Report
on
Energy Audit
of
Progressive Education Society's
Modern College of Arts, Science & Commerce
Ganeshkhind, Pune 411 016

Year: 2019-20

Prepared by

Enrich Consultants,
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MAHARASHTRA ENERGY DEVELOPMENT AGENCY

Maharashtra Energy Development Agency
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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)

Enrich Consultants

Yashashree, 26, Nirmal Bag Society,
Near Muktangan English School, Parvati, Pune 411 009
Tel: 09890444795 Email: enrichcons@gmail.com

Ref: EC/PESMCASC/01 Date: 20/8/2020

CERTIFICATE

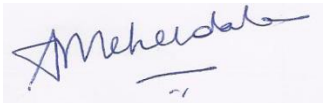
This is to certify that we have conducted Energy Audit at P.E.S. Modern College of Arts, Science & Commerce, Ganeshkhind, Pune as per the guidelines of Maharashtra Energy Development Agency (www.mahaurja.com) in the year 2019-20.

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

- Usage of Energy Efficient LED Fittings
- Usage of Energy Efficient BEE STAR Rated equipment
- Installation of **21 kW** Hybrid Roof Top Solar PV/Wind Power Plant.

We appreciate the support of Management, involvement of faculty members and students in the process of Energy Conservation & making the campus Green.

For Enrich Consultants,



A Y Mehendale,
Certified Energy Auditor
EA-8192

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ACKNOWLEDGEMENT

We at Enrich Consultants, Pune wish to express our sincere gratitude to the management of P.E.S. Modern College of Arts, Science & Commerce, Ganeshkhind, Pune for assigning the work of Energy Audit of Ganeshkhind campus for the Year: 2019-20.

We appreciate the co-operation and support extended to our team members during the entire tenure of field study.

We express our sincere thanks to

1. Prof. Dr. G. R. Ekbote, Chairman, Progressive Education Society
2. Prof. Dr. Sanjay S. Kharat, Principal
3. Prof. Dr. Mrs. Pallawi Bulakh, Faculty Member
4. Prof Dr Sanjay Patil, Head, Geology Department

We are also thankful to all other staff members who helped us during the Measurements at the field and for giving us the necessary inputs to carry out this vital exercise of Energy Audit.

EXECUTIVE SUMMARY

After the Field Study and analysis we summarize the following points.

1. P.E.S. Modern College of Arts, Science & Commerce, Ganeshkhind, Pune uses Electrical Energy as the source of Energy for various equipment in the college campus.

2. Present Level of Energy Consumption:

No	Parameter/ Value	Energy Consumed, kWh	CO_2 Emissions, MT
1	Total	150377	120.30
2	Maximum	19006	15.20
3	Minimum	6711	5.37
4	Average	12531.42	10.03

3. Various measures adopted for Energy Conservation & renewable Energy:

1. Usage of LED tube lights
2. Usage of STAR Rated equipment
3. Maintenance of good power factor
4. Installation of **21 kWp Solar & Wind Hybrid** roof top plant.

4. Percentage of Usage of Alternate Energy:

The College has installed a Roof Top Hybrid Solar plus Wind Energy Plant. The percentage of usage of Alternate Energy to Annual Energy Requirement is **10.56 %.**

5. Percentage of Usage of LED Lighting:

The College has various Types of Light fittings, namely: LED, FTL & CFL. The percentage of Annual LED Lighting Usage to Annual Lighting requirement works out to be **32.33 %.**

6. Recommendation:

No	Recommendation	Annual Saving potential, kWh/Annum	Annual Monetary saving potential, Rs	Investment required, Rs	Simple payback period, Months
1	Replacement of 269 Nos T-8 fittings by 20 W LED fittings	18077	198847	94150	6
2	Replacement of 14 Nos Old ACs by STAR Rated ACs	63504	698544	700000	13
3	**Total**	**81581**	**897391**	**794150**	**11**

7. Notes & Assumptions:

1. **1 Unit** of Electrical Energy releases **0.8 Kg of CO_2** into atmosphere
2. Daily working hours-**6 Nos.**
3. Annual working Days-**250 Nos**
4. Rate of Electrical Energy is considered as **Rs 11/ per kWh**

