Report

on

GREEN & ENERGY AUDIT

of

RAJGAD DNYANPEETH'S

SHRI CHHATRAPATI SHIVAJIRAJE COLLEGE OF ENGINEERING,

Gat No. 237, Pune Bangalore Highway, Dhangawadi, Tal – Bhor, Dist- Pune

Year: 2018

Prepared by

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ECN/2018-19/CR-05/4174 19th September , 2018

CERTIFICATE OF REGISTRATION
FOR CLASS 'A'

We hereby certify that, the firm having following particulars is registered with ***MAHARASHTRA ENERGY DEVELOPMENT AGENCY (MEDA)*** under given category as "Energy Planner & Energy Auditor" in Maharashtra for Energy Conservation Programme of MEDA.

Name and Address of the firm	:	**Enrich Consultants** Yashashree, Plot No. 26, Nirmal Bag Society, Near Muktangan English School, Parvati, Pune - 411009.
Registration Category	:	Empanelled *Consultant for Energy Conservation Programme*
Registration Number	:	***MEDA/ECN/CR-05/2018-19/EA-03***

- Energy Conservation Programme intends to identify areas where wasteful use of energy occurs and to evaluate the scope for Energy Conservation and take concrete steps to achieve the evaluated energy savings.
- MEDA reserves the right to visit the firm at any time without giving any prior information and canceling the registration, if the information is found incorrect.
- This empanelment is valid till **31st March 2021** from the date of registration, to carry out energy audits under the Energy Conservation Programme
- The Director General, MEDA reserves the right to cancel the registration at any time without assigning any reasons thereof.

19/9/18

(Smita Kudarikar)
General Manager (EC)

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Ref: EC/CSRCOE/01 Date: 10/1/2019

CERTIFICATE

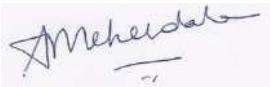
This is to certify that we have conducted Energy & Green Audit at Rajgad Dnyanpeeth's Shri Chhatrapati Shivajiraje College of Engineering, Dhangawadi, Tal: Bhor, Dist: Pune as per the guidelines of Maharashtra Energy Development Agency (www.mahaurja.com) in the year 2018.

The College has already adopted **Energy Efficient and Green** practices like:

- Usage of Energy Efficient LED Fittings,
- Bio gas plant for conversion of bio degradable waste into Biogas
- Installation of 10 kWp Roof top Solar PV Plant
- Rain water harvesting

We appreciate the involvement of the students and faculty members and the cooperation extended by the management, in the process of Energy Conservation & making the campus Green.

For Enrich Consultants,



A Y Mehendale,
Certified Energy Auditor
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ACKNOWLEDGEMENT

We at Enrich Consultants, Pune, express our sincere gratitude to the management of Rajgad Dnyanpeeth's Shri Chhatrapati Shivajiraje College of Engineering, Dhangawadi, Tal: Bhor, Dist: Pune for awarding us the assignment of Green & Energy Audit of their Dhangawadi Campus

We are thankful to:

- Prof. Dr. S. B. Patil, Principal, SCSCOE
- Prof. D. B. Shelke, Assistant Professor, Mechanical Engg Department
- Prof. L. P. Maskepatil, Assistant Professor, Mechanical Engg Department

We are also thankful to various Head of Departments & other Staff members for helping us during the field measurements.

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EXECUTIVE SUMMARY

1. Shri Chhatrapati Shivajiraje College of Engineering, Dhangawadi, Tal: Bhor, Dist: Pune consumes Energy in the form of **Electrical Energy** used for various gadgets, Office & other facilities.

