DETAILED ENERGY AUDIT REPORT

Year-2021-2022

Sarojini Naidu Govt Girls' Post Graduate College, Bhopal

Madhya Pradesh ,India

CONDUCTED BY :

SABS INDIA

WE BUILD A SOLID FOUNDATION FOR SAVING ENERGY

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The officials of **Sarojini Naidu Govt Girls Post Graduate College** have coordinated and helped to the audit team during the field study and measurement. **SABS INDIA** express special thanks to the following persons of **Sarojini Naidu Govt Girls Post Graduate College.**

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7. Dr. Mukesh Dixit Professor

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We would be happy to provide any further clarifications, if required, to facilitate implementation of the recommendations

List of Contents

LIST OF TABLE 6

EXECUTIVE SUMMARY 9

College Details :..... 9
SAVING HIGHLIGHTS :..... 12
Summary of Energy Conservation Measures 13

1 CHAPTER 14

INTRODUCTION 14

1.1 Energy Audit..... 14
1.2 Methodology & Approach..... 14
1.3 Instrument used in Energy Audit: 15

2 CHAPTER 16

SITE VISIT AND INSPECTION 16

2.1 Site visit and site inspection 16

3 CHAPTER 18

ELECTRICITY BILL ANALYSIS 18

3.1 Month Wise Energy Consumption..... 18
3.2 OBSERVATIONS & COMMENTS 20

4 CHAPTER 21

LIGHTING SYSTEM 21

4.1 Lighting Fixtures..... 21
4.2 OBSERVATIONS & COMMENTS 23

5 CHAPTER 25

FAN SYSTEM..... 25

5.1 OBSERVATIONS & COMMENTS 27
5.2 CEILING FAN PROPOSAL..... 28

6 CHAPTER 29

OTHEREQUIPMENTS LOAD 29

6.1 Different Type OtherEquipments 29
6.2 Observation and Comments 29

7 CHAPTER 30

PUMPING SYSTEM..... 30

7.1 Submerssible Pumps 30
7.2 Pumps Details : 30
7.3 Observation and Comments 30

8 SOLAR DETAILS 31

8.1 BASIC DETAILS 31
8.2 SAVING BY SOLAR 32
8.3 OBSERVATION AND COMMENTS 32

9 CHAPTER 33

GENERAL TIPS FOR ENERGY CONSERVATION IN DIFFERENT UTILITIES SYSTEMS 33

ANNEXURE - 1 37

STANDARD LUX LEVEL 37

ANNEXURE - 2 38

ENERGY SAVER FOR AIR CONDITIONING SYSTEM 38

ANNEXURE – 3 39

SUPER ENERGY EFFICIENT BLDC CEILING FAN 39

COMPARISION BETWEEN ORDINARY,5 STAR RATED ANDSUPER EFFICIENT FANS 40

List of Table

TABLE 1 :TOTAL CONNECTED LOAD (KW) 10
TABLE 2 : SAVING HIGHLIGHTS..... 12
TABLE 3 :SUMMARY OF ENERGY CONSERVATION MEASURES 13
TABLE 4 : ELECTRICITY BILL 2020-21 19
TABLE 5: DIFFERENT TYPE OF LIGHTING FIXTURE..... 21
TABLE 6: DIFFERENT TYPE OF FAN..... 25
TABLE 7: DIFFERENT TYPE OF EQUIPMENT SYSTEM 29
TABLE 8 : DETAILS OF SOLAR SYSTEM..... 31
TABLE 9 : SAVING BY SOLAR SYSTEM..... 32

List of figure

FIGURE 1:ELECTRICITY CONNECTED LOAD DETAILS OF CAMPUS IN DIFFERENT ZONE 10
FIGURE 2 ENERGY AUDITOR WITH THE COLLEGE COMMITEE 16
FIGURE 3: GREENERY IN COLLEGE 16
FIGURE4: SUR JHANKAR BHAWAN 17
FIGURE5 : VIVEKANAND SABHAGRAH 17
FIGURE 6 ELECTRICITY TARIFF 2020-21 18
FIGURE 7 : POWER FACTOR VS SURCHARGE PAID GRAPH 20
FIGURE8: 5MAJOR USAGE AREA OF PUMP 30
FIGURE 9 : SOLAR PANELS INSTALLED ON ROOF 31

ABBREVIATION

O&M	Operation and maintenance
KW	Kilo Watt
P.F	Power Factor
kVA	Kilo Volt Ampere
kWh	Kilowatt Hour
kVAh	Kilovolt Amperes Hour
kVAr	Kilovolt Amperes Reactive
ACs	Air Conditioners
FTL	Fluorescent Tube Light Lamp
TR	Ton of Refrigeration
SPC	Specific Power Consumption
CMH	Cubic Meter per Hour
STL	Single Tube Light
DTL	Double Tube Light
Amp	Ampere
Volt	Voltage
BLDC	Brushless Direct current
Nos	Numbers
Hrs	Hours
MPPKVVCL	Madhya Pradesh PaschimKshetraVidyutVitaran Company Ltd.

EXECUTIVE SUMMARY

College Details :

Particulars	Units	Details
Name of the College	-	Sarojini Naidu Govt Girls Post Graduate College
Location	-	Bhopal (M.P), India
Owner	-	Government
Contact Person	-	Prof. Sanjay Sahay
No. of Shifts	Nos.	1
Daily Operating Hours	Hrs./day	8
Annual Working Days	Days/yr.	300
Source of Electricity	-	MPMKVVCL
Total connected Load	kW	72.54 KW
Total Sanctioned Load	(kW)	80 KVA
Average Energy Charge in per unit	Rs./kWh	7.45

a. Existing Major Energy Consuming Technology and Electricity billing analysis :

The major equipmentsinstalled in **Sarojini Naidu Govt Girls Post Graduate College** like Lighting fixtures , Ceiling Fans and Other appliances

Table 1 :Total Connected Load (kW)

S.No.	Connected Load	Power (kW)	Connected Load (%)
1	Lighting Systerm	22.84	31.49%
2	Fan System	33	45.49%
3	Water Pumping	11.2	15.44%
4	Other Appliances	5.5	7.58%
Total Connected Load		**72.54**	**100%**

