Preliminary Energy Audit
Of
Central library
DAVV

School of Energy and Environmental Studies
Devi Ahilya Vishwavidyalaya, Indore
Indore

Submitted by:
Lav Kumar Singh

Guided by:
Dr. S.P Singh
(Head & Professor)

ACKNOWLEDGMENT

First and foremost we would like to give our sincere thanks to **Dr. Ajay Kumar (Librarian)** and the entire staff for their kind cooperation.

we take this opportunity to express our hearty thanks to all of them who directly or indirectly helped us in this project.

Yours Sincerely
Lav Kumar Singh
SEES DAVV, Indore

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EXECUTIVE SUMMARY

Energy Conservation measures in existing utilities- Central Library

S.N	Section	Scheme	No. of fixtures	Energy saving (kwh/year)	Saving (Rs./year)	Investment (Rs.)	Simple Pay Back period (months)
1	Lighting	Replacement of52W & 42Wconventional tube-light with new energy efficient 18W LED Tube- light	132	8,268	57,879	29,040	6
2	Cooling	Replacement 90W classic model ceiling fans with new energy efficient fan of 53W ceiling fan	112	8,951	62,657	1,34400	26
		TOTAL		**17,219**	**1,20536**	**1,63,440**	

CHAPTER 1

INTRODUCTION

The University Library was established in the year 1964 along with the establishment of the university. The University Library is catering to the information needs of the academic community. The University Library started the Bachelor of Library and Information Science Program from the year 1993- 94, as a part of time course, with its goals to train the manpower to manage the libraries of the 21st century. The following regular courses have been introduced during 2006, BLISc and MLISc. M.Phil in Library and Information Science has started from the academic year 2009-10. The University Library has qualified, experienced, devoted professional along with the latest information facilities. The university library is providing ITELS for its members.

Central Library is connected to the common transformer of 350 KVA. The connected load of the department is **30.854 kW**. The Energy Audit conducted in the month of **Oct-18** taken the relevant measurements on all gadgets and utilities used in the building. Also, several important observations have been recorded to suggest energy conservation measures.

The objectives of the energy audit are as under:

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

The energy consumption data for the year 2018 was collected. Data analysis and consumption pattern are 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 detained of energy consumption of Central Library, DAVV, Indore and general observations, Included the analysis of energy consumption in the various floor of the department.

CHAPTER 2
DATA COLLECTION

Electrical Energy Consumption & Bills:-

The power supply for the Central Library, DAVV, Indore is from common feeder from M.P.P.K.V.V.Co. Ltd. with the help of 11 KV non industry urban feeders from the 350 kVA transformer. The monthly electricity bills for the one year showing Energy consumption. The monthly electrical consumption for the plant of the year 2018 is given in the following table:

Monthly Estimated Bill

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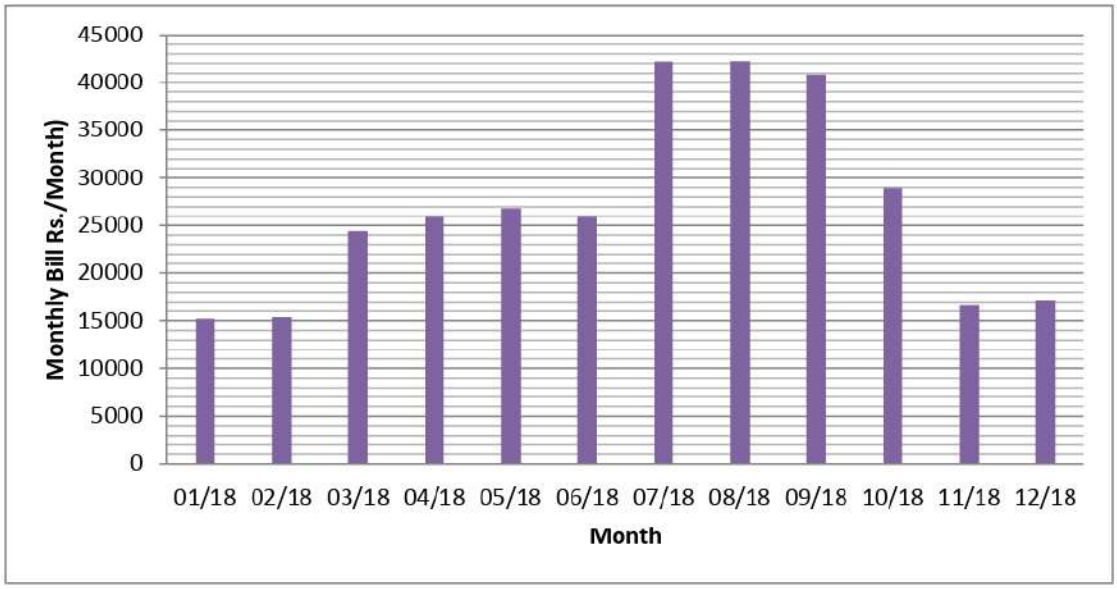
Sr. No.	Month	Energy Consumption(kWh)	Energy Charges (Rs/kWh)	Monthly Bill Rs./Month)
1	Jan-18	2173.86	7/-	15217.02/-
2	Feb-18	2196.93	7/-	15378.51/-
3	Mar-18	3487.65	7/-	24413.55/-
4	Apr-18	3708.69	7/-	25960.83/-
5	May-18	3832.31	7/-	26826.17/-
6	Jun-18	3708.69	7/-	25960.83/-
7	Jul-18	6032	7/-	42224/-
8	Aug-18	6032.29	7/-	42226.03/-
9	Sep-18	5837.7	7/-	40863.9/-
10	Oct-18	4130.68	7/-	28914.76/-
11	Nov-18	2376.36	7/-	16634.52/-
12	Dec-18	2455.57	7/-	17188.99/-


45000
40000
35000
30000
25000
20000
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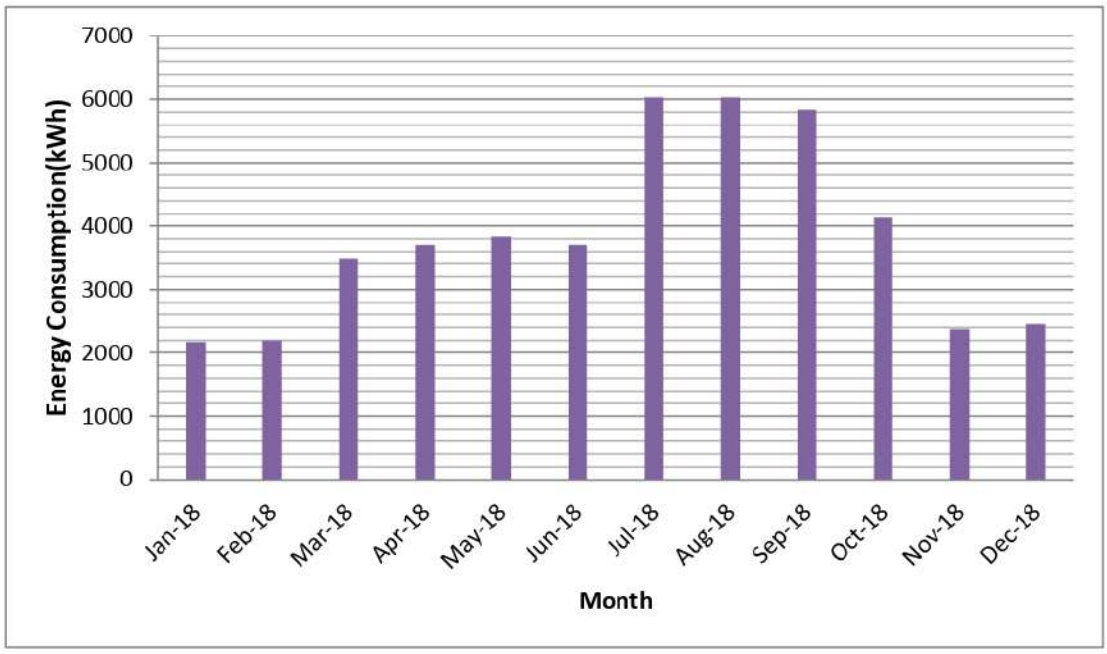
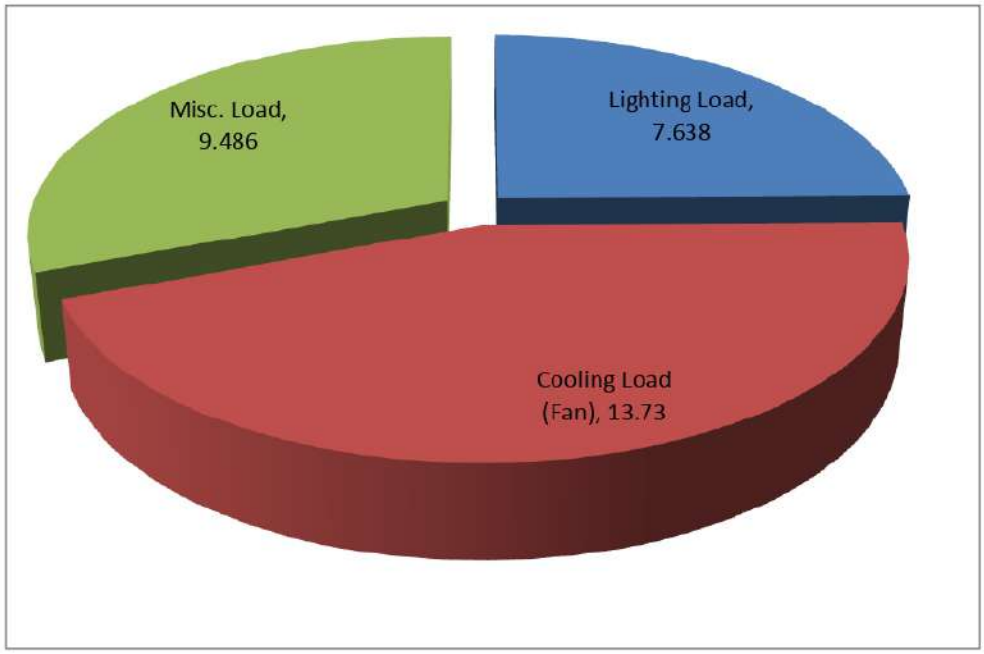
5000
0
Monthly Bill Rs./Month)
01/18 02/18 03/18 04/18 05/18 06/18 07/18 08/18 09/18 10/18 11/18 12/18
Month


7000
6000
5000
4000
3000
2000
1000
0
Energy Consumption(kWh)
Jan-18 Feb-18 Mar-18 Apr-18 May-18 Jun-18 Jul-18 Aug-18 Sep-18 Oct-18 Nov-18 Dec-18
Month

CONNECTED LOAD OF OVERALL DEPARTMENT

Type of load	Kw
Lighting Load	7.638
Cooling Load (Fan)	13.73
Misc. Load	9.486
Total	**30.854**



TOTAL LOAD CONNECTED OF LIBRARY

S. NO.	Type of Load	Type	Rated power (watts)	Quantity	Total wattage (kw)
1	Lighting	FTL	52	66	3.432
		FTL	42	66	2.772
		LED	18	38	0.684
		Metal Halide	150	5	0.75
				Total Consumption	7.638
2	Cooling	Ceiling Fan	90	112	10.08
		Wall Fan	70	3	0.21
		Exhaust	60	3	0.18
		Water Cooler	775	1	0.775
		cooler	175	3	0.525
		AC 3*	1960	1	1.96
		Refrigerator(80Lit)			
				Total Consumption	13.73
3	Computer	LCD	150	12	1.8
		CRT	250	3	0.75
4	Printer	Hp laserjet	315	9	2.835
5	Xerox Machine		1400	1	1.4
6	Fax Machine		415	1	0.415
7	Wi-Fi Router		20	2	0.04
9	induction		2126	1	2.126
10	CCTV		40	3	0.12
				Total consumption	9.486

ENERGY SAVING CALCULATION:-

Tube light

Replacement of 52Watt tube light with 18 Watt LED tube light.

S.No	Parameter	Value
1	Type of load	TUBELIGHT
2	Power in watt	**52**
3	Total no of fixtures	66
4	No of hrs/day	8
5	No of day/year	270
6	Suggested watt	18
7	Saving in kWh/Year	4847.04
8	Load Factor	0.9
9	Energy Charges Rs/kWh	7
10	Saving in Rs/Year	33929.28
11	Cost/Piece(Rs)	220
12	Total Investment	14,520
13	Pay Back period(YEAR)	0.427948957
14	Pay Back period(Month)	5.135387488

Replacement of 42 Watt tube light with 18 Watt LED tube light.

S.No	Parameter	Value
1	Type of load	TUBELIGHT
2	Power in watt	**42**
3	Total no of fixtures	66
4	No of hrs/day	8
5	No of day/year	270
6	Suggested watt	18
7	Saving in kWh/Year	3421.44
8	Load Factor	0.9
9	Energy Charges Rs/kWh	7
10	Saving in Rs/Year	23950.08
11	Cost/Piece(Rs)	220
12	Total Investment	14,520
13	Pay Back period(YEAR)	0.606261023
14	Pay Back period(Month)	7.275132275

Fan:

Calculations for replacement of 90W fans with 5 star rated 53W

S.No	Parameter	Value
1	Type of load	FAN
2	Power in watt	**90**
3	Total no of fixtures	112
4	No of hrs/day	8
5	No of day/year	270
6	Suggested watt	53
7	Saving in kWh/Year	8951.04
8	Load Factor	0.9
9	Energy Charges Rs/kWh	7
10	Saving in Rs/Year	62657.28
11	Cost/Piece(Rs)	1200
12	Total Investment	1,34,400
13	Pay Back period(YEAR)	2.145002145
14	Pay Back period(Month)	25.74002574

Recommendations:-

- Replacement of tube-lights in place of two 42W conventional tubes with single 18W T5 LED Tube.
- Replacement of 90W ceiling fan with 53W energy efficient fan.
- In classrooms daylight is sufficient for lighting; here we can reduce the lighting load.
- Use air to air heat exchanger to reduce energy requirements for heating and cooling of outside air.
- Using heat reflective glass windows which can help to reducing the cooling load.
- Replacement of CRT with energy efficient LED monitors.
- Suggested MCB RATING for lighting load **20A.**
- Suggested MCB RATING for cooling load **12**

Energy Conservation Opportunities In Building
HVAC (Heating / Ventilation / Air Conditioning):-

- Consider daylighting, skylights, etc.
- Consider painting the walls a lighter color and using less lighting fixtures or lower wattages.
- Re-evaluate exterior lighting strategy, type, and control. Control it aggressively.
- Change exit signs from incandescent to LED.
- 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.
- Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.
- Use task lighting and reduce background illumination.

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 the 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.

Annexure (i)

Specifications required for LED Tube light (includes LED batten):

S. No.	Parameter	Value
01.	Size	Standard T5
02.	Color	Cool Day Light
03.	Wattage	18 watts
04.	Warranty (Years)	2-3
05.	Operating Life (Hrs)	35000-50000

Specifications required for Fan:

S. No.	Parameter	Value
01.	Span (MM/INCH)	1200/48
02.	Wattage	53(BEE 5 Star)
03.	Air Delivery (CMM)	230
04.	RPM	300
05.	Warranty (Years)	3-5
06.	Power Factor	>.98
07.	Number of Blades	3

Annexure (ii)

Parameter	Type of Lamp						
	Incandescent (Bulb)	CFL	Metal Halide	HPSV	LED	Fluorescent Tube light (T8)	LED Tube light (T8)
Power (watt)	25-150	18-95	50-400	50-400	150	25-125	18-36
Output (lumens)	210-2700	1000-7500	1900-30000	3600-46000	7200	2000	2000
Efficacy (lumens/ Watt)	8-18	55-79	38-75	72-115	48	50-100	80-150
Life Span (Hrs.)	750-2000	10000-20000	10000-20000	18000-24000	50000	7000-15000	35000-50000
CRI	Excellent (100)	Good	Good	Poor (20)	Very Good	Good	Very Good

Appendix

List of Vendors and Distributors of LED & Fan:-

HELPLINE NUMBER: 18001803580/155275	
1	AAZAD NAGAR MPEB, INDORE
2	AGRASEN NAGAR MPEB, INDORE
3	ANNAPURNA MPEB, INDORE
4	ARANYA NAGAR ,MPEB, INDORE
5	ELECTRIC COMPLEX MPEB, INDORE
6	GANDHI NAGAR MPEB, INDORE
7	GUMASHTA NAGAR MPEB, INDORE
8	KHAJRANA ,MPEB, INDORE
9	MAHA LAXMI MPEB, INDORE

10	MALVA MILL MPEB, INDORE
11	MANORAMA GANJ, MPEB, INDORE
12	MECHANIC NAGAR, MPEB, INDORE
13	NARSING BAZAR MPEB, INDORE
14	NAVLAKHA MPEB, INDORE
15	POLO GROUND MPEB, INDORE
16	RAJ MOHALLA-KALANI NAGAR MPEB, INDORE
17	SANGAM NAGAR, MPEB, INDORE
18	SIYA GANJ MPEB, INDORE
19	SUBHAS CHOK MPEB, INDORE
20	TILAK NAGAR MPEB, INDORE

21 VIJAY NAGAR MPEB, INDORE

School Of Physical Education,DAVV,Indore

Criteria-7(Section:7.1.3)

7.1.3 Annual power requirement of the Institution met by the renewable energy sources (1) (current year Data)

Power requirement met by renewable energy sources	Total power requirement	Renewable energy source	Renewable energy generated and used	Energy supplied to the grid
NIL	15.623 kw	NIL	NIL	

HEAD
School of Studies in Physical Education

7.1.3 Annual power requirement of the Institution met by the renewable energy sources (1) (current year Data)

Power requirement met by renewable energy sources	Total power requirement	Renewable energy source	Renewable energy generated and used	Energy supplied to the grid
0	4028 kWh	0	0	0

EMRC

माह	2014		2015		2016		2017		2018	
	यूनिट	बिल राशि	यूनिट	बिल राशि	यूनिट	बिल राशि	यूनिट	बिल राशि	यूनिट	बिल राशि
जनवरी	7649	60121	6019	50123	6172	56537	4676	43914	12000	98830
फरवरी	7060	57005	6015	49879	7000	53760	18000	134237	10600	88995
मार्च			5737	48821	3000	42971	18000	134023	11040	92119
अप्रेल			10951	92731	3000	36677	20000	145924	1840	-41063
मई			13178	119745	22534	167086	25000	203273	8480	37513
जून	14498	125461	10953	102114	8824	72379	18000	143054	8640	80037
जुलाई	12335	104124	9692	89067	7694	55603	9920	91958	6480	63802
अगस्त			8211	71610	4622	41887	8160	72055	8000	70490
सितम्बर	9929	76737	8528	83029	8234	66972	9040	76276	8840	76582
अक्टूबर	7987	67936	8324	78276	5524	48211	3000	32775	1760	24929
नवम्बर	7995	62530	6633	60858	5614	49321	2720	31742	3800	40232
दिसम्बर	5618	47957	5671	54086	2664	29334	6560	60351	7380	67232
कुल	73071	601871	99912	900339	84882	725738	143076	1169582	88860	699698

add

Preliminary Energy Audit
Of
Institute of Management Studies (IMS)

Submitted By

Project Team

Mr. Rajat Rathore
(M.Tech SEES)

Guided by:
Dr S.P. Singh

School of Energy and Environmental Studies
Devi Ahilya Vishwavidyalaya, Indore

ACKNOWLEDGEMENT

First and foremost we would like to give our sincere thanks to the **Dr.(Mrs.) Sangeeta Jain M.B.A., PhD (Head & Professor), IMS, DAVV, Indore** and the entire staff for their kind cooperation.

We take this opportunity to express our heartily thanks to all of them who directly or indirectly helped us in this project.

Yours Sincerely,
Mr. Rajat Rathore
M.Tech SEES
2017-19

EXECUTIVE SUMMARY

Sr. No	Section	Energy Conservation Measures	Saving (Rs./year)	Investment (Rs.)	Simple Payback Period (Year/month)
1	Lighting	Replacement of T12 (54W) Conventional tube light with Energy Efficient LED(18W) lights	2,35,690/-	71,500/-	0.30/3.6
2	Cooling Load (Fan)	Replacement of Old Fan (90W) with 53W Energy Efficient ceiling Fan	3,03,816/-	2,86,800/-	0.94/11.32
3	Cooling Load (ACs)	Replacement of Old Window ACs (2250W) ACs with 3 star rated (1070W) ACs	3,93,176/-	4,01,200/-	1.02/12.24
		Total	**9,32,682/-**	**7,59,500/-**	**0.81/9.8**

CHAPTER – 1

INTRODUCTION

The Institute of Management Studies, IMS is established in 1969, under the aegis of the University, Institute of Management Studies (IMS), and Devi AhilyaVishwavidyalaya (DAVV) acts as the management education wing of DAVV and shares the responsibility to provide leadership in fulfilling the joint mission of education, research and training. The institute is one of the top ranking institutions in India.

The Institute has dedicated young and highly qualified faculty and is supported by distinguished visiting and guest faculty from industry and professions like consulting, chartered accountancy, etc. It has developed strong linkage with industry which has continuously provided it unstinted support and co-operation. The Institute is a Centre of Excellence in management education and research. . The programmers are designed to develop confidence, self-esteem, communications and teamwork. Learners have strong ownership of the process which encourages cooperation, commitment, input and decision making.

Courses offered by IMS are…

MBA (Fulltime)

The Master of Business Administration is a two year full time programme is aimed at bringing together students of various backgrounds from all over India and grooming their conceptual and analytical skills so as to streamline the talents to adapt to the ever demanding requirements of the modern business world. The MBA programme spread over four semesters aiming at imparting quality management education in specialized areas of Marketing, Finance, Information Systems and Human Resources Development designed to cater to the ever-evolving demands of the market. Students are exposed to various dimensions of management and behavioral sciences with dual specialization - major and minor.

MBA (Part-time)

Masters of Business Administration - Part Time is a three-year programme offered by Institute of Management Studies designed to cater the need of pursuing management education for working executives.

MBA (Distance Education)

Masters of Business Administration - Distance Education is a three-year programme offered by Institute of Management Studies providing management

education through correspondence to people located at far off places in various part of the country.

MBA (FA) Programme

Recognizing the need for the business school curriculum to incorporate the requirements of corporate changes and to prepare today's graduates for the new and varied challenges offered by the real business world, IMS conceived Master of Financial Administration in 1995.

The Master of Financial Administration is a two-year full time tailor made programme engineered to impart quality management education arising out of fundamental rethinking in Capital Market, Financial Services, International Finance, Insurance and other financial areas.

The MFA programme aims to equip the students with the requisite knowledge and skills In financial planning, decision making and

MBA(e-commerce)

The **MBA (e-commerce)** programme at IMS is conducted with the following primary objectives: Enriching the students with interdisciplinary and multidimensional flavor to IT and management. Bridging the gap between management and technology. Enhancing the capacity for creative thinking, problem solving and decision making familiarizing them with integrative business processes.

MBA-DISASTER MANAGEMENT

Recognizing the need for the business school curriculum to incorporate the requirements of environment changes and to prepare today's graduates for the new and varied challenges offered by the real social economic world, IMS conceived Master of Business Administration (Disaster Management) in 2007. The main objective of the program is to equip the students with the requisite knowledge and skills in planning, decision making and control, specifically in the field of Disaster Management.

VISION BEHIND MBA (DISASTER MANAGEMENT) PROGRAMME

The MBA (DM) curriculum is open to periodic review and update. It includes several additional inputs in different functional areas not offered in conventional management programmes, specifically incorporated to meet the socio-economic challenges. Disaster Managers seeks to optimize within the parameters of economic, political, legal, social and cultural environment.

The MBA (DM) program incorporates cross functional integration by providing knowledge about legal and economic environment, safety and health, disaster management, civil society organizations, organization structure, organization behavior, strategic management, information system and quantitative techniques. In distinguished sectors in the light of moral responsibility and individual interest of socioeconomic organizations of vibrant economy. The broad and diverse career prospects of safety, health and environment management, insurance and bank management, including risk management, project management, NGO management in respect to corporate social responsibility. Risk reduction & vulnerability assessment, Carbon credit, microfinance, livelihood development, and preparedness and capacity development.

MBA (HA) Programme

The MBA (HA) program at IMS is conducted with the following primary objectives: Developing effective hospital managers capable of fulfilling the needs of twenty first century by imparting knowledge and skills required in the area of hospital administration. Providing quality educational inputs, attitude and personality development facilities. Equipping students with up to date knowledge of modern management concepts and techniques. Providing consultancy services to business organizations and public system. Grooming the students for health care industry including hospitals, pharmaceutical industry, insurance companies and other commercial organizations.

B.B.A. (e-Commerce)

Course Objective: • To enforce the students with the strength of e-Commerce fundamentals and scope of mobile technology; • To provide the foundation for 360 degree dimensional platform of technology and business integration so that it would open vistas for profession, startup, entrepreneurship, business or career.

Learning Outcome: At the end of the course students should be able to; • Create focused technical ability to exploit the computing and communication infrastructure in business processes. • Explore the applications and domain based utility of internet services and web platforms for e-Commerce and m-Commerce • Set the parametric usage towards the unexplored area of market to gain the base or potentials of customer and market.

M.B.A. 2 Year Component of 5 Year Integrated MBA (e-Commerce)

Course Objective: The objective of teaching this course is to enable students to integrate knowledge of various functional areas and technologies use for business integration.

Learning Outcome: At the student will get the knowledge of various functional areas uses for businesses integrations

BBA (Hospital Administration)

Course Objectives: To expose the students to the different functions performed by managers, the roles they have to perform for those functions, and the knowledge and skills they have to develop for the roles through real life examples and cases.

Learning Outcomes: At the end of the course students should be able to 1. Define Management and explain how management differs according to level and whether a manager is a line manager or on an enabling role. 2. Briefly describe and contrast four models of management; rational, goal, scientific, human relations, open systems and, describe and attain some elementary level of skills in the main management processes; planning, organizing, decision making and control.

M.B.A. (EXECUTIVE)

Course Objective: • To expose the students to the different functions performed by managers, the roles they have to perform for those functions , and the knowledge and skills they have to develop for the roles through real life examples and cases; • To provide the necessary foundation for all other courses based on management practices across the world

Learning Outcome: At the end of the course students should be able to; 1. Define Management and explain how management differs according to level and whether a manager is a line manager or an enabling role. 2. Briefly describe and contrast four models of management; rational, goal, scientific, human relations, open systems 3. Describe and attain some elementary level of skills in the main management processes; planning, organizing, decision making and control

M.Phil. (Management) Programme

Ph.D. (Management) Programme

Necessity of Energy Audit:

The Energy Audit conducted in month of OCT-18, and taken the relevant measurements on all gadgets and utilities used in the building. Also the several important recorded to suggest the energy conservation measures.
The objectives of the energy audit are as under:

1. To analysis of energy supply and demand pattern of the IMS, Indore.
2. To measure and analysis of power consumption at different gadgets utilities.
3. To analysis existing trends of energy consumption.
4. To propose suitable energy conservation measure with proper techno-economic analysis.

The energy consumption data for the year 2018 (Jan-Sep) 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 detained of energy consumption of IMS, Indore and general observations, include the analysis of energy consumption in various floor of IMS, Indore.

CHAPTER-2

DATA COLLECTION

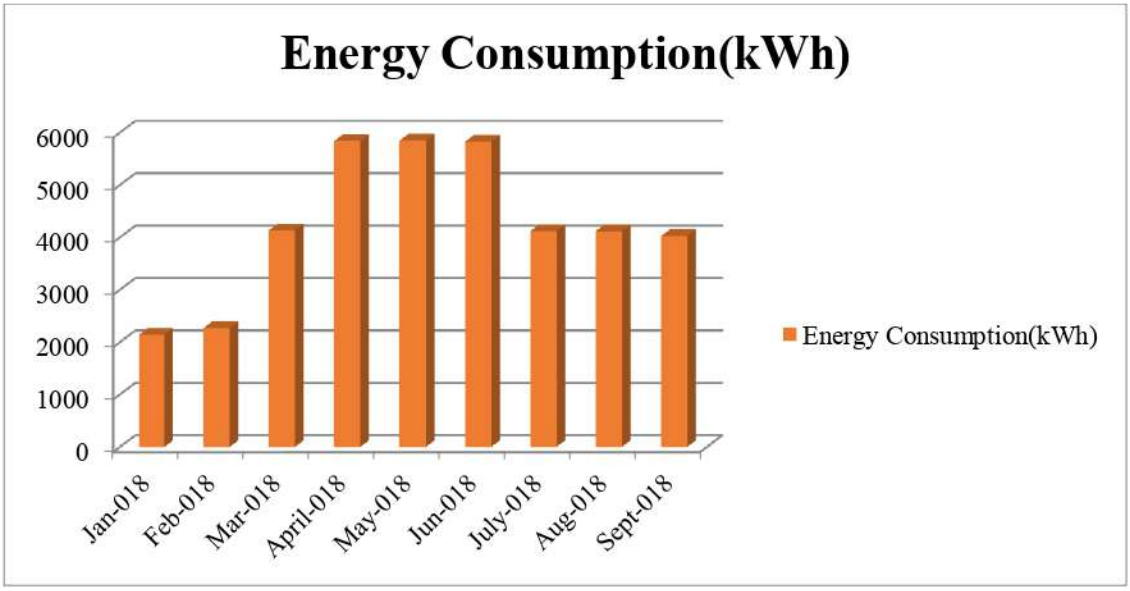
This section contains consumption figures of electricity, etc.

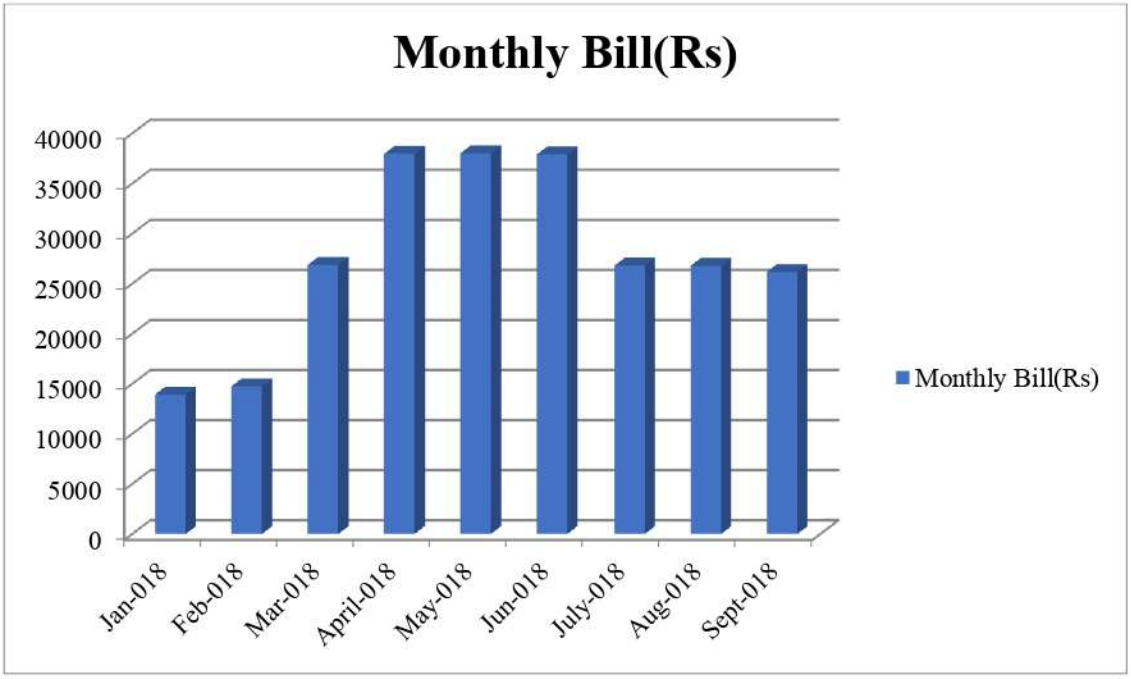
2.1. Electrical Energy Consumption and Bills:

The power supply for The Institute of management studies, Indore is from M.P.P.K.V.V.Co. Ltd. with the help of 33 KV non industry urban feeders from 350 kVA transformer. The monthly electricity bill for the one year showing kWh consumption. The monthly electrical consumption for the deptt. from**Jan-2018 to Sept-2018** is given in the following table:

Table: - Monthly Electricity Consumption

Sr. No	Month	Estimated Energy Consumption (kWh/Month)	Energy Charges (Rs/kWh)	No. of Working (Day/Month)	Estimated Energy Bill (Rs/-)
1	Jan-18	248	7	24	43183/-
2	Feb-18	246	7	22	41632/-
3	Mar-18	352	7	24	60655/-
4	Apr-18	762	7	24	1,29,740/-
5	May-18	778	7	18	97306/-
6	June-18	192	7	24	35,482/-
7	July-18	536	7	24	99,053/-
8	Aug-18	486	7	22	82,328/-
9	Sept-18	436	7	24	80,572/-


Energy Consumption(kWh)
6000
5000
4000
3000
2000
1000
0
Jan-018
Feb-018
Mar-018
April-018
May-018
Jun-018
July-018
Aug-018
Sept-018
Energy Consumption(kWh)


Monthly Bill(Rs)
40000
35000
30000
25000
20000
15000
10000
5000
0
Jan-018
Feb-018
Mar-018
April-018
May-018
Jun-018
July-018
Aug-018
Sept-018
Monthly Bill(Rs)

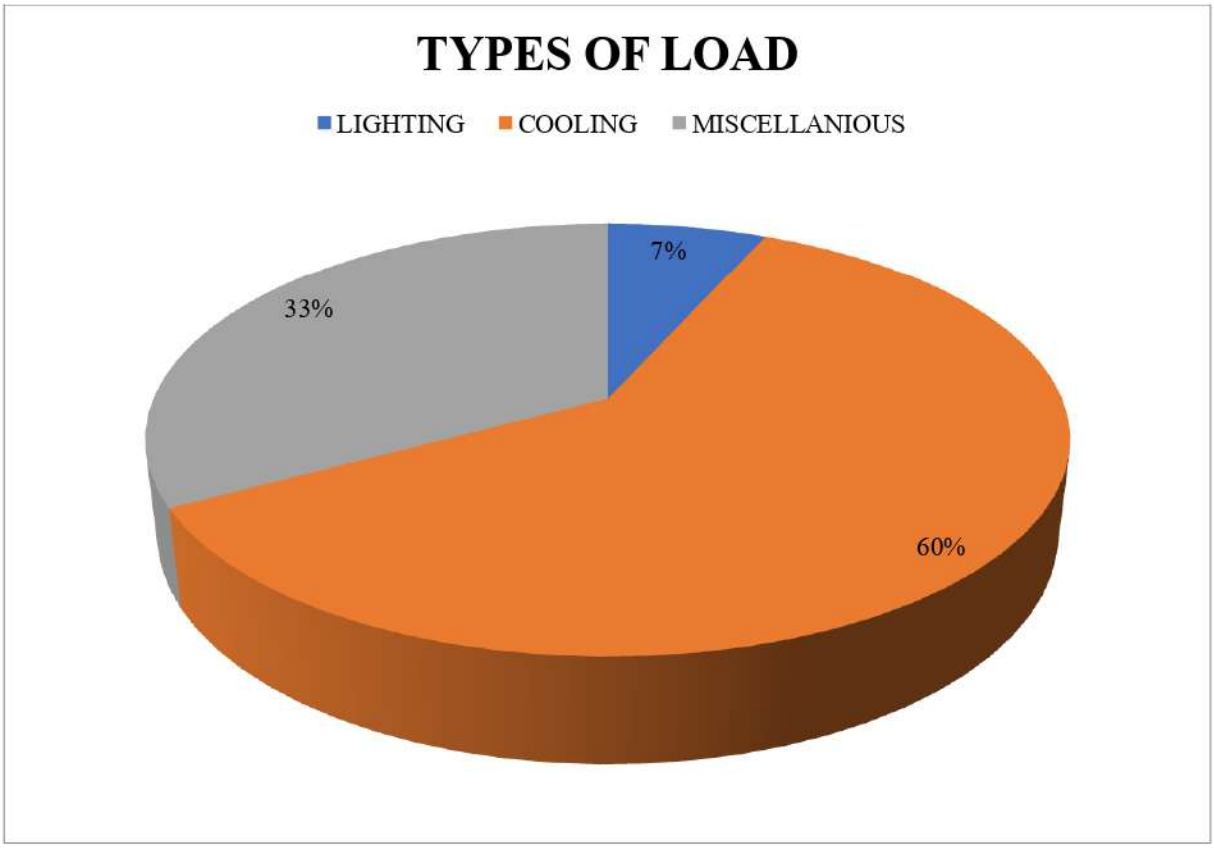
2.2 Connected Load of overall department:-

Lighting Load –42.78kW

Cooling Load (AC) –54.65 kW

Cooling Load (Fan) –21.65 kW

Misc. Load – 13.05 kW



2.3 Connected Load of Department:-

Sr. No	Type of Load	Rated Power (W)	No of Fixtures	Total Connected Load (kW)
1	FTL	54	325	17.5
		36	42	1.5
		28	43	1.2
		20	253	5.1
		18	14	0.2
2	BULB	40	4	0.4
		200	24	4.8
		1000*	8	8.0
3	Ceiling Fan	90	239	21.5
4	Table fan	65	1	0.1
5	Exhaust Fan	70	6	0.4
	Pedestal fan	65	10	0.6
5	Computer (CRT)	110	3	0.3
6	Computer (LCD)	35	76	2.7
7	Printer+ Scanner	425	2	0.8
	Printer	370	17	6.3
	Dot Matrix Printer Laser printer	400 50	1 15	0.4 0.75
8	ACs (Split)	2250	12	24.24
	ACs (Window)	1850	17	31.4
9	Air Cooler	250	2	0.5
10	Water Cooler	625	2	1.2
11	Fax	120	1	0.12
12	Projector	265	8	2.12
Total				**132.13**

2.3 Connected Load of Department:-

Note:* Metal Halide on building. Total connected load in building is around 132.13kW

Savings and Calculations:-

Calculations for replacement of 54W tube light with LED LIGHT (18 W)

Factors	UNITS	LED	FTL
Rating per lamp	Watt	18	54
Operating Hours per day	Hrs.	10	10
No of days per years	Days	280	273
No of lamps	Nos.	1	1
Annual consumption for 10 hrs per day	kWh	49.14	147.42
energy charges (Rs/kWh)	Rs.	7/-	7/-
Operating cost per year	Rs.	343.98	1031.94
Life	Hrs.	50000	7500
Life	Years	13.7	3
unit cost	Rs.	220/-	200/-
Comparison for replacement	No.	1	4
Replacement time	Days	3000	750
Net saving for whole life	Rs.	2334	3690
Total lamps	Nos.	325	
Total Savings	Rs.	2,35,690/-	
Total investment	Rs.	71500/-	
Simple payback period	Years/Month	0.30/3.6	

Calculation for Cooling load (FAN)

Sr. No	Factors	Parameter	Unit
1	System Power Consumption	90	W
2	Suggested System Consumption	53	W
3	Operating Hours	10	
4	No. of Days System used in a Year	273	
5	No. Of fixtures	239	
6	L1(NEW SYSTEM)	0	years
7	L2(OLD SYSTEM)	0	years
8	Cost of 1 piece	1200	INR
8	Investment	286800/-	INR
9	Salvage Value	200	INR
	Total salvage values	47800/-	
10	Maintenance cost	0	INR
11	Saving in kWh/Year	43402.4	KWh / Y
12	Subsidy	0	INR
13	Cost of Electricity per Unit	7	INR
15	Cost Savings per year	303816/-	INR
16	Net Investment	239000/-	INR
17	Escalation in Electricity cost /year (%)	1	

Calculation for Cooling load (AC)

Sr.No	Factors	Parameter	Unit
1	System Power Consumption	2250	W
2	Suggested System Consumption	1070	W
3	Operating Hours	8	
4	No. of Days System used in a Year	280	
5	No. Of fixtures	17	
6	L1(NEW SYSTEM)	0	Years
7	L2(OLD SYSTEM)	0	Years
8	Cost of 1 piece	23600/-	INR
8	Investment	401200/-	INR
9	Salvage Value	2000	INR
	Total salvage values	44000	
10	Maintenance cost	0	INR
13	Cost of Electricity per Unit	7	INR
14	Energy Savings/year	56168/-	kWh
15	Cost Savings per year	393176/-	INR
16	Net Investment	357200/-	INR
17	Escalation in Electricity cost /year (%)	1	

Recommendations

- Replace existing single fitting **54W** conventional tubes with convention chokes by **18 W** energy efficient **LED LIGHT**.
- Replacement of **90 W** Fan is needed with **53 W** EESLfan.
- Replacement of **1.8 kW (1.5 TR)** with **1.5 kW (1.5 TR VIDEOCON 3 STAR)*** split AC.
- 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.
- Stop wasting of energy due to unnecessary switch on for long times.
- Proper ventilation of air movement to reduce fan power consumption.
- At some places open electrical wiring which can meet to an accident so should be solved as early as possible
- Replace old computer's with new one for energy saving.
- Install roof top solar panel ,a step towards renewable energy.
- **Philips Lighting** has announced the launch of first-of-its-kind **LED bulb** in India known as **T Bulb**. The bulb is meant for home lighting segment and comes with a price tag of **Rs350**/-.
- The device is available in **10W (1000 Lumens)** and **8W (800 Lumens)** variants in the country. The major highlight of the bulb is the new **'T'shape**, which the company claims can provide wider light spread as compared to regular LED bulb. It is a well-known fact that a single LED

bulb is not enough to brighten up a room as compared to a tube light. So, in order to fill this gap, the company has introduced this plug-and-play Philips T Bulb.

Energy Conservation Opportunities in Building

HVAC (Heating / Ventilation / Air Conditioning):

- ☐ Tune up the HVAC control system.
- ☐ Consider installing a building automation system (BAS) or energy management system
- ☐ (EMS) or restoring an out-of-service one.
- ☐ Balance the system to minimize flows and reduce blower/fan/pump power requirements.
- ☐ Eliminate or reduce reheat whenever possible.
- ☐ Use appropriate HVAC thermostat setback.
- ☐ Use morning pre-cooling in summer and pre-heating in winter (i.e. before electrical peak hours).
- ☐ Use building thermal lag to minimize HVAC equipment operating time.
- ☐ In winter during unoccupied periods, allow temperatures to fall as low as possible without freezing water lines or damaging stored materials.

- ☐ In summer during unoccupied periods, allow temperatures to rise as high as possible without damaging stored materials.
- ☐ Improve control and utilization of outside air.
- ☐ Use air-to-air heat exchangers to reduce energy requirements for heating and cooling of outside air.
- ☐ Reduce HVAC system operating hours (e.g. -- night, weekend).
- ☐ Optimize ventilation.
- ☐ Ventilate only when necessary. To allow some areas to be shut down when unoccupied, install dedicated HVAC systems on continuous loads (e.g. -- computer rooms).
- ☐ Provide dedicated outside air supply to kitchens, cleaning rooms, combustion equipment, etc. to avoid excessive exhausting of conditioned air.
- ☐ Use evaporative cooling in dry climates.
- ☐ Reduce humidification or dehumidification during unoccupied periods.
- ☐ Use atomization rather than steam for humidification where possible.
- ☐ Clean HVAC unit coils periodically and comb mashed fins.
- ☐ Upgrade filter banks to reduce pressure drop and thus lower fan power requirements.
- ☐ Check HVAC filters on a schedule (at least monthly) and clean/change if appropriate.
- ☐ Check pneumatic controls air compressors for proper operation, cycling, and maintenance.

- ☐ Isolate air conditioned loading dock areas and cool storage areas using high-speed doors or clear PVC strip curtains.
- ☐ Install ceiling fans to minimize thermal stratification in high-bay areas.
- ☐ Relocate air diffusers to optimum heights in areas with high ceilings.
- ☐ Consider reducing ceiling heights.
- ☐ Eliminate obstructions in front of radiators, baseboard heaters, etc.
- ☐ Check reflectors on infrared heaters for cleanliness and proper beam direction.
- ☐ Use professionally-designed industrial ventilation hoods for dust and vapor control.
- ☐ Use local infrared heat for personnel rather than heating the entire area.
- ☐ Use spot cooling and heating (e.g. -- use ceiling fans for personnel rather than cooling the entire area).
- ☐ Purchase only high-efficiency models for HVAC window units.
- ☐ Put HVAC window units on timer control.
- ☐ Don't oversize cooling units. (Oversized units will "short cycle" which results in poor humidity control.)
- ☐ Consider dedicated make-up air for exhaust hoods. (Why exhaust the air conditioning or heat if you don't need to?)
- ☐ Minimize HVAC fan speeds.
- ☐ Consider desiccant drying of outside air to reduce cooling requirements in humid climates.
- ☐ Consider ground source heat pumps.

- ☐ Seal leaky HVAC ductwork.
- ☐ Seal all leaks around coils.
- ☐ Repair loose or damaged flexible connections (including those under air handling units).
- ☐ Eliminate simultaneous heating and cooling during seasonal transition periods.
- ☐ Zone HVAC air and water systems to minimize energy use.
- ☐ Inspect, clean, lubricate, and adjust damper blades and linkages.
- ☐ Establish an HVAC efficiency-maintenance program. Start with an energy audit and follow-up, then make an HVAC efficiency-maintenance program a part of your continuous energy management program.

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 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.

Annexure -1

Specification of Fan

S.No	Parameter	Value
1	Span (MM/INCH)	1200/48
2	Wattage	53
3	Air Delivery(CMM)	230
4	RPM	300
5	Warranty(Years)	3.5
6	Power Factor	>.95
7	Number of Blades	3

Specification of Tube light

S.No	Parameter	Value
1	Size	Standard T5
2	Colour	Cool Day Light
3	Wattage	18 Watts
4	Warranty(Years)	3-5.
5	Operating Life (Hrs)	35000-50000

Annexure-2

Parameter	Type Of Lamp						
	Incandescent (Bulb)	CFL	Metal Halide	HPSV	LED	Fluorescent Tube light (T8)	LED Tube light (T8)
Power (watt)	25-150	18-95	50-400	50-400	150	25-125	18-36
Output (lumens)	210-2700	1000-7500	1900-30000	3600-46000	7200	2000	2000
Efficacy (lumens/ Watt)	8-18	55-79	38-75	72-115	48	50-100	80-150
Life Span (Hrs)	750-2000	10000-20000	10000-20000	18000-24000	50000	7000-15000	35000-50000
CRI	Excellent (100)	Good	Good	Poor (20)	Very Good	Good	Very Good

List of Authorized Distributors:

All the accessories of light and fan can be found in MPPKVVCL, Indore.

CHAPTER-2
DATA COLLECTION

The Energy Audit conducted in month of October-2018, taken the relevant measurements on all gadgets and utilities used in the building. Also the several important observations have been recorded to suggest the energy conservation measures.

The objectives of the energy audit are as under:

- To analysis of energy supply demand pattern of the School of Commerce and School of Social Science, DAVV, Indore.
- To measure and analysis of power consumption at different gadgets utilities.
- To analysis existing trend of energy consumption.
- To propose suitable energy conservation measures with proper techno-economic analysis.

The energy consumption data for the year 2013 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 detailed of energy consumption of School of Commerce, Indore and general observations, Included the analysis of energy consumption in various floor of the School of Commerce, Indore.

2.1 Electrical Energy Consumption and Bills:

The power supply for the School of Commerce and School of Social Science, Indore is from M.P.P.K.V.V.Co. Ltd, with the help of 33 KV non industry urban feeders. The monthly electrical consumption for the department of the year 2018 is given in the following table:

Estimated Monthly Bill

Monthly Energy Consumption in the year 2013:

S. No.	Month	Connected Load (KW)	Energy Consumption (kWh/Month)	Monthly Bill (Rs.)
1	JAN-18	76.89	7620	53340
2	FEB-18	76.89	7819	54733
3	MAR-18	76.89	10504	73528
4	APR-18	76.89	12017	84119
5	MAY-18	76.89	15023	105161
6	JUN-18	76.89	10326	72282
7	JUL-18	76.89	16230	113610
8	AUG-18	76.89	16500	115500
9	SEP-18	76.89	16800	117600
10	OCT-18	76.89	16650	116550

Note: Energy Charge @ Rs. 7/kWh

Preliminary Energy Audit
of
School of Pharmacy

Submitted By

Tashmeer Khan
Priya Patidar
Rishabh Gupta
Aditya Kumar
Shravan Yadav
Anish Pandey
Tushar Pawar
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Dr S.P. Singh

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Devi Ahilya Vishwavidyalaya, Indore

ACKNOWLEDGEMENT

First and foremost we would like to give our sincere thanks to the **Dr.Rajesh Sharma M.Pharm, PhD (Head & Professor), School of pharmacy, DAVV, Indore** and the entire staff for their kind cooperation.

We take this opportunity to express our heartily thanks to all of them who directly or indirectly helped us in this project.

Yours Sincerely,
M.Tech Students
SEES 2018-2020

EXECUTIVE SUMMARY

Sr. No	Section	Energy Conservation Measures	Saving (Rs./year)	Investment (Rs.)	Simple Payback Period (estimate) in months
1	Lighting	Replacement of T12 Light with Energy Efficient LED(18W) lights	7,056/-	4,400/-	7.5
2	Cooling Load (Fan)	Replacement of Old Fan (70W) with53W Energy Efficient ceiling Fan	2,49,155.2/-	2,68,800/-	13
3	Cooling Load	Replacement of Old Window ACs (3000W) ACs with 3 star rated (1070W) ACs	2,26,968/-	1,41,600/-	7.5
		Total	**4,83,179.2/-**	**4,14,800/-**	**28**

CHAPTER – 1

INTRODUCTION

School of Pharmacy of Devi Ahilya Vishwavidyalaya, Indore is one of the best institutes in the country and was established on Oct. 15, 2001.The Institute has dedicated young and qualified faculty and is supported by distinguished visiting and guest faculty from industry and professions. It has developed strong linkage with industry which has continuously provided it unstinted support and co-operation. It has a peaceful and congenial environment in a campus, impressive infrastructure, well-equipped laboratories and adequate library facilities. This institute offers a wide array of educational and professional service programmes.The academic programmes, in this School, have been developed to provide educational and personality development facilities for preparing young pharmacists for highly professional and top positions in drug and pharmaceutical industries.

COURSES OFFERED BY SCHOOL OF PHARMACY ARE…

1. B.Pharmacy (B.Pharm)-4 Years course

2. Master of Pharmacy (Pharmaceutical Chemistry)[M.Pharm]-2 Years course

3. Ph.D. Programe

Necessity of Energy Audit:

The Energy Audit conducted in month of MAR-19, and taken the relevant measurements on all gadgets and utilities used in the building. Also the several important recorded to suggest the energy conservation measures.

The objectives of the energy audit are as under:

1. To analysis of energy supply and demand pattern of the School of Pharmacy, Indore.
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The energy consumption data for the year 2019 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 detained of energy consumption of IMS, Indore and general observations, include the analysis of energy consumption in various floor of IMS, Indore.

CHAPTER-2

DATA COLLECTION

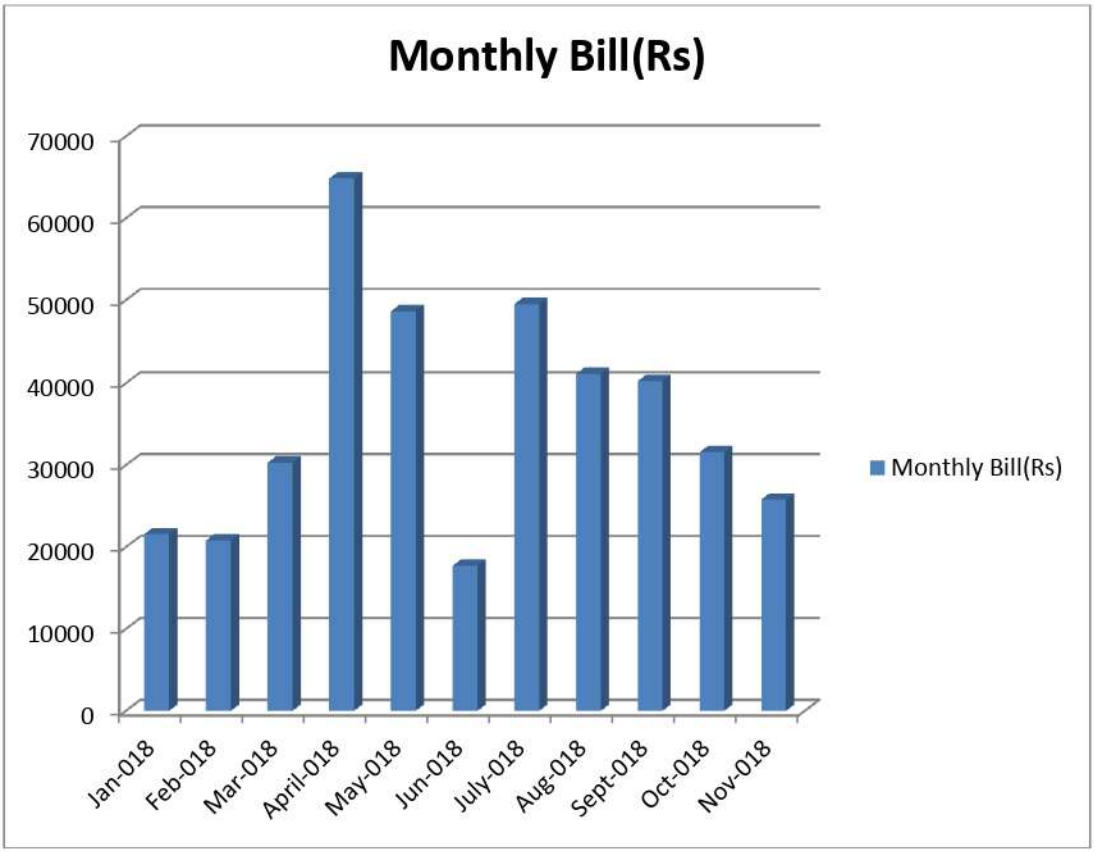
This section contains consumption figures of electricity, etc.

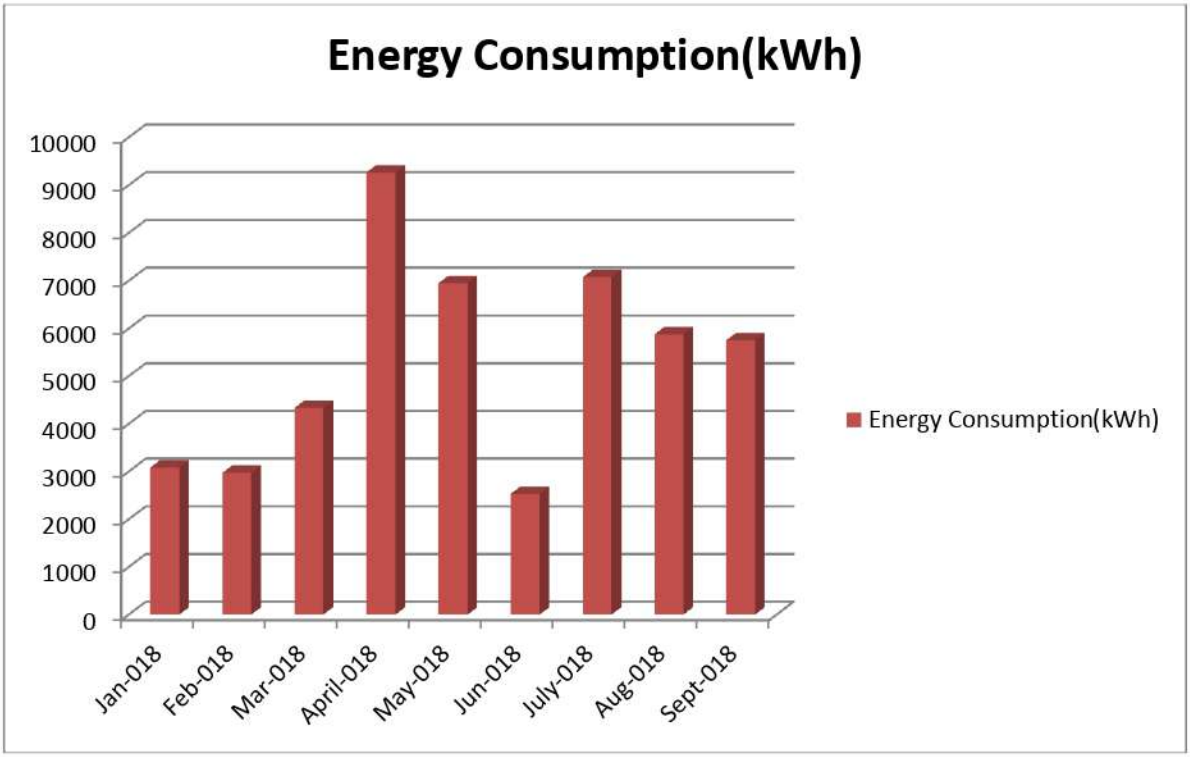
2.1. Electrical Energy Consumption and Bills:

The power supply for School of Pharmacy, Indore is from M.P.P.K.V.V.Co. Ltd. with the help of 33 KV non industry urban feeders from 350 kVA transformer. The monthly electricity bill for the one year showing kWh consumption. The monthly electrical consumption for the deptt. From **Jan-2018 to Dec-2018** is given in the following table:

Table: - Monthly Electricity Consumption

Sr.No	Month	Energy Consumption(kWh)	Energy Charges(Rs/kWh)	Monthly Bill(Rs)
1	Jan-018	3085	7	21592
2	Feb-018	2974	7	20816
3	Mar-018	4333	7	30328
4	April-018	9267	7	64870
5	May-018	6950	7	48653
6	Jun-018	2534	7	17741
7	July-018	7075	7	49527
8	Aug-018	5881	7	41164
9	Sept-018	5755	7	40286
10	Oct-018	4513	7	31592
11	Nov-018	3688	7	25816
12	Dec-018	2929	7	20500


Monthly Bill(Rs)
70000
60000
50000
40000
30000
20000
10000
0
Jan-018
Feb-018
Mar-018
April-018
May-018
Jun-018
July-018
Aug-018
Sept-018
Oct-018
Nov-018
Monthly Bill(Rs)


Energy Consumption(kWh)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan-018
Feb-018
Mar-018
April-018
May-018
Jun-018
July-018
Aug-018
Sept-018
Energy Consumption(kWh)

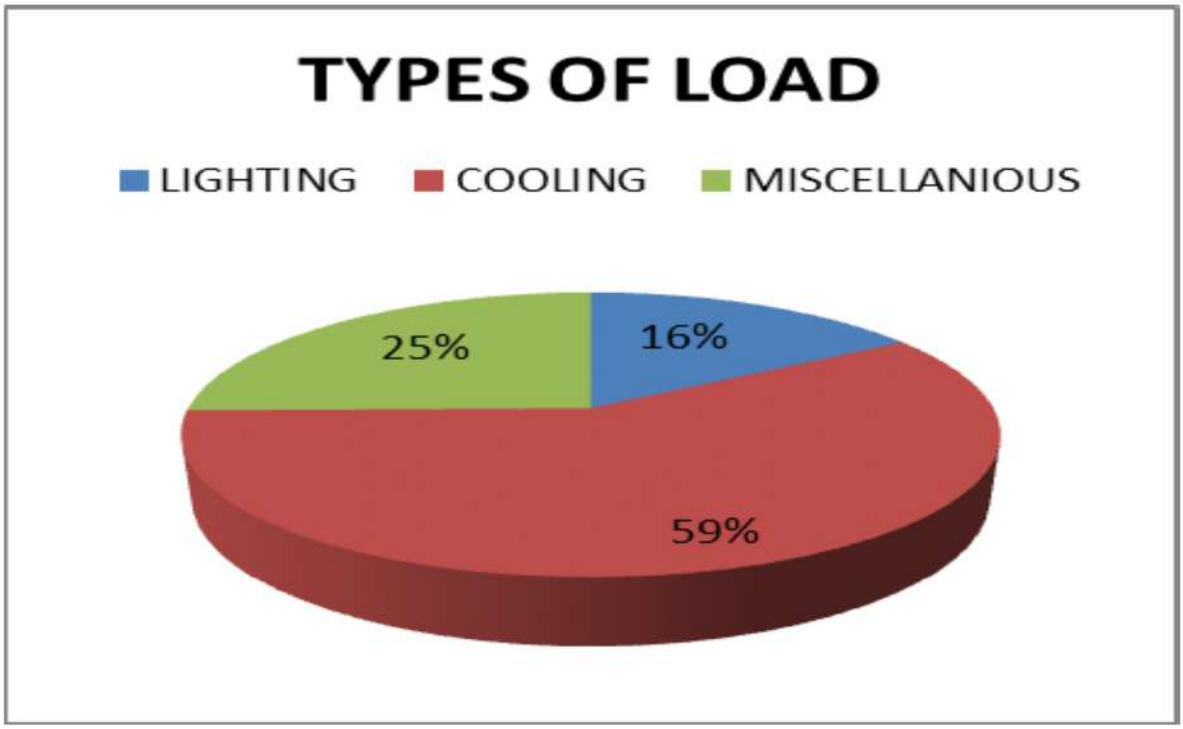
2.2 Connected Load of overall department:-

Lighting Load –9.60 kW

Cooling Load (AC) –18 kW

Cooling Load (Fan) –16.83kW

Misc. Load – 15 kW



2.3 Connected Load of Department:-

Sr. No	Type of Load	Rated Power(W)	No of Fixture	Total Connected Load (kW)
1	FTL	72	10	0.72
		36	20	0.72
		40	2	0.08
		18	394	7.09
2	LED BULB	9	2	0.01
3	LED tube light	18	35	0.63
4	Ceiling Fan	70	224	15.68
		55	11	0.60
5	Exhaust Fan	55	14	0.77
6	Pedestal fan	58	1	0.05
7	Computer (CRT)	66	14	0.92
8	Computer (LCD)	35	25	0.87
9	Miscellaneous	-	-	15
10	Printer	550	6	3.3
	Photo copy machine	1320	1	1.32
11	ACs (Split)	3000	6	18
12	Water Cooler	550	2	1.1
13	Projector	265	5	1.32
14	Refrigerator	160	3	0.48
		94	1	0.09
Total				**68.75**

2.3 Connected Load of Department:-

Note:* Metal Halide on building. Total connected load in building is around 68.75

Savings and Calculations:-

Calculations for replacement of 36 W tube light with LED LIGHT (18 W)

Factors	UNITS	LED	FTL
Rating per lamp	Watt	18	36
Operating Hours per day	Hrs.	10	10
No of days per years	Days	280	280
No of lamps	Nos.	1	1
Annual consumption for 10 hrs per day	kWh	50.4	100.8
energy charges (Rs/kWh)	Rs.	7/-	7/-
Operating cost per year	Rs.	352.8	705.6
Life	Hrs.	50000	7500
Life	Years	13.7	3
unit cost	Rs.	220/-	200/-
Comparison for replacement	No.	1	4
Total lamps	Nos.	20	
Total Savings	Rs.	7,056/-	
Total investment	Rs.	4,400/-	
Simple payback period	Month	7.5	

Calculation for Cooling load (FAN)

Sr. No	Factors	Parameter	Unit
1	System Power Consumption	70	W
2	Suggested System Consumption	53	W
3	Operating Hours	10	
4	No. of Days System used in a Year	280	
5	No. Of fixtures	224	
6	L1(NEW SYSTEM)	0	years
7	L2(OLD SYSTEM)	0	years
8	Cost of 1 piece	1200	INR
8	Investment	268800/-	INR
9	Salvage Value	200	INR
	Total salvage values	44800/-	
10	Maintenance cost	0	INR
11	Saving in kWh/Year	35593.6	KWh /Y
12	Subsidy	0	INR
13	Cost of Electricity per Unit	7	INR
15	Cost Savings per year	249155.2/-	INR
16	Net Investment	204355.2/-	INR
17	Escalation in Electricity cost /year (%)	1	

Calculation for Cooling load (AC)

Sr.No	Factors	Parameter	Unit
1	System Power Consumption	3000	W
2	Suggested System Consumption	1070	W
3	Operating Hours	8	
4	No. of Days System used in a Year	280	
5	No. Of fixtures	6	
6	L1(NEW SYSTEM)	0	Years
7	L2(OLD SYSTEM)	0	Years
8	Cost of 1 piece	23600/-	INR
8	Investment	141600/-	INR
9	Salvage Value	2000	INR
	Total salvage values	12000	
10	Maintenance cost	0	INR
13	Cost of Electricity per Unit	7	INR
14	Energy Savings/year	32424/-	kWh
15	Cost Savings per year	226968/-	INR
16	Net Investment	214968/-	INR
17	Escalation in Electricity cost /year (%)	1	

Recommendations

- Replace existing single fitting **36 W** conventional tubes with convention chokes by **18 W** energy efficient **LED LIGHT**.
- Replacement of 70 **W** Fan is needed with **53 W** EESLfan.
- Replacement of **3 kW (2 TR)** with **1.5 kW (1.5 TR VIDEOCON 3 STAR)*** split AC.
- Sitting arrangement is not proper as per the day lighting hence it should be arranged as per maximum day lighting situation.
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- (EMS) or restoring an out-of-service one.
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- Eliminate or reduce reheat whenever possible.
- Use appropriate HVAC thermostat setback.
- Use morning pre-cooling in summer and pre-heating in winter (i.e. before electrical peak hours).
- Use building thermal lag to minimize HVAC equipment operating time.
- In winter during unoccupied periods, allow temperatures to fall as low as possible without freezing water lines or damaging stored materials.

- In summer during unoccupied periods, allow temperatures to rise as high as possible without damaging stored materials.
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- Reduce HVAC system operating hours (e.g. -- night, weekend).
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- Ventilate only when necessary. To allow some areas to be shut down when unoccupied, install dedicated HVAC systems on continuous loads (e.g. -- computer rooms).
- Provide dedicated outside air supply to kitchens, cleaning rooms, combustion equipment, etc. to avoid excessive exhausting of conditioned air.
- Use evaporative cooling in dry climates.
- Reduce humidification or dehumidification during unoccupied periods.
- Use atomization rather than steam for humidification where possible.
- Clean HVAC unit coils periodically and comb mashed fins.
- Upgrade filter banks to reduce pressure drop and thus lower fan power requirements.
- Check HVAC filters on a schedule (at least monthly) and clean/change if appropriate.
- Check pneumatic controls air compressors for proper operation, cycling, and maintenance.

- ☐ Isolate air conditioned loading dock areas and cool storage areas using high-speed doors or clear PVC strip curtains.
- ☐ Install ceiling fans to minimize thermal stratification in high-bay areas.
- ☐ Relocate air diffusers to optimum heights in areas with high ceilings.
- ☐ Consider reducing ceiling heights.
- ☐ Eliminate obstructions in front of radiators, baseboard heaters, etc.
- ☐ Check reflectors on infrared heaters for cleanliness and proper beam direction.
- ☐ Use professionally-designed industrial ventilation hoods for dust and vapor control.
- ☐ Use local infrared heat for personnel rather than heating the entire area.
- ☐ Use spot cooling and heating (e.g. -- use ceiling fans for personnel rather than cooling the entire area).
- ☐ Purchase only high-efficiency models for HVAC window units.
- ☐ Put HVAC window units on timer control.
- ☐ Don't oversize cooling units. (Oversized units will "short cycle" which results in poor humidity control.)
- ☐ Consider dedicated make-up air for exhaust hoods. (Why exhaust the air conditioning or heat if you don't need to?)
- ☐ Minimize HVAC fan speeds.
- ☐ Consider desiccant drying of outside air to reduce cooling requirements in humid climates.
- ☐ Consider ground source heat pumps.

- ☐ Seal leaky HVAC ductwork.
- ☐ Seal all leaks around coils.
- ☐ Repair loose or damaged flexible connections (including those under air handling units).
- ☐ Eliminate simultaneous heating and cooling during seasonal transition periods.
- ☐ Zone HVAC air and water systems to minimize energy use.
- ☐ Inspect, clean, lubricate, and adjust damper blades and linkages.
- ☐ Establish an HVAC efficiency-maintenance program. Start with an energy audit and follow-up, then make an HVAC efficiency-maintenance program a part of your continuous energy management program.

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.

- ☐ 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 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.

Annexure-1

Specification of Fan

S.No	Parameter	Value
1	Span (MM/INCH)	1200/48
2	Wattage	53
3	Air Delivery(CMM)	230
4	RPM	300
5	Warranty(Years)	3.5
6	Power Factor	>.95
7	Number of Blades	3

Specification of Tube light

S.No	Parameter	Value
1	Size	Standard T5
2	Colour	Cool Day Light
3	Wattage	18 Watts
4	Warranty(Years)	3-5.
5	Operating Life (Hrs)	35000-50000

Annexure-2

Parameter	Type Of Lamp						
	Incandescent (Bulb)	CFL	Metal Halide	HPSV	LED	Fluorescent Tube light (T8)	LED Tube light (T8)
Power (watt)	25-150	18-95	50-400	50-400	150	25-125	18-36
Output (lumens)	210-2700	1000-7500	1900-30000	3600-46000	7200	2000	2000
Efficacy (lumens/ Watt)	8-18	55-79	38-75	72-115	48	50-100	80-150
Life Span (Hrs)	750-2000	10000-20000	10000-20000	18000-24000	50000	7000-15000	35000-50000
CRI	Excellent (100)	Good	Good	Poor (20)	Very Good	Good	Very Good

List of Authorized Distributors:

All the accessories of light and fan can be found in MPPKVVCL, Indore.

Preliminary Energy Audit
Of
School of Commerce & School of Social Science

Project team:
Krishna Kant Dubey

Guided by:
Dr. S. P. Singh

School of Energy and Environmental Studies
Devi Ahilya Vishwavidyalaya, Indore
Indore

ACKNOWLEDGEMENT

First and foremost I would like to give my sincere thanks to **Dr. Preeti Singh (HOD) School of Commerce, Dr. RekhaAcharya (HOD) School of Social Science** andthe entire staff for their kind cooperation.

I take this opportunity to express my heartily thanks to all of them who directly or indirectly helped me in this project.

Yours Sincerely
Krishna Kant Dubey
SEES DAVV, Indore

INDEX

Executive Summary

Sr. No	Section	Conservation Measure	Energy Saving (kWh/yr)	Saving (Rs/year)	Investment (Rs)	Simple Pay Back Period (months)	Feasibility
1	Lighting	Replacement of 40 W convectional tube light with 20W LED tube light	21996.8	153957.6	108020	8.42	Yes
2		Replacement of 36 W convectional tube light with 20W LED tube light	537.6	3763.2	3300	10.52	Yes
3	Cooling	Replacement of 73W fan from 53W energy efficient fan.	31153.48	218074.36	282000	15.52	Yes
		Total	53687.88	375795.16	393320		

CHAPTER – 1
INTRODUCTION

The School of Commerce is a department of Devi AhilyaVishwavidayalaya, which has been established to provide job/industry oriented professional commerce education at undergraduate and post graduate level. Commerce, as a faculty, is seen for traditional education only. The SOC will strive to be pioneer in providing new dimensions to commerce education. The school started working in academic session 2006-07 with M. Com. (Accounting & Financial Control) and M. Com. (Bank Management) as its pioneer programs. These programs have been designed keeping in view the changing requirements of related Industry aiming at developing necessary skills in the students.

The school also started 5 years integrated programme in Foreign Trade MBA (FT) 5 years from the academic session 2007-08 and 2 Year MBA programme in Foreign Trade from the academic session 2008-09. Four new post graduate programs M.Com. (Insurance Management), M. Com.(FT) 2 Years, P.G. Diploma in Banking and Insurance and P.G. Diploma in Computer Application are in pipeline. Being a UTD providing Post Graduate education in Commerce stream, the school also takes necessary steps to promote research in the area of commerce. In this regard Master of Philosophy in commerce (M.Phil. Commerce) programme is also run by the school. Simultaneously, in academic session 2008-09, the school has also started two new Post Graduate Diploma Courses in Retail Management and Financial Services.

The School of Social Sciences (SOSS) was established in 1989. Earlier it was known as Department of Advanced Liberal Studies and was renamed as the School of Social Sciences in 2008. The year 2016 was an important landmark in the history of the Institute, when it was declared as a UGC-Centre with potential for Excellence in Social Sciences. (CPEPA)Since its inception, SOSS has been to be an institution of excellence that continually responds to changing social realities through the development and application of knowledge, towards creating a people-centred, ecologically sustainable and just society that promotes and protects dignity, equality, social justice and human rights for all. In Changing and dynamic environment it became indispensible to understand and study the effect of globalisation on the social system and the foreseeable challenges arising from the social, political, cultural and economic conditions. Social sciences not only create awareness among the generation about rising problems in society, of society and for society but also provide the solution to the problems. The Social Science Program provides a multidisciplinary learning environment that teaches students how to think critically and globally about human interactions in society and to apply this expanded worldview to their profession. The program promotes an understanding of cultures, the value of research and service to the community, and the importance of social responsibility and active participation in civic life.

Objective

Aim of the Activity:
The main purpose of this study is to identify energy saving opportunities in The School of Commerce and School of Social Science to achieve benefits of significant cost reduction through various technical interventions.

Scope of Energy Audit:
The scope of work would cover the following facilities:
Name of the faculty: School of Commerce and School of Social Science

Major Energy Using Applications
a) Key Parameters

These parameters are the key performance indicators i.e. They are measures of efficiency. There are standards for performance of systems e.g. the Indian Standards specify requirements of illumination levels in different areas depending upon the function .However, they do not specify the corresponding energy required.

b) Energy Auditing Procedures
Instruments
Where standard methods are prescribed, those methods would indicate type, accuracy and features of the instruments that are needed for conducting the measurements required by the method. Where such instrument description is lacking, or where there is no standard method prescribed.

Measurement
Usually the auditing method prescribes how these measurements should be made.

Data Recording Formats
These formats are recommendatory and might have to be modified to suit local conditions .They however, cover all the principal requirements of the tests.

Calculation Procedures
The standard Auditing method would also specify the method of calculation of the results.

CHAPTER-2
DATA COLLECTION

The Energy Audit conducted in month of October-2018, taken the relevant measurements on all gadgets and utilities used in the building. Also the several important observations have been recorded to suggest the energy conservation measures.

The objectives of the energy audit are as under:

- To analysis of energy supply demand pattern of the School of Commerce and School of Social Science, DAVV, Indore.
- To measure and analysis of power consumption at different gadgets utilities.
- To analysis existing trend of energy consumption.
- To propose suitable energy conservation measures with proper techno-economic analysis.

The energy consumption data for the year 2013 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 detailed of energy consumption of School of Commerce, Indore and general observations, Included the analysis of energy consumption in various floor of the School of Commerce, Indore.

2.1 Electrical Energy Consumption and Bills:

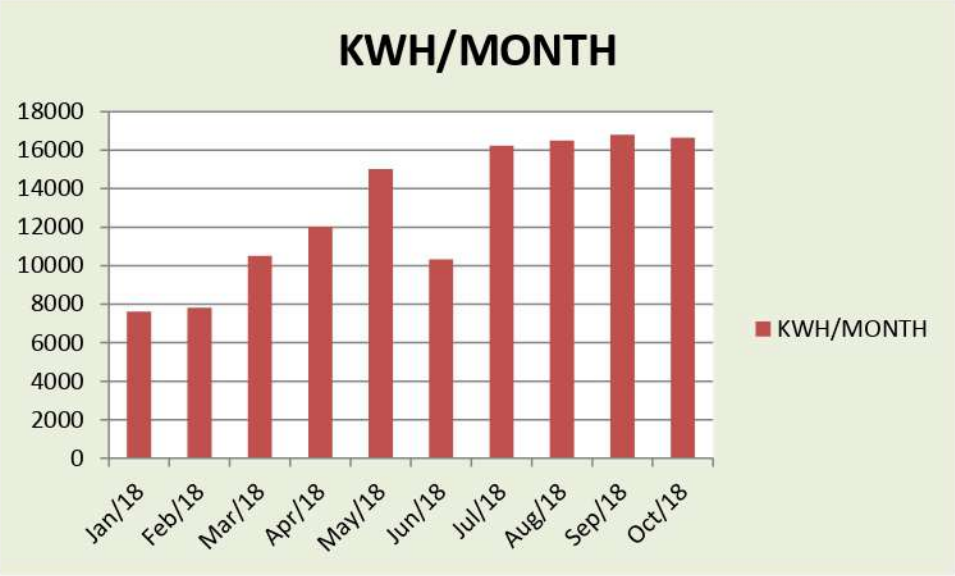
The power supply for the School of Commerce and School of Social Science, Indore is from M.P.P.K.V.V.Co. Ltd, with the help of 33 KV non industry urban feeders. The monthly electrical consumption for the department of the year 2018 is given in the following table:

Estimated Monthly Bill

Monthly Energy Consumption in the year 2013:

S. No.	Month	Connected Load (KW)	Energy Consumption (kWh/Month)	Monthly Bill (Rs.)
1	JAN-18	76.89	7620	53340
2	FEB-18	76.89	7819	54733
3	MAR-18	76.89	10504	73528
4	APR-18	76.89	12017	84119
5	MAY-18	76.89	15023	105161
6	JUN-18	76.89	10326	72282
7	JUL-18	76.89	16230	113610
8	AUG-18	76.89	16500	115500
9	SEP-18	76.89	16800	117600
10	OCT-18	76.89	16650	116550

Note: Energy Charge @ Rs. 7/kWh



Electricity consumption (KWH) per month

Electricity charges (Rs) per month

2.2 Connected Load of overall Department:-

Types of Load	kW
LIGHTING	21.78
COOLING	29.14
MISCELLANIOUS	25.969
TOTAL	76.889

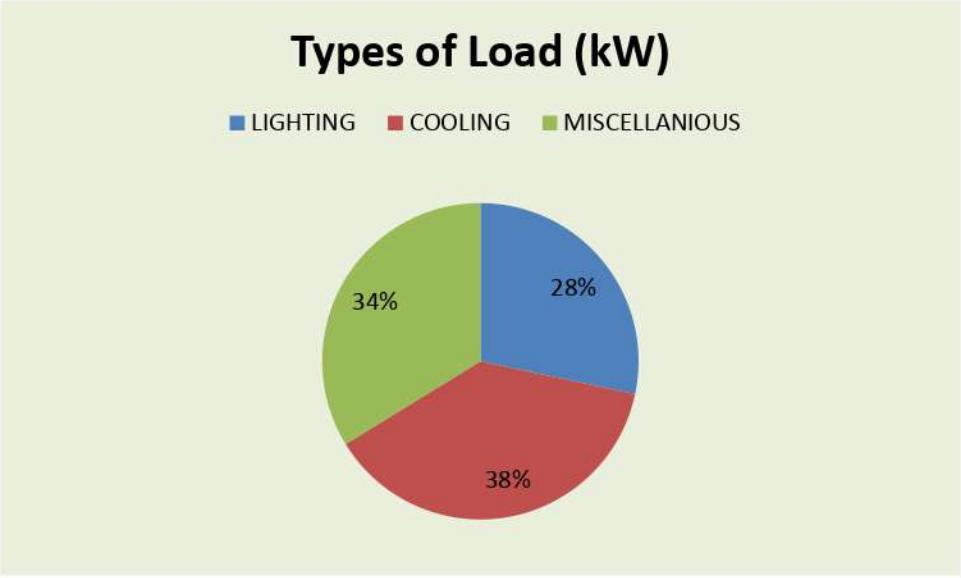


Figure: Total Load of Building

2.2 Connected Load of Department:-

S. NO.	Type of Load	Type	Rated power (watts)	Quantity	Total wattage (KW)
1	**Lighting**	FTP	40	491	19.64
		FTP	36	15	0.54
		Mercury Vapour Lamp	400	4	1.6
Total Consumption on Lighting					**21.78**
2	**Cooling**	Ceiling Fan	73	235	17.155
		Wall Fan	50	9	0.45
		Water Cooler	280	1	0.28
			575	1	0.575
		AC 3*(1.5T)	2200	3	6.6
		5*(1.5)	1800	2	3.6
		Refrigerator 3*80L	100	1	0.1
		Cooler	190	2	0.38
Total Consumption on Cooling					**29.14**
3	**Misc. Load**	Exhaust Fan	40	6	0.24
		Computer	150	91	13.65
		Printer	315	13	4.095
		Projector	320	7	2.24
		CCTV	40	13	0.52
		RO	18	1	0.018
		Photocopy Machine	1200	2	2.4
		Coil Heater	1500	1	1.5
		Lan Connection	250	2	0.5
		Router	20	3	0.06
		Submersible	746	1	0.746
Total Consumption on Misc. Load					**25.969**
4	**Overall Connected Load of Building**				**76.889**

Note: Total connected load in building is around 76.889 kW.

Energy Saving Calculations

Tube lights-

Replacement of 40W Tube Light with 20W LED Tube Light

S. No	Parameter	Value
1	Type of load	TUBELIGHT
2	Power in watt	40
3	Total no of fixtures	491
4	No of hrs/day	8
5	No of day/year	280
6	Suggested watt	20
7	Saving in kWh/Year	21996.8
8	Load Factor	0.9
9	Energy Charges Rs/kWh	7
10	Saving in Rs/Year	153977.6
11	Cost/Piece(Rs)	220
12	Total Investment	1,08,020
13	Pay Back period(YEAR)	0.70153061
14	Pay Back period(Month)	8.41836735

Replacement of 36W Tube Light 20W LED Tube Light

S. No	Parameter	Value
1	Type of load	TUBELIGHT
2	Power in watt	**36**
3	Total no of fixtures	15
4	No of hrs/day	8
5	No of day/year	280
6	Suggested watt	20
7	Saving in kWh/Year	537.6
8	Load Factor	0.9
9	Energy Charges Rs/kWh	7
10	Saving in Rs/Year	3763.2
11	Cost/Piece(Rs)	220
12	Total Investment	3,300
13	Pay Back period(YEAR)	0.8769133
14	Pay Back period(Month)	10.522959

Fan-

Replacement of 73W Fan with BEE rated 5 star 53W fan

S. No	Parameter	**Value**
1	Type of load	Fan
2	Power in watt	73
3	Total no of fixtures	235
4	No of hrs/day	8
5	No of day/year	280
6	Suggested watt	53
7	Saving in kWh/Year	31153.48
8	Load Factor	0.9
9	Energy Charges Rs/kWh	7
10	Saving in Rs/Year	218074.36
11	Cost/Piece(Rs)	1200
12	Total Investment	282000
13	Pay Back period(YEAR)	1.2931369
14	Pay Back period (Month)	15.517643

Recommendations

This building is based on the green building technology. In this building the day light is properly used, that's why in this building no artificial light requirement in the day time. There are some recommendations that are useful to reduce the significant energy consumption:-

- Replace existing **40W& 36W** tube lights with **20 W** energy efficient tube lights.
- Replace existing **73W** Fan with **50W** BEE 5 star rated Fan or **35W** Super efficient Fan. Here a table that differentiates between these fans and also payback period.
- Replace 3 star AC by 5 star AC, and proper maintenance of Air Conditioner is most important for good cooling.
- One Coil Heater of 1500W is being used in pantry which is a very inefficient device in terms of energy consumption resulting in huge heat loss. It is recommended that the coil heater must be replaced by the induction heater.
- Four Mercury vapour lamps are installed on the roof for lighting; it must be replaced by LED high intensity discharge (HID) lams.
- **Public Awareness: -** Awareness program may also reduce the energy consumption. Much energy can be saved by Individual responsibility and staff understanding.
  Saving Energy is Saving of Money

➢ Day light is sufficient for the rooms; using light is wastage of energy in daylight.
➢ Switch of the lights, fans, computers and AC when out of the room.
➢ Windows and Doors should be closed when AC is on.
➢ In winter season water coolers should be off.

Energy Conservation Opportunities in Building
HVAC (Heating / Ventilation / Air Conditioning):

- Tune up the HVAC control system.
- Consider installing a building automation system (BAS) or energy management system
- (EMS) or restoring an out-of-service one.
- Balance the system to minimize flows and reduce blower/fan/pump power requirements.
- Eliminate or reduce reheat whenever possible.
- Use appropriate HVAC thermostat setback.
- Use morning pre-cooling in summer and pre-heating in winter (i.e. before electrical peak hours).
- Use building thermal lag to minimize HVAC equipment operating time.

- In winter during unoccupied periods, allow temperatures to fall as low as possible without freezing water lines or damaging stored materials.
- In summer during unoccupied periods, allow temperatures to rise as high as possible without damaging stored materials.
- Improve control and utilization of outside air.
- Use air-to-air heat exchangers to reduce energy requirements for heating and cooling of outside air.
- Reduce HVAC system operating hours (e.g. -- night, weekend).
- Optimize ventilation.
- Ventilate only when necessary. To allow some areas to be shut down when unoccupied, install dedicated HVAC systems on continuous loads (e.g. -- computer rooms).
- Provide dedicated outside air supply to kitchens, cleaning rooms, combustion equipment, etc. to avoid excessive exhausting of conditioned air.
- Use evaporative cooling in dry climates.
- Reduce humidification or dehumidification during unoccupied periods.
- Use atomization rather than steam for humidification where possible.
- Clean HVAC unit coils periodically and comb mashed fins.
- Upgrade filter banks to reduce pressure drop and thus lower fan power requirements.
- Check HVAC filters on a schedule (at least monthly) and clean/change if appropriate.
- Check pneumatic controls air compressors for proper operation, cycling, and maintenance.
- Isolate air conditioned loading dock areas and cool storage areas using high-speed doors or clear PVC strip curtains.
- Install ceiling fans to minimize thermal stratification in high-bay areas.
- Relocate air diffusers to optimum heights in areas with high ceilings.
- Consider reducing ceiling heights.

Lighting

- Reduce excessive illumination levels to standard levels using switching, decamping, etc.
- 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 colour 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 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.

Annexure-1

Specification of Fan

S .No	Parameter	Value
1	Span (MM/INCH)	1200/48
2	Wattage	53
3	Air Delivery(CMM)	230
4	RPM	300
5	Warranty(Years)	3.5
6	Power Factor	>.95
7	Number of Blades	3

Specification of Tube light

S. No	Parameter	Value
1	Size	Standard T5
2	Colour	Cool Day Light
3	Wattage	18 Watts
4	Warranty(Years)	3-5.
5	Operating Life (Hrs)	35000-50000

Annexure-2

Different types of Lamps

Parameters	Incandescent (Bulb)	CFL	Metal Halide	HPSV	LED	Fluorescent Tube light (T8)	LED Tube light (T8)
Power (watt)	25-150	18-95	50-400	50-400	150	25-125	18-36
Output (lumens)	210-2700	1000-7500	1900-30000	3600-46000	7200	2000	2000
Efficacy (lumens/ Watt)	8-18	55-79	38-75	72-115	48	50-100	80-150
Life Span (Hrs)	750-2000	10000-20000	10000-20000	18000-24000	50000	7000-15000	35000-50000
CRI	Excellent (100)	Good	Good	Poor (20)	Very Good	Good	Very Good

Preliminary Energy Audit
Of
School of Future Studies and Planning

Submitted By

Project Team:
Yashul Dehariya

Guided by:
Dr S.P. Singh

School of Energy and Environmental
Studies Devi Ahilya Vishwavidyalaya,
Indore

ACKNOWLEDGEMENT

First and foremost we would like to give our sincere thanks to **Dr V.B. Gupta (**HOD) of the School of Future Studies and Planning**,** and the entire staff for their kind cooperation.

We take this opportunity to express our heartily thanks to all of them who directly or indirectly helped us in this project.

Yours Sincerely,
Yashul Dehariya

INDEX

SAVE ENERGY, SAVE ENVIRONMENT

EXECUTIVE SUMMARY

Sr.No	Section	Conservation Measure	No. of fixtures	Energy Saving (kWh/yr)	Saving (Rs/year)	Investment Rs	Simple Pay Back Period(months)
1	Lighting	Replacement of 40W conventional tubelight with 15W LED tubelight	62	5902.4	41316.8	13640	3.96
		Replacement of 36 W convectional tubelight with 15W LED tubelight	57	4788	33516	12540	4.49
2	Cooling	Replacement of 75W fan from 40W energy efficient fan.	49	8898.4	62288.8	58800	11.33
3	Computer Monitor	Replacement of CRT monitor (110W) with 18 W LED	9	2484	17388	40500	27.95
		Total		22072.8	154509.6	125480	47.73

CHAPTER – 1
INTRODUCTION

Futures Studies is an emerging academic and professional discipline, arising in the 1950s and 1960s in response to the growing complexity of organizational life and world affairs. The tools and techniques were invented in think tanks and activist organizations in order to understand and respond to the rapidly changing and largely unpredictable future. The discipline has grown due to increasing awareness of the long-term consequences of population and economic growth on our planet. It concerned with envisioning, forecasting and planning a range of possible, probable, and preferable long-term futures in business, governmental, educational, environmental, social, and personal domains.

The School of Futures Studies and Planning, a University Teaching Department under the Faculty of Engineering Sciences was established in the year 1990 to run M.Tech. programme in Future Studies and Planning. It was the first M.Tech. level programme in Future Studies and Planning duly recognized by AICTE, New Delhi in the country. The school has also started another M.Tech. programme in Systems Management duly recognized by AICTE, New Delhi from the year 2005.

School of Future studies and planning is connected to the common transformer of 350 KVA. The connected load of the department is **55 kW**. The Energy Audit was conducted in month of October 2018, and taken the relevant measurements on all gadgets and utilities used in the building. Also the several important observations have been recorded to suggest the energy conservation measures.

The objectives of the energy audit are as under:

- To analysis of energy supply demand pattern of the School of Future Studies and Planning.
- 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 2018 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 detained of energy consumption of School of Future Studies and Planning, Indore and general observations, included the analysis of energy consumption in various floor of the department.

CHAPTER-2

DATA COLLECTION

This section contains consumption figures of electricity, etc.

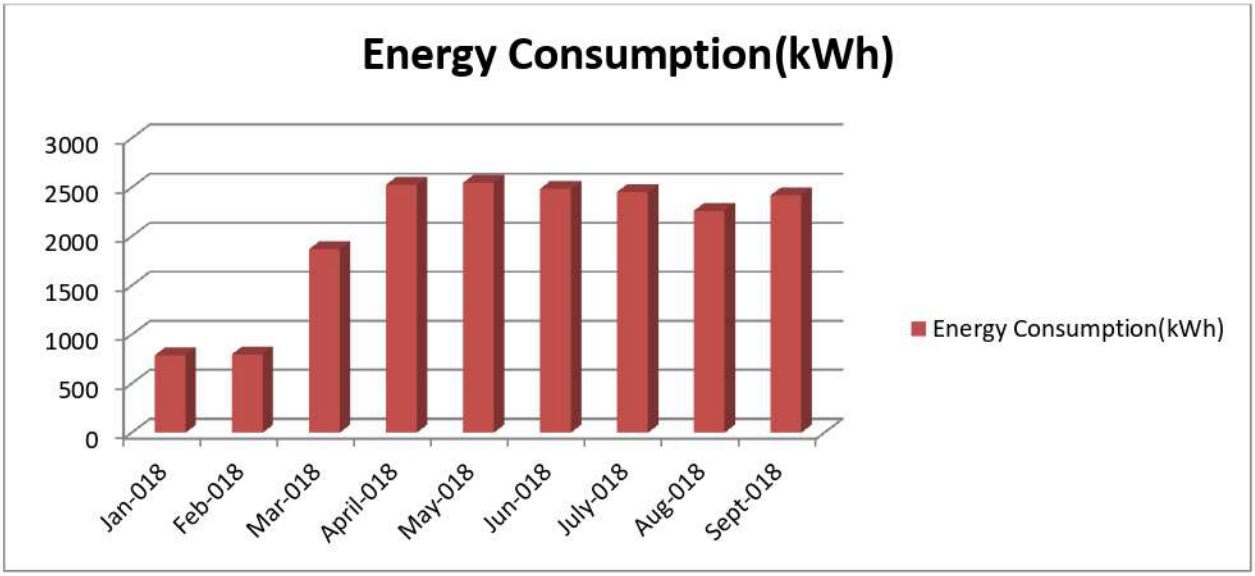
2.1. Electrical Energy Consumption and Bills:

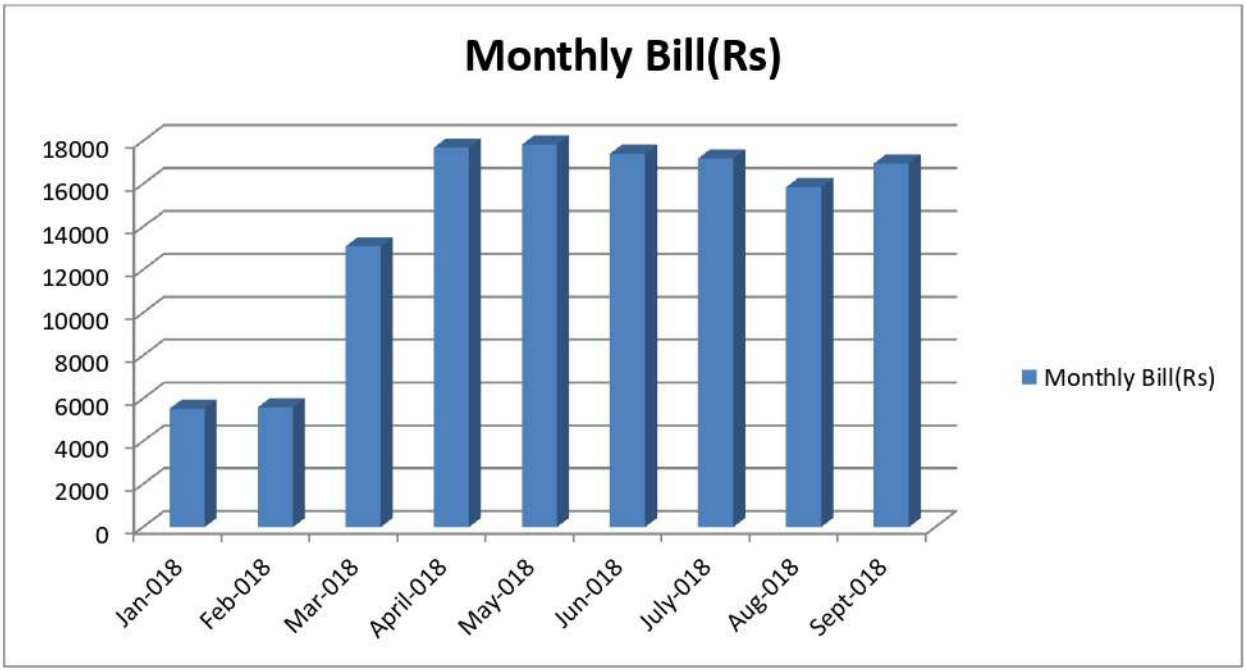
The power supply for Future Studies, Indore is from M.P.P.K.V.V.Co. Ltd. with the help of 11 kV non industry urban feeders from common 350 KVA transformer that also supplies other departments. The monthly electricity bill for the one year showing kWh consumption

ESTIMATED MONTHLY BILL

The department does not receive separate bill instead its bill is summed up with other departments in the university bill.

Sr.No	Month	Energy Consumption(kWh)	Energy Charges(Rs/kWh)	Monthly Bill(Rs)
1	Jan-018	789	7	5523
2	Feb-018	798	7	5586
3	Mar-018	1870	7	13090
4	April-018	2528	7	17696
5	May-018	2548	7	17836
6	Jun-018	2487	7	17409
7	July-018	2456	7	17192
8	Aug-018	2265	7	15855
9	Sept-018	2422	7	16954


Energy Consumption(kWh)
3000
2500
2000
1500
1000
500
0
Jan-018
Feb-018
Mar-018
April-018
May-018
Jun-018
July-018
Aug-018
Sept-018
Energy Consumption(kWh)


Monthly Bill(Rs)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan-018
Feb-018
Mar-018
April-018
May-018
Jun-018
July-018
Aug-018
Sept-018
Monthly Bill(Rs)

2.1 Connected Load of overall Department:

Types of Load	Kw
LIGHTING	4.69
COOLING	34.6
MISCELLANIOUS	16.04
TOTAL	**55.33**

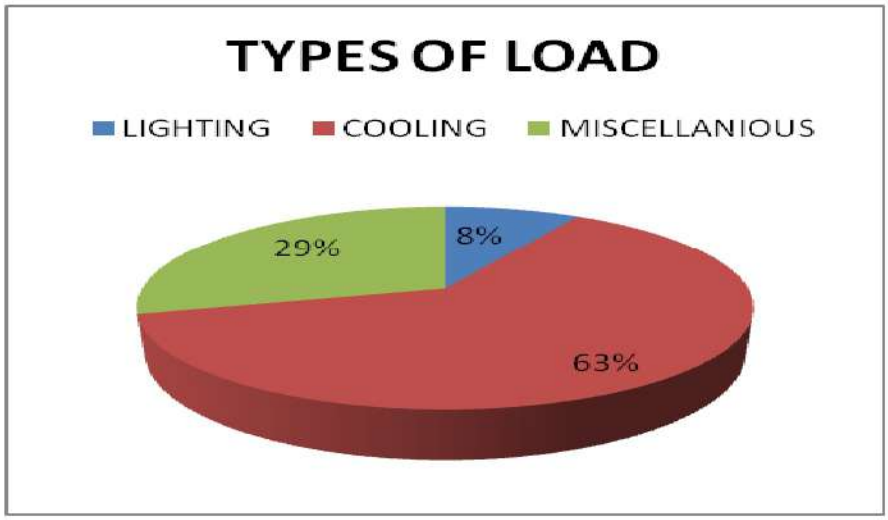


Figure: Total Load of Building.

2.2 Suggestions & Savings calculations:-

1. Replacement of (52W) Conventional tube light with (18W) T5 lights

S.No	Parameter	Value
1	Type of load	TUBELIGHT
2	Power in watt	**52**
3	Total no of fixtures	62
4	No of hrs/day	10
5	No of day/year	280
6	Suggested watt	18
7	Saving in kWh/Year	5902.4
8	Load Factor	0.9
9	Energy Chaarges Rs/kWh	7
10	Saving in Rs/Year	41316.8
11	Cost/Piece(Rs)	220
12	Total Investment	13,640
13	Pay Back period(YEAR)	0.3301321
14	Pay Back period(Month)	3.9615846

- **Replacement of (48W) Conventional tube light with (28W) T5 lights**

S.No	Parameter	Value
1	Type of load	TUBELIGHT
2	Power in watt	**48**
3	Total no of fixtures	57
4	No of hrs/day	10
5	No of day/year	280
6	Suggested watt	18
7	Saving in kWh/Year	4788
8	Load Factor	0.9
9	Energy Chaarges Rs/kWh	7
10	Saving in Rs/Year	33516
11	Cost/Piece(Rs)	220
12	Total Investment	12,540
13	Pay Back period(YEAR)	0.37414966
14	Pay Back period(Month)	4.489795918

2. Fan

S.No	Parameter	Value
1	Type of load	Fan
2	Power in watt	80
3	Total no of fixtures	49
4	No of hrs/day	10
5	No of day/year	280
6	Suggested watt	53
7	Saving in kWh/Year	8898.4
8	Load Factor	0.9
9	Energy Chaarges Rs/kWh	7
10	Saving in Rs/Year	62288.8
11	Cost/Piece(Rs)	1200
12	Total Investment	58800
13	Pay Back period(YEAR)	0.9439899
14	Pay Back period (Month)	11.327879

3. Calculation for Replacement of 110W CRT monitor with 18W LED:

S.No	Parameter	
1	Type of load	CRT
2	Power in watt	110
3	Total no of fixtures	9
4	No of hr/day	10
5	No of day/year	300
6	Suggested watt (LED)	18
7	Saving in kWh/year	2484
8	Load Factor	0.9
9	Energy charges Rs/kWh	7
10	Saving in Rs/year	17388
11	Cost/piece(Rs)	4500
12	Total investment(Rs)	40500
13	Pay Back Period(year)	2.329192547
14	Pay Back Period(Month)	27.95031056

Recommendations

- Replace existing single fitting **40 W and 36 W** conventional tubes with convention chokes by **18 W** energy efficient **(T5)** tubes.
- Replacement of conventional AC with energy efficient AC.
- Replacement of **110 W** Computer monitor **(CRT)** is needed with low wattage **15 W** LED Screen.
- 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.

Energy Conservation Opportunities In Building

HVAC (Heating / Ventilation / Air Conditioning):

- Tune up the HVAC control system.
- Consider installing a building automation system (BAS) or energy management system
- (EMS) or restoring an out-of-service one.
- Balance the system to minimize flows and reduce blower/fan/pump power requirements.
- Eliminate or reduce reheat whenever possible.
- Use appropriate HVAC thermostat setback.
- Use morning pre-cooling in summer and pre-heating in winter (i.e. before electrical peak hours).
- Use building thermal lag to minimize HVAC equipment operating time.
- In winter during unoccupied periods, allow temperatures to fall as low as possible without freezing water lines or damaging stored materials.
- In summer during unoccupied periods, allow temperatures to rise as high as possible without damaging stored materials.
- Improve control and utilization of outside air.
- Use air-to-air heat exchangers to reduce energy requirements for heating and cooling of outside air.
- Reduce HVAC system operating hours (e.g. -- night, weekend).
- Optimize ventilation.

- Ventilate only when necessary. To allow some areas to be shut down when unoccupied, install dedicated HVAC systems on continuous loads (e.g. -- computer rooms).
- Provide dedicated outside air supply to kitchens, cleaning rooms, combustion equipment, etc. to avoid excessive exhausting of conditioned air.
- Use evaporative cooling in dry climates.
- Reduce humidification or dehumidification during unoccupied periods.
- Use atomization rather than steam for humidification where possible.
- Clean HVAC unit coils periodically and comb mashed fins.
- Upgrade filter banks to reduce pressure drop and thus lower fan power requirements.
- Check HVAC filters on a schedule (at least monthly) and clean/change if appropriate.
- Check pneumatic controls air compressors for proper operation, cycling, and maintenance.
- Isolate air conditioned loading dock areas and cool storage areas using high-speed doors or clear PVC strip curtains.
- Install ceiling fans to minimize thermal stratification in high-bay areas.
- Relocate air diffusers to optimum heights in areas with high ceilings.
- Consider reducing ceiling heights.
- Eliminate obstructions in front of radiators, baseboard heaters, etc.
- Check reflectors on infrared heaters for cleanliness and proper beam direction.
- Use professionally-designed industrial ventilation hoods for dust and vapor control.
- Use local infrared heat for personnel rather than heating the entire area.
- Use spot cooling and heating (e.g. -- use ceiling fans for personnel rather than cooling the entire area).
- Purchase only high-efficiency models for HVAC window units.
- Put HVAC window units on timer control.
- Don't oversize cooling units. (Oversized units will "short cycle" which results in poor humidity control.)
- Consider dedicated make-up air for exhaust hoods. (Why exhaust the air conditioning or heat if you don't need to?)
- Minimize HVAC fan speeds.
- Consider desiccant drying of outside air to reduce cooling requirements in humid climates.
- Consider ground source heat pumps.
- Seal leaky HVAC ductwork.

- Seal all leaks around coils.
- Repair loose or damaged flexible connections (including those under air handling units).
- Eliminate simultaneous heating and cooling during seasonal transition periods.
- Zone HVAC air and water systems to minimize energy use.
- Inspect, clean, lubricate, and adjust damper blades and linkages.
- Establish an HVAC efficiency-maintenance program. Start with an energy audit and follow-up, then make an HVAC efficiency-maintenance program a part of your continuous energy management program.

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.

- 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 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.

Annexure -1

Specification of Fan

S.No	Parameter	Value
1	Span (MM/INCH)	1200/48
2	Wattage	53
3	Air Delivery(CMM)	230
4	RPM	300
5	Warranty(Years)	3.5
6	Power Factor	>.95
7	Nmber of Blades	3

Specification of Tube light

S.No	Parameter	Value
1	Size	Standard T5
2	Colour	Cool Day Light
3	Wattage	18 Watts
4	Warranty(Years)	3-5.
5	Operating Life (Hrs)	35000-50000

ANNEXURE-2

Parameter	Type Of Lamp						
	Incandescent (Bulb)	CFL	Metal Halide	HPSV	LED	Fluorescent Tube light (T8)	LED Tube light (T8)
Power (watt)	25-150	18-95	50-400	50-400	150	25-125	18-36
Output (lumens)	210-2700	1000-7500	1900-30000	3600-46000	7200	2000	2000
Efficacy (lumens/ Watt)	8-18	55-79	38-75	72-115	48	50-100	80-150
Life Span (Hrs)	750-2000	10000-20000	10000-20000	18000-24000	50000	7000-15000	35000-50000
CRI	Excellent (100)	Good	Good	Poor (20)	Very Good	Good	Very Good

List of Vendors and Distributors of LED & Fan:-

HELPLINE NUMBER: 18001803580/155275	
1	AAZAD NAGAR MPEB, INDORE
2	AGRASEN NAGAR MPEB, INDORE
3	ANNAPURNA MPEB, INDORE
4	ARANYA NAGAR ,MPEB, INDORE
5	ELECTRIC COMPLEX MPEB, INDORE
6	GANDHI NAGAR MPEB, INDORE
7	GUMASHTA NAGAR MPEB, INDORE
8	KHAJRANA ,MPEB, INDORE
9	MAHA LAXMI MPEB, INDORE
10	MALVA MILL MPEB, INDORE
11	MANORAMA GANJ, MPEB, INDORE
12	MECHANIC NAGAR, MPEB, INDORE
13	NARSING BAZAR MPEB, INDORE
14	NAVLAKHA MPEB, INDORE

15	POLO GROUND MPEB, INDORE
16	RAJ MOHALLA-KALANI NAGAR MPEB, INDORE
17	SANGAM NAGAR, MPEB, INDORE
18	SIYA GANJ MPEB, INDORE
19	SUBHAS CHOK MPEB, INDORE
20	TILAK NAGAR MPEB, INDORE
21	VIJAY NAGAR MPEB, INDORE