2021

ENERGY AUDIT REPORT

MAITREYI COLLEGE

(Chanakya Puri, New Delhi)

Presented by: -

Katyani Energy Solution Private Limited

6/19/2021

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2. Acknowledgement

Katyani Energy Solution *Private Limited* places on record its sincere thanks to the management of Maitreyi College, Chanakya Puri (New Delhi) for their interest and cooperation for conduction detailed Energy Audit.

The interactions and deliberations with Maitreyi College, Chanakya Puri (New Delhi), Admin / electrical/ energy team were exemplary and the whole exercise was thoroughly a rewarding experience for **Katyani Energy Solution *Private Limited.***

We thank the team members of the Electrical department for providing all necessary coordination and information.

The study team acknowledges the vital support and contributions of Mrs. Haritma Chopra (Principal), e-mail principal@maitreyi.du.ac.in, Maitreyi College, Chanakya Puri (New Delhi)

The audit team is also thankful to Mr. Ranu Kumar, Administrative Officer, M.No.-9873899970 and Brijesh Mishra (Assistant) for coordinating and facilitating the audit team and for collection of necessary information during the study.

Date-19/06/2021

Katyani Energy Solution Private Limited

Place-Delhi

3. STUDY TEAM

Team Leader		
Name	Designation	Experience
Mr. Manoj Kakar	Energy Auditor	>35 Years
Team Members		
Name	Designation	Experience
Mr. Durgesh Kumar	Sr. Energy Engineer	6 years
Mr. Ritu Raj	Energy Engineer	5 years

1. Study Team

4. General Information

Katyani Energy Solution Private Limited conducted the energy audit at Maitreyi College, Chanakya Puri (New Delhi) in 3rd week of Jun 2021. The purpose of the energy audit was to address the status of the Electrical systems, Energy uses, performance assessment of various facilities like A.C. system, Fans, lighting system, Pumps etc.

2. General Information

General Information about the Maitreyi College	
Location	Chanakya Puri, New Delhi
Establishment Year	1967
Campus Size	10 acres
Affiliation	University of Delhi
Approval	AICTE
Recognition	by NIRF (2020)
Ranking	35th by NIRF (2020)
Department	16
Faculties	170+
No. of Courses	18 Courses across 3 streams
Mode of Education	Full Time
Official Website	www.maitreyi.ac.in

Katyani Energy Solution Private Limited has observed certain shortcomings in energy systems and their uses. Some of the techno-commercially implementable solutions to improve system efficiency, performance of different equipment's and safety level are purposed in this report.

5. Executive Summary

Summary of recommendations for performance enhancement and energy cost reduction of Maitreyi College are:

Sr. no	Energy saving measures	kWh saving	Annual Saving Approx.	Investment (Rs)	Simple Payback Period (months)
A	*Saving on replacement of Old Tube Lights with LED Bulbs*	31406	20,771	1,45,400	7
B	*Saving on replacement of Old Fans with EE Fans*	23598	15,795	13,11,000	83
C	Installation of Solar Power generation system	120000	80,647	50,00,000	62
D	Installation of Motion Sensor/Occupancy Sensor	13537	9,400	2,35,000	25
E	Reduction in contract demand to 90KVA i.e. by 44%		2,50,000		Immediate

3. Executive Summary

Note:-All the savings (Electricity and monetary) shown in the table are yearly savings.

6. Critical Comments

The Maitreyi College is relatively low power consumption category building. However, there is lot of potential for energy saving and some of the critical / high priority areas are:

- Distribution board area is dangerously exposed and is a potential hazard - Danger Sign must be put up to prevent any accident.
- The college being in a the Embassy area, the power availability in the college building is fairly regular with hardly any power cuts. Thus the DG set is seldom used.
- Pump and motors need servicing and should be done regularly preferably under an AMC arrangement, every year.

7. Introduction

7.1 Background

Availability and utilization of energy drives the growth of economy and advancement of any country and thus, the demand of energy is increasing day by day. The worldwide mounting energy crisis with galloping cost hike, concern for environmental protection and open market competitive economy possesses serious challenge to Indian College to survive and grow.

One of the easier available options for survival is '**Energy Conservation**' thereby saving environment and cost reduction through strategic energy management. It also gives a positive orientation to energy cost reduction, preventive maintenance and quality control programs. This is the translation of conservation ideas into reality by blending techno-economically feasible solutions within a specified time frame.

Energy conservation is a worldwide objective. The energy policy of the Government of India calls for conservation of energy. With the enactment of Energy Conservation Act- 2001 amongst others has emphasized upon the power of the appropriate Govt. to enforce efficient use of energy and its conservation.

This study has mapped power system parameters at the source, Distribution Panels and various equipment's. It has also mapped illumination level at various activity areas in the Maitreyi College, where the team was permitted to enter for the study. The study could identify concerned problem areas, barriers towards maintaining right use of available facilities and come out with cost effective solutions. It also recommends cost effective and fast pay back solutions for performance improvement of all the systems.

7.2 Objective of the Study

The objective of the study is to assess overall efficiency of the various systems and defined pacific energy consumption of the public building and make recommendations about potential energy saving opportunities, based on the observation of energy audit.

- Electrical Structural details
- Use & occupancy of the building.
- Energy supply features
- Details of systems/equipment's/appliance etc.
- Quality of power

7.3 Methodology for Energy Audit

Detail energy audit consists of evaluation of the present trend of energy consumption. Energy Audit activities, in general, include.

- The activity starts with collection of basic information and general overview of the Maitreyi College- Based on the dissections with Mr. Sachin (Jr. Asstt.), Maitreyi Collage, Chanakya Puri (New Delhi)
- Maitreyi College was requested to provide the electricity bills for last 3yr.
- At incomer panel, locating all energy sources coming into a facility.
- Identification of energy streams.
- Quantification of energy streams into discrete functions (system/ equipment's/ appliances etc.)
- Identification of energy and cost savings opportunities.
- Establish measurement and verification protocol i.e., objective measurement through meters by identifying measurement points.
- Required data collection, field measurements and analysis of data, etc.

The Deliverables are a report consisting of following:

a) Performance of major energy consuming equipment
b) Energy saving measures recommendation.
c) The financial calculation for the investment involved and the return on investment.
d) Evaluate the use and occupancy of the building and the condition of the building and building systems equipment.