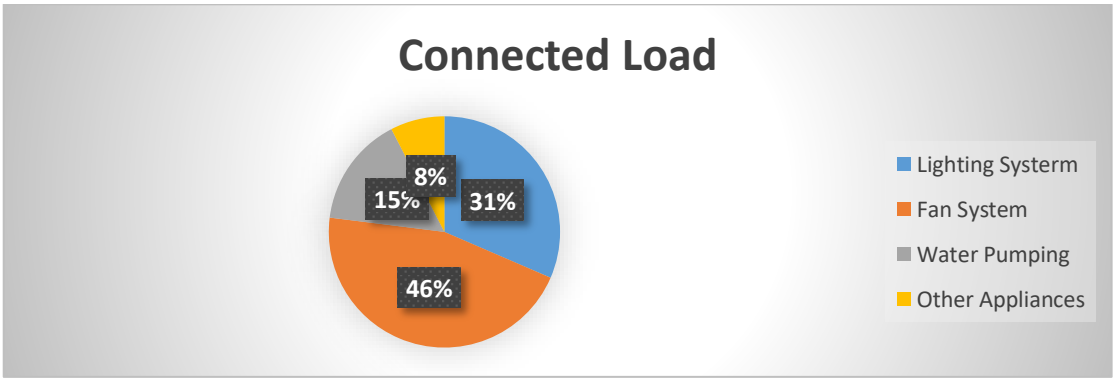

Figure 1:Electricity Connected Load details of campus in different zone

- As per electricity bills observation and analysis, Total Sanction load is **80 KVA** for electricity bill connection in Collegepremises.
- As per electricity bills observation and analysisfrom December 2020 to July 2021 , average electricity unit (kWh) supplied is **928 kWh** and **Total 12 month expenditure is Rs 649830** for electricity bill in Collegepremises.

b. Proposed Energy Saving Technologies with Cost Economics

❖ LIGHTING SYSTEM

- We **appreciate to use LED Lighting luminaries** at some location as per site visit.
- We observed during visit, few Lights were **not working** properly.
- We **are suggesting to purchases all electrical** equipment as per star leveling program by Bureau of energy efficiency, and will get huge amount of electricity saving .
- We are suggesting to conduct regular **Cleaning and maintenance of lighting fixtures** in every 5-6 months to increase performance of Lighting and also improve their Lux level.
- As per data collection and site visit ,Total Connected lighting load at College Campus is **22.84 KW.**

❖ Ceiling Fan System

- We observed, most of the Fan were conventional 50 W Fans
- We are recommended to**replace 550 no. of 60 W Ceiling fan with New Super energy efficient 5 star rated BLDC ceiling fan** and will get huge amount of electricity saving as per Star leveling program by Bureau of Energy Efficiency.
- We are **suggesting to purchases New energy efficient BLDC fan as per Star leveling program by Bureau of Energy Efficiency, and will get** huge amount of electricity saving.
- Energy Saving calculation **and recommendation for the existing Conventional** Ceiling fans with BLDC super energy efficient fan has been given in this report.
- We are suggesting **to conduct regular Cleaning and maintenance** of Fan at least in every 6 months to increase performance of Fan.
- We are also suggesting to improve their Air delivery of Fan by Replacing New energy efficient BLDC Fan as per 5 star leveling of Bureau of energy efficiency.
- We will get energy saving approximately **42240KWh** per year and also will get amount saving approximately **Rs. 314688** per year by replacing conventional Fan with new energy efficient BLDC fan.
- The total load for Ceiling Fan is **33 kW**.

❖ Pumping System

- We observed during Energy Audit and site visit**, 2 Pumps of Capacity 7.5 HP pump were installed** within College campus for drinking water, Flushing and gardening purpose.
- Power consumption of 7.5 HP pump was **5.6 KW as** per site visit and measurement.
- We are suggesting to **purchse 5 star rated pumps and will get huge** amount of savingas per Star leveling program by Bureau of Energy Efficiency 2020.
- We are **suggesting to install Solar Pumping system and** will get huge amount of savings.

❖ Other Diffrent Type Of Connected Load :

There are different types of other equipments like Computer, Printer, Xerox machine,Water Cooler,Refrigretor and other lab equipmentsare installed at various location and they also contribute electricity consumption.

- Total Connected Load of other load **is 5.5kW.**
- We **purchase of other equipments as per Star leveling** program by Bureau of Energy Efficiency 2020, and will get huge amount of electricity saving.

SAVING HIGHLIGHTS :

Table 2 : Saving Highlights

Sr.No.	Energy Saving Analysis	
1	Total annual savings as per available connected load of equipments in Rs.	391938
2	Total annual savings in kWh	76920
3	Total investments in Rs.	1694196
4	Pay Back Period in months	33

Summary of Energy Conservation Measures

Table 3 :Summary of Energy Conservation Measures

S.No.	Energy Conservation Measures	Annual Savings		Investment	Payback
		kWh	Rs.	Rs.	Months
CEILING SYSTEM					
1	Replacement of 550 no.Existing 60 W Ceiling Fan with Energy efficient Energy Efficient 28 W GORILLA Atomberg Fan in college.	48840	363858	1485000	49
LIGHTING SYSTEM					
2	Replacement of 468 no. Existing 40 W Conventional FTL light With Energy efficient Energy Efficient 20 watt LED light In college	28080	28080	209196	16

1 CHAPTER INTRODUCTION

1.1 Energy Audit

Energy Audit is an effective means of establishment present efficiency levels and identifying Potential areas of improvement in energy consumption.

Energy audit of utility systems largely helps , Which are given below :

- Reducing the energy consumption with resultant reduction in electricity bills.
- Audit involves data collection ,data verification and detailed analysis of the data.
- The analysis leads to recommendations, which are short term (with minimum investment), medium term (with moderate investment) and long term (with capital expenditure).
- The cost benefit analysis of various energy conservation proposals enables managements to take decisions regarding implementation schedules.