2. Present Level of Energy Consumption:

No	Value	Energy Consumed, kWh	Power Factor	Maximum Demand, kVA	CO_2 emissions, MT
1	Maximum	13290	0.997	53	10.63
2	Minimum	5334	0.965	33	4.27
3	Average	10977.5	0.989	44	8.78

3. Various Majors Adopted for Energy Conservation:

The various projects already implemented by the College are

- Usage of Energy Efficient LED fittings for new installations
- Maintenance of Power Factor at about 0.99
- Usage of STAR Rated ACs

4. Usage of Alternate Energy Source:

The College has installed Roof top Solar PV Plant of capacity **10 kWp**. The College has Solar Thermal Water Heater for Hostel blocks of Capacity **10000 LPD**. The percentage of Annual Power requirement met by Renewable Energy Source is **50.98 %.**

5. Percentage of Lighting Power Requirements met by LED bulbs:

No	Parameter	Value	Unit
1	Total Lighting power requirement per annum	61375.44	kWh/Annum
2	Total Lighting requirement met by LED bulbs	7145.04	kWh/Annum
3	% of Lighting power requirement met by LED bulbs	**11.64**	**%**

6. Waste Management:

6.1 Solid Waste Management:

The College has installed a Bio gas plant of capacity 1.68 m3 and the bio degradable waste is converted in to Bio gas, which in turn is used in the college mess.

6.2 Liquid Waste Management:

In Campus liquid waste collected from various places like wash basin, urinals, toilets, water cooler etc. through plumbing system and is connected to Septic tank of capacity 240000 litre.

6.3 e-Waste Management:

All the internal communication is through emails and hardly any e-Waste is generated in the Day to Day operation of the College. The College authorities have already contacted Authorized e-Waste management vendor to dispose any wastage generated during the day-to-day operations.

7. Rain Water Harvesting:

The College has already installed **Rainwater Harvesting System** to collect the Rain Water collected at the Terrace & coming from other slopes, which in turn is used to enrich the underground water level and water level in well.

8. Recommendations:

No	Recommendation	Energy Saving, kWh/Annum	CO_2 reduction, MT/Annum	Monetary Saving, Rs	Investment, Rs	Payback period, Months
1	Replacement of 777 Nos 40 W FTLs with 20 W LEDs	26107.2	20.88	237576	194250	10
2	**Total**	**26107.2**	**20.88**	**237576**	**194250**	**10**

9. Notes & Assumptions:

1. 1 Unit of Electrical Energy releases **0.8 Kg of CO_2** into atmosphere
2. **1 kWp** Solar PV system generates **4 Units (kWh)** of Electrical Energy per Day
3. Daily working hours-**6 Nos** (For Lighting Load Calculations)
4. Annual working Days-**280 Nos**
5. Average Rate of Electrical Energy : **Rs 9.10/- per kWh**

ABBREVIATIONS

DP	:	Double Pole
CFL	:	Compact Fluorescent Lamp
F P	-	Feeder Pillar
LED	-	Light Emitting Diode
MSEDCL	:	Maharashtra State Electricity Distribution Company Ltd.
MEDA	-	Maharashtra Energy Development Agency
V	:	Voltage
I	:	Current
kW	:	kilo-Watt
kVA	:	Active Power
kVAr	:	Reactive Power
P F	:	Power Factor
Kms.	:	Kilometers

CHAPTER-I
INTRODUCTION

1.1 Objectives:

1. To study present level of Energy Consumption
2. To Study the present CO_2 emissions
3. To assess the various equipment/facilities from Energy efficiency aspect
4. To study Scope for usage of Renewable Energy
5. To study various measures to reduce the Energy Consumption

1.2 Audit Methodology:

1. Study of connected load
2. Study of Electrical Energy Consumption pattern
3. Study usage of Renewable Energy Usage
4. Study of Lighting Load and Usage of LED Lights
5. Study of Rain water harvesting, Waste management
6. To prepare the Report with various Energy conservation measures

1.3 Table No-1: General Details of College:

No	Head	Particulars
1	Name	Shri Chhatrapati Shivajiraje College of Engineering
2	Address	Dhangawadi, Tal: Bhor, Dist: Pune
3	Year of Establishment	2006
4	Courses Offered	Graduate courses in Engineering disciplines