ABBREVIATIONS

AC	:	Air conditioner
PES	:	Progressive Education Society
CFL	:	Compact Fluorescent Lamp
FTL	:	Fluorescent Tube Light
LED	:	Light Emitting Diode
kWh	:	kilo-Watt Hour
Qty	:	Quantity
W	:	Watt
kW	:	Kilo Watt
PF	:	Power Factor
M D	:	Maximum Demand
PC	:	Personal Computer
MSEDCL	:	Maharashtra State Electricity Distribution Company Ltd

CHAPTER 1
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 measure various Electrical parameters
5. To study Scope for usage of Renewable Energy
6. To study various measures to reduce the Energy Consumption

1.2 Audit Methodology:

1. Study of connected load
2. Study of various Electrical parameters
3. To prepare the Report with various Encon measures with payback analysis

1.3 General Details of College: Table No-1:

No	Head	Particulars
1	Name of Institution	PES Modern College of Arts, Commerce & Science
2	Address	Ganeshkhind, Pune
3	Year of Establishment	Pl insert
4	Affiliation	Savitribai Phule Pune University

CHAPTER-II
STUDY OF CONNECTED LOAD

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

2.1.1 Details of Tube Light Fittings & Fans at various locations: Table No-2:

No	Location	LED 5W	LED 9W	LED 15W	LED 22W	T-8 FTL	CFL 18W	FAN	WALL FAN	PC	AC
1	IQAC Cell			4					1	1	1
2	Student Section		14	33	1			4	1	12	4
3	Principal Office			13					3	2	1
4	Vice Principal Office		4					1		1	
5	**Dept of Computer Science**										
6	Vice Principal	5	9					4		4	
7	Staff Room		13		2			3		1	
8	LAB I			9	4					36	2
9	LAB II			13					4	51	
10	LAB III			8	1	1			1	21	1
11	LAB IV				2	4		2		22	
12	Server Room			2						2	2
13	HOD CABBIN				6			1		1	1
14	Placement Cell				2			1			
15	**Deptt of Elect Science**										
16	LABI			11				4			
17	LAB II			9				3		1	
18	LAB III			9				3		19	
19	Mobile App Company	6							1	2	
20	Staff Room			5				3		2	
21	**DEPT.OF STATISTICS**				3	2		4		2	
22	**DEPT.OF MATHEMATICS**										
23	Staff Room	6						1		6	
24	HOD CABIN	6						1		1	
25	Computer Lab			10		1		1	2	20	

26	**DEPT.OF PHYSICS**										
27	HOD CABIN		5					2		6	
28	LAB I		10					3			
29	LAB II		5					2		6	
30	**DEPT.OF CHEMISTRY**										
31	HOD Cabin					2		1		1	
32	LAB I					16		2			
33	LAB II					7		3		4	
34	LAB III					8					
35	LAB IV					13		4			
36	Staff Room				1	12		2		1	
37	**2ND LOOR**										
38	Class room- A1-A4					34		24			
39	Wing				1	4					
40	**DEPT.OF MICROLOGY**										
41	UG LAB					12		7			
42	PG LAB					4		8			
43	Instrument Room					6		2		4	
44	**DEPT.OF ZOOLOGY**					14		3		2	
45	**DEPT.OF BIOTECHNOLOY(PG)**				2	13		5		21	1
46	**3RD FLOOR**										
47	Class Rooms- A5-A9		70			14		41			
48	DEPT.OF BIOTECHNOLOGY(UG)					24		10		6	
49	DEPT.OF Botany					10		6		3	
50	**Deptt of Physical Education**				4	3		2	1	2	
51	**BUILDING 2**										
52	**DEPT.OF HISTORY**										
53	Staff Room	9						2			
54	ROOM C2-C3			3	4	5		4		1	

