

## **ADITI ENGINEERING SERVICES NASHIK**

**Firm Address- Flat No-5, Rajani Pandit Apartment, Mangalmurtinagar,  
Bodhalenagar,Nashik-422011**

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### **CERTIFICATE OF ENERGY AUDIT**

**This is to certify that R.B. N. B. College Shirampur-423609, Dist.-  
Ahmednagar, Maharashtra(India) has conducted **Energy Audit** in  
September 2016 for year 2016 - 2017 for knowing present profile of electrical  
energy consumption, Identification of energy conservation & saving  
opportunities for implementation to mitigate greenhouse gas emission for  
environmental protection.**



**Er. Deokar B. L.**

**Certified Energy Auditor EA-2700**

**(Bureau of Energy Efficiency Govt. of India)**

**Date-26 -10- 2016**

**Er. Deokar Bhausaheb**  
Certified Energy Auditor (BEE)  
Aditi Engineering Services, Nashik

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Ahmednagar, Maharashtra(India) has conducted Energy Audit in  
March 2018 for year 2017 - 2018 for knowing present electrical energy  
consumption, Identification of energy conservation & saving  
opportunities for implementation to mitigate greenhouse gas emission  
for environmental protection. This energy audit is also aimed to  
assess impact of installed various Renewable energy applications.**



**Er. Deokar B. L.**

**Certified Energy Auditor EA-2700**

**Date-28 -03- 2018**

**(Bureau of Energy Efficiency Govt. of India)**

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**Aditi Engineering Services, Nashik**

## Acknowledgement

Energy Audit of system is key instrument in knowing the present level of efficiency of various components and establishing the areas of shortfall for improvement.

We are very thankful for Hon. Principal Dr. K. H. Shinde (M.Com. Phd) R.B.N.B. College Shirampur Dist- Ahmednagar for having given opportunity to conduct Energy audit of various facilities in college campus. We are also thankful for Hon. Dr. S. P. Cholake Dr. Gunjal R.T., various respected HOD, Lecturers, Hostel Rectors & their respective subordinate staffs who have given their valuable contribution for guiding & supporting us during campus round for data collection, network study & measurement for accomplishing successful Energy audit.

This report made with sincere efforts gives details of the relevant data collected during energy audit study, observation, analysis & recommendations made pertaining to different facilities in campus.

Several Energy Conservation Opportunities( Measures) have been identified & proposed in course of our study & these options when implemented , are expected to bring in lasting benefits( saving) in term of energy as well as cost saving to the management.

We are pleased to submit this Detailed Energy Audit Report to Hon. Principal Dr. K. H. Shinde (M.Com. PhD) R.B.N.B. College Shirampur Dist- Ahmednagar representing on behalf of management of Rayat Shikshan sanstha Satara and wish him all the best for implementation of identified Energy Conservation Opportunity as well as recommendations after sincere study & observations.

Aditi Engineering services Nashik is willing to support management technically toward implementation of Energy Saving Measures for deriving energy conservation & cost effective benefits.

For Aditi Engineering services Nashik



Mr. B.L. Deokar

BEE Certified Energy Auditor & Team

**Er. Deokar Bhausaheb**  
Certified Energy Auditor (BEE)  
Aditi Engineering Services, Nashik

**Total percentage of LED lighting load in total lighting load**

Particulars	Total Lighting Requirement	Lighting met through LED bulb	Lighting through other type lamp
A) Load in KW	20.734	5.744	14.99
Percentage	100	27.70	72.30
B) Energy in KWH per year	49952	13975.68	35976.32
Percentage	100	27.98	72.02



Er. Deokar B. L.

Certified Energy Auditor( EA 2700)  
Aditi Engineering Services , Nasik

Date 3/12/2018

**Er. Deokar Bhausaheb**  
Certified Energy Auditor (BEE)  
Aditi Engineering Services, Nasik

**Percentage Of Annual Power Of College Met By Renewable Energy Sources**

Power requirement met by renewable energy source in KWH	Total power requirement in KWH	Renewable Energy source	Renewable energy generated & used in KWH	% of Renewable Energy on total requirement	Energy supply to grid
228243	324301	Solar photovoltaic panel	31641	9.76	Nil
		Solar LED street light	420	0.13	
		Solar water heater	155974	48.10	
		Turbo ventilator	40208	12.40	
228243	324301		228243	70.38	



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Date 3/12/2018

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Certified Energy Auditor (BEE)  
Aditi Engineering Services, Nasik

# **ENERGY AUDIT REPORT**



## **R. B. N. B. COLLEGE SHRIRAMPUR DIST- AHMEDNAGAR**

**ENERGY AUDITED DURING  
DT-6-03-2018 TO DT-9-03-2018**



**AUDITED BY  
ADITI ENGINEERING SERVICES NASHIK**



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Aditi Engineering services Nashik is willing to support management technically toward implementation of Energy Saving Measures for deriving energy conservation & cost effective benefits.

**For Aditi Engineering services Nashik**

Mr. B.L. Deokar

BEE Certified Energy Auditor & Team

## Energy Audit Team

Name	Company	Designation
Dr Shri- Pawar Kulbhushan	R.B.N. B. College Shrirampur	Assist professor
Dr Shri- Genudas Kakade	R.B.N. B. College Shrirampur	Assist professor
Shri- Desale D. S.	R.B.N. B. College Shrirampur	Laboratory Assistant
Er. Deokar Bhausheb & Team	Aditi Engineering Services Nashik	Certified Energy Auditor

# INDEX

Sr No	Particulars	Page No
	Acknowledgement	
	Audit Team	
1	Introduction	
	A. Scope of energy audit	
	B. Energy audit methodology	
	C. System study during energy audit	
2	Executive Summary	
	A) Average Cost of Power	
	B) Total percentage of LED lighting load in total lighting load	
	C) Green Energy application per year & CO2 emission reduction	
3	Analysis of Connected Load in Campus Other Than Motive Power	
4	Identified Energy Saving Opportunity	
	A) Energy Saving Opportunity Details	
	B) Compliance in year 2017-2018	
	C) Relief in Load on Split Air conditioner in instrument lab(senior)	
5	New introduction of solar Electrical power in campus	
6	Installation of turbo ventilator	
7	Solar Water Heater	
8	Total assessed updated annual energy requirement of college campus & Estimated Greenhouse Gas Reduction	
9	Awareness program & sign Board Display near switch board	
10	Electrical Safety Audit	
11	List of Instrument used for measurement in Energy Audit	



# **1. Introduction**

R.B.N. B. College is situated at Shrirampur in Ahmednagar District Maharashtra state. This college is affiliated with Savitribai Phule University Pune. This college is established in June 1975 by Rayat Shikshan Sanstha Satara, premier educational institution founded By Hon .Late Padmvibhushan Dr. Shri- Karmveer Bhaurao Patil veteran social activist which has been imparting higher education up to PG level in science & Art faculty. In addition to this college also provides education in M.C.V.C. Stream.

R.B.N. B. College campus consists of buildings named as Block- A, Block- C, Block –E, Block- F, Block-H Block-I in which administrative office , various HOD cabins ,staff rooms , classrooms , various laboratory like Physics, chemistry, botany, biology as well as MCVC laboratory various faculty departments are functioning with basic motto to impart quality , employment, entrepreneur and Agro oriented higher education to mostly rural as well as marginal urban student. Besides this there are multistoried hostel building identified by Block-O & Block- J1, J2 for facilitating student accommodation to many rural boys & girl students. This college also provides gymkhana facility to student undergoing through various type of physical education. There is also beautiful library building Block- D where student studying in various branches have facility to refer books. The college developed garden & teak wood plantation in campus.

