.965	5.03
13	Pratap Hostel	406	13.20	0.976	9.06
14	STP plant	412	30.00	0.965	20.66
15	B-Block	408	8.00	0.943	5.33
	Total Operating Load At 16/05/2022				407.75

Photograph of On-Site Power measurement:-

Figure 3.7:- On-site power measurement Dated 16/05/2022

Table 3.8:-Total Connected load share % on equipments

Sr. NO	Equipments	Rated Power (Watt)	Quntity (Nos)	Total Power (Watt)	Load Share (%)
1	Tubelight (28 W)	28	1134	31752	8.49
2	Tubelight (36 W)	36	98	3528	0.94
3	Celling Fan (60 W)	60	2702	162120	43.36
4	LED tubelight (20 W)	20	1306	26120	6.99
5	CFL (18 W)	18	506	9108	2.44
6	AC	1500	49	73500	19.66
7	PC	85	414	35190	9.41
8	Printer	250	54	13500	3.61
9	Exhaust	180	68	12240	3.27
10	Round Light	18	44	792	0.21
11	High Mast	1500	4	6000	1.60
Total Connected load (KW)				**373.850**	**100.00**

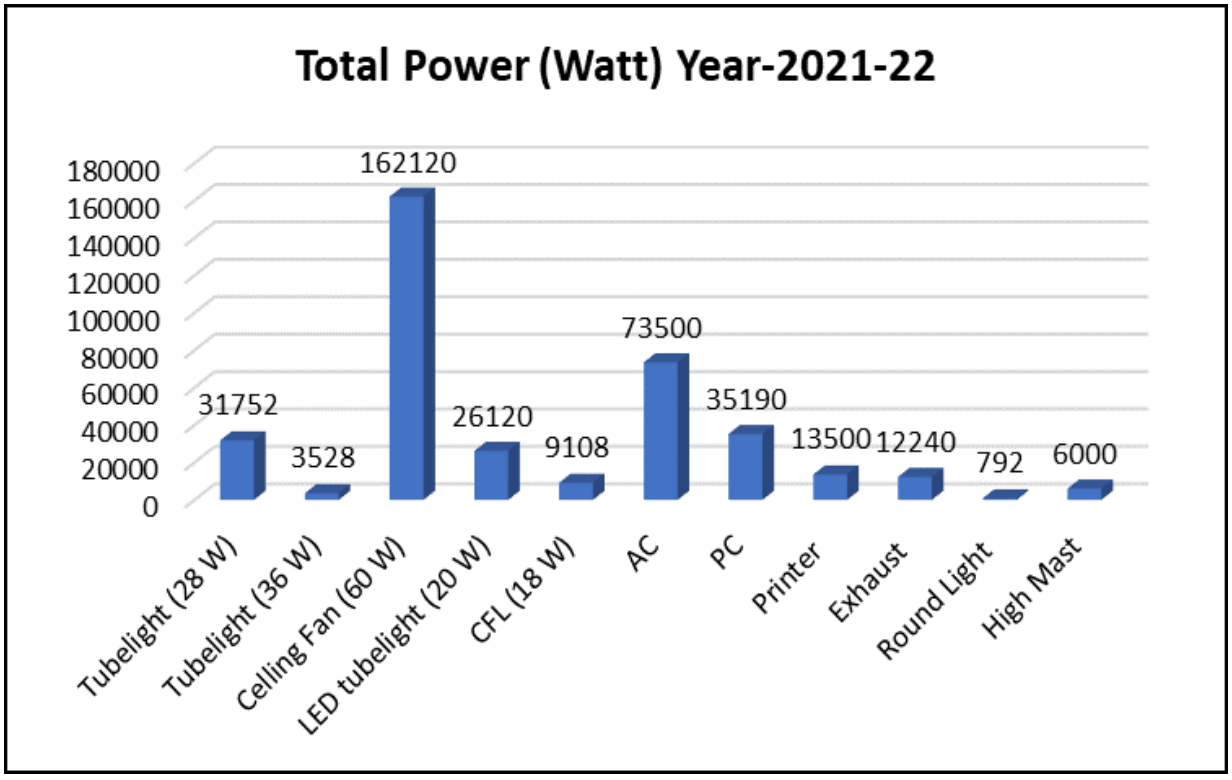
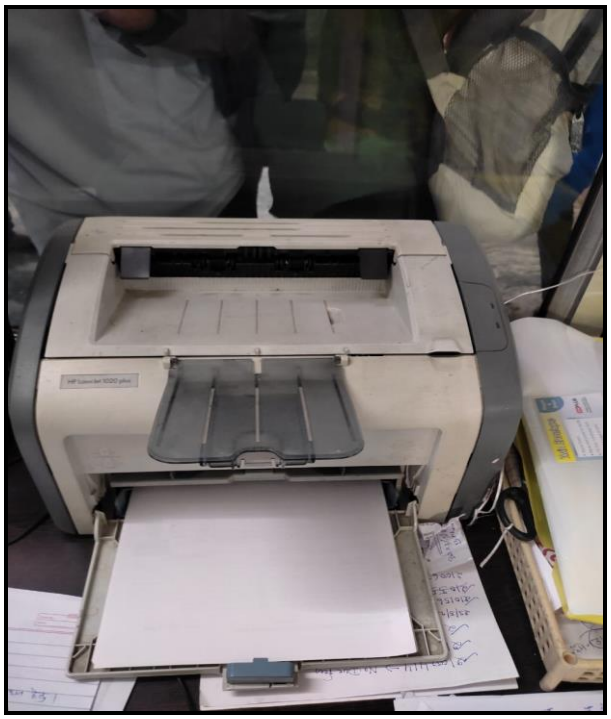