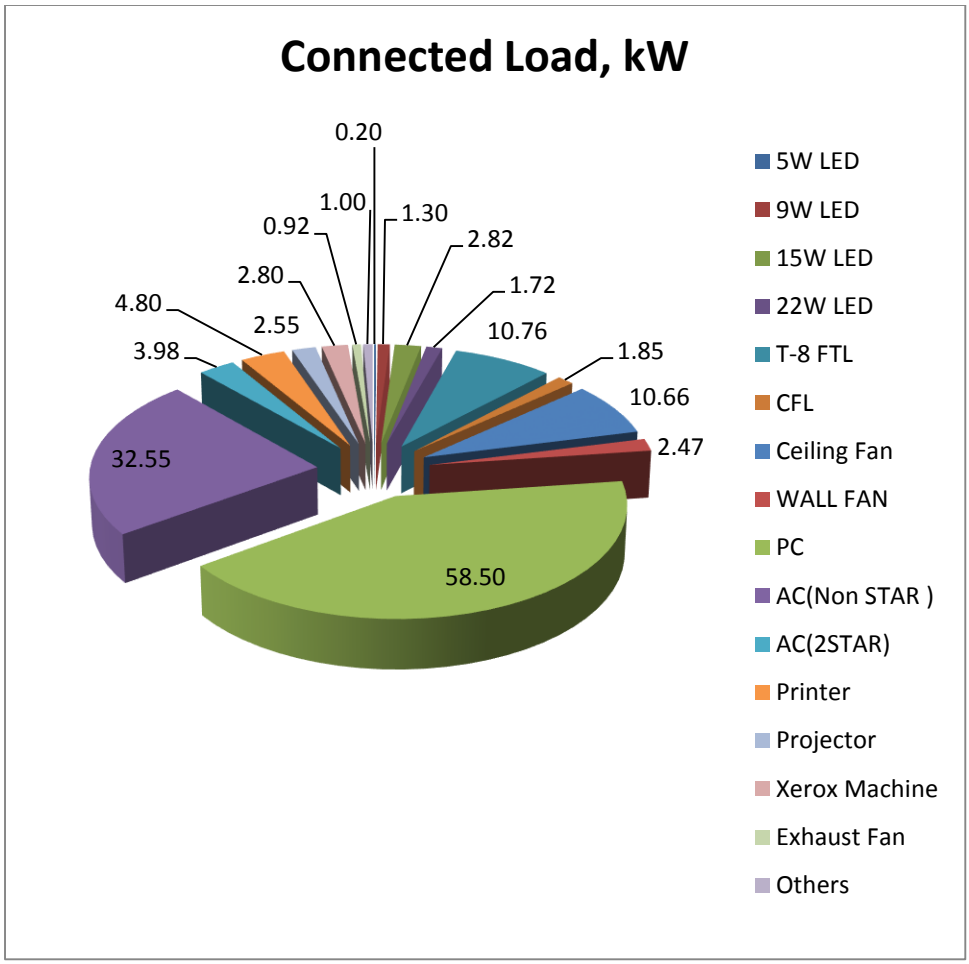
55	Corridor					1					
56	**DEPT.OF BBA(CA)**										
57	Lab					10		8		60	
58	Class Room- N1-N2				8			4			
59	Staff Room				1		1	1		1	
60	Corridor				3						
61	**FIRST FLOOR**										
62	Class Rooms- C4-C7				4	10		11		22	
63	Deptt of Zoology					2					
64	**2ND FLOOR**										
65	Dept of Social Science				3			1		2	
66	Class Rooms C8-C11				1	16		8			
67	BBA CA F.Y.				9			5			
68	**THIRD FLOOR**										
69	Deptt of Geography										
70	Competitive Exam Cell			2					1	1	
71	HOD Cabin			8					2	1	
72	Deptt of Economics			2		1			1	1	
73	Lecture Hall			12					6		
74	**FOURTH FLOOR**										
75	Class Rooms- C12-C15			24		4		20			
76	Counselling Hall		13						7	1	
77	GYM					7			4		
78	Class Rooms- L1-L3					9		9			
79	Maintenance Rooms			3	2						
80	DEPT.OF B.VOC.	7	10	8				7		2	
81	Library				1		102	12	1	35	
82	Canteen				13			9			
83	**Total**	**39**	**153**	**188**	**78**	**269**	**103**	**264**	**36**	**390**	**13**

2.2 Details of Overall Connected Load: Table No-3:

No	Equipment	Qty	Load, W/Unit	Load, kW
1	5W LED	39	5	0.20
2	9W LED	144	9	1.30
3	15W LED	188	15	2.82
4	22W LED	78	22	1.72
5	T-8 FTL	269	40	10.76
6	CFL	103	18	1.85
7	Ceiling Fan	164	65	10.66
8	WALL FAN	38	65	2.47
9	PC	390	150	58.50
10	AC(Non STAR)	14	2325	32.55
11	AC(2STAR)	2	1987.5	3.98
12	Printer	32	150	4.80
13	Projector	17	150	2.55
14	Xerox Machine	4	700	2.80
15	Exhaust Fan	23	40	0.92
16	Others	10	100	1.00
17	Total			139

2.3 Details of Connected Load:

We present the above Data in a PIE Chart as under.