CHAPTER-II
STUDY OF CONNECTED LOAD

In this chapter, we present the details of various Electrical loads as under

2.1 Table No-2: Details of Overall Connected Load:

No	Location	FTL-40 W	LED-20W	Fan	P C	A C	Printer	L E D	Others
1	CAD-CAM LAB	4	4	7	28		1		
2	Faculty Room	2	2	2	1		1		
3	I.C Engine Lab	0	6	2			-		
4	TOM -DOM Lab	0	8	3					
5	Placement Office	0	4	2	1		1		
6	First aid Room	2							
7	Testing of material	8		3					
8	Transportation Engg	4		3					
9	House Keeping	1						8	
10	Department Office	4		3	2		1		
11	Principal			2	1		1	8	
12	Board Room	4		2					
13	Room -5	8		5					
14	Room -3	14		9	8		5		
15	Room-35	9		3	2		3		
16	Gents Toilet	4							
17	Girls Toilet	4							
18	Room-1			2		1		8	1 T.V
19	Corridor							7	2 CCTV,
20	ATM					2			
21	Room Nu 016	25		5					
22	Passage	50							
23	LIFT								
1	Tutorial Room	3		2					
2	Class Room	6			18				

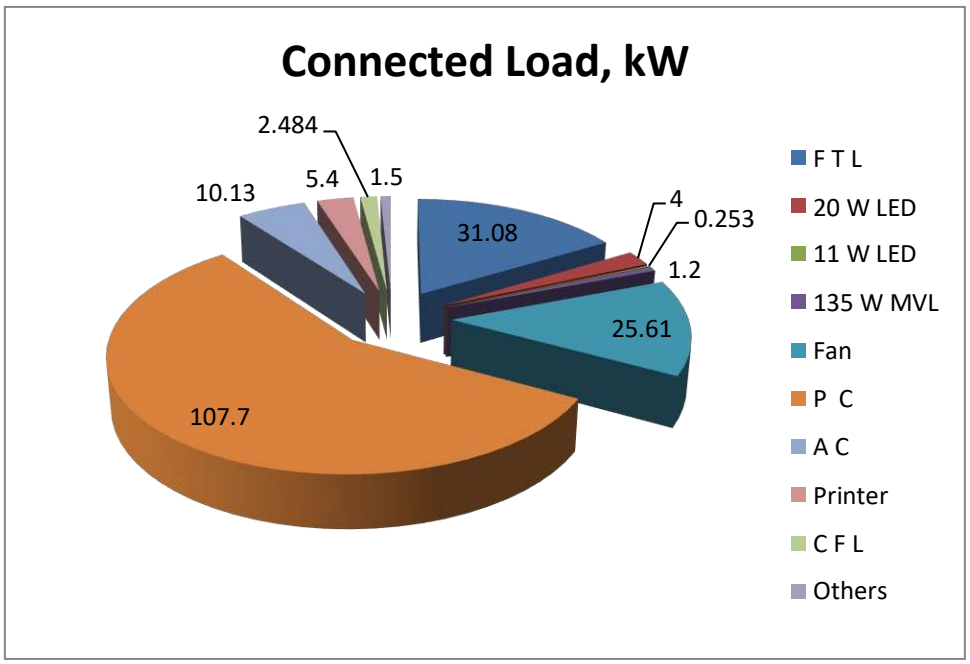
3	Class Room	6		3					
4	Class Room	7		1					
5	Class Room	8		3					
6	Class Room	8		2					
7	Class Room	6		3					
8	Gents Toilet	4							
9	Ladies Toilet	4							
10	Faculty Room	10		3	1				
11	Exam Control Room								
12	Reading Room	5		3					
13	Library	37		15	12		2		
14	Tutorial Room	3		2					
15	Environmental Engg	7		4					
16	Passage		47						
1	Class Room	8		3					
2	Class Room	8		2					
3	Class Room	8		3					
4	Class Room	8		2					
5	Class Room	7		2					
6	Tutorial LAB	8		4	2				
7	Operating system LAB			18	58		1		
8	Hardware LAB	6		3	1				
9	HOD Cabin	6		2	2		2		
10	Programming Lab	8		3	19		1		
11	Server lab	4		2	3	1			
12	Software LAB	6		3					
13	Computer LAB	6		3					
14	Network LAB	7		2	20				
15	DATA Base LAB	7		3	21				
16	Seminar Hall	8		4	1				
17	Gents Toilet	4						3	
18	Ladies Toilet	4							