Energy conservation is a worldwide objective to save the human being from possible disaster. Under the mandate of The Energy Conservation Act 2001, the Bureau of Energy Efficiency and Government of India are implementing various programmers to provide momentum of the energy conservation movement in the country. Energy Auditing is most vital part of the conservation of energy. In order to improve the efficiency of the Energy consuming system, energy auditing is the first necessary action to be taken by the concerned firm. Through the energy auditing actual parameters can be detected at each step, which can be compared with the standard achievable parameters. For proper Energy auditing and energy accounting, parameters need to be monitored on regular.

Sarojini Naidu Govt Girls' Post Graduate College has engaged **SABS INDIA** for conducting detailed energy audit in their premises for the year of 2020.

1.2 Methodology & Approach

The audit involved basic design data collection for various electrical & thermal utilities, kick of meeting with concern departmental engineers & managers, carrying out various field measurements, performance analysis and loss analysis covering all major energy consuming sections of **Sarojini Naidu Govt Girls' Post Graduate College** to realistically assess losses mainly in energy consuming utility areas and potential for energy savings. The major areas of study include:

- Building energy bills analysis.
- Electrical supply and distribution system analysis
- Lighting system analysis.
- Water pumping system analysis.
- Buildings envelop analysis.
- Specific Energy Consumption.

During study several interactions was made to the office personnel and technicians to share the actual operational features of equipment, equipment's maintenance schedule and equipment break down, down time of machineries, safety measures etc. At the same time required data was collected from the various departments and review the same with the operational actual data.

The study focused on improving energy use efficiency and identifying energy saving opportunities at various equipments. The analyses included simple payback period and life cycle cost calculations where investments are required to be made to implement recommendations, to establish their economic viability.

1.3 Instrument used in Energy Audit:

We have a wide array of latest, sophisticated, portable, diagnostic and measuring instruments to support our energy audit investigations and analyses. The audit study made use of various portable instruments along with plant online instrumentations, for carrying out various measurements and analyses. The specialized instruments that were used during the energy audit include:

- Power Analyzer.
- Ultra Sonic Flow Meter.
- Digital power clamp meter & multi-meter (2745 KUSAM MECO)
- Digital Hygrometer HD-304 HTC
- Digital Lux Meter (LX-101A HTC TM)
- Digital Anemometer (AVM -07 HTC)
- IR Thermometers for temperature measurement HTC TM (IR -50 to 1550 0C)
- Digital distance meter
- Measuring Tap meter

2 CHAPTER
Site Visit and inspection

2.1 Site visit and site inspection

Energy audit team visited at Collegecampus premises and also had completed of electrical measurement and appliances data collection.

Figure 2 Energy Auditor with the College commitee

Figure 3: Greenery in College

Figure 4: Sur Jhankar Bhawan

Figure 5 : Vivekanand Sabhagrah

3 CHAPTER
ELECTRICITY BILL ANALYSIS

Sarojini Naidu Govt Girls Post Graduate Collegereceives power from ,Madhya Pradesh Madhya KshetraVidyutVitran Company Limited.

3.1 Month Wise Energy Consumption

The maximum demand, energy consumption, fixed charges, energy charges and total bill inRs for the Financial year 2020-2021are shown in below tables as per the details from the Collegebill.All the one years data has been represented by the various graphs. This indicator addresses energy consumption, energy sources, energy monitoring, and electricity consumption .

Tariff Schedule LV - 2

NON-DOMESTIC:
LV 2.1

Applicability:
This tariff is applicable for light, fan and power to Schools / Educational Institutions including workshops and laboratories of Engineering Colleges / Polytechnics/ITIs (which are registered with /affiliated/ recognized by the relevant Govt. body or university), Hostels for students or working women or sports persons.

Tariff:
Tariff shall be as given in the following table:

Sub category	Energy Charge (paise/unit) Urban/ Rural areas	Monthly Fixed Charge (Rs.)	
		Urban areas	Rural areas
Sanctioned load-based tariff (only for connected load up to 10 kW)	630	150 per kW	120 per kW
Demand based tariff **Mandatory** for Connected load above 10 kW	630	270 per kW or 216 per kVA of billing demand	230 per kW or 184 per kVA of billing demand

Figure 6 Electricity Tariff 2020-21

Table 4 : Electricity Bill 2020-21

Monthly Electrical bill detail in Sarojani Naidu Govt. Girls College Bhopal 2020-2021										
Months	**Sanctioned Load (KW)**	**MDI**	**KWH**	**KVAH**	**Fixed charges (Rs)**	**Energy Charges (Rs)**	**Power Factor**	**Total bill (Rs)**	**Energy Charges Rs/KWh**	**Surchage Paid (Rs)**
Jul-20	80	**Bill Not Available**						61909	**Bill Not Available**	
Aug-20	80							59840		
Sep-20	80							59291		
Oct-20	80							53984		
Nov-20	80							55181		
Dec-20	80	30	532	698	23040	3883.6	0.76	55017	7.45	906
Jan-21	80	34	459	639	23509	3415	0.72	55289	7.45	1075
Feb-21	80	19	509	703	23544	3792	0.72	55705	7.45	1194
Mar-21	80	35	480	637	23544	3576	0.75	37479	7.45	908
Apr-21	80	26	464	633	23544	3456	0.73	54528	7.45	1003
May-21	80	38	366	540	23544	2726	0.68	53031	7.45	955
Jun-21	80	*NV	1271	1434	28122	9467	0.89	26923	7.45	92.15
Jul-21	80	Nv	3340	3768	23544	24883	0.89	21653	7.45	242
Avg Values			**928**	**1132**	**24049**	**6900**			7.45	
Total annual electricity bill paid								**649830**	**Total Surcharge Paid (Rs)**	**6375.15**

*NV – Not visible.