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7.4 About Maitreyi College

1. **Maitreyi College, Chanakya Puri (New Delhi)**

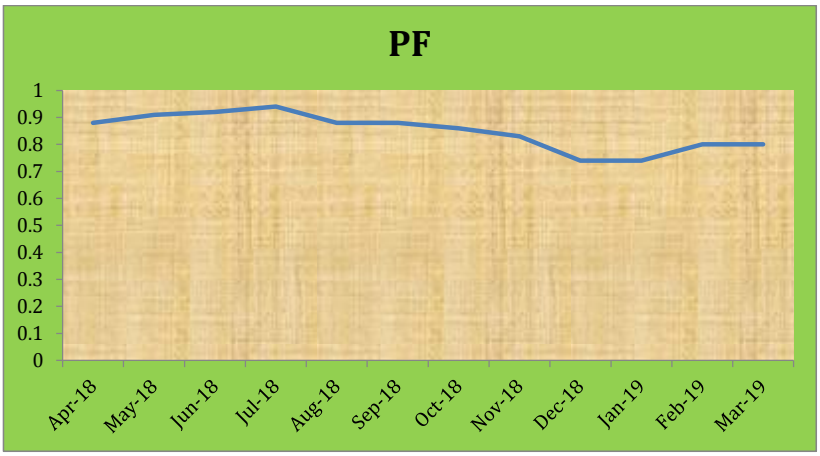
7.4.1 About Maitreyi College:

Maitreyi College, University of Delhi is a renowned women's college situated in Chanakyapuri, South Delhi. Maitreyi College practices a pedagogical approach which aims at the holistic development of the students. The ever-increasing growth and progress of the institution can be comprehended by the way the college moved from the 86th position in NIRF ranking-2018 to the 35th position in 2021. Apart from offering courses in Arts, Commerce and Science to more than 3000 students at the undergraduate level, the college also offers Certificate courses in Journalism & Web designing and Certificate/Diploma/Advanced Diploma in French, Spanish as non-credit add on courses. Maitreyi not only tries to create competent, aware and persevering students, it also makes them acutely conscious of their responsibility towards society. The college initiated Sashakt and community outreach programme. Sashakt Nadal Sports Centre for PwDs (Person with Disabilities) is the country's first initiative, in which NATIONAL and INTERNATIONAL level Paralympics and basketball players practice in college premises. Through various training programs and activities, the college bridges the gap between industry and academics by contributing to the growth and personality development of students through departmental magazines and various start-up initiatives by the Entrepreneurship Cell. The college also conducts various summer internship programs under the guidance of mentors but also engages students in annual research projects to instill the ability to think deeply and analyze minutely. The College also publishes biannual peer reviewed e-magazine ‘Samvedana’ (ISSN No. 2581-9917) and e-journal ‘Vantage: The Journal of Thematic Analysis’ (ISSN No. 2582-7391).

8. Electricity: -

8.1 Electricity bill analysis: (2018-2019): -

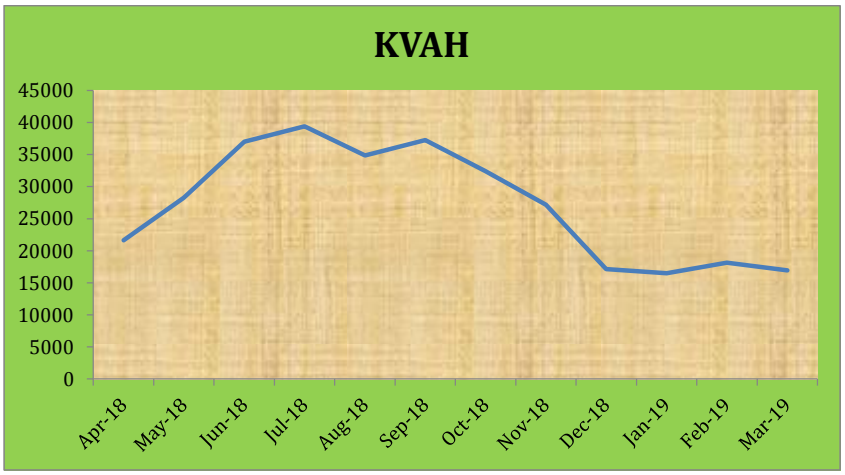
Electricity Bill Analysis (2018-19). Meter No.: BE83987							
Month	**Contract Demand**	**Fixed Charges**	**Units Adjusted**	**Energy Consumption**	**Energy charges**	**Power Factor**	**Total Energy Charges**
	Kw	INR	kVAH	kVAH	INR		INR
Apr-18	160	24570	-230	21617.2	190231.36	0.88	235207
May-18	160	44000	-440	28286.8	226294.4	0.91	28286.8
Jun-18	160	43250	-830	37019.8	296158.4	0.92	371652.2
Jul-18	160	42750	-1370	39406.6	315252.8	0.94	392013.07
Aug-18	160	45250	-140	34842.4	278739.2	0.88	354768.17
Sep-18	160	45500	0	37279.2	298233.6	0.88	392328.69
Oct-18	160	46250	0	32437.8	259502.4	0.86	347523.65
Nov-18	160	48250	0	27177.6	217420.8	0.83	290909.64
Dec-18	160	53750	0	17132.4	137059.2	0.74	208936.07
Jan-19	160	53750	0	16479	131832	0.74	203212
Feb-19	160	49500	0	18157.2	145257.6	0.8	213259.57
Mar-19	160	50000	0	16930.2	135441.6	0.8	203058.55
TOTAL		**546820**	**-3010**	**326766.2**	**2631423.4**	**0.85**	**3241155.4**



Power factor as per electricity bills (2018-2019)

It can be seen from the above figure the average power factor for the Maitreyi College is 0.85 (2018-2019).

It may be noted that the Utility charges Rs 8.0 per kvah. As the power factor goes down the net Kvah consumption becomes higher and thus the higher energy cost. The power factor can be maintained near unity using Automatic Power Factor Controller which is basically a bank of capacitors which automatically switch on to match the running PF to attain the near unity factor.

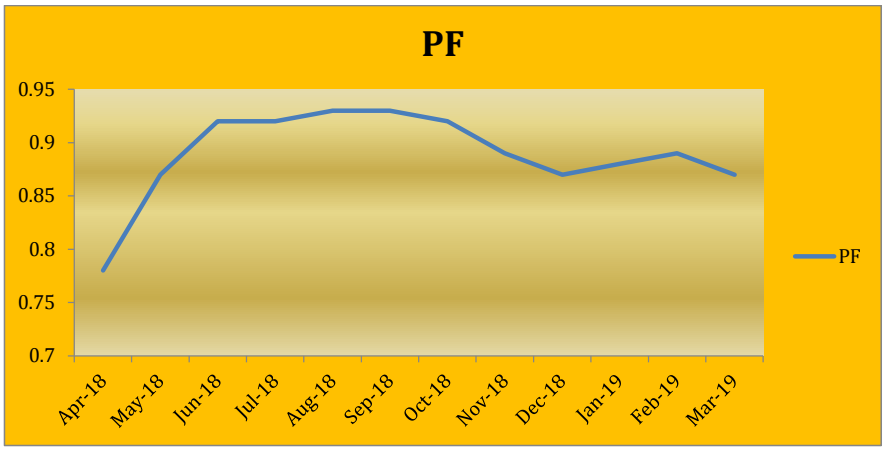


Energy Consumption for the FY 2018-2019

It is observed that from the above figure that the energy consumption is highest during the months of Jun, July, August and September. This is primarily due to use of Fans and Air Conditioning. This increase is almost 50% compared to other months. Use of energy efficient Fans and inverter type Air Conditioning can save some of this energy.