19	Passage	26	21						
1	Class Room	8		3					
2	Class Room	8		4					
3	Class Room	8		3					
4	Class Room	8		3					
5	Class Room	8		3					
6	Class Room	8		3					
7	Class Room	8		3					
8	Girls Common Room	6		1					
9	Analog & Digital Communication	6		3					
10	Micro Processor & controller	6		3	1				
11	Tutorial Room	5		2					
12	HOD Cabin	4		2	2		2		
13	Project Room	12		8	1		1		
14	Faculty Room	8		3	4				
15	Power lab	6		1	22				
16	EDC & Circuit Design	6		1					
17	Basic Electrical	9		3	1				
18	Drawing Hall	12		4					
19	Engg. Physics	6		3	1		1		
20	HOD (Gen. Engg)	3		3	1				
21	Engg. Chemistry	11		3	0				
22	Gents Toilet	4			0				
23	Ladies Toilet	4							
24	Passage								
25	Workshop	27		2	8				MVL-8
26	Hostel Block	75		65					
27	Diploma Section	190		112	88	1	13		
28	**Total**	**777**	**200**	**394**	**330**	**5**	**36**	**34**	**0**

Table No-3: Equipment wise connected Load:

No	Equipment	Qty	Load, W/Unit	Load, kW
1	F T L-40 W	777	40	31.08
2	LED-20 W	200	20	4
3	LED-11W	23	11	0.253
4	MVL-135 W	8	150	1.2
5	Fan	394	65	25.61
6	P C	1077	100	107.7
7	A C	5	2025	10.13
8	Printer	36	150	5.4
9	Others	15	100	1.5
10	**Total**			**186.87**

We present the same in a PIE Chart as under:
Chart No-1: Details of Connected Load:



Note: From the above Table, we observe that out of Total Connected Load of **186.87 kW**.

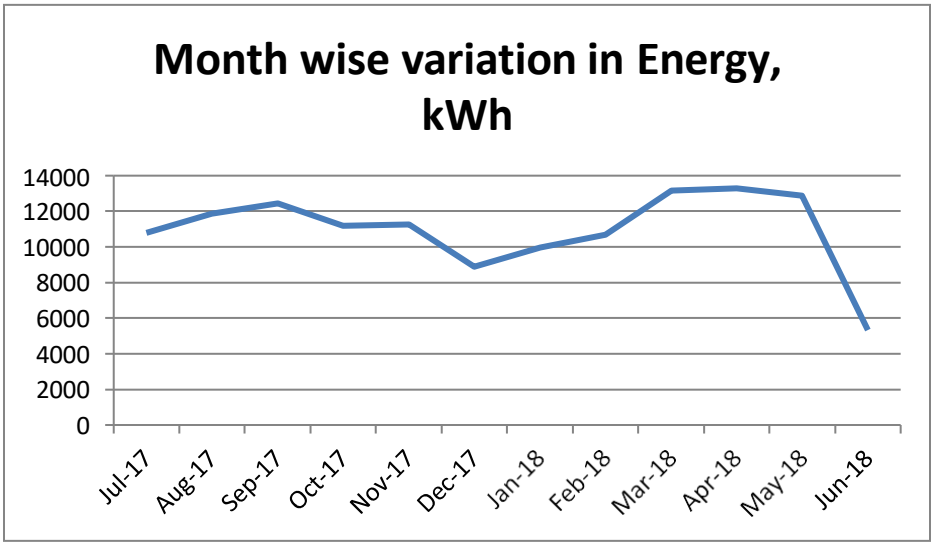
CHAPTER-III
STUDY OF ELECTRICAL ENERGY CONSUMPTION