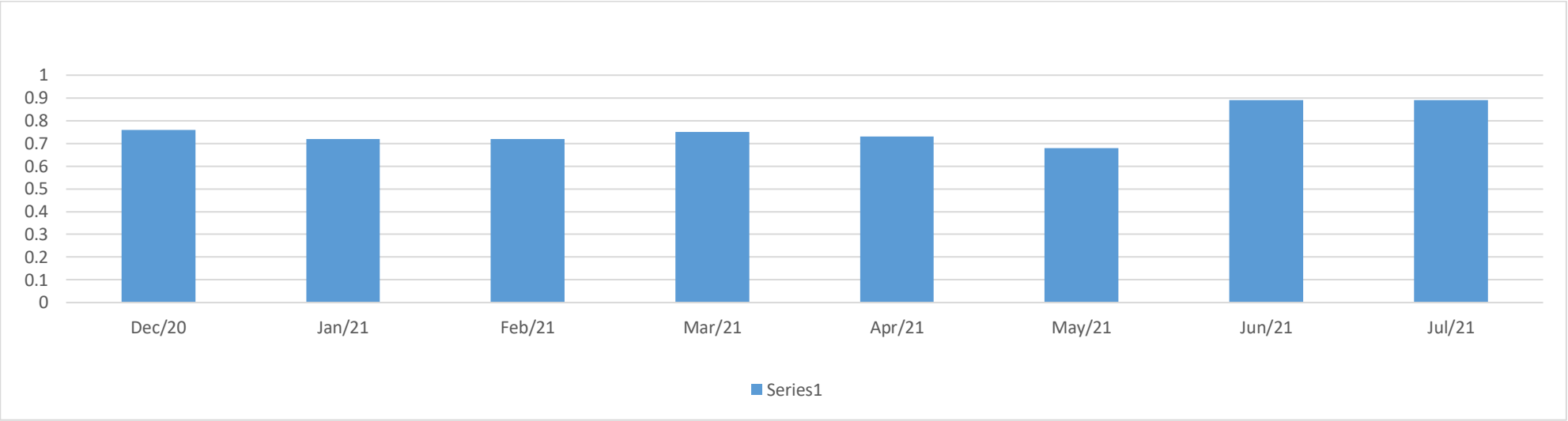

Figure 7 : Power factor vs Surcharge paid graph

3.2 OBSERVATIONS & COMMENTS

- As per electricity bills observation and analysis, **Total Sanction load is 80KVA** in Collegepremises.
- As per electricity bills observation and analysisfrom Dec-2020 to Jul-2021 **, average electricity unit (kWh)supplied is928 kWh** and for electricity bill in Collegepremises.
- As per electricity bills observation and analysis **Total annual (12 month) electricity bill Paid is Rs. 649830/-**
- As per electricity bills observation and analysisfrom Dec-2020 to Jul-2021 **electricity bill Power Factor varies from 0.68-0.89** , which is very low .
- It is suggested to install capacitor bank to improve power factor
- As per electricity bills observation and analysis **Energy Charge applied per unit supply is Rs 7.45.**

4 CHAPTER
LIGHTING SYSTEM

4.1 Lighting Fixtures

The Sarojini Naidu Govt Girls' Post Graduate Collegehas high lighting load and various type of indoor and outdoor lighting fixture are installed in Collegecampus .

The lux measurement was also done at the time of audit. All the parameters all given in the below table:

Table 5: Different type of lighting fixture

Sr No	Location	Type of Light	No. of Lights	Watt	Total Watt
1	Chemistry	FTL	13	40	520
2	Biotechnology	FTL	7	40	280
3	Zoology	FTL	5	40	200
4	Museum	FTL	4	40	160
5	Research Room	FTL	2	40	80
6	Lab-1	FTL	8	40	320
7	Lab-2	FTL	5	40	200
8	Staff Room	FTL	2	40	80
9	Library		5	100	500
10	Physics	FTL	3	40	120
11	Lab-1	FTL	2	40	80
12	Lab-2	FTL	2	40	80
13	English Dept	LED	2	20	40
14	Maths Dept	LED	2	20	40
		FTL	1	40	40
15	Political Science	FTL	4	40	160
16	History	LED	2	20	40
17	Urdu, Sanskrit and Philosophy	FTL	1	40	40
18	Sociology and social work	LED	3	20	60
		FTL	2	40	80
19	Economics	FTL	1	40	40
		LED	2	20	40
20	Enabling Unit	LED	2	20	40
21	Hindi	FTL	4	40	160
22	UGC Cell	FTL	2	40	80
		LED	1	20	20
23	Human Development	FTL	13	40	520
24	Dept of Psychology	FTL	3	40	120
25	Painting	FTL	23	40	920
26	Nutrition	LED	2	20	40
		FTL	5	40	200

Sr No	Location	Type of Light	No. of Lights	Watt	Total Watt
27	Textile	LED	1	20	20
28	Family Resources	FTL	4	40	160
29	Botany	LED	1	20	20
		FTL	3	40	120
30	Lab-1	FTL	8	40	320
31	Office Staff	FTL	4	40	160
32	Lab-2	FTL	8	40	320
Saraswati Bhawan					
33	49	FTL	6	40	240
34	50	FTL	5	40	200
35	88	FTL	1	40	40
36	51	FTL	4	40	160
37	52	FTL	4	40	160
38	54	FTL	4	40	160
39	56	FTL	4	40	160
40	57	FTL	6	40	240
41	58	FTL	8	40	320
42	59	FTL	8	40	320
43	171	FTL	10	40	400
44	172	FTL	9	40	360
45	170	FTL	7	40	280
46	169	FTL	4	40	160
47	168	FTL	2	40	80
48	167	FTL	4	40	160
49	166	FTL	2	40	80
50	165	FTL	5	40	200
51	164	FTL	5	40	200
52	163	FTL	5	40	200
53	162	FTL	5	40	200
Various location					
54	Account	LED	2	20	40
55	Account2	FTL	3	40	120
56	Account 3	LED	3	20	60
57	Scholarship	FTL	3	40	120
58	Sthapna	FTL	6	40	240
59	Office Gallary	LED	1	20	20
		FTL	2	40	80
60	PA Principal	LED	1	20	20
		FTL	1	40	40
61	Principal Room	FTL	14	40	560
62	RUSA	FTL	8	40	320
63	Counselling desk	LED	6	20	120
64	Room 1	LED	6	20	120