CHAPTER-III
STUDY OF PRESENT ENERGY CONSUMPTION

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

Table No-4: Electrical Bill Analysis- 2019-20:

No	Month	Energy Consumed, kWh
1	Aug-19	19006
2	Sep-19	15836
3	Oct-19	13538
4	Nov-19	11277
5	Dec-19	14145
6	Jan-20	15181
7	Feb-20	16313
8	Mar-20	16313
9	Apr-20	6907
10	May-20	7251
11	Jun-20	7899
12	Jul-20	6711
13	Total	150377
14	Maximum	19006
15	Minimum	6711
16	Average	12531.41667

Chart No-2: Monthly Unit Consumption (kWh) Variation:

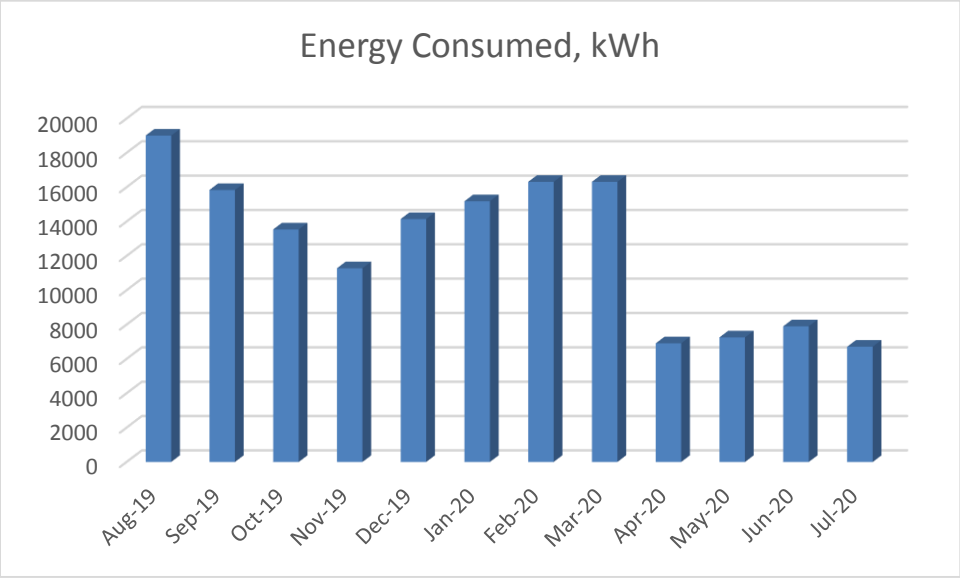


Table No-5: Important Parameters:

No	Parameter/ Value	Energy Consumed, kWh
1	Total	150377
2	Maximum	19006
3	Minimum	6711
4	Average	12531.42

CHAPTER IV
CARBON FOOTPRINTING

4.1 A Carbon Foot print is defined as the Total Greenhouse Gas emissions (CO_2 emissions), emitted due to various activities. In this we compute the emissions of Carbon-Di-Oxide, by usage of the various form of Electrical Energy used by the College for performing its day to day activities