## **A) Scope of Energy Audit-**

The task of energy audit undertaken by Aditi Engineering Services Nasik has objective to identify energy saving & conservation opportunity with electrical network & equipment load study with measurement & to recommend action plan with saving & financial calculation for implementation to materialize energy saving & conservation opportunity to save input energy cost. **The energy audit was conducted during 6-3-2018 to 9-3-2018 & reviewed implementation of energy saving & conservation opportunity already identified as well as quantified it.**

- 1) Inventory of various electrical load
- 2) MSEDCL bill study & working out average cost of power.
- 3) Identification of various energy conservation measures & saving opportunity.
- 4) Review of Awareness program if any for optimum use of electricity & water as well as its saving.
- 5) Review of implemented non-conventional energy installation & applications in college campus & its quantification.

## **B) ENERGY AUDIT METHODOLOGY:-**

The audit involves visiting physical position of load & carry out inventory of load. Due measurement of electrical load of equipment & circuit is carried out. Energy bill received from MSEDCL is audited & studied for KWH requirement & how efficiently energy is used. Various positions are interacted, familiarized with energy audit & involved for successful & result oriented energy audit. Energy conservation & saving opportunities are identified during round & measurement for implementation

## **C) SYSTEMS STUDIED DURING ENERGY AUDIT:-**

- 1) Lighting fixtures have been physically in various campuses verified & recorded.
- 2) Reviewed implemented non-conventional energy installation & applications in college for use.
- 3) Electricity bills served by MSEDCL are verified & worked out cost of power

4) It is reviewed about Awareness program if any for optimum use of electricity & water as well as its saving undertaken at college level. There is tremendous scope to create awareness among user about efficient & optimum use of energy & water to save. Instruction cum Request Sign board shall be displayed near each switch-board & toilet block, bathrooms to influence & guide to user to arrest misuse & wastage of power & water.

## **2. Executive Summary**

R.B.N. B. College has been imparting higher education to Junior & senior level student in science & Art faculty. It uses majorly electricity as input energy source for application of various college activities. The electricity is procured from MSEDCL by various 18 No LT connection (single phase & three phase) located in various college building. MSEDCL serves monthly electricity bill for payment & on receipt of monthly electricity bill it is paid. Standby power source DG set of 45 KVA is available to use during power failure from MSEDCL.

### **A) Average Cost of Power-**

There are various type of electricity connection being power supplied by MSEDCL. Monthly electricity bill is served by MSEDCL against electricity used & is paid by college. **A cost of power is worked out by summing up total KWH of all connections & their amount. By dividing total amount by total KWH works out average cost of power per KWH.**

Month	Connection No & Tarrif category									
	850710613285		850710399615		850710403442		850710399569		850710408525	
	Tarrif-LT II A		Tarrif-LT XB		Tarrif-LT X B		Tarrif-LT II Com		Tarrif-LT X B	
	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs
Dec-17	857	10278	799	6200	350	3050	83	850	1393	13050
Jan-18	1584	19583	1253	9930	350	3170	126	1190	1393	13530
Feb-18	861	10754	824	6520	350	3160	94	950	1393	13550
Total	3302	40615	2876	22650	1050	9380	303	2990	4179	40130

Month	Connection No & Tariff category						Total	Average Cost of power in Rs per KWH	
	850710489711		850710407260		850710399623				
	LT V B I		LTX B		LTX B				
	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs	
Dec-17	1832	11181	1423	13470	661	6040	7398	64119	8.7

Jan-18	1767	13334	2022	19650	661	6250	9156	86637	9.5
Feb-18	2844	18080	2504	25540	661	6260	9531	84814	8.9
Total	6443	42595	5949	58660	1983	18550	26085	235570	<b>9.0</b>

**Average cost of power per KWH works out to be Rs- 9.00/KWH**

**B) Total percentage of LED lighting load in total lighting load- 27.70 %**

Particulars	Total Lighting Requirement	Lighting met through LED bulb	Lighting through other type lamp
A) Load in KW	20.734	5.744	14.99
Percentage	100	27.70	72.30
B) Energy in KWH per year	49952	13975.68	35976.32
Percentage	100	27.98	72.02

**C) Percentage Of Annual Power Of College Met By Renewable Energy Sources -**

Power requirement met by renewable energy source in KWH	Total power requirement in KWH	Renewable Energy source	Renewable energy generated & used in KWH	% of Renewable Energy on total requirement	Energy supply to grid
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		Turbo ventilator	40208	12.40	
<b>228243</b>	<b>324301</b>		<b>228243</b>	<b>70.38</b>	

## D) Green Energy application per year & CO2 emission reduction

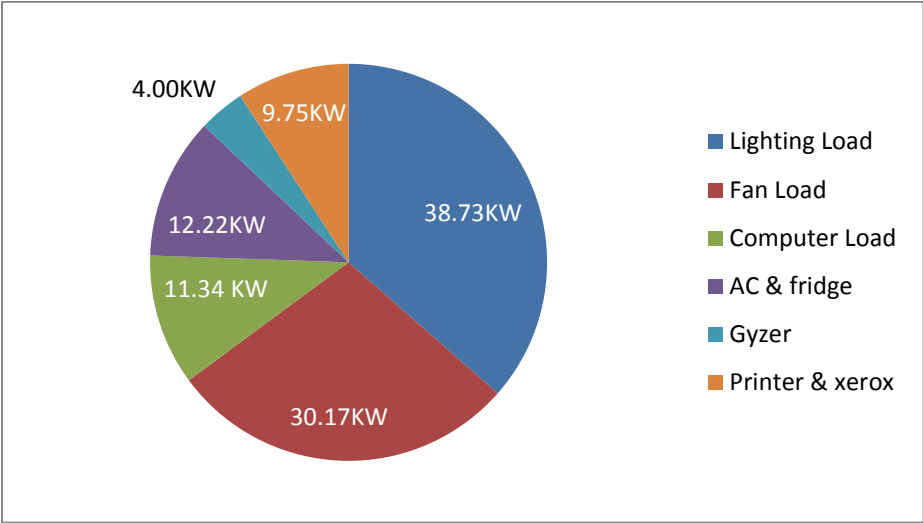
<b>Total annual Energy requirement KWH</b>	<b>318415</b>
<b>Total application of green Energy in KWH</b>	<b>222357</b>
<b>% on total requirement</b>	<b>70%</b>
<b>Estimated CO2 Green House Gas Emission reduction per year in Ton</b>	<b>189</b>