Sr No	Location	Type of Light	No. of Lights	Watt	Total Watt
65	Room 2	LED	6	20	120
66	Room 3	LED	6	20	120
67	Room 4	LED	6	20	120
68	Room 5	LED	6	20	120
69	Room 6	LED	6	20	120
70	Botany Gallary	FTL	1	40	40
71	Room 108	LED	3	20	60
		FTL	3	40	120
72	Room 109	LED	2	20	40
73	Room 110	LED	4	20	80
74	Room 111	FTL	4	40	160
75	Room 112	FTL	4	40	160
76	Room 113	LED	1	20	20
77	Vivekanand	FTL	6	40	240
78	Canteen1	LED	1	20	20
79	Canteen 2	LED	3	20	60
Sur Jhankar Bhawan					
80	204	FTL	4	40	160
81	205	FTL	4	40	160
82	206	FTL	4	40	160
83	207	LED	10	20	200
84	208	LED	11	20	220
85	211	LED	11	20	220
86	Gym	FTL	9	40	360
87	Gallary	FTL	2	40	80
88	48	LED	3	20	60
89	Gallary	FTL	2	40	80
90	Central Library	LED	45	20	900
91	Research Section	FTL	37	40	1480
92	Other	LED	20	20	400
		FTL	104	40	4160
	Total no. of Lights		**654**	**Total KW**	**22.84**

4.2 OBSERVATIONS & COMMENTS

- We **appreciate to use LED Lighting luminaries** at some location as per site visit.
- We observed during visit, fewLights were **not working** properly.
- We **are suggesting to purchases all electrical** equipment as per star leveling program by Bureau of energy efficiency, and will get huge amount of electricity saving .
- We are suggesting to conduct regular **Cleaning and maintenance of lighting fixtures** in every 5-6 months to increase performance of Lighting and also improve their Lux level.
- As per data collection and site visit ,Total Connected lighting load at CollegeCampus is **22.84 KW.**

Replacement of 468 no. Existing 40 WFTL With Energy efficient Energy Efficient 20 W LED light in College.

Energy Saving	
Total no of Approximate 40 W lights	468
Total Energy Consumed by 40 W FTL	45
Replacement of 40 Watt FTL with 20 Watt LED	20
Average daily running time for 40 Watt FTL in hour	8
Total Energy Consumed by 468 no. of 40 Watt kWh per day	168.48
Annual Energy Consumed by 40 Watt Ceiling Fan (300 working Days) kWh	50544
Annual Energy Consumed by 468 no. of 20 Watt in kWh	22464
Prospective Annual Energy Savings in kWh	28080
Annual Savings in Rupees (taking Average 7.45 Rs. Per unit charge for 300 day a year)	209196
Initial investment required for 468 no. of 20 Watt LED (Price for LED STL @ 600 per 20 Watt)	280800
Payback Period in Months only	16.1
Life of the project years	5
Depreciation Cost Rs	41839
ROI {(Net annual savings – Depreciation cost)/ Investment} x 100%	59.6

5 CHAPTER
FAN SYSTEM

There arevarious ceilingfaninstalled at various location in the Sarojini Naidu Govt Girls' Post Graduate Collegeand they also contribute very high electricity consumption. All of the fans are conventional and hence high energy consuming

The detail of the fans is given in the below table:

Table 6: Different type of Fan

Sr. No.	Location	No. of fan	Watt	Total Watt
1	Chemistry	4	60	240
2	Biotechnology	4	60	240
3	Zoology	2	60	120
4	Museum	2	60	120
5	Research Room	1	60	60
6	Lab-1	7	60	420
7	Lab-2	5	60	300
8	Staff Room	2	60	120
9	Library	4	60	240
10	Physics	2	60	120
11	Lab-1	2	60	120
12	Lab-2	6	60	360
13	English Dept	1	60	60
14	Maths Dept	1	60	60
15	Political Science	3	60	180
16	History	3	60	180
17	Urdu, Sanskrit and Philosophy	1	60	60
18	Sociology and social work	2	60	120
19	Economics	3	60	180
20	Enabling Unit	2	60	120
21	Hindi	3	60	180
22	UGC Cell	2	60	120
23	Human Development	6	60	360
24	Dept of Psychology	1	60	60
25	Painting	21	60	1260
26	Nutrition	7	60	420
27	Textile	6	60	360
28	Family Resources	3	60	180
29	Botany	3	60	180
30	Lab-1	8	60	480
31	Office Staff	2	60	120
32	Lab-2	8	60	480
33	Account	1	60	60
34	Account2	2	60	120
35	Account 3	2	60	120
36	Scholarship	1	60	60
37	Sthapna	2	60	120

Sr. No.	Location	No. of fan	Watt	Total Watt
38	Office Gallary	4	60	240
39	PA Principal	1	60	60
40	Principal Room	5	60	300
41	RUSA	4	60	240
42	Counselling desk	6	60	360
43	Room 1	6	60	360
44	Room 2	6	60	360
45	Room 3	6	60	360
46	Room 4	6	60	360
47	Room 5	6	60	360
48	Room 6	6	60	360
49	Room 108	6	60	360
50	Room 109	3	60	180
51	Room 110	3	60	180
52	Room 111	3	60	180
53	Room 112	6	60	360
54	Room 113	1	60	60
55	Vivekanand	5	60	300
56	Canteen 1	4	60	240
57	Canteen 2	12	60	720
	Saraswati Bhawan			
58	Room no. 49	5	60	300
59	Room no. 50	5	60	300
60	Room no. 88	0	60	0
61	Room no. 51	5	60	300
62	Room no. 52	5	60	300
63	Room no. 54	5	60	300
64	Room no. 56	5	60	300
65	Room no. 57	6	60	360
66	Room no. 58	6	60	360
67	Room no. 59	6	60	360
68	Room no. 171	6	60	360
69	Room no. 172	6	60	360
70	Room no. 170	6	60	360
71	Room no. 169	4	60	240
72	Room no. 168	3	60	180
73	Room no. 167	4	60	240
74	Room no. 166	3	60	180
75	Room no. 165	5	60	300
76	Room no. 164	5	60	300
77	Room no. 163	5	60	300
78	Room no. 162	5	60	300
	Sur jhankar Bhawan			
79	204	4	60	240
80	205	4	60	240
81	206	4	60	240

Sr. No.	Location	No. of fan	Watt	Total Watt
82	207	5	60	300
83	208	4	60	240
84	209	4	60	240
85	211	1	60	60
86	Gym	4	60	240
87	Gallary	3	60	180
88	48	1	60	60
89	Gallary	1	60	60
90	Central Library	24	60	1440
91	Research Section	30	60	1800
92	Class	20	60	1200
93	Other	107	60	6420
Total		550	Total KW	33

5.1 OBSERVATIONS & COMMENTS

- We observed, most of the Fan were conventional 50 W Fans
- We are recommended to**replace 550 no. of 60 W Ceiling fan with New Super energy efficient 5 star rated BLDC ceiling fan** and will get huge amount of electricity saving as per Star leveling program by Bureau of Energy Efficiency.
- We are **suggesting to purchases New energy efficient BLDC fan as per Star leveling program by Bureau of Energy Efficiency, and will get** huge amount of electricity saving.
- Energy Saving calculation **and recommendation for the existing Conventional** Ceiling fans with BLDC super energy efficient fan has been given in this report.
- We are suggesting **to conduct regular Cleaning and maintenance** of Fan at least in every 6 months to increase performance of Fan.
- We are also suggesting to improve their Air delivery of Fan by Replacing New energy efficient BLDC Fan as per 5 star leveling of Bureau of energy efficiency.
- We will get energy saving approximately **42240 KWh** per year and also will get amount saving approximately **Rs. 314688** per year by replacing conventional Fan with new energy efficient BLDC fan.
- The total load for Ceiling Fan is **33 kW**.

5.2 CEILING FAN PROPOSAL

Proposal 1

Replacement of 550 no. Existing 60 WCeilingFan With Energy efficient Energy Efficient 28 W GORILLA Atomberg Fan in College.

Energy Saving	
Total no of Approximate 60 W Ceiling Fan	550
Replacement of 60 Watt Ceiling Fan with capacity of 28 Watt GORILLA Atomberg Fan	28
Average daily running time for 60 Watt Ceiling Fan in hour	8
Total Energy Consumed by 60 W Ceiling Fan	65
Total Energy Consumed by 550 no. of 60 Watt Ceiling Fan kWh per day	286
Annual Energy Consumed by 60 Watt Ceiling Fan (300 working Days) kWh	85800
Annual Energy Consumed by 550 no. of 28 Watt Ceiling Fan in kWh	36960
Prospective Annual Energy Savings in kWh	48840
Annual Savings in Rupees (taking Average Rs. 7.45 Per unit charge for 300 day a year)	363858
Initial investment required for 550 no. of 28 Watt Ceiling Fan(Price for GORILLA Atomberg Fan @ 2700 per 28 Watt GORILLA Atomberg Fan)	1485000
Payback Period in Months only	49.0
Life of the project years	15
Depreciation Cost Rs	24257
ROI {(Net annual savings – Depreciation cost)/ Investment} x 100%	22.9

6 CHAPTER
OTHEREQUIPMENTS LOAD

There are different types of other equipments like Printer,PC ,Water Cooler,Refrigretor and other lab equipmentsare installed at various location in the Sarojni NaiduCollege,Indoreand they also contribute electricity consumption.

6.1 Different Type OtherEquipments

Table 7: Different type of equipment system

Sr No	Equipments	No. of Equipments	Average Rated Power Consumption (W)
1	Air Conditioner	16	1500
2	Computer	41	200
3	Printer	21	300
4	Aqua Guard	4	500
5	Water Cooler	3	200
6	Cooler	7	750
7	Exhaust Fan	30	70
8	Microwave	6	800
9	Fridge	9	350
10	TV	2	80
11	Xerox Machine	10	750
Total KW			**5.5**

6.2 Observation and Comments

- We suggest to **purchase equipments as per Star leveling program** by Bureau of Energy Efficiency 2020, and will get huge amount of electricity saving.
- Maintainance of all the equipments should be done regularly.

7 CHAPTER
PUMPING SYSTEM

7.1 Submerssible Pumps

There is 1 no.of 5 HP capacity of submersiblepump installed within Collegecampus for drinking water, Flushing and gardening purpose.

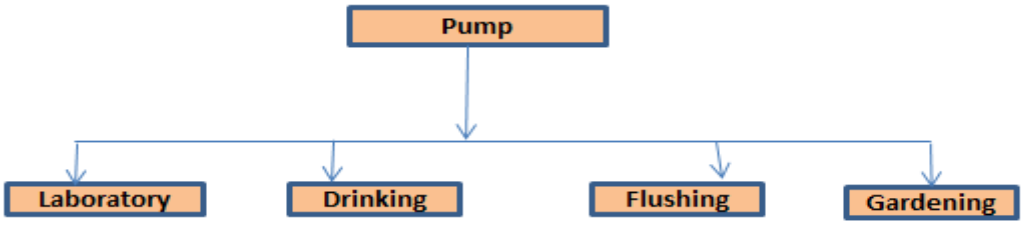

Figure8: 5Major usage area of pump

7.2 Pumps Details :

Pump Details	
No. of pump	2
Power in HP	7.5
Power in KW	5.6
Total Power in KW	11.2
Average Running time Daily (Hrs)	0.5

7.3 Observation and Comments

- We observed during Energy Audit and site visit**, 2 Pumps of Capacity 7.5 HP pump wereinstalled** withinCollegecampus for drinking water, Flushing and gardening purpose.
- Power consumption of 7.5 HP pumpwas**5.6 KW as** per site visit and measurement.
- We are suggesting to **purchse 5 star rated pumps and will get huge** amount of savingas per Star leveling program by Bureau of Energy Efficiency 2020.
- We are **suggesting to install Solar Pumping system and** will get huge amount of savings.

8 Solar Details

8.1 Basic Details

There is a solar system installed in the campus. It saves a lot of energy as well as money for the college. The capacity of the system is 61.05 KW. The basic details of the solar system has been given in the following table.