8.2 Electricity bill analysis: (2019-2020): -

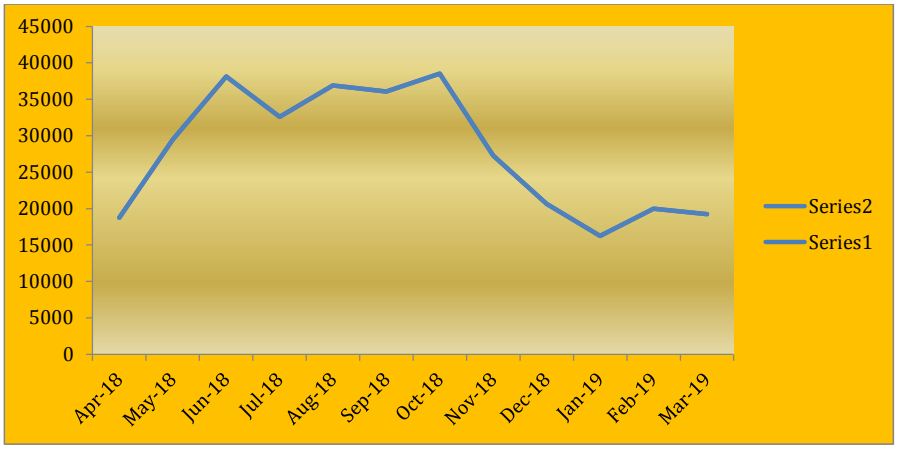
Electricity Bill Analysis (2019-20). Meter No.: BE83987							
Month	**Contract Demand**	**Fixed Charges**	**Units Adjusted**	**Energy Consumption**	**Energy charges**	**Power Factor**	**Total Energy Charges**
	Kw	INR	kVAH	kVAH	INR		INR
Apr-19	160	51000	0	18729.6	149836.8	0.78	219916.3
May-19	160	46000	0	29460	235680	0.87	308439.6
Jun-19	160	43500	0	38151	305208	0.92	399258.9
Jul-19	160	48250	0	32607	260856	0.92	341032.2
Aug-19	160	47250	0	36894.6	295156.8	0.93	385651.9
Sep-19	160	48750	0	36043.8	306372.3	0.93	400211.9
Oct-19	160	48000	0	38514.6	327374.1	0.92	429516.7
Nov-19	160	44750	0	27293.4	231993.9	0.89	303034.6
Dec-19	160	45750	0	20652.6	175547.1	0.87	242320.3
Jan-20	160	45500	0	16231.8	137970.3	0.88	200900
Feb-20	160	45000	0	19977.6	169809.6	0.89	228364.1
Mar-20	160	45750	0	19214.4	163322.4	0.87	222264.9
TOTAL		**559500**	**0**	**333770.4**	**2759127.3**	**0.88**	**3680911**



Power factor as per electricity bills (2019-2020)

It can be seen from the above figure the average power factor for the Maitreyi College is 0.88 (2019-2020).

It may be noted that the Utility charges Rs 8.0 per kvah. The power factor can be maintained by an Automatic Power Factor Controller which is basically a bank of capacitors which are switched on to suit the existing PF.



Energy Consumption for the FY 2019-2020

It is observed that from the above figure that the energy consumption is highest during the months of Jun to Oct. This primarily due to use of Fans and Air Conditioning. This increase is almost 50% compared to other months. Use of energy efficient Fans and inverter type Air Conditioning can save some of this energy.

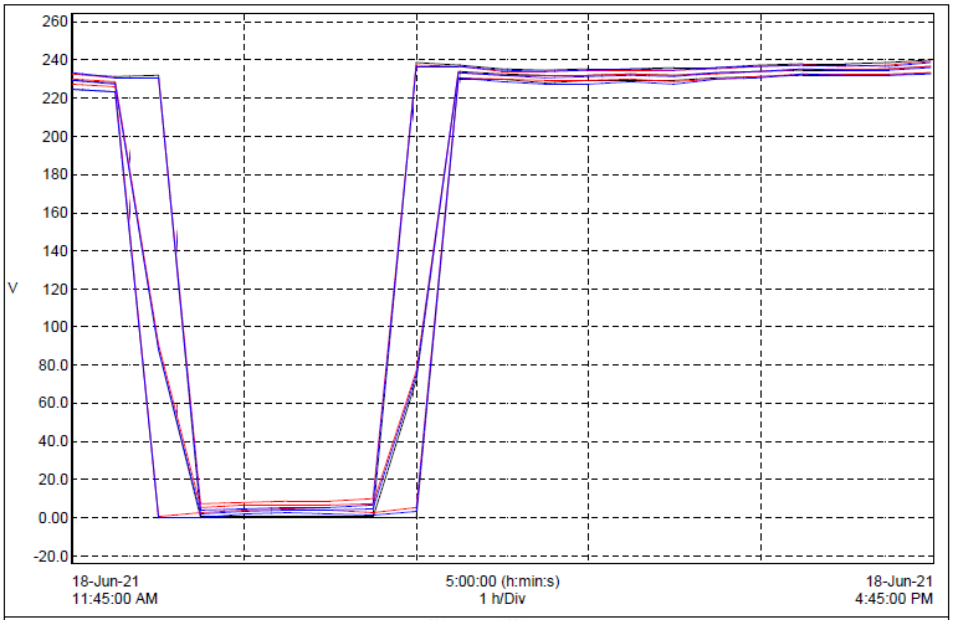
9. Power Quality Measurements - Readings at Incoming Supply Panels

Different quality parameters of the power supply are discussed below along with graphical representation. With the help of Power analyser and other measuring instruments various electrical parameters were measured at the main incomer panel. Their data analyses and the related interpretation with respect to power quality are summarise below.

5. Power measured at main incomer panel

Voltage trends

Name	Date	Time	AVG	MIN	MAX	Units	Duration	Units
V1 rms	18-Jun-21	11:45:00 AM	191.9	0.0	240.1	V	5:15:00	(h:min:s)
V2 rms	18-Jun-21	11:45:00 AM	192.0	1.000	239.4	V	5:15:00	(h:min:s)
V3 rms	18-Jun-21	11:45:00 AM	191.5	0.0	238.7	V	5:15:00	(h:min:s)



V1 rms (V)

Date	Time	Val	MIN	MAX	Units
18-Jun-21	11:45:00 AM	229.4	224.6	232.7	V
18-Jun-21	12:00:00 PM	227.9	223.3	231.4	V
18-Jun-21	12:15:00 PM	88.30	0.0	231.7	V
18-Jun-21	12:30:00 PM	0.0	0.0	800m	V
18-Jun-21	12:45:00 PM	0.0	0.0	800m	V
18-Jun-21	1:00:00 PM	0.0	0.0	800m	V
18-Jun-21	1:15:00 PM	0.0	0.0	800m	V
18-Jun-21	1:30:00 PM	0.0	0.0	800m	V
18-Jun-21	1:45:00 PM	72.20	0.0	238.7	V
18-Jun-21	2:00:00 PM	234.0	229.9	237.5	V
18-Jun-21	2:15:00 PM	232.7	229.8	235.3	V
18-Jun-21	2:30:00 PM	231.7	228.2	234.8	V
18-Jun-21	2:45:00 PM	232.3	229.5	235.3	V
18-Jun-21	3:00:00 PM	232.9	229.2	235.6	V

