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A REVIEW ON IMPROVEMENT OF ENERGYEFFICIENCYINRESIDENTIALBUILDINGS

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ABSTRACT- Energy conservation in utilities has played a vital role in improving energy efficiency in the industrial, commercial, and residential sectors. Improvement of electrical energy efficiency is understood as the reduction in power and energy demands from the electrical system without affecting the normal activities carried out in buildings, industrial plants or any other transformation process. India has emerged as one of the fastest-growing economies in the world, necessitating an equally rapid increase in modern energy consumption. A significant amount of research is being carried out to improve energy efficiency using artificial intelligence (AI) and smart networks, including sensors. Modern energy-efficient technologies are needed to improve energy efficiency. Such technologies are investigated and studied in this term paper. A comparative analysis will be carried out on some of the modern technologies that really improve the energy efficiency in residential buildings, and the findings will be summarized.

KEYWORDS: Comparison between energy consumption in residential and commercial buildings, Energy Efficient Electrical Appliances.

1.INTRODUCTION

The enhancement of the reduction in power and energy demands from the electrical system without disrupting regular operations carried out in buildings, industrial plants, or any other transformation process is referred to as electrical energy efficiency. Energy efficiency gains are typically achieved by adopting a more efficient technology or manufacturing process, or by employing well acknowledged methods for reducing energy losses. Efficient energy use, often known as energy efficiency, is the goal of reducing the quantity of energy necessary to supply products and services while also reducing pollution consequences. Furthermore, an energy-efficient electrical installation enables for cost and technical improvement. That is, the lowering of operation's technical and economic costs. Inshort,astudy onenergysavingsandefficiencywillinvolvethreebasicpoints:

- Supportthesustainabilityofthesystemandtheenvironmentbyreducinggreenhouse emissions as aresult of reducing theenergy demand.

- Improvingofthetechnicalmanagementoftheinstallationsbyincreasingitsefficiencyandavoiding stoppages and breakdowns.
- Reductionoftheeconomiccostoftheenergyaswellastheoperatingcostsoftheinstallations.

Actions to promote energy efficiency will become increasingly important as global energy consumption grows. Although the technical possibilities are numerous and the potential savings are substantial, consumers and utilities have been sluggish to invest in the most cost-effective and energy-efficient technology available. Buildings, electric equipment, and appliances in use are inefficient in comparison to what is technically possible. Electric utility energy efficiency measures have a lot of promise to close this gap and save a lot of money. Simply said, energy efficiency implies using less energy to do the same work - in other words, eliminating energy waste. Energy efficiency has a number of advantages, including lowering home and economy-wide expenses, lowering greenhouse gas emissions, and reducing demand for energy imports. While renewableenergy technologiesalsohelpaccomplish these objectives, improving energy efficiency is the cheapest – and often themost immediate – way to reduce the use of fossil fuels. There are enormous opportunitiesforefficiencyimprovementsineverysectoroftheeconomy,whetheritisbuildings, Transportation, manufacturing, or energy generation are all possible options. Among the several advantages of energy efficiency are: Increased efficiency can reduce greenhouse gas (GHG) emissions and other pollutants, as well as water use. Economic: Improving energy efficiency can help stabilize power costs and volatility by lowering individual utility bills, creating jobs, and lowering individual utility bills.

From a technical point of view, four basic points are considered in order to have a moreefficientelectrical installation as shown in fig1.

- Contractoptimizing
- Measurementsystems
- Demandmanagement
- Productivityimprovingbycontrollingperturbances andcosts.