In this chapter, we present the analysis of last year Electricity Bills

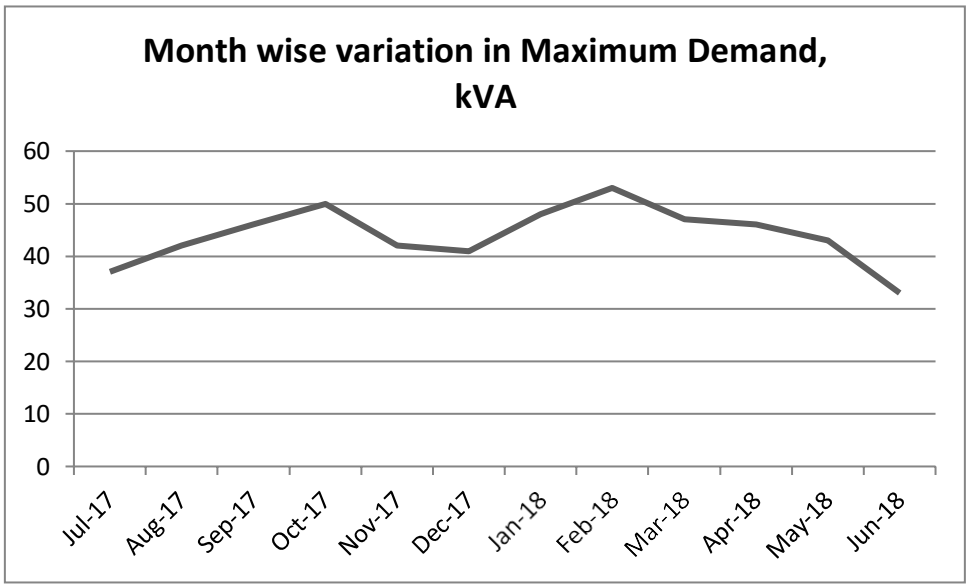
Table No 4: Electrical Energy Consumption: 2017-18:

No	Month	Energy, kWh	P F	M D kVA	CO2, MT
1	Jul-17	10784	0.996	37	8.63
2	Aug-17	11859	0.996	42	9.49
3	Sep-17	12447	0.997	46	9.96
4	Oct-17	11185	0.994	50	8.95
5	Nov-17	11261	0.995	42	9.01
6	Dec-17	8906	0.965	41	7.12
7	Jan-18	9971	0.99	48	7.98
8	Feb-18	10681	0.993	53	8.54
9	Mar-18	13151	0.996	47	10.52
10	Apr-18	13290	0.995	46	10.63
11	May-18	12861	0.995	43	10.29
12	Jun-18	5334	0.966	33	4.27
13	Maximum	13290	0.997	53	10.63
14	Minimum	5334	0.965	33	4.27
15	Average	10977.5	0.989833	44	8.78

