



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 3, March 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com



Energy Audit and Energy Retrofit for Residential Building

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ABSTRACT: Electric energy plays an important role in our daily life. No part of our daily life can be imagined without electricity. As there are a limited number of resources that can help us generate electricity, saving and conserving electricity is not only our responsibility, but also our hope for a more sustainable future. Through efficient energy management and auditing methods, the environment can be protected; Energy and money can be saved without affecting the natural and quality work carried out in all sectors. Generally speaking, an energy audit involves collecting and analyzing billing data for all energy sources and determining total energy consumption, a site analysis to identify where energy is used and energy saving opportunities, calculations to estimate the cost / benefit of energy saving opportunities, and preparing and submitting a report recommending what can be done to save energy.

KEYWORDS: Energy Audit, Energy Conservation, Energy Retrofit, Residential building.

I. INTRODUCTION

As a developing country, it is important for India to focus on energy conservation. Energy conservation is a good practice to reduce energy consumption by using less energy. This can be achieved by using energy more efficiently (using less energy for constant service) or by reducing the amount of service used (for example, driving less). Apart from this practice, another effective way to save energy is to perform an energy audit. As explained above, Energy Audit is a great way to analyze energy consumption. This process is usually followed by energy management, where solutions to the problems found in the energy audit and how they can be implemented effectively are discussed with the authorities. This whole process is known as energy retrofit.[1]

An energy audit is an analysis of a facility, showing how and where that facility can reduce its energy consumption and lower its energy costs. His vision of energy efficiency and energy conservation can result in significant savings on your company's utility bill. Energy audits find you're your daily consumption of electricity, identify waste, over-expenditure and make you fully aware of where your energy are going. This knowledge will allow you to be more efficient in your energy consumption and to be able to track and accelerate the savings. As we think Energy Audits expensive or complicated, but they can be free and are easier. An energy audit is a systematic approach that analyzes energy flow and provides suggestions for reducing energy waste. It is an inspection, examination and study of energy flows, for the conservation of energy in a building, process or system to reduce the amount of energy entered into the system without affecting normal work and its production. [1]

Energy Audit: An energy audit is an inspection survey and an analysis of energy flows for energy conservation in a building. It may include a process or system to reduce the amount of energy input into the system without negatively affecting the output. [2]

Energy Management: It is the process of monitoring, controlling and conserving energy in the building or an organization, including planning and operation of energy production and energy consumption units as well as energy distribution and storage. [2]

To be followed by Energy retrofit also known as Energy Efficiency, a term that revolves around modifications to the building that may improve energy efficiency or decrease energy demand.

Household Energy Efficiency Retrofits (HEER) method may be used to calculate energy savings from a range of household and small business energy efficiency upgrades. In this method, the term 'energy' may refer to electricity, gas or both.

Importance of Energy Retrofitting or Energy Efficiency is:

- Financial savings – buildings that operate more efficiently have a reduced energy demand. That means lower operating costs.
- Reduced carbon footprint – by generating less energy, the buildings emit fewer greenhouse gases. That means improved environmental performance.
- Environmental legislation – organizations operating in energy-efficient buildings will find it easier to comply with the tightening environmental regulations. That means improved productivity.
- Sustainable credentials – environmentally-responsible organizations gain a reputation for ethical operation. That means enhanced profitability.

II TYPES OF ENERGY AUDIT

Preliminary energy audit (phased audit): In a preliminary energy audit, the available data is mainly used for a simple analysis of energy consumption and plant performance. This type of audit does not require a lot of measurement and data collection just we have to take notes only from site. These audits take a relatively short time and the results are more general, offering common opportunities for energy efficiency. Economic analysis is usually limited to calculating the simple payback period or the time required to pay off the initial capital investment from the energy savings achieved. [3]

Detailed Energy Audit (Diagnostic Energy Audit) - Detailed energy audits require more detailed data and information. Typically, measurements and data inventory are taken and different supply systems (pump, fan, compressed air, steam, process heater, etc.) are evaluated in detail. Therefore, the time required for this type of audit is longer than that of preliminary audits. The results of these audits are more comprehensive and useful as they provide a more accurate picture of the energy performance of the power plant and more specific recommendations for improvements. The economic analysis performed for the recommended efficiency measures generally goes beyond the simple payback period and generally includes the calculation of an internal rate of return (IRR), the net present value (NPV), and often the cost of the life cycle (LCC).[3]

III. PROCEDURE

Our team conducted Energy Audit Survey in a residential society Vardhman Sawli, Pune which consists of 7 flats. The first phase of energy audit starts with site inspection work. In this paper the first initiative we have done auditing in a home and giving them an appropriate result with single line diagram in ETAP simulation software and recommendation regarding their usage of electricity with suggestions to reduce the tariff of the electricity bill. The procedure adopted for our work is presented below.