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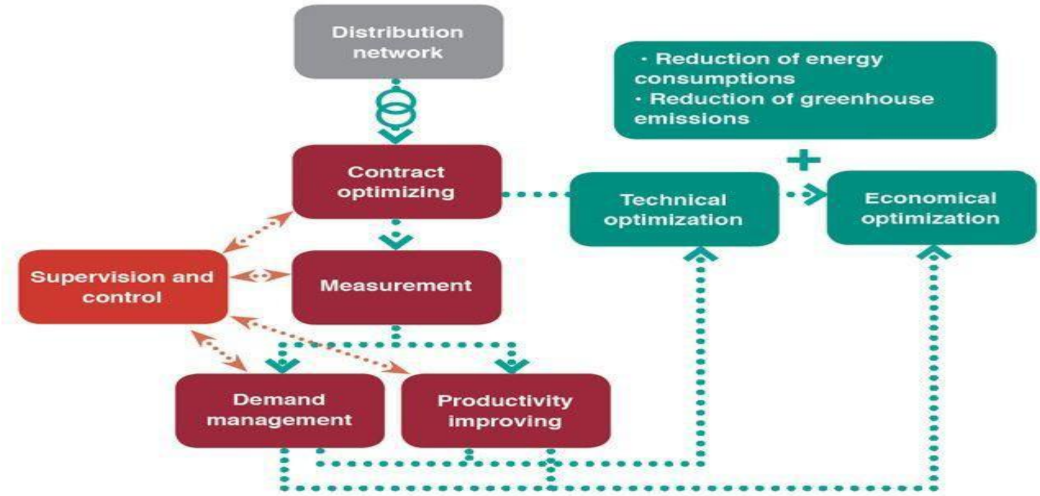

Fig1:Flowchat toimproveenergyefficiency

1.1 Comparison between energy consumption in residential andCommercial buildings

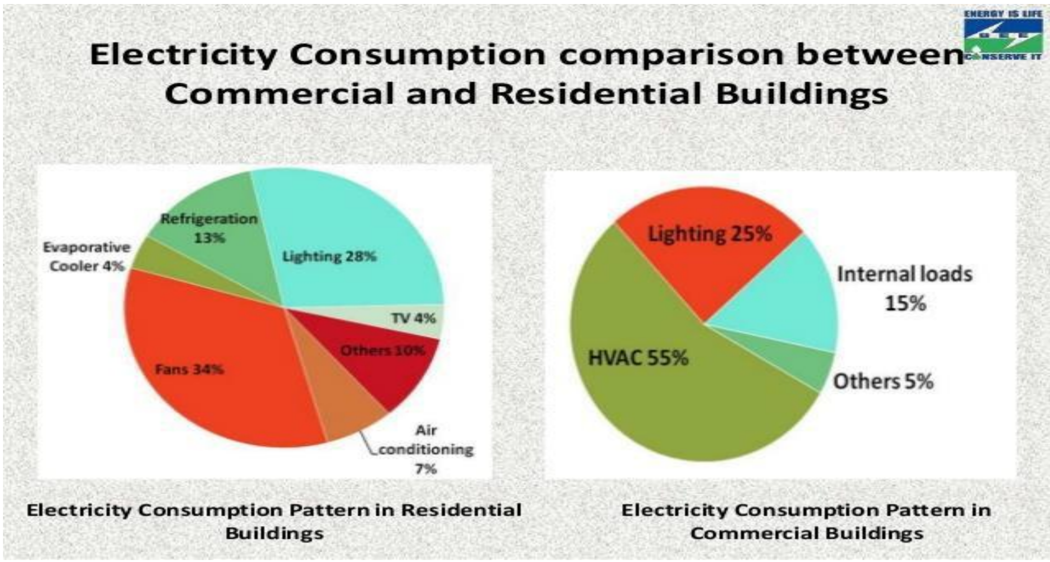

Fig2:ElectricityconsumptioncomparisonbetweencommercialandResidentialBuildings.

In Fig2 As of 2006, roughly 80.8 million single-family houses, 24.8 million multifamily housing units, and nearly 6.9 million mobile homes in the United States were utilizing this energy.

As of 2006, roughly 75 billion square feet (7 billion square meters) of floor space was available in 5 million commercial buildings. The building stock is long-lasting: dwellings can last 100 years or more, commercial buildings can last 50 years or more, and building appliances and equipment can last 10–20 years (IWG, 1997). Nonetheless, throughout the last 30 years, there have been considerable advancements in building energy consumption and efficiency.

2 ENERGY EFFICIENT ELECTRICALAPPLIANCES:

Occupancy Sensors - Infrared, ultrasonic, and microwave sensors that detect movement or noise in room areas can be used to create occupancy linked control. When occupancy is detected, these sensors turn on the lights, then turn them off after a defined amount of time if no movement is observed. They're meant to take the place of manual switches and prevent illumination from being left on in empty places. An occupancy sensor is an interior motion detector that detects the presence of a person and controls lighting, temperature, and ventilation systems.