4.2 Basis for computation of CO_2 Emissions:

The basis of Calculation for CO_2 emissions due to Electrical Energy is as under

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

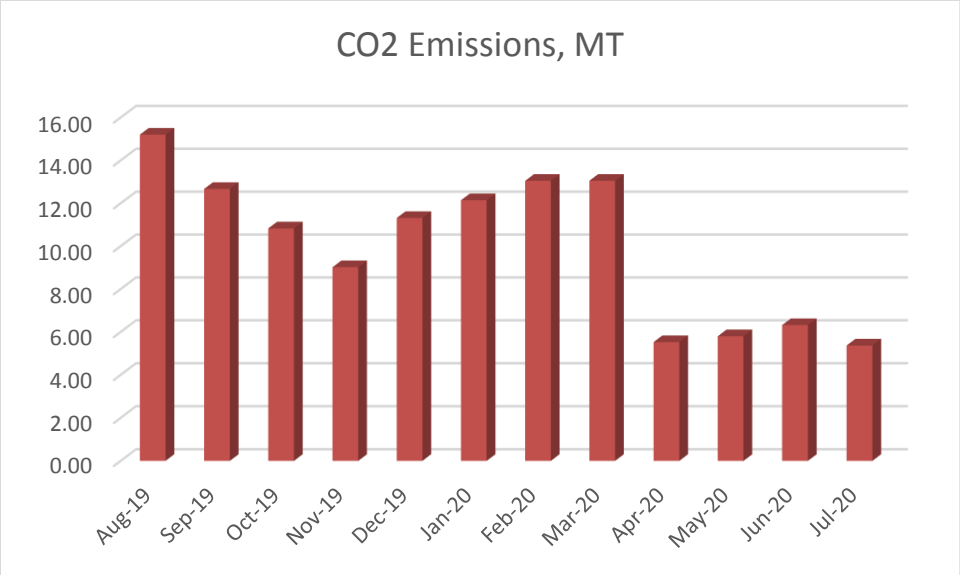
Based on the above Data we compute the CO_2 emissions which are being released in to the atmosphere by the College due to its Day to Day operations
We herewith furnish the details of various forms of Energy consumption as under

Table No-6: Month wise Consumption of Electrical Energy & CO_2 Emissions:

No	Month	Energy Consumed, kWh	CO_2 Emissions, MT
1	Aug-19	19006	15.20
2	Sep-19	15836	12.67
3	Oct-19	13538	10.83
4	Nov-19	11277	9.02
5	Dec-19	14145	11.32
6	Jan-20	15181	12.14
7	Feb-20	16313	13.05
8	Mar-20	16313	13.05
9	Apr-20	6907	5.53
10	May-20	7251	5.80
11	Jun-20	7899	6.32
12	Jul-20	6711	5.37
13	Total	**150377**	**120.30**
14	Maximum	19006	15.20
15	Minimum	6711	5.37
16	Average	12531.41667	10.03

In the following Chart we present the CO2 emissions due to usage of Electrical Energy.

4.3 Representation of Month wise CO_2 emissions: Chart No-3:



CHAPTER V
STUDY OF USAGE OF ALTERNATE ENERGY

5.1 In this Chapter, we compute the percentage of Usage of Alternate/Renewable Energy to Annual Energy Requirement of the College. The College has installed Roof Top Solar Wind Hybrid System. The Installed Capacity of Solar PV Plant is **15 kWp**, while of Wind Power is **6 kW.**

5.2 Table No-7: Computation of % Usage of Alternate Energy to Annual Energy Requirement:

No	Particulars	Value	Unit
1	Annual Energy Purchased from MSEDCL	150377	kWh/Annum
2	Energy Generated by Roof Top Hybrid System	17747	kWh/Annum
3	Total Energy Requirement of College= 1+2	168124	kWh/Annum
4	% of Usage of Alternate Energy to Annual Energy Requirement = 2*100/3	**10.56**	**%**

5.3 Photograph of Hybrid Solar/Wind Power Generation Plant:

CHAPTER VI
STUDY OF USAGE OF LED LIGHTING

In this Chapter, we compute the percentage of Annual Lighting Energy requirement met by LED Lighting.

Table No-8: Calculation of % Annual Usage of LED Lighting:

No	Particulars	Value	Unit
1	Quantity of 5 W LED Fittings	39	Nos
2	Load/Unit of W LED Fittings	5	W/Unit
3	Total Load of 39 No of fittings	0.195	kW
4	Quantity of 9 W LED Fittings	144	Nos
5	Load/Unit of 9 W LED Fittings	9	W/Unit
6	Total Load of 144 Nos of fittings	1.296	kW
7	Quantity of 15 W LED Fittings	188	Nos
8	Load/Unit of 15 W LED Fittings	15	W/Unit
9	Total Load of No 188 of fittings	2.82	kW
10	Quantity of 22 W LED Fittings	78	Nos
11	Load/Unit of 22 W LED Fittings	22	W/Unit
12	Total Load of 78 Nos of fittings	1.716	kW
13	Quantity of CFL Fittings	103	Nos
14	Load/Unit of CFL Fittings	18	W/Unit
15	Total Load of 103 Nos of fittings	1.854	kW
16	Quantity of T-8 Fittings	269	Nos
17	Load/Unit of T-8 Fittings	40	W/Unit
18	Total Load of 269 No of fittings	10.76	kW
19	Total LED Lighting Load = 3+6+9+12	6.027	kW
20	Total Lighting Load = 3+6+9+12+15+18	18.641	kW
21	Daily Usage Period	6	Hrs/Day
22	Annual Working Days	250	Nos