Fig no 1. Site Picture

1. Collect all the usage details with a maximum demand of the Electrical Equipment/s used in each apartment.
2. Calculate the Usage of equipment.
3. Identify and calculate the usage of power in the layout using graphs.
4. Draw the Power Utilization Chart for each apartment.
5. Calculate the daily utilization of Power by all the equipment's.
6. Plot graph of energy consumption by each apartment.
7. Data Collection of all the major equipment's and find out their performance.
8. Interaction about the energy usage.
9. Identify the Energy Saving and Conservations Opportunities for each apartment.
10. Report on suitable recommendation with existing and implementation suggestions about energy saving.
11. Plot Cost Benefit Analysis in charts.
12. Provide Awareness on Electrical Safety to the Person there.
13. Submission of Suitable Energy Audit Report with Analysis.



IV. DIFFERENT WAYS OF ENERGY CONSERVATION FOR HOUSEHOLD APPLIANCES:

1. Microwave:

- Make sure to unplug it when not in use.
- Use a toaster oven to reheat.
- Steam or roast your veggies.
- Use your teapot for boiling water.

2. Washing Machine:

- Use cold water whenever possible to reduce the energy cost associated with heating the water.
- Front-loading washing machines use less water than top-loading models and can significantly save on energy.
- Cut down on the number of times each week you run the dryer.
- Use the minimum heat and drying time to dry your laundry.

3. Refrigerator:

- Open the door of your appliance as little as possible and for as little time as possible.
- Defrost your food 24 hours in advance in the fridge (it is not just safer in terms of bacteria, but it also helps your appliance stay cold).
- Do not overfill your appliance (air must be able to circulate).
- Wrap up food stored in your appliance (as this reduces the amount of ice that forms and stops food drying out).

4. Air Conditioner:

- Keep it at 24 °C, Instead of 18 °C
- Shutting the door seems like a no-brainer when it comes to an air-conditioner.
- Keep the ceiling fan switched on when the AC is running. Together, they keep the room ventilated and circulate the cool air in all corners.
- Regular Servicing and Cleaning Saves Electricity.

5. Electric Iron:

- Iron large batches of clothing at one time.
- Iron first those that require low temperature to reduce warm up time, and then work up to those requiring higher heat.
- Never overheat the iron. Use the appropriate temperature for the type of clothes you're ironing.
- Dampen clothes moderately. Excessively moistened clothes take longer to iron.

6. Electric Fan:

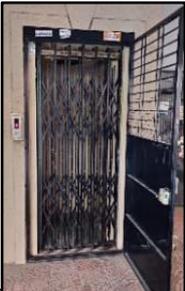
- Install the right type of fan – desk fans for small rooms, stand fans for medium-sized rooms and ceiling fans for large and spacious areas. Like air-conditioners, there is a right type and size of fan for every space.
- Keep your fan speed at the lowest possible level that will provide comfort.
- Never leave an electric fan running – always turn it off after use.
- Clean it regularly to keep the motor running smoothly and efficiently.

Fig. no. 2
Microwave



Fig. no. 3
Washing
Machine



<p>Fig. no. 4 Refrigerator</p> 	<p>Fig. no. 5 Air conditioner</p> 
<p>Fig. no. 6 Electric iron</p> 	<p>Fig. no. 7 Electric Fan</p> 
<p>Fig. no. 8 Television</p> 	<p>Fig. no. 9 Elevator</p> 
<p>Fig. no. 10 Water Pump</p> 	<p>Fig. no. 11 Solar Panel</p> 
<p>Fig. no. 12 Solar Panel</p> 	<p>Fig. no. 13 Wind Mill</p> 



7. Television:

- Always buy Led tv because it uses less power than plasmas because of the use of a backlighting technology that offers more picture contrast.
- It is best to turn it off and unplug it completely.
- The sleeping mode allows your television to automatically turn off when left untouched after a certain number of minutes or hours. Turning this mode on saves energy because of its ability to turn off the television when not in use.

8. Elevator:

- Replacing fluorescent tubes, incandescent and halogen lights with high-efficiency, low-heat LED lighting and replacing push buttons in cab panels, overhead fixtures and floor indicators.
- Using door drive motors that can go into standby mode when not in use and then recover efficiently when needed.
- Replacing old starters with new ones for greater energy efficiency while also protecting against poor quality power which can lead to brownouts.
- Replacing old landing systems that use magnets or tape with new ones that stop the cab faster and don't run the motor for as long.