Typesofoccupancysensors:

- PassiveInfraredSensorsdetectmovementand/orincreasedheatinanareacausedbynaturalincrease in movement andheat as peopleenterthearea.
- Ultra-SonicSensorsemitultra-sonicwavesthatbounceoffobjectsinaroomwithanecho sent to the sensors. The sensitivity of the sensors recognizes movement in theroomand responds accordingly shown in the figure3.
- Micro-PhonicSensorslistentoirregularsoundpatterns todetectmotioninaroom.

Fig3:OccupancySensors

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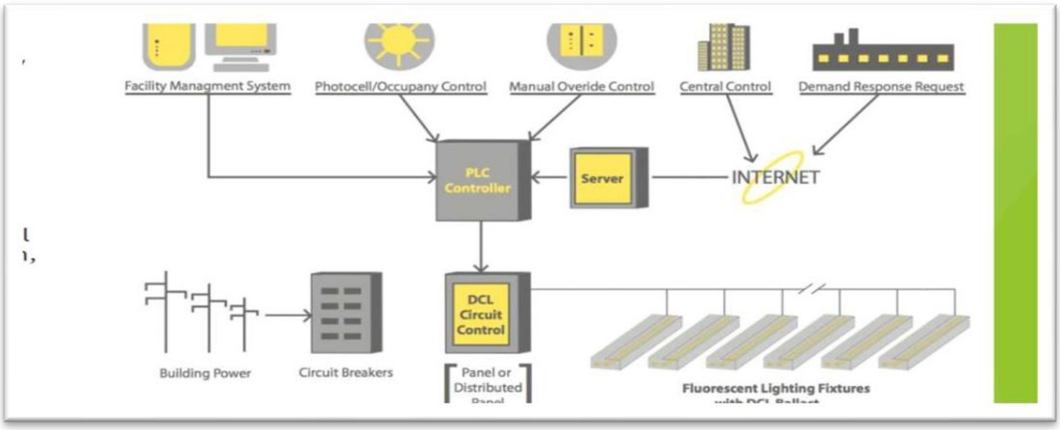
LocalizedSwitching

In applications with vast areas, localized switching should be employed. Individual inhabitants have control over their visual environment, and local switches help save energy. Localized switching allows you to turn off artificial lighting in select places while keeping it on in other parts where it's needed, which is hard to do with a single switch that controls the lighting for the whole room.

DaylightLinkedControl

Photoelectric cells can be used either simply to switch lighting on and off, or fordimming. By using an internally mounted photoelectric dimming control system, it ispossible to ensure that the sum of daylight and electric lighting always reaches the designlevelbysensingthetotallightinthecontrolledareaandadjustingtheoutputoftheelectric lighting accordingly. If daylight alone is able to meet the design requirements, then theelectriclightingcanbeturnedoff.Theenergysavingpotentialofdimmingcontrolisgreaterthanasimple photoelectric switching system.



Howdoesitwork:

As shown in the figure4 When the occupancy sensor detects that the room is inhabited, the photocell calculates how much artificial light is required to maintain the desired level of lighting. The photocell instructs the ballasts to run at their pre-programmed maximum level when there is no natural light. When the photocell detects natural light, the ballasts are muted by the same amount, ensuring that the room's overall lighting remains constant. This is referred to as Daylight Harvesting. The photocell begins a shut-down programmed when the occupancy sensor detects that the room is vacant. It starts with a 30-second dimming process that may be adjusted in the field. For 10 minutes, the ballasts' power will be reduced to 35 percent. The fixtures will then switch off. This process is called Dimming. Should the space be re-occupied prior to thesystem timeout, the occupancy sensor would alert the PLC, and ballast output wouldimmediatelyreturn to thelevel established by the photocell.

2.1. EnergySavingLamps

A bulb's energy efficiency is usually measured by how much energy it requirescomparedtohowmuchenergyisrequiredbyatraditionalincandescentbulbtoproducethesame amount of light. For this example, we're going to compare each bulb to a 60-watttraditional incandescent. Motion sensors are often used in indoor spaces to control electriclighting. If no motion is detected, it is assumed that the space is empty, and thus does notneed to be lit. In lighting practice occupancy sensors are sometime also called "presencesensors"or "vacancy sensors".

Beforeenergy-efficientbulbswerereleased,brightnesswasmeasuredinwatts.Itmadesense at the time – the more watts, the brighter the bulb. However, now that you've gotbulbs producing the same amount of light with far less wattage required, a new metric isused:lumens.Thankfully,eachtypeoflightcan produceanylevelofbrightnessfromacommonhouseholdsetting(roughly500lumens)toastrongbackyardsetting(1000+lumens). With that said, there's really no winner when it comes to overall brightness. Thedifference here lies in the time it takes to reach full brightness, and the shade of the lightitself. Halogen incandescent and LEDs provide bright, consistent light as soon as you fliptheswitch,butCFLsusuallytakeaminuteortwotoreachfullbrightnessandarestillknowntooccasionallyflickerevenafterthey'vebeenwarmedup.Additionally,LEDsandhalogensareavailableinawiderangeofhuesfromwarmwhitetocoolblue,whereasCFLstypicallyfallinto thecool blue category.

As shown in figure 5 Comparison between LED and CFL bulbs.

- CFL Lighting- Efficient, Less Expensive, Reduces Air and Water Pollution, High-QualityLight, Versatile.
- LEDLighting-Long-lasting,durable,cost-effective,moreefficient.
- CandlelightBulbs-Replicatingthetaperedshapeofacandleflame,candlelightbulbsaregreat for decorativefittings, especiallywhen thebulb itself ison show.
- IncandescentBulbs-Anincandescentlamp or incandescentlight globeisanelectriclightwithawirefilamentheateduntilitglows.Thefilamentisenclosedinaglassbulb witha vacuumorinert gasto protect the filament fromoxidation.

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Fig5:LED Bulbs Vs CFLBulbs

Efficiency,lifespan, andcolor renderingofabove-mentionedbulbs areshown infigure6.

Fig6:Comparisonofdifferentbulbs.

Lumens(Brightness)	**LED Watts(Viribright)**	**CFLWatts**	**IncandescentWatts**
400 – 500	6 – 7W	8 – 12W	40W
650 – 850	7 – 10W	13 – 18W	60
1000 – 1400	12 – 13W	18 – 22W	75
1450-1700+	14 – 20W	23 – 30W	100
2700+	25 – 28W	30 – 55W	150

Table1:Comparinglumens

2.2. EnergyEfficientMotors

Minimizing Watts Loss in Motors Improvements in motor efficiency can be achievedwithout compromising motor performance - at higher cost - within the limits of existingdesign and manufacturing technology. Any improvement in motor efficiency must resultfrom reducing the Watts losses. All of these changes to reduce motor losses are possiblewith existing motor design and manufacturing technology.They would, however, requireadditionalmaterialsand/ortheuseofhigherqualitymaterialsandimprovedmanufacturingprocess esresultinginincreasedmotorcost.Energyefficientmotorsuselesselectricity,runcooler, and often last longer than NEMA (National Electrical Manufacturers Association)Bmotors ofthe same size. To effectively evaluate the benefits of high efficiency electric motors, we must define"efficiency".Foranelectricmotor,efficiencyistheratioofmechanicalpowerdeliveredbythemotor (output) to theelectrical powersuppliedto themotor (input).

Efficiency =(Mechanical PowerOutput/ElectricalPowerInput)x100%.

Thus, a motor that is 85 percent efficient converts 85 percent of the electrical energy inputinto mechanical energy. The remaining 15 percent of the electrical energy is dissipated asheat, evidenced by a rise in motor temperature. Energy efficient electric motors utilizeimprovedmotordesignandhigh-qualitymaterialstoreducemotorlosses,thereforeimprovingmotor efficiency.

Fig7:energyefficientmotor

2.3. EnergyEfficientTransformers

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Most energy loss in dry-type transformers occurs through heat or vibration from thecore.Thenewhigh-efficiencytransformersminimizetheselosses.Theconventionaltransformer is made up of a silicon alloyed iron (grain oriented) core. However, the latesttechnology is to use amorphous material - a metallic glass alloy for the core with uniquephysicalandmagneticproperties-thesenewtypesoftransformershaveincreasedefficienciesevenatlowloads-98.5%efficiencyat35%load.An amorphousmetaltransformer (AMT)isatype of energy efficient transformer found on electricgrids. The magneticcore ofthistransformerismadewitha ferromagnetic amorphousmetal. The typical material (Metglas) is an alloy of iron with boron, silicon,and phosphorus in the form of thin (e.g. 25 µm) foils rapidly cooled from melt. Thesematerialshavehigh magneticsusceptibility,verylow coercivity andhigh electricalresistance.Many more transformers are needed to reliably meet the increasing demand forelectricityaroundtheworld.Theinstalledglobalstockisexpectedtoincreasebyacompounded annual growth rate of 3.7 per cent, more than a doubling the number oftransformers between 2015 and 2040. Africa has the highest projected annual growth rateoverthis period, 4.9 percent, with the installed stockmorethan tripling.

Fig8:1600 kVAAmorphous CoreTransformer

2.1. AutomaticPowerFactorController

Varioustypesofautomaticpowerfactorcontrolsareavailablewithrelay/microprocessorlogic.Ex-VoltageControlandkVArControl.Automaticpowerfactorcontroller projectisdesignedtoimprove powerfactorautomatically whenever powerfactor fallsbelowacertainlevel.Inductiveloadsaremainreasonforlow powerfactor in power system.

Therefore, we need to develop a method to improve power factorautomatically.Capacitorsgroupedintoseveralsteps.Suitableswitchingdeviceswithcoupledwithinrushcurrentlimitingdevicesareprovidedforeachstep.PowerFactorsensedby CT in line side. kVAr required to achieve target PF is computed by the Microprocessorbased APFC relay. APFC relay switches appropriate capacitor steps. CT senses improvedPFand gives feedback.Thus, target PFis achieved.

Fig9:ReactivePowerControlRelay

2.1VoltageControl

Voltage alone can be used as a source of intelligence when the switched capacitorsareappliedatpointwherethecircuitvoltagedecreasesascircuitloadincreases.Generally,where theyareappliedthevoltageshoulddecreaseascircuitloadincreasesandthedrop involtage should be around 4–5 % with increasing load. Voltage is the most common type ofintelligence used in substation applications, when maintaining a particular voltage is ofprime importance. This type of control is independent of load cycle. During light load timeand low source voltage, this may give leading PF at the sub-station.

2.2 KVARControl

Kvar sensitive controls are used at locations where the voltage level is closelyregulatedandnotavailableasacontrolvariable.Thecapacitorscanbeswitchedtorespondto a decreasing power factor as a result of change in system loading. This type of controlcan also be used to avoid penalty on low power factor by adding capacitors in steps as thesystem power factor begins to lag behind the desired value. Kvar control requires twoinputs - current and voltage from the incoming feeder, which are fed to the PF correctionmechanism,either themicroprocessor ortherelay. The company claims that the KEC reduces overall energy costs for a home or business by 6% to 25%. We were given several studies that KVAR referenced as proof of their product's efficacy. These studies shared their results but did not describe their testing apparatus or procedure. We tested the KEC ourselves, to determine whether or not the device could reduce a residential electricity bill.

4:CONCLUSION

As a result, by employing energy-efficient electrical equipment, energy efficiency may be enhanced. New technologies are emerging these days that can assist us in enhancing our energy efficiency. As a result, energy management should be viewed as a collection of managerial techniques to increase energy efficiency that are based on mathematical models that explain the object's technological and engineering attributes as well as its operational activities. Only a mix of numerous administrative and engineering methods, carefully chosen for each circumstance, can ensure the optimal outcome. If technical innovations and engineering solutions are part of the management system, they will lead to a more efficient use of energy resources in the enterprise, taking into account possible risks associated with establishing a management decision-making support system aimed at improving energy efficiency and sustainable operation of the organization in general. Since the 1970s, structural modifications in residential structures have typically equalled or outperformed efficiency advances. In all economies, they include increasing gadget ownership and usage, as well as a large increase in average per- capita home floor area. Certainly, there are a variety of motivations for improving energy efficiency, as well as a variety of benefits and drawbacks. Theoretically, the positives win out using the magic formula ceteris paribus, and experience from industrialised countries backs this up in practise. Transition economies have the opportunity to enhance or establish energy efficiency, and despite the challenges and drawbacks, EE offers a lot of promise that should be used. While increasing energy efficiency investment might create economic and commercial possibilities, it is impossible to do so without an adequate institutional system to supply both funding and technology inputs.

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