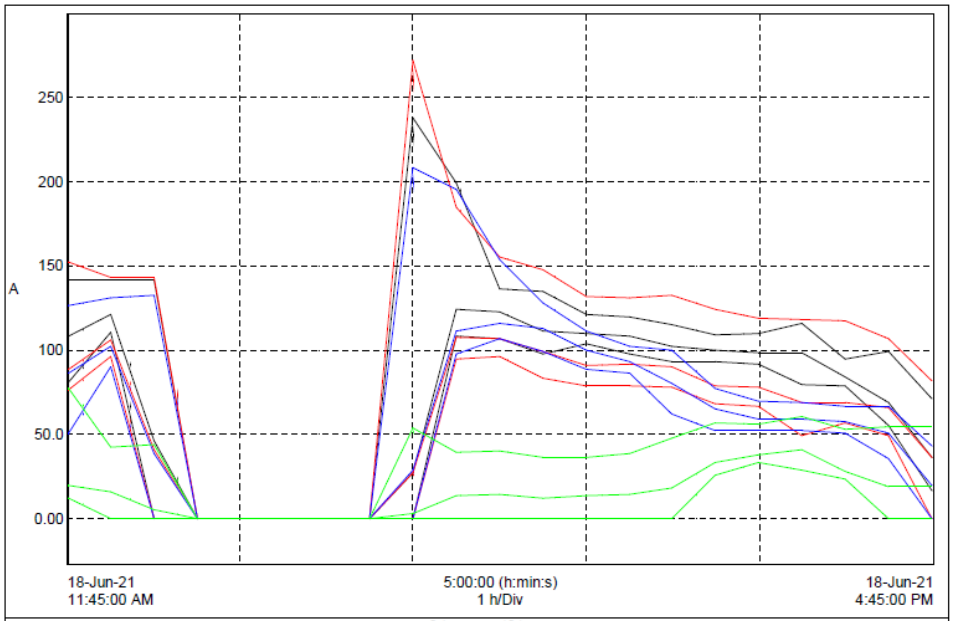
Figure .1 Voltage trends of Incomer Panel

Observation

From fig 1 it can be seen that the voltage distribution is fairly uniform and reflects that supply transformer are functioning properly. However, the voltage drop between 12:30 hrs. and 13:45 hrs is due to power failure from the side of utility service provider, in this case the NDMC. The average voltage for the testing duration is around 239V.

Current Trends

Name	Date	Time	AVG	MIN	MAX	Units	Duration	Units
A1 rms	18-Jun-21	11:45:00 AM	84.29	0.0	238.0	A	5:15:00	(h:min:s)
A2 rms	18-Jun-21	11:45:00 AM	71.24	0.0	272.0	A	5:15:00	(h:min:s)
A3 rms	18-Jun-21	11:45:00 AM	69.57	0.0	208.5	A	5:15:00	(h:min:s)
AN rms	18-Jun-21	11:45:00 AM	19.20	0.0	77.20	A	5:15:00	(h:min:s)



A1 rms (A)

Date	Time	Val	MIN	MAX	Units
18-Jun-21	11:45:00 AM	108.3	81.00	142.0	A
18-Jun-21	12:00:00 PM	121.3	110.5	142.0	A
18-Jun-21	12:15:00 PM	46.60	0.0	142.0	A
18-Jun-21	12:30:00 PM	0.0	0.0	0.0	A
18-Jun-21	12:45:00 PM	0.0	0.0	0.0	A
18-Jun-21	1:00:00 PM	0.0	0.0	0.0	A
18-Jun-21	1:15:00 PM	0.0	0.0	0.0	A
18-Jun-21	1:30:00 PM	0.0	0.0	0.0	A
18-Jun-21	1:45:00 PM	27.30	0.0	238.0	A
18-Jun-21	2:00:00 PM	124.0	108.0	199.5	A
18-Jun-21	2:15:00 PM	122.5	107.0	136.5	A
18-Jun-21	2:30:00 PM	111.7	98.00	134.5	A
18-Jun-21	2:45:00 PM	110.2	103.5	121.5	A
18-Jun-21	3:00:00 PM	108.3	98.00	120.0	A

Figure 2. Currents trends of Incomer Panel

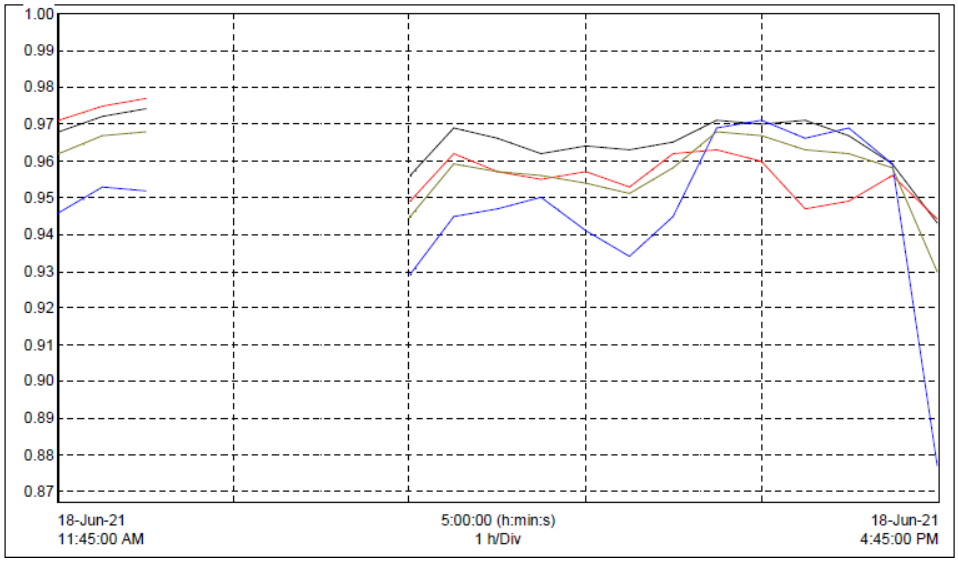
Observation

It can be seen from the fig.2 that average current 204 A, also the current distribution shows little deviation between the three phases.

Suggestion/recommendation

Load balancing can be adopted for low harmonics development. Which can give significant amount of energy saving.

Power factor Trends



Date:	Time:	Cos φ1 (DPF)	Cos φ2 (DPF)	Cos φ3 (DPF)	Cos φT (DPF)
18-06-2021	11:45:00	0.97	0.973	0.947	0.964
18-06-2021	12:00:00	0.973	0.976	0.953	0.968
18-06-2021	12:15:00	0.975	0.978	0.953	0.97
18-06-2021	12:30:00	- - -	- - -	- - -	- - -
18-06-2021	12:45:00	- - -	- - -	- - -	- - -
18-06-2021	13:00:00	- - -	- - -	- - -	- - -
18-06-2021	13:15:00	- - -	- - -	- - -	- - -
18-06-2021	13:30:00	- - -	- - -	- - -	- - -
18-06-2021	13:45:00	0.958	0.95	0.931	0.948
18-06-2021	14:00:00	0.97	0.963	0.946	0.961
18-06-2021	14:15:00	0.967	0.958	0.947	0.958
18-06-2021	14:30:00	0.963	0.956	0.95	0.957
18-06-2021	14:45:00	0.965	0.958	0.942	0.956
18-06-2021	15:00:00	0.964	0.955	0.934	0.953
18-06-2021	15:15:00	0.967	0.963	0.945	0.959
18-06-2021	15:30:00	0.972	0.964	0.97	0.969
18-06-2021	15:45:00	0.972	0.961	0.973	0.969
18-06-2021	16:00:00	0.972	0.948	0.968	0.965
18-06-2021	16:15:00	0.968	0.951	0.971	0.964
18-06-2021	16:30:00	0.96	0.957	0.96	0.959
18-06-2021	16:45:00	0.948	0.947	0.878	0.937