3.1.1 Chart No-2: To study the variation of Month wise Energy Consumed, kWh:



3.1.2 Chart No-3: To study the variation of Month wise Maximum Demand, kVA:



3.1.3 Chart No-4: To study the variation of Month wise Power Factor:

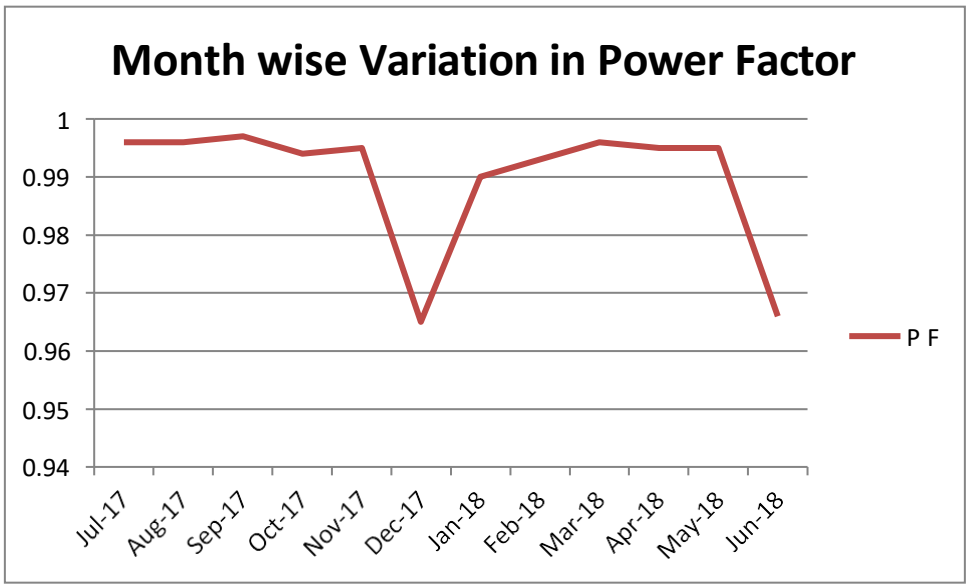


Table No 5: Key observations:

No	Value	Energy Consumed, kWh	Power Factor	Maximum Demand, kVA	CO2 emissions, MT
1	Maximum	13290	0.997	53	10.63
2	Minimum	5334	0.965	33	4.27
3	Average	10977.5	0.989833333	44	8.78

CHAPTER-IV
CARBON FOOTPRINTING

4.1 A Carbon Foot print is defined as the Total Greenhouse Gas emissions, emitted due to various activities.

In this we compute the emissions of Carbon-Di-Oxide, by usage of the various forms of Energy used by the College for performing its day to day activities

The College uses Electrical Energy for various Electrical gadgets.

4.2 Basis for computation of CO_2 Emissions:

The basis of Calculation for CO_2 emissions due to LPG & Electrical Energy are as under

- 1 Unit (kWh) of Electrical Energy releases **0.8 Kg of CO_2** into atmosphere

Based on the above Data we compute the CO_2 emissions which are being released in to the atmosphere by the College due to its Day to Day operations

4.3 Table No 6: Month wise CO_2 Emissions:

No	Month	Energy, kWh	CO2, MT
1	Jul-17	10784	8.63
2	Aug-17	11859	9.49
3	Sep-17	12447	9.96
4	Oct-17	11185	8.95
5	Nov-17	11261	9.01
6	Dec-17	8906	7.12
7	Jan-18	9971	7.98
8	Feb-18	10681	8.54
9	Mar-18	13151	10.52
10	Apr-18	13290	10.63
11	May-18	12861	10.29
12	Jun-18	5334	4.27
13	Maximum	13290	10.63
14	Minimum	5334	4.27
15	Average	10977.5	8.78