## 3) Analysis of Connected Load in Campus Other Than Motive Power –

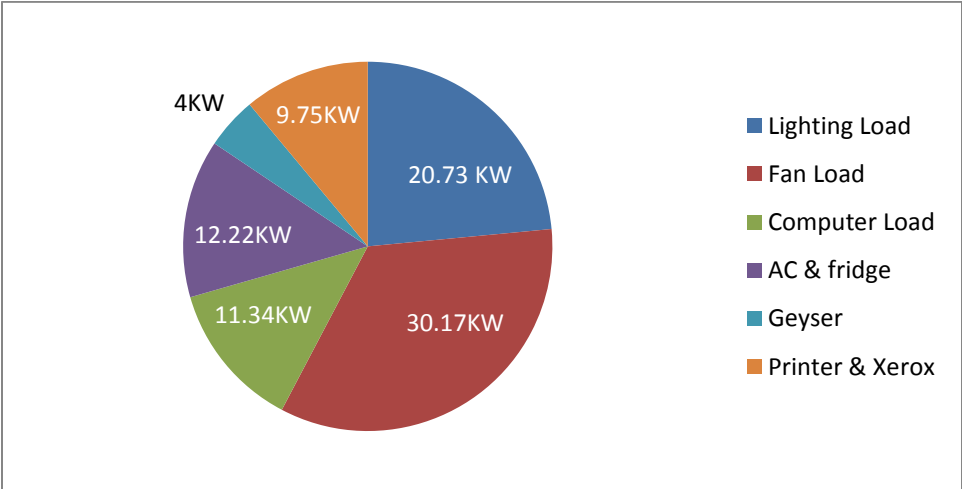
As Viewed from below table, it understands that lighting & fan load has dominance in total load mix & shares more electrical consumption. This load has most potential to identify energy saving opportunity. College has been taking initiative in energy conservation & energy saving work. As part of this college has replaced CFL down light, FTL & incandescent lamp with LED down light & LED Tube light during year 2017-2018. Hence it appears reduced lighting Load in PIE chart given below.

Type	Earlier			Existing		
	No	Total KW	% Load	No	Total KW	% Load
<b>Lighting Load</b>	<b>944</b>	<b>38.73</b>	<b>36.47</b>	<b>981</b>	<b>20.73</b>	<b>23.50</b>
Fan Load	436	30.17	28.41	436	30.17	34.20
Computer Load	189	11.34	10.68	189	11.34	12.86
AC & fridge	11	12.22	11.51	11	12.22	13.85
Geyser	2	4	3.77	2	4	4.53
Printer & Xerox	19	9.75	9.18	19	9.75	11.05
	1601	106.21	100.00	1638	88.21	100.00

### Earlier Load Mix



### Existing Load Mix



## 4) Identified Energy Saving opportunity & Compliance –

### A) Energy Saving Opportunity Details –

There is major load of lighting & fan in college campus. Hence it is focused for identification of energy saving opportunity. Energy saving & conservation opportunities are identified which are mentioned below with cost benefit analysis based on revised average cost of power. Lowest pay back option shall be implemented on priority.

Existing equipment details				Proposed replacement with				Saving in		Capital investment in Rs	Payback period in years
Equipment	No	Watt per No	Total Watts	Equipment	No	Watt per No	Total Watts	KWH per year	cost Rs		
Incandescent Lamp	4	60	240	CFL	4	5	20	528	4752	360	<b>0.08</b>
Ceiling fan Regulator ( Resistance type) at position No- 1	32	47.6	1523.2	Electronic Regulator	32	28.4	908.8	1474.56	13271.04	11200	<b>0.84</b>
Metal Halide Lamp fitting	5	400	2000	LED flood Light fixture	5	70	350	3960	35640	17500	<b>0.49</b>
CFL Down -light	130	25	3250	LED Down Light	130	15	1950	3120	28080	77870	<b>2.77</b>
FTL T8	210	36	7560	T5 LED Tube light	210	18	3780	9072	81648	78750	<b>0.58</b>
T12	330	40	13200	T5 LED Tube light	330	18	5940	17424	156816	123750	<b>0.58</b>
FTL Choke			0				0	0	0	0	
Magnetic	238	15	3570	nil			0	8568	77112		
Electronic	302	5	1510	nil			0	3624	32616		
<b>Total</b>			<b>32853</b>				<b>12949</b>	<b>19904</b>	<b>429935</b>	<b>309430</b>	<b>0.72</b>

Note- Half of total saving by each type of tube ballast is added in saving of FTL replacement for working out pay-back period

**Average cost of power Rs/KWH- 9**, Operation hours per day- 8 No, Operation day per year-300 ,

Cost of-1) CFL 5W /No Rs-90, Electronic regulator Rs/No-350, LED down light 18 W/ No- 599, LED Flood light Rs/No-3500, LED tube light Rs/No-375

## B) Compliance in year 2017-2018

College has been taking initiative in energy conservation & energy saving work. As part of this college has replaced CFL down light, FTL & incandescent lamp with LED down light & LED Tube light during year 2017-2018. Hence it appears reduced lighting Load in PIE chart. New solar street light brackets has been also added during year 2017-2018 . Estimated saving of this work is reassessed as below

Existing Lighting fixture details				Replacement work carried out with				Saving in	Saving in per year (300 days)	Saving per year cost in Rs	Capital investment in Rs	Pay back period in years
Lamp	No	Watt/Unit	Total Watts	Lamp	No	Watt/Unit	Total Watts	watt	KWH			
Incandescent Lamp	4	60	240	LED Lamp	4	12	48	192	460.8	4147.2	820	0.20
CFL Down - light	130	25	3250	LED Lamp	130	12	1560	1690	4056	36504	26650	0.73
FTL T8	170	36	6120	LED Lamp	170	12	2040	4080	9792	88128	34850	0.40
T12	100	40	4000	T5 LED Tube light	100	20	2000	2000	4800	43200	34500	0.80
FTL Choke			0				0	0	0	0	0	
Magnetic	170	15	2550	nil			0	2550	6120	55080	0	
Electronic	100	5	500	nil			0	500	1200	10800	0	
			16660				5648	11012	26428.8	237859.2	0	

Cost of LED Down light in Rs 205

Cost of LED Tube light per unit in Rs 345

Cost of power per KWH in Rs 9

### Percentage of LED Light Load in Total Lighting Load

Total percentage of various type lighting load based on total lighting load is worked out for information.



Type of Lamp	No	Watt per Unit	Total Lighting Load			Total KWH per year	
			Watts	% on Total	Total LED light Load % on total	KWH	% on Total
Incondascent Lamp	0	0	0	0.00		0	0.00
Metal Halide Lamp fitting	5	400	2000	9.65		4800	9.61
<b>LED light</b>	<b>304</b>	<b>12</b>	<b>3648</b>	<b>17.59</b>	<b>17.59</b>	<b>8755.2</b>	<b>17.53</b>
FTL T8	40	36	1440	6.95		3456	6.92
T12	230	40	9200	44.37		22080	44.20
FTL Choke							
Magnetic	100	15	1500	7.23		3600	7.21
Electronic	170	5	850	4.10		2040	4.08
<b>T5 LED Tubelight</b>	<b>100</b>	<b>20</b>	<b>2000</b>	<b>9.65</b>	<b>9.65</b>	<b>4800</b>	<b>9.61</b>
<b>LED Solar Street Light fixture</b>	<b>32</b>	<b>3</b>	<b>96</b>	<b>0.46</b>	<b>0.46</b>	<b>420.5</b>	<b>0.84</b>
<b>Total</b>	<b>981</b>		<b>20734</b>	<b>100</b>	<b>27.70</b>	<b>49952</b>	<b>100</b>

Particulars	Total Lighting Requirement	Lighting met through LED bulb	Lighting through other type lamp
A) Load in KW	20.734	5.744	14.99
Percentage	100	27.70	72.30
B) Energy in KWH per year	49952	13975.68	35976.32
Percentage	100	27.98	72.02

**Total percentage of LED lighting load in total lighting load 27.70 %**

### **C) Relief in Load on Split Air conditioner in instrument laboratory (senior)-**

There are some instrument placed requiring maintained temperature in lab. If instrument are shifted one side & room is partitioned for making confined space for instrument, one Split AC will be spared & electricity will be saved as below.