Figure 3.8:- Equipment loading Share % year-2021-22

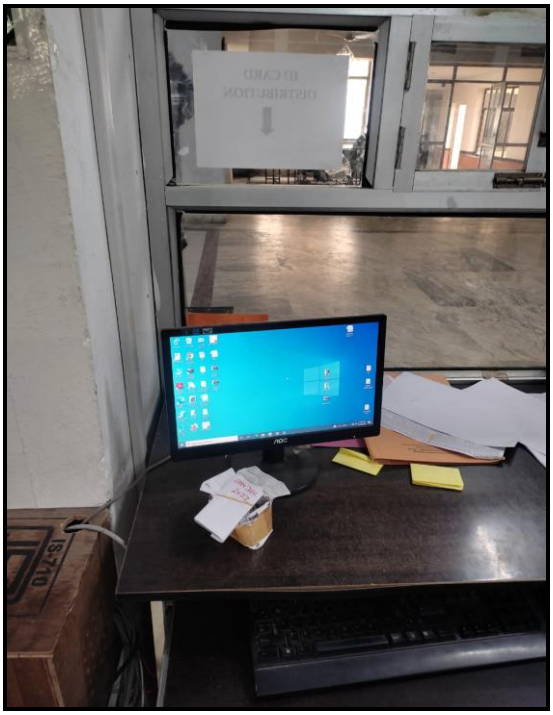
3.9 Some Photographs of Electrical Equipment's

CFL (PL type)

Efficient light (LED Downlighter)



Printer



Computer System

Figure 3.9:- Electrical Equipment in Mewar university

Some Photographs of Energy slogans

CHAPTER- 4
ENERGY CONSERVATION MEASURES

Case Study No. -01

Replacement of conventional 36 Watt to energy-efficient LED tube light 20 Watt in phase manner:-

Sr. No	Items	Parameters	Units
1	Power Consumption by T-12 LED (08 to 10 watt Blast power)	36 + 10 = 46	W
2	No of T-8	98	Nos.
3	Working Hrs/Day	8	Hrs/Day
4	Working Days/Year	250	Days/Year
5	Energy Efficient T-5 (LED)	20	W
6	Expected Energy Saving	5096	kWh/Year
7	Load Factor@90% Assume	0.90	NA
8	Overall Per Unit Charges	8.93	Rs./kWh
9	Expected Money Saving	44,997	Rs./Year
10	Cost of T-5	200	Rs./ Pices
11	Investment on New Light Purchasing	19600	Rs.
12	Maintenance Investment	5,000	Rs.
13	Total Investment	24600	Rs
14	Simple Pay Back Period	0.54	Year

Total Calculated Monetary Saving Potential in lighting = Rs 44,997 /-

Note:- Energy savings depend on the operation hour per day and the load factor of the systems.

Case Study No. -02

Replacement of conventional 18 Watt to energy-efficient Downliter 09 Watt in Phase manner

Sr. No	Items	Parameters	Units
1	Power Consumption by CFL (18 Watt)	18	W
2	No of CFL	506	Nos.
3	Working Hrs/Day	8	Hrs/Day
4	Working Days/Year	250	Days/Year
5	Energy Efficient downlighter (09 Watt)	09	W
6	Expected Energy Saving	9108	kWh/Year
7	Load Factor@90% Assume	0.90	NA
8	Overall Per Unit Charges	8.93	Rs./kWh
9	Expected Money Saving	81,334	Rs./Year
10	Cost of Downlighter (01 Nos)	150	Rs./ Pices
11	Investment on New Light Purchasing	75,900	Rs.
12	Maintenance Investment	5,000	Rs.
13	Total Investment	80,900	Rs
14	Simple Pay Back Period	01	Year

Total Calculated Monetary Saving Potential in lighting = Rs 81,334 /-

Note:- Energy saving depends on the operation hour per day and the load factor of the systems.

Case Study No. 3

Replacement of 60W conventional ceiling fan by 28W BLDC Energy Efficient ceiling fan in Phase manner

Sr. No	Items	Parameters	Units
1	Power Consumption by 60W	60	W
2	No of Fan	2702	No,s
3	Working Hrs/Day	8	Hrs/Day
4	Working Days/Year	250	Days/Year
5	Energy Efficient 28W	28	W
6	Expected Energy Saving	1,72,928	kWh/Year
7	Load Factor	0.9	NA
8	Per Unit Charges	8.93	Rs./kWh
9	Expected Money Saving	15,44,247	Rs./Year
10	Cost of New Celling Fan	2500	Rs./ Pices
11	Investment on New Fan Purchasing	67,55,000	Rs.
12	Maintenance Investment	1,00,000	Rs.
13	Total Investment	68,55,000	Rs.
14	Simple Pay Back Period	4.43	Year

Total Calculated Monetary Saving Potential in Celling Fan = Rs 15,44,247/-

Note:- Energy savings depend on the operation hour per day and the load factor of the systems.

Annexure-01

Green Campus policy & Initiative

Mewar University
Knowledge to Wisdom

MEWAR UNIVERSITY

GANGRAR, CHITTORGARH

RAJASTHAN

GREEN CAMPUS POLICY & INITIATIVE

Registrar
Mewar University
Gangrar, Chittorgarh

Continues……..

GREEN CAMPUS INITIATIVES INCLUDE

The institutional initiatives for greening the campus are as follows:

- **Restricted entry of automobiles**
- **Ban on use of Plastic**

RESPONSE:

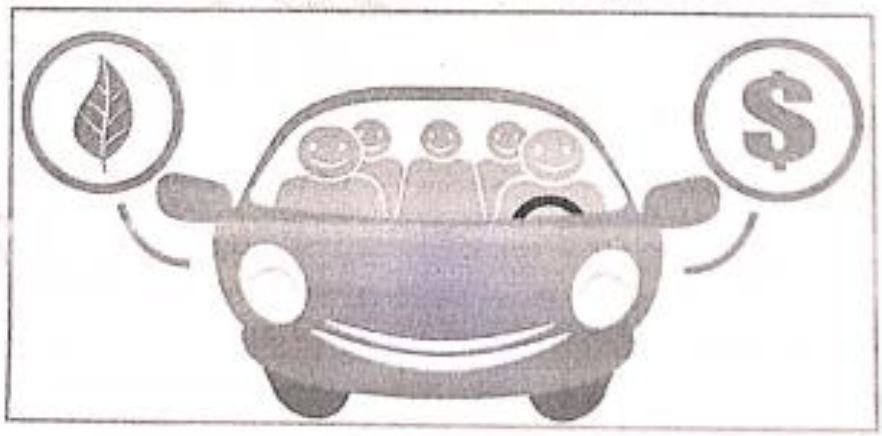
Mewar University has always followed a green agenda and has shown remarkable awareness of maintaining an eco-friendly campus. On visiting the Campus, one can experience the appealing and well-designed buildings, beautiful lawns, spacious sports grounds, and lush green environment favorable for the teaching-learning process.

INSTITUTIONAL INITIATIVES:

RESTRICTED ENTRY OF AUTOMOBILES

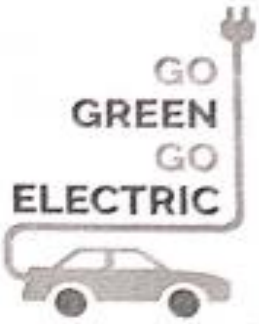
The university operates a fleet of 3 buses covering each corner of Chittorgarh, Bhilwara, and its nearby areas to facilitate the students and staff. The institute encourages the staff and students to use the university conveyance instead of their vehicles for safety, security, fuel conservation, and to reduce environmental pollution.

The University buses are periodically checked for pollution by the authorized agency. University has a vehicle parking area available outside the main entrance of the campus for the guests, visitors, faculties, students, and any other vehicles. The vehicles should possess pollution check stickers. Only bicycles are allowed inside the campus. Random checks are made to check the validation and periodicity of this certificate. For two-wheelers or four-wheelers, security measures are compulsory. Stakeholders are also encouraged to adopt carpooling to reduce the toxic emissions in the air.



Registrar
Mewar University

Continues …….



USE OF BICYCLES

The students staying on the university campus are using bicycles to move within the campus as well as to travel the nearby areas outside the campus. Students and staff coming from nearby villages also prefer bicycles as a mode of transport for attending the University. It is environmentally friendly and helps to decrease pollution.

BAN ON USE OF PLASTIC

Mewar University is making an untiring effort to "Reduce Plastic Pollution" by minimizing plastic footprint and by way of refuse, reduction, reuse, and recycling. Hence, the subsequent initiatives are taken by all the stakeholders to spread awareness of environmental conservation:

1. To refuse and reduce plastic products in daily use, and pledge to a plastic-free environment within the campus.

Registrar
Mewar University

Continues …….

2. Ban single-use plastic water bottles, takeaway cups, lunch wrapped in disposable plastic packaging, plastic bags, disposables food service cups, plates, and containers fabricated from polystyrene foam, plastic straws, etc, within the university premises and canteens.
3. Encourage the use of biodegradable and other kinds of compostable utensils in situ of plastic and shall bring a fork, knife, and spoon from home.
4. Encourage the use of durable, foldable, and cheap reusable bags that may be carried around in a car, pocket, or purse.
5. Discourage plastic bottles and instead use glass, steel, or clay bottles in offices.
6. Welcome innovative ideas to cut back plastic footprints.
7. Mobilize students of schools/ colleges/ polytechnic/ITIs and other offices across the country in a cleanliness drive.

Single-use plastic items like plastic bottles, bags, spoons, straws, and cups are banned completely and awareness is made among staff and students through orientation and display boards within the premises. To limit the utilization of plastic, measures are taken to switch plastic teacups and glasses with steel glasses within the canteen. The staff and students are informed to use steel or copper water bottles rather than plastic bottles.

Registrar
Mewar Univer ity
Gangrar, (Chi rgarh

END OF THE REPORT

THANKS