4.4 Representation of Month wise CO_2 emissions:

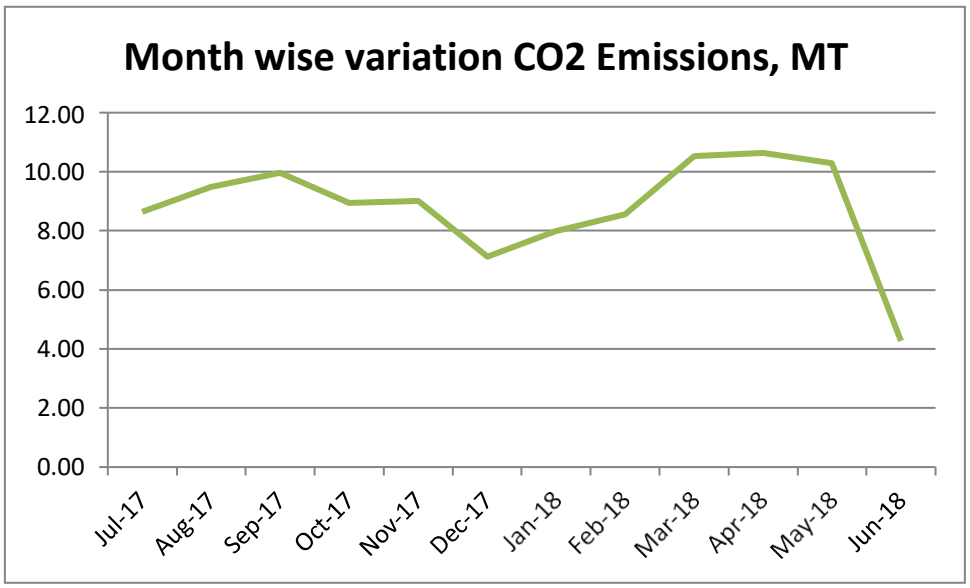


Table No 7: Key observations:

No	Value	CO2 emissions, MT
1	Maximum	10.63
2	Minimum	4.27
3	Average	8.78

CHAPTER-V
STUDY OF USAGE OF RENEWABLE ENERGY

The College has installed Roof top Solar PV Plant of Capacity **10 kWp**. For Hostel blocks, the Solar Thermal Hot water System is used. The capacity is **10000 LPD**. As per the MNRE paper, a 100 LPD Solar Thermal Water heating system saves about 1250 kWh of Electrical Energy per annum.

Photograph of 10 kWp Roof top Solar PV Plant

Photograph of Solar Thermal Water Heating System at Hostel block:

In the following Table, we present the Percentage of Power Requirement met by the Renewable Energy Source, as under:

Table No 8: Computation of Percentage of Annual Power Requirement met by the Renewable Energy Source:

No	Particulars	Value	Unit
A)	**Computation of Annual Energy Requirement**		
1	Annual Power Requirement of College-As per MSEDCL Bills	**131730**	kWh/Annum
2	Equivalent Electrical Energy Demand-For Hostel-On account of Solar Thermal Heating System	**125000**	kWh/Annum
3	Energy generated & used by Roof top Solar PV Plant	**12000**	kWh/Annum
4	Total Annual Energy requirement= (1) + (2) +(3)	**268730**	kWh/Annum
B)	**Computation of Usage of Alternate Energy**		
5	Roof top Solar PV Plant Capacity	10	kWp
6	Average Energy generated per kWp per Day	4	kWh/Day
7	Average Annual working Days	300	Nos
8	Annual Energy generated by 10 kWp Plant=(4)*(5)*(6)	**12000**	kWh/Annum
9	Capacity of Solar Thermal Water Heating System	10000	LPD
10	Annual Electrical saved by 100 LPD System	1250	kWh/Annum
11	Annual Energy saved by 10000 LPD System	**125000**	kWh/Annum
12	Total contribution of Renewable Energy = (8) + (11)	**137000**	kWh/Annum
13	% of Total Power met by Renewable Energy = (12) * 100 / (4)	**50.98**	%

CHAPTER VI
STUDY OF USAGE OF LED BULBS

Previously the College had T-12 FTL fittings. But now they have replaced almost 500 FTLs with 20 W LED fittings.