23	Annual Total Lighting Energy Requirement=20*21*22	27961.5	kWh/Annum
24	Annual LED Lighting Requirement=1*21*22	9040.5	kWh/Annum
25	% of Annual LED Lighting Usage to Total Lighting Requirement=24*100/23	**32.33**	**%**

CHAPTER VII
ENERGY CONSERVATION PROPOSALS

7.1: Replacement of 269 Nos T-8 FTL fittings by 20 W LED Fittings:

During the Audit it was observed that there are about 269 Nos T-8 FTL fittings in the College facility. It is recommended to replace these old fittings by 20 W LED fittings.

In the following Table, we present the saving potential, investment required and payback analysis.

No	Particulars	Value	Unit
1	Present Qty of T-8 fittings	1142	Nos
2	Energy Demand of T-8 fitting	40	W/Unit
3	Energy Demand of 20 W LED fitting	20	W/Unit
4	Reduction in demand	20	W/Unit
5	Average Daily Usage period	8	Hrs/Day
6	Daily saving in Energy	182.72	kWh/Day
7	Annual Working Days	280	Nos
8	Annual Energy Saving possible	51161.6	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	562777.6	Rs/Annum
11	Rate of 20 W LED tube light	350	Rs/unit
12	Investment required for 1142 tubes	399700	Rs lump sum
13	Simple Payback period	8.52	Months

7.2: Replacement of 14 Nos Old ACs by STAR Rated ACs:

During the Audit it was observed that there are about 14 Nos 1.5 TR capacity old ACs. It is recommended to replace these old ACs by BEE 5 STAR Rated ACs.

In the following Table, we present the saving potential, investment required and payback analysis.

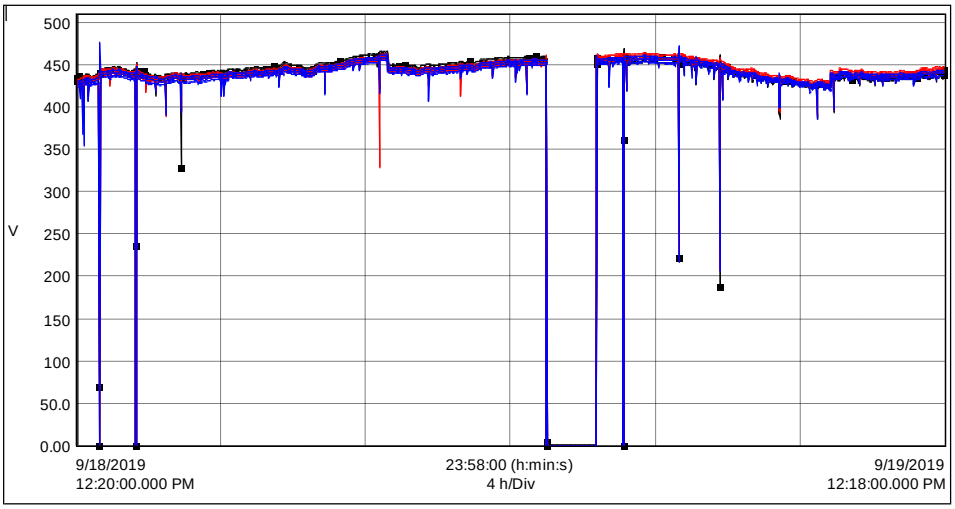
No	Particulars	Value	Unit
1	Present Qty of Old ACs	14	Nos
2	Energy Demand of Old A	2.325	kW/Unit
3	Energy Demand of STAR Rated AC	2.025	kW/Unit
4	Reduction in demand	0.3	kW/Unit
5	Average Daily Usage period	8	Hrs/Day
6	Daily saving in Energy	226.8	kWh/Day
7	Annual Working Days	280	Nos
8	Annual Energy Saving possible	63504	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	698544	Rs/Annum
11	Rate of STAR Rated AC	50000	Rs/unit
12	Investment required for 14 ACs	700000	Rs lump sum
13	Simple Payback period	12.03	Months

7.3 Summary:

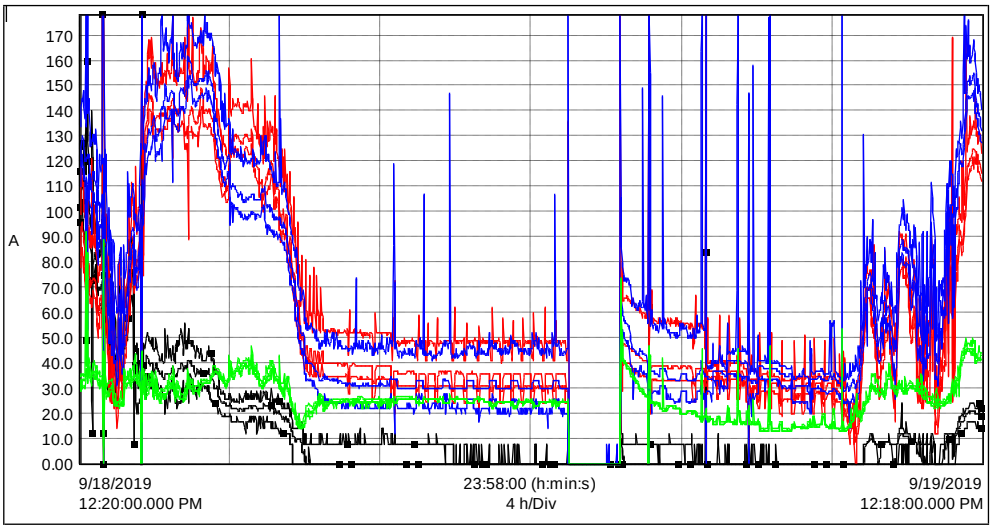
No	Recommendation	Annual Saving potential, kWh/Annum	Annual Monetary saving potential, Rs	Investment required, Rs	Simple payback period, Months
1	Replacement of 269 Nos T-8 fittings by 20 W LED fittings	18077	198847	94150	6
2	Replacement of 14 Nos Old ACs by STAR Rated ACs	63504	698544	700000	13
3	**Total**	**81581**	**897391**	**794150**	**11**

ANNEXURE

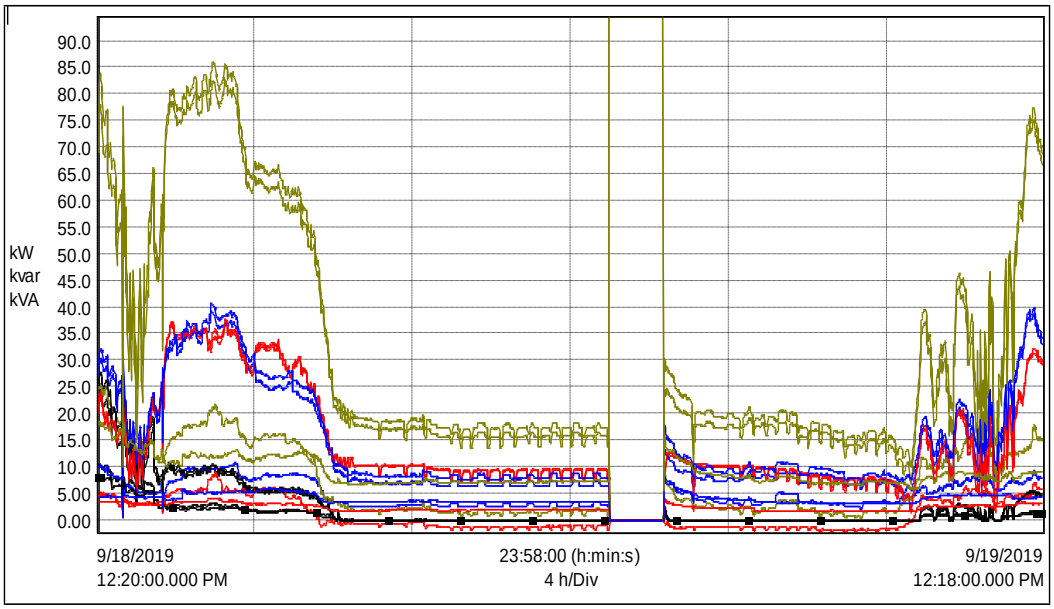
1 Voltage Variation:



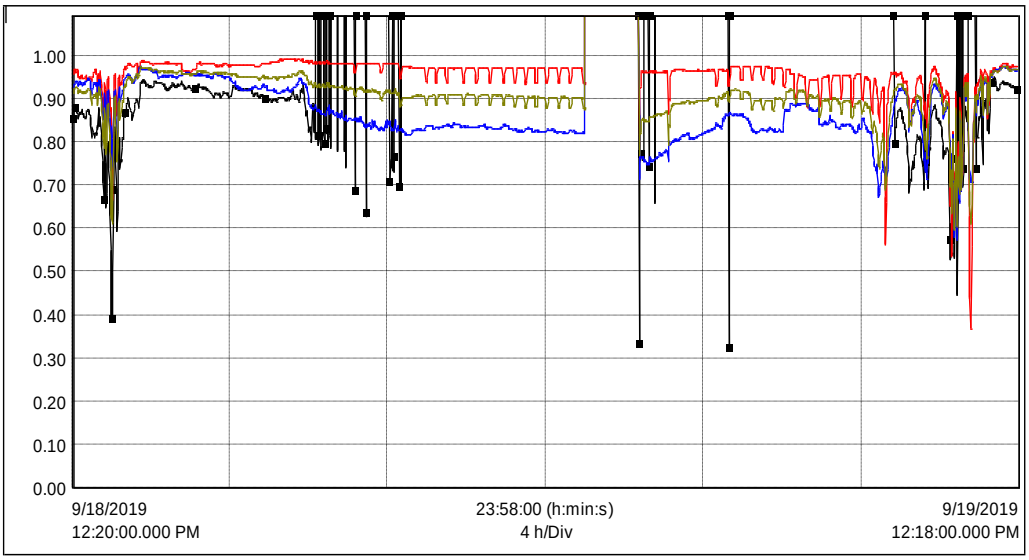
2. Current Variation:



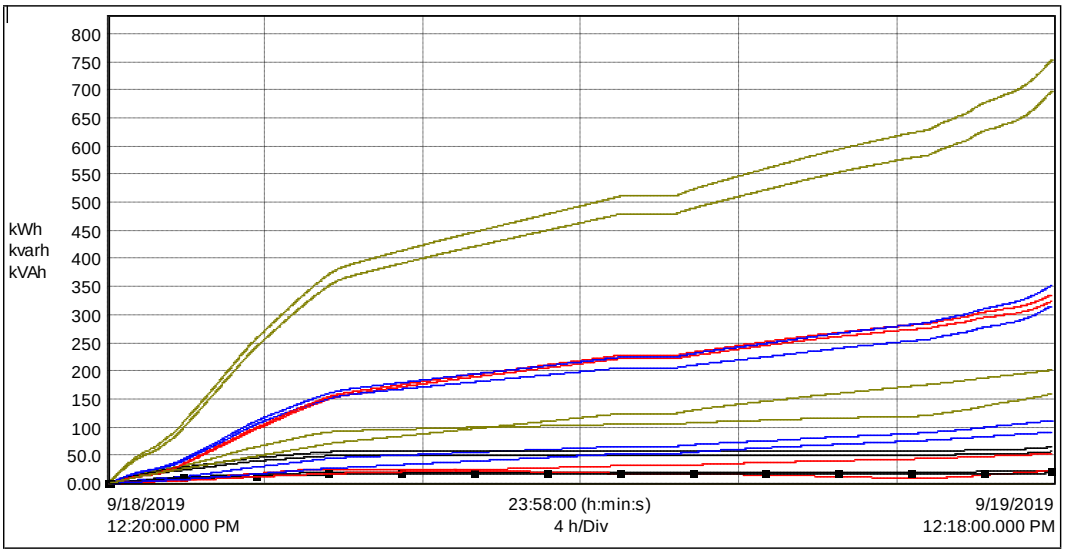
3. Power Variation:



4. Power Factor Variation:



5. Energy Consumption Variation:



6. Total Harmonic Distortion Variation: