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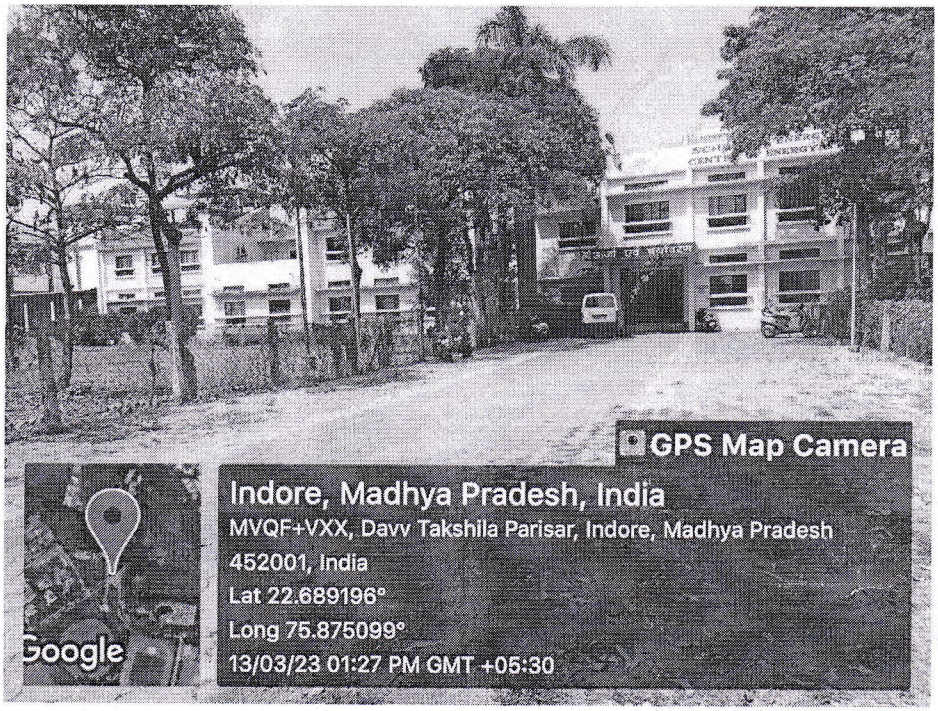
SAVE ENERGY, SAVE ENVIRONMENT

Preliminary Energy Audit
Of
School of Energy & Environmental Studies (SEES)



2021-2022

School of Energy and Environmental Studies
Devi Ahilya Vishwavidyalaya, Indore
(M.P.)

EXECUTIVE SUMMARY

Sr. No	Section	Energy Conservation Measures	Energy Saving (kWh/yr)	Saving (Rs./year)	Investment (Rs.)	Simple payback Period (Months)
1	Lighting	Repl. of 54W Conv. TL with 28W T5 lights	26,910	1,83,870/-	1,72,500/-	11
		Replacement of 100W Bulb with 28W CFL	236	1650/-	500/-	4
2	Cooling Load (Fan)	Replacement of 90W Fan with 52W ceiling fan	166	1160	1800	35
3	Ventilation Load(Ex. Fan)	Replacement of 70W Ex.Fan with 35W Ex.Fan	840	5885/-	1100/-	24
4	Computer	Replacement of 110 W CRT with 25 W (LED)	2005	14035/-	50400/-	43
5	Regulator Fan	Replacement of 15W resiostive regulator with 25 W Electronic Regulator	483	3375/-	200/-	17
		Total	**30,640**	**2,09,975/-**	**2,26,500/-**	**12**

CHAPTER 1

INTRODUCTION

THE SCHOOL

School of Energy and Environmental Studies (SEES), a University Teaching Department under the Faculty of Engineering Sciences was established in 1990. It also has an autonomous sister unit Center of Energy Studies and Research (CESR). The school offers Ph.D., M. Tech., (Regular), M. Tech. (Distance Learning) and M. Phil. Degree Programmes. It is housed in the Takshashila Campus on Khandwa Road.

OBJECTIVES

Development, planning, implementation and evaluation of energy conservation, renewable energy and environment programmes in the country are to a great extent limited by the availability of trained personnel at research, design and engineering level. Hence there is need to train engineers/scientists in energy planning, conservation technologies, renewable energy systems, and their linkages with environment.

ACADEMIC PROGRAMS

1. Ph.D. in Energy and Environment .
2. M.Tech (Energy Management), AICTE approved
3. M.Tech Executive in Energy Management
4. Dual degree (B.tech + M.tech) Energy and Environmental Engineering

INFRASTRUCTURE

The School is having 5 kW solar power plant to cater the needs of lighting and other needs of electricity of class rooms, seminar hall, labs etc. The infrastructure is excellent in school and also equipped with latest computers (Pentiums), internet connection to most of the computers. All the class rooms are equipped with multimedia projection system

METHODOLOGY FOR ENERGY AUDIT

The energy audit is carried out based on actual measurement on site, as well as placing special focus on identifying several sections that has the potential to implement energy savings measures. The following is a list of general procedure and information undertaken during the preliminary energy audit:

1. General information of the Building.
2. Baseline energy description
3. Estimated energy consumption on the basis of connected load
4. Detailed data collection of power consuming equipment's
5. Power measurements of major electrical energy equipments
6. Analysis of collected data and measurements to develop specific energy saving proposals.
7. Energy analysis of different sections, including the CRSE, Distance Education Cell , NABL, etc

The primary goal of the preliminary energy audit was to identify sources and areas of potential energy savings and cost saving throughout the premises by measures of optimization, replacement, retrofitting, and on the other hand, to also provide recommendations on operational and maintenance practices improvements.

The objectives of the energy audit are as under:

- To analysis of energy supply demand pattern of the SEES.
- To measure and analysis of power consumption at different gadgets utilities.
- To analysis existing trend of energy consumption.
- To propose suitable energy conservation measurer with proper techno-economic analysis.

The energy consumption data for the year 2021 was collected. Data analysis and consumption pattern is given in the report. Energy conservation measures are given along with the detailed analysis in the Different sections. Audit report included the introduction, Executive summary, the details of energy consumption of SEES, DAVV, Indore and general observations, Included the analysis of energy consumption in various floor of the department.

CHAPTER-2

DATA COLLECTION

Connected Load Detail:

S. No	Location	Type of Load	Type	Rated Power	Quantity	Total Power (W)
1	G1	Lighting	T5	28	1	28
			CFL	11	8	88
			LED	18	2	36
		Cooling	FAN	60	2	120
			Ex. FAN	30	1	30
			5* AC(1.5TR)	1660	1	1660
		Computer	LCD	360	1	360
				170	1	170
			TV LCD	24	1	24
			Printer	720	2	1440
		UPS		1500	1	1500
2	G2	Lighting	T12	20	1	20
			T5	28	1	28
		Cooling	FAN	60	2	120
			AC	2000	1	2000
		Computer	CRT	240	1	240
			Printer	600	0	0
		UPS		600	0	0
3	G3	Lighting	T5	28	1	28
			CFL	13	1	13
		Cooling	FAN	60	2	120
			REGULATOR	15	2	30
		Computer		240	1	240
4	G4	Lighting	T5	28	1	28
			CFL	13	2	26
		Cooling	FAN	60	2	120
		Computer	LCD	216	1	216
			CRT	480	1	480
			LAPTOP	60	1	60
5	G5	Lighting	T5	28	2	56
			T12	54	1	54
		Cooling	FAN	60	2	120
		Computer	LAPTOP	60	1	60

S. No	Location	Type of Load	Type	Rated Power	Equ. Quantity	Total Power (W)
6	G6	Lighting	T5	28	2	56
		Cooling	FAN	60	1	60
7	G7	Lighting	T5	28	2	56
			BULB	100	1	100
		Cooling	FAN	60	2	120
			REGULATOR	15	2	30
			Ex.FAN	70	1	70
8	G8	Lighting	T5	28	1	28
			T12	54	1	54
		Cooling	FAN	60	1	60
		Computer	LCD	260	1	260
			PRINTER	600	1	600
9	G9	Lighting	T5	28	4	112
			CFL	9	8	72
			FPL	36	6	216
		Cooling	FAN	60	4	240
			AC(1.5 TR)	2000	1	2000
10	G10	Lighting	T5	28	1	28
			CFL	8	1	8
		Cooling	FAN	60	1	60
			REGULATOR	15	1	15
			AC	1900	1	1900
		Computer	LCD	240	1	240
			PRINTER	600	1	600
11	G11	Lighting	T12	54	2	108
		Cooling	FAN	60	1	60
			Fan	90	2	180
			E. FAN	70	2	140
		UPS (1KVA)		1000	1	1000
12	G12	Lighting	T5	28	1	28
			T8	46	1	46
			CFL	18	1	18
		Cooling	FAN	60	2	120
			REGULATOR	15	2	30
		Computer	LCD	75	1	75
			CRT	240	1	240

			PRINTER	480	1	480
		UPS		500	1	500

S. No	Location	Type of Load	Type	Rated Power	Equ. Quantity	Total Power (W)
12	G12	PHOTOCOPY		1400	1	1400
13	G13	Lighting	T5	28	5	140
		Cooling	FAN	60	6	360
			REGULATOR	15	6	90
		Computer	LCD	168	2	336
				288	1	288
			PRINTER	600	1	600
		UPS		500	1	500
14	F1	Lighting	T5	28	4	112
			CFL	36	8	288
		Cooling	FAN	55	2	110
			AC(1.5 TR)	2000		0
15	F2	Lighting	T5	28	1	28
		Cooling	FAN	60	1	60
			AC	1060	1	1060
16	F3	Lighting	T5	28	3	84
		Cooling	FAN	55	4	220
		Computer	LAPTOP	60	1	60
17	F4	Lighting	CFL	36	12	432
		Cooling	FAN	55	3	165
			5* AC	1650	1	1650
			NON *1.5 TR	2000	1	2000
		Computer	LCD	240	2	480
				75	5	375
				85	2	170
		UPS		5000	1	5000
18	F5	Lighting	T5	28	2	56
		Cooling	FAN	60	2	120
			REGULATOR	15	2	30
			5*AC	1660	1	1660
		Computer	LCD	70	1	70
				240	1	360
			PRINTER	600	2	1200
		UPS		600	2	1200

S. No	Location	Type of Load	Type	Rated Power	Equ. Quantity	Total Power (W)
19	F6	Lighting	T5	28	4	112
			BULB	60	1	60
		Cooling	FAN	60	2	120
			REGULATOR	15	2	30
			EX FAN	70	2	140
		Computer	LCD	288	1	288
20	F7	Lighting	T5	28	1	28
		Cooling	FAN	60	2	120
		Computer	LCD	288	2	576
21	F8	Lighting	T5	28	4	112
			CFL	9	8	72
			FPL	36	6	216
		Cooling	FAN	60	4	240
			AC(2TR)	2550	1	2550
		Computer	LCD	360	1	360
			SPEAKER	32	2	64
			PROJECTOR	190	1	190
22	F10	Lighting	T5	28	2	56
			CFL	15	1	15
		Cooling	FAN	60	3	180
			REGULATOR	15	3	45
			EX.FAN	70	2	140
			COOLER	106	1	106
		Computer	CRT	720	1	720
23	F11	Lighting	T5	28	2	56
			CFL	15	1	15
		Cooling	FAN	60	2	120
		Computer	LCD	360	2	720
			PRINTER	600	1	600
			Photocopy	1080	1	1080
			Printer	330	2	660

S.No	Location	Type of Load	Type	Rated Power	Equ. Quantity	Total Power (W)
24	SEMINAR HALL	Lighting	T5	42	12	504
			CFL	36	12	432
		Cooling	FAN	60	8	480
			4*AC	1785	4	7140
		Computer	LCD	40	1	40
			PROJECTOR	190	1	190
			SPEAKERS	40	4	160
				25	2	50
			SYNCHRONIZER	2200	1	2200
				15	1	15
		UPS		2000	1	2000
25	CORIDORE	Lighting	CFL	20	6	120
			T5	28	3	84
			T8	46	1	46
			T12	54	2	108
			CFL	18	3	54
				13	3	39
				15	1	15
		Cooling	FAN	60	2	120
26	TOILET	Lighting	T5	28	2	56
			CFL	18	3	54
			BULB	100	1	100
		Fresh Air	Ex.FAN	70	4	280
28	RTC	Lighting	CFL	80	1	80
		Cooling	AC	1800	1	1800
		Computer	LCD	360	3	1080
			CRT	720	1	720
			PRINTER	600	3	1800
		UPS		1000	1	1000
				1500	1	1500
29	BUILDING	Lighting	TUBELIGHT	28	3	84
			CFL	30	4	120
				18	1	18
			INDUCTION LAMP	150	2	300
			SODIUM VAPOR LAMP	125	1	125
TOTAL CONNECTED LOAD =72.4 kW						

Table: Estimated Monthly Bill

S.NO	MONTHS	kWh	Rs/kWh	MONTHLY BILL
1	JAN	4320	6	28512/-
2	FEB	4320	6	28512/-
3	MAR	4100	6	27060/-
4	APRIL	4250	6	28050/-
5	MAY	4560	6	30096/-
6	JUNE	4560	6	30096/-
7	JULY	3270	6	19,620/-
8	AUG	3270	6	19,620/-
9	SEPT	3100	6	18,600/-
10	OCT	3210	6	19,260/-

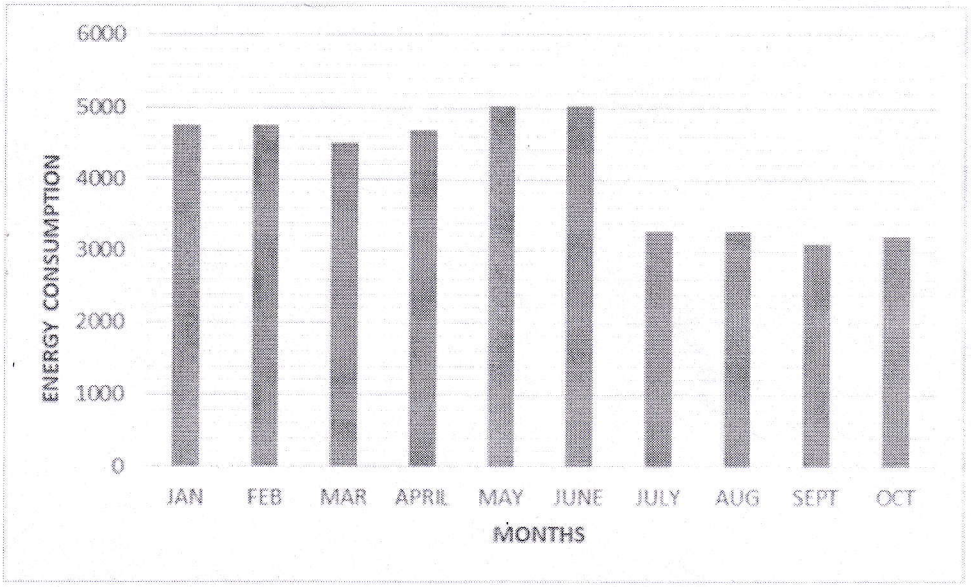


Fig.1 Monthly Energy consumption of the department

SAVINGS & CALCULATIONS:

- **Calculation for replacement of 40W Tubelights with T5(28W):**

Parameter	
Type of load	FTL
Power in watt	54
Total no of fixtures	6

No of hrs/day	12
No of day/year	273
Suggested watt	28
Saving in kWh/Year	460
Load Factor	0.9
Energy Charges Rs./kWh	7
Saving in Rs/Year	3219
Cost/Piece (Rs)	500
Total Investment (Rs)	3000
Pay Back Period (Month)	11.2
Pay Back Period (Year)	0.9

Replacement of 100 W Bulb with T5 (28 W)

Parameter	
Type of load	BULB
Power in watt	100
Total no of fixtures	1
No of hrs/day	12
No of day/year	273
Suggested watt T5	28
Saving in kWh/Year	235
Load Factor	1
Energy Charges Rs./kWh	7
Saving in Rs/Year	1651
Cost/Piece (Rs)	500
Total Investment (Rs)	500
Pay Back Period (Month)	3.6
Pay Back Period (Year)	0.3

Replacement of 110 W CRT with 35 W LED

Parameter	
Type of load	CRT
Power in watt	110
Total no of fixtures	8
No of hrs/day	12
No of day/year	273
Suggested watt(LED)	25
Saving in kWh/Year	2004.91
Load Factor	0.9
Energy Charges Rs./kWh	7
Saving in Rs/Year	14034.4
Cost/Piece (Rs)	6300
Total Investment (Rs)	50400
Pay Back Period (Month)	43
Pay Back Period (Year)	3.59

Replacement of 90 W Fan with 52 W:

Parameter	
Type of load	Fan
Power in watt	90
Total no of fixtures	2
No of hrs/day	8
No of day/year	273
Suggested watt	52
Saving in kWh/Year	165
Load Factor	1
Energy Charges Rs./kWh	7
Saving in Rs/Year	1161
Cost/Piece (Rs)	1800
Total Investment (Rs)	3600
Pay Back Period (Month)	37
Pay Back Period (Year)	3.09

Replacement of 70 W exhaust fan with 35 W

Parameter	
Type of load	Ex .Fan
Power in watt	70
Total no of fixtures	11
No of hrs/day	8
No of day/year	273
Suggested watt	35
Saving in kWh/Year	840.8
Load Factor	1
Energy Charges Rs./kWh	7
Saving in Rs/Year	5885.8
Cost/Piece (Rs)	1100
Total Investment (Rs)	12100
Pay Back Period (Month)	24
Pay Back Period (Year)	2.05

General Recommendations

- Replace existing single fitting **40 W** conventional tubes with convention chokes by **28 W** energy efficient **(T5)** tubes.
- Replacement of **75 W and 73 W** Fan is needed with **52 W** fan.
- Sitting arrangement is not proper as per the day lighting hence it should be arranged as per maximum day lighting situation.
- At some places the condensing units are placed near the window or the door area, which is increasing the heat flux inside the conditioned room.
- Required lux level for reading is 500 so the place like library, it should be noticed and lux level should be increased wherever needed and use of daylight should be encouraged.
- Install motion sensors: If the school has areas that are frequently unoccupied, such as hallways or classrooms, installing motion sensors can help reduce energy consumption by automatically turning off lights when no one is present.
- Energy-Efficient Lighting: Replace existing lighting fixtures with LED lights to reduce energy consumption and maintenance costs.
- HVAC Optimization: Optimize HVAC systems by using programmable thermostats, regular maintenance, and air filter replacements to improve efficiency and reduce energy consumption.
- Energy-Efficient Equipment: Replace outdated and inefficient equipment with energy-efficient models that are certified by BEE to reduce energy consumption.
- Power Factor Correction: Install power factor correction devices to minimize energy consumption and improve the efficiency of electrical systems.
- Renewable Energy: Consider expanding the existing solar power plant or adding more renewable energy sources such as wind turbines to generate clean energy and reduce reliance on grid power.
- Energy Management System: Implement an energy management system to monitor and manage energy consumption in real-time, identify areas of high consumption, and optimize energy usage.
- Education and Awareness: Educate students and staff about energy conservation and efficiency to promote a culture of energy conservation in the school.

- Green Building Standards: Consider adopting green building standards such as LEED or GRIHA to optimize building design and construction for energy efficiency.

- These recommendations focus on optimizing the use of existing infrastructure such as the solar power plant, while also identifying opportunities to improve energy efficiency and reduce energy consumption through the use of energy-efficient equipment, renewable energy, and energy management systems. Implementing these recommendations can help your school reduce its environmental footprint and energy costs.

Energy Conservation Opportunities in Building:-

Lighting:

- Reduce excessive illumination levels to standard levels using switching, decamping, etc.
- (Know the electrical effects before doing decamping.)
- Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.
- Install efficient alternatives to incandescent 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.

Buildings:

- Seal exterior cracks/openings/gaps with caulk, 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 sun light 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.

COMPARISION B/W DIFFERENT TYPES OF LAMPS

	Different lamps					
Factor	Incandescent (Bulb)	Fluorescent (CFL)	Metal Halide	HPSV	LED	Induction
Power (watt)	25-150	18-95	50-400	50-400	150	80-150
Output (lumens)	210-2700	1000-7500	1900-30,000	3600-46,000	7200	9600-12,000
Efficacy (lumens/ Watt)	8-18	55-79	38-75	72-115	48	75-80
Lumen	85	80	65	70	90	90
Lamp life (Hr)	750-2000	10,000-20,000	10,000-20,000	18,000-24,000	50,000	1,00,000
Life (operating hrs)	< 1 yr	5.5 yr	4 yr	5.5 yr	< 14 yr	27 yr
CRI	Excellent (100)	Good	Good	Poor (20)	Very Good	Very Good (80)

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