AC Rating in Watt	Operation Hours per day	Operation days per year	Total KWH consumption per year	Average cost of tariff Rs/KWH	Total operating cost Rs per year
1250	15	365	<b>5475</b>	9	<b>49275</b>

### **5) New introduction of solar Electrical power in campus-**

As moved around in earlier energy audit, there was identified immense potential in campus to introduce solar power in total power mix. There is lot of useful roof top available in campus for installation of solar panel. Same potential has been utilized during 2017-2018 year by college to generate & utilize solar electric power in campus for own use in progressive manner. Almost installation have been completed & commissioned. This is very commendable step in energy sector taken by college. Details are given as below.

Sr No	Roof Top Location	Details of Solar panel installed				Capacity factor	Assessed Annual energy generation in KWH	Average cost of utility power Rs/KWH	Total Assessed Annual cost saving in Rs
		Make	Watt/panel	No of panel	Total installed Generation capacity in KWp				
1	MVC Building	Jain Irrigation System	315	64	20.16	20%	11773	9	105961
2	Chemistry Laboratory	Jain Irrigation System	315	16	5.04	20%	2943	9	26490.2
3	J2 Ladies Hostel	Jain Irrigation System	315	51	16.065	20%	9382	9	84437.6
4	Principal Bungalow	Jain Irrigation System	315	9	2.835	20%	1656	9	14900.8
5	Administrative building	Jain Irrigation	315	32	10.08	20%	<b>5887</b>	9	<b>52980.5</b>

	Rooftop	System							
		Total	315	140	44.1	20%	31641	9	284770

**Assessed Annual energy generation in KWH 31641**

**Total Assessed Annual Energy cost saving in Rs 284770**

**The installed solar power generation has following benefits to college-**

- 1) This is generating green power mitigating greenhouse gas emission for protection of environment as well as it is conserving conventional energy resources.
- 2) This mode of power generation saves energy cost for purchasing power from MSEDCL & overcome dependency on utility power supply.
- 3) This also helps to student as demonstrative model for studying to imbibe technical knowledge

## **6) Installation of turbo ventilator -**

College management has installed turbo ventilator for ventilation of various halls in college campus. These turbo ventilators absorb pressure energy from blowing natural air & convert into velocity of buckets of turbo ventilator to rotate it about axis. [In this way green energy is used](#) .If college management had installed electrical exhaust fan in halls, operational cost of these fans would have been spent by management. So this requiring energy & operational cost is saved as well as CO2 emission resulting from this energy use is also reduced to protect environment. This is illustrated as below.

No of turbo ventilator installed	Turbo ventilator Working hours per day	If expulsion of air from hall would have done with electrical exhaust fan						
	No of Hrs	No of fan	Wattage of each fan	Total watt	Total working hrs per year	Total KWH required per year	Cost of power Rs/KWH	Amount per year in Rs
51	24	51	90	4590	8760	40208	9	361876

**Assessed Annual energy saving in KWH 40208**

**Total Assessed Annual Energy cost saving in Rs 361876**

## **7) Solar Water Heater-**

College has installed solar water heater in boys & Girls hostel to harness cost free solar green energy for heating water requiring to be bathed by student. This reduces demand of conventional commercial energy. This will also help to reduce greenhouse gas emission mitigating environmental damage. Application of this hot water in various laboratory can be explored which is generated without input energy cost.

Sr No	Solar Heater( SH) Location	No of Student occupancy	No of Solar Heaters	Each SH Capacity in Ltrs/Day	Average Water Temperature		Total Solar Heat gained by water per Day in Kcal	Equivalent Electricity saving in KWH per year	Average Electricity Cost in Rs/KWH	Electricity Cost saving in Rs per year
					Hot (Out)	Cold (In)				
1	Ladies Hostel- J1	40	1	1500	70	35	52500	22281.98	9	200537.79
2	Ladies Hostel- J2	208	2	1500	70	35	105000	44563.95	9	401075.58
3	Ladies Hostel- J3	152	2	1500	70	35	105000	44563.95	9	401075.58
4	Boys Hostel	192	2	1500	70	35	105000	44563.95	9	401075.58
		592	7				367500	<b>155973.84</b>		<b>1403764.53</b>

## **8) Total assessed updated annual energy requirement of college campus & Estimated Green House Gas Reduction**

Total annual energy requirement of college campus is assessed based on various energy generating & supplying sources. As solar power generating installations have been commissioned almost, generated solar power shares total requirement. Similarly turbo ventilators are working on natural blowing air. Present input power mix scenario is given below.

Sr No	Input Energy Mix	Unit	Quantity	% on Total	Type of energy	Estimated CO2 Green House Gas Emission reduction per year in Kg
1	Total annual Electrical Energy requirement from MSEDCL in KWH	KWH	96058	29.62	Conventional	0
2	Assessed added Annual solar power generation	KWH	31641	9.76	Non-conventional	26895
3	Annual Electrical Equivalent Solar energy used for heating water through solar heater	KWH	155974	48.10	Non - conventional	132578
4	Annual Solar energy used for LED Solar Street Light	KWH	420	0.13	Non-conventional	357
5	Saving of electrical energy from turbo ventilator	KWH	40208	12.40	Non - conventional	34177
<b>Total annual Energy requirement</b>		<b>KWH</b>	<b>324301</b>	<b>100</b>		<b>194007</b>

**Total annual Energy requirement KWH 324301**

**Total application of green Energy in KWH 228243**

**% on total requirement 70.38 %**

**Estimated CO2 Green House Gas Emission reduction per year in Ton 194**

## 9) **Awareness program & sign Board Display near switch board.**

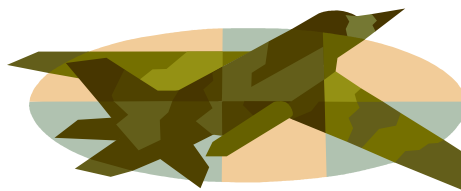
It is reviewed about Awareness program if any undertaken at college level for optimum use of electricity & water as well as its saving. There is still tremendous scope to create awareness among user about efficient & optimum use of energy & water to save. Instruction cum Request Sign board shall be displayed near each switch-board, toilet block & bathrooms to influence & guide to user to arrest misuse & wastage of power & water.

## 10) **Electrical Safety Audit -**

Considering huge human occupancy in building Electrical Safety Audit is recommended to identify unsafe location & condition to comply to ensure electrical safety with human being, property & equipment. **This is very serious thing & is priority issue.**

## **11) List Of Instrument used for measurement in Energy Audit**

<b>Sr No</b>	<b>Instrument Name</b>
1	3- Phase Electric Power Analyzer
2	Lux Meter
3	Thermometer & Hygrometer
4	Measuring steel tape
5	IR Thermometer



# **THANKS**



# **ENERGY AUDIT REPORT**

## **R. B. N. B. COLLEGE SHRIRAMPUR DIST- AHMEDNAGAR**

**ENERGY AUDITED DURING  
DT-14-09-2016 TO DT-16-09-2016**

**AUDITED BY  
ADITI ENGINEERING SERVICES NASHIK**

**(Total Pages-18 No)**

## **Acknowledgement**

Energy Audit of system is key instrument in knowing the present level of efficiency of various components and establishing the areas of shortfall for improvement.