Table 8 : Details of solar system

Solar Details	
Approved System Capacity	60 KWp
Installed Capacity	61.05 KWp
Commisioned Capacity	61.05 KWp
Make	Vikram Solar
Capacity of Each Module	330 KWp
No. of SPV modules	185
Type of modules	Polycrystalline
Type of Inverter	String Inverter
Make of inverter	Sungrow
Capacity of Inverter 1	50 KW
Capacity of Inverter 2	10KW
Type of Connection	HT
No. of Generation Meters	1

Figure 9 : Solar panels installed on roof

8.2 Saving By Solar

The system fulfiills maximum requirement of the college and the remaining is fulfilled by the Electricity dept.

The power generation and calculation is given in the table.

Table 9 : Saving by solar system

Month	Total units consumed	Total units supplied	Units generated by solar	Per unit energy charges	Saving
	KWH	KWH	KWH	Rs	Rs
Dec-20	2699	532	**2167**	7.45	16144
Jan-21	2316	459	**1857**	7.45	13835
Feb-21	1946	509	**1437**	7.45	10706
Mar-21	2231	480	**1751**	7.45	13045
Apr-21	1698	464	**1234**	7.45	9193
May-21	1274	366	**908**	7.45	6765
Jun-21	4874	1271	**3603**	7.45	26842
Jul-21	5641	3340	**2301**	7.45	17142
Total Units (KWH) generated by solar			**15258**	Total Savings in Rs.	**113672**

8.3 Observation and Comments

- We observed during Energy Audit and site visit that the Capacity of solar system is **61.05 KW**.
- We observed during Energy Audit that Total Units generated by solar system is **15528 KWH.**
- We observed during Energy Audit that Total saving by solar system is **Rs 113672 by energy charges**.
- We appreciate the decision of installing solar system in the campus.
- Solar system has saved a lot of energy as well as money of the college campus.

9 CHAPTER
GENERAL TIPS FOR ENERGY CONSERVATION IN DIFFERENT UTILITIES SYSTEMS

Electricity:

- Schedule your operations to maintain a high load factor
- Minimize maximum demand by tripping loads through a demand controller
- Use standby electric generation equipment for on-peak high load periods.
- Correct power factor to at least 0.99 under rated load conditions.
- Set transformer taps to optimum settings.
- Shut off unnecessary computers, printers, and copiers at night.

Motors:

- Properly size to the load for optimum efficiency.
- (High efficiency motors offer of 4 - 5% higher efficiency than standard motors)
- Check alignment.
- Provide proper ventilation
- (For every 10°C increase in motor operating temperature over recommended peak, the motor life is estimated to be halved)
- Check for under-voltage and over-voltage conditions.
- Balance the three-phase power supply.
- (An Imbalanced voltage can reduce 3 - 5% in motor input power)
- Demand efficiency restoration after motor rewinding.

Fans :

- Use smooth, well-rounded air inlet cones for fan air intakes.
- Avoid poor flow distribution at the fan inlet.
- Minimize fan inlet and outlet obstructions.
- Clean screens, filters, and fan blades regularly.
- Use aerofoil-shaped fan blades.
- Minimize fan speed.
- Use variable speed drives for large variable fan loads.

Pumps:

- Operate pumping near best efficiency point.
- Modify pumping to minimize throttling.
- Adept to wide load variation with variable speed drives or sequenced control of smaller units.
- Stop running both pumps -- add an auto-start for an on-line spare or add a booster pump in the problem area.
- Use booster pumps for small loads requiring higher pressures.
- Increase fluid temperature differentials to reduce pumping rates.
- Repair seals and packing to minimize water waste.
- Balance the system to minimize flows and reduce pump power requirements.
- Use siphon effect to advantage: don't waste pumping head with a free-fall (gravity) return.

Lighting:

- Reduce excessive illumination levels to standard levels using switching; delamping, etc. (Know the electrical effects before doing delamping.)
- Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.
- Install efficient alternatives to incandescent lighting, mercury vapor lighting, etc. Efficiency (lumens/watt) of various technologies range from best to worst approximately as follows: low pressure sodium, high-pressure sodium, metal halide, fluorescent, mercury vapor, incandescent.
- Select ballasts and lamps carefully with high power factor and long-term efficiency in mind.
- Upgrade obsolete fluorescent systems to Compact fluorescents and electronic ballasts
- Consider lowering the fixtures to enable using less of them.
- Consider day lighting, skylights, etc.
- Consider painting the walls a lighter color and using less lighting fixtures or lower wattages.
- Use task lighting and reduce background illumination.
- Re-evaluate exterior lighting strategy, type, and control. Control it aggressively.
- Change exit signs from incandescent to LED.

DG Sets:

- Optimize loading
- Use waste heat to generate steam/hot water /power an absorption chiller or preheat process or utility feeds.
- Use jacket and head cooling water for process needs

- Clean air filters regularly
- Insulate exhaust pipes to reduce DG set room temperatures
- Use cheaper heavy fuel oil for capacities more than 1MW

Buildings:

- Seal exterior cracks/openings/gaps with caulk, gasketing, weather stripping, etc.
- Consider new thermal doors, thermal windows, roofing insulation, etc.
- Install windbreaks near exterior doors.
- Replace single-pane glass with insulating glass.
- Consider covering some window and skylight areas with insulated wall panels inside the building.
- If visibility is not required but light is required, consider replacing exterior windows with insulated glass block.
- Consider tinted glass, reflective glass, coatings, awnings, overhangs, draperies, blinds, and shades for sunlit exterior windows.
- Use landscaping to advantage.
- Add vestibules or revolving doors to primary exterior personnel doors.
- Consider automatic doors, air curtains, strip doors, etc. at high-traffic passages between conditioned and non-conditioned spaces. Use self-closing doors if possible.
- Use intermediate doors in stairways and vertical passages to minimize building stack effect.
- Use dock seals at shipping and receiving doors.
- Bring cleaning personnel in during the working day or as soon after as possible to minimize lighting and HVAC costs.