Figure 3. Power factor of Incomer Panel trend

Observation

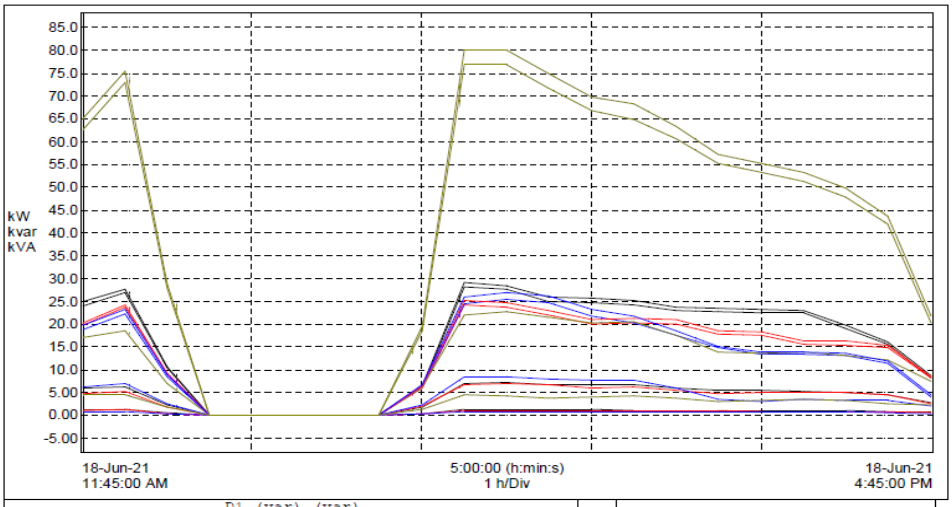
It can be seen from the figure number 3, that pf is average 0.95 and not showing significant deviation over time.

Suggestion/recommendation

Capacitor bank can be used in supply side for energy savings.

Power Trends

Name	Date	Time	AVG	MIN	MAX	Units	Duration	Units
D1 (var)	18-Jun-21	11:45:00 AM	826.7	0.0	1.444k	var	5:15:00	(h:min:s)
D2 (var)	18-Jun-21	11:45:00 AM	716.2	0.0	1.230k	var	5:15:00	(h:min:s)
D3 (var)	18-Jun-21	11:45:00 AM	581.6	0.0	940.7	var	5:15:00	(h:min:s)
DT (var)	18-Jun-21	11:45:00 AM	2.611k	0.0	4.549k	var	5:15:00	(h:min:s)
P1 (W)	18-Jun-21	11:45:00 AM	15.75k	0.0	28.13k	W	5:15:00	(h:min:s)
P2 (W)	18-Jun-21	11:45:00 AM	13.26k	0.0	24.16k	W	5:15:00	(h:min:s)
P3 (W)	18-Jun-21	11:45:00 AM	12.41k	0.0	25.49k	W	5:15:00	(h:min:s)
PT (W)	18-Jun-21	11:45:00 AM	41.41k	0.0	76.86k	W	5:15:00	(h:min:s)



Date	Time	D1 (var) (var) Val	Units
18-Jun-21	11:45:00 AM	1.356	kvar
18-Jun-21	12:00:00 PM	1.380	kvar
18-Jun-21	12:15:00 PM	515.2	var
18-Jun-21	12:30:00 PM	0.0	var
18-Jun-21	12:45:00 PM	0.0	var
18-Jun-21	1:00:00 PM	0.0	var
18-Jun-21	1:15:00 PM	0.0	var
18-Jun-21	1:30:00 PM	0.0	var
18-Jun-21	1:45:00 PM	423.4	var
18-Jun-21	2:00:00 PM	1.444	kvar
18-Jun-21	2:15:00 PM	1.390	kvar
18-Jun-21	2:30:00 PM	1.260	kvar
18-Jun-21	2:45:00 PM	1.253	kvar
18-Jun-21	3:00:00 PM	1.207	kvar

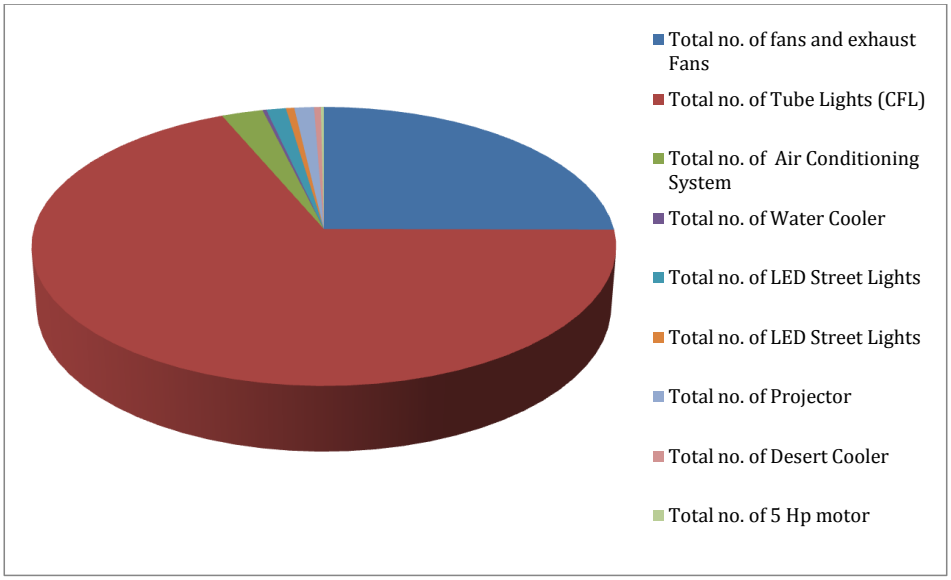
18-Jun-21 - 11:45:00 AM
Value
24.09k — P1 (W)
19.76k — P2 (W)
18.74k — P3 (W)
62.60k — PT (W)
6.014k — Q1 (var)
4.667k — Q2 (var)
6.313k — Q3 (var)
16.99k — QT (var)
24.87k — S1 (VA)
20.35k — S2 (VA)
19.80k — S3 (VA)
65.02k — ST (VA)

Figure 4. Power Trends of transformer

Observation

It can be seen from the figure number 4, that average loading of transformer is 13.33 KW and maximum loading of transformer is 28 KW.

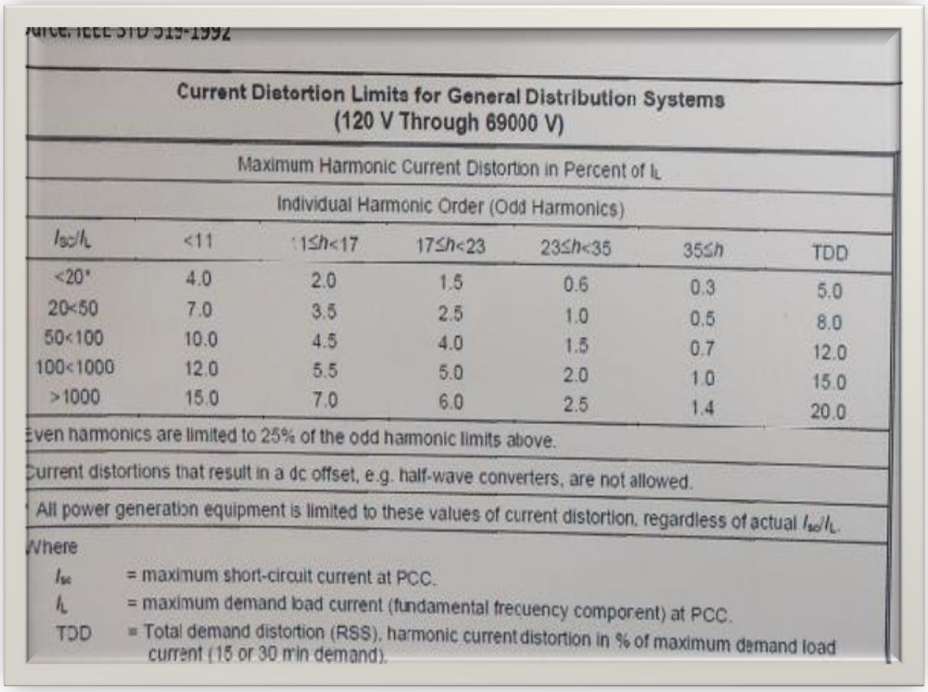
7. Electrical Appliances major load Details



	Description	Nos.	Watts (W)	Total (Watts)
1	Total no. of fans and exhaust Fans	532	60	31920
2	Total no. of Tube Lights (CFL)	1454	28	40712
3	Total no. of Air Conditioning System	55	1490	81950
4	Total no. of Water Cooler	5	750	3750
5	Total no. of LED Street Lights	26	60	1560
6	Total no. of LED Street Lights	11	20	220
7	Total no. of Projector	26	282	7332
8	Total no. of Desert Cooler	9	250	2250
9	Total no. of 5 Hp Pump (1 not working)	4	746	2984

10. Harmonic Analysis

Harmonics current generated by any non-linear load flows from the load into the power system. These harmonics currents degrade the power system performance and reliability and could also cause safety problem. Harmonics need to be clearly located, sources identified, and corrective measures taken to prevent these problems. THD (Total Harmonic Distortion) can be computed as per IEE-519 standard as: voltage 5 % and ampere 10 %.



Source: IEEE STD 519-1992

Current Distortion Limits for General Distribution Systems (120 V Through 69000 V)

	Maximum Harmonic Current Distortion in Percent of I_L					
	Individual Harmonic Order (Odd Harmonics)					
I_{sc}/I_L	<11	11≤h<17	17≤h<23	23≤h<35	35≤h	TDD
<20*	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

Even harmonics are limited to 25% of the odd harmonic limits above.

Current distortions that result in a dc offset, e.g. half-wave converters, are not allowed.

* All power generation equipment is limited to these values of current distortion, regardless of actual I_{sc}/I_L.

Where

I_{sc} = maximum short-circuit current at PCC.

I_L = maximum demand load current (fundamental frecuency component) at PCC.

TDD = Total demand distortion (RSS), harmonic current distortion in % of maximum demand load current (15 or 30 min demand).

Limitation of harmonics

11. Lux levels measures as: -

Sr.No.	Name of the Location	Lux level Measures	Standard/Recommended
1	Committee Room	145-183	250-300
2	Room No. 7	220-377	200-250
3	Room No. 18	226-385	200- 250
4	Room No. 20	135-179	200-250
5	Room No. 12	250-499	200-250
6	Corridor	39-49	50-80
7	Principle Office	109-187	250-300
8	Sr. P.A to Principle	137-171	200-250
9	Administration Office	193-200	200-250
10	Entrance Corridor	86-107	100-200
11	Office	157-180	200-250
12	Exam Admission Block	65-87	200-250
13	Accounts (Room-2)	97-122	200-250
14	Accounts (Room-1)	145-177	200-250

8. Lux level

The Lux level below the recommended Lux level in some of the areas, it may require installation of additional light fittings.

VENTILATION

Maitreyi College is an old building, and the construction has all the features of good insulation and ventilation. The building has thick walls that insulate from ingress of heat as well retain heat for a longer time if the windows and doors are kept shut. In fact, the rooms need only fans for cooling since the ambient temperature is moderate for most of the months in a year. Offices spaces are provided with good ventilation with the help of windows. No energy saving measures is recommended as natural ventilation provisions are there. However, exhaust fans can be used in the areas where the heat sources are more due to Computers or higher occupancy, for better ventilation in future.

12. Energy Saving Measures Calculation for Maitreyi College

Ceiling Fans/ Air Circulator Fan

- **What Is A DC Brushless Fan?**

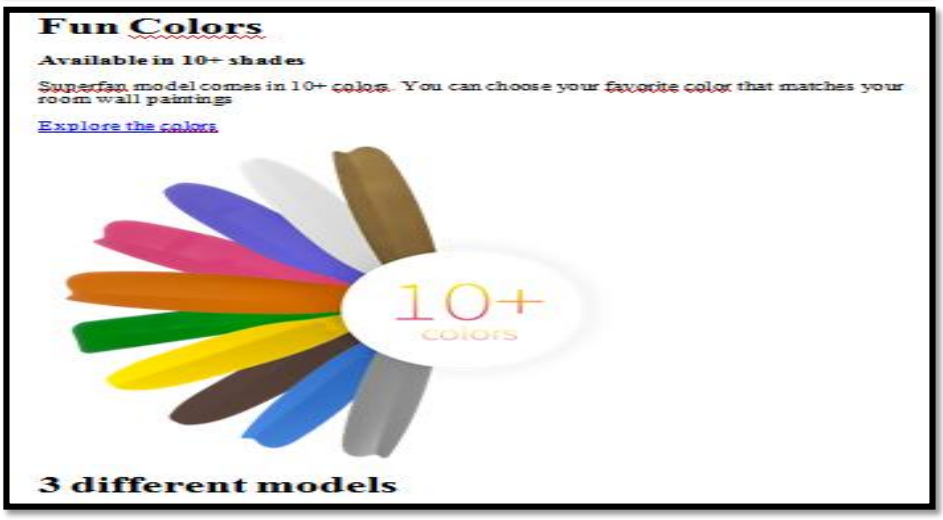
A brushless DC fan uses brushless DC motors (BLDC motor) that have a cross pattern arrangement of four permanent magnets mounted on the sides of the rotor. Unlike brushed DC motors, BLDC motors do not require any commutate or brushes to operate. The brushless DC fan is a combination of a powerful BLDC motor, shaft, and fan blades. These fans are durable, reliable, and highly energy efficient. They do not produce sparks in the circuit and operate noiselessly.

The initial torque produced in DC motors is quite high, and hence, brushless DC fans reach their full potential in no time. Their speed can be controlled merely by increasing or decreasing the voltage input.

Brushless DC fans are classified into two categories:

BLDC fan with Sensor Motor: These fans are equipped with a sensor – called the half effect sensor – those aids in detecting the position of the magnet.

BLDC fan with Sensor-less Motor: In these fans, back EMF is used to detect the position of the magnet.