9. Water Pump:

- Select the most efficient pump type for the application.
- Right-sizing the pump represents a significant economic opportunity to reduce energy consumption. This is important because centrifugal pumps can consume up to 60 percent of motor energy in a facility,
- Control valves are typically used to control flow and/or pressure. They can help to reduce energy losses
- When multiple pumps operate as part of a parallel pumping system, there are opportunities for significant energy savings.
- One of the simplest, but often overlooked, measures to save energy is to eliminate unnecessary use.

10. Solar Energy:

Solar energy is a renewable and versatile source of energy. Basically, all energy sources, even fossil fuels, were originally powered by seemingly ubiquitous solar energy. At home, solar energy can be used to heat water for bathing or cleaning in the same way that camping enthusiasts use solar bags. They are filled with water and placed in the sun to warm up, then connected to a solar shower and used as a source of water for the shower.

Solar panels can be used to collect solar energy and convert it into electricity, and they are increasingly being used in homes. In fact, you may already have a garden lantern powered by solar panels.

When used as a major energy source, solar panels are usually quite large and can be mounted on the roof of a house. The collected solar energy is converted into electricity and can be used and stored, just like purchased electricity. Solar panels can also be used to charge batteries and perform smaller electrical tasks.

11. Windmill:

A windmill is usually connected to a generator driven by its rotation: when the wind blows, its force turns the windmill. Wind power was first used not to generate electricity, but to perform repetitive mechanical tasks, such as pumping water from wells or grinding grain.

Today, windmills can be used in a variety of situations, even when a small amount of power is required. They can be used in most places because they can be made in any size.



13. Other Ways to Adapt Energy Efficiency:

1. Adjust your daily behavior: Conserving energy can be as easy as turning off lights or appliances when you don't need them. You can also use less energy consuming appliances by doing household chores by hand, such as drying clothes instead of putting them in the dryer or washing dishes by hand.
2. Replace your bulbs - Traditional incandescent bulbs consume an excessive amount of electricity and need to be replaced more frequently than their energy efficient alternatives. Light-emitting diode (LED) bulbs consume 25-80% less electricity and last 3-25 times longer than traditional bulbs.
3. Install a programmable or smart thermostat: A programmable thermostat can be set to automatically turn off or reduce heating and air conditioning during times when you sleep or are away. When you install a programmable thermostat, you eliminate wasted heating and cooling energy without upgrading your HVAC system. On average, we can save \$ 180 per year.
4. Buy energy efficient appliances: On average, appliances are responsible for about 13% of total home energy use. When buying a device, you need to pay attention to two figures: the initial purchase price and the annual operating cost. While energy-efficient devices may have higher initial purchase prices, their operating costs are typically 9-25% lower than conventional models.
5. Reduce your water heating costs: Water heating is a major factor contributing to your overall energy use. In addition to buying an energy efficient water heater, there are three ways to reduce your water heating costs: You can simply use less hot water, lower the water heater thermostat, or insulate the water heater. Water and the first six feet of the water heater. Cold water pipes.
6. Install energy efficient windows: Windows are a major source of energy waste; they can represent up to 10-25% of your total heating bill. To prevent heat loss through your windows, you can replace single-glazed windows with double-glazed products. For homes in colder areas, gas-filled windows with "low-e" coatings can dramatically reduce your heating costs, or interior or exterior shutters can reduce unnecessary heat loss by 10 to 20 percent.
7. Upgrade your HVAC system: An HVAC system is made up of heating, ventilation, and air conditioning equipment. Heating alone is responsible for more than 40% of household energy consumption. Upgrades to the third component of an HVAC system, ventilation, can also improve its energy efficiency.
8. Weatherize your home: Weathering or sealing air leaks around your home is a great way to reduce your heating and cooling costs. The common sources of air leaks in your house are windows and doors. To avoid these leaks, you need to make sure that there are no cracks or openings between the wall and the vent, window, or door frame.
9. Insulate Your Home: Insulation plays a important role in lowering your electricity bills by retaining heat during the winter and keeping heat out of your home during the summer. In warmer climates, the recommended R-value is much lower than for buildings located in cooler regions such as the Northeast.
10. Use smart power strips: "phantom loads," or the electricity that electronic devices use when they are turned off or in sleep mode, are a major source of wasted energy. It can cost up to \$ 200 per year. Smart power strips, also known as advanced power strips, eliminate the problem of phantom charging by removing power to electronic components when not in use. Smart power strips can be configured to turn off at any time, during a period of inactivity, using remote switches [2]

**V. ELECTRICAL ENERGY AUDIT SURVEY:**

Our team conducted Energy Audit Survey in a residential society Vardhman Sawli, Pune which consists of 7 flats. The following data represents Electricity usage of each apartment and Electricity consumption of each appliance in individual apartment for detailed structuring of graphical analysis.

NO	Electrical appliances	Brand	Quantity	Power Usage	Avg. Power Usage	Avg. Duration	Power Consumption/day	Monthly consumption	Cost/Day	Monthly Total cost in Rs.
FLAT NO.1	Television (42")	Samsung	1	80-120 Watts	110 Watts	6	0.66kWh	19.8kWh	3.58	107.51
	Fan	Bajaj	4	50-54 Watts	51 Watts	8	0.408kWh	12.24kWh	2.21	265.2
	WIFI connection	D Link	1	8-16 Watts	12 Watts	24	0.288kWh	8.6kWh	1.56	46
	Air Conditioner	Samsung	1	900-1500 Watts	1100 Watts	6	6.6kWh	198kWh	36.1	1075.14
	LED Bulb	Wipro	8	4-15 Watts	8 Watts	6	0.048kWh	1.44kWh	0.26	62.48
	Fridge	LG	1	100-200 Watts	150 Watts	20	3kWh	90kWh	16.29	488.7
	Mixer	Usha	1	500-800 Watts	500 Watts	0.16	0.08kWh	2.4kWh	0.43	13
	Microwave	Crompton	1	800-2000 Watts	1000 Watts	0.16	0.16kWh	4.8kWh	0.86	26
	Water Purifier	Kent RO	1	15-35 Watts	25 Watts	6	0.15kWh	4.5kWh	0.81	24.43
	Water Heater	Bajaj	1	1000-2000 Watts	1500 Watts	1	1.5kWh	45kWh	8.15	244.35
	Washing machine	LG	1	400-800 Watts	500 Watts	1	0.5kWh	3.5kWh	2.71	19
	Desktop	Intel	1	60-300 Watts	100 Watts	3	0.3kWh	7.2kWh	1.62	38.87
	Iron	Bajaj	1	800-1500 Watts	1050 Watts	1	1.05kWh	7.35kWh	5.7	40
	Other battery Products	Samsung, Asus, Mi	5	2 - 10 Watts	6 Watts	4	0.024kWh	0.72kWh	0.13	19.5
										Total bill = Rs. 2470.18



NO	Electrical appliances	Brand	Quantity	Power Usage	Avg. Power Usage	Avg. Duration	Power Consumption/day	Monthly consumption	cost/D ay	Monthly Total cost in Rs.
FLAT NO.2	Television (37")	Sony	1	60-80 Watts	75 Watts	6	0.45kWh	13.5kWh	2.44	73.31
	Home Theatre	JBL	2	200-400 Watts	300 Watts	3	0.9kWh	27kWh	4.89	293.22
	Fan	Usha	5	50-55 Watts	52 Watts	8	0.416kWh	12.48kWh	2.26	271.04
	WIFI connection	D Link	1	8-16 Watts	12 Watts	24	0.288kWh	8.6kWh	1.56	46
	Air Conditioner	Haier	2	900-1600 Watts	1050 Watts	5	5.25kWh	157.5kWh	28.5	1710.45
	LED Bulb	Wipro	7	4-15 Watts	8 Watts	6	0.048kWh	1.44kWh	0.26	54.6
	Fridge	Whirlpool	1	100-200 Watts	140 Watts	20	2.8kWh	84kWh	15.2	456.12
	Mixer	Bajaj	1	500-800 Watts	510 Watts	0.16	0.0816kWh	2.44kWh	0.44	13.29
	Microwave	Samsung	1	800-1600 Watts	1000 Watts	0.16	0.16kWh	4.8kWh	0.86	26
	Water Purifier	Kent RO	1	15-35 Watts	25 Watts	6	0.15kWh	4.5kWh	0.81	24.43
	Water Heater	Havells	1	900-1800 Watts	1400 Watts	1	1.4kWh	42kWh	7.6	228
	Washing machine	Samsung	1	400-800 Watts	500 Watts	1	0.5kWh	3.5kWh	2.71	19
	Desktop	Dell	2	60-300 Watts	100 Watts	3	0.3kWh	7.2kWh	1.62	38.87
										Total bill = Rs. 3309.40



NO	Electrical appliances	Brand	Quantity	Power Usage	Avg. Power Usage	Avg. Duration	Power Consumption/day	Monthly consumption	cost/Day	Monthly Total cost in Rs.
FLAT NO. 3	Television (32")	LG	2	40-70 Watts	50 Watts	6	0.3kWh	9kWh	1.63	97.74
	Fan	Havells	4	40-60 Watts	50 Watts	7	0.35kWh	10.5kWh	1.9	228
	WIFI connection	D Link	1	8-16 Watts	12 Watts	24	0.288kWh	8.6kWh	1.56	46
	Air Conditioner	Samsung	2	900-1500 Watts	1100 Watts	6	13.2kWh	396kWh	71.67	2150.28
	LED Bulb	Wipro	6	4-15 Watts	8 Watts	6	0.048kWh	1.44kWh	0.26	54.6
	Toaster	Philips	1	800-1500 Watts	1000 Watts	0.16	0.16kWh	3.2kWh	0.89	26
	Fridge	LG	1	100-200 Watts	150 Watts	20	3kWh	90kWh	16.29	488.7
	Mixer	Bajaj	1	500-800 Watts	510 Watts	0.16	0.0816kWh	2.44kWh	0.44	13.29
	Microwave	LG	1	800-1600 Watts	1000 Watts	0.16	0.16kWh	4.8kWh	0.86	26
	Water Purifier	Kent RO	1	15-35 Watts	25 Watts	6	0.15kWh	4.5kWh	0.81	24.43
	Water Heater	Havells	2	900-1800 Watts	1400 Watts	1	1.4kWh	28kWh	7.6	304.08
	Washing machine	Samsung	1	400-800 Watts	500 Watts	1	0.5kWh	3.5kWh	2.71	19
	Iron	Wipro	1	800-1500 Watts	900 Watts	1	0.9kWh	27kWh	4.89	34.2
	Other battery Products	Samsung, iPhone, iPhone	5	2-15 Watts	8 Watts	4	0.032kWh	0.96kWh	0.17	20.85
										Total bill = Rs. 3533.17

NO	Electrical appliances	Brand	Quantity	Power Usage	Avg. Power Usage	Avg. Duration	Power Consumption/day	Monthly consumption	cost /Day	Monthly Total cost in Rs.
FL AT NO . 4	Television (32")	Samsung	1	40-70 Watts	50 Watts	5	0.25kWh	7.5kWh	1.35	40.73
	Fan	Bajaj	4	40-60 Watts	50 Watts	11	0.55kWh	16.5kWh	2.98	358.38
	WIFI connection	D Link	1	8-16 Watts	12 Watts	24	0.288kWh	8.6kWh	1.56	46
	Air Conditioner	Samsung	1	900-1500 Watts	1100 Watts	6	13.2kWh	396kWh	71.67	2150.28
	LED Bulb	Syska	3	4-15 Watts	8 Watts	8	0.064kWh	1.92kWh	0.35	31.27
	Fridge	LG	1	100-200 Watts	150 Watts	24	3.6kWh	108kWh	19.54	586.44
	Mixer	Usha	1	500-800 Watts	510 Watts	0.15	0.076kWh	2.3kWh	0.41	12.38
	Microwave	Crompton	1	800-1600 Watts	1000 Watts	0.2	0.2kWh	4.8kWh	1.09	26
	Water Purifier	Kent RO	1	15-35 Watts	25 Watts	3	0.075kWh	2.25kWh	0.4	12.21
	Water Heater	Bajaj	1	900-1800 Watts	1400 Watts	0.3	0.42kWh	8.4kWh	2.28	68.41
	Washing machine	LG	1	400-800 Watts	500 Watts	2	1kWh	8kWh	5.43	43.44
	Desktop	Intel	1	60-300 Watts	100 Watts	3	0.3kWh	9kWh	1.62	49
	Iron	Bajaj	1	800-1500 Watts	900 Watts	0.3	0.27kWh	8.1kWh	1.46	44
	Other battery Products	Samsung, Asus, Mi	4	2-15 Watts	8 Watts	3	0.024kWh	0.72kWh	0.13	3.9
										Total bill = Rs. 3472.44



NO	Electrical appliances	Brand	Quantity	Power Usage	Avg. Power Usage	Avg. Duration	Power Consumption/day	Monthly consumption	cost /Day	Monthly Total cost in Rs.
FL AT N O. 5	Television (32")	LG	1	40-70 Watts	55 Watts	5	0.275kWh	8.25kWh	1.5	44.79
	Fan	Bajaj	5	40-60 Watts	45 Watts	9	0.40kWh	12.15kWh	2.17	329.87
	WIFI connection	D Link	1	8-16 Watts	10 Watts	24	0.24kWh	7.2kWh	1.3	39
	Tube light	Philips	5	30-45 Watts	41 Watts	4	0.164kWh	4.92kWh	0.89	133.55
	LED Bulb	Wipro	5	4-15 Watts	8 Watts	8	0.064kWh	1.92kWh	0.35	52.12
	Fridge	Whirlpool	1	100-200 Watts	160 Watts	24	3.84kWh	115.2kWh	20.85	625.53
	Mixer	Usha	1	500-800 Watts	650 Watts	0.3	0.195kWh	5.85kWh	1.05	21
	Microwave	Samsung	1	800-1600 Watts	1300 Watts	0.3	0.39kWh	11.7kWh	2.11	44
	Water Purifier	Kent RO	1	15-35 Watts	30 Watts	2	0.06kWh	1.8kWh	0.32	9.77
	Water Heater	Bajaj	1	900-1800 Watts	950 Watts	0.3	0.28kWh	8.55kWh	1.52	45.61
	Washing machine	LG	1	400-800 Watts	660 Watts	1	0.66kWh	5.28kWh	3.6	28.67
	Desktop	Asus	2	60-300 Watts	110 Watts	3	0.33kWh	7.92kWh	1.8	86
	Iron	Wipro	1	800-1500 Watts	1210 Watts	0.15	0.181kWh	1.81kWh	0.98	9.8
	Other battery Products	Mi, iPhone, iPad, Dell	6	2-15 Watts	15 Watts	3	0.045kWh	1.35kWh	0.24	7.33
										Total bill = Rs. 1477.04



NO	Electrical appliances	Brand	Quantity	Power Usage	Avg. Power Usage	Avg. Duration	Power Consumption/day	Monthly consumption	cost /Day	Monthly Total cost in Rs.
FLAT NO.6	Television (37")	Samsung	1	80-120 Watts	115 Watts	3	0.345kWh	10.35kWh	1.87	56.2
	Fan	Bajaj	4	50-54 Watts	55 Watts	6	0.33kWh	9.9kWh	1.79	215
	WIFI connection	D Link	1	8-16 Watts	12 Watts	24	0.288kWh	8.6kWh	1.56	46.6
	Air Conditioner	Samsung	1	900-1500 Watts	1100 Watts	4	4.4kWh	132kWh	23.89	716.67
	LED Bulb	Wipro	5	4-15 Watts	8 Watts	8	0.064kWh	1.92kWh	0.34	52.12
	Fridge	LG	2	100-200 Watts	150 Watts	24	3.6kWh	108kWh	19.54	1172.88
	Mixer	Usha	1	500-800 Watts	500 Watts	0.1	0.05kWh	1.2kWh	0.27	6.51
	Water Purifier	Kent RO	1	15-35 Watts	25 Watts	4	0.1kWh	3kWh	0.54	16.29
	Water Heater	Bajaj	1	1000-2000 Watts	1500 Watts	0.3	0.45kWh	9kWh	2.44	48.87
	Washing machine	LG	1	400-800 Watts	500 Watts	0.45	0.225kWh	2.25kWh	1.22	12.21
	Iron	Bajaj	1	800-1500 Watts	1050 Watts	0.15	0.1575kWh	2.36kWh	0.85	12.81
	Other battery Products	Samsung, Asus, Mi	6	2 - 10 Watts	10 Watts	2	0.02kWh	0.6kWh	0.1	3.25
										Total bill = Rs. 2359.41

NO	Electrical appliances	Brand	Quantity	Power Usage	Avg. Power Usage	Avg. Duration	Power Consumption/day	Monthly consumption	cost /Day	Monthly Total cost in Rs.
	Television (43")	LG	1	80-120 Watts	110 Watts	4	0.44kWh	13.2kWh	2.38	71.67
	Home Theatre	JBL	2	200-400 Watts	300 Watts	3	0.9kWh	27kWh	4.89	293.22
	Fan	Usha	5	50-55 Watts	50 Watts	11	0.55kWh	16.5kWh	2.98	358.38
	WIFI connection	D Link	1	8-16 Watts	12 Watts	24	0.288kWh	8.6kWh	1.56	46.91
	Air	Samsung	1	900-	1100	4	4.4kWh	132kWh	23.	716.76



FLAT NO.7	Conditioner			1600 Watts	Watts				89	
	LED Bulb	Wipro	12	4-15 Watts	8 Watts	8	0.064kWh	1.92kWh	0.35	125.1
	Fridge	Whirlpool	1	100-200 Watts	150 Watts	24	3.84kWh	115.2kWh	20.85	625.53
	Mixer	Usha	1	500-800 Watts	650 Watts	0.16	0.08kWh	2.4kWh	0.43	13
	Microwave	Samsung	1	800-1600 Watts	1110 Watts	0.15	0.166kWh	2.49kWh	0.9	13.52
	Water Purifier	Kent RO	1	15-35 Watts	35 Watts	3	0.075kWh	2.25kWh	0.4	12.21
	Washing machine	LG	1	400-800 Watts	540 Watts	1	0.5kWh	3.5kWh	2.71	19
	Iron	Bajaj	2	800-1500 Watts	900 Watts	0.15	0.181kWh	1.81kWh	0.98	9.8
	Other battery Products	Mi, iPhone, iPad, Dell	1	2-15 Watts	8 Watts	3	0.024kWh	0.72kWh	0.13	3.9

Other Electrical appliances	Brand	Quantity	Power Usage	Avg. Power Usage	Avg. Duration	Power Consumption/day	Monthly consumption	cost/Day	Monthly Total cost in Rs.
Led Bulb	Syska	22	4-15 Watts	15 Watts	12	0.180kWh	5.4kWh	0.97	645.08
Water Pump	Kirloskar Brothers	2	250-1500 Watts	1250 Watts	4	5kWh	150kWh	27.71	1629
Elevator	Panasonic	1	2000-4500 Watts	3455 Watts	3	10.36kWh	311kWh	56.25	1688.7
Elevator Invertor	Panasonic	1	1000-2500 Watts	2300 Watts	1	2.3kWh	69kWh	12.48	374.6
Security Camera	RS PRO Network	4	5-25 Watts	20 Watts	24	-	-	-	-
									Total bill = Rs. 4337.38



VI. DATA ACQUISITION ANALYSIS: (GRAPHS)

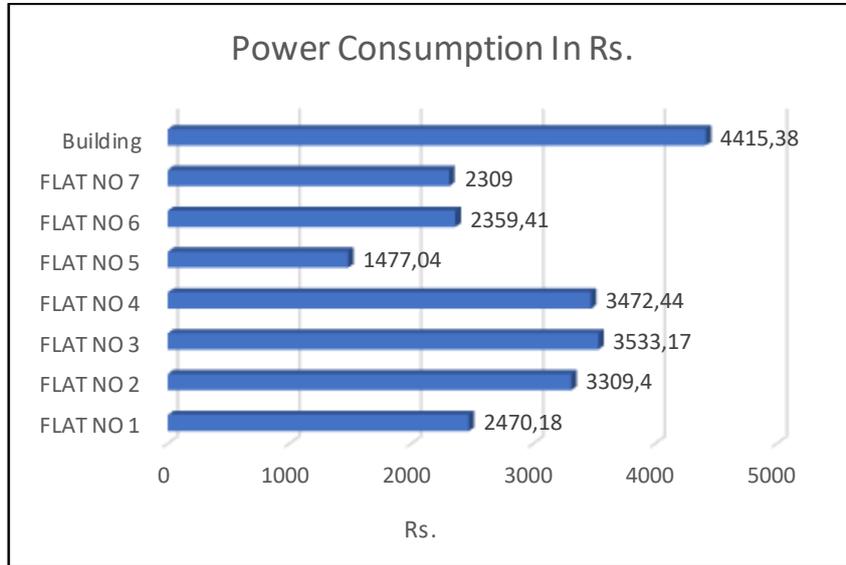


Fig. 2 Power consumption of Flats in Rs.

In fig. 2, we can see how much electricity bill of each flat is, which ultimately explains that flat number 3 consumes the maximum amount of energy while flat number 5 consumes least amount of Energy.

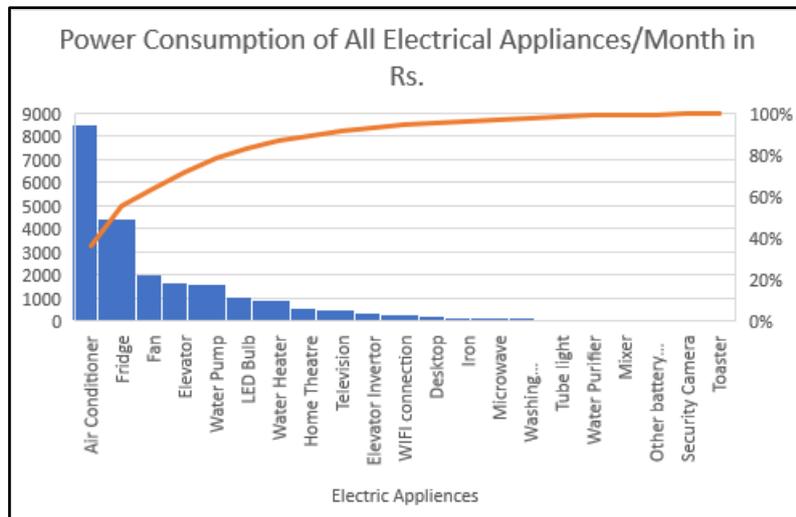


Fig. 3Power consumption by all electrical appliances per month in Rs

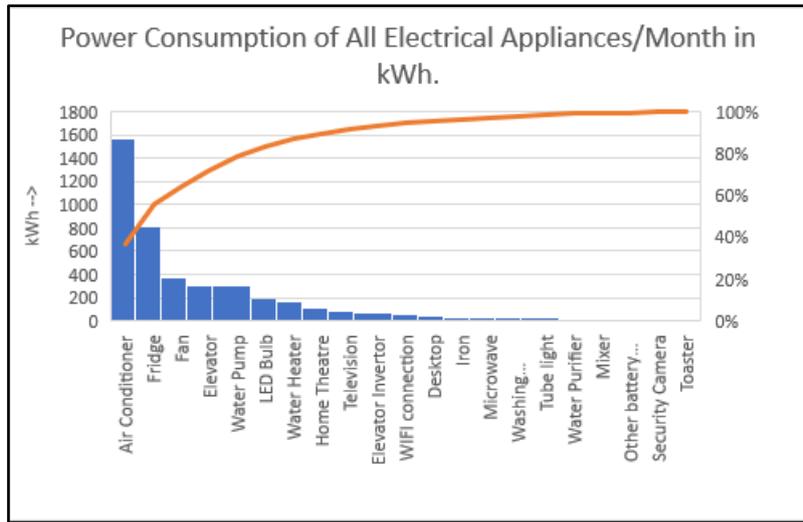


Fig.4 Power consumption by all electrical appliances per month in kWh

Fig 3,4 shows the Power Consumption of electric appliances per month in Rs. and in kWh. In this chart we can see that the power consumption of Air conditioner is very high as compared to other appliances and very less consumption of security camera and toaster appliances.

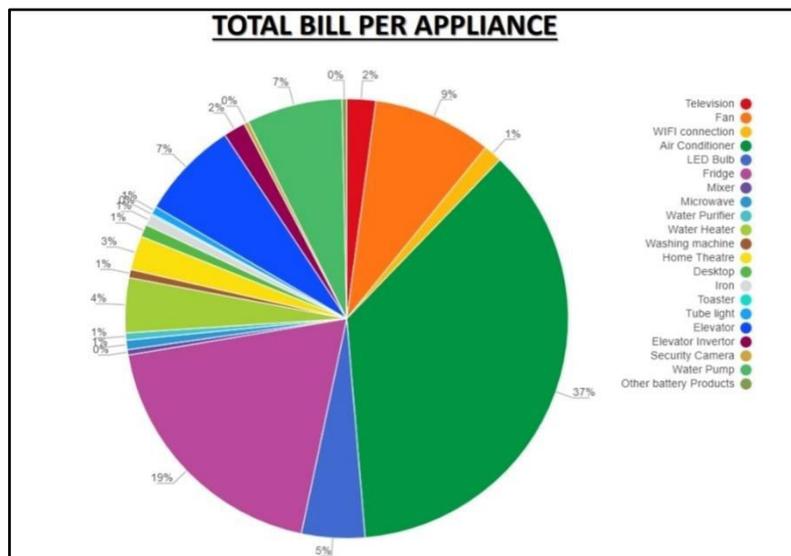


Fig. 5 Percentage of consumption of Electricity of electric Appliances

Fig .5 indicates which appliance has consumed highest energy in each flat. Air-conditioner is the most energy consuming appliance in each of the apartments as the energy required to operate Air-conditioner is highest.

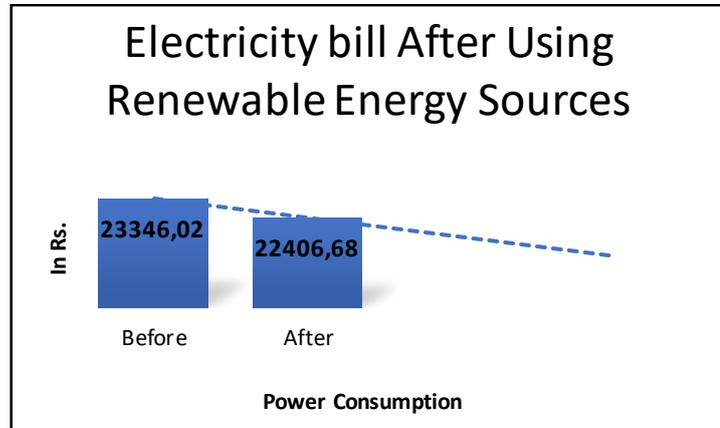


Fig.6 Electricity Bill After Using Renewable Energy

Here in Fig. 6, we can see that, if we use renewable energy source for electric energy, we save some amount of electricity bill. If we use this type of energy source, it will be helpful for power conservation.

VII. CONCLUSION

From this Energy Audit and Energy Retrofitting we can say that there are numerous ways of cutting down the wastage of energy. By making small, simple and efficient changes in energy usage practices, we can create more sustainable energy consumption environment.

By opting renewable sources of energy such as Solar and Wind, we can obtain more environment-friendly way to fulfill our energy needs. The bar graph above displays the cost reduction that can be achieved by obtaining Solar Energy, we highly recommend it's installment to our customers as almost 6% of monthly bill of the building will be reduced.

As there are abundant sources of such forms of energy, scarcity of energy will never be an issue. And also, as these forms of energy are produced on large scale with one-time installment charges, these forms are pocket-friendly as well as sustainable.

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**Impact Factor:
7.512**

ISSN INTERNATIONAL
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