Waste & Waste water:

- Recycle water, particularly for uses with less-critical quality requirements.
- Recycle water, especially if sewer costs are based on water consumption.
- Balance closed systems to minimize flows and reduce pump power requirements.
- Eliminate once-through cooling with water.
- Use the least expensive type of water that will satisfy the requirement.
- Fix water leaks.
- Test for underground water leaks. (It's easy to do over a holiday shutdown.)
- Check water overflow pipes for proper operating level.

- Automate blow down to minimize it.
- Provide proper tools for wash down -- especially self-closing nozzles.
- Install efficient irrigation.
- Reduce flows at water sampling stations.
- Eliminate continuous overflow at water tanks.
- Promptly repair leaking toilets and faucets.
- Use water restrictors on faucets, showers, etc.
- Use self-closing type faucets in restrooms.
- Use the lowest possible hot water temperature.
- Do not use a heating system hot water boiler to provide service hot water during the cooling season -- install a smaller, more-efficient system for the cooling season service hot water.
- If water must be heated electrically, consider accumulation in a large insulated storage tank to minimize heating at on-peak electric rates.
- Use multiple, distributed, small water heaters to minimize thermal losses in large piping systems.
- Use freeze protection valves rather than manual bleeding of lines.
- Consider leased and mobile water treatment systems, especially for deionized water.
- Seal sumps to prevent seepage inward from necessitating extra sump pump operation.
- Install pretreatment to reduce TOC and BOD surcharges.
- Verify the water meter readings. (You'd be amazed how long a meter reading can be estimated after the meter breaks or the meter pit fills with water!)
- Verify the sewer flows if the sewer bills are based on them.

Miscellaneous:

- Meter any unmetered utilities. Know what is normal efficient use. Track down causes of deviations.
- Shut down spare, idling, or unneeded equipment.
- Make sure that all of the utilities to redundant areas are turned off -- including utilities like cooling water.
- Install automatic control to efficiently coordinate , chillers, cooling tower cells, etc.
- Renegotiate utilities contracts to reflect current loads and variations.
- Consider buying utilities from neighbors, particularly to handle peaks.
- Minimize use of flow bypasses and minimize bypass flow rates.
- Consider alternatives to high-pressure drops across valves.
- Turn off winter heat tracing that is on in summer.

Annexure - 1

Standard Lux Level

Activity	Illumination *(lux, lumen/m^2)*
Public areas with dark surroundings	20 - 50
Simple orientation for short visits	50 - 100
Working areas where visual tasks are only occasionally performed	100 - 150
Warehouses, Homes, Theaters, Archives	150
Easy Office Work, Classes	250
Normal Office Work, PC Work, Study Library, Groceries, Show Rooms, Laboratories	500
Supermarkets, Mechanical Workshops, Office Landscapes	750
Normal Drawing Work, Detailed Mechanical Workshops, Operation Theatres	1,000
Detailed Drawing Work, Very Detailed Mechanical Works	1500 - 2000
Performance of visual tasks of low contrast and very small size for prolonged periods of time	2000 - 5000
Performance of very prolonged and exacting visual tasks	5000 - 10000
Performance of very special visual tasks of extremely low contrast and small size	10000 - 20000

Annexure - 2

Energy saver for air conditioning system

IMPORTANT VALIDATIONS

N.B. The Set Temp. was the Same WITH / WITHOUT the Airtron.

SL. NO.	NAME OF THE COMPANY	COUNTRY	AC TYPE	SAVINGS
1	ENERGY EFFICIENCY SERVICES LTD. (EESL GOVT. OF INDIA)	INDIA	SPLIT	44.00%
2	L.G. ELECTRONICS INDIA LTD.	INDIA	SPLIT (INVERTER)	26.00%
3	VIDEOCON TELECOM	INDIA	SPLIT	20.00%
4	TATA COMMUNICATION LTD.	INDIA	SPLIT	28.30%
5	LARSEN & TOUBRO LTD.	INDIA	SPLIT	25.80%
6	TATATELE SERVICES LTD.	INDIA	SPLIT	33.00%
7	TATA POWER LTD.	INDIA	SPLIT	37.50%
8	ASHOK LEYLAND LTD.	INDIA	WINDOW	29.40
9	ZENITH ENERGY (BEE, ACCREDITED ENERGY AUDITOR)	INDIA	SPLIT	37.00%
10	ACCENTURE SERVICES PVT. LTD.	INDIA	SPLIT	37.00%
11	M/S. UNIC MAGNATE	INDIA	SPLIT	58.00%
12	SATURN PYRO (UTIM REGISTRATION OFFICE)	MALAYSIA	CEILING-SPLIT	36.00%
13	SATURN PYRO (AT MALAYSIA POLICE H.Q.)	MALAYSIA	WALL -SPLIT	34.00%
14	CPE ENERGY SDN BHD	MALAYSIA	SPLIT	57.00%

Annexure – 3

Super Energy efficient BLDC Ceiling Fan

	900 mm	1050 mm	1200 mm	1400 mm
Warranty (Years)	3 Years	3 Years	3 Years	3 Years
Blade Span (mm/inch)	900/36	1050/42	1200/48	1400/56
RPM	450	430	350	270
Service Value	7.1	6.6	7.8	7.7
Input Voltage (V)	140-285	140-285	140-285	140-285
Power Consumption (W)	28	32	28	35
Frequency (Hz)	48-52	48-52	48-52	48-52
Air Delivery (CMM)	200	210	220	270
Power Factor	>0.98	>0.98	>0.98	>0.99
No. of Blades	3	3	3	3
Bearing (Double)	Deep Groove Double Sided Steel Shielding			
Remote Control (12 Keys)	Speed Control, Boost Mode, Timer and Sleep Mode			

Comparision Between Ordinary,5 Star Rated AndSuper Efficient Fans

Parameters	Ordinary Fan	5 Star Rated Fan	Super Efficient Fan
Wattage	75	50	28
RPM(speed)	380	**330**	360-380
CMM(air delivery)	230	**210**	220-230
Power factor	>0.9	>0.95	>0.99
Regulator	Yes	Yes	Not Required (Remote controlled)
Input Voltage	230	230	140-285V
Warranty	1-2 year	1-2 year	3 years
MRP	1300-1600	1800-2500	3690