Different -2 colours of fan

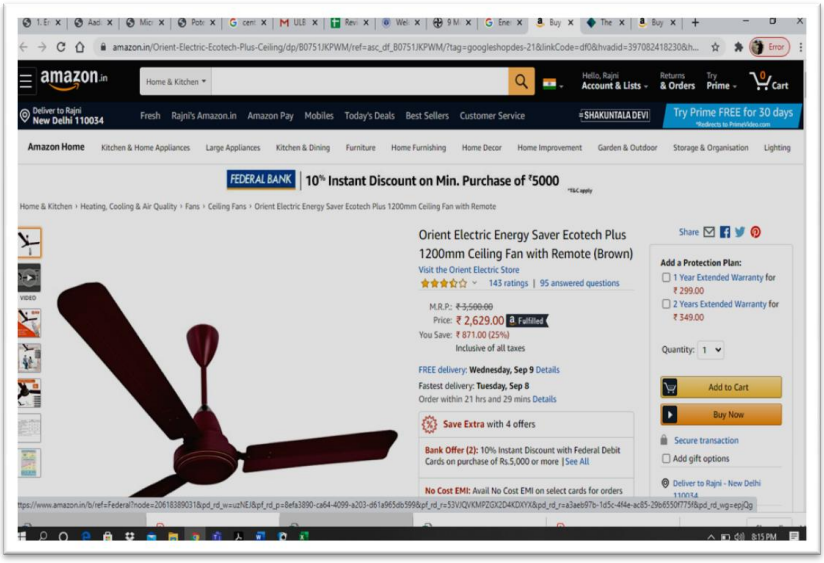
BLDC fans save 50% energy compared to traditional induction fans that draw 60W power. BLDC fan draws only 30W for the same output and this can be as low as 10W at lower fan speeds.

ECO 1: Replacement of ceiling fan with BLDC fans System:

It is recommended to replace the present ceiling fan with 30 W BLDC fan. Ceiling fans are one of the major electrical appliances out of the total electrical fixtures that are being use for public and administrative areas at the Maitreyi College, Chanakya Puri. There are a total of 437 ceiling fans. These fans are 60w, These Energy Efficient fan have longer life cycle, consume less electricity at lower operating speeds and can operate at lower voltage range.

10. Saving Calculation on replacement of EE fans

Saving on Replacement of Old Fans with Energy Efficient Fans		
Total no. of Old Fans	nos.	437
Avg. running hours per day	Hrs.	9
Avg. working days per year	nos.	200
Avg. Power consumption of Old fans	W	60
Total electricity consumed by traditional fans per year	kWh	47196
Avg. Power consumption of EE fans	W	30
Total electricity consumed by EE Fans	kWh	23598
Total electricity saving per year	kWh	23598
Rate of electricity	INR	8
Total monetary saving per year	INR	188784
Investment	INR	1311000
Simple payback period	Months	83



Implementation of above recommendations would give an expected saving of INR (Rs) 1,88,784per year from the 23598 kWh/year reduction in electrical units consumption. The expected cost of implementation would be Rs. 13,11,000 for 437 Fans, with a simple payback period of 83 months.

ECO 2: -Energy Saving measurement on replacement of Old Tube Lights to LED Lights

Saving on Replacement of Tube Lights with Energy LED Lights		
Total no. of Tube Lights (CFL)	nos.	1454
Avg. running hours per day	Hrs.	9
Avg. working days per year	nos.	200
Avg. Power consumption of Tube Lights	W	30
Total electricity consumed by Tube Lights per year	kWh	78516
Avg. Power consumption of LED Lights	W	18
Total electricity consumed by LED lights	kWh	47109
Total electricity saving per year	kWh	31406
Rate of electricity	INR	8
Total monetary saving per year	INR	251251
Investment	INR	145400
Simple payback period	Months	7

11. Saving Calculation on replacement of LED Lights

Luminous efficacy is the measure of the number of lumens a bulb produces per watt i.e., how much visible light is produced compared to the power consumed. If we compare Orient LED Battens against traditional tube lights, we get the following results:

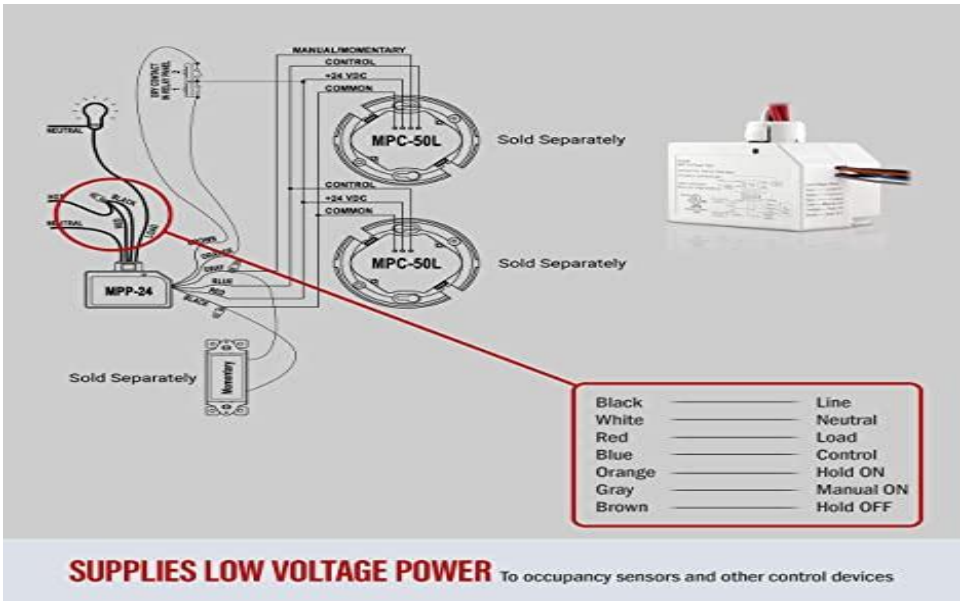
- 40W tube light churns out approx. 1900 lumens for 36 watts.
- 18W Orient LED Batten easily produces over 1800 lumens for 18 watts.

An Orient LED Batten consumes less than half the power to match the light produced by a conventional tube light.

NOTE: - Check with the manufacture for the specific bulb you want to use. Bulbs are rated in initial Lumens and design lumens.

ECO 3: Automatic motion sensor/occupancy sensor switch control for Building lighting

As per details collected, there are approximately 473 lights fixtures at the Maitreyi College. These lights fixtures have 18 W Led lamps, consuming approximately 22,562 kwh of energy per year. These lights always remain on at night, irrespective of the presence/moment of passengers on the platforms. It is suggested that the platform may be divided into 45-47 segments for lighting and motion sensor switches may be installed in each segment. These motion sensor/Occupancy sensor switches will turn ON the lights when the areas are occupied and switch the lights OFF when there is no moment of passengers on the platforms. These switches will result in power saving approximately 50% to 70%.



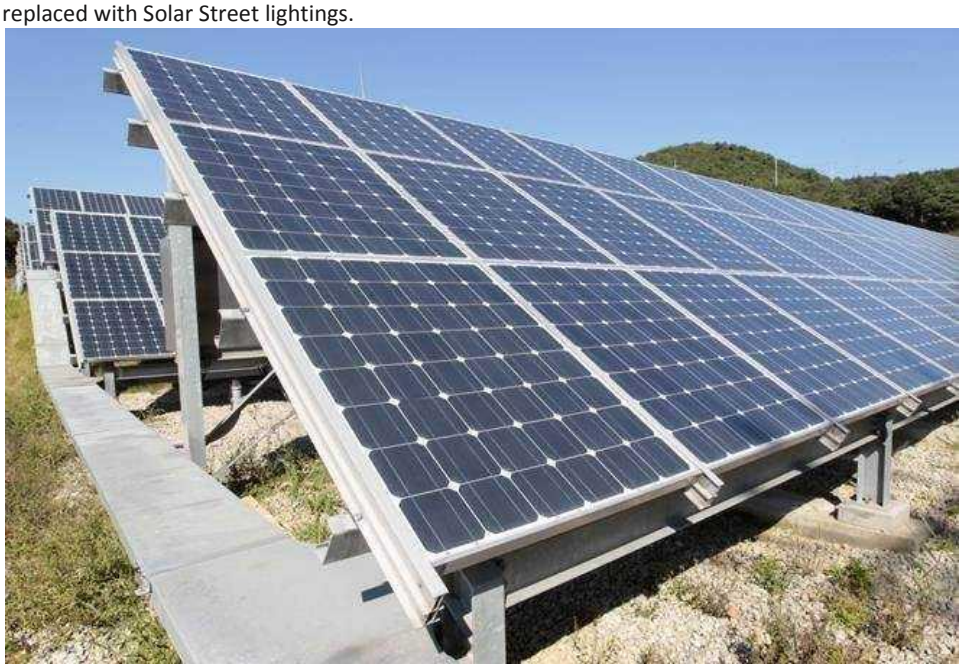
12. Saving on installation of sensor

Particular	Unit	Value
No. of lights at Corridors/Street light/Library...	no.	473
Present load at Corridors/Street light/Library...	W/light	18
Operating duration	hrs./day	10
	days/year	265
Electrical unit consumption	kWh/year	22562
Electrical Unit Cost	Rs. /kWh	8
Operating duration after installing this sensor 50%	hrs./day	4
Electrical unit consumption	kWh/year	9024
Savings	kWh/year	13537
	Rs. /Year	1,08,298
Investment @ 5000 per sensor	Rs.	2,35,000
Simple Payback Period	months	25

Implementation of above recommendations would give an expected saving of INR (Rs) 1, 08,298 per year from the reduction in electrical unit consumption of 13537 kWh/year. The expected cost of implementation would be INR (Rs) 2, 35,000which has a simple payback period of 25 months.

ECN's 4: - Installation of Solar Plant

Maitreyi College, Chanakya Puri (New Delhi) is having lots of space on the roof which can be used for solar power plant. Now, the auditing team observed the Maitreyi College is not operated by Solar system, so it is recommended that the streetlights of Maitreyi College replaced with Solar Street lightings.



Particular	**Unit**	**Value**
Installation of Solar Power Plant	kWp	100
Annual Generation	kWh/year	120000
Electrical Unit Cost	Rs. /kWh	8
Annual Monetary Value	Rs/ Year	960000
Investment	Rs	5000000
Simple Payback Period	**months**	62

13. Saving on installation of sensor

Implementation of above recommendations would give an expected saving of Rs. 9, 60,000 per year from the reduction in electrical unit consumption of 120000 kWh/year. The expected cost of implementation would be Rs. 50, 00,000 which has a simple payback period of 62 months.

Note: Maitreyi College should get detailed study for costing and engineering from the solar expert.

ECN's 5: - Reduction in Contract Demand

The Electricity Utility Service Provider for Maitreyi College, Chanakya Puri (New Delhi) is NDMC. The current Fixed Charges in lieu of contract demand, as per the tariff plan of NDMC, are for 160 KW fixed demand (sanctioned load). However, from the power analyser reading it is observed that the maximum demand is not exceeding 80KW. During the audit period all the lights, fans and Air conditioners were kept on. Therefore, it is possible that during the normal course the building may be using even less energy. Also, from the Energy bills analysis it is clear that during winters the demand is about 40 to 50 percent less compared to summer.

In view of above it is recommended that the fixed / contract demand for electricity connection may be reduced by 44%. This will result in direct saving of approximately Rupees 2.5 lakhs per year. These charges can be further reduced if the Capacitor bank is installed, and power factor is brought close to unity.

General Recommendation

Fans

- Use aero foil shaped fan blades.
- Use energy efficient motor for continuous or near continuous operations.
- Turn fans off when not needed.

Lighting

- Reduce excessive illumination levels to standard levels using switching, decamping etc. (Know the electrical effects before doing decamping.)
- Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.
- Install efficient alternatives to incandescent lightings, etc. Efficient (lumens/watt) of various technologies range from best to worst approximately as follows: - low pressure sodium, high pressure sodium, metal halide, fluorescent, mercury vapour, incandescent.
- Consider lowering the fixtures to enable using less of them.
- Consider day lighting, sky lightings etc.
- Use task lighting and reduce background illumination.
- Re-evaluate exterior lighting strategy, type, and control. Control it aggressively.

Buildings

- Seal exterior cracks/openings/gaps with caulk, casketing, weather stripping, etc.
- Consider new thermal doors, thermal windows, roofing insulation etc.
- Install windbreaks near exterior doors.
- Consider covering some window and skylight areas with insulated wall panels inside the building.
- If visibility is not required but light is required, consider replacing exterior windows with insulated glass block.
- Consider tinted glass, reflective glass, coatings, awnings, overheads, draperies, blinds and shades for sunlit exterior windows.

Note: Remote control operated appliance use about 5% of the normal use electricity on Standby mode, therefore switching off the appliances from the mains can save avoidable waste of energy.

While buying new appliances attention should be paid to standby energy usage and equipment with lower energy consumption and BEE star labelled product must be procured.

Man-made energy wastage

Ways energy is wasted in the office- Please control.

- Computer wastage: Computer should be switched off when it is not being used it should be in Standby mode to save energy.
  Off the lights: Switching off bathroom or Labs lights when they are not in use is an easy option to save energy and costs. Using automatic switches that turn on and off depending on movement is an efficient way to ensure that the costs are kept to a minimum.

- Switch off your machines: The photocopier as well as printers can all be switched off overnight and at weekends to save energy. Make it the responsibility of a staff member to switch off the machines nearest to their desk or install a timer for them to switch off or go to stand by automatically.

  Utilize your free resources: The biggest and brightest energy resource is outside and is free to use all year round, the sunshine. Instead of turning on all the lights in the office, if there is enough window space, open the curtain and let the sunshine to come in. This will reduce the use of heating and lighting need and hence energy cost.

- Don't be wasteful: Printing only when it is absolutely necessary will save energy as well as paper costs.

- Climate Control: Using programmable thermostats, office managers can automatically dial down the climate control at night and at other times when the office is unoccupied. Thermostats with zone control can adjust settings room-by-room, turning off, for example, air-conditioning to an unused conference room.

The man-made energy wastages pointed in the report are not indented to blame anyone rather to encourage people to save energy and make contribution towards the prosperity of our nation.

13. List of some Suppliers

Product	Company Name	Website
Ceiling Fans	Havells	www.havells.com
	Crompton Greaves	www.cgglobal.com
Lighting System	Syska LED	http://syskaledlights.com
Energy Efficient Pumps	Mather & Platt Pumps Ltd.	Ø www.matherplatt.com
Electric Panels & Control/Safety	L&T electrical and automation	www.larsentoubro.com
	Havells	www.havells.com
Oil Heaters	Kanti Lal	http://www.heaterhub.com
Solar System Product	Bosch Energy & Building Solutions Limited	www.boschindiaewww.boschindiaenergy@in.bosch.comnergy@in.bosch.com
	Steage Energy Service India	www.steag.in
Pumps	Beacon	http://www.bestcrompton.com