In the following Table, we compute the % of total Lighting requirement met by LEDs

Table No 9: Computation of % Lighting Power met by LEDs:

No	Particulars	Value	Unit
1	Number of T-8 FTLs in the campus	777	Nos
2	Load/Unit of T-8 FTL	40	W/Unit
3	Total Lighting Load of T-8 FTL	**31.08**	kW
4	Number of 20 W LEDs in the campus	200	Nos
5	Load/Unit of 20 W LED	20	W/Unit
6	Total Lighting Load of 20 W LEDs	**4**	kW
7	Number of 11 W LEDs in the campus	23	Nos
8	Load/Unit of 11 W LED	11	W/Unit
9	Total Lighting Load of 11 W LEDs	**0.253**	kW
10	Number of 135 W MVLs in the campus	8	Nos
11	Load/Unit of 135 W MVL	150	W/Unit
12	Total Lighting Load of 135 W MVLs	**1.2**	kW
13	Total Lighting Load= 3+6+9+12	**36.533**	kW
14	Total LED Lighting Load = 6+9	**4.253**	kW
15	Daily working hours	6	Hrs/Day
16	Annual Working Days	280	Days/Annum
17	Annual Total Lighting Load = 13*15*16	61375.44	kWh/Annum
18	Annual Lighting Load met by LED lights = 14*15*16	7145.04	kWh/Annum
19	% of LEDs to total Lighting Load= (14) *100/ (13)	**11.64**	**%**
20	% of other lighting load to total Lighting Load	**88.36**	**%**

CHAPTER VII
STUDY OF WASTE MANAGEMENT

In this Chapter, we study the Waste management systems of the College.

7.1 Organic Waste Management:

In Campus canteen approximately 30 kg /day waste material viz. leftover food waste is collected and utilized for producing biogas. It takes 24 hours to convert waste into biogas. This biogas plant specification is volume of digester 2.2 m3 and gas holding capacity of 1.68 m3. The energy generated from the biogas plant is utilized in canteen itself under regenerative objective.

Photograph of Biogas Plant:

7.2 Liquid Waste Management:

In Campus liquid waste collected from various places like wash basin, urinals, toilets, water cooler etc. through plumbing system and is connected to Septic tank of capacity 240000 liter

7.3 e-Waste Management:

In campus non-repairable electronic items like computer components, mouse, cables, CDs, chargers, earphones, batteries, non-working switches, electric cables, etc. is stored properly. E-waste bins are made available in the department at various locations. This Collected E- Waste is given to the authorized dealers NGO 'SWaCH' Pune Seva Sahakari Sanstha Ltd. Kothrud-Pune for reuse and disposed. Articles on e-waste management are also frequently displayed on the Notice Boards.

CHAPTER VIII
STUDY OF RAIN WATER HARVESTING

The College has already implemented the Rain Water Harvesting Project. The College has installed Pipes from the terrace and the Rain water falling on the terrace is used to enrich the ground water level & water in the well. This is further used for gardening purpose.

Photograph of Rain water Harvesting project:

CHAPTER IX
ENERGY CONSERVATION PROPOSALS

ECP-1: Replacement of 777 Nos 40 W FTLs with 20 W LEDs:

There are about **777 Nos 40 W** FTLs in the College premises. It is proposed to replace about 1000 Nos FTLs with **20 W LEDs**.
In the following Table, we present the saving potential.

No	Particulars	Value	Unit
1	No of 40 W FTL	777	Nos
2	Load of 40 W FTL	40	W/Unit
3	Load of 20 W LED	20	W/Unit
4	Saving per fitting	20	W/Unit
5	Daily usage period	6	Hrs/Day
6	Daily saving potential	93.24	kWh/Day
7	Annual working Days	280	Days/Annum
8	Annual Saving potential	26107.2	kWh/Annum
9	Proposed reduction in CO2 emissions	20.88	MT/Annum
10	Present Rate of Electrical Energy	9.1	Rs/kWh
11	Annual monetary Gain	237576	Rs/Annum
12	Investment required	194250	Rs lumpsum
13	Simple payback period	10	Months

Summary of Recommendations:

No	Recommendation	Energy Saving, kWh/Annum	CO_2 reduction, MT/Annum	Monetary Saving, Rs	Investment, Rs	Payback period, Months
1	Replacement of 777 Nos 40 W FTLs with 20 W LEDs	26107.2	20.88	237576	194250	10
2	**Total**	**26107.2**	**20.88**	**237576**	**194250**	**10**