We are very thankful for Hon. Principal Dr. K. H. Shinde (M.Com. Phd) R.B.N.B. College Shrirampur Dist- Ahmednagar for having given opportunity to conduct Energy audit of various facilities in college campus. We are also thankful for Hon. Dr. S. P. Cholake Dr. Gunjal R., various respected HOD, Lecturers, Hostel Rectors & their respective subordinate staffs who have given their valuable contribution for guiding & supporting us during campus round for data collection, network study & measurement for accomplishing successful Energy audit.

This report made with sincere efforts gives details of the relevant data collected during energy audit study, observation, analysis & recommendations made pertaining to different facilities in campus.

Several Energy Conservation Opportunities( Measures) have been identified & proposed in course of our study & these options when implemented , are expected to bring in lasting benefits( saving) in term of energy as well as cost saving to the management.

We are pleased to submit this Detailed Energy Audit Report to Hon. Principal Dr. K. H. Shinde (M.Com. PhD) R.B.N.B. College Shrirampur Dist- Ahmednagar representing on behalf of management of Rayat Shikshan sanstha Satara and wish him all the best for implementation of identified Energy Conservation Opportunity as well as recommendations after sincere study & observations.

Aditi Engineering services Nashik is willing to support management technically toward implementation of Energy Saving Measures for deriving energy conservation & cost effective benefits.

**For Aditi Engineering services Nashik**

Mr. B.L. Deokar

BEE Certified Energy Auditor & Team

## Energy Audit Team

Name	Company	Designation
Dr. Shri- Cholake S. P.	R.B.N. B. College Shrirampur	Geography Department
Shri- Desale	R.B.N. B. College Shrirampur	Physics Depart.
Er. Deokar Bhausahab & Team	Aditi Engineering Services Nashik	Energy Auditor

# INDEX

Acknowledgement

Audit Team

1. Introduction
  - A. Scope of energy audit
  - B. Energy audit methodology
  - C. System study during energy audit
2. Executive Summary
  - 1) Identified Energy saving opportunity
  - 2) Average Cost of Power
  - 3) Tariff category comparison study
- 3 Analysis of Connected Load in Campus Other Than Motive Power
- 4 Identified Energy Saving Opportunity
  - A) Energy Saving Opportunity Details
    - B) Relief in Load on Split Air conditioner in instrument lab(senior)
  - C) Scope for introduction of solar power
  - D) Rain Water Harvesting
  - E) Solar Water Heater
  - F) Solar Street Light
  - G) Awareness program & sign Board Display near switch board
  - H) Electrical Safety Audit
- 5) Motor Pump Set Load Study
- 6) Power & Harmonics measurement of computer Laboratory
- 7) Power Losses measured in operation of UPS
- 8) Illumination measurement & study
- 9) Observation & Recommendation
- 10) List Of Instrument used for measurement in Energy Audit

# **1. Introduction**

R.B.N. B. College is situated at Shrirampur in Ahmednagar District Maharashtra state. This college is affiliated with Savitribai Phule University Pune. This college is established in June 1975 by Rayat Shikshan Sanstha Satara, premier educational institution founded by Hon. Late Padmavibhushan Dr. Shri- Karmveer Bhaurao Patil veteran social activist which has been imparting higher education up to PG level in science & Art faculty. In addition to this college also provides education in M.C.V.C. Stream.

R.B.N. B. College campus consists of buildings named as Block- A, Block- C, Block –E, Block- F, Block-H Block-I in which administrative office, various HOD cabins, staff rooms, classrooms, various laboratory like Physics, chemistry, botany, biology as well as MCVC laboratory various faculty departments are functioning with basic motto to impart quality, employment, entrepreneur and Agro oriented higher education to mostly rural as well as marginal urban student. Besides this there are multistoried hostel building identified by Block-O & Block- J1, J2 for facilitating student accommodation to many rural boys & girl students. This college also provides gymkhana facility to student undergoing through various type of physical education. There is also beautiful library building Block- D where student studying in various branches have facility to refer books. The college developed garden & teak wood plantation in campus.

## **A) Scope of Audit-**

The task of energy audit undertaken by Aditi Engineering Services Nasik has objective to identify energy saving & conservation opportunity with electrical network load study, measurement & to recommend action plan with saving & financial calculation for implementation to materialize energy saving & improvement.

- 1) Inventory of various electrical load
- 2) Illumination level measurement wherever it needs.
- 3) MSEDCL bill study & working out average cost of power.
- 4) Water pumping motor load measurement to study motor loading.
- 5) UPS Loading Study & Harmonics measurement.
- 6) Identification of various energy conservation measures & saving opportunity.
- 7) To give recommendation based on study & observations for implementation
- 8) Review of Awareness program if any for optimum use of electricity & water as well as its saving.
- 9) Review of non-conventional energy application in college campus

## **B) ENERGY AUDIT METHODOLOGY:-**

The audit involves visiting physical position of load & carry out inventory of load. Due measurement of electrical load of equipment & circuit is carried out. Energy bill received from MSEDCL is audited & studied for KWH requirement & how efficiently energy is used. Various positions are interacted, familiarized with energy audit & involved for successful & result oriented energy audit. Energy conservation & saving opportunities are identified during round & measurement for implementation

## **C) SYSTEMS STUDIED DURING ENERGY AUDIT:-**

- 1) Lighting fixtures have been physically verified & recorded in various campuses.
- 2) Exhaust fans & ceiling fan physically verified & recorded.
- 3) Split Air Conditioner Physically verified & recorded.
- 4) Bore well motor load measurement for motor loading study with Power Analyzer.
- 5) Illumination measurement with Lux Meter in various places to determine adequacy of illumination

- 6) UPS Load Measurement & Power Harmonic study
- 7) Reviewed non-conventional energy introduction in college for use.
- 8) Electricity bills served by MSEDCL are verified & worked out cost of power
- 9) It is reviewed about Awareness program if any for optimum use of electricity & water as well as its saving undertaken at college level. There is tremendous scope to create awareness among user about efficient & optimum use of energy & water to save. Instruction cum Request Sign board shall be displayed near each switch-board & toilet block, bathrooms to influence & guide to user to arrest misuse & wastage of power & water.

## **2. Executive Summary**

R.B.N. B. College has been imparting higher education to Junior & senior level student in science & Art faculty. It uses majorly electricity as input energy source for application of various college activities. The electricity is procured from MSEDCL by various 18No LT connection (single phase & three phase) located in various college building. MSEDCL serves monthly electricity bill for payment & on receipt of monthly electricity bill it is paid. Standby power source DG set of 45 KVA is available to use during power failure from MSEDCL.

**1) Identified Energy saving opportunity-** The energy consuming system & load are studied & measured for identifying energy saving & conservation opportunity. Details of same are given below with cost benefit analysis. After implementation of energy saving opportunities identified, estimated energy & cost saving will be obtained.

Sr No	Energy Saving opportunity	No	Total yearly expected KWH saving	Total yearly expected cost saving in Rs	Capital investment in Rs	Pay-back period in years
1	Incandescent Lamp replacement with CFL	4	528	4514	360	0.08
2	Ceiling fan Regulator (Resistance type) replacement with electronic regulator	32	1475	12607	11200	.089

3	Metal Halide Lamp fitting replacement with LED flood light	5	3960	33858	17500	0.52
4	CFL Down -light replacement with LED downlight	130	3120	26676	195000	7.31
5	FTL replacement with T5 LED tube light	210	9072	77566	147000	1.13
	T8	330	20592	176062	231000	1.01
	T12					
6	FTL choke replacement					
	Magnetic	238	8568	73256	-	
	Electronic	302	3624	30985		
			50939	435524	602060	

Note- Half of each total saving by tube ballast is added in saving of FTL replacement for working out pay-back period

**2) Average Cost of Power-** There is eighteen number of various type of electricity connection being power supplied by MSEDCL. Monthly electricity bill is served by MSEDCL against electricity used & is paid by college. **A cost of power is worked out by summing up total KWH of all connections & their amount over the year 2015-16. By dividing total amount by total KWH works out average cost of power per KWH.**

Month	Connection No & Tariff category					
	850710399569	850710399577	850710402152	850710403434	850710407260	850710400869
	LT II Com	LTX B	LT I Res	LT I Res	LTX B	LT I Res



	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs
Feb-16	0	0	0	0	613	6475.53	11	94.76	1376	12566.34	133	1183.57
Jan-16	0	0	0	0	521	5148.42	14	106.97	2250	20193	121	1096.63
Dec-15	111	1063.56	0	0	592	6381.29	14	109.66	2086	20387.43	450	1509.31
Nov-15	16	341.57	10	276.8	376	3374.97	20	140.69	894	8517.89	50	305.16
Oct-15	242	2200.38	112	856.32	979	12069.89	22	143.75	2812	27602.09	50	305.16
Sep-15	314	2834.61	154	1064.69	898	10323.91	15	110.96	2552	24336.7	50	273.71
Aug-15	320	2897.36	146	1020.81	882	10099.25	18	123.15	2531	24133.45	0	0
Jul-15	186	1521.83	81	660.75	672	6757.64	17	116.79	1773	16682.39	0	0
Jun-15	111	986.55	37	420.99	499	4317.62	21	131	1238	11618.69	0	0
Total	1300	11845.9	540	4300.36	6032	64948.52	152	1077.73	17512	166038	854	4673.54

Month	Connection No & Tariff category											
	850710399607		850710405941		850710399615		850710403442		850710399577		850710399623	
	LT II Com		LT I Res		LTX B		LTX B		LTX B		LTX B	
	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs
Feb-16	55	747	205	1265	521	3765.95	292	2418.05	0	0	0	0
Jan-16	55	747.42	274	1803.71	480	3447.61	292	2418.05	0	0	0	0
Dec-15	0	0	271	1863.51	621	3511.9	292	2552.45	0	0	699	6598.65
Nov-15	0	0	277	1900.62	50	504	292	2552.26	10	276.8	699	6598
Oct-15	0	0	226	1498.4	0	0	292	2552.26	112	856.32	2096	9363.81
Sep-15	0	0	225	1399.48	2	230.97	292	2480.68	154	1064.69	574	5210
Aug-15	0	0	218	1360.69	0	220	292	2480.68	146	1020.81	574	5210.13
Jul-15	55	731.07	193	1108.55	0	220	292	2462.95	81	660.75	2295	7083.83
Jun-15	55	724.89	258	1540.88	17	314.36	292	2472.65	37	420.99	498	4462.49
Total	220	2950.38	2147	13740.8	1691	12214.79	2628	22390	540	4300.36	7435	44526.91

Month	Connection No & Tariff category							
	LT con. No-850710613285		LT con. No-850710588558		LT con. No-850710647201		LT con. No-850710489711	
	Tariff-LT II A	Load KVA-10	Tariff-LT I Res	Load KVA-0.5	Tariff-LT V B	Load KVA-5	Tariff-LT v B	Load KVA-5
	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs
Feb-16	825	10012.74	23	282.56	97	2763.18	3315	21766.79

Jan-16	941	11472.61	21	273.12	121	1708.91	3890	25500.62
Dec-15	677	8286.92	18	262.98	219	3030	2575	17509.34
Nov-15	709	8849.94	12	233.32	89	1500	3170	21530
Oct-15	1313	16833	36	351.96	75	1269.86	2002	13682
Sep-15	1334	16315.11	33	329.57	128	1900.44	2732	18279.32
Aug-15	1207	14710.11	49	405	84	1319.39	3588	23931.33
Jul-15	1327	15550.84	21	1359.7	84	680	3307	22240
Jun-15	976	10494.28			35	708.59	4406	29503.56
Total	9309	112525.55	213	3498.21	932	14880.37	28985	193943

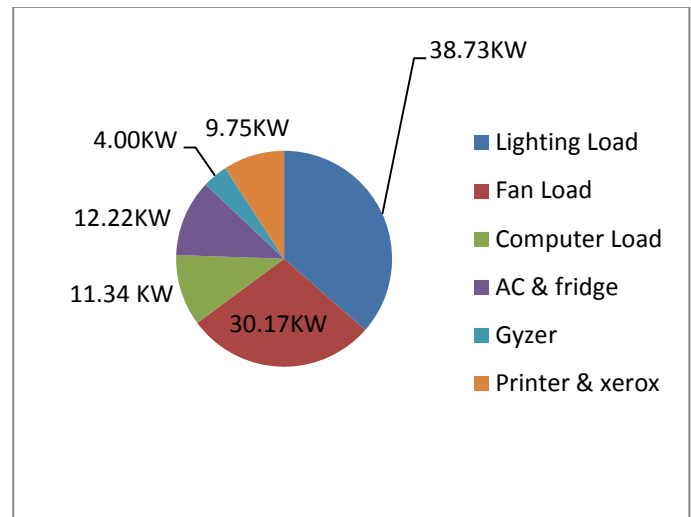
Month	850710408525		850710399585		Total of all connections		Average cost of power Rs/KWH
	LTX B		LT II Com				
	KWH	Bill amount Rs	KWH	Bill amount Rs	KWH	Bill amount Rs	
Feb-16	1161	10567.64	12	306.94	8639	74216.1	8.59
Jan-16	1161	10567.64	11	299.69	10152	84784.4	8.35
Dec-15	1161	11191.33	10	296	9796	84554.3	8.63
Nov-15	1161	11190.48	6	265.69	7841	68358.2	8.72
Oct-15	1161	11190.48	19	364.36	11549	101140	8.76
Sep-15	1161	10891.66	20	364.19	10638	97410.7	9.16
Aug-15	1161	10891.66	29	429.07	11245	100253	8.92
Jul-15	1161	10806.44	29	422.97	11574	89066.5	7.70
Jun-15	1161	10806.44	10	287.14	9651	79211.1	8.21
Total	10449	98103.77	146	3036.05	91085	778994	8.55

**Average cost of power per KWH works out to be Rs- 8.55/KWH**

### 3) Analysis of Connected Load in Campus Other Than Motive Power –

As Viewed from below table, it understands that lighting & fan load has dominance in total load mix & shares more electrical consumption. This load has most potential to identify energy saving opportunity.

Type	No	Total KW	% Load
Lighting Load	944	38.73	36.47
Fan Load	436	30.17	28.41
Computer Load	189	11.34	10.68
AC & fridge	11	12.22	11.51
Geyser	2	4.00	3.77
Printer & Xerox	19	9.75	9.18
	1601	106.21	100



### 4) Identified Energy Saving opportunity –

#### A) Energy Saving Opportunity Details –

There is major load of lighting & fan in college campus. Hence it is focused for identification of energy saving opportunity. Energy saving & conservation opportunities are identified which are mentioned below with cost benefit analysis. Lowest pay back option shall be implemented on priority.

Existing equipment details				Proposed replacement with				Saving in		Capital investment in Rs	Pay back period in years
Equipment	No	Watt per No	Total Watts	Equipment	No	Watt per No	Total Watts	KWH per year	cost Rs		
Incandescent Lamp	4	60	240	CFL	4	5	20	528	4514.4	360	0.08
Ceiling fan Regulator (Resistance type) at position No- 1	32	47.6	1523.2	Electronic Regulator	32	28.4	908.8	1474.56	12607.488	11200	0.89
Metal Halide Lamp fitting	5	400	2000	LED flood Light fixture	5	70	450	3960	33858	17500	0.52
CFL Down - light	130	25	3250	LED Down Light	130	15	1950	3120	26676	195000	7.31

FTL T8	210	36	7560	T5 LED Tube light	210	18	3780	9072	77565.6	147000	1.13
T12	330	44	14520	T5 LED Tube light	330	18	5940	20592	176061.6	231000	1.01
FTL Choke			0				0	0	0	0	
Magnetic	238	15	3570	nil			0	8568	73256.4	0	0.00
Electronic	302	5	1510	nil			0	3624	30985.2	0	0.00
			34173				12948.8	21224.4	435524.7	602060	

Note- Half of each total saving by tube ballast is added in saving of FTL replacement for working out pay-back period

Average cost of power Rs/KWH- 8.55, Operation hours per day- 8 No, Operation day per year-300 ,

Cost of-1) CFL 5W /No Rs-90, Electronic regulator Rs/No-350, LED down light 18 W/ No- 1500, LED Flood light Rs/No- 3500, LED tube light Rs/No-700

**B) Relief in Load on Split Air conditioner in instrument lab(senior)-** There are some instrument placed requiring maintained temperature in lab. If instrument are shifted one side & room is partitioned for making confined space for instrument, one Split AC will be spared & electricity will be saved as below.

AC Rating in Watt	Operation Hours per day	Operation days per year	Total KWH consumption per year	Average cost of tariff Rs/KWH	Total operating cost Rs per year
1250	15	365	<b>5475</b>	8.55	<b>46811</b>

### C) Scope for introduction of solar power-

As moved round in campus there is immense potential to introduce solar power in power supply mix. There is lot of useful roof top available in campus for installation of solar panel. This will help to generate green power mitigating greenhouse gas emission for protection of environment as well as energy conservation. This mode of power generation will save energy cost for purchasing power from MSEDCL & overcome dependency on utility power supply. This will also prove demonstrative model for studying student to imbibe technical knowledge. For exercise of this separate technically feasibility study has to be conducted to what extent solar power generation capacity is feasible.

**D) Rain Water Harvesting** – It is very appreciable thing that rain water harvesting program is being undertaken by college for harvesting stray water of rain for water conservation. This work is under progress. Once this work is completed, rain water will be harvested for ready use as well as to percolate it in ground to raise ground water potential.

**E) Solar Water Heater**- It is recommended to install solar water heater in boy's hostel to harness cost free solar green energy for heating water requiring to be bathed by student. Application of this hot water in various laboratory can be explored which is generated without input energy cost. This will also help to reduce greenhouse gas emission mitigating environmental damage

**F) Solar Street Light-** It is strongly recommended to introduce solar street light (**LED solar street light 12 w with li-ion battery**) in campus to illuminate campus at night time without input energy cost. Existing street light operation cost will be saved. This will also help to reduce greenhouse gas emission mitigating environmental damage. This will also be available demonstrative model for studying science student. **You can avail significant depreciation benefit in Income – Tax Return other than saving.**

Proposal is put up here with cost benefit analysis.

No of set	Watt of each solar lamp	Hours of operation per day	Estimated KWH generated & used per year	Cost of generated unit per year in Rs.	Investment in Rs	Payback period in years
15	12	12	788.4	6740.82	132000	19.58

Cost per Solar Street Light in Rs-8800, operating hours/day- 12 No, operation day/year-365 No, Average cost/ KWH in Rs-8.55

### G) Awareness program & sign Board Display near switch board.

It is reviewed about Awareness program if any undertaken at college level for optimum use of electricity & water as well as its saving. There is still tremendous scope to create awareness among user about efficient & optimum use of energy & water to save. Instruction cum Request Sign board shall be displayed near each switch-board, toilet block & bathrooms to influence & guide to user to arrest misuse & wastage of power & water.

**H) Electrical Safety Audit** – Considering huge human occupancy in building Electrical Safety Audit is recommended to identify unsafe location & condition to comply to ensure electrical safety to human being, property & equipment. **This is very serious thing & is priority issue.**

### 5) Motor Pump Set Load Study -

Sr No	Pump Location	Motor Type	KW	Power Measurement details							Need of Power capacitor rating KVAR	% Motor loading	Purpose
				KW	KVAR	KVA	P.F.	Volt	Amps	Hz			
1	Ladies hostel J3	mom block	1.5	0.46	1.48	1.56	0.297	389.3	2.13	50		no load	hostel - water lifting
2	Boys hostel O-Block	Bore well	5	6.3	4.48	7.94	0.79	388	11.8	50	4	107.1	hostel - water lifting

3	West side I-block	Bore well	5	4.83	3.98	6.28	0.77	400	9	50	4	82.11	garden & hostel
4	Sagawan Plot	Bore well	5	5.22	4.19	6.69	0.78	433.5	8.9	50	4	88.74	plantati on waterin g

1) Motor pump set working at boy's hostel -water lifting purpose is operating at overload. So it shall be checked for maintenance requirement 7 do needful to avoid burning & breakdown.

2) Motors shall be provided power capacitor for improvement of power factor to save KVA demand.

## **6) Power & Harmonics measurement of computer Laboratory-**

As computer laboratory load is non-linear responsible for generation of harmonics which pollutes power quality. **Measured voltage harmonics are exceeding permissible limit 5% according to IEEE-519 1992 standard.** Active harmonics filters are suggested for mitigation of harmonics to maintain optimum power quality. UPS are very oversized & under loaded. So It is recommended to divert all computer laboratory load on single UPS to load adequately & save energy. One UPS shall be kept off to save loss power.

This will also reduce your laboratory KVA demand.

Sr No	Name of premise	No of PC on	UPS Capacity in KVA	Load measurement					% Loading	% Total Harmonic Distortion	
				KW	KVAR	KVA	Volt	Amps		Voltage	Current
1	Computer lab room no-10	28	10	1.91	-1.38	2.36	224.2	10.5	23.6	6.6	58.8
2	BCS Lab	27	10	1.37	-0.5	1.45	218.8	6.6	14.5	6.6	33.4

## **7) Power Losses measured in operation of UPS**

Power losses are worked out by measuring input & output power on individual UPS as below. Annual energy & financial loss is shown below

Sr No	Name of premise	Power Measurement				Amount Loss per year in Rs
		Output KW	Input KW	Power Loss KW	Energy Loss per year in KWH	
1	Computer lab room no-10	1.91	2.15	0.24	720	5760
2	BCS Lab	1.37	1.52	0.15	450	3600

**Total annual KWH Loss in KWH – 1170**

**Total annual financial Loss in Rs-9360**

## 8) Illumination measurement & study

Standard referred from illumination Engineering society Handbook

Sr No	Location	Source of artificial lighting	Source for natural light	Average illumination measured in Lux	Recommended illumination level in Lux
1	Staff Room A- Block	Tube light	Windows	110	200
2	I- Block-1/A	Tube light	Windows	142	200
3	I- Block-1	Tube light	Windows	374	200
4	I- Block-11	Tube light	Windows	287.8	200
5	I- Block-9	Tube light	Windows	599	200
6	A- Block-32	Tube light	Windows	400	200
7	A- Block-37	Tube light	Windows	558	200
8	A- Block-38	No	Windows	262	200
9	A- Block-43	Tube light	Windows	80	200
10	H-Block-10	No	Windows	520	200
11	H-Block-9	No	Windows	395	200
12	Central Library	Tube light	Windows	79	200
	<b>Ladies Hostel</b>				
13	J1- Block Room No-102	Tube light	Windows	79	200
14	105	Tube light	Windows	88	200
15	106	Tube light	Windows	310	200
16	205	Tube light	Windows	378	200
17	J2- Block Room No-201	Tube light	Windows	82	200
18	209	Tube light	Windows	281	200
19	212	Tube light	Windows	134	200
	O- Block Boys hostel ( First floor)				
20	Study room	Tube light	Windows	22	200



21	Room No-218	Tube light	Windows	40	200
22	Room No-219	Tube light	Windows	26	200
23	Room No-231	Tube light	Windows	32	200
24	Room No-229	Tube light	Windows	25	200
25	Room No-227	Tube light	Windows	28	200
26	Room No-220	Tube light	Windows	26	200
27	Room No-213	Tube light	Windows	22	200
	O- Block Boys hostel ( Ground floor)				
28	Room No-128	Tube light	Windows	35	200
29	Room No-118	Tube light	Windows	25	200
30	Room No-127	Tube light	Windows	37	200
31	Guest Room-	Tube light	Windows	65	200

**Note – 1)** Illumination in various premises is measured on Dt 16/9/2016 during 13-00 hrs. to

16-00 hrs keeping artificial light on wherever it is available. Boy's hostel Lux measurement was carried out on 15-9-2016 during 20 Hrs to 21-30hrs

2) Illumination is measured with Lux Meter vide reference standard **IS 3646(Part1): 1992**

3) In boys hostel adequate artificial lighting is required to add in each room to provide sufficient eye comfort level to occupant at night hours.

4) College activities are conducted during 7-00 am to 6-00pm each day excepting holiday. Pupils study at night time in hostel.

## 9) Observation & Recommendation

During movement for study the various element in campus in scope of Energy Audit, many improvement potential areas & energy saving opportunities are observed. These are highlighted below with recommendation for action plan & its implementation for enhancing energy efficiency & cost saving

- 1) **It is identified Water Conservation Opportunity** .Presently used water in bathrooms of Boys Hostel is drained. This water can be chemically analyzed for confirmation of its degree of harmfulness for application for college campus botanical garden purpose. Trees & herbs shall be categorized under direct application of untreated water & application of treated water. Quantity of treated water required for category of trees & herbs shall be approximately quantified & shall be treated or dosed chemically to recycle its application.

Engineering of System Design - 1) It is supposed to discharge used water in bathroom under gravity to storage tank. The storage tank will have two compartment .The discharged water from bathroom will be flown directly in one compartment & once this compartment is over-flooded, water will be flown in second compartment for chemical treatment or dozing. Untreated water from first compartment will be ready for use expressly to respective category of trees & herbs as well as treated water for respective category of trees & herbs under gravity.

This measure is very useful in scarcity of water as well as waste water management.

Merit of application of recycled water-

- 1) As Ground water need for botanical garden is substituted, **water conservation will be achieved which is imperative for national interest.**
  - 2) As system is engineered to flow water under gravity from source of water to user end, electricity required for pump set for pumping water for garden & cost thereof will be saved.
  - 3) Cost of water required for garden during scarcity will be saved.
- 2) It was found during campus electrical load inventory round many HOD cabins without occupancy. However Tube light & ceiling fan loads were on wasting costly electrical energy as well as adding unwanted cost to college. It is proposed herewith to stick **Awareness cum Warning Sticker** to each switch board to take care of this negligence.

It is advised herewith to provide **KEY TAG SYSTEM** to each hostel room, library, office cabin, staff rooms to safeguard premises from wastage of electrical energy.

- 3) As there is huge surface area for collection of rain water on roof top, the rain water can be collected in storage tank installed at sufficient height to cater for need of various toilet block water during rainy season. This will help to achieve rain water harvesting as well as saving in electricity cost required for pumping water.
- 4) Exhaust Fan- Exhaust fans shall be sealed properly between internal & external space to enable proper suction of internal chemical fumes to expel outside. Otherwise electricity is wasted without effective operation. Exhaust fans shall be properly installed.

5) Illumination level in Lecture hall, library, hostel admeasure below standard in day time with existing artificial light on. Artificial lighting is necessary to increase for human comfort. Adequate artificial lighting shall be provided in boy's hostel to maintain human eye comfort at night time.

6). There is more scope to add Solar Street light in campus to mitigate greenhouse gas emission and environment damage. Provision of separate transformer for college is good step to maintain supply reliability.

7) There is vital scope for energy conservation in lighting & fan system as below. The financial analysis with cost effectiveness study of various options is already given.

A) Replacement of conventional fan regulator with electronic regulator.

B) Replacement of T12 & T8 tube light with LED T5 tube light.

C) Replacement of incandescent bulb with CFL

D) Replacement of MHL fixture with LED flood light

8) It is strongly recommended to introduce Solar Electrical Power( Green Energy) in campus for various application for energy conservation & reducing greenhouse gas emission Which will also prove demonstrative model for studying student as well as enhance awareness about Non- Conventional Energy Source among student .

9) It is reviewed about Awareness program if any undertaken at college level for optimum use of electricity & water as well as its saving. There is still tremendous scope to create awareness among user about efficient & optimum use of energy & water to save. Instruction cum Request Sign board shall be displayed near each switch-board, toilet block & bathrooms to influence & guide to user to arrest misuse & wastage of power & water.

**10) Department wise KWH meter installation is necessary to monitor & control use of electricity by concern Department to enable to fix responsibility.**

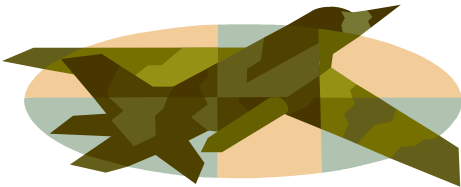
11) Power capacitors shall be provided to motor-pump set in campus as below for reducing electrical demand & improving power factor.

**12) Tariff category of electricity connection other than LT X B(i) shall be changed to applicable LT X B(i) Tariff category to avail tariff with lower rate.**

**13) Electrical Safety Audit** – Considering huge human occupancy in building Electrical Safety Audit is recommended to identify unsafe location & condition to comply to ensure electrical safety to human being, property & equipment. **This is very serious thing & is priority issue.**

**10) List Of Instrument used for measurement in Energy Audit**

<b>Sr No</b>	<b>Instrument Name</b>
1	3- Phase Electric Power Analyzer
2	Lux Meter
3	Thermometer & Hygrometer
4	Measuring steel tape
5	IR Thermometer